Creating a world fit for the future

Southern Water's Water for Life: Hampshire

Technical Report 5: High level air quality assessment to inform site selection and mitigation requirements

Report for Southern Water

FINAL

Ricardo for Southern Water

ED 15470 | Issue number 5 | Date 16.11.2021

Customer:

Southern Water

Customer reference:

ED 15470

Confidentiality, copyright and reproduction:

Contact:

[redacted]
Water Team – London Office
13 Eastbourne Terrace,
London, W2 6AA

[redacted]

Authors:

[redacted]

Date:

16 November 2021

Ref: ED 15470

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001

Document history and status:

Version	Date	Description	Author	Checked	QA
1	08.07.2021	Introduction and methodology sections	[redacted]		
2	30.07.2021	Task 1 results			
3	18.08.2021	Task 2 results			
4	16.11.2021	Consistent introduction sections			

5	16.11.2021	FINALISED READY FOR ISSUE	[redacted]

Table of Contents

1 Introduction 1

1.1 Background 1

1.2 Southern Water's Strategic Challenge and SROs 1

1.3 Purpose of this Report 1

1.4 Structure of this Report 2

2 Description of the Southern Water Strategic Resource Options 3

2.1 Summary 3

2.2 Desalination 3

2.2.1 A1 - 75Ml/d or A2 61Ml/d - Base Case: Fawley and Calshot 6

2.2.2 A1 - 75Ml/d or A2 61Ml/d – Alternative: Lepe 6

2.2.3 A3 - 75Ml/d or A2 61Ml/d – Alternative: Meon 7

2.3 Water Recycling 7

2.3.1 B2 - 61 Ml/d Recycled Water from new Water Recycling Plant (fed from [redacted]) to Otterbourne WSW via Lake Otterbourne environmental buffer 8

2.3.2 B4 - 15 Ml/d Recycling Water from new Water Recycling Plant (fed from [redacted]) to Otterbourne WSW via Havant Thicket Reservoir environmental buffer 10

2.3.3 B5 - 75 Ml/d Recycling Water from new Water Recycling Plant (fed from [redacted]) to Otterbourne WSW via Lake Otterbourne environmental buffer 10

2.4 Havant Thicket Reservoir Alternative Use 11

3 Approach 12

3.1 Site Selection Risk Assessment 12

3.1.1 Overview 12

3.1.2 Guidance 12

3.1.3 Scope of Assessment 12

3.1.4 Sensitive Receptor - Location 13

3.2 Traffic Modelling: [redacted] and River Itchen tunnel 14

3.2.1 Overview 14

3.2.2 Scope of Assessment 15

3.2.3 Sensitive Receptor - Location 15

3.2.4 Methodology 16

4 Assessment Findings 22

4.1 Site Selection Risk Assessment 22

4.1.1 Main sites 22

4.1.2 Pipeline routes 22

4.1.3 Mitigation Requirements 31

4.2 Indicative Air Quality Modelling 33

5 Conclusions 38

5.1 Site Selection Risk Assessment 38

5.1.1 Air Quality Route Preference 38
5.1.2 Emerging Route Preferences 38
5.2 Indicative Air Quality Modelling 40

List of Figures

Figure 2.1 Desalination components: Fawley, Calshot, Lepe and Meon
Figure 2.2 Water Recycling Plant land parcels from site selection process
Figure 3.1 Wind rose for Southampton city centre 2019 meteorological data
Figure 4.1 Proposed configurations: Desalination ([redacted]
Figure 4.2 Proposed configurations: Water recycling and Desalination (Meon)
Figure 4.3 Modelled human and ecological receptors

List of Tables

Table 2.1 Water for Life-Hampshire Strategic Solution Review
Table 2.2 Desalination solution components
Table 2.3 Water recycling and water transfer solution components
Table 3.1 NO_2 monitoring results
Table 3.2 Indicative location of pipeline tunnelling plant
Table 3.3 Assumptions for pipeline tunnelling plant
Table 3.4 IAQM human health significance criteria
Table 4.1 Proposed configurations
Table 4.2 Number of properties within the construction screening buffer zones
Table 4.3 Number of ecological receptors located within the selected construction buffer zones
Table 4.4 Sensitivity of the area to dust soiling effects on people and property (source: IAQM, 2014)
Table 4.5 Examples of air quality mitigation
Table 4.5 NO_2 impacts at worst-case locations for human health exposure
Table 4.6 Annual Mean NO_x impacts at worst-case ecological receptor locations
Table 4.7 24hr NO_x impacts at worst-case ecological receptor locations
Table 4.8 Nutrient nitrogen deposition at ecological receptors
Table 4.9 Acid deposition at ecological receptors
Table 4.10 2025 NO_x estimates from River Itchen tunnelling works
Table 5.1 Air quality risk of emerging pipeline route preferences

List of Appendices

Appendix A1 Air quality modelling
Appendix A2 Stakeholder comments log

1 Introduction

1.1 Background

Water companies in England and Wales are required to produce a Water Resources Management Plan (WRMP) every five years. The Plan sets out how the company intends to maintain the balance between supply and demand for water over the selected planning horizon (minimum 25 years) in order to ensure security of supply in each of the water resource zones making up its supply area.

Following submission of WRMPs in 2019, Ofwat through the Price Review 2019 (PR19) Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options (SROs) over the next 5 to 15 years with solutions considered to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination in December 2019 set out a gated process for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and WRMPs.

1.2 Southern Water's Strategic Challenge and SROs

The River Itchen, the River Test, and the Candover Stream are the three primary surface water resources utilised in Southern Water's Western Operating Area. In March 2019, the Environment Agency (EA) enacted sustainability reductions on all three sources, imposing new abstraction limitations to protect biodiversity in periods of drought. These reductions have fundamentally changed the water resources position in Hampshire and Isle of Wight (IOW) water resource zones (WRZs), and there is uncertainty regarding the potential for further changes in the future. The scale of the sustainability reductions is expected to generate sizeable supply-deficits during periods of severe drought.

Water supply modelling completed in development of Southern Water's WRMP, published in 2019, identified a 167 Ml/d supply-demand deficit across Southern Water's Western Operating Area during a 1-in-200-year drought scenario, accounting for the sustainability reductions referenced above. The WRMP19 preferred strategy included a 75Ml/d desalination plant in the Hampshire Southampton West (HSW) Water Resource Zone (WRZ). This was confirmed as the Base Case for the Gate 1 submission.

As part of the RAPID Gated process, Southern Water have been investigating a number of alternative Strategic Resource Options (SROs) to the Base Case including water recycling and water transfer from Portsmouth Water's Havant Thicket Reservoir.

The Gate 1 work included a gap analysis and look ahead to activities required prior to the Gate 2 submission (September 2021) to further understand the environmental risks of progressing with the base case or alternatives. This included an understanding of likely air quality impacts to sensitive ecological receptors.

1.3 Purpose of this Report

This report therefore documents further desk-based assessment into the air quality issues arising from the construction of key components of the SROs[1]. This report aims to support the following workstreams being undertaken by Southern Water and the wider WfLH team:

---

[1] Individual company solutions only. Southern Water are working with other water companies on a range of joint SRO solutions.

- Site selection work – a review of the different SRO components is being undertaken to determine which are least impacting from an air quality perspective, to help inform the site selection work and MCDA of the resulting configurations.
- Location specific modelling – although air quality issues are likely to arise from a number of different component locations, two are considered to be more critical in terms of implications to construction techniques and programme if adverse effects were identified to the European designated sites in close proximity. These are:
    - Desalination - construction of the Fawley to Testwood WSW [redacted] in direct proximity to the New Forest Special Area of Conservation, Special Protection Area and Ramsar site.
    - Water recycling – construction of the River Itchen pipeline crossing between Colden Common and Otterbourne WSW, in direct proximity to the River Itchen SAC[2].

The assessment completed is not a full air quality EIA chapter, and this would be required for the SRO selected to proceed at Gate 3.

1.4 Structure of this Report

This report includes the following sections:

Section 1: Introduction

Section 2: Description of the Southern Water SROs

Section 3: Approach

Section 4: Assessment Finding

Section 5: Conclusions

[2] A similar exercise will need to be completed for the River Meon as this is compensatory habitat, and therefore afforded SAC status. However, the crossing location is subject to further refinement of the pipelines, and therefore a location to use in the assessment cannot be confirmed for Gate 2.

2 Description of the Southern Water Strategic Resource Options

2.1 Summary

As part of the RAPID Gate 2 submission, Southern Water is progressing the 'base case' (Fawley desalination) as well as eight potential alternatives, which are being considered in case the Base Case is not deliverable. These can be broken down into the following options:

- Desalination alternatives
- Water recycling
- Water transfer

Those configurations relevant to this report are provided in **Table 2.1**.

Table 2.1 Water for Life-Hampshire Strategic Solution Review

Solution	Configuration	Description
Desalination	**Base Case**	75Ml/d of drinking water produced by desalination plant in Fawley area supplying Hampshire Southampton West (HSW) Water Resources Zone with the interface between the new and existing distribution system located at Testwood WSW.
	A.2	61Ml/d of drinking water produced by desalination plant in vicinity of Fawley supplying HSW WRZ (as in Strategy A.1).
	A.3	75Ml/d or 61Ml/d of drinking wate produced by desalination plant at land parcel D55 supplying HSW WRZ with interface between the new and existing distribution system located at Otterbourne WSW.
Water Recycling	**B.2**	61 Ml/d recycled water from Water Recycling Plant (fed from [redacted] transferred to Lake Otterbourne environmental buffer and treated at Otterbourne WSW
	B.4	15 Ml/d recycled water from Water Recycling Plant (fed from [redacted]) transferred to Havant Thicket Reservoir environmental buffer, with bulk supply to 61Ml/d, treated at Otterbourne WSW
	B.5	75 Ml/d recycled water from Water Recycling Plant (fed from ([redacted]) transferred to Lake Otterbourne environmental buffer and treated at Otterbourne WSW
Water Transfer Alternatives	**D.2**	75 Ml/d Alternative direct raw water transfer from Havant Thicket Impounding Reservoir to Otterbourne WSW

The following sections describe the components of each solution.

2.2 Desalination

The key components of the desalination solution considered in this environmental assessment include:

- Sea water intake and outfall with brine waste-stream.
- Pumping station (PS) and brine tank.
- Pipeline from intake to the desalination plant.
- Pipeline from desalination plant to outfall (assumed to be within same corridor as intake pipeline).
- The desalination plant itself.
- A transfer pipeline to a water supply works.
- Receiving tank at water supply works.

As indicated above, two sizes for the desalination plant are being considered; 75Ml/d and 61Ml/d. The engineering information used within this assessment is based on the conceptual design produced for a 75Ml/d solution for costing purposes only. The full 75Ml/d will only be required to supply potable water in a 1 in 200 year drought event, and therefore the output at this level is periodic (one in every 20 years) and considered very much the worst-case scenario. However, the plant will need to be run with a sweetening flow of 15Ml/d to main operational processes, ready for output to be increased when required. This would therefore be the likely, and more frequent, mode of operation.

For a 75Ml/d Deployable Output desalination solution, 189Ml/d of seawater is required which gives rise to 87m^3/d solid waste and 114Ml/d brine waste stream. When operating at a baseline level to provide 15Ml/d, 38Ml/d seawater is required resulting in 17m^3/d solid waste and 23Ml/d brine waste stream. The solid waste would need to be taken from site to landfill, requiring c. 1-2 movements per day when operating at 15Ml/d and c.6-7 movements when operating at 75Ml/d.

Two alternatives to the Base Case were worked up in additional detail by the WfLH Engineering team, as to a potential alternative to the Base Case. These considered an alternative site for the intake and outfall at Lepe, but with the desalination plant remaining at [redacted] and transferring water to Testwood WSW. The latter alternative (A.3) was to locate the desalination plant on Southampton Water, in an area close to Meon, with the transfer of water to Otterbourne WSW.

Table 2.2 provides a summary of the components required for each configuration, and these are shown in **Figure 2.1**. Sections 2.21 to 2.2.3 describe the configurations in more detail.

Table 2.2 Desalination solution components[3]

Component	Locations	A1/A2 Base Case desalination (Calshot)	A1/A2 Base Case desalination (Lepe)	A3 desalination
Intake within Southampton Water or Solent	[redacted]	Calshot intake/ outfall	Lepe	Meon
[redacted]		x		
Pumping station at Fawley (x1 site)		x		
Pumping station at Lepe (x3 site locations)			x	
Pumping station at Meon				x
Transfer from intake/to outfall via Fawley PS to desalination plant (x1 route)		x		
Transfer from intake/to outfall via Lepe PS to desalination plant			x	
Transfer from intake/to outfall via Meon PS to desalination plant				x
Desalination plant at [redacted]		x	x	
Desalination plant at Meon				x
Brine discharge * outfall from desalination plant to Solent		x	x	x
Transfer from desalination plant at [redacted] to Testwood WSW (x5 routes)		x	x	
Transfer from desalination plant at Meon to Otterbourne WSW (x2 routes)				x
Receiving tanks at Testwood WSW		x	x	
Receiving tanks at Otterbourne WSW				x
*** In report referred to as abstraction and discharge structures**				

[3] The 'x' denotes where a component is included in the solution.

Figure 2.1 Desalination components: Fawley, Calshot, Lepe and Meon[4]

[redacted]

[4] Note: the site selection clusters were not included in the BNG and NC assessments.

2.2.1 A1 - 75Ml/d or A2 61Ml/d - Base Case: Fawley and Calshot

The components of the desalination solution at Fawley are as follows:

- Sea water intake:
    - Disused Fawley intake off Southampton Water (Fawley Waterside Marina) **OR**
    - Offshore at Calshot
- Brine waste-stream and diffuser:
    - Offshore at Calshot utilising the disused Fawley outfall for some of the length **OR**
    - Offshore at Calshot but with completely new pipeline
- Pumping station to be located south of Fawley [redacted] (permanent land take c. 6,070m^2, additional temporary land take for construction compound c. 4,070m^2)
- Pipeline to/from intake and outfall and desalination plant along western boundary of Fawley site.
- Desalination plant at [redacted] (including brine Contact Tank, Clear Water Tanks, Reject Water Tank and site drain) (c. 96,000m^2 for 75Ml/d (permanent land take, 4,047m^2 temporary construction compound).
- Transfer pipeline to Testwood WSW (no water booster stations or break pressure tanks are required):
    - Route 1: [redacted] New Forest SAC, SPA and Ramsar, then adjacent to it (west) to Testwood WSW.
    - Route 2: as for Route 1 but extending to west of Holbury, and avoiding some junctions ([redacted]).
    - Route 3: extending north west from [redacted] west of Holbury, then north east picking up disused railway track through Hythe, joins Route 1 and 2 corridor at Hounsdown.
    - Route 4: extends north west from [redacted] west of Holbury (closer to urban area than Route 3), follows [redacted] past section of New Forest, then west hugging New Forest boundary between [redacted], joins Route 1/2/3 corridor from [redacted] to Testwood.
    - Route SIA: similar to Route 1 with some sections routed outside [redacted].
- Receiving tank at Testwood WSW.

2.2.2 A1 - 75Ml/d or A2 61Ml/d – Alternative: Lepe

The components of the desalination solution at Lepe are as follows:

- Sea water intake off Lepe coast (all new infrastructure).
- Brine waste-stream and diffuser off Lepe coast (completely new infrastructure).
- Pumping station and brine reception to be located close to offshore components at Lepe (permanent land take c. 6,070m^2, additional temporary land take for construction compound c. 4,070m^2):
    - Land parcel FAWPS 19 (north of Lepe Country Park car park).
    - Land parcel FAWPS 21 (west of Pits Copse).
    - Land parcel FAWPS 23 (west of Allwoods Copse).
- Pipeline to/from intake and outfall and desalination plant:
    - Route 1: extends north to Stanswood Common, west of Sprats Down Plantation and along [redacted] to [redacted]
    - Route 2: extends north west around Cadland Solar Park, through Tom's Down to [redacted] site (requires crossing of [redacted]).
- Desalination plant at [redacted] (including Tanks) (c. 96,000m^2 for 75Ml/d (permanent land take, 4,047m^2 temporary construction compound).

- Transfer pipeline to Testwood WSW – five route options as described in Section 2.2.1 Fawley.
- Receiving tank at Testwood WSW.

2.2.3 A3 - 75Ml/d or A2 61Ml/d – Alternative: Meon

The components of a desalination solution at in land parcel D55 (in Meon) are as follows:

- Sea water intake offshore into Southampton Water/Solent (completely new infrastructure).
- Brine waste-stream and diffuser offshore (completely new infrastructure).
- Pumping station on coastline close to White House [redacted] (permanent land take c. 6,070m^2, additional temporary land take for construction compound c. 4,070m^2).
- Pipeline from pumping station to desalination plant.
- Desalination plant located off Meon Road, close to Thatchers Copse (c. 96,000m^2 for 75Ml/d (permanent land take, 4,047m^2 temporary construction compound).
- Transfer pipeline to Otterbourne WSW:
    - Route 1
    - Route 2

2.3 Water Recycling

Table 2.3 provides a summary of the components required for each configuration, and Sections 2.3.1 to 2.3.3 describe the configurations in more detail.

Table 2.3 Water recycling and water transfer solution components[5]

Component	Location	B2 Water Recycling to Lake Otterbourne	B4 Water Recycling to Havant Thicket Reservoir	B5 Water Recycling [redacted] to Lake Otterbourne	D2 Havant Thicket Transfer
Effluent transfer from [redacted] to WRP (x1 route)	[redacted]	x	x	x	
Effluent transfer from [redacted] o WRP (x1 route)	[redacted]			x	
WRP sites (x7 sites)	[redacted]	x	x	x	
Waste-stream to [redacted] and out [redacted] LSO	[redacted]	x	x	x	
Transfer pipeline WRP to Lake Otterbourne environmental buffer (x3 routes)	[redacted]	x		x	
Water booster stations (WBS) and break pressure tanks (BPT) (along pipeline routes)	[redacted]	x	x	x	x
Lake Otterbourne environmental buffer with emergency discharge pipeline to Otter Bourne watercourse **<u>OR</u>** to overland discharge area	[redacted]	x		x	
Transfer pipeline WRP to Havant Thicket Reservoir (x2 routes)	[redacted]		x		
Havant Thicket Reservoir high lift pumping station (x4 land parcels)	[redacted]		x		x
Transfer pipeline HTR to Otterbourne WTW (x4 routes)	[redacted]		x		x
Pre-disinfection ceramic membrane plant at Otterbourne WSW	[redacted]	x	x	x	

[5] The 'x' denotes where a component is included in the solution.

Component	Location	B2 Water Recycling to Lake Otterbourne	B4 Water Recycling to Havant Thicket Reservoir	B5 Water Recycling [redacted] to Lake Otterbourne	D2 Havant Thicket Transfer
Overflow and drawdown to Overland flow		x		x	

2.3.1 B2 - 61 Ml/d Recycled Water from new Water Recycling Plant (fed from [redacted]) to Otterbourne WSW via Lake Otterbourne environmental buffer

The components of the water recycling solution are as follows:

- Site for water recycling plant
  - Seven separate sites are currently being considered in the vicinity of [redacted] (land parcels 68, 70, 71, 72, 73, 74, 75), see **Figure 2.2** (permanent land take c. 45,000m^2, 4,047m^2 for temporary construction compound).
- Pipeline connection between [redacted] and water recycling plant site (assumed tunnelled under watercourse)
- Transfer pipeline from water recycling plant to Lake Otterbourne environmental buffer
  - Route 1
  - Route 2
  - Route SIA
- 2nd Stage Pumping stations and break pressure tanks along routes.
- Lake Otterbourne environmental buffer with emergency discharge pipeline to Otter Bourne watercourse[6] **OR** overland discharge area
  - The infrastructure on the Otterbourne/ River Itchen has not been assessed as the data is not available. Gate 3 will include assessment of this infrastructure if the information is available at the time.
- Pre-disinfection ceramic membrane plant at Otterbourne WSW.

[6] A discharge structure will be required at the Otter Bourne watercourse, however this has currently not been sized (re: requirements to reduce scour etc) and therefore has not been included in the assessment.

Figure 2.2 Water Recycling Plant land parcels from site selection process

[redacted]

2.3.2 B4 - 15 Ml/d Recycling Water from new Water Recycling Plant (fed from [redacted]) to Otterbourne WSW via Havant Thicket Reservoir environmental buffer

The components of the water recycling solution are as follows:

- Site for water recycling plant:
  - Seven separate sites are currently being considered in the vicinity of [redacted][7].
- Pipeline connection between [redacted] and water recycling plant site (assumed tunnelled under watercourse)
- Transfer pipeline from water recycling plant to Havant Thicket Reservoir
  - Route 1
  - Route 2
- Transfer pipeline from Havant Thicket Reservoir to Otterbourne WSW:
  - Route 1
  - Route 2
  - Route 3
  - Route 4
- Initial high lift pumping station close to Havant Thicket Reservoir (permanent land take c. 1,500m^2, temporary construction compound c.1,000m^2).
- 2nd Stage Pumping stations and break pressure tanks along routes.
- Pre-disinfection ceramic membrane plant at Otterbourne WSW.

2.3.3 B5 - 75 Ml/d Recycling Water from new Water Recycling Plant (fed from [redacted]) to Otterbourne WSW via Lake Otterbourne[8] environmental buffer

The components of the water recycling solution are as follows:

- Site for water recycling plant
  - Seven separate sites are currently being considered in the vicinity of [redacted].
- Pipeline connection between [redacted] and water recycling plant site (assumed tunnelled under watercourse).
- Final effluent transfer from [redacted] to water recycling plant.
- The transfer from the water recycling plant will either utilise the Lake Otterbourne environmental buffer as described in B2 (Section 2.3.2).
- Pre-disinfection ceramic membrane plant at Otterbourne WSW.

---

[7] The total footprint for the WRP will be smaller than the 45,000m^2 required for the 75Ml/d option: c.25,000m^2. However, as a worst case, the larger footprint has been used for all water recycling solutions as the exact location within the site boundary is unknown. This therefore assumes removal of the same habitats until design refinement at Gate 3.

[8] There is currently no option being progressed where B5 would use Havant Thicket Reservoir as an environmental buffer instead of Lake Otterbourne. (*pers. Correspondence Southern Water 21.05.2021).*

2.4 Havant Thicket Reservoir Alternative Use

An operating regime will be explored jointly with Portsmouth Water and include elements such as the introduction of recycled water and increased abstraction volumes in drought events.

The components of the alternative water transfer are the same transfer routes between Havant Thicket Reservoir and Otterbourne WSW, and high lift pumping station, as described in B4 (Section 2.3.2). The Havant Thicket Reservoir itself is not included in the assessment.

Therefore, the following components have been considered:

- Transfer pipeline from Havant Thicket Reservoir to Otterbourne WSW:
    - Route 1
    - Route 2
    - Route 3
    - Route 4
- Initial high lift pumping station close to Havant Thicket Reservoir.
- 2nd Stage Pumping stations and break pressure tanks along routes.

3 Approach

3.1 Site Selection Risk Assessment

3.1.1 Overview

To support the land-based site[9] and route selection for the desalination, water recycling plant and alternative bulk supply, the main issue to consider from an air quality perspective will be construction related issues, assuming no emissions for energy generation during operation. Therefore, the proposed sites and pipeline routes, have been reviewed, in the context of screening distances for potentially significant air quality impacts (e.g. from IAQM guidance relating to control of dust from construction, and guidance on assessment of the effects of air pollution on habitat sites). This will consider proximity to sensitive human populations and potential impacts on nationally and internationally designated habitat sites. The nature of the construction activities likely to be carried out (e.g. excavation; demolition; construction; tunnelling; road vehicle movements) has also been considered.

Based on this evaluation, areas and aspects of greater or lesser concern with regard to air quality have been identified, and recommendations for preferred components have been made, where possible, from the perspective of minimising air quality impacts. An indication of the measures required to minimise/mitigate air quality impacts have been provided, where impacts could be significant.

At this stage, there is insufficient information on construction routes to assess potential air quality risks of the haul routes, as required by the IAQM guidance. This will be required at Gate 3.

3.1.2 Guidance

The task provides a ranking of the scheme pipeline components, in terms of their potential for dust effects and a need for mitigation during construction activities.

The assessment uses screening criteria as outlined by guidance published by the Institute of Air Quality Management IAQM "Guidance on the assessment of dust from demolition and construction"[10]. This assessment considers two groups of receptors:

- Human receptors represented within this assessment as a number of residential properties, hospitals, schools, and residential care homes affected by the scheme; and
- Ecological receptors represented within this assessment as a number of locations with an international or national ecological designation.

The assessment also considers Air Quality Management Areas (AQMAs) located alongside each option.

3.1.3 Scope of Assessment

The methodology under the IAQM guidance considers the potential for fugitive dust emissions to be generated from the following sources:

[9] The potential offshore air quality issues from use of barges and vessels for the desalination intake and outfall structures is not considered to be a key differentiator in the site selection process.
[10] Institute of Air Quality Management (2014) Guidance on the assessment of dust from demolition and construction. V1.1.

- Demolition;
- Earthworks;
- Construction;
- Trackout - the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The risk of dust effects (low, medium or high) is determined by the scale and nature of the works and the proximity of sensitive human and ecological receptors. Although this assessment refers to risks, it is not expected that the dust impact can be fully mitigated. The risk descriptors provide indication of the extent of mitigation that would be required for each component.

As this is a screening assessment, seeking to provide a comparative ranking of components, a number of conservative assumptions were made:

- The assessment is based on unmitigated scheme and is not considering any embedded construction mitigation measures.
- The magnitude of unmitigated dust effects of the relevant sources has been assessed as large according to IAQM classifications.
- Construction activity occurs everywhere, along each pipeline route, at all times for the duration of approximately one year.
- The sensitivity of individual receptors has been considered as high.

Additional criteria not considered in the assessment at this stage:

- History of dust generating activities in the area.
- Likely cumulative dust effects from nearby construction sites.
- Pre-existing physical screening such as trees or buildings.
- Impact of road network used by the construction vehicles.
- The influence of the prevailing wind direction.
- Local topography.

3.1.4 Sensitive Receptor - Location

Key receptors of interest considered by this screening assessment are human receptors and ecological receptors. The assessment also considers proximity of AQMAs as an indication of areas of poor air quality. The datasets used to identify sensitive receptors are as follows[11]:

- Air quality management areas.
- Land cover – CORINE high resolution urban (2018).
- Built up areas.

[11] Local ecological designations and other priority habitats have not been considered at this stage but should be included for assessment once the SRO is selected.

- Ordnance Survey Open Map Local.
- Special Areas of Conservation, Special Protection Areas and Ramsar sites.
- Sites of Special Scientific Interest and National Nature Reserves.
- Ancient woodlands.

The proximity of the receptors to the sources of emission has been assessed using IAQM criteria.

IAQM guidance recommends that an assessment be undertaken where there are sensitive human receptors within 350m of the site boundary.

An assessment should also be carried out where there are dust-sensitive ecological receptors within 50m of the site boundary.

As such, the assessment of options is based on an initial screening assessment which mapped all receptors within these boundary distances from the proposed routes options. The 350m and 50m buffers correspond with screening criteria recommended by IAQM dust assessment guidance and provide a qualitative overview of all sensitive receptors located in the area potentially affected by the construction activities. Additionally, a 25m buffer was used to determine a total number of sensitive receptors located in very close proximity to the construction sites, and therefore indicate the number of receptors that might require a higher level of mitigation.

3.2 Traffic Modelling: [redacted] and River Itchen tunnel

3.2.1 Overview

To further understand the implications of construction and air quality issues where components lie close to or within nationally/internationally designated habitat sites, air quality modelling assessments was completed for the following key sites; pipeline along the [redacted] and tunnel under the River Itchen. The desalination plant at [redacted] intake and outfalls at Calshot or Lepe, and water recycling plant at Land Parcel 72, are considered to be lower risk at this stage and further modelling is unlikely to be beneficial in project decisions. An indication of the types of appropriate mitigation will therefore be specified for these sites in accordance with the relevant IAQM guidance, as part of the site selection task.

The approach to the [redacted] and tunnel under the River Itchen is as follows:

- [redacted]: a screening model has been developed using ADMS-Roads to investigate the potential extent of air quality impacts that could result from disruption to traffic on the [redacted] – increased traffic congestion/queueing, leading to increased emissions. This highlights the zone over which such effects could be significant, expressed as a distance away from the road. This information can be used to target further modelling and evaluation, if required. The potential effect of the construction programme (indicative) on traffic flows and speeds on the [redacted] were also discussed.
- River Itchen tunnel: an air quality model has been developed using ADMS 5 to evaluate the potential impact of emissions from Non-Road Mobile Machinery (NRMM) on the River Itchen SAC at this location. This part of modelling work draws on Ricardo's experience of [redacted] on similar issues in relation to major infrastructure projects on the Suffolk coast. The aim was to identify suitable controls on NRMM emissions, and the zone within which potentially significant impacts could occur at the nearby designated site.

3.2.2 Scope of Assessment

The aim of this work is to undertake an air quality modelling screening exercise of potential impacts caused by the [redacted] pipeline options and NRMM associated with the River Itchen tunnel works.

The assessment considers emissions of NO_x (NO_2 and NO) and particulates (PM_{10} and $PM_{2.5}$) from exhausts and particulate emissions from brake and tyre wear associated with congestion and slower speeds caused by the [redacted] pipeline options. The assessment also considers air quality impacts of these pollutants associated with use of NRMM during River Itchen tunnel works. As such, the assessment only includes emissions from the trenchless construction technique.

Heavy Goods Vehicles (HGV) and construction vehicles associated with the [redacted] pipeline works have not been included in the air quality assessment.

3.2.3 Sensitive Receptor - Location

The two groups of receptors which will be included are:

- Human health receptors - any human health receptors identified as 'at risk' of significant impacts, was included in air quality modelling. Annual mean NO_2 concentrations (µg/m^3) was estimated if receptors are identified as 'at risk' of significant impacts from this pollutant. PM_{10} and $PM_{2.5}$ are screened out as the background levels are too low for scheme vehicular exhaust contributions to cause significant impacts and are not considered useful to inform this route option appraisal. Sensitive receptors include locations where the general public has access and could be exposed to air pollution for an hour or the majority of the year such as gardens, residential dwellings, schools and hospitals.
- Ecological receptors - annual mean NO_x (µg/m^3) was estimated at designated sites (Ramsar, SAC, SPA[12] and Site of Special Scientific Interest (SSSI)). Ecological receptors were included within this assessment where scheme components are in very close proximity to habitats sensitive to nutrient nitrogen and acidification.

The receptor locations and approach used to determine inclusion varies between human health and habitat receptors. The approach used to include these two receptors groups is set out below:

- Human health receptors – where a sensitive location such as a residential dwelling or school is within 200 metres of a road section intersected by a pipeline on the [redacted] or River Itchen NRMM, a receptor has been included.
- Ecological receptors- a receptor has been included to represent habitats within 200 metres of a road section intersected by a pipeline on the [redacted] and the River Itchen NRMM.

Different distances have been used when selecting receptors for a qualitative dust impact assessment (site selection risk assessment) and a quantitative air quality modelling assessment (this stage). The distance receptors selected during a construction dust assessment are directed within IAQM guidance. There is no guidance directly relevant for distance of receptor selection in the air quality modelling study. Guidance developed by Highways England (LA105 Air Quality) for road schemes highlights that human health and ecological receptors should be considered within 200 meters of the affected road network (roads

[12] Including candidate/potential sites, Sites of Community Importance (SCI) and known areas of compensatory habitat.

which experience a significant change in traffic). The Natural England advice to competent authorities considering air impacts in Habitats Regulations Assessment also uses this distance[13]. The use of 200 metres is therefore informed by this guidance and professional judgement on distances that significant impacts can be detected at receptors.

3.2.4 Methodology

3.2.4.1 Background concentrations

Background air pollutant concentrations are required to capture emission sources which are not modelled in this study, thereby improving the accuracy of total concentrations. Background pollutant concentrations for a modelling study within an urban environment in England can be sourced from either a local monitoring location classified as an urban background site, or the background maps produced by Ricardo Energy & Environment for Defra. The background maps provide estimates of annual mean background concentrations of key pollutants at a resolution of 1 x 1km for England projected from a base year of 2018 and can be projected forward to future years up to 2030. These annual mean pollutant maps combine pollutant measurement data with the emissions information from the UK's National Atmospheric Emissions Inventory (NAEI) to provide estimated pollutant concentrations for the whole of England.

Defra background modelled concentrations were used in this study as urban background monitoring did not cover enough of the study area. Primary A road contributions to background concentrations were removed to avoid double counting this source, as these roads have also been included in the dispersion model. Varying background concentrations were used in this study and have been presented for the worst-case receptors in **Table 4.6** and **Table 4.7** for the [redacted] and **Table 4.10** for the River Itchen.

3.2.4.2 Monitoring data and model verification

The New Forest District Council currently monitors NO_2 concentrations using diffusion tubes. Diffusion tube 39 is the only measurement within the study area and is representative background air quality along the [redacted]. However, only kerbside and roadside diffusion tubes can be used in model verification and additional diffusion tubes were sourced from outside the study area in the town of Totton. The annual mean concentrations measured at these sites are presented in **Table 3.1**. Diffusion tubes 30, 32, 34 and 35 were used to carry out verification of the air quality road traffic model. A process which compares modelled estimates against measured concentrations to either confirm the model is sufficiently accurate or whether further amendments are required to improve accuracy. Further details on model verification will be set out in **Appendix A1**. It is not industry standard practice to undertake model verification for non-road emission sources such as NRMM sources and therefore no model verification of NRMM has been undertaken.

Table 3.1 NO_2 monitoring results

Site ID	Site Name	Type	2018 (µg.m-3)	2019* (µg.m-3)	2019 Data Capture (%)	X	Y
33	[redacted]	Roadside	39.8	42.4	91.7	436473	113085
35		Roadside	38	38.8	100	436679	113399

[13] Natural England (2018) Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.

34	[redacted]	Roadside	34	35.7	100	436610	113252
32		Roadside	28.7	31.1	100	436210	112902
30		Roadside	23.7	24.1	100	436213	112940
39		Background	16.8	16	100	438363	109694

*** The 2019 concentrations without relevant exposure distance correction have been presented.**

The air quality assessment of trenchless tunnelling technique in River Itchen does not consider human health. Therefore, NO_2 concentrations are not required. The River Itchen assessment only considers impacts at habitats and as the critical level for habitats is NO_x (30 µg/m^3), existing NO_x concentrations have been reviewed. As there are no NO_x monitoring locations close to the River Itchen, Defra's background concentrations have been used, see **Table 4.10**.

3.2.4.3 Operational assumptions

For the purpose of this screening assessment, it was assumed that the [redacted] pipeline and River Itchen construction works will release emissions for a year

3.2.4.4 Traffic data

The baseline assessment year is 2019, representing higher pre-pandemic vehicle numbers than those observed from 2020. Traffic flows and vehicle fleet mix were taken from the Department of Transport's (DFT) national traffic count network[14].

As detailed within Ricardo's report 'Southern Water's Water for Life: Hampshire' report section 1.1, the plan is for the schemes to be construction ready by 2025-2030. In air quality terms, it is likely that the older fleet in 2025 will be more polluting than the growth in road vehicles in 2030. Consequently, the with scheme scenario is assumed to be 2025. The DfT traffic counts were adjusted using the DfT's road traffic growth forecasts[15] for the South East between 2019 and 2025.

Vehicle speeds were derived from street view imagery and assumed to remain the same in the 2025 future year without scheme scenario. A highly conservative approach was adopted when assessing the impact of the [redacted] scheme options upon speed, where speeds were assumed to decrease to 5 km/h where the pipeline intersects the road. The Department for Environment, Food and Rural Affairs (Defra) have released an emission factor toolkit[16] (EFT) which facilitates the calculation of vehicular emission rates (g/km/s), the latest version 10.1 was used in this assessment. A speed emission curve can be calculated using EFT which shows the relationship between speed and emissions. The speed emission curve highlights that vehicular emissions are highest at the lowest input speed

[14] https://roadtraffic.dft.gov.uk/#6/55.254/-6.053/basemap-regions-countpoints
[15] https://www.gov.uk/government/publications/road-traffic-forecasts-2018
[16] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

of 5 km/h, with emissions decreasing as vehicle speed increases to 80 km/h. Vehicular emissions then increase gradually from 80 km/h until 112 km/h, although they are never higher than emissions at 5 km/h.

This formed the basis of the 5 km/h speed selection to represent congestion and lower speeds resulting from the [redacted] pipeline works. Consequently, the air pollutant concentrations estimated assuming vehicles travel at the speed limit and those assuming a speed of 5 km/h represent the maximum range of air pollutant increases. The year set in the EfT was 2019 in the base year and 2025 in the with and without scheme scenarios.

The effect of speed decreases upon air pollutant concentrations was applied to all sections of the [redacted] where pipelines intersect the road.

3.2.4.5 NRMM

There are uncertainties regarding the exact type of plant that will be used for pipeline tunnelling. Consequently, two types of plant setup have been considered in this air quality assessment:

1. Where plant used in pipeline tunnelling has an internal combustion engine or a generator with <1MWth (megawatt thermal input), it has been assumed to meet stage IIIB NRMM NOx emission standards of 2g/KWh. It has been assumed that the NRMM plant will be diesel fuelled and have a KVA of 500, this type of plant will have a rated thermal input (MWth) of 1. With a power factor of 0.8, this plant will generate 400KW electricity. Consequently, it is assumed that the plant emits 800g of NO_x when operating for an hour at 100% load.
2. Where the pipeline tunnelling plant used does not have an internal combustion engine and depends on an external power supply, it has been assumed that the generator is >1MWth. A large diesel generator with a 2,100 KVA has been assumed, this type of plant will have a rated thermal input (MWth) of 4.5. A it has been assumed that the plant meets the medium combustion plant directive emission limit value of 200mg/Nm^3.

These two plant configurations have been assumed to operate continuously for the entire year at all four launch/reception points for pipeline tunnelling, locations have been presented within **Table 3.2**. This is highly conservative, given that the plant will only be in use for a small proportion of the year.

Assumptions for the exhaust emissions release height, exhaust gas temperature and exhaust diameter were informed by a manufacturer's generator specification sheet. With some professional judgement being applied in the absence of information in manufacturers specification sheets. These assumptions have been presented within **Table 3.3**. The exit velocity calculations were informed through the NERI dataset, which provides typical combustion gas volumes based upon gas-oil (diesel) fuel supply[17].

Table 3.2 Indicative location of pipeline tunnelling plant

Location Number	X	Y
1	[redacted]	
2		

[17] https://www.dmu.dk/Pub/FR786.pdf

3	[redacted]
4	

Table 3.3 Assumptions for pipeline tunnelling plant

Plant Type	Plant Description	Emission Limit Value	MWth	Stack Diameter (m)	Stack Height m (height of emission release)	Exit Velocity (m/s)	NOx emission rate (g/s)
1	NRMM Stage IIIB	2 g/KWh	1	0.3	2.5	36.02	0.22
2	MCPD Compliant	200 mg/Nm3	4.5	0.5	2.5	36.80	0.26

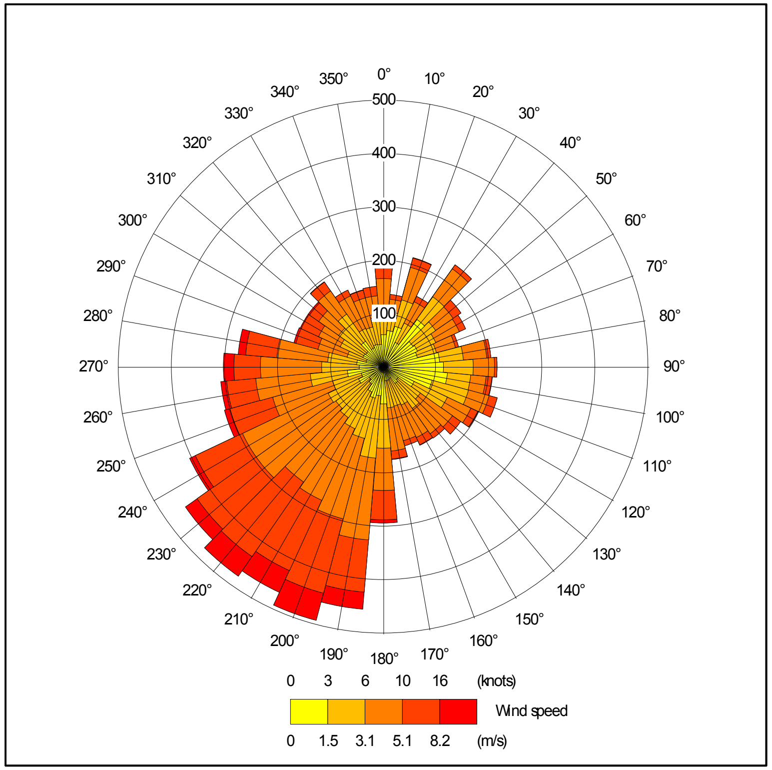
3.2.4.1 Air dispersion model

Current and with scheme air quality impacts of increased road traffic and NRMM emissions on concentrations of NO_x and NO_2 have been quantified using atmospheric dispersion modelling. Annual mean concentrations of each pollutant have been modelled within the study area using the atmospheric dispersion model ADMS Roads version 4.1 and ADMS 5 for NRMM.

3.2.4.2 Meteorological data

2019 annual meteorological data was procured from the Southampton city centre weather station. The data capture is 99.9% for temperature, wind speed and wind direction, whereas cloud cover has a data capture of 94.9%. A wind rose of 2019 met data can be seen in **Figure 3.1**. This demonstrates that the prevailing wind direction is south westerly, typical of the UK.

Figure 3.1 Wind rose for Southampton city centre 2019 meteorological data



3.2.4.3 Significance criteria

Human health

The Institute of Air Quality Management's (IAQM) Land-Use Planning & Development Control: Planning for Air Quality significance criteria[18] will be used if there is a risk of significant impacts at human health receptors. This categorises the scheme's pollutant contributions into 'impact descriptors', with descriptors ranging from 'substantial beneficial' through to 'substantial adverse'. These impact descriptors are used alongside professional judgement to determine scheme significance. The significance criteria matrix has been presented within **Table 3.4**.

Table 3.4 IAQM human health significance criteria

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Ecological

The IAQM's 'A guide to the assessment of air quality impacts on designated nature conservation sites (2020)[19]' and CIEEM (2021[20]) was used to determine the significance of impacts at habitats. A screening process will be undertaken prior to assessing the scheme's impact upon nutrient nitrogen and acid deposition critical loads of various habitats. The scheme's impacts will be identified as insignificant if the contribution of NO_x annual mean is ≤ 1% of the critical level (30 µg/m^3). However, an assessment of the scheme's impact against the nutrient nitrogen and acid deposition critical load will be undertaken if the scheme's annual mean NO_x contribution is ≤ 1%. The scheme's impacts will be classed as insignificant if the nutrient nitrogen or acid deposition contribution is ≤ 1% of the habitat critical load. Significance will need to be determined by an Ecologist if the nutrient nitrogen or acid deposition is > 1% of the critical load. However, as this scheme is at the route option appraisal stage it is not considered necessary for an Ecologist to review nutrient nitrogen and acid deposition impacts at habitats. The work completed and detailed in this report has been used to support the Gate 2 Habitats Regulations Assessment.

[18] http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf
[19] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2019.pdf
[20] Chartered Institute of Ecology and Environmental Management (CIEEM), (2021). Advisory Note: Ecological Assessment of Air Quality Impacts. (January 2021).

4 Assessment Findings

4.1 Site Selection Risk Assessment

4.1.1 Main sites

The main sites; water recycling site options, desalination site, intake and outfall sites are either within industrialised settings, and therefore within 350m of the site there are lower sensitivity human receptors such as offices e.g., water recycling plant, or there are generally fewer higher sensitivity residential properties e.g., [redacted] desalination which includes properties on Stonehills and [redacted] within 350m, but none within 50m or 25m. At the Calshot intake/outfall location there are several properties at Hillhead that would be within 350m, although there are no properties within 50m or 25m. At the alternative location for the desalination plant at Meon, there are several properties along Meon Road that would be within 350m of the main construction site. There is little in terms of air quality to differentiate the selection of these sites in terms of human receptors. The end points at Testwood WSW and Otterbourne WSW are fixed. No AQMA will be affected by works at these sites.

4.1.2 Pipeline routes

Pipeline infrastructure is a key element of each SRO configuration, and there is optionality as to which is selected. The SRO configurations considered within the site selection risk assessment are as follows:

Desalination alternatives:

- A1 75Ml/d or A2 61Ml/d - Base Case: Fawley and Calshot.
- A1 75Ml/d or A2 61Ml/d – Alternative: Lepe.
- A3 - 75Ml/d or 61Ml/d – Alternative: Meon.

Water recycling:

- B2b - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer.
- B4 - [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer.
- B5 - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer.
- D2 Havant Thicket Reservoir Alternative Use.

The list of SRO configurations and available pipeline routes is presented in **Table 4.1**. Each pipeline has been assessed individually within the air quality GIS. The routes were itemised and the locations are presented in **Figure 4.1** (west Solent) and

Figure 4.2 (east Solent).

Table 4.1 Proposed configurations

Route Number	Options
Desalination	
A1/A2 Fawley ([redacted]) to Abstraction and Discharge	
2	Fawley (AC) to Abstraction and Discharge - Calshot to [redacted] Route 1
3	Fawley (AC) to Abstraction and Discharge - Lepe to [redacted] Route 1
4	Fawley (AC) to Abstraction and Discharge - Lepe to [redacted] Route 2
A1/A2 Fawley ([redacted] to Testwood Water Supply Works (WSW)	
5	Fawley (AC) to Testwood WSW Route 1
6	Fawley (AC) to Testwood WSW Route 2
7	Fawley (AC) to Testwood WSW Route 3
8	Fawley (AC) to Testwood WSW Route 4
9	Fawley (AC) to Testwood WSW Route SIA
A3/D55 Meon Desalination	
10	Meon to Otterbourne Route 1
11	Meon to Otterbourne Route 2
12	Meon to Otterbourne Route SIA
Water Recycling	
B2b - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer	
1	[redacted] to Water Recycling Plant (WRP) Route 1
16	WRP to Otterbourne Route 1
17	WRP to Otterbourne Route 2
18	WRP to Otterbourne Route SIA
13	Otterbourne Emergency Discharge Pipeline
B4 - [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer	
15	WRP to Havant Thicket Reservoir Route 1
19	WRP to Havant Thicket Reservoir Route 2
20	WRP to Havant Thicket Reservoir Route 2a
21	HTR (Havant Thicket) B4 D2 to Otterbourne Route 1
22	HTR (Havant Thicket) B4 D2 to Otterbourne Route 2
23	HTR (Havant Thicket) B4 D2 to Otterbourne Route 3
24	HTR (Havant Thicket) B4 D2 to Otterbourne Route 4
B5 - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer.	
14	[redacted] Route 1
In addition to option 14 This option uses the same pipelines between the WRP and Lake Otterbourne as B2b	
D2 Havant Thicket Reservoir Alternative Use	
This option uses the same pipelines as B4 between HTR and Otterbourne WSW and for that reason dose not required a separate assessment	

Figure 4.1 Proposed configurations: Desalination [redacted]

[redacted]

Figure 4.2 Proposed configurations: Water recycling and Desalination (Meon)

[redacted]

4.1.2.1 Human receptors

Table 4.2 provides details of the number of properties, representing the human sensitive receptors, within the various construction work buffers in accordance with IAQM guidance.

Table 4.2 Number of properties within the construction screening buffer zones

Route number	25m Buffer	50m Buffer	350m Buffer	AQMA
Desalination				
A1/A2 Fawley (AC) to Abstraction and Discharge				
2	3	10	104	None
3	3	6	71	None
4	1	2	444	None
A1/A2 Fawley (AC) to Abstraction and Discharge				
5	93	354	4,234	None
6	155	408	4,438	None
7	206	473	5,091	None
8	175	444	4,377	None
9	93	354	4,234	None
A3/D55 Meon desalination				
10	112	246	2,067	None
11	293	536	2,614	None
12	293	536	2,624	None
Water Recycling				
B2b - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer.				
1	0	0	70	None
13	0	0	44	None
16	126	313	3,149	None
17	226	476	3,337	None
18	107	264	3,091	None
B4 - [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer				
15	173	315	1,890	None
19	83	139	1,266	None
20	4	8	268	None
21	118	277	2,508	None
22	203	424	3,330	None
23	437	822	5,845	None
24	100	265	3,145	None
B5 - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer				
14	39	121	2,194	None
This option uses the same pipelines between the WRP and Lake Otterbourne as B2b				

A1/A2/A3 Desalination

None of the assessed routes pass within 350m of an Air Quality Management Area.

A1/A2 Fawley (AC) to Abstraction and Discharge

Route 4 (Lepe to [redacted] Route 2) captures the highest number of receptors within the 350m buffer (444 receptors) but only two or one receptors are captured by 25m and 50m buffer respectively.

Route 2 (Calshot to [redacted]) and Route 3 (Lepe to [redacted] Route 1) capture from 71 to 104 receptors within 350m buffer and from 10 to 6 within the 50m buffer respectively. Both routes capture only 3 receptors within the 25m buffer.

The results indicate that neither of the routes passes in close proximity to a considerable number of sensitive receptors.

A1/A2 Fawley (AC) to Testwood WSW

Routes 5 to 9 were assessed. Route 7 (Fawley to Testwood WSW Route 3) captures the highest number of receptors within the 350m buffer (5,091). This route also captures the highest number of receptors within 50m and 25m buffer – 473 and 206 receptors respectively. Route 6 (Fawley to Testwood WSW Route 2) and 8 (Fawley to Testwood WSW Route 4) capture 4438 and 4377 receptors within 350m buffer, 408 to 444 receptors within 50m buffer and 155 and 175 receptors within 25m buffer, respectively.

Routes 5 (Fawley to Testwood Route 1) and 9 (Fawley to Testwood WSW SIA) capture the same number of receptors in all buffers. Routes 5 and 9 capture the least number of receptors out of all assessed routes.

A3 Meon desalination

Routes 10 (Meon to Otterbourne WSW Route 1),11 (Meon to Otterbourne WSW Route 2) and 12 Meon to Otterbourne WSW Route 2 v2) were assessed. Routes 11 and 12 give identical results of 293 receptors captured in the 25m buffer and 536 captured in the 50m buffer. However, in the 350m buffer, route 11 captured less receptors (2614) compared to route 12 (2624).

The results indicate that route 10 (Meon to Otterbourne WSW Route 1) would be the preferential route as it encounters the least receptors at all distances (350m – 2067, 50m – 246, 25m – 112).

B2/B4/B5 Water Recycling

B2b - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer

Routes 16 (WRP to Otterbourne Route 1), 17 (WRP to Otterbourne Route 2) and 18 (WRP to Otterbourne SIA) were assessed for the WRP to Otterbourne pipeline options.

The results indicate that route 17 captured the most receptors at all buffer distances (350m – 337, 50m – 476, 25m – 226), followed by route 16 (350m – 3149, 50m – 313, 25m – 126)

Route 18 (WRP to Otterbourne SIA) captured the least receptors comparatively, making it the preferential option (350m – 3091, 50m – 264, 25m – 107).

Routes 1 ([redacted] to WRP Route 1) and 13 (Otterbourne emergency drawdown pipeline) were also assessed as components of the water recycling solution. The [redacted] to WRP Route 1 captured 70 receptors within the 350m buffer, and the Otterbourne emergency drawdown pipeline 44. Both routes captured nothing from within 50m.

B4 - [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer

Routes 15 (WRP to Havant Thicket Reservoir Route 1), 19 (WRP to Havant Thicket Reservoir Route 2) and 20 (WRP to Havant Thicket Reservoir Route 2a) were assessed for pipeline between WRP to Havant Thicket. The results indicate that there is a significant difference in captured receptors between route 20 and the other routes. Route 20 captures 268 receptors within the 350m buffer which drastically reduces to 8 at 50m and 4 at 25m. Route 15 and 19 comparatively capture many more receptors at all distances with route 19 scoring slightly better (350m – 1266, 50m – 139, 25m – 83) than route 15 (350m – 1890, 50m – 315, 25m – 173).

Route 20 (WRP to Havant Thicket Reservoir Route 2a) captures the least receptors making it the preferential choice

Routes 21 (HTR to Otterbourne WSW Route 1), 22 (HTR to Otterbourne WSW Route 2), 23 (HTR to Otterbourne WSW Route 3) and 24 (HTR to Otterbourne WSW Route 4) were assessed for pipeline between HTR and Otterbourne WSW. At 350m buffer distance route 21 performs the best capturing 2508 receptors, followed by 24 (3145), 22 (3330) and 23 (5845). Within the 50m buffer, route 24 performs the best capturing 265. This is followed by Route 21 (277), 22 (424) and Route 23 (822). This order remains the same at the 25m buffer (Route 24 – 100, Route 21 – 118, Route 22 – 203, Route 23 - 437).

Route 21 (HTR to Otterbourne WSW Route 1) or 24 (HTR to Otterbourne WSW Route 4) would be preferential. Route 21 captures the least receptors at 350m distance, but Route 24 captures the least at the other 2 buffers.

B5 - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer

This option uses the same pipelines between the WRP and Lake Otterbourne as B2b (13, 16, 17 and 18). Route 14 was also assessed between [redacted] and WRP and captured 2,194 receptors at 350m, 121 receptors at 50m and 39 receptors at 25m.

D2 Havant Thicket Reservoir Alternative Use

This option uses the same pipelines as B4 between HTR and Otterbourne WSW (21, 22, 23 and 24).

4.1.2.2 Ecological receptors

Table 4.3 provides details of the number of properties within the various construction work buffers.

Table 4.3 Number of ecological receptors located within the selected construction buffer zones

Route Number	50m Buffer	350m Buffer
Desalination		
A1/A2 Fawley (AC) to Abstraction and Discharge		
2	AW - 1	AW – 1 SPA - 2 SSSI - 1 Ramsar - 1
3	AW – 1 NNR – 1 SSSI - 1	AW - 3* NNR – 1 SSSI – 1 SPA – 1 Ramsar - 1
4	AW – 1 NNR – 1 SSSI – 1	AW - 4* NNR – 1 SSSI – 1 SPA - 2 Ramsar - 1
A1/A2 Fawley (AC) to Testwood WSW		
5	AW - 9* SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1	AW - 20* SPA – 1 SSSI – 2 Ramsar – 1
6	AW - 9* SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1	AW - 23* SPA – 1 SSSI – 2 SAC -1 Ramsar – 1
7	AW - 7* SSSI – 3 SPA - 2 SAC – 2 Ramsar - 2	AW - 23* SSSI – 4 SPA - 3 SAC -2 Ramsar - 2

Route Number	50m Buffer	350m Buffer
8	AW – 2 SSSI – 1 SAC – 1 Ramsar - 1	AW - 16* SSSI – 1 SAC -1 SPA – 1 Ramsar – 1
9	AW - 9* SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1	AW - 20* SPA – 1 SSSI – 2 SAC -1 Ramsar – 1
A3 Meon desalination		
10	AW - 9* SSSI – 2 SAC - 1	AW - 30* SSSI – 2 SAC -1
11	AW - 7* SSSI – 2 SAC - 1	AW - 23* SSSI – 3 SAC -1
12	AW - 8* SSSI – 2 SAC - 1	AW - 23* SSSI – 3 SAC -1
Water Recycling		
B2b - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer		
1	None	SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1
16	AW - 11* SSSI – 1 SAC - 1	AW - 35* SSSI – 2 SAC -1
17	AW - 15* SSSI – 1 SAC - 1	AW - 32* SSSI – 4 SAC -1
18	AW - 12* SSSI – 1 SAC - 1	AW - 29* SSSI – 2 SAC -1
13	None	SAC -1 SSSI - 3
B4 - [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer		
15	None	None
19	AW - 1	AW - 1
20	AW - 4*	AW - 9*
21	AW - 20* SSSI - 1 SAC - 1	AW - 24* SSSI - 1 SAC - 1
22	AW - 16* SSSI - 1 SAC - 1	AW - 21* SSSI - 1 SAC - 1
23	AW - 13* SSSI - 1 SAC - 1	AW - 18* SSSI - 2 SAC - 1
24	AW - 15* SSSI - 1 SAC - 1	AW - 20* SSSI - 1 SAC - 1
B5 - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer		
14	AW - 3*	AW - 19* SSSI - 1
This option uses the same pipelines between the WRP and Lake Otterbourne as B2b		
Note: AW - Ancient Woodland. SPA - Special Protected Area. SSSI - Site of Special Scientific Interest. Ramsar - Wetland		

Route Number	50m Buffer	350m Buffer
sites of international importance. SAC - Special Area of Conservation. NNR – National Nature Reserves. Note: * represents uncertainty in the value due to possible duplication. As such, values provided with * may be overestimated.		

Desalination

A1/A2 Fawley (AC) to Abstraction and Discharge

Routes 2, 3 and 4 were assessed. The Solent and Southampton Water SPA and Ramsar is located within the 350m buffer from each route. However, none of the routes capture this site within the 50m buffer. In addition to the Solent and Southampton Water SPA and Ramsar, Route 2 and 4 also capture the Solent and Dorset Coast SPA within a 350m buffer.

The North Solent Site of Special Scientific Interest (SSSI) and National Nature Reserve was captured for all 3 routes within the 350m buffer. However, Routes 3 and 4 pass closer to the site, and therefore the North Solent SSSI is captured within the 50m buffer for these routes. Routes 3 and 4 capture this site within both 350m and 50m buffers but not route 2.

All routes capture Ancient Woodland (AW) site within both buffer distances.

The data suggests that between these route options, Route 2 captures the fewest nationally designated sites, and therefore would not require significant re-routing from an air quality perspective. Route 3 would be the preferred route to the Lepe intake/outfall as it captures fewer SPA designations and fewer areas of Ancient Woodland in the 350m buffer zone.

A1/A2 Fawley (AC) to Testwood WSW

Routes 5, 6, 7, 8 and 9 were assessed. All routes intersect the New Forest Ramsar site at both 50m and 350m buffers. Route 7 is additionally positioned within 50m of the Solent & Southampton Water Ramsar.

In terms of SPAs, all routes intersect at least one site. All routes cross the New Forest SPA to within 50m. Route 7 additionally captures the Solent and Dorset Coast SPA within 350m and the Solent & Southampton Water SPA within 50m.

All routes capture the New Forest SSSI within 50m and the River Test SSSI to within 350m. Route 7 additionally captures Dibden Bay SSSI and Hythe to Calshot Marshes SSSI to within 50m. The New Forest is also classified as a SAC and all routes pass within 50m of the SAC site. Solent Maritime SAC is also within 50m of route 7. All routes lie close to many AW but route 8 avoids the most.

The data suggests that between these route options, route 8 would be preferential. In terms of Ancient Woodland, it captured the least at both distances and where all other routes passed within 50m of an SPA, route 8 passed within 350m.

A3 Meon desalination

Routes 10 (Meon to Otterbourne WSW Route 1), 11 (Meon to Otterbourne WSW Route 2) and 12 (Meon to Otterbourne WSW Route SIA) were assessed. All routes lie within 50m of the River Itchen SSSI and the Botley Wood and Everett's and Mushes Copses SSSI. Routes 11 and 12 also lie within 350m of the Waltham Chase Meadows SSSI. The River Itchen is also classified as a SAC with all routes within 50m from the SAC site. Routes 11 and 12 pass through not as many AW as Route 10.

Based on available data, the preferential route to take in terms of ecological receptors is Route 10 (Meon to Otterbourne WSW Route 1). It potentially has the most AW encountered within the buffers, however due to the lack of clarity in AW data, a conclusion drawn from an SSSI point of view would have greater reliability. As Route 10 encounters 2 instead of 3 SSSIs at the 350m buffer it presents itself as the more preferential option.

Water Recycling

B2b - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer

Routes 16 (WRP to Otterbourne Route 1), 17 (WRP to Otterbourne Route 2) and 18 (WRP to Otterbourne SIA) were assessed for the WRP to Otterbourne pipeline options. All routes lie close within the 50m buffer of the River Itchen SSSI, and within the 350m all routes capture the Portsdown SSSI. Additionally, route 17 is within 350m of the Waltham Chase Meadows SSSI and the Moors, Bishop's Waltham SSSI. The River Itchen is also classified as a SAC and all routes pass within 50m of it. In terms of AW, all routes lie within 50m of multiple AWs.

The data suggests that Routes 16 (WRP to Otterbourne Route 1) or 18 (WRP to Otterbourne SIA) would be the preferential options to take. Route 17 encounters more SSSIs than the other routes.

Routes 1 and 13 were also assessed for Budds farm to WRP route 1 and an Otterbourne emergency discharge pipeline respectively. Route 1 passed within 350m of the Chichester and Langstone Harbour's Ramsar and SAC, the Langstone Harbour SSSI and the Solent Maritime SAC. Route 13 passed within 350m of the River Itchen SAC and SSSI.

B4 - [redacted] to Otterbourne WSW via Havant Thicket Reservoir environmental buffer

Routes 15 (WRP to Havant Thicket Reservoir Route 1), 19 (WRP to Havant Thicket Reservoir Route 2) and 20 (WRP to Havant Thicket Reservoir Route 2a) were assessed for pipeline between WRP to Havant Thicket. Route 15 had no environmental receptors captured within a 350m buffer. Route 19 passed within 50m of an AW and Route 20 passed within 50m of the greatest number of AW.

Based on available data sets, Route 15 (WRP to Havant Thicket Reservoir Route 1) would be the preferential route to take between the WRP and Havant Thicket as it encounters no ecological receptors.

Routes 21 (HTR to Otterbourne WSW Route 1), 22 (HTR to Otterbourne WSW Route 2), 23 (HTR to Otterbourne WSW Route 3) and 24 (HTR to Otterbourne WSW Route 4) were assessed for pipeline between HTR and Otterbourne WSW. All 4 routes passed within 50m of the River Itchen SSSI and SAC. Additionally, Route 23 passed within 350m of the Portsdown SSSI. Route 21 encountered the most woodlands within both buffer distances and route 23 encountered the least at both.

Based on available information Route 23 (HTR to Otterbourne WSW Route 3) would be considered as the least preferential option. This is because this route passes within 350m from the additional SSSI.

B5 - [redacted] to Otterbourne WSW via Lake Otterbourne environmental buffer

This option uses the same pipelines between the WRP and Lake Otterbourne as B2b (13, 16, 17 and 18). Route 14 was also assessed between [redacted] and WRP. The route passed within 350m of the Portsdown SSSI. A moderate number of AW is also captured within 350m however this drops significantly within the 50m buffer.

D2 Havant Thicket Reservoir Alternative Use

This option uses the same pipelines as B4 between HTR and Otterbourne WSW (21, 22, 23 and 24).

4.1.3 Mitigation Requirements

Where a route is located within 25m of 10 or more sensitive human receptors, mitigation will be required. The exact level of mitigation will depend on the sensitivity of the area, taking account of the following factors:

• the specific sensitivities of receptors in the area;

• the proximity and number of those receptors;

• in the case of PM10, the local background concentration; and

• site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

Table 4.4 gives an indication of the sensitivity of an area for dust effects to people and property, taken from the IAQM guidance.

Table 4.4 Sensitivity of the area to dust soiling effects on people and property (source: IAQM, 2014)

Sensitivity of area	Number of receptors	Distance from the source			
		<20m	**<50m**	**<100m**	**<350m**
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 risk of effects from dust will be determined based on the scale of the anticipated works at different locations. For example, the risk at the main desalination plant site and water recycling plant site is likely to be larger than when constructing the pipeline routes, and will depend on the amount of demolition, earthworks, construction and trackout involved.

It was assumed during the site selection work that the risk of impacts was high. This will need to be refined through the project level EIA once a route is selected and construction techniques and programme confirmed. An indication of potential mitigation measures, taken from the IAQM guidance, is set out in **Table 4.5**.

Table 4.5 Examples of air quality mitigation

Desalination plant/water recycling plant sites	Pipeline routes (open cut in arable fields)
Avoid scabbling (roughening of concrete surfaces) if possible	Only remove the cover in small areas during work and not all at once
Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional measures are in place	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use;	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
Avoid dry sweeping of large areas	Ensure all vehicles switch off engines when stationary - no idling vehicles.
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport	Sensitive route management (e.g. avoidance of local roads, residential areas, schools) where possible to access start and end point of pipeline construction corridors.
Record all inspections of haul routes and any subsequent action in a site log book	
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	

Desalination plant/water recycling plant sites	Pipeline routes (open cut in arable fields)
Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	

As part of a Dust Management Plan for the sites, a monitoring programme should be included. This is likely to consist of daily visual inspections of dust emissions around the perimeter of the site and reported in a dust monitoring visual inspection log. A communications strategy will also be required for the effective handling and response to any complaints received from local residents.

4.2 Indicative Air Quality Modelling

The results at human health receptors have been presented within **Table 4.6**, with receptor locations shown in **Figure 4.3**.

Table 4.6 NO_2 impacts at worst-case locations for human health exposure

NO_2 annual mean (µg/m^3)							
Receptor ID	Background 2025	Without Scheme 2025	With Scheme 2025 Route 1	With Scheme 2025 Route 2	With Scheme 2025 Route 3	With Scheme 2025 Route 4	With Scheme 2025 Route 5
R2532	10.6	13.5	21.0	20.9	20.8	20.9	20.9
R3164	10.5	13.7	20.6	20.6	13.8	20.6	20.6

The increase in NO_2 associated with the majority of pipeline routes is classed as moderate adverse according to IAQM's impact descriptors, with the exception of route 3 which has a negligible increase (0.1 µg/m^3) in NO_2 at R3164. The background concentrations at human health receptors are so low, that even a highly conservative worst-case increase in NO_2 is not sufficient to cause an exceedance of the NO_2 annual mean above the annual mean national objective level of 40 µg/m^3. Consequently, impacts at human health receptors are considered to be insignificant. As modelled concentrations of NO_2 are very low, it is anticipated that particulate emissions from combustion vehicle exhausts will be lower than NO_x emissions. Furthermore, the maximum background PM_{10} concentration across the study area is 13.5 µg/m^3, which is well below the annual mean national objective level of 40 µg/m^3. For that reasons particulate matter has been screened out of this assessment.

Whilst the impacts from all routes upon human health are considered to be insignificant, the increase in NO_2 concentrations from route option 3 are smaller than other options and from an air quality point of view, this would be the preferred scheme. The remaining scheme options have similar impacts upon human health receptors along the [redacted].

All designated sites (Ramsar, SAC, SPA and SSSI) within 200 metres of roads affected by the [redacted] pipeline have been included in the air quality assessment, this includes various designations for the New Forest and Solent & Southampton habitats. Receptor groups have been developed to identify areas in the New Forest and Solent & Southampton, with one or more designations. The maximum estimated NO_x annual mean and 24hr mean concentration for each of these receptor groups has been presented within **Table 4.6** and **Table 4.7**.

Figure 4.3 Modelled human and ecological receptors

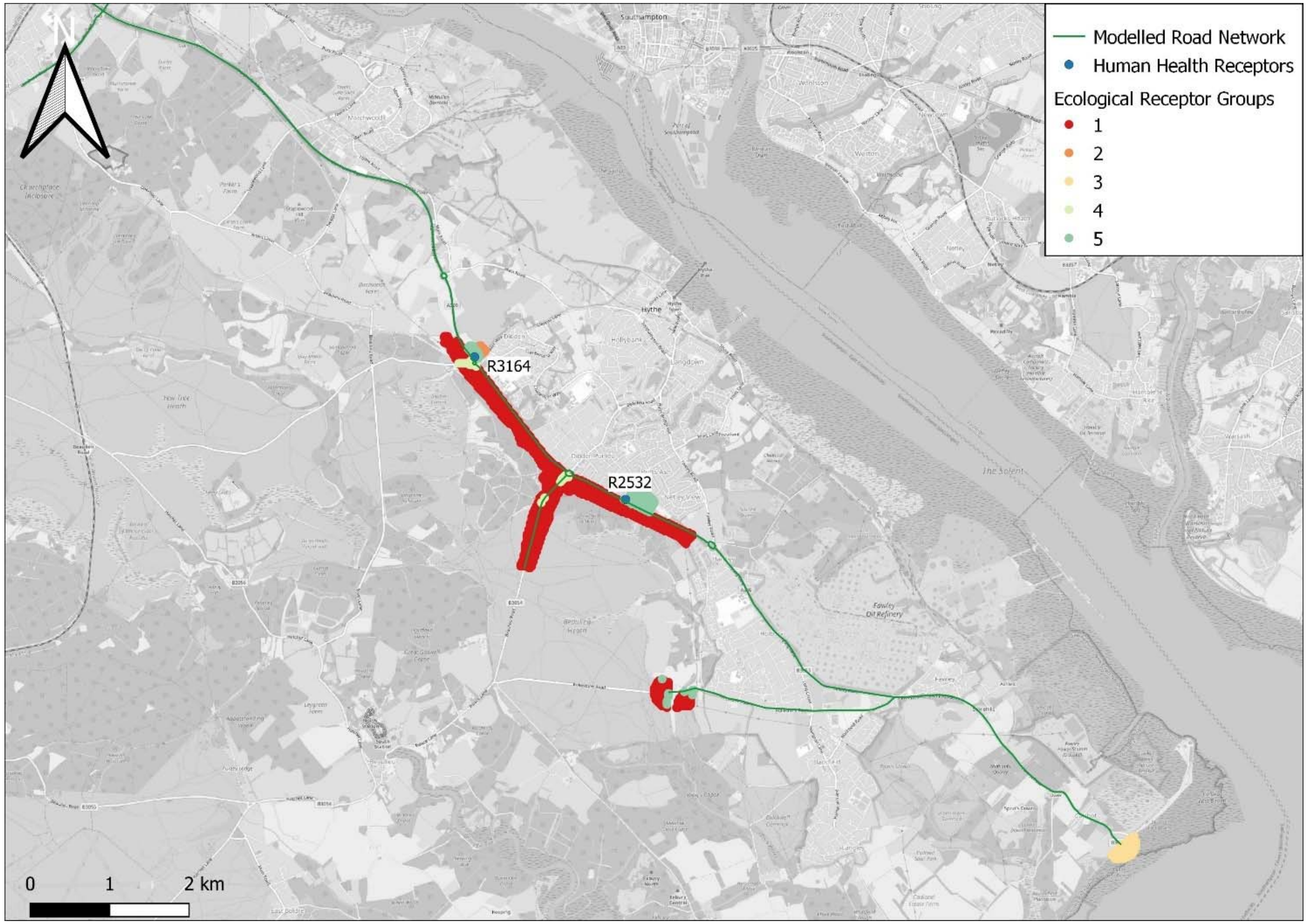


Table 4.7 Annual Mean NO_x impacts at worst-case ecological receptor locations

NO_x annual mean (µg/m^3)								
Receptor Designations	Receptor Group	Background 2025	Without Scheme 2025	With Scheme 2025 Route 1	With Scheme 2025 Route 2	With Scheme 2025 Route 3	With Scheme 2025 Route 4	With Scheme 2025 Route 5
SSSI, SPA, Ramsar, SAC New Forest	1	15.2	26.3	51.5	51.3	49.3	50.6	50.6
SSSI The New Forest	2	15.1	18.6	22.5	22.5	18.8	22.4	22.5
SPA&Ramsar Solent & Southampton	3	16.8	18.0	21.2	21.2	21.2	21.2	21.2
SPA & Ramsar New Forest	4	15.2	27.0	52.9	52.9	45.1	52.9	53.1
SAC & SSSI The New Forest	5	15.2	32.4	77.1	77.1	76.9	77.1	77.1

As the NO_x annual mean concentrations are < 30 µg/m^3 in receptor groups 2 and 3, they are screened out from further assessment. The other receptor groups with annual mean NO_x concentrations > 30 µg/m^3 have gone through a nutrient nitrogen (NN) and acid deposition (AD) assessment. The purpose of the NN and AD assessment is to determine whether there is a risk of a >1% NN or AD contribution as a% of the habitats critical load. The assessment of the NO_x critical level again shows that route 3 is favourable as it results in lower NO_x concentrations across all receptor groups. With the exception of receptor group 1, routes 1 and 2 are the most polluting schemes for this receptor group.

Table 4.8 24hr NO_x impacts at worst-case ecological receptor locations

NO_x annual mean (µg/m^3)								
Receptor Designations	Receptor Group	Background 2025	Without Scheme 2025	With Scheme 2025 Route 1	With Scheme 2025 Route 2	With Scheme 2025 Route 3	With Scheme 2025 Route 4	With Scheme 2025 Route 5
SSSI, SPA, Ramsar, SAC New Forest	1	30.5	43.5	66.3	66.3	64.1	65.4	65.6
SSSI The New Forest	2	34.7	36.0	38.9	38.8	36.2	38.7	38.9
SPA&Ramsar Solent & Southampton	3	33.7	34.9	38.1	38.1	38.1	38.1	38.1
SPA & Ramsar New Forest	4	30.5	41.8	67.0	67.0	59.7	67.0	67.0
SAC & SSSI The New Forest	5	30.5	47.6	91.9	91.9	91.7	91.7	91.9

IAQM's habitat guidance Appendix D highlights that in the presence of low SO_2 and O_3 concentrations a threshold of 200 µg/m^3 should be used to identify locations at risk of exceeding the 24hr annual average. Consequently, there are no receptor groups at risk of exceeding the 24hr annual average NO_x critical level.

Table 4.9 Nutrient nitrogen deposition at ecological receptors

Nutrient Nitrogen Deposition (kgN/ha/yr)								
Receptor Designations	Receptor Group	Critical load	APIS BG nutrient nitrogen deposition	DS1 Nitrogen Deposition & (% against critical load)	DS2 Nitrogen Deposition & (% against critical load)	DS3 Nitrogen Deposition & (% against critical load)	DS4 Nitrogen Deposition & (% against critical load)	DS5 Nitrogen Deposition & (% against critical load)
SSSI, SPA, Ramsar, SAC New Forest	1	5	21	10.4 (208.6)	10.4 (207.3)	9.8 (195.9)	10.2 (203.5)	10.2 (203.5)
SPA & Ramsar New Forest	4	5	21	10.9 (217.5)	10.9 (217.5)	8.6 (171.7)	10.9 (217.5)	10.9 (218.8)
SAC & SSSI The New Forest	5	5	21	17.8 (356.2)	17.8 (356.2)	17.7 (354.9)	17.8 (356.2)	17.8 (356.2)

The most sensitive designated feature across all receptor groups to nutrient nitrogen is the Woodlark, which depends upon coniferous woodland habitat and has a critical load of 5 kg/ha/yr. The average deposition reported by APIS in this area is 21 kgN/ha/yr, as such the coniferous woodland habitat is already in exceedance of critical load threshold. As each route option contributes >1% of the critical load and that the habitat is already in exceedance, each route option has the potential to cause significant impacts. For every receptor group, route option 3 contributes the least nutrient nitrogen and is favourable from an air quality point of view. Receptor group 1 has the largest difference in nutrient nitrogen between route options, the two most polluting route options are 1 and 2, with 5.1% and 3.8% more nutrient nitrogen contribution than route option 4/5.

As the air quality model has assumed the highest emission speed of 5 km/h, it is recommended that traffic modelling, with an ability to reflect dynamic speed changes associated with congestion, is used to estimate road speeds during construction for the environmental statement assessment. In addition, this information may be useful for the transport planners to avoid a traffic signalling configuration that could result in annual average speeds of 5 km/h. This assessment demonstrates that air quality cannot be screened out and improvements in the sophistication of congestion speed estimates are required to improve confidence in pollutant concentration estimates.

Table 4.10 Acid deposition at ecological receptors

Acid Deposition (keq/ha/yr)								
Receptor Designations	Receptor Group	Critical load	APIS BG acid nitrogen depositio n	DS1 Acid Deposition (keq/ha/yr) & (% against critical load)	DS2 Acid Deposition (keq/ha/yr) & (% against critical load)	DS3 Acid Deposition (keq/ha/yr) & (% against critical load)	DS4 Acid Deposition (keq/ha/yr) & (% against critical load)	DS5 Acid Deposition (keq/ha/yr) & (% against critical load)
SSSI, SPA, Ramsar, SAC New Forest	1	0.586	1	0.7 (127.1)	0.7 (126.4)	0.7 (119.4)	0.7 (124)	0.7 (124)
SPA & Ramsar New Forest	4	0.862	1	0.8 (90.1)	0.8 (90.1)	0.6 (71.1)	0.8 (90.1)	0.8 (90.6)

SAC & SSSI The New Forest	5	0.586	1	1.3 (217.1)	1.3 (217.1)	1.3 (216.3)	1.3 (217.1)	1.3 (217.1)

The most sensitive designated feature within receptor groups 1 and 5 to acid deposition is a range of acid grasslands such as *Festuca ovina* and has a critical load of 0.586 keq/ha/yr. The most sensitive designated feature within receptor group 4 to acid deposition is the Dartford Warbler, which depends upon the dwarf shrub heath for habitat and has a critical load of 0.862 keq/ha/yr. The average deposition reported by APIS for both acid grassland and dwarf shrub heath is 1 keq/ha/yr, as such these habitats are already in exceedance of the critical load threshold. As each route option contributes >1% of the critical load and that the habitat is already in exceedance, each route option has the potential to cause significant impacts. For every receptor group, route option 3 contributes the least acid deposition and is favourable from an air quality point of view. Receptor group 1 has the largest difference in nutrient nitrogen between route options, the two most polluting route options are 1 and 2, with 3.1% and 2.4% more nutrient nitrogen contribution than route option 4/5. As the air quality model has assumed the highest emission speed of 5 km/h, it is recommended that traffic modelling, with an ability to reflect dynamic speed changes associated with congestion, is used to estimate road speeds during construction for the environmental statement assessment. In addition, this information may be useful for the transport planners to avoid a traffic signalling configuration that could result in annual average speeds of 5 km/h. This assessment demonstrates that air quality cannot be screened out and improvements in the sophistication of congestion speed estimates are required to improve confidence in pollutant concentration estimates.

NO_x estimates from combustion plant associated with the River Itchen works has been presented within **Table 4.11**. There are two designated sites within 200 metres of the proposed launch/landing sites, the River Itchen SSSI and SAC. These two designations have been broken down into two receptor groups, receptor group 1 is representative of both the SSSI and SAC designation areas, whereas receptor group 2 is representative of only the SSSI designation. As the SSSI designation covers a greater extent than the SAC, there is a receptor group just for the SSSI designation.

Table 4.11 2025 NO_x estimates from River Itchen tunnelling works

		2025 Background NOx (µg/m3)	MCPD NO_x (µg/m3)		NRMM Stage IIIB NO_x (µg/m3)	
Receptor Designations	Receptor Group	Annual Mean	PEC Annual Mean NOx	PEC 24hr NOx	PEC Annual Mean NOx	PEC 24hr NOx
SSSI and SAC River Itchen	1	14.3	21.4	35.3	23.5	37.4
SSSI River Itchen	2	12.9	15.9	30.0	16.4	30.4

The results show that the annual mean NO_x critical level of 30 µg/m^3 is not exceeded from using either NRMM Stage IIIB or MCPD plant for the pipeline tunnelling works. In addition, the NO_x 24hr critical level of 200 µg/m^3 is not exceeded from using either the MCPD or NRMM plant. This assessment demonstrates that typical NRMM or MCPD plant is unlikely to cause an exceedance of threshold levels at nearby sensitive ecological receptors. Consequently, the emissions from plant used for pipeline tunnelling can be minimised to acceptable levels through a minimum of Stage IIIB or MCPD compliant plant selection. It is recommended that once final details of NRMM are known, that this is modelled in the EIA to confirm that the plant will not cause significant impacts upon nearby ecological receptors. The maximum PEC of annual mean NO_x is 27.3 µg/m^3, assuming that 100% of NO_x consist of the NO_2 species results in ambient concentrations being substantially below the annual mean NO_2 threshold for NO_2. The River Itchen works are not considered to pose a risk to air quality at human health receptors.

5 Conclusions

5.1 Site Selection Risk Assessment

5.1.1 Air Quality Route Preference

Consideration was given to the air quality implications of the multiple pipeline route options being considered for the SROs; desalination, water recycling and alternative bulk supply. There is less optionality with regards the end point of these schemes; Testwood WSW and Otterbourne WSW and therefore these were not considered. Similarly, the site locations for the desalination plant and water recycling plant are well defined, and without significant optionality to reduce air quality impacts. As such, these latter components will require mitigation to reduce any adverse effects arising.

When assessing the pipelines, there is more flexibility in the routing, and therefore the findings of this risk assessment will help to inform where potential changes are required.

In summary, from an air quality perspective only, the following routes were preferred:

Desalination - Fawley:

- Fawley [redacted] to Abstraction and Discharge - Calshot to [redacted] Route 1 (no optionality).
- Fawley [redacted] to Abstraction and Discharge - Lepe to [redacted] Route 1.
- Fawley to Testwood WSW either Routes 1 or SIA (for human receptors).
- Fawley to Testwood WSW Route 4 (for ecological receptors – ancient woodland only).

Desalination – Meon:

- Meon desal to Otterbourne WSW Route 1

Water recycling:

- All configurations: [redacted] Route 1 (no optionality).
- B2 Lake Otterbourne:
    - WRP to Otterbourne WSW SIA Route
    - Otterbourne emergency discharge pipeline (no optionality).
- B4 Havant Thicket Reservoir:
    - WRP to Havant Thicket Reservoir Route 2a (for human receptors)
    - WRP to Havant Thicket Reservoir Route 1 (for ecological receptors)
    - HTR (Havant Thicket Reservoir) to Otterbourne WSW Route 4
- B5 [redacted]
    - [redacted] Route 1 (no optionality).
    - WRP to Otterbourne WSW SIA Route
    - Otterbourne emergency discharge pipeline (no optionality).

Alternative bulk supply:

- HTR (Havant Thicket Reservoir) to Otterbourne WSW Route 4

Mitigation measures will likely be required and should follow the IAQM guidance to lessen the impacts.

5.1.2 Emerging Route Preferences

Ongoing site selection work, considering a range of criteria, has identified a different sub-set of pipeline routes to progress with through the MCDA and Gate 2 assessment process. The results for these routes, in terms of numbers of human receptors and ecological receptors, is provided in **Table 5.1**.

Table 5.1 Air quality risk of emerging pipeline route preferences

Route	Human Receptors			Ecological Receptors	
	25m	50m	350m	50m	350m
A1/A2 Desalination					
Fawley (AC) to Abstraction/Discharge Calshot	3	10	104	AW - 1	AW – 1 SPA - 2 SSSI - 1 Ramsar - 1
Fawley (AC) to Testwood WSW Route 2	155	408	4,438	AW - 9** SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1	AW - 23** SPA – 1 SSSI – 2 SAC -1 Ramsar – 1
B2 Water Recycling via Lake Otterbourne Environmental Buffer					
[redacted] to WRP*	0	0	70	None	SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1
WRP to Otterbourne WSW Route 1	126	313	3,149	AW - 11** SSSI – 1 SAC - 1	AW - 35** SSSI – 2 SAC -1
Otterbourne emergency discharge pipeline	0	0	44	None	SAC -1 SSSI - 3
B4 Water Recycling via Havant Thicket Reservoir Environmental Buffer					
[redacted] to WRP*	0	0	70	None	SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1
WRP to Havant Thicket Reservoir Route 1	173	315	1,890	None	None
Havant Thicket Reservoir to Otterbourne WSW Route 3	437	822	5,845	AW - 13** SSSI - 1 SAC - 1	AW - 18** SSSI - 2 SAC - 1
B5 Water Recycling with [redacted] via Lake Otterbourne Environmental Buffer					
[redacted] to WRP*	0	0	70	None	SPA – 1 SSSI – 1 SAC – 1 Ramsar – 1
[redacted] to WRP*	39	121	2,194	AW - 3**	AW - 19** SSSI - 1
WRP to Otterbourne WSW Route 1	126	313	3,149	AW - 11** SSSI – 1 SAC - 1	AW - 35** SSSI – 2 SAC -1
Otterbourne emergency discharge pipeline*	0	0	44	None	SAC -1 SSSI - 3
D2 Havant Thicket Reservoir Alternative Bulk Supply					
Havant Thicket Reservoir to Otterbourne WSW Route 3	437	822	5,845	AW - 13** SSSI - 1 SAC - 1	AW - 18** SSSI - 2 SAC - 1

*no route optionality. ** uncertainty in the value due to possible duplication.

5.2 Indicative Air Quality Modelling

The air quality assessment contains very conservative assumptions regarding speed reductions on roads that are intersected by the [redacted] pipeline works. All sections of the [redacted] intersected by the pipeline are assumed to have the highest emission speed of 5 km/h. There are two designation habitats identified within 200 metres of the [redacted] which are the New Forest and Solent & Southampton. Solent & Southampton can be screened out from further assessment, as the NO_x critical levels are not exceeded.

The assessment at the New Forest demonstrates, assuming speeds are reduced to 5 km/h, that there is the potential for significant air quality impacts upon ecological receptors. However, the risk upon human health receptors along the [redacted] is insignificant for all options. The most favourable scheme, from an air quality point of view, is route option 3, which has the lowest estimated nutrient nitrogen and acid deposition concentrations. The lower impacts from route option 3 are a result of the pipeline route intersecting the [redacted] less and therefore minimising disruption to traffic.

Overall, there is not necessarily a least favourable scheme as all route options have the potential for significant impacts assuming speeds are reduced to 5 km/h. As the air quality model has assumed the highest emission speed of 5 km/h, it is recommended that traffic modelling, with an ability to reflect dynamic speed changes associated with congestion, is used to estimate road speeds during construction for the environmental statement assessment. In addition, this information may be useful for the transport planners to avoid a traffic signalling configuration that could result in annual average speeds of 5 km/h.

Typical NRMM or MCPD plant associated with River Itchen pipeline tunnelling does not cause an exceedance of ecological or human health air quality thresholds. This assessment demonstrates that typical NRMM or MCPD plant is unlikely to cause an exceedance of threshold levels at nearby sensitive ecological and human health receptors. Consequently, the emissions from plant used for pipeline tunnelling can be minimised to acceptable levels through a minimum of Stage IIIB or MCPD compliant plant selection. It is recommended that once final details of NRMM are known, that this is modelled in the EIA to confirm that the plant will not cause significant impacts upon nearby ecological receptors.

Appendices

A1 Air Quality Modelling

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations; this helps to identify how the model is performing and if any adjustments should be applied. The verification process involves checking and refining the model input data to try and reduce uncertainties and produce model outputs that are in better agreement with the monitoring results. This can be followed by adjustment of the modelled results if required. The LAQM.TG(16) guidance recommends making the adjustment to the road contribution of the pollutant only and not the background concentration these are combined with.

The total diffusion tubes within the study area and near have been presented within Table A.1.

Table A.1 NO_2 diffusion tubes in New Forest District Council

Site ID	Site Name	Type	2018 (µg.m-3)	2019* (µg.m-3)	2019 Data Capture (%)	X	Y
[redacted]	[redacted]	Roadside	39.8	42.4	91.7	436473	113085
[redacted]	[redacted]	Roadside	38	38.8	100	436679	113399
[redacted]	[redacted]	Roadside	34	35.7	100	436610	113252
[redacted]	[redacted]	Roadside	28.7	31.1	100	436210	112902
[redacted]	[redacted]	Roadside	23.7	24.1	100	436213	112940
[redacted]	[redacted]	Roadside	16.8	16	100	438363	109694

The approach outlined in LAQM.TG(16) section 7.508 – 7.534 has been used in this case for selecting diffusion tubes for verification, 2 of these diffusion tubes were removed from verification for the following reasons:

- Diffusion tube 39 is classed as Roadside within the New Forest District Councils Annual Status Report[21]. Table 7.7 of LAQM.TG(16) notes that a roadside locations within 15 metres of the kerbside are classed as Roadside. As measurement location 39 is approximately 25 metres from the kerbside this has been removed from model verification.
- Section 7.132 of LAQM.TG(16) highlights that monitoring locations should be selected without any overhanging trees. Location 33 has been removed from the model verification, as images of the monitoring location indicate that the diffusion tube might be affected by overhanging trees.

A single road NOx adjustment factor of 2.2089 was derived and used to calculate: Modelling results at receptor points adjacent to relevant affected road links.

It is appropriate to verify the performance of the ADMS model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). To verify the model, the predicted annual mean Road NOx concentrations were compared with concentrations measured at the various monitoring sites during 2019. The model output of Road NOx (the total NOx originating from road traffic) was compared with measured Road NOx, where the measured Road NOx contribution is calculated as the difference between the total NOx and the background NOx value. Total measured NOx for each diffusion tube was calculated from the measured NO_2 concentration using the Defra NOx/NO_2 calculator (v8.1).

[21] https://www.newforest.gov.uk/media/1128/Air-Quality-Annual-Status-Report-2020/pdf/Air_Quality_Annual_Status_Report_2020.pdf?m=637357084031100000

The initial comparison of the modelled vs measured Road NOx identified that the model was under-predicting the Road NOx contribution at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible.

The gradient of the best fit line for the modelled Road NOx contribution vs. measured Road NOx contribution was then determined using linear regression and used as a domain wide Road NOx adjustment factor. This factor was then applied to the modelled Road NOx concentration at each discretely modelled receptor point to provide adjusted modelled Road NOx concentrations. A linear regression plot comparing modelled and monitored Road NOx concentrations before and after adjustment is presented in Figure A.0.1. The total annual mean NO2 concentrations were then determined using the NOx/NO2 calculator to combine background and adjusted road contribution concentrations.

A primary NOx adjustment factor (PAdj) of 2.2089 based on model verification using 4 of the 2019 NO_2 measurements was applied to all modelled Road NOx data prior to calculating an NO_2 annual mean.

A plot comparing modelled and monitored NO_2 concentrations before and after adjustment during 2019 is presented in Figure A.0.2.

Figure A.0.1 Comparison of modelled Road NOx Vs Measured Road NOx before and after adjustment

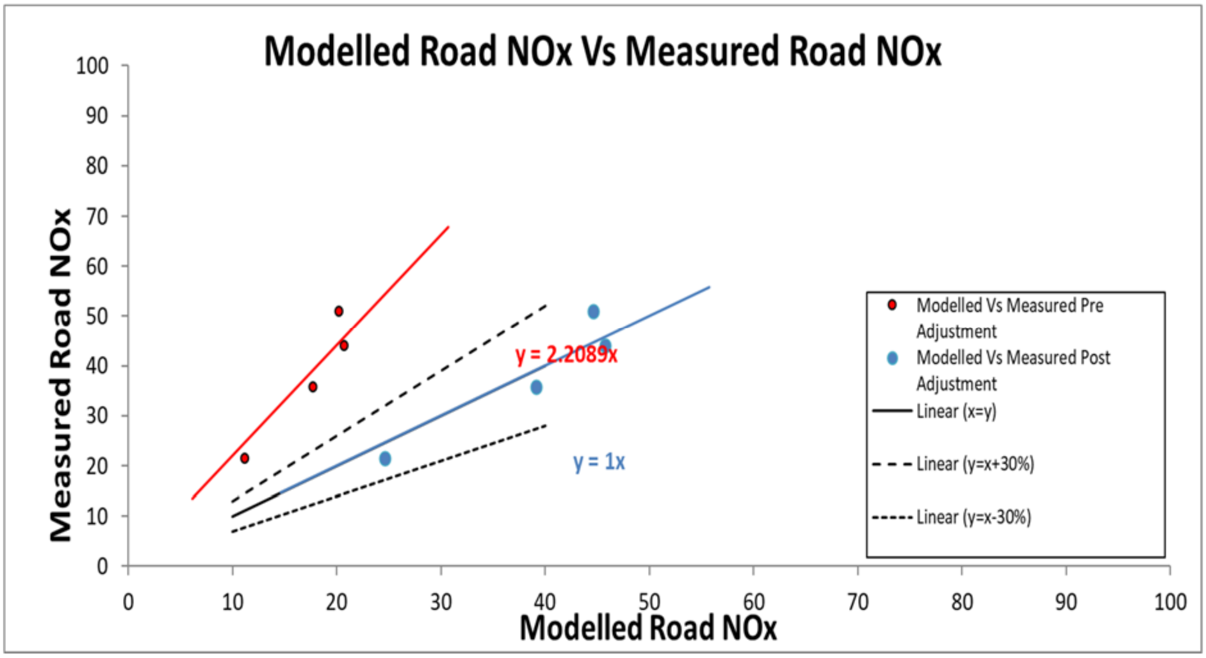
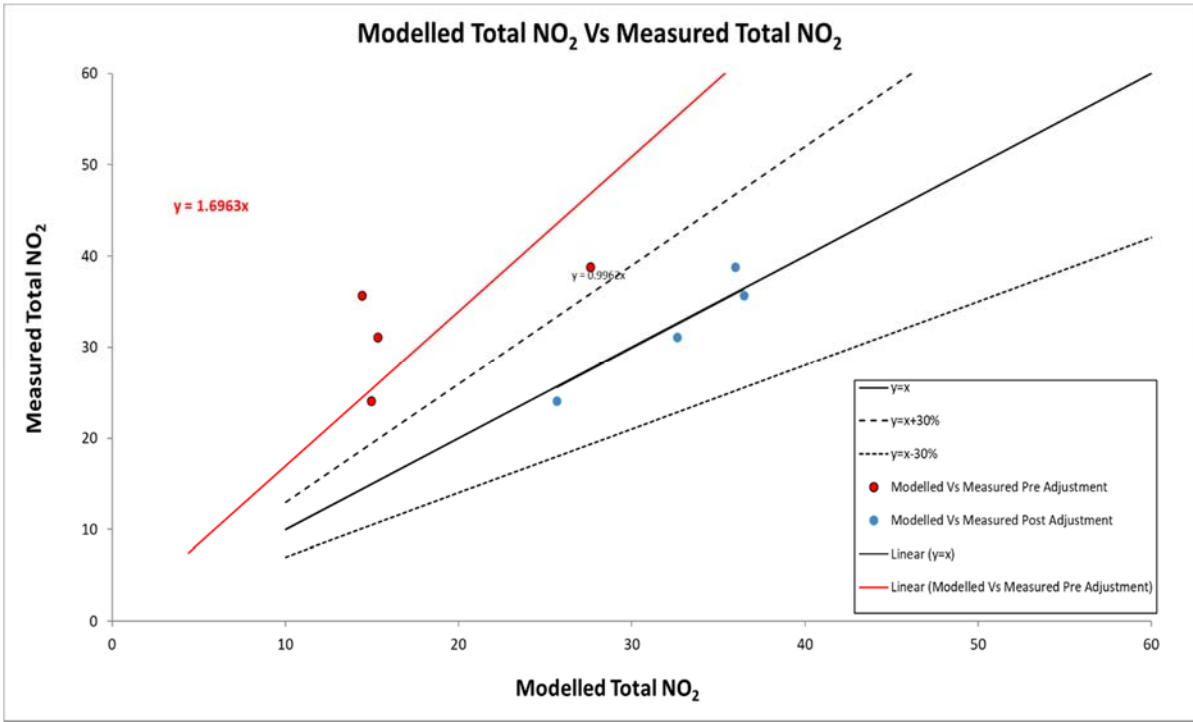


Figure A.0.2 Modelled vs. measured NO2 annual mean 2019 before and after adjustment



Model performance

To evaluate the model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that an RMSE of up to 4 μg/m^3 is ideal, and an RMSE of up to 10 μg/m^3 is acceptable. The calculated RMSE is presented in **Table A.2**. In this case the RMSE was calculated at 1.8 μg.m^{-3} which is within the ideal range suggested by the guidance.

Table A.2 Comparison of measured and modelled concentrations at measurement locations in 2019, and the model root mean square error.

NO_2 monitoring site	Measured NO_2 annual mean concentration 2019 ($\mu g.m^{-3}$)	Modelled NO_2 annual mean concentration 2019 ($\mu g.m^{-3}$)
30	24.1	25.7
32	31.1	32.6
34	35.7	36.5
35	38.9	36.0
	RMSE (all sites)	**1.8 $\mu g/m^3$**

A2 Stakeholder Comments Log

[redacted]

[redacted]

.

T: +44 (0) 1235 753000

E: enquiry@ricardo.com

W: ee.ricardo.com