Before the Board of Inquiry
Waterview Connection Project

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in the matter of: the Resource Management Act 1991

and

in the matter of: a Board of Inquiry appointed under s 149J of the Resource Management Act 1991 to decide notices of requirement and resource consent applications by the NZ Transport Agency for the Waterview Connection Project

Statement of evidence of Gavin Fisher (Air Quality) on behalf of the **NZ Transport Agency**

Dated: 11 November 2010

REFERENCE: Suzanne Janissen (suzanne.janissen@chapmantripp.com)
Cameron Law (cameron.law@chapmantripp.com)

Chapman Tripp
T: +64 9 357 9000
F: +64 9 357 9099

23 Albert Street
PO Box 2206, Auckland 1140
New Zealand

www.chapmantripp.com
Auckland, Wellington,
Christchurch

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STATEMENT OF EVIDENCE OF GAVIN FISHER ON BEHALF OF THE NZ TRANSPORT AGENCY

INTRODUCTION

1 My full name is Gavin Westwood Fisher, and my evidence covers air quality effects from the Waterview Connection Project.

2 I am a research scientist and consultant with 32 years' experience in atmospheric science and 21 years' experience in air pollution modelling, transport effects and meteorology. I have an MSc in Physics. I am currently self-employed as a consultant (Endpoint Ltd). I was previously employed by the National Institute of Water and Atmospheric Research Ltd (NIWA) in Auckland in various roles, including (for 8 years) Manager of the Auckland office and senior air quality scientist. I am President of the Clean Air Society of Australia and New Zealand. I am also past President of the 67,000 strong International Union of Air Pollution Prevention Association. I have produced over 500 reports and publications, including 68 refereed papers, and over 350 client reports on air quality issues. I have appeared in 47 hearings on resource consenting matters.

3 I have conducted numerous air quality assessments for traffic effects in Auckland, Wellington, Christchurch, Napier and Nelson. I am very familiar with the air quality issues in Auckland and the Central City area, and have previously advised both the Auckland City Council and the Auckland Regional Council on a number of air quality matters. I gave evidence at the 2006 hearings for both the Victoria Park tunnel project, which is currently underway, as well as the Newmarket viaduct extension, which is just about completed.

4 I have also recently been in charge of a major research programme to assess health effects due to transport, the 2007 "Health and Air Pollution in New Zealand" study, and was author of the 2002 Ministry of Transport study on the health effects of vehicle emissions. I am co-author of the 2006 Ministry for the Environment's "Good Practice Guide for Assessing Transport Emissions", and have completed a Land Transport New Zealand project on developing air quality assessment tools for transport emissions.

5 My evidence is given in support of notices of requirement and applications for resource consents lodged with the Environmental Protection Authority (*EPA*) by the NZ Transport Agency (*NZTA*) on 20 August 2010 in relation to the Waterview Connection Project (*Project*). The Project comprises works previously investigated and developed as two separate projects, being:

5.1 The State Highway 16 (*SH16*) Causeway Project; and

5.2 The State Highway 20 (*SH20*) Waterview Connection Project.

6 I am familiar with the area that the Project covers, and the State highway and roading network in the vicinity of the Project.

7 I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Consolidated Practice Note (2006), and agree to comply with it. In preparing my evidence, I have not omitted to consider material facts known to me that might alter or detract from my opinions expressed.

SCOPE OF EVIDENCE

8 My evidence will deal with the following:

8.1 Executive summary;

8.2 Background and role;

8.3 Summary of assessment of air quality effects;

8.4 Post-lodgement events;

8.5 Comments on submissions; and

8.6 Proposed air quality conditions.

9 I have not included full detailed results here and just restricted my comments to key summary issues, with some key example results. The full results are in the reports, and I will amplify on these as required in response to any questions.

EXECUTIVE SUMMARY

10 An extensive, comprehensive and thorough scientific assessment has been undertaken for the air quality effects of the Project. This is probably the largest air quality assessment ever conducted in New Zealand on a specific project. It has covered a range of key potential contaminants, considered all sources, considered all potential effects over a wide area, and used the most up-to-date data sources and methodologies.

11 The results show that the Project will have an insignificant effect on both the local and regional air quality, over and above what might have occurred anyway without the Project. Indeed for many areas the Project results in better air quality than would occur otherwise. The small changes that do occur are mainly as a result of a re-distribution of traffic.

12 Air quality standards and guidelines are met everywhere. There are a few specific locations where one Auckland Regional air quality target for $PM_{2.5}$ is not met – but the contribution of the Project to this is insignificant, the main cause of the exceedence being domestic wood burning.

13 Concerns have been expressed about the effects associated with the tunnel emissions. This is a first for New Zealand in that it is a large tunnel in a central urban area. However full measures have been proposed to ensure these effects are not significant, through the use of large and effective tunnel vents, and the assessment has shown these are an excellent method for reducing effects to a perfectly acceptable level.

14 I have carefully reviewed all the submissions raising air quality issues and no new issues have been raised that have not already been considered in the technical assessments or cannot be addressed in the proposed consent conditions. I respond in detail later in my evidence to issues raised by submitters, but none of these submissions alter my conclusions.

15 In summary, it is my opinion that:

15.1 This is a large project, with a significant feature not seen before in New Zealand – the vented tunnels.

15.2 In recognition of the potential for air quality effects, the NZTA has completed one of the largest and most thorough air quality effects investigations ever undertaken in New Zealand.

15.3 This has shown that the air quality effects of the Project are minimal, and meet all relevant standards and guidelines.

15.4 There are no significant additional health effects on the community.

15.5 In many areas, there are air quality benefits as a result of the Project. In the few small areas where air quality effects increase slightly, these are minimal and still within standards and guidelines.

15.6 There are no specific extra mitigation measures required.

16 Overall, in relation to air quality effects, I consider that there is no reason to decline the Project notices of requirement and resource consent applications on the basis of air quality effects.

BACKGROUND AND ROLE

17 I have been involved as an air quality advisor to the Project since its inception in 2000. The technical requirements for the environmental assessment were significant, and so the NZTA retained Endpoint, Beca and NIWA as part of a consortia team to assist with the planning of the Project and to prepare the assessment of the air quality effects of the Project. The main technical assessment and modelling was carried out by Dr Ian Longley, Dr Guy Coulson and Dr Gustavo Olivares, Senior Urban Air Quality Scientists at NIWA. Further assessments, some of the modelling, and the main assessment of air quality effects were prepared by Ms Camilla Borger, Dr Mathew Noonan and Mr Charles Kirkby, Air Quality Specialists at Beca. The final Assessment of Air Quality Effects Report (*Report*) was completed with input from all of these authors, and myself.

18 I have been involved in the details of each stage of the work and am familiar with all the methodologies used, the assumptions made, the details of the results, and the wider implications of the effects.

19 The Report was lodged with the EPA in August 2010 as part of the overall Assessment of Environmental Effects (*AEE*) (specifically, Part G, Report No. G.1).

SUMMARY OF ASSESSMENT OF AIR QUALITY EFFECTS

20 In this section of my evidence, I will outline the methodology used in the assessment and describe the key points of the Report.

Methodology

21 The air quality assessment followed the procedures outlined in the Ministry for the Environment's Good Practice Guide for Assessing Discharges to Air from Land Transport (2008) and the draft NZTA Standard for Producing Air Quality Assessments for State Highway Projects (2010).

22 Dispersion modelling was 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. The dispersion model inputs of vehicle emission rates and traffic volumes were derived using traffic modelling and the Auckland Regional Council's Vehicle Emissions Prediction Model v3 (2009) emission factors. Potential effects were assessed by comparing predictions against relevant health-based National Environmental Standards for Air Quality (AQNES) (2005), New Zealand Ambient Air Quality Guidelines (NZAAQG) (2002) and Auckland Regional Air Quality Targets (ARAQT) (2009).

23 All the models used were the more advanced available, and the input data gathered was the most extensive possible.

24 The potential air quality impacts were predicted for a 'base year' of 2006 and for two future years, 2016 and 2026. For the years 2016 and 2026, the emission scenarios considered both "Do Nothing" (i.e. the Project not being undertaken) and the "With Project" scenario. The assessment focused on the relative impacts that the 2016 and 2026 emissions scenarios will have on existing air quality, when compared to the existing baseline as modelled in the 2006 emission scenario.

25 The assessment considered the potential effects of carbon monoxide (CO), fine particles (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2) and benzene. Although these are not the complete suite of contaminants emitted from vehicles, they are very adequate indicators of total effects. That is if standards and guidelines are met for these main contaminants, then they will also be met for all others.

26 Although the assessment was carried out for a large domain, covering much of west Auckland, much of the analysis and results are presented in tables for 98 key sensitive receptors, such as schools, playcentres, hospitals etc, and including those residential locations that are closest to the completed Project areas. These are shown in **Annexure A**.[1] However the results are not restricted to these receptors, as the relevant information for any location can be extracted from the basic modelling results down to a 50m resolution. In addition, the key determining results (as used later in the evidence) are for the worst case anywhere in the domain, regardless of whether it is a location where people live or work.

27 Air quality impacts from construction activities, including dust effects and the operation of concrete batching and rock crushing plant, were also assessed.

Conclusions in my assessment[2]

28 All of the relevant standards and guidelines are met. That is, as result of the Project, there will be no additional exceedences of air quality standards, and no additional health effects. In some locations, the Auckland Regional targets are not met. However this is due to the cumulative effects of a wide range of sources in the Auckland region, including traffic, domestic emissions (much of them from wood burners) and industrial sources. The effects of the Project do not generally increase any of these emissions, and indeed as shown below can lead to a direct reduction.

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1 Data extracted from AEE Report G.1, Appendix A.

2 AEE Report G.1, pp 150-151.

29 People living, working or spending time (e.g. at school or in reserves) close to most of the existing busy arterial routes through the Project area will have a reduced exposure to vehicle related contaminants as a result of the Project, than would occur without the Project. Indeed, for most locations the Project results in a modest improvement in air quality over what would occur without the Project. This is shown in **Annexure B**.[3]

30 The actual quantum of contribution to contaminant concentrations by the Project over and above the existing background values for this part of Auckland are relatively low, especially for the contribution from the tunnel vents. This is shown in **Annexure C**.[4]

31 The operation of the tunnel will improve air quality in many parts of the Project area, due to the emissions being taken off local roads and being vented and dispersed higher in the atmosphere. Tunnel vents 25m high are designed to provide effective and efficient dispersion of vehicle emissions. Moving the traffic through tunnels and venting the emissions means better air quality than would exist with the same traffic volumes using local roads. The actual effects due to vent emissions are very minor. This is shown in **Annexure D**.[5]

32 Some locations are predicted to slightly increase the exposure of people living, working or spending time in the Project area to vehicle related contaminants above the "Do Nothing" scenario (i.e. without the Project), due to the southern surface portion of SH20 south of the tunnels and increased flows on the existing section of SH20 at Mt Roskill. However, exposure levels in all areas will comply with the AQNES which are designed to protect the health of the most vulnerable individuals in the community. The predicted exposure levels for $PM_{2.5}$ may, due to conservative ambient baseline assumptions, slightly exceed the ARAQT at some locations close to SH20. As explained earlier, this is almost entirely due to sources other than vehicles. There is no AQNES for $PM_{2.5}$, but there is a guideline.

33 The exceedence levels for $PM_{2.5}$ do need to be managed in order to mitigate potential health effects but the level of contribution to this from the Waterview Project is extremely small and completed dominated by other sources – especially the public's use of wood burners for home heating. This can be clearly shown by examining a detailed time series of measurements made of $PM_{2.5}$ in the district,

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[3] Data extracted from AEE Report G.1, Appendix H.

[4] Data extracted from AEE Report G.1, Appendix H.

[5] Data extracted from AEE Report G.1, Appendix H.

shown in **Annexure E**.[6] This shows that high concentrations of $PM_{2.5}$ only occur at night, generally after 11 pm. Since there is very little traffic around at this time, these peaks are due to home heating emissions. There are vehicle emissions – and most of the day time concentrations will be due to these. However they are much lower than night time levels. And in particular the quantum of contribution from the Project is very low – less than the thickness of a line on this plot. This implies that even if the $PM_{2.5}$ emissions from the Project were to be completed mitigated (i.e. reduced to zero), this would have an imperceptibly small effect on reducing the monitored $PM_{2.5}$ levels that are completely dominated by other sources.

34 In terms of regional effects, the Project is expected to have an insignificant effect on Auckland's regional air quality, despite a slight increase in vehicle kilometres travelled overall, due to improvements in traffic flow through the Project area combined with the continuing improvements in vehicle emissions generally.

35 Air quality monitoring of the operational effects of the Project will be undertaken in order to demonstrate compliance with the relevant in-tunnel air quality standards and ambient air quality standards. This ambient air quality monitoring will be undertaken at two monitoring stations (i.e. one near to each tunnel ventilation station). Ambient air quality will be monitored in real time and will be run continuously for at least 24 months, in order to confirm the validity of the overall assessment, ensure compliance, and assess any unanticipated changes in traffic flows and/or emissions profiles.

36 The quantities to be monitored are PM_{10}, $PM_{2.5}$ and NOx. The detailed methods are covered in proposed condition OA.2, and are entirely consistent with the methods used by the Auckland Council at all its sites.

37 An extensive construction dust monitoring programme is proposed, using regular visual monitoring in all areas, continuous monitoring of TSP (total suspended particulates) at a number of locations, continuous meteorological monitoring at three locations and procedures for prompt responses to potential complaints from the public and regulatory authorities.

38 In addition, the NZTA proposes to run a widely publicised 0800 hot-line that members of the community can use to express any specific concerns about dust generation. This will be a useful tool in assisting with monitoring the effectiveness of the Construction Air Quality Management Plan (discussed below).

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[6] Data extracted from newly published report "Particulate matter and meteorological monitoring monthly report: August 2010. WaterCare Services Ltd. September 2010."

39 Overall, it is concluded that there would be no significant adverse air quality impacts as a direct result of the Project.

Monitoring and mitigation

40 As discussed above, ambient air quality monitoring of the operational effects of the Project will be undertaken at two monitoring stations near to the tunnel ventilation stations. Discussions are underway with potentially affected parties and the regulators as to the exact locations of these monitors.

41 In relation to air quality impacts from construction activities, the draft Construction Air Quality Management Plan (*CAQMP*)[7] attached to the Report details methods to be used to mitigate discharges of contaminants into air (including dust) from the construction of the Project. A high standard of emissions control and management is proposed to adequately avoid or mitigate the effects of the construction dust discharges. An extensive dust monitoring programme will also be put in place. The Management Plan will also include measures to be put into effect in the event that any odorous material is disturbed during excavations through the former Alan Wood landfill. Appropriate maintenance of construction machinery is also proposed to minimise discharges of vehicle exhaust emissions. (Further details on this Plan and its operations are described in the evidence of Ms Siiri Wilkening.)

42 The construction programme for the Project requires the operation of concrete batching and rock crushing plant, which will be located very close to the tunnel portals. Recommended mitigation and monitoring measures to avoid or mitigate adverse effects that may otherwise be caused by discharges of dust from concrete batching or rock crushing are detailed in the draft Concrete Batching and Rock Crushing Plant Management Plan (*CBCMP*)[8] attached to the Report. These monitoring and mitigation measures include standard methods, for example, enclosure of plant and materials, use of water sprays and bag filter units.

43 In response to pre-lodgement queries regarding mitigation, a more detailed analysis and discussion on potential mitigation of the air quality effects of the Project, including the potential for offsets was carried out. I have considered this question of offset, and in my opinion (a) no mitigation or offset is required, (b) it is beyond the scope of this Project to control the most effective mitigation (which is reducing vehicle emissions overall), and (c) other forms of mitigation proposed are either impractical, ineffective, or hugely expensive. The latter include filtration of the tunnel vent emissions, restricting the types of vehicles using the route, or offsetting emissions through a programme of, say, improving or removing

[7] AEE Report G.1, Appendix M.

[8] AEE Report G.1, Appendix N.

wood burners in the Auckland airshed. I discuss later in my evidence specific mitigation issues raised by submitters (such as filtration of tunnel vent emissions).

POST-LODGEMENT EVENTS

Addendum to the Report

44 An addendum to the Report was lodged with the EPA on 15 September 2010, as Appendix 1 to the Technical Addendum Report[9] (*the Addendum*). The Addendum provides additional discussion of the best practicable option (*BPO*) for the control of dust from aggregate storage and handling associated with concrete batching. The Addendum outlines the mitigation measures proposed for aggregate handling and concludes that these measures are considered to be the BPO for aggregate handling (due to the separation distance achieved from potentially sensitive receptors in the relevant locations).

COMMENTS ON SUBMISSIONS

45 I have read the submissions lodged on the Project that raised air quality or related issues relevant to my area of expertise. In this section of my evidence I will address submissions to the extent that the issues and/or concerns raised have not already been addressed in the Technical Report or elsewhere in my evidence.

46 I note that I also attended a number of pre-lodgement community meetings and listened to the issues raised. These have been valuable forums, and a number of additional analyses were made prior to lodgement of the Project application as a result of concerns expressed. As outlined below, many concerns raised at pre-lodgement meetings have subsequently also been raised in submissions.

Submissions

47 The submissions raising air quality issues fall into the following categories:-

47.1 General air quality degradation concerns;

47.2 Tunnel vents generally;

47.3 Requesting filtration on the vents;

47.4 General visual effects of emissions;

47.5 Concern with existing air quality;

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[9] See Technical Addendum Report, G.31, September 2010.

47.6 Concern with portal emissions;

47.7 Concern about effects of worsening traffic;

47.8 Desire to see World's best practice used;

47.9 Concern with effects outside the Project area;

47.10 Construction dust effects;

47.11 Requesting specific health studies.

48 I address each of these issues within this evidence.

Health effects

49 In response to pre-lodgement queries raised, a more extensive analysis of the total potential health effects from the air emissions, as recommended in the assessment guidelines,[10] was undertaken. A section on health effects is given in the Report (see Appendix P to the Report). In summary, the health effects assessment shows that there are insignificant health effects – amounting to an increased mortality rate of 0.008 per thousand people per year considering all the residences affected. For context, the natural rate is 5.8 per thousand people per year.

50 Submitters have also suggested that the NZTA undertakes a full health study on the residents around the Project.[11] In my opinion, such a study would not only be unnecessary and hugely expensive, but is unlikely to show any useful results. Such studies have been carried out in Melbourne, for the M5 route, and in Sydney for the Lane Cove route and both showed no significant results. Both projects were of similar scale to Waterview and both involved vented tunnels. I have been fully involved in the Lane Cove study as an external peer reviewer. These investigations were full scale epidemiological studies, covering a number of contaminants, costing over $3M each and involving thousands of residents. Neither have shown anything significant. In particular both studies showed that the effects of the tunnel vents could not be detected even in the most sensitive members of the community. Indeed the studies do indicate some health benefits for residents along the route replaced by the tunnel, associated with lower traffic flows at grade. I note that Dr David Black's evidence also addresses this health study issue and that Dr Black agrees that such a study is not necessary.

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

[11] These concerns have been raised by various submitters, including Submitter Nos. 91, 102, 191, and 225.

Air quality degradation

51 Another main concern raised by submitters relates to the general concept of "air quality degradation" due to various aspects of the Project, such as (a) increased traffic flows, (b) route changes bringing traffic closer to houses and buildings, and (c) discharges from the tunnel vents and portals.[12] I note that, as a result of issues raised at pre-lodgement community meetings, I ensured that the main Report addressed them[13].

Tunnel vent discharges

52 A series of specific concerns have been raised by submitters on the potential effects of tunnel vents discharges, both from people very close to the vents (e.g. Waterview Primary School), as well as those further away (e.g. Point Chevalier residents overlooking the Project).[14]

53 The detailed dispersion modelling given in the Report shows that the effects of tunnel vent discharges are very minor (as shown earlier in **Annexure D**). The whole rationale in deciding the 25m vent stack height was to ensure that good dispersion is achieved under all possible conditions. The greatest effects close to the vents. The modelling shows slight increased effects, but do not exceed any standards or guidelines. For instance the maximum added 24-hour PM_{10} contribution is of the order of 1 $\mu g\ m^{-3}$, on top of an existing background value of 30-35 $\mu g\ m^{-3}$, and compared to the standard of 50 $\mu g\ m^{-3}$.

54 It appears, from the comments in the submissions, and in those at the public meetings, that the principal issue is one of perception. People are thinking…"*That's a large industrial stack…therefore it must be emitting lots of harmful pollution..therefore it should be not allowed or put somewhere else or filtered..*". This is a perfectly natural concern. However, the facts show that this concern is unfounded. The concentration of contaminants in the vents is no greater than in the tunnel itself – which thousands of people will breathe as they travel through the tunnel – and is on a par with those found near many busy intersections, roads and car parks throughout Auckland. The emissions will not be particularly visible. They will be nothing like the older style perception of a billowing brown or black smoke plume, and once the vent buildings themselves become an accepted part of the visual landscape of the

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[12] These concerns have been raised by various submitters, including Submitter Nos. 17, 18, 23, 41, 43, 44, 53, 59, 61, 62, 65, 72, 90, 91, 101, 113, 114, 116, 121, 126, 136, 138, 153, 156, 160, 178, 179, 186, 197, 202, 203, 213, 221, 223, 230, and 250.

[13] For example, by undertaking a new section on portal emissions modelling, detailed in Appendix I, and by modelling the effects of different vent stack heights detailed in Appendix K.

[14] Contained in submissions 22, 36, 50, 63, 68, 86, 107, 147, 153, 167, 175, 176, 185, 218, 228, 231, and 232.

area, residents will hardly be aware that they are discharging anything.

55 In addition, a point I have made at all the community meetings should be re-iterated. For most local residents the very action of taking vehicles off the road, putting them in a tunnel, and then venting the collected emissions higher into the atmosphere is a far better environmental prospect than leaving all these emissions at ground level. This point was particularly appreciated by the Owairaka District School Board of Trustees for example who learned at a community meeting that the new route would lead to a reduction of heavy traffic – and its attendant emissions – on Richardson Road outside their school.

56 A large number of submitters have indicated a desire to have the vent stack emissions filtered.[15] Put simply (a) the emissions do not need to be filtered, (b) it is almost impossible to completely remove all the contaminants, and (c) it is hugely expensive to install and operate filters for almost no benefit to the community or the environment.

57 Amplifying on these points in regard to filters, firstly the reason the emissions do not need to be filtered is that the amount and concentration of contaminants is not that great. Even though they are the accumulated emissions of some 3,000 vehicles per hour travelling through the 2.5 km tunnels, at peak times, this is not sufficient to result in adverse concentrations. Indeed the exit concentrations are no worse than occur in the tunnel anyway, and because they are vented through a tall stack they are dispersed by 100 fold or more before anyone outside breathes them. I note that the evidence of Dr Black is that filters are not needed from a health effects perspective.

58 Secondly, specific filtration systems generally target only one contaminant, or at best a small subset of the total range of contaminants. For instance electrostatic precipitators, or bag filters, might be used to target particulates, but these have no effect on nitrogen dioxide, carbon monoxide or hydrocarbons. For these contaminants different filtering systems need to be used. To completely eliminate all contaminants a chain of different filtering systems would be needed, consuming a great deal more electricity as well as a range of potential dangerous additional chemicals.

59 Finally, the filtration equipment, even if only one contaminant such as particulates is selected, is very expensive indeed. Some

[15] This issue has been raised by various submitters, including Submitter Nos. 11, 23, 33, 45, 50, 51, 53, 56, 57, 78, 85, 86, 87, 88, 89, 94, 95, 97, 103, 104, 115, 119, 122, 127, 132, 133, 134, 135, 139, 141, 143, 148, 151, 159, 165, 167, 172, 175, 176, 178, 179, 180, 185, 186, 188, 191, 195, 196, 199, 200, 208, 213, 218, 220, 222, 225, 227, 229, 230, 231, 232, 234, and 235.

preliminary estimates put the total capital cost in the region of up to $70M plus $1.5M per year to run,[16] and much more if nitrogen dioxide and other contaminants are also filtered. In an informal survey of some other vented tunnel systems in other parts of the world it was found that only a very small portion have filters, and many of these do not work. Indeed some filtering systems have been abandoned after commissioning.[17]

60 Submissions have also been made that filtration should be applied for other reasons, one of which is to allow the vent stacks to be lower than 25m thus reducing their visual impact.[18] Whilst this is an idea not without merit, it becomes impractical in implementation because of the range of filtration equipment that would be needed. Put simply, there is no one-size-fits-all filter. There would have to be electrostatic precipitators for particulates, selective catalytic reduction converters for oxides of nitrogen, activated carbon filters for benzene and hydrocarbons, large chemical scrubbing plants for carbon monoxide – and there might still be a range of minor contaminants that go through unabated. This filtration equipment would probably cost over $500M to install, and maybe $10M per year to run.[19]

61 Another issue raised in submissions is that since Auckland currently suffers somewhat from existing air pollution in some areas, every effort should be made to extract contaminants at the source, and the vents provide an opportunity to do this.[20] This is an admirable aim, but as noted above, the cost/benefit for doing this with vent filters is simply unjustifiable and extremely resource inefficient. In my opinion, a far more appropriate measure would be to reduce actual vehicle emissions, producing a benefit for the whole region, for all time – not just for the tiny fraction of time these vehicles are in the tunnel. Such measures might include tighter emissions standards, greater use of public transport, improved fuel specifications, trip frequency and length reduction and so on – none of which can be ascribed as a direct responsibility of the Project. However, these all raise broader questions of national and regional policy regarding control of vehicle emissions in New Zealand that go well beyond consideration of the direct effects of this Project.

Vent filtration in context

62 As there have been so many submissions from people obviously concerned about the potential effects of vent stack emissions, I

16 Private communication with NSW Road Transport Authority, October 2010.

17 Road tunnels: A guide to optimising the air quality impact on the environment. World Road Association. PIARC. 2008.

18 See Submitter Nos. 88, 141, 176, 188, 196, and 221.

19 These estimates are not formal, but indicators obtained during my discussions with specialist suppliers.

20 See Submitter Nos. 104, 180, and 191.

asked my self the question "*What more can I do to assure these submitters that the effects are acceptable?"*. All through the technical assessment we have used scientific criteria to show that the air quality degradation is minor and that no one will be adversely affected by the Project. But I appreciate that very few people are familiar with these scientific criteria, and fewer have the technical background required to fully appreciate understand and assess the concepts of, for instance *"…micrograms per cubic metre of nitrogen dioxide...".*

63 I have therefore calculated only what is going to be in the direct vents at their source, and tried to put this into some context with other conditions that people may be more familiar with. I have done this below, just going back to basics and doing a simple worst case calculation, using the following inputs (all of which can be extracted from the technical reports):

63.1 The vents stacks are approximately 6.2 m diameter[21] (or 30 m^2 in area);

63.2 The fans produce a maximum exit velocity[22] of 11.1 m/s, giving a volume of air discharged as 333 m^3/s;

63.3 The contaminants emitted by vehicles in the tunnel are all collected and the amounts discharged through each vent are: PM 0.1 g/s; NO_2 1.2 g/s (assumes all NOx is converted to NO_2); and CO 2.5 g/s;[23]

63.4 This gives the following concentrations of these contaminants – in the vents <u>before they are dispersed</u>. Also shown in this table are some indicative assessment criteria (discussed further below).

Contaminant	**Vent Concentration ($\mu g\ m^{-3}$)**	**Workplace Exposure Standard (STEL*) ($\mu g\ m^{-3}$)**
Particulate matter (PM_{10})	300	3,000
Nitrogen dioxide (NO_2)	3,600	9,400
Carbon monoxide (CO)	7,510	240,000

** Short term exposure limit. The concentration that workers should never be exposed to for any period of time.*

[21] AEE Report G.1, Table 7.1.

[22] AEE Report G.1, Table 6.6.

[23] AEE Report G.1, Appendix C.

64 These figures are not absolute, since the emissions vary and the fans operate at different speeds as necessary – but this is the worst case, occurring during the afternoon rush hour traffic. I also note that this calculation is not intended to be highly accurate; it is a 'ball park' illustration (although I expect it be accurate to within +/- 20% or so), and none of this analysis is very sensitive to fine scale adjustments to the fans, buildings or vent design.

65 The first comparison is with the New Zealand Workplace Exposure Standards (revised edition 2010) issued by the Department of Labour. These are used by the Department to assess the safety and suitability of air in workplaces. If these values are exceeded the Department has a mandate to close the workplace to protect workers' safety. The table above shows that the tunnel vent values are 3-30 times lower than the Workplace Exposure Standards.

66 A second comparison might be made with other places. For instance many of the worlds' large cities have PM levels that are 300 $\mu g\ m^{-3}$ and often well above. Cairo has had average levels of 700 $\mu g\ m^{-3}$ for decades. Places such as Mumbai, Jakarta, Beijing, Athens – and many others – regularly have levels above 300 $\mu g\ m^{-3}$. This is not at all to say we want this sort of thing in Auckland, but in context, people would experience higher particulate levels by visiting these cities than they would sitting directly in the middle of the vents.

67 A similar case occurs for NO_2. I myself have carried out NO_2 measurements inside peoples' homes as part of an investigation on the effects on unflued gas heaters in Auckland and Australia. We found levels of several hundred in many homes, and more than a thousand in some. That is, some people are living in conditions in their own homes which are well in excess of standards and guidelines and approaching those that occur inside the tunnel and the vents. Many schools also still use unflued gas heaters with similar exposure concentrations on their occupants. This of course is no justification, because home exposure is a voluntary risk and a very different concept. However I have presented this here simply to give the whole exposure scenario some context.

68 As for CO, this vent level of 7,510 $\mu g\ m^{-3}$ is already within the NZ guidelines (of 30,000 $\mu g\ m^{-3}$ for 1 hour), and this level of concentration can occur already at times at some ambient ground level monitoring sites.

69 Finally the level of exposure (indicated in the table above) to all of these contaminants would also occur in other commonly experienced situations in New Zealand, such as in parking buildings, in traffic jams, in busy streets with lots of buses and trucks, at sports events involving vehicles and so on. Although the air in the vents would certainly be comparable to a large heavily trafficked

urban area, but there is nothing particularly untoward or dangerous about it compared with many other situations in peoples' lives.

70 And importantly for this Project, it is relevant to note that before anyone is actually exposed to air from the tunnel vents, it will be dispersed by a factor of at least 300 by going up the 25m high vents and then dispersed more by any wind currents. In other words, by the time emissions exit the vents, the concentrations in the above table will have decreased by a factor of at least 300, and will then be decreased further by winds.

Tunnel portals

71 Another issued raised in pre-lodgement community meetings and by submitters has been the potential for emissions from the tunnel portals to affect houses located very close to the portals, at both the south and north ends.[24]

72 Although the tunnel ventilation system is designed to avoid such emissions, an additional detailed assessment was made on the basis that (a) people had asked for it, (b) concerns were expressed about times when the fans might be shut down, either deliberately because they are not needed (e.g. at night when there is little traffic in the tunnel), or accidentally (e.g. equipment failure).

73 It is highly desirable that the tunnel fans be allowed to be turned off at certain times, such as during the night when traffic volumes are low. This is desirable since the fans consume very large amount of electricity which will be wasted if their operation is not required.

74 A specialised modelling assessment was made, using a dispersion model specifically developed for tunnel portals. The exact operational aspects of the tunnel fans will be covered in a Tunnel Traffic Management Plan[25] that will include all the necessary criteria to ensure that portal emissions do not result in any adverse effects. The details given in the Report[26] show that even very close to the tunnel the air quality effects are acceptable at all times under anticipated fan operating conditions. It is proposed that at least one of the monitoring stations will be sited to capture and confirm the insignificant nature of these potential effects. The exact site and nature of the monitoring will be developed in consultation with the Auckland Council, and informed by results from a large number of tunnel related monitoring studies that have been carried out in Sydney and Melbourne.[27]

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[24] See Submitter Nos. 85, 139, 167, 185, 200, and 218.

[25] This Management Plan will be prepared as part of proposed condition OT.2.

[26] AEE Report G.1, Appendix I.

[27] Numerous reports on various technical topics can be extracted from the RTA web sites for NSW and Victoria.

Traffic numbers and types

75 Another issue raised in pre-lodgement community meetings and by submitters has been the accuracy of assumptions made about traffic numbers and types using the tunnel and other roads in the Project area.[28] The concern here is that the air quality assessment may have underestimated potential effects.

76 This concern was recognised very early in our assessment and particular care was made to use worst case assumptions. The basic traffic emissions data was taken from the emissions model developed recently by the Auckland Regional Council (VEPM), and this is generally accepted as appropriately conservative. A fairly major factor is determining the number of high-emitting heavy duty trucks and buses that might use the route. In this case, a very conservative assumption was used. The general Ministry of Transport national fleet assumes 4% (of vehicles in the over 3.5 tonnes heavy duty diesel vehicle category), whereas here for the modelling assessment a factor of 8.3% was used, from the Auckland specific inventory.

Monitoring

77 Several submitters have sought that air quality monitoring and assessment be carried out to *"..best world practice.."* rather than to the NZ air quality standards, seeking this on the basis that the NZ standards are lower.[29] With respect, this is simply not true. The NZ standards and assessment methodologies are probably the most stringent in the world, on a par with those in Scandinavia. They are certainly more strict that those in Australia (for instance the allowable 24-hour PM_{10} exceedence is only 1, whereas in Australia it is 5). They are also more strict that those in the USA, Japan, most of Europe and much more strict than those in the developing world. They closely follow the World Health Organisation recommendations.

Effects outside of Project area

78 Finally, some submitters have questioned the assessment of what are termed "edge effects".[30] That is, consequent effects on air quality outside of the main Project area that might be a result of the Project. The details in the Report do show all of these effects – indeed the full scale modelling covers a significant portion of the Auckland region. There are defined effects, especially in the south around feeder roads, but the modelling shows that these are still within the standards.

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28 See Submitter Nos. 104, and 167.

29 See Submitter Nos. 5, and 185.

30 See Submitter Nos. 53, and 167.

Construction effects

79 Construction effects have been raised by a number of submitters[31]. These have been covered in the main Report to a very significant extent[32]. This component of the assessment process is more detailed than most, reflecting the anticipated public concern. It is very specific and prescriptive on all aspects of the construction work that might lead to dust, odour, exhaust, or other air quality effects during construction. The construction issues are also covered to a significant degree in the consent conditions (AQ.1 to AQ.19) which are very tight by industry standards.

The Auckland Regional Council Submission

80 A very detailed submission was received from the Auckland Regional Council (*ARC*). This submission is addressed point by point, since matters raised were quite specific, rather than as more general points made by other submitters.

PM2.5

81 In paragraphs 4.3.4 and 4.3.12 the ARC requests mitigation measures for $PM_{2.5}$ to "an acceptable level".[33]

82 Unfortunately the submission does not state what the ARC would regard as an acceptable level, and there is no accepted guidance in the Standards or Ambient Guidelines. The ARC air quality target (*ARAQT*) is exceeded in some places, but as explained earlier this is largely due to emissions from other sources that are beyond the control of NZTA. Any mitigation measures contemplated by the NZTA would be either (a) ineffective, (b) very costly, or (c) require the imposition of controls on vehicles using the route.

Vent Stack Modelling

83 In paragraph 4.3.5 the ARC questions the vent stack modelling methodology. The final assessment as presented in the Report used only a two-week period in winter to produce the result. This was done deliberately to cut down on modelling time. The dispersion model is so detailed that even on a very fast computer this item takes 5 days to run. In the several earlier versions of the modelling, a full year had been used showing that indeed this winter case was the worst circumstance. However in response to the ARC's concern, the model is being run again with the full year of data. Given the length of time it takes to run a full year's data, the results are not yet available but I anticipate that the results will show no significant difference from those already presented.

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[31] See Submitter Nos. 13, 16, 52, 72, 92, 93, 97, 98, 101, 106, 117, 125, 156, 160, 165, 166, 175, 177, 184, 185, 192, 197, 209, and 240.

[32] AEE Report G.1, Chapters 12 and 13.

[33] See paragraph 4.3.4 of the ARC submission (Submitter No. 207).

Receptors

84 In paragraph 4.3.6, the ARC asks for more detail on receptors close to the route and queries whether the effects on residences located closest to the Great North Road (Waterview) Interchange have been taken into account.

85 A deliberate choice was made to show key results only for a range of sensitive receptors – mainly to avoid having a Report full of lists of numbers. In response to the ARC's comment, I would like to assure the Board that a great deal of discussion and analysis took place to ensure that the worst case effects on all residents have been covered in the Report. The specific addresses given in the detailed results are those closest to the route, and are those likely to experience the greatest potential effect.

Traffic volume sensitivity analysis

86 In paragraph 4.3.7, the ARC requests a sensitivity analysis for higher than predicted traffic volumes.

87 In air quality modelling, we rely on the expert traffic engineers to provide the information on traffic flows. In order to undertake some form of sensitivity analysis I have examined the figures discussed by the traffic experts and used the sensitivity test they developed. This is covered in the evidence of Andrew Murray where he reports that the traffic flows using different input assumptions could be 12-20% higher than the current estimates with the Project. Mr Murray notes that traffic flows without the Project would also be 10-15% higher than forecast under this test.

88 I have thus analysed what might happen under the worst case circumstances if the traffic flows along the route were fully 20% higher than anticipated.

89 A 20% increase in traffic essentially raises the emissions by 20%, and the effects due to those emissions by 20% also. I have indicated the scale of this effect by calculating it at just a few of the receptors, for just one key parameter – 24 hour PM_{10} (where the standard is 50 $\mu g\ m^{-3}$):[34]

[34] Data all taken from AEE Report G.1, Appendix H.

Traffic sensitivity. 24 Hour PM_{10}. Standard is 50 $\mu g\ m^{-3}$

Location	2010 (current)	2026 (no Project)	2026 (with Project)	2026 (with Project + 20%)
Alan Wood Reserve (greatest effect). S6.	38.2	37.6	41.9	42.7
Waterview School. E8	38.2	36.9	37.1	37.2
5 Barrymore St. (2nd highest). R8	38.2	37.6	41.5	42.3
Rutherford School. E3	37.1	36.4	36.6	36.7

90 This shows that the final cumulative concentrations of PM_{10}, even at the worst locations, are not greatly sensitive to the specific traffic flow parameters for the Project. The effects are strongly dominated by the total traffic in the area.

91 A similar picture occurs for all of the other contaminants, and the conclusion is that traffic projections would have to be very significantly underestimated before there would be any significant increase on the predicted air quality effects.

Tunnel ventilation system

92 In paragraph 4.3.8, the ARC comments that the proposal of turning off the tunnel fan at night is related to hour of the day, not to air quality criteria (other submitters also raised this point).

93 This is correct, and was a very careful and deliberate choice. The desire to have the fans turned off when not needed is strong and sensible. However it is accepted that this must not compromise air quality either in the tunnel itself or outside the portals. 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 off/on criteria for the fans, and (4) keeping it all working (with fairly complex and, at times not completely reliable, monitoring equipment).

94 As noted before, the exact operational requirements will be covered by the Tunnel Traffic Management Plan, and include all the necessary criteria to ensure no adverse effects from portal emissions. For instance, in the event of any "upset" events – where there might, for some unforeseen reason, be high traffic flows at unexpected times, the operators do of course have the flexibility to turn the fans on again, based on the operational in-tunnel CO monitoring. The efficacy of this approach can be reviewed using the

proposed air quality monitoring site that will be situated near the southern tunnel portal. The exact location for this site will be agreed with the ARC (now Auckland Council).

Use of CO as an indicator

95 In paragraph 4.3.9 the ARC questions the proposed use of CO as the primary indicator of conditions within the tunnel. This is done for reasons of utility, precedent and practicability. Firstly one of the reasons in-tunnel monitoring is carried out is to protect the health and safety of people using the tunnel. Most people do not suffer serious ill effects to high exposures of particulates or NO_2 for short times (such as fires, dust events, stuck in a traffic jam, etc). But CO can have a serious effect over a quite short time in high enough concentrations. It can make people drowsy, give them headaches, and in the worst cases cause death. In my opinion, CO is therefore by far the most appropriate measure of safe air quality in the tunnel.

96 Secondly monitoring CO has become a reasonably standard methodology for such tunnel operations all around the world. Its use and interpretation is well understood by non-specialists in the industry and there are well defined PIARC guidelines that tunnel operations use.[35]

97 Finally, on a practical basis, CO is probably about the most reliable indicator of air pollution to measure in real time. Monitors are robust and can be operated with very little down time. There are a range of methodologies for monitoring CO, and most are accurate and convenient. In contrast, most other contaminants require more complex and potentially unreliable equipment.

National Environmental Standards

98 In paragraph 4.3.10 the ARC requests that post Project monitoring comply with the NES. It will of course, as do all of NZTA's other continuous monitoring sites, and this is specified in the draft conditions (reference Condition OA.2), which has been amended to make express reference to the NES (see **Annexure F**).

Information about methodology

99 By way of relief, in paragraph 4.3.11 the ARC has requested a number of other detailed explanations around the methodology used.

[35] Road tunnels: A guide to optimising the air quality impact upon the environment. PIARC Technical Committee. World Road Association. 2008.

100 The matters outlined in paragraphs 4.3.11(a) to (e) relate to issues that have been addressed in earlier sections of my evidence, namely requests for:

100.1 More information on ground level air concentrations along the route;

100.2 More information on ground level concentrations for residences closest to the Waterview (Great North Road) Interchange;

100.3 Effects of air discharges from the ventilation stacks from a full year of remodelling;

100.4 Sensitivity analysis of traffic flows; and

100.5 Clarification of the choice of CO as the indicator contaminant for in-tunnel monitoring.

101 The issues raised in paragraphs 4.3.11(f) to (k) are discussed below.

Clarification on why data from other ARC sites (at Pakuranga and Penrose) were not used

102 Lack of site specific data is often a problem in air quality assessments. However, the NZTA, in consultation with the ARC, went to some trouble and expense to establish two monitoring sites in the vicinity over two years ago. These have been absolutely invaluable in providing site specific information. The use of data from other sites would not have added any value to the air quality assessment for this Project, for the following reasons:- (1) other sites have slightly different characteristics – different meteorology, different traffic profiles, and a different mix of sources (especially the local prevalence of domestic and industrial emissions); (2) any in-depth assessment would quite naturally be strongly biased with local data, and there would be no justification for adjusting this local data based on something happening several tens of kilometres away. In my opinion, the conclusions would not change if any or all of the data from the other ARC sites had been used. (For completeness, I note that it is not strictly true that other data were not used. The detailed technical work that went into developing the modelling methodology did use Auckland wide data. This work is not fully covered in the main Report – since it is essentially peripheral to the case – but is about to be published separately and will be the subject of a peer reviewed paper[36].)

[36] Longley., et al 2008. The determinants of levels of secondary particulate pollution and nitrogen dioxide in urban New Zealand. NIWA Report AKL 2008 053.

Clarification of the use of second highest values

103 Air quality monitoring data – even that with 'exceptional' events removed – is very 'spiky'. It is usually characterised by a fair number of low values, a lot of values close to the median, a few higher values and the occasional very high value – or spike. Often the highest value has the appearance of an outlier, even though it may be real, say due to a particularly calm period, a local fire or a nearby idling truck. Often the second highest value is a lot lower and more representative of the expected peaks.

104 For instance the median value might be 10, the average value 15, the second highest value 40 – and the single spike might be 80. Air quality scientists must use some judgement here in what to use as a representative worst case value. Assessments that are based on single and rare spikes in the data will be overly conservative and not at all a representative picture of what might happen. This technique is widely used in other disciplines. For instance engineers never design roads, bridges, houses, pipes or wharfs to cover the very worst that might happen. To do so would make the structures large, costly and unmanageable. They generally design using a criterion such as the "50-year rainfall return period" – that is the worst that could be expected in a 50 year period, rather than the worst ever. The choice of the second highest value in air quality monitoring is exactly analogous – it allows for a sensible and practical approach to covering the risks. On a balance of probability argument the occurrence of an occasional rare spike is acceptable, and basing design decisions – or consent conditions – on single spikes would, in my opinion, be impractical, restrictive, unwieldy and would add serious significant and unnecessary costs to just about any development project.

Development of meteorological datasets

105 The use of an accurate and validated dataset is crucial to accurate dispersion modelling. In recognition of previous problems, the ARC and the NZTA had recently developed and promulgated an "approved" data set for the Auckland region. This is now widely used, and was used to the greatest extent possible in the Waterview Project. However simply because of the size of the Auckland area, and the detail required in the dataset, the files are broken down into several subsections each covering a particular part of Auckland. The Project area, because of its several kilometre extent, ran across two of these datasets. Thus a new dataset had to be created by melding two of the standard ARC ones together. In addition, in order to further improve the accuracy of this dataset, the site specific meteorological monitoring results from the two local sites was also incorporated. (These data were not available to the ARC when they it developed the main dataset.) This is a straightforward process and for all intents and purposes the dataset ultimately used is completely consistent with the standard ARC dataset, but with a more accurate representation of the specific conditions around

Waterview, especially the complex drainage wind flows along Oakley Creek.

Benzene factors

106 The annual benzene effects were calculated using the known strong correlation between benzene and NO_2 in Auckland as described by an ARC study[37] and then applying this generally in the urban Auckland area. Consequently seasonal adjustment factors were derived which relate monthly mean concentrations to annual mean concentrations for NO_2 and apply equally to benzene.[38] These were then applied to each month of available passive NO_2 monitoring data, and used to then calculate the annual mean of all the available monthly benzene monitoring data.

Calculation of NO_2

107 The calculation of NO_2 uses a more sophisticated and reliable method than those proposed in the 2008 Ministry for the Environment Good Practice Guide for Assessing Emissions from Land Transport (of which I was a primary author). Those guidelines were essentially prepared for more general circumstances without a great deal of background monitoring data needed for the complex oxidation calculations. However in Auckland over the last few years, there is an extensive NO_x/NO_2 dataset from the ARC monitoring network. This was used to develop a new site specific sub-model of NO_2 conversion for this Project. The full scientific development is contained in a separate report, currently being prepared for peer reviewed publication.[39] The methodology is based on the behaviour of the relationship between the emissions of NOx and the eventual monitoring record of NO_2 in NZ urban situations. Because of the detailed Auckland monitoring, this relationship is now well established, allowing an accurate assessment of the NO_2 effects due to vehicle emissions.

Traffic numbers from AEE Table 6.4

108 The ARC has queried what the overall traffic numbers are as a result of applying the proportions in Table 6.4 of the AEE. These details are given fully, for all hours, for north and south bound in Appendix C of the main Report. The totals are as given in the previous summary table (Table 6.3).[40] This point was not made clear in the Report, but can be confirmed just by totalling the hourly numbers in the table and Appendix C.

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37 ARC Report TR 2009/048, section 6.4.2. 2009.

38 NIWA Report AKL-010-023. 2010.

39 Longley., et al 2008. The determinants of levels of secondary particulate pollution and nitrogen dioxide in urban New Zealand. NIWA Report AKL 2008 053.

40 AEE Report G.1, p 62.

Revised Consent Conditions

109 In paragraph 4.3.13, the ARC seeks various additional consent conditions. I have considered the issues raised and in a number of cases accept that the proposed conditions can appropriately be amended as sought by the ARC. I do not however agree with all of the ARC's proposed amendments. My assessment of each issue is set out below.

109.1 A minimum height of 25m for the vent stack – accepted, can be added (see proposed condition OA.1);

109.2 Monitoring methodologies meet the NES – already there by implication – accepted, can be made explicit (see proposed condition OA.2);

109.3 Monitoring equipment be operated according the Ministry for the Environment Good Practice Guide NES – already there by implication – accepted, can be made explicit (see proposed condition OA.2);

109.4 That the tunnel vents be turned on/off according to air quality criteria or traffic flows (rather than hour of the day or some other criterion) – this is not accepted or proposed for the reasons discussed above earlier in my evidence;

109.5 Regular maintenance and proper calibration of monitoring equipment – accepted, but this is already fully covered under the requirements above and no further amendment to condition wording is required.

Air quality effects during construction

110 Under section 4.3.14 the ARC calls for more work on air quality effects during construction. This is impossible to undertake at this time, since this is essentially the responsibility of the contractors and is subject to a vast array of details which are simply not known. In recognition of this, a very specific and detailed Construction Air Quality Management Plan has been prepared that the site works contractors will be required to comply with. This is standard practice. In addition, the proposed consent conditions (AQ.1 to AQ.19) are comprehensive on the matter of any activities that might lead to air quality degradation, especially dust nuisance. I note that (in paragraph 4.3.16) the ARC endorses the NZTA's plans to use Management Plans for mitigating construction effects on air quality.

111 In paragraph 4.3.15 the ARC recommends that the concrete batching plant be fully enclosed. This will be done, mainly to mitigate noise effects, but the outcome will also mitigate any dust effects (refer evidence of Ms Siiri Wilkening for details).

112 In paragraph 4.3.17 the ARC seeks four new specific conditions on construction operations, which I now address:

112.1 Fully enclosing the concrete batching plant in Construction Yard 10 – accepted and covered by condition AQ.1;

112.2 ARC to approve dust monitoring equipment – accepted and built into proposed condition AQ.14;

112.3 Break down of equipment is replaced within two days – accepted and built into proposed condition AQ.14;

112.4 Conveyors in Construction Yard 6 be fully enclosed – accepted, and the details are covered in the Draft Concrete Batch and Crushing Plant Management Plan.[41] This does not require a specific condition since any potential effects are fully covered by the criteria as specified in condition AQ.1.

PROPOSED AIR QUALITY CONDITIONS

113 In the documentation lodged with the AEE, the NZTA included a set of Proposed Designation and Consent Conditions (see Part E, Appendix E.1, pp 22-25). This included proposed air quality conditions which I recommended would be appropriate to attach as conditions to the designations and resource consents sought.

114 Since lodgement, these proposed conditions have been amended in response to submissions, particularly that from the ARC. A copy of the proposed amended conditions is contained in **Annexure F** to my evidence (with the revisions shown clearly in strike through and underline).

115 I consider that those conditions (as amended) are appropriate and will give the community sufficient assurance that air quality will not be significantly degraded as a result of the Project, either in the short term (construction) or the longer term (the lifetime of the Project).

Gavin Fisher

November 2010

[41] AEE Report G.1, Appendix N.

ANNEXURES:

A – Sensitive receptors used

B – Summary of effects at receptors

C – Worst case effects

D – Effects due to tunnel vents

E – Analysis of $PM_{2.5}$ effects

F – Proposed conditions relating to air quality (amended)

ANNEXURE A: SENSITIVE RECEPTORS USED

E1	TKKM o Te Kotuku
E2	Rutherford College
E3	Rutherford School
E4	Pt Chevalier School
E5	Western Springs College
E6	Pasadena Intermediate
E7	St Francis School
E8	Waterview School
E9	Gladstone School
E10	Rosebank School
E11	Avondale College
E12	Avondale Intermediate
E13	Hebron Christian College
E14	Mt Albert Grammar School
E15	TKKM o Nga Maungarongo
E16	Owairaka District School
E17	Odyssey House School
E18	Avondale Primary School
E19	St Mary's School
E20	Immanuel Christian School
E21	Glenavon School
E22	New Windsor School
E23	Christ The King School
E24	Wesley School
E25	Wesley Intermediate
C1	Te Kotuku Kohanga Reo
C2	Rutherford Preschool
C3	Te Puna Reo O Manawanui
C4	Pt Chevalier Kindergarten
C5	Stylee Kids Ahead ELC
C6	Learning at the Point
C7	Collectively Kids
C8	Waterview Kindergarten
C9	UNITEC Early Learning Centre
C10	UNITEC ELC - Pukeko Whare
C11	Mt Albert Kindergarten
C12	Bright Beginnings ECEC
C13	ABC Waterview
C14	Mt Albert Playcentre
C15	Little Scholars ELC - Mt Albert
C16	Ferndale Kindergarten
C17	Jump Start Kids Centre
C18	Rocket Kids Early Learning Centre
C19	Rosebank Early Childhood Centre
C20	Avondale College ECE
C21	Kids World
C22	Avondale Community Pre-School
C23	Treasure Hunt Preschool
C24	Kidz Unlimited Learning Centre

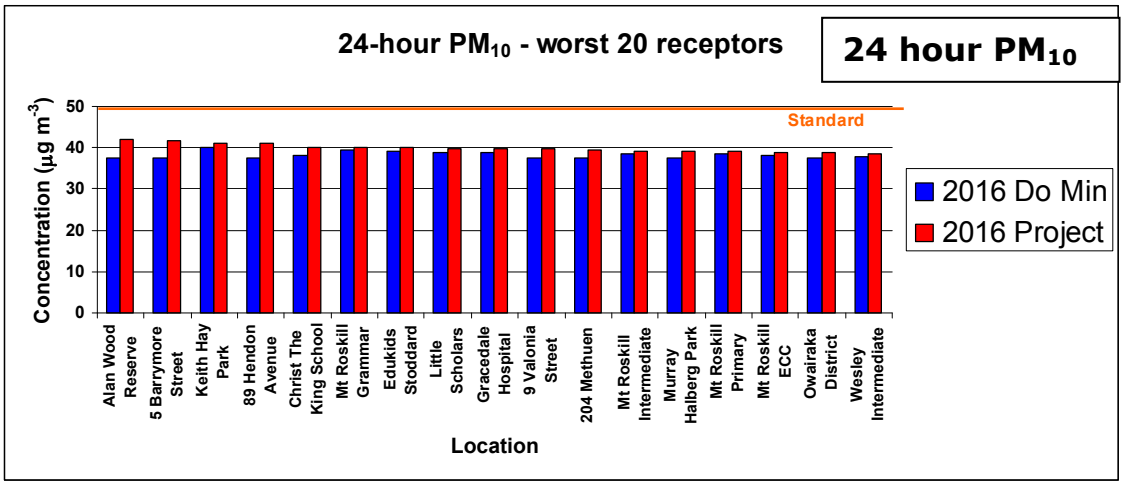
C25	Owairaka Kindergarten
C26	Mt Royal Early Learning Centre
C27	TPRM O Nga Maungarongo
C28	Minimarc Childcare Centre
C29	St Marys Preschool
C30	Avondale Christian Kindergarten
C31	Kiwicare Preschool Avondale
C32	Kiwicare Preschool West
C33	Kiwicare Wolverton
C34	Glenavon Early Childhood Centre
C35	New Windsor Playcentre
C36	Edukids Stoddard Road Centre
C37	Wesley Kindergarten
C38	Little Scholars Baby Cottage
H1	Selwyn Village
H2	WDHB Addiction Unit
H3	Rehab Plus
H4	Mason Clinic
H5	Aranui House
H6	Warrengate Private Hospital
H7	Rosaria Rest Home
H8	Avondale Rest Home & Hospital
H9	Avon Rest Home
H10	Tiverton House Rest Home
H11	Bettina Residential Care Home
R1	17 Milich Terrace
R2	20 Titoki Street
R3	21 Alwyn Avenue
R4	77 Herdman Road
R5	1102G Great North Road
R6	Avondale Motor Park
R7	89 Hendon Avenue
R8	5 Barrymore Street
R9	204 Methuen
R10	9 Valonia Street
S1	Walker Park
S2	Phyllis Reserve
S3	Mt Albert-Owairaka Domain
S4	Avondale Race Course
S5	Murray Halberg Park
S6	Alan Wood Reserve
D1	Little Scholars ELC
D2	Gracedale Hospital
D3	Keith Hay Park
D4	Mt Roskill Intermediate
D5	Mt Roskill ECC
D6	Mt Roskill Grammar
D7	Mt Roskill Primary School
D8	Hillsborough Playcentre

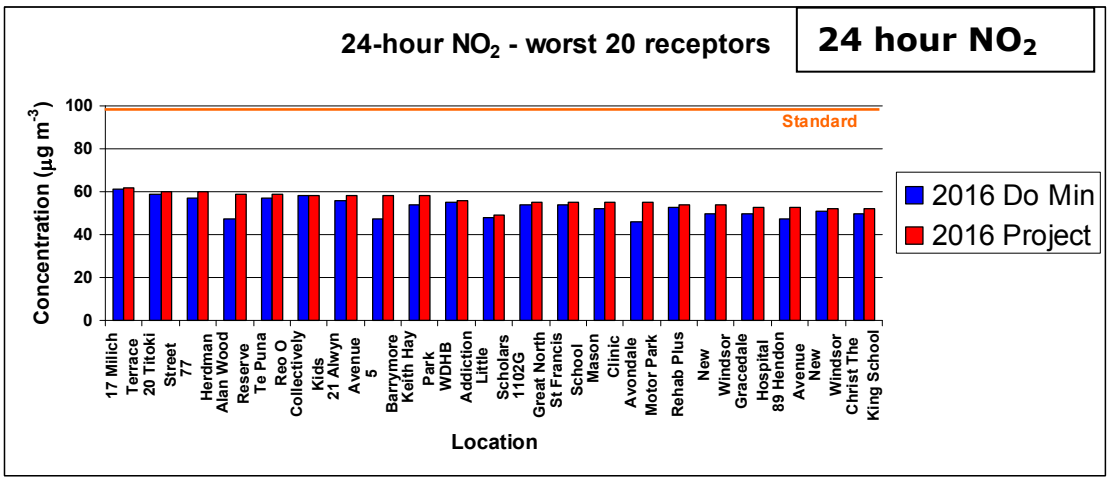
Note that this specifically includes those residences left closest to the motorway after the works are completed.

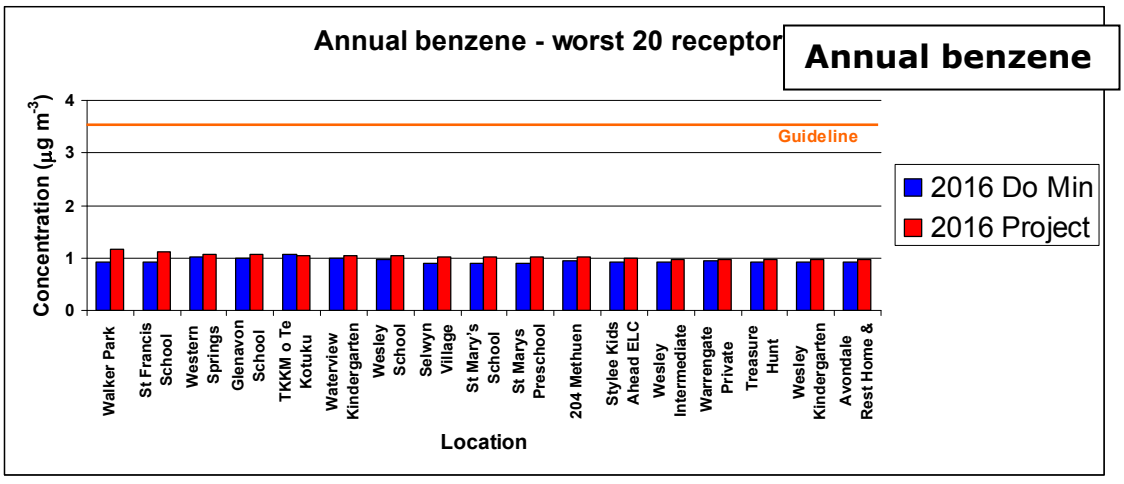
ANNEXURE B: SUMMARY OF EFFECTS AT RECEPTORS

EFFECTS AT VARIOUS SENSITIVE RECEPTORS – PARTICULATES, NITROGEN DIOXIDE AND BENZENE

(A similar picture occurs for other parameters)







ANNEXURE C: WORST CASE EFFECTS

THE WORST CASE GROUND LEVEL CONCENTRATIONS OF CONTAMINANTS ANYWHERE IN THE MODELLING DOMAIN

Worst Case - All emissions	PM_{10} 24 Hour	$PM_{2.5}$ 24 Hour	NO_2 1 Hour	CO 8 Hour	Benzene Annual
	($\mu g\ m^{-3}$)	($\mu g\ m^{-3}$)	($\mu g\ m^{-3}$)	($mg\ m^{-3}$)	($\mu g\ m^{-3}$)
Standard/Target	50.0	25.0	200.0	10.00	3.60
Current	38.2	24.0	108.8	3.73	1.00
2016 No Project	37.6	26.8	91.3	3.64	0.92
2016 With Project	42.1	28.1	92.8	3.76	1.17
2026 No Project	37.6	26.6	86.3	3.58	0.90
2026 With Project	41.9	28.2	87.8	3.43	1.11
Location	Alan Wood Reserve (S6)	Keith Hay Park (D3)	17 Milich Tce (R1)	9 Valonia St (R10)	Walker Park (S1)

In general the "worst case" values are slightly higher that the "current", or the "no project" values.

But they all are lower than the standard. $PM_{2.5}$ slightly exceeds the target value.

$PM_{2.5}$ is projected to exceed the target value of 25 by 2016 anyway – regardless of the Project.

The Project adds less than 5% to this.

ANNEXURE D: EFFECTS DUE TO TUNNEL VENTS

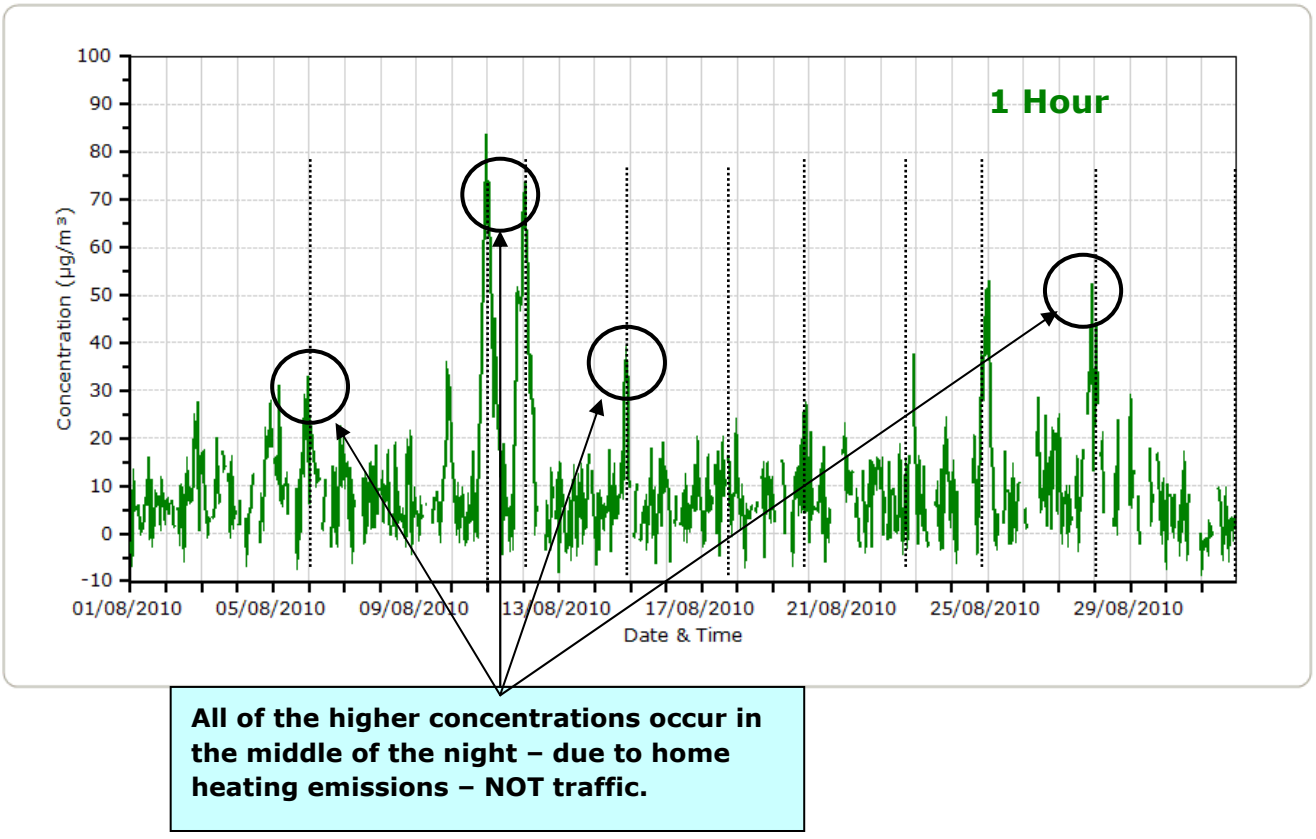
CONTRIBUTIONS TO GROUND LEVEL CONTAMINANT CONCENTRATIONS DUE TO THE TUNNEL VENTS ALONE

Worst Case - Tunnel vent only	PM_{10} 24 Hour	$PM_{2.5}$ 24 Hour	NO_2 1 Hour	CO 8 Hour	Benzene Annual
	($\mu g\ m^{-3}$)	($\mu g\ m^{-3}$)	($\mu g\ m^{-3}$)	($mg\ m^{-3}$)	($\mu g\ m^{-3}$)
Standard/Target	50.0	25.0	200.0	10.0	3.6
Current	0.00	0.00	0.0	0.000	0.000
2016 No Project	0.00	0.00	0.0	0.000	0.000
2016 With Project	0.29	0.20	29.3	0.011	0.010
2026 No Project	0.00	0.00	0.0	0.000	0.000
2026 With Project	0.29	0.17	26.6	0.007	0.009
Location	Rehab Plus (H3)	Rehab Plus (H3)	Rehab Plus (H3)	9 Valonia St (R10)	St Francis School (E7)

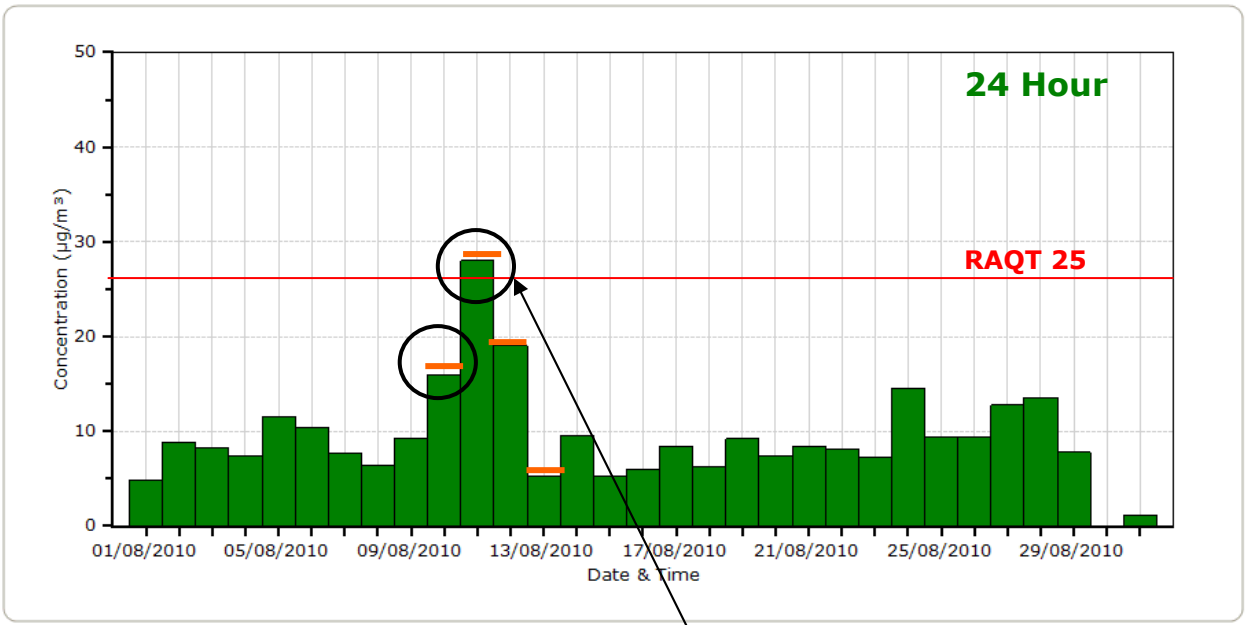
The contributions from the tunnel vents are very low relative to the standard and targets

ANNEXURE E: ANALYSIS OF $PM_{2.5}$ EFFECTS

PM2.5 CONCENTRATIONS AT ALAN WOOD RESERVE FOR AUGUST 2010



All of the higher concentrations occur in the middle of the night – due to home heating emissions – NOT traffic.



The contribution due to the project is at worst less than 1.5 µg m^{-3}. This is the thickness of the orange line, or less than 5% of the domestic peaks – an insignificant effect.

ANNEXURE F: PROPOSED AIR QUALITY CONDITIONS (AMENDED)[42]

Proposed Air Quality Conditions – Construction

	GENERAL CONDITIONS
AQ.1.	The NZTA shall finalise and implement, through the CEMP, the Construction Air Quality Management Plan (CAQMP) and Concrete Batching and Crushing Management Plan (CBCMP) submitted with the application. The NZTA shall provide the CAQMP and CBCMP to the [Auckland Council] prior to the commencement of any site works. The CAQMP and CBCMP shall be revised to accurately reflect the conditions of this consent and changes to the details of construction processes prior to construction commencing. The CAQMP and CBCMP shall include, but not be limited to, details of: (a) Daily visual monitoring of dust emissions; (b) Procedures for responding to process malfunctions and accidental dust discharges; (c) Criteria, including consideration of weather conditions and procedures for use of water sprays on stockpiles and operational areas of the site; (d) Continuous monitoring of Total Suspended Particulate (TSP) concentrations and meteorology; (e) ~~Monitoring of odour emissions;~~ Monitoring of the times of detectable odour emissions from the ground; (f) Procedures for responding to discharges of odour (including in the event of excavation of contaminated sites); (g) Monitoring of construction vehicle maintenance; (h) Process equipment inspection, maintenance, monitoring and recording, including baghouses, pressure relief valves and high level alarms; (i) Complaints investigation, monitoring and reporting; and (j) The identification of staff and contractors' responsibilities.
AQ.2.	The NZTA shall review the CAQMP and CBCMP at least annually and as a result of any material change to the Project. Any material changes to the CAQMP and CBCMP shall be submitted to the [Auckland Council] for review at least 10 working days prior to the changes taking effect.
AQ.3.	All construction activities shall be operated, maintained, supervised, monitored and controlled at all times so that all emissions authorised by this consent (being XXX) are maintained at the minimum practicable level.
AQ.4.	The NZTA shall undertake construction activities in accordance with the CEMP, CAQMP and CBCMP, such that: (a) Hard surfaced areas of the construction yards and active construction areas are vacuum swept or scraped down at least twice each week and additionally as reasonably required; (b) All unsealed areas of the site used for vehicle movement are maintained visibly damp by the use of water sprays or a water cart during weather conditions where the potential for dust emissions exist; (c) Wheel wash systems are installed at all truck exits from unpaved areas of the site onto public roads are used for all trucks that depart from the site; (d) All stockpiles are constructed and positioned to minimise the potential for dust emissions. The surfaces of all stockpiles are maintained adequately damp at all times to minimise the release of particulate matter; (e) Belt conveyors for moving dry materials are fitted with water sprays or

[42] Contained in AEE, Appendix E.1, pages 21-25, with revisions in underlining and strike through.

	enclosed to minimise wind entrainment of dust. Where installed, water suppression is used whenever the conveyors are used for moving dry materials.
	PROCESS CONDITIONS – CONCRETE BATCHING:
AQ.5.	Air displaced from concrete batching plant during silo filling or concrete batching shall be vented to atmosphere via filter units as follows: (a) Cement silos – a pulse jet baghouse mounted on top of the silo designed to meet a particulate discharge concentration limit of 30 mg/m3, a collection efficiency of 99.9% and a maximum air to cloth ratio of 3.0 m3/m2/min. (b) Cement weigh hopper - a static baghouse mounted on top of the weigh hopper designed to meet a particulate concentration discharge limit of 30 mg/m3, a collection efficiency of 90% and a maximum air to cloth ratio of 1.0 m3/m2/min. (c) Mixer drum – either via the cement silo or via a separate baghouse designed to meet a particulate concentration discharge limit of 30 mg/m3, a collection efficiency of 99.9% and a maximum air to cloth ratio of 3.0 m^3/m^2/min. If a separate baghouse is used, the pressure drop across this baghouse shall be continuously monitored.
AQ.6.	Each cement silo on site shall be fitted with a high fill alarm that shall be adequately maintained and be operating whenever bulk cement is being transferred into that silo. In the event of the alarm operating, filling into that silo shall cease immediately and shall not be resumed until the cause has been located and remedied.
AQ.7.	No part of the concrete batching process shall be operated without the associated emission control equipment being fully operational and functioning correctly.
	PROCESS CONDITION - ROCK CRUSHING
AQ.8.	Air extract ventilation from the rock crushing plant shall be ducted to a baghouse that shall either discharge entirely within the building or be designed to meet a particulate concentration discharge limit of 30 pmg/m^3, a collection efficiency of 99.9% and a maximum air to cloth ratio of 3.0 m^3/m^2/min. If the baghouse does not discharge entirely within the building, the pressure drop across this baghouse shall be continuously monitored.
AQ.9.	No part of the rock crushing process shall be operated without the associated emission control equipment being fully operational and functioning correctly.
	MONITORING
AQ.10.	The NZTA shall undertake visual inspections of dust emissions as follows: (a) Visual inspections of all active construction areas at least three times daily during October to April inclusive, whenever there are construction activities. The results of visual monitoring shall be logged. (b) Visual inspections of dust emissions from the concrete batching plants and rock crushing plant shall be undertaken daily while the plant is operating.
AQ.11.	The operation of water sprays shall be checked at least once each day.
AQ.12.	Continuous monitoring of TSP concentrations shall be undertaken in at least one location in Sector 1, in at least two locations in Sectors 5 and/or 7, and in at least two locations in Sector 9 while construction activities are being undertaken in those Sectors. The locations of continuous TSP monitors shall, as far as practicable, comply with the requirements of AS/NZ 3580.1.1:2007 Method for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment.
AQ.13.	Continuous monitoring of wind speed and direction shall be undertaken in at least one location in each of Sector 1, Sectors 5 or 7 and Sector 9 while

	construction activities are being undertaken in those Sectors. The locations of wind speed and direction monitors shall, as far as practicable, comply with the requirements of AS 2923:1987 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications and be at the same locations as the TSP monitors required by Condition ~~AQ.13~~ AQ.12.
AQ.14.	The locations and types of continuous TSP and meteorological monitoring sites required by Conditions AQ.12 and AQ.13 shall be selected by the NZTA in consultation with the [Auckland Council]. In the event of a failure of the monitoring equipment this shall be repaired or replaced within two working days.
	REPORTING
AQ.15.	All records, logs, monitoring and test results that are required by the conditions of this consent shall be made available on request, during operating hours, to an [Auckland Council] enforcement officer and shall be kept for the duration of the consent.
AQ.16.	If the monitoring required by Condition A.12 shows that concentrations of TSP in ambient air at or beyond the boundary of the site exceeds 80 µg/m^3 as a 24-hour average, the NZTA shall undertake an investigation into the cause of the ~~exceedance~~ exceedence.
AQ.17.	A report into the outcome of any investigation required by Condition AQ.16 shall be forwarded to the [Auckland Council] within 20 working days of the ~~exceedance~~ exceedence. If the cause of the ~~exceedance~~ exceedence is identified as being an activity undertaken on the site, the report shall also identify additional measures to be taken to reduce discharges of particulate matter into air from that activity.
AQ.18.	Log books shall be maintained that record all relevant information that is required to demonstrate compliance with the conditions of this consent. This information shall include, but is not limited to: (a) Visual assessments of any dust emissions from the site and the source; (b) Any dust control equipment malfunction and any remedial action taken; (c) When a water cart was used and, if so, the frequency of use and the volume of water used (including identification of location); (d) All relevant details of the TSP and meteorological monitoring required by Conditions AQ.12 and AQ.13; (e) Any additional dust control measures undertaken; and (f) The date and time of the entry and the signature of the person entering the information.
AQ.19.	The NZTA shall maintain a log of any complaints received relating to air quality. Details of each complaint received shall be forwarded to the [Auckland Council] within 24 hours of receipt of the complaint. The log shall include any complaints lodged with the [Auckland Council] where the Council has informed the NZTA of the complaint. The log shall include, but not be limited to the following: a) The date, time, location and nature of the complaint; b) Weather conditions at the time of the complaint (including approximate wind speed, wind direction, cloud cover); c) Any possible other contributing factors (such as a fire, a smokey vehicle, a local chimney emission, etc). ~~c)~~d) The name, phone number and address of the complainant (unless the complainant elects not to supply these details); ~~d)~~e) Any remedial actions undertaken; and ~~e)~~f) The date and time of the entry and the signature of the person entering the information.

Proposed Operational Air Quality Conditions

OA.1	The vents used to discharge emissions in the tunnel shall be a minimum height of 25m above the ground.
~~OA.1~~ OA.2	Prior to the tunnels becoming operational, the Requiring Authority shall establish two ambient air quality monitoring stations. The location and type of these monitoring stations shall be selected by the NZTA in consultation ~~determined and agreed~~ with the [Auckland Council]. Ambient air quality shall be monitored continuously in real time, to monitor potential effects associated with the operation of the ventilation system from the tunnels. Monitoring shall include fine particulates (PM10 and PM2.5) and nitrogen dioxide. Results shall be compared with the relevant National Standards for air quality and Auckland Regional air quality targets. Monitoring shall be undertaken for at least 24 months once the tunnels are operational, unless it has been agreed with the [Auckland Council] that monitoring is no longer required. The locations and maintenance schedules of the continuous monitors shall, as far as practicable, comply with the requirements of AS/NZ 3580.1.1:2007 Method for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment, and with methods specified in the National Environment Standards.
~~OA.2~~ OA.3	Continuous monitoring of wind speed and direction shall be undertaken at each ambient air quality monitoring location as required by Condition ~~OA.1~~ OA.2. The locations of wind speed and direction monitors shall, as far as practicable, comply with the requirements of AS 2923:1987 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications.
~~OA.3~~ OA.4	For the first 12 months of tunnel operation, the results of the ambient air quality monitoring shall be reported via validated reports and issued for information via the Project website. Following this period, reporting shall take place quarterly as follows: quarter 1 (Dec to Feb) by 31 Mar, quarter 2 (Mar to May) by 30 Jun, quarter 3 (Jun to Aug) by 30 Sep and quarter 4 (Sep to Nov) by 31 Dec.
~~OA.4~~ OA.5	If the monitoring required by Condition ~~OA.1~~ OA.2 shows that concentrations of contaminants in ambient air at the monitoring locations exceeds the relevant air quality standards, the NZTA shall undertake an investigation into the cause of the ~~exceedance~~ exceedence.
~~OA.5~~ OA.6	The air quality monitoring shall be undertaken in general accordance with the Operational Air Quality Management Procedure (Appendix O of Technical Report G.1 Assessment of Air Quality Effects) submitted with this application.

Proposed Operational Traffic Conditions

	Tunnel Traffic Management Plan
OT.2	The NZTA shall prepare a Tunnel Traffic Management Plan in consultation with the [Auckland Council]. The plan shall include, but not be limited to: a) Procedures for maintenance requirements. b) Procedures for managing traffic to avoid or minimise potential congestion within the tunnel, particularly during peak periods. c) Procedures for the management of traffic during incidents. d) Procedures for the operation of tunnel fans and the management of portal emissions.