Western Ring Route-Waterview Connection

Review of the Air Quality Assessment and evidence with relevance to air quality

Preliminary Report prepared for the Board of Inquiry

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Contents

1. Summary

Scope and limitations

1. The New Zealand Transport Agency (NZTA) has lodged applications with the Environmental Protection Authority for the proposed Waterview Connection Project, a project of national significance. The EPA has engaged emission impossible Ltd to review the application material (as-lodged) and evidence in chief including any changes made to the application post-lodgement relevant to air quality.

2. This is an interim report, which is intended to highlight any major issues prior to finalisation of our review report. An interim report has been prepared due to the relatively short timeframes available to NZTA for preparation of any rebuttal evidence.

3. At this stage we have not reviewed the construction effects assessment or management plans, and we have not specifically commented on proposed consent conditions. These will be addressed in our final report.

4. Our review has focussed primarily on PM_{10} and $PM_{2.5}$ which are already close to standards and targets within the area being assessed.

5. We have identified key areas of disagreement based on review of the lodged air quality assessment, the NZTA's evidence in chief, as well as a number of submissions that specifically relate to air quality.

Overview of Methodology

6. Our review concludes that the NZTA assessment is comprehensive and has been undertaken *generally* in accordance with Section 44 of the Resource Management Act 1991 (RMA) and the relevant guidelines. However, we identified the following issues with the assessment methodology:

    i. The choice of model (AUSROADS) for surface roads is not supported given the presence of complex terrain and non-spatially uniform meteorology. We note the ARC user guide for transport assessments recommends ADMS-Roads in such situations. [1] It is unclear whether the use of AUSROADS will adequately predict worst case effects in the Oakley Creek valley.
    ii. Dispersion modelling of stack emissions was carried out for only two weeks despite the minimum recommendation of one year in the Dispersion Modelling Good Practice Guide and the collection of two years of ambient monitoring data.[2] We note that additional modelling is being undertaken.
    iii. 'Average' emissions have been used as the basis for cumulative assessment. Sensitivity analysis demonstrates that under congested

[1] ARC/NZTA (2010)
[2] Good Practice Guide for Atmospheric Dispersion Modelling, Ministry for the Environment, June 2004.

conditions (which are likely to occur) hourly emissions from the ventilation stack could be approximately 4 times higher than 'average'. Using 'average' emissions for assessment of surface road effects does not provide any conservatism and goes against Transport GPG recommendations for such assessments.[3]

iv. Compounding the above, *background* concentrations do not reflect actual, measured maximum concentrations in the Oakley Creek valley. This is not in accordance with Transport GPG recommendations.[4]

v. In addition to this, the assessment of cumulative effects is complex and has a 'black box' effect making informed comment difficult.

vi. The assessment does not seriously consider alternatives (e.g. stack heights) or mitigation options as required by Schedule 2 of the RMA.

vii. The choice of model for estimating *background* concentrations of nitrogen dioxide is unique and complex. We have not reviewed this methodology in detail.

viii. There is some uncertainty around the management of portal emissions. The tunnel traffic management plan should be subject to approval.

Exceedance of regional targets and national environmental standards

7. The assessment predicts exceedances of the regional air quality target for $PM_{2.5}$ in the Oakley Creek Valley (sector 9 and existing parts of SH20). Existing levels of $PM_{2.5}$ already exceed the regional air quality target in this area. Any increase in emissions is inconsistent with the purpose of the *Resource Management Act 1991*, regarding safeguarding the life-supporting capacity of air, and should be mitigated or offset.

8. There are a number of residential houses very close to the proposed new highway in Sector 9. In these locations we consider that exceedance of the PM_{10} NES is likely. People living in these houses would be adversely affected by the proposed new highway. The air quality assessment includes no information on minimum separation distances and whether these are adequate to ensure compliance with national environmental standards at residential properties.

9. There are residential houses very close to the existing alignment of SH16 in sectors 1, 5 and 6. We consider that there is a real risk of exceedances of the regional air quality target for $PM_{2.5}$, as well as the National Environmental Standard for PM_{10}, at these houses very close to the road. This is a risk with or without the project in place. However any increase in road capacity, and any decrease in separation distance would exacerbate this risk. This issue has not been addressed to **any** extent by the assessment.

Cumulative net effects

10. We are extremely concerned that the assessment is underpinned by an assumption that induced traffic amounts to an increase in vehicle trips of just 0.06%. This does not seem realistic.

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[3] Good Practice Guide for Assessing Discharges to Air from Land Transport, Ministry for the Environment, June 2008.

[4] Ibid.

Monitoring

11. We have proposed additional monitoring requirements to ensure that air quality effects of the project are understood. In addition, we consider that:
    - In the event that ambient monitoring records an exceedance of a standard, target or guideline the monitoring period shall be extended for a minimum of two years from the date of the exceedance; and
    - In the event that ambient monitoring records an exceedance of a standard, target or guideline the NZTA should work with the Auckland Council to develop an air quality mitigation strategy.

Mitigation

12. We do not consider that mitigation has been adequately addressed by the NZTA Assessment or evidence as required by Schedule 2 of the RMA. We consider that:
    - Emissions of $PM_{2.5}$ in the Oakley Creek valley (sector 9 and existing sections of SH20) should be mitigated or offset.
    - Separation distances have not been assessed in any detail in the AEE, and we are not convinced that separation distances are adequate to ensure compliance with national environmental standards at some residential locations.
    - Any net increase in $PM_{2.5}$ as a result of the project should be offset.

Stack height

13. We do not consider that alternative stack heights have been adequately considered as required by Schedule 2 of the RMA. The limited information provided suggests that a 15m stack may result in similar effects to a 25m stack, at least in the current built environment.
14. We note that discharges from the ventilation stacks during emergency (fire) conditions have not been specifically assessed and have not been considered in our review. We also note that the NOR for the emergency stack at Craddock street has been withdrawn. We assume any emergency discharges will be dispersed via the two ventilation stacks. Emergency discharges should be considered in any evaluation of alternative stack heights.

Treatment of tunnel emissions

15. We do not agree that mitigation is unnecessary for this project. We consider the most cost effective mitigation options that should be considered include:
    i. emission controls on vehicles using the route, or
    ii. offsets to reduce emissions from other sources.

16. We agree that treatment of tunnel ventilation air is unlikely to be cost effective.

2. Introduction

2.1 Background

17. The Waterview Connection project includes key works to progress completion of the Western Ring Route. This project includes works on both State Highway 16 (SH16) (the Northwestern Motorway) and State Highway 20 (SH20). The Western Ring Route is a 48 km motorway section providing a regional connection across Auckland and linking the south (Manukau), west (Waitakere) and north (North Shore).

2.2 Objectives

18. The EPA has engaged emission impossible Ltd to review the application material (as-lodged) and evidence in chief including any changes made to the application post-lodgement relevant to air quality.

19. The objectives of the review include:

    i. to identify any areas of disagreement with the applicant's evidence regarding the nature and/ or magnitude of potential effects and/ or proposed mitigation relevant to air quality

    ii. review the proposed conditions and management plans included in the Assessment of Environmental Effects and NZTA's evidence in chief relevant to air quality, and comment.

20. This is an interim draft report, which is intended to highlight any major issues prior to finalisation of our review report. This interim report has been prepared due to the relatively short timeframes available to NZTA for preparation of any rebuttal evidence. This report is provided as a draft which is subject to change and review. At the time of writing our review has not considered the effects of construction, the management plans or the consent conditions in any detail.

2.3 Review Layout

21. The review is structured as follows:

    - Chapter 3 outlines the review process, including the skills and qualification of the review team, and the air quality documentation reviewed.

    - Chapter 4 reviews the application material and evidence in chief relating to air quality, and identifies areas of disagreement.

3. Review Process

3.1 Relevant Experience of the Reviewers

22. This report has been prepared by Jayne Metcalfe and Rachael Nicoll, both of Emission Impossible Ltd.

23. Emission Impossible Ltd is a consultancy specialising in the improved management of air quality and vehicle emissions. Jayne and Rachael have both worked as air quality scientists at the Auckland Regional Council and have extensive experience in review and assessment of resource consent applications to discharge contaminants to air.

24. Jayne has specialist knowledge in motor vehicle emissions and transport assessments. Jayne was the principal author of the MfE Good Practice Guide for Assessing Discharges to Air from Land Transport, and has been involved in the development of the Auckland Council's Vehicle Emission Prediction Model since its inception.

25. Further details of their qualifications and relevant work experience are included in Appendix 1.

3.2 Technical Documents Reviewed

26. The following documents have been considered in this review:

NZTA (2010a). *Western Ring Route – Waterview Connection: Assessment of Air Quality Effects*, including appendices prepared by Beca, and NIWA, July 2010

Statement of Evidence of Gavin Fisher (Air Quality) on behalf of the NZ Transport Agency. Dated 11 November 2010.

Statement of Evidence of Amelia Linzey (Planning-Designation) on behalf of the NZ Transport Agency

Waterview Connection Project – Summary of Submissions. Prepared for Environmental Protection Authority by Environmental Management Services. 11 November 2010.

In addition, we have reviewed specific air quality issues raised in submissions from:

- Auckland Regional Public Health Service (submission 91)
- Auckland Regional Council (Submission 207)
- Auckland City Council (Submission 111)

3.3 Overall Approach to the Evaluation

27. We have evaluated the Air Quality Assessment (and associated documents, as listed in Section 2.2) against Schedule 2 of the RMA and the recommendations of relevant guidelines, in particular:

- Standard for Producing Air Quality Assessments for State Highway Projects (Draft) (NZTA, 2010);
- Good Practice Guide for Assessing Discharges to Air from Land Transport (MfE, 2008), (also known as "the transport GPG");
- Good Practice Guide for Atmospheric Dispersion Modelling (MfE, 2004);
- Meteorological Datasets for the Auckland Region - User Guide (ARC/NZTA 2010);
- Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions (MfE, 2001);
- Assessing Discharges of Contaminants to Air (Draft) (ARC, 2002).

28. This report is provided as an interim draft.

29. Key conclusions, including issues where we disagree with the assessment, are highlighted throughout the report, and are summarised at the end of each section.

4. Review of the Assessment

30. This section reviews the assessment of air quality effects.

31. Comments in this section are addressed under the same headings as they appear in the Air Quality Assessment (NZTA, 2010a), viz:

- Description of the project
- Methodology
- Assessment matters
- Existing environment
- Traffic and emissions modelling
- Dispersion modelling
- Effects assessment: operation of project
- Operational effects – post project monitoring
- Operational effects – mitigation measures
- Consideration of alternatives
- Effects assessment: Construction activities
- Effects assessment: Concrete batching and rock crushing
- Summary and conclusions

4.1 Description of the project

32. The Air Quality Assessment (NZTA, 2010a) summarises the project, which includes the following key features.

- *Completing the Western Ring Route (which extends from Manukau to Albany via Waitakere);*
- *Improving resilience of the SH16 causeway between the Great North Road and Rosebank Interchanges to correct historic subsidence and "future proof" it against sea level rise;*
- *Providing increased capacity on the SH16 corridor (between the St Lukes and Te Atatu Interchanges);*
- *Providing a new section of SH20 (through a combination of surface and tunnelled road) between the Great North Road and Maioro Street Interchanges; and*
- *Providing a cycleway throughout the surface road elements of the Waterview Connection Project corridor.*

33. The aspects of the project that directly relate to discharges of contaminants into air - including the proposed widening of existing roads, new road

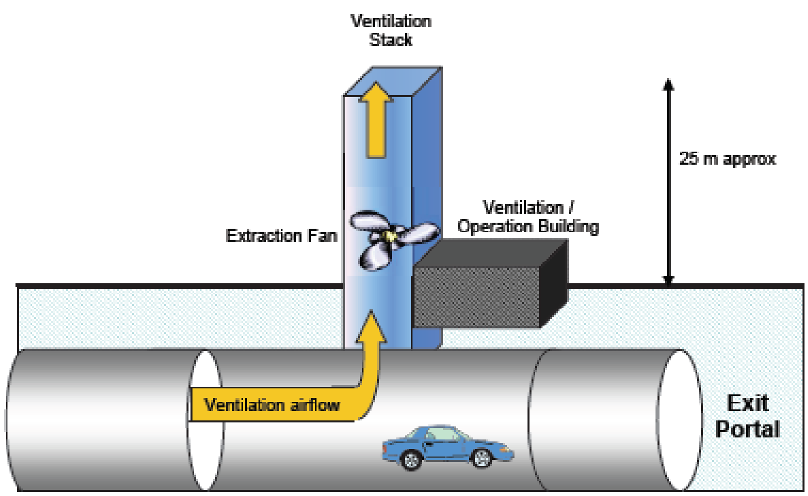
construction and tunnel ventilation - are described in Section 2.1 of the Air Quality Assessment (NZTA, 2010a).

34. An important feature of the project from an air quality perspective is the tunnel ventilation system. The system is designed to:

- Maintain in-tunnel air quality in accordance with NZTA in-tunnel air quality guidelines
- Control emissions from the portals
- Provide adequate atmospheric dispersion of pollutants that are discharged via stacks
- Control the spread of fire smoke, enabling safe occupant egress under fire conditions and to facilitate an effective emergency response

35. The ventilation system is illustrated in Figure (taken from Figure 2.2 of NZTA, 2010a)

Figure 1: Schematic of the proposed tunnel ventilation system (NZTA, 2010a)



4.2 Methodology

4.2.1 Approach to assessment of effects: operation of project

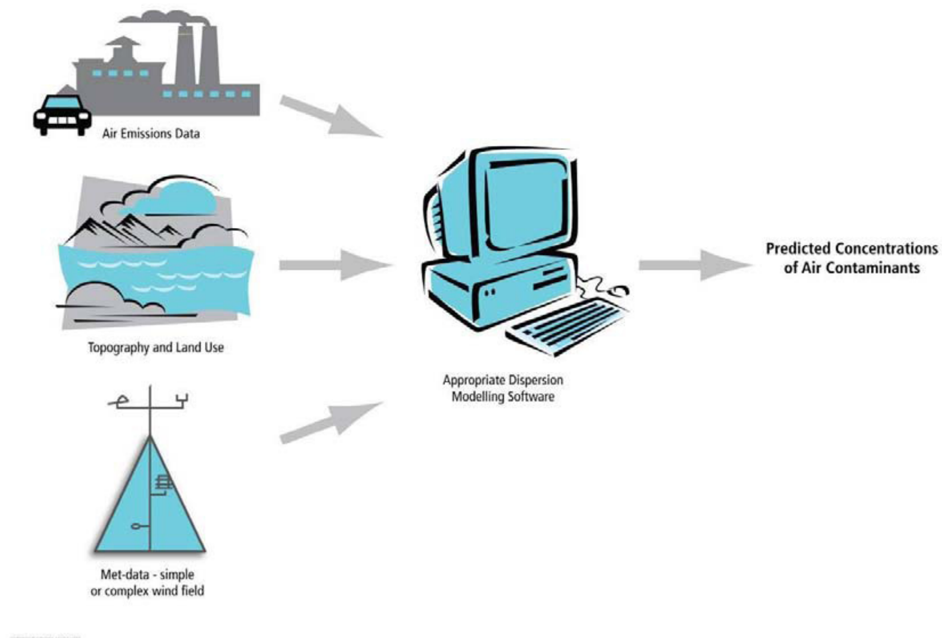
36. Dispersion modelling has been used as the primary tool to quantitatively assess pollutant concentrations associated with the motorways, the tunnel and changes in the existing road network as a result of the project.

37. Air dispersion models are computational tools used to calculate air pollutant concentrations downwind of an emission source. They require information on the contaminant emission rate, other characteristics of the source, the local topography and meteorology of the area, and ambient or background

concentrations of pollutants. A schematic of the dispersion modelling process is shown in Figure 2.

38. Emission rates have been estimated based on the results of traffic modelling and the Vehicle Emission Prediction Model (VEPM) (ARC, 2009).

Figure 2: Schematic of the dispersion modelling process (ARC/NZTA, 2010)



39. The concentration of air contaminants has been predicted for a base year of 2006 and for 2016 and 2026. For the future years, pollution concentrations are predicted for a "do nothing" scenario as well as a "with project" scenario. The assessment includes emissions from the new and altered road sections, the tunnel stacks, the tunnel portals, as well as any changes in traffic emissions as a result of the project on existing roads.

40. Concentrations of carbon monoxide (CO), fine particles (PM_{10} and $PM_{2.5}$), nitrogen dioxide, and benzene have been assessed at a total of 98 receptor locations. To assess the cumulative effect of the proposal on air quality, the predicted traffic-derived concentration of air pollutants is added to existing air quality. The concentrations predicted by dispersion modelling are then compared with relevant assessment criteria.

41. Figure 3 illustrates the approach taken in the Air Quality Assessment to incorporate existing air quality.

42. The key steps are:

a) The *background* concentration is estimated and is assumed to be constant in future years.

b) The concentration of pollutants from local and project traffic are estimated using dispersion modelling for 2016 and 2026.

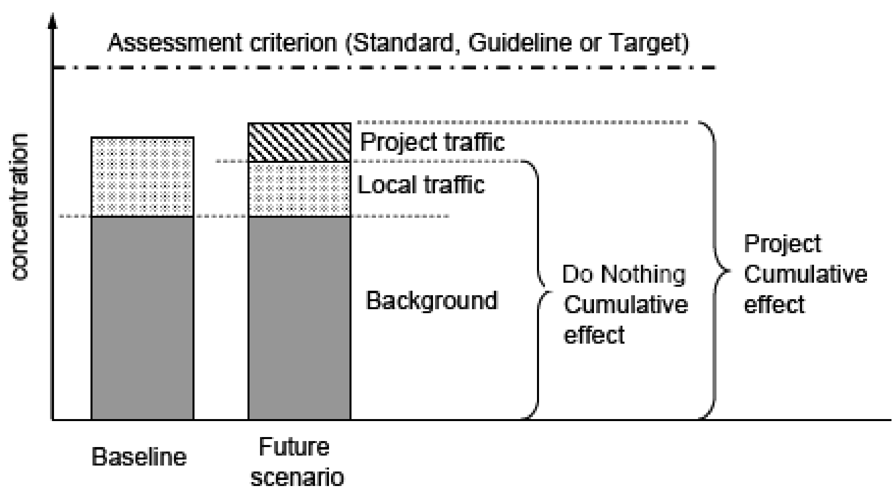
c) This predicted concentration of pollutants from local and project traffic is added to the background concentration to predict the cumulative concentration of each pollutant at each receptor.

d) The cumulative concentrations predicted by dispersion modelling are then compared with relevant assessment criteria.

43. For NO_2, the *background* air quality has been estimated based on the results of monitoring and empirical modelling. The approach is unusual and has not been technically peer reviewed. We have not reviewed this methodology in detail.

44. For PM_{10}, $PM_{2.5}$, CO and benzene the *background* air quality is estimated based on the results of ambient monitoring (to estimate baseline) and dispersion modelling (to estimate the contribution of local traffic to existing air quality).

Figure 3: Approach taken to incorporate existing air quality (NZTA, 2010a)



4.2.2 Approach to assessment of effects: tunnel portal emissions

45. Tunnel portal emissions have been assessed separately in the "Tunnel Portal Air Quality Assessment" which is an appendix to the Air Quality Assessment (NZTA, 2010).

46. Under normal operating conditions the tunnels will be mechanically ventilated, and it is expected that all tunnel emissions will be discharged to air via the ventilation stacks. However, during periods of low traffic volumes, it may be appropriate to cease or reduce tunnel ventilation to

conserve energy. This would allow some discharge of contaminants via the portals.

47. The assessment considers two scenarios. Either:

e) portal emissions are allowed for 6 hours between midnight and 6am; or

f) portal emissions are allowed for 8 hours between 11pm and 7am.

48. The approach to assessment of tunnel portals is essentially the same as the surface roads and stack emissions except for the incorporation of baseline (existing) air quality. For tunnel portal emissions the estimated concentration of pollutants from portal emissions is added directly to baseline air quality to provide an indication of cumulative effects.

4.2.3 Assessment criteria: operation of project

49. The assessment criteria for ambient air pollutants are summarised in Table 3.6 of the NZTA Air Quality Assessment, and reproduced in Table 1 which follows. These assessment criteria are used to assess the effects of the surface roads as well as ventilation stack and portal emissions from the tunnels.

50. The assessment criteria are consistent with the recommendations of the transport GPG and are considered appropriate.

Table 1: Air quality assessment criteria for the project operation (NZTA, 2010a)

Pollutant	Threshold concentration	Averaging period	Rationale
Fine particles (as PM_{10})	$50\ \mu g/m^3$ $20\ \mu g/m^3$	24-hour Annual	AQNES NZAAQG, ARAQT
Fine particles (as $PM_{2.5}$)	$25\ \mu g/m^3$ $10\ \mu g/m^3$	24-hour Annual	ARAQT WHO
Carbon monoxide	$30\ mg/m^3$ $10\ mg/m^3$	1-hour Rolling 8-hour	NZAAQG, ARAQT AQNES
Nitrogen dioxide	$200\ \mu g/m^3$ $100\ \mu g/m^3$ $40\ \mu g/m^3$	1-hour 24-hour Annual	AQNES NZAAQG, ARAQT WHO
Benzene	$3.6\ \mu g/m^3$	Annual	NZAAQG, ARAQT

Where:

AQNES = National Environmental Standard for Air Quality (MfE)

NZAAQG = Ambient Air Quality Guidelines, 2002 (MfE)

ARAQT = Regional Air Quality Target (ARC)

WHO = World Health Organisation air quality guidelines

µg = microgram

mg = milligram

ARC = Auckland Regional Council

MfE = Ministry for the Environment

4.2.4 Summary of review: methodology

51. The overall methodology for assessment of effects of the project is thorough and is *generally* in accordance with the recommendations of Schedule 2 of the RMA and relevant guidance. Deviations are, however, noted and discussed in the following sections.

4.3 Assessment Matters

52. The legislative and policy context for the assessment are outlined in the assessment matters Chapter.

53. We consider that the objectives and policies of the Auckland Regional Plan: Air Land and Water, which refer to relevant to regional air quality targets are also relevant to this assessment. These policies are relevant because the assessment predicts maximum concentrations that exceed the regional air quality target for $PM_{2.5}$.

54. In particular Objectives 4.3.1, 4.3.2(a) and 4.3.3 and Policies 4.4.3 and 4.4.4 as follows:

55. Objective 4.3.1 is:
To maintain air quality in those parts of the Auckland Region that have excellent or good air quality and enhance air quality in those parts of the Region where it is poor or unacceptable.

56. Objective 4.3.2(a) is:
*"To avoid, remedy or mitigate significant adverse effects from the discharge of contaminants into air on human health, **amenity** and the environment. In particular:*
*To achieve the **National Environmental Standards for Ambient Air Quality** and the Auckland Regional Air Quality Targets (given in Tables 4.1 and 4.2);…"*

57. Objective 4.3.3 States:
*"To avoid, remedy or mitigate the cumulative and synergistic impacts of discharges into air from individual sources, in particular from **mobile sources** and **domestic fires** in **urban areas**."*

58. Policy 4.4.3 States:
"Significant adverse effects from the discharge of contaminants into air from any source shall be avoided; where this is not practicable for the cumulative effects from small sources, the effects of such discharges shall be minimized".

59. Policy 4.4.4 States:

" The discharge of contaminants into air that significantly compromises the Auckland Region's ability to meet the ***National Environmental Standards for Ambient Air Quality*** *and the Auckland Regional Air Quality Targets shall be considered inappropriate."*

4.3.1 Summary of review: assessment matters

60. We consider that Objectives 4.3.1, 4.3.2(a) and 4.3.3 and Policies 4.4.3 and 4.4.4 of the Auckland Regional Plan: Air Land and Water are relevant assessment matters.

4.4 Existing Environment

61. The Assessment describes the relevant aspects of land use, topography and the sensitivity of the receiving environment in accordance with the recommendations of the transport GPG.

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62. The assessment is based on estimated air quality effects at 98 discrete "sensitive receptors". In response to submissions, Mr Fisher's evidence states that *"a great deal of discussion and analysis took place to ensure that the worst case effects on residents have been covered in the report*".

63. We consider that further evidence is required to adequately address submitters concerns, and demonstrate that the sensitive receptors represent the worst case effects.

4.4.1 Baseline (existing) air quality

64. Baseline concentrations are discussed in Section 5.7 of the Air Quality Assessment. Two ambient monitoring sites were established by NZTA – one at Alan Wood Reserve and the other at Cowley Street - to provide existing air quality data. The monitoring covered two complete years at Alan Wood Reserve and one complete year at Cowley Street between 2006 and 2009.

65. Pre-project ambient monitoring is recommended by the transport GPG to determine realistic existing air quality levels. The establishment of two monitoring sites in the vicinity of the project has provided an excellent basis for understanding existing air quality.

66. The baseline concentrations used in the Air Quality Assessment are summarised in Table 2, which follows[5].

[5] For particulate and carbon monoxide the baseline consists of an hourly concentration for every hour of 2007, however for the purpose of comparison with other monitoring sites, the relevant averages and maxima from the baseline time series are summarised in Table 2.

Table 2: Summary of baseline air quality concentrations used in the assessment (NZTA. 2010a)

Pollutant		annual	24 hour	8 hour	1 hour
PM_{10} (µg/m^3)	West Auckland	15	37		
	Oakley Creek	15	38		
$PM_{2.5}$ (µg/m^3)	All receptors	7	24		
CO (mg/m^3)	All receptors			3.7	5.4
Benzene (µg/m^3)	All receptors	1			
NO_2(µg/m^3)	All receptors (background)	16	44		65[2]

67. The derivation of baseline for the Waterview assessment utilises data from Alan Wood Reserve and Cowley Street as well as a range of other ambient monitoring sites.

68. The methodology for derivation of baselines is complex. Detailed review of the methodology is not attempted here. However, we have compared the assumed baseline concentrations with the results of ambient air quality monitoring around Auckland (as reported in Section 5.5 of the NZTA assessment). The baseline concentrations are generally considered appropriate, except for the Oakley Creek valley, and roadside locations, as discussed below.

Oakley Creek PM_{10} and $PM_{2.5}$ baseline

69. In response to lack of $PM_{2.5}$ monitoring results in the Project area NZTA commissioned monitoring at Cowley Street and Alan Wood Reserve during winter 2009. The Alan Wood Reserve monitoring recorded 4 exceedances of the Regional Air Quality Target for $PM_{2.5}$ of 25µg/m^3 between June and August, with values of 25.4 µg/m^3, 36.5 µg/m^3, 35.6µg/m^3 and 28µg/m^3. The maximum PM_{10} concentration during this period was 43.8 µg/m^3 and the second highest value was 39.9µg/m^3.

70. The results of NZTA monitoring demonstrate that the concentration of $PM_{2.5}$ in the Oakley Creek valley is elevated, primarily due to localised domestic fire emissions. To reflect the results of monitoring that has been undertaken subsequent to the preparation of the assessment, it should be recognised that background concentrations of PM_{10} and $PM_{2.5}$ are higher than assumed in the Assessment.

71. The assessment is based on an assumed baseline concentration of PM_{10} in the Oakley Creek valley of 38µg/m^3. The highest measured concentration at Alan Wood Reserve was 43.8µg/m^3 in 2009. This means that the cumulative concentration of PM_{10} could realistically be 5.8µg/m^3 (over 10% of the standard) higher than predicted in Sector 9.

72. The assessment is based on an assumed baseline concentration of $PM_{2.5}$ in the Oakley Creek valley of 24µg/m^3. The highest measured concentration at Alan Wood reserve was 36.5 µg m^3 in 2009. This means that the cumulative concentration of $PM_{2.5}$ could realistically be 12.5µg/m^3 higher (50% of the regional target) than predicted in Sector 9.

Roadside PM_{10} and $PM_{2.5}$ baseline

73. The results of Auckland Regional Council monitoring clearly demonstrate that air quality close to motorways is degraded. The West Auckland baseline is not considered representative for residential houses that are very close to the existing SH16 alignment (represented by residential receptors R1, R2, R3 and R5). There are residential houses very close to the highway in these areas, and based on review of roadside and state highway monitoring sites, it is considered likely that existing concentrations of PM_{10} and $PM_{2.5}$ are close to, or exceeding the regional target for $PM_{2.5}$ and the NES for PM_{10}.

4.4.2 Summary of review: existing environment

74. The description of the existing environment, including the sensitivity of the receiving environment to adverse effects, is considered to be appropriate.

75. Further evidence should be provided to demonstrate that sensitive receptors represent the locations where effects are worst.

76. Monitoring has demonstrated that baseline concentrations of PM_{10} and $PM_{2.5}$ are higher than assumed in the AEE for the Oakley Creek Valley. This needs to be reflected in assessing cumulative effects, particularly in Sector 9. The implications are serious, as underassessment could be in the order of magnitude 50% of the regional target in the case of $PM_{2.5}$.

77. Based on the results of Auckland Council monitoring at motorway sites, we consider that the existing concentration of PM_{10} and $PM_{2.5}$ is likely to be close to or exceeding targets or standards at locations close to SH16. This means the airshed is close to, or already, over-allocated here.

4.5 Traffic and Emissions Modelling

4.5.1 Traffic modelling

78. A key component of the assessment is the calculation of changes to traffic as a result of the project. Traffic models provide estimated traffic volume, composition and speeds, which are used to calculate pollution emission rates.

79. The transport GPG states "*Many traffic studies provide estimates of daily and peak-hour traffic for an average day, whereas air quality studies must estimate worst case air quality. The national ambient air quality standards* *only allow between one and 24 hours of exceedance per year, depending on the pollutant. To assess whether these criteria are likely to be exceeded, traffic data for a 'high' traffic day are needed. High traffic emissions will occur on days with high traffic flow and associated low speed…"*

80. For the Air Quality Assessment, average weekday traffic flow rates and associated speeds have been used to predict emissions from roads.

81. We do not consider that average weekday traffic flow rates and associated speeds are appropriate for prediction of worst case air quality impacts. It is important that the sensitivity of predictions to traffic parameters is assessed. This is discussed further below.

4.5.2 Emission factors

82. Emission factors provide an estimate of emissions from individual vehicles. When combined with traffic volume, composition and speed, they are used to estimate emission rates from roads. Vehicle emission factors from the Vehicle Emission Prediction Model (VEPM) (ARC, 2009) are used in the Air Quality Assessment.

83. VEPM is considered to be an appropriate model for this type of assessment. The parameters adopted to predict emissions from VEPM are considered appropriate.

84. The NZTA assessment assumes that brake and tyre wear do not contribute to $PM_{2.5}$ emissions. The brake and tyre wear factors in VEPM are based on USEPA factors, which do include a proportion of $PM_{2.5}$. This is unlikely to have a significant effect on $PM_{2.5}$ emissions, but should be considered by NZTA.

85. For the tunnel modelling, the assessment assumes that the proportion of heavy commercial vehicles is 8%, which is higher than the traffic model prediction. This is considered to be appropriate.

86. VEPM is sensitive to the speed assumed. As stated above, it is important that the sensitivity of predictions to likely worst case traffic parameters is assessed.

4.5.3 Sensitivity analysis

87. Sensitivity analysis has been undertaken for tunnel emissions in Appendix D of the assessment (Table entitled "Effects of Congestion on Vehicle Exhaust Emissions" page 203). Emissions have been estimated for a scenario where the tunnel is operating at capacity and traffic is congested, which is likely to represent worst case emissions. This analysis demonstrates that, under these conditions, hourly emissions of particulate and nitrogen oxides would be approximately four times higher than under the "free flow" scenario and emissions of CO and VOC would be approximately ten times higher.

88. The assessment does not provide similar sensitivity analysis for surface road emissions. In response to submissions, Mr Fisher's evidence includes

sensitivity analysis for a scenario where traffic flows are 20% higher than anticipated. We do not accept that this represents "worst case". The figure of 20% quoted in Mr Fisher's evidence is based on sensitivity analysis of traffic modelling results, which is all based on annual *average* daily traffic. So, this means that the *average* daily traffic could realistically be 20% higher than predicted by the models. This does not provide any indication of the traffic effects on a "high traffic" day.

4.5.4 Summary of review: traffic and emissions modelling

89. Emissions are estimated based on an average traffic day. In the absence of specific sensitivity analysis, it is considered appropriate to assume that hourly emissions of PM_{10} $PM_{2.5}$ and NO_x from surface roads could feasibly be four times higher than predicted, under congested conditions. This means that the concentration of PM_{10} $PM_{2.5}$ and NO_x could be significantly higher than predicted, particularly in Sector 9 where the difference between the 'with project' and 'do minimum' scenarios is most significant.

90. Sensitivity analysis should be undertaken for surface to reflect a "high traffic" day as recommended by the transport GPG.

4.6 Dispersion Modelling

91. Dispersion modelling has been used to predict pollutant concentrations associated with the motorways, the tunnel and changes in the existing road network as a result of the project.

4.6.1 Surface roads dispersion modelling

92. For surface roads the roadside model AUSROADS was used to predict ground level concentrations of pollutants. This is a steady state Gaussian plume dispersion model.

93. The ARC and NZTA have published recently published the "Meteorological Datasets for the Auckland Region – User Guide" (ARC/NZTA, 2010). The user guide states that steady state models, such as AUSROADS, are appropriate for near field applications where terrain is not complex, meteorology is spatially uniform and periods of calm or light winds are infrequent.

94. The ARC/NZTA user guide states that the Auckland region contains complex terrain, and experiences complex land-sea breeze interactions and periods of calm or light wind. Section 5.6 of the Air Quality Assessment discusses a local-scale climate in the "Oakley Creek valley". The assessment states that "*….at the southern (Alan Wood Reserve) end of the valley, winds can be extremely light and variable, suggesting meandering or pooling of air on the sheltered valley floor*".

95. ADMS-Roads is recommended by the ARC user guide for transport assessments where an advanced dispersion model is required.

96. The choice of model (AUSROADS) for surface roads is not supported given the presence of complex terrain and non-spatially uniform meteorology. We note the ARC user guide for transport assessments recommends ADMS-Roads in such situations. It is unclear whether the use of AUSROADS will adequately predict worst case effects in the Oakley Creek valley.

4.6.2 Tunnel ventilation stacks dispersion modelling

97. For stack emissions the dispersion model CALPUFF was used to predict ground level concentrations of pollutants. CALPUFF is an advanced dispersion model, which is recommended by the ARC for assessment of large industrial air discharges in Auckland.

98. CALPUFF is considered to be appropriate for dispersion modelling of stack emissions.

99. The model has been used to predict effects over a two week period in winter. Mr Fisher's evidence states that, in response to submissions, the model is being run with a full year of data.

100. We agree that stack dispersion modelling should be undertaken for a full year of meteorological data in accordance with ARC guidance (ARC/NZTA, 2010).

4.6.3 Tunnel portal emissions dispersion modelling

101. Tunnel portal emissions have been assessed using a model that has been developed specifically for the assessment of portal emissions (The Graz University of Technology, Graz Lagrangian Model (GRAL)). The Tunnel Portal Air Quailty Assessment (NZTA, 2010c) includes justification for the choice of dispersion model.

102. The overall approach for portal assessment is similar to the surface roads and ventilation stacks, so the same limitations apply. The assessment is based on average traffic flows, which will provide an estimate of emissions for an average day.

103. This issue is less critical for the assessment of portal emissions, because portal emissions only occur during off-peak times when high traffic flows are unlikely. However, it is important that portal emissions are carefully managed because meteorological conditions are likely to be less favourable to dispersion during off-peak times, and this is when background concentrations of contaminants are most likely to be elevated.

104. It is unclear (from the assessment and subsequent evidence from Mr Fisher) why the proposal to turn off the tunnel fans at night (and thereby allow for portal emissions) relates to hour of day, not air quality or traffic criteria.

105. According to the assessment, tunnel airflow will be managed according to measured carbon monoxide (CO) concentration inside the tunnel. It would seem logical to have air quality criteria (CO or NO_2 concentration) for turning fans on in the event that concentrations inside the tunnel are higher than expected during off peak times in order to manage portal emissions.

106. According to Mr Fisher's evidence (paragraph 93) "*While it would be possible to have an operational system that monitored air quality, this would be subject to a number of crucial criteria, namely (1) monitoring the right contaminants, (2) in the right place, (3) selecting the right on/off criteria for the fans, and (4) keeping it all working (with fairly complex and, at times not completely reliable, monitoring equipment).*"

107. This evidence seems to undermine the proposed tunnel airflow management system, which is based on measured CO concentration according to the assessment. In fact, it is common practice to manage tunnel ventilation systems based on air quality measurements. It is entirely unclear why the proposed system uses CO concentration to manage ventilation flowrate, but not to manage ventilation on/off times.

108. According to Mr Fisher's evidence, the exact operational requirements for tunnel ventilation will be covered by the Tunnel Traffic Management Plan, which will "*include all the necessary criteria to ensure that portal emissions do not result in adverse effects*". The plan is not yet available. There is some uncertainty around management of portal emissions. Unless this uncertainty is resolved, we consider that the tunnel traffic management plan should be subject to approval by the Auckland Council or an independent peer review panel appointed by the Council.

4.6.4 Summary of review: dispersion modelling

109. The following issues have been identified with respect to dispersion modelling:

- The use of AUSROADS is not supported given the complex terrain and spatially non-uniform meteorology. It is unclear whether this will adequately predict worst case effects in the Oakley Creek valley.
- Stack dispersion modelling should be undertaken for a full year of meteorological data in accordance with ARC guidance (ARC/NZTA, 2010). Dispersion modelling and sensitivity analysis should also be undertaken to evaluate alternative stack heights.
- There is some uncertainty around the management of portal emissions. The tunnel traffic management plan should be subject to approval.

4.7 Effects Assessment: Operation of Project

110. To assess localised adverse effects, the cumulative concentrations of pollutants predicted by dispersion modelling are compared with relevant assessment criteria.

111. The approach taken to estimate cumulative concentrations is complex and has a "black box" effect. It is difficult to interpret results and to understand the relative contribution of background air quality, local traffic and project traffic as well as the relative importance of reductions in vehicle emissions which are assumed between 2006, 2016 and 2026.

112. To interpret the assessment of localised effects of the project we have focussed on comparison of the 2016 with project vs the 2016 do minimum.

113. The predicted effects are briefly discussed in the following sections.

4.7.1 Sectors 1,2 5 and 6

114. In general, the assessment predicts very small changes in air quality for the project compared to the 'do minimum' scenario in these sectors.

115. The assessment predicts that the cumulative concentration of contaminants for the 'with project' scenarios will be well within air quality assessment criteria for all contaminants.

116. For receptors close to existing sections of SH16 (e.g. residential receptors R1, R2, R3, R4 and R5) it is likely that any increase in road capacity is offset by a predicted improvement in emissions due to reduced congestion. As discussed in previous sections, we have strong reservations about the conservatism of the assessment approach. We consider that sensitivity analysis is required.

117. At some receptors, the relatively small change in air pollution concentrations may be due to a reduction in emissions from local traffic offsetting any increase in emissions due to the project.

118. We note that there are residential houses which are very close to the existing SH16 alignment in these sectors. The concentration of air pollutants falls rapidly with increasing distance from roads. Maintaining a reasonable separation distance between roads and sensitive receptors is the most effective air pollution mitigation measure available.

119. We are unclear whether there will be any change in the separation distances between the existing highway and residential houses in sectors 1, 2, 5 and 6. We note that any reduction in separation distance could significantly degrade air quality at these receptors, and this would not necessarily be reflected in the results of modelling. This is a matter that should be clarified.

120. Given the very close proximity of residential houses to the existing alignment of SH16 in these sectors, we consider that there is a real risk of exceedances of the regional air quality target for $PM_{2.5}$ as well as the National Environmental Standard for PM_{10} at residential houses. This is a risk with or without the project in place, however any increase in road capacity, and any decrease in separation distance would exacerbate this risk. This issue has not been specifically addressed by the assessment.

4.7.2 Sector 7 and 8

121. The northern portal and ventilation stack are located in Sector 7.

122. The assessment predicts an overall reduction in air pollution in these sectors, due to a reduction in traffic on major arterial roads. Emissions from vehicles travelling in the proposed tunnel are dispersed by the ventilation stack.

123. The tunnel ventilation system is designed to manage portal emissions. The assessment has considered the potential effects of portal emissions being allowed during off-peak times. This assessment predicts relatively minor effects. For example, the maximum predicted concentration of PM_{10} at a residential receptor as a result of portal emissions is 0.51µg/m^3, which is 1% of the air quality standard. However there is some uncertainty about how the portal emissions will be managed, as discussed in Paragraph 108 of this report.

124. Dispersion modelling predicts maximum ground level concentrations of contaminants that are well below standards or guidelines. For example, the maximum predicted concentration of PM_{10} as a result of ventilation stack emissions is 0.3µg/m^3.

125. The effect of emissions from the ventilation stack is an important issue, which is discussed at length in Mr Fisher's evidence. We generally agree with Mr Fisher's conclusion that the ground level concentrations of contaminants discharged from the stacks are predicted to be well within acceptable levels.

126. Sensitivity analysis demonstrated that under congested conditions, hourly emissions from the ventilations stacks could be approximately 4 times higher than under the assumed "average" traffic conditions. If we make a conservative assumption that emissions are 4 times higher than average across the entire 24hour period, maximum ground level concentrations as a result of emissions from the stack could be 1.2µg/m^3, which is relatively minor compared to the air quality standard of 50µg/m^3.

4.7.3 Sector 9

127. The assessment predicts exceedances of the $PM_{2.5}$ regional air quality target in Sector 9.

128. As discussed in paragraphs 70 to 72, existing air quality in this sector is worse than previously assumed in the assessment. Four exceedances of the regional air quality target were recorded at the NZTA monitoring site in 2009.

129. This effectively means that the airshed is already over allocated, and any increase in emissions could potentially result in further exceedances of the regional air quality target.

130. The implications of this conclusion are discussed further in the mitigation section of this review.

131. The existing concentration of PM_{10} in this sector is also higher than previously assumed, with a maximum measured concentration of 43.8μg/m^3. The assessment predicts a maximum increase in PM_{10} concentration of 4μg/m^3 at residential receptor R8 (5 Barrymore Street). This suggests that the maximum cumulative concentration (existing + predicted increase) at a residential receptor could be 47.8μg/m^3, which is close to the National Environmental Standard for PM_{10}. As previously discussed, the predicted increase in concentration is based on an "average" traffic day. We consider that under congested conditions, the predicted increase could be significantly higher than 4μg/m^3. On this basis we consider that there is potential for exceedance of the NES for PM_{10} at residential receptors close to the proposed highway.

132. The proposed alignment is very close to existing residential houses. We understand that some houses are being removed as part of the NOR, however it is not clear whether air quality was a consideration in identifying affected properties. The separation distance between the proposed highway and residential receptors is not discussed in the assessment.

4.7.4 Regional Cumulative Effects

133. Previous sections have focussed on assessment of localised effects on air quality. It is also important to consider the overall regional cumulative effects, which are considered in Section 8.3 of the assessment.

134. The assessment predicts virtually no change in emissions from the overall road network. This is a fundamental assumption, which underpins the assessment.

135. As discussed in previous sections, we consider that it is appropriate to make worst case assumptions for the assessment of *localised* impacts, effectively assuming that under worst case conditions the highways operate at capacity.

136. This assumption may be overly conservative for assessment of overall *net* effects, however we are not convinced that the additional capacity provided by the proposed project will not result in a net increase of emissions across the road network.

137. This issue is addressed by the evidence of Andrew Murray who argues that (paragraph 56 of Andrew Murray's evidence) induced traffic effects have been considered, with a predicted net increase in vehicle trips across the Region of 0.06% (Induced traffic is the growth in new traffic that would not have occurred at all without the capacity improvement).

138. We are extremely concerned that the assessment of the effects of this project are underpinned by the assumption that induced traffic amounts to an increase in vehicle trips of just 0.06%. This does not seem realistic.

139. The Auckland Regional Public Health Service submission (submission 91) discusses this issue in some detail. Their submission refers to a recent American meta-analysis which has estimated that for every 1% increase in

road capacity that nearly three quarters of that increase is absorbed by induced traffic.

140. Regional cumulative effects are important when we consider mitigation measures. Monitoring demonstrates that the existing concentration of $PM_{2.5}$ in Auckland is hovering around the regional air quality target at all urban air quality monitoring sites. Therefore, it can be concluded that the airshed is fully allocated, and any significant *net* increase should be mitigated.

4.7.5 Summary of review: effects assessment – operation of project

141. The air quality effects have been assessed generally in accordance with the Draft NZTA Standard (NZTA, 2009) and the transport GPG (MfE, 2008). However we do not consider that the assessment is adequately conservative to demonstrate likely compliance with air quality standards and targets.

142. To assess the adverse effects associated with this project, the concentration of pollutants predicted by dispersion modelling are compared with assessment criteria. These criteria only allow between one and 24 hours of exceedence per year. So, for comparison with criteria, the transport GPG recommends that dispersion modelling predictions must be conservative and provide an estimate of "worst case" air quality for the relevant averaging period.

143. Conservatism is also important because the assessment is complex and relies on multiple layers of modelling, each with its own assumptions and limitations.

144. We have made some attempt to conservatively assess effects based on the information available, and we conclude that exceedances of the PM_{10} NES and $PM_{2.5}$ regional target are likely in some locations.

145. In particular:

146. Given the very close proximity of residential houses to the existing alignment of SH16 in sectors 1, 5 and 6, we consider that there is a real risk of exceedances of the regional air quality target for $PM_{2.5}$ as well as the National Environmental Standard for PM_{10} at residential houses which are close to the road. This is a risk with or without the project in place, however any increase in road capacity, and any decrease in separation distance would exacerbate this risk. This issue has not been addressed to **any** extent by the assessment.

147. In sector 9, existing levels of $PM_{2.5}$ exceed the regional air quality target, so any increase in emissions is considered unacceptable. We also consider that exceedance of the PM_{10} NES is likely at residential houses that are very close to the proposed road.

148. The assessment of cumulative net effects is based on traffic assessments. We are extremely concerned that the assessment of the effects of this project are underpinned by the assumption that induced traffic amounts to an increase in vehicle trips of just 0.06%, which does not seem realistic.

4.7.6 Assessment of air quality health effects

149. Compliance with air quality criteria is the most important consideration in any assessment. The ambient air quality standards are the minimum requirements that outdoor air quality should meet in order to guarantee a set level of protection for human health and the environment.

150. However, the standards are not intended as a "green light" to pollute up to, and compliance with the standards does not necessarily mean that there are no adverse impacts. For some pollutants (including particulate) there is not a threshold below which no adverse health effects would be anticipated.

151. A review of the health effects assessment has not been completed at the time of writing this interim draft report.

4.8 Operational Effects – Post Project Monitoring

152. The assessment includes proposed monitoring measures to be implemented post-project.

153. Monitoring of visibility, CO and NO_2 and vehicle numbers is proposed in the tunnel. Vehicle speed and fleet composition (proportion of heavy duty vehicles should also be recorded.

154. At this stage particulate (PM_{10} or $PM_{2.5}$) monitoring is not proposed for the tunnel or ventilation stacks. In-stack particulate monitoring would provide a valuable opportunity to validate model assumptions.

155. Post-project ambient monitoring is proposed in order to demonstrate compliance with standards and targets. The Assessment proposes ambient monitoring stations close to each end of the tunnel. Specific site locations are to be confirmed. Two years of monitoring is proposed, with sites to be established at least 6 months prior to commencement of tunnel operations.

156. We consider that monitoring should also be undertaken on SH16 in a residential location close to the highway that is likely to be affected by the project.

157. We note that Mr Fisher's evidence states that ambient air quality monitoring will be undertaken to "ensure compliance". Monitoring in itself cannot ensure compliance. There are no mitigation or contingency plans in place in the event of measured exceedances, except to "investigate the cause" of non-compliance.

158. Post-project ambient monitoring is in accordance with the recommendations of the transport GPG. However, at this stage there are no proposed mitigation or contingency plans in the event that exceedences of ambient air quality targets or standards occur.

159. We consider that in the event of an exceedance, the monitoring period should be extended for an additional two years. Any investigation into the cause of the exceedance should include development of a mitigation

strategy, which should be developed in collaboration with the Auckland Council.

4.8.1 Summary of review: post project monitoring

160. We consider that additional monitoring requirements should be included as follows:

- post-project monitoring should include: traffic speed and composition (%HCV) as well as traffic counts in the tunnel and close to each ambient monitoring station; and
- In-stack, or in tunnel particulate monitoring should be undertaken to measure peak as well as average operation emissions.
- NZTA should undertake a review of monitoring results, and how these compare with the assumptions and predictions included in the NZTA Assessment (NZTA 2010a), prior to cessation of monitoring at each monitoring site. This should be subject to review by the Auckland Council or an independent peer review panel appointed by the Council; and
- In the event that ambient monitoring records an exceedance of a standard, target or guideline the monitoring period shall be extended for a minimum of two years from the date of the exceedance; and
- In the event that ambient monitoring records an exceedance of a standard, target or guideline the NZTA should work with the Auckland Council to develop an air quality mitigation strategy.
- Ambient monitoring should be undertaken at a location that represents the most significantly affected residential area on SH16 in Sector 1,5 or Sector 6.

4.9 Operational Effects - Mitigation Measures

161. Existing concentrations of PM_{10} and $PM_{2.5}$ are elevated in Auckland, and in some locations the concentration of air pollutants increases as a result of the project. This means that in some locations, predicted PM_{10} levels are relatively close to the standard, and predicted $PM_{2.5}$ levels are in excess of the regional air quality target. Given that there is some uncertainty associated with predictions, we consider that it would be appropriate to consider mitigation options more seriously in these locations.

4.9.1 Mitigation measures – separation distances

162. The transport GPG states that “If the assessment shows there will be locations where people will be exposed to air pollution levels that exceed the national ambient air quality standards, then mitigation will very likely be required. Because contaminants generally disperse quickly with distance from their source, separation is likely to be one of the most effective mitigation measures. Options to achieve adequate separation include:

- Moving the road alignment away from receptors
- Placing part of the road in a ventilated tunnel
- Relocating properties

- Placing operational restrictions on sections of roads (similar to on-ramp signals)"

163. The proposed waterview tunnels will mitigate localised air quality effects through sectors 7 and 8. As noted in the assessment, removing surface traffic from heavily trafficked roads and discharge the same amount of contaminants from a ventilation exhaust (with sufficient height) results in much lower concentrations at ground level where people are most likely to be exposed.

164. We are concerned that separation distances are not adequate to ensure compliance with national ambient air quality standards in Sector 9.

165. There are a number of properties very close to the existing SH16 alignment in Sectors 1, 5 and 6. It is likely that these properties already have degraded air quality. Any decrease in separation distance or increase in emissions as a result of the project needs to be assessed and mitigated if necessary.

4.9.2 Mitigation measures – $PM_{2.5}$ in Sector 9

166. Offsets have been considered in Section 10.5 of the Assessment (NZTA 2010a). The Assessment states that offsets are not proposed because no unacceptable localised impacts have been identified. However, the Assessment has predicted exceedence of the regional air quality target for $PM_{2.5}$ at some locations close to SH20.

167. The Assessment concludes that although $PM_{2.5}$ concentrations exceed the regional air quality target in the vicinity of Sector 9, "this is not regarded as unacceptable *per se*, since these predicted exceedances are largely due to the very high baseline (ambient background) value assumed for the assessment."

168. Ambient monitoring undertaken by NZTA has demonstrated that the baseline (ambient background) value assume in this area should in fact be higher than assumed, and that existing air quality already exceeds the regional air quality target for $PM_{2.5}$ in the Oakley Creek Valley. In Sector 9, this means that the airshed is already over allocated and any increase in $PM_{2.5}$ emissions could potentially result in an exceedance of the regional air quality target.

169. The Objectives and Policies of the ARP:ALW (as outlined is Section 4.2 of the NZTA Assessment (NZTA 2010a) and Section 4.3 of this report) clearly indicate that exceedence of regional targets is inappropriate and that methods to avoid, mitigate or minimise effects should be considered. In particular Policy 4.4.4 States:

> *" The discharge of contaminants into air that significantly compromises the Auckland Region's ability to meet the **National Environmental Standards for Ambient Air Quality** and the Auckland Regional Air Quality Targets shall be considered inappropriate."*

170. This issue has been discussed in Mr Fisher's evidence in response to the Auckland Regional Council submission, which requests mitigation of $PM_{2.5}$ to

an acceptable level. Mr Fisher concludes that the $PM_{2.5}$ is largely due to other sources and any mitigation measures would be either (a) ineffective, (b) very costly, or (c) require the imposition of controls on vehicles using the route.

171. We agree that the existing concentration of $PM_{2.5}$ is largely due to other sources. However, this does not mean that mitigation is not required. This is why **cumulative** impacts are assessed.

172. This issue is recognised by the transport GPG which states that "*Measures to offset any overall increase in emissions may sometimes be the only realistic mitigation option, particularly when existing air quality is relatively poor.*" The GPG goes on to state "*Some offsets may also be necessary if emissions from the project are sufficient to cause unacceptable localised impacts when added to (relatively high) background levels.*"

173. Offsets are discussed in detail in the Ministry for the Environment discussion document on the proposed amendments to the National Environmental Standards for air quality (MfE 2010). The MfE document includes some examples of consent conditions that have required offset of emissions.

174. Any offset programme would ideally be developed and implemented in collaboration with the Auckland Council.

175. Offsets, for example through reduction of domestic fire emissions in the area, may be the most realistic mitigation option. However, there are a range of other options that could be considered. For example, imposition of controls on heavy duty diesel vehicles using the route.

176. By way of example, Auckland Regional Council analysis has demonstrated that retrofit of particulate traps on diesel buses could reduce PM_{10} emissions by up to 90% at a cost of approximately $120,000 per tonne. A catalyst retrofit scheme for older buses could reduce emissions from these vehicles by 30% at a cost of $39,000 per tonne of PM_{10} emitted.

4.9.3 Mitigation measures – cumulative net PM_{10} and $PM_{2.5}$ emissions

177. As discussed in previous sections (4.7.4), the assessment predicts virtually no net increase in emissions for the "with project" compared with the "do nothing" scenario.

178. We are not convinced that this is realistic. Any net increase in particulate emissions should be offset because the airshed is effectively fully allocated.

4.9.4 Summary of review – mitigation measures

179. We do not consider that mitigation has been adequately addressed by the NZTA Assessment or evidence. We consider that:

- Separation distances have not been assessed in any detail in the AEE, and we are not convinced that these are adequate in some locations.
- Emissions of $PM_{2.5}$ in the Oakley Creek valley (sector 9 and existing sections of SH20) should be mitigated.
- Any net increase in $PM_{2.5}$ as a result of the project should be offset.

4.10 Consideration of Alternatives

180. Alternatives are discussed in Section 11 of the NZTA Assessment.

4.10.1 Alternative ventilation stack locations and alternative stack heights

181. The location of the stack has been proposed based on consideration of a number of project constraints. It is noted that alternative ventilation stack locations would not be expected to significantly affect air quality impacts.

182. The proposed ventilation stack height is 25m. From an air quality perspective, higher is better. As stated in the assessment, "The basic principle of dispersion is that the greater the height of discharge above ground, the more effective the dispersion".

183. However, there is some concern about the visual impact of the stack, and this needs to be balanced against the air quality risks.

184. Limited sensitivity analysis has been presented in the Assessment which concluded that a 15m would have similar air quality impacts to a 25m stack. Modelling showed that the difference between the 15m and 25m stack moved the peak effects closed to the stack, but the difference in cumulative effects was predicted to be less than 1%.

185. The assessment states that "To minimise the effects of the discharge from the stacks, it is best for the stacks to be taller than anything else that is (or might be) built close to it in the future."

186. The implication is that a 25m height has been selected to 'future proof' the stack against the impacts of possible future buildings.

187. Modelling of the 15m stack is presented as sensitivity analysis, with a number of limitations. It is not entirely clear whether it can be concluded from this modelling that a 15m stack would be acceptable in the current built environment, but may not be acceptable in future.

188. The assessment does not appear to have considered other alternative stack heights (why not 30m, or 20m?)

189. Discharges from the ventilation stacks during emergency (fire) conditions have not been specifically assessed, and should be considered in any evaluation of alternatives.

190. We do not consider that alternative stack heights have been adequately considered as required by Schedule 2 of the RMA.

191. Dispersion modelling should be undertaken to evaluate the potential air quality effects of alternative stack heights.

4.10.2 Tunnel Emissions Management

192. The assessment includes consideration of emission treatment technologies for tunnel air. This is also addressed in some detail by Mr Fisher's evidence.

193. We agree that treatment of tunnel air is unlikely to be cost effective. It would be more effective to control emissions from motor vehicles, or to implement offsets from other sources (eg domestic fires).

194. However, as discussed in other sections, we do not agree that mitigation is unnecessary.

4.10.3 Summary of review – consideration of alternatives

195. We do not consider that alternative stack heights have been adequately considered as required by Schedule 2 of the RMA. The limited information provided suggests that a 15m stack may result in similar effects to a 25m stack, at least in the current built environment.

196. Dispersion modelling should be undertaken to evaluate the potential air quality effects of alternative stack heights.

197. We do not agree that mitigation is unnecessary for this project. We consider the most cost effective mitigation options that should be considered include:
   i. emission controls on vehicles using the route, or
   ii. offsets to reduce emissions from other sources.

198. We agree that treatment of tunnel ventilation air is unlikely to be cost effective.

5. References

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NZTA (2010). *Standard for Producing Air Quality Assessments for State Highway Projects (Draft)*, Version 5, 16 July 2010

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Appendix 1: Summary of Relevant Experience

This section includes a summary of experience, qualifications and experience for Jayne Metcalfe and Rachael Nicoll.

(a) Jayne Metcalfe

Technical Specialist, Air Quality & Vehicle Emissions Management
Emission Impossible Ltd (since Nov 2008)

Relevant Academic and Employment History

Air Quality Consultant, Endpoint and Metcalfe Consulting Ltd, NZ (4 years)
Air Quality Scientist, ARC, NZ (4 years)
Air Quality Officer/Senior Air Quality Officer, ARC, NZ (5 years)
Assistant Environmental Engineer, Opus, NZ (1 year)

ME, Chemical & Process Engineering (Canterbury, NZ), 1996
BE Hons II, Chemical & Processs (Canterbury, NZ), 1993

Professional and Other Involvement

Member, Clean Air Society of Australia & New Zealand

Key Employment Highlights

Technical Specialist – Air Quality & Vehicle Emissions Management (since Nov 2008)

Providing specialist advice to a range of clients on the improved management of air quality and vehicle emissions.

Example projects include:

- Developed an air quality assessment screening tool for Tier 1 and Tier 2 assessments
- Peer reviewed the air pollution health effects assessment for the MED LPG Cabinet Heater Review
- Developed various emissions predictions models for motor vehicles and domestic fires
- Provided technical guidance in the preparation of the Auckland Regional Council's 2006 Air Emissions Inventory
- Undertook sensitivity analyses and prepared report detailing the impact of various domestic fire policy option scenarios
- Participated on the air quality and health expert panel which developed criteria for the Ministry of Education to consider when locating early childhood education centres

Air Quality Consultant (2004 to 2008)

Providing specialist advice to a range of clients on the improved management of air quality and vehicle emissions.

Example projects include:

- Primary author of the draft MfE Good Practice Guide on Assessing Discharges to Air from Land Transport
- Developed the user interface and user guide for the ARC's Vehicle Emission Prediction Model
- Developed a Health Risk Assessment Toolkit for assessing air quality impacts from roadways

Air Quality Scientist/Officer – Auckland Regional Council (1995 to 2004)

Provided specialist advice to regional government politicians, council staff and the general public on transport and air quality issues. Designed and led various air emissions research and education projects.

Example projects include:

- Reviewed and processed resource consent applications for discharges to air from industry, including: evaluation of resource consents applications; preparation of officer's reports; hearing reports; and commissioners decision reports; compliance monitoring; and complaints response. Major consents included: Pacific Steel; Waste Management Redvale Landfill; BHP NZ Steel; Nuplex Industries; Fletcher Wood Panels.
- Supervised the activities of other air quality officers and peer reviewed officer reports.
- Lead several prosecutions including Nuplex Industries and Dominion Oil. This involved preparation and presentation of evidence to the Environment Court.
- Took primary responsibility for developing and implementing ARC's vehicle emissions management programme. This included review and comment on assessments of effects for transport projects.
- Managed and reported on the ambient air quality monitoring network.

(b) Curriculum Vitae for Rachael Nicoll

Technical Specialist, Air Quality Management
Emission Impossible Ltd

Qualifications

BE, Chemical & Materials Engineering (Auckland, NZ), 1996

Academic and Employment History

Technical Specialist, Emission Impossible Ltd, since November 2010
Air Quality Scientist, Auckland Regional Council, NZ (5 years)
Environmental Project Co-Ordinator, Metrowater Limited, NZ (2 years)
Air Quality Officer/Senior Air Quality Officer, Auckland Regional Council, NZ (6 years)

Professional and Other Involvement

Member, Resource Management Law Association of New Zealand Inc
Member, Clean Air Society of Australia & New Zealand

Key Employment Highlights

Air Quality Scientist– Auckland Regional Council (2004 to 2009)

Provided specialist advice to regional government politicians, council staff and the general public on the improved management of air quality issues. Involved in air quality research, policy development, and public education.

Example projects include:

- Overall responsibility for resolving appeals on air related issues for the Proposed Auckland Regional Plan: Air, Land and Water (October 2004). Major appeals included: Domestic Fires, Outdoor Burning, Agrichemicals, Air Quality Management Areas, Mobile Sources and Intensive Livestock Farming.
- Overall responsibility for developing ARC's policy for management of emissions from industrial activities.
- Overall responsibility for developing ARC's policy direction on domestic fires.
- Participated in the Ministry for the Environment Warm Homes Project as a local government representative.
- Overall responsibity for co-ordinating air and landuse impacts within Auckland region with territorial local authorities including submissions, reviews of landuse consents and plan changes including presenting at hearings and the Environment Court.
- Overall responsibility for air quality policy documents including changes and variations to the Auckland Regional Policy Statement and Proposed Auckland Regional Plan: Air, Land and Water.
- Presentations to the Auckland Regional Council Environmental Management Committee.

Environmental Project Co-ordinator– Metrowater limited (2002 to 2004)

Providing specialist planning and consent advice to Metrowater and Auckland City Council Stormwater Department on environmental issues relating to drinking water, waste water and stormwater impacts.

Example projects include:

- Project managing consent applications to Auckland Regional Council for stormwater and wastewater projects. Major applications include: Auckland City Stormwater Network Consents Application; Point Chevalier Stormwater and Wastewater Separation Project; Orakei Basin Stormwater and Separation Project.
- Member of the team co-ordinating joint appeals by all Auckland territorial local authorities and water management agencies against stormwater, wastewater and network provisions of the Proposed Auckland Regional Plan: Air, Land and Water (October 2001)
- Project management of $11M stormwater contract with Auckland City Council

Senior Air Quality Officer/Air Quality Officer– Auckland Regional Council (1996 to 2002)

Provided specialist advice to regional government politicians, council staff and the general public on air quality issues. Involved in air quality research, policy development, resource consent processing, compliance, enforcement and public education.

Example projects include:

- Supervision and mentoring of consents officers.
- Lead officer responsible for all aspects of consent processing, compliance and enforcement of air discharge consents, including presenting at hearings and the Environment Court. Major consents included: Contact Energy Limited – Otahuhu A, B and C Power Stations; North Shore City Council Rosedale Wastewater Treatment Plant; Waste Disposal Services Whitford Landfill; ACI New Zealand Glass; CSR Monier Building Materials Brickmaking; Carter Holt Harvey Insulation, Winstone Aggregates 3 Kings and Lunn Avenue Quarries.
- Overall responsibility within the air quality team for management of air quality consent processing and compliance, including development of budgets and resource allocation.
- Primary author of industrial, outdoor burning, domestic fires and greenhouse gas sections, and co-author of air quality managment section of the notified version of the Proposed Auckland Regional Plan: Air Land and Water (October 2001).
- Overall responsibility for developing ARC's management approach for odour and dust emissions from industrial activities.
- Overall responsibility for developing ARC's policy direction on domestic fires.
- Author of *Assessing Discharges of Contaminants into Air (Draft)*. Technical Publication prepared for the Auckland Regional Council. TP 152 April
- Author of ARC air quality publications, reports and submissions including: fact sheets, submissions and correspondence on behalf of ARC Councillors.
- Overall responsibity for co-ordinating air and landuse impacts within Auckland region with territorial local authorities including submissions, reviews of landuse consents and plan changes including presenting at hearings and the Environment Court.
- Presentations to the Auckland Regional Council Environmental Management Committee.

Appendix 2: Health effects of air pollution

TO BE COMPLETED.