



## 1 Response to Practice Note Information

**(i) Name and address of the expert.**

Dr Lyn Denison

**(ii) Expert's qualifications and experience.**

PhD (University of Melbourne), BSc(Hons) (University of Melbourne)

Currently Principal Consultant DLA Environmental Services. Over 25 years experience in air quality in particular policy development and human health risk assessment. This includes 17 years with EPA Victoria in various roles including Principal Scientist. Prior to joining EPA I was a Research Associate at the Peter MacCallum Cancer Institute. I conducted training on behalf of the World Health Organization Africa to the Ministry of Health in Mozambique on Environmental Health Risk Assessment. As part of an AusAid funded program I was involved in the development of a framework for a National Environmental Health Strategy for Mozambique. I have represented Victoria in the development of National policies for air quality and was involved in the review of the SEPP(AQM) in 2001. I have been involved in a number of epidemiological studies on the health effects of air pollution including the national Air Pollution and Children's Health Study and the Multicity Mortality and Morbidity Study as well as the Melbourne Mortality Study and Air Pollution and Hospital Admissions Study. I have conducted health risk assessments for a large range of projects including as assessment of the health impacts of air pollution in Port Hedland which was conducted to inform future planning decisions for the town. I also conducted the health risk assessment for air and noise for the Western Sydney Airport EIS.

**The expert's area of expertise to make the report.**

Air Quality Policy

Health effects of air pollution and noise

Air Quality Management

**(iii) Any other significant contributors to the report and where necessary outlining their expertise.**

N/A

**(iv) All instructions that define the scope of the report (original and supplementary and whether in writing or oral).**

Scope of Task

There will need to be some flexibility in the task to account for material that comes forward in evidence and the Hearing but the scope will be generally as follows.

1. Review the IAC's Terms of Reference.

2. Review relevant (to your area of expert advice) parts of the Environment Effects Statement (including EMF and EPRs), Planning Scheme Amendment and Works Approval Application.
3. Provide a brief written statement to the IAC (a template will be provided) by Tuesday 11 July 2017 which contains, in dot point form, relevant to your expertise and within the scope of the IAC's Terms of Reference:
  - a. Identification of key issues; and
  - b. Requests for information from the Proponent, including points of clarification arising from your review of the EES material, which are necessary to inform your expert opinion on the key issues that you have identified.

Please also note that any requests for information should be made in respect of key issues only and should be referable to the IAC's Terms of Reference.

Your advice will be attached to the IAC's request for information to the Proponent to be tabled at the Directions Hearing on 19 July 2017.

4. Review the expert evidence filed by other parties in so far as it relates to your area of expertise.
5. Attend the relevant expert witness Conclave(s) as an observer and review the joint statements arising from those conclaves.
6. Provide an interim report to the IAC to be tabled at the commencement of the Hearing on 14 August 2017 which sets out, within your area of expertise:
  - a. The matters required by the PPV Practice Note – Expert Evidence including all facts matters and assumptions upon which you have proceeded;
  - b. The key issues, including whether the key issues you identified prior to the circulation of evidence have changed, and if so, how;
  - c. Your expert view on the matters raised by paragraph 13(e)(i)-(iv) of the Terms of Reference in so far as they relate to the key issues you have identified;
  - d. Any areas in which you consider that there is insufficient information, having regard to the current and proposed future stages of the project (eg detailed design); and
  - e. Recommended changes to the approval documentation (if any).
7. Review any technical responses provided by the Proponent to the IAC's requests for information in so far as they fall within your area of expertise, as and when required, and provide a written response, if requested to do so.
8. Provide written responses to any questions that the IAC asks of you during the Hearing.
9. Provide counsel assisting with any questions you have of the expert witnesses called by the parties. Depending upon time availability, this may be done orally or in writing.
10. Attend the Hearing, by agreement with the IAC, and particularly the relevant expert Panel session(s).

11. Review the Proponent's proposed changes to the approval documents (if any) and any other party's suggested changes to the approval documents referred to you by the IAC.
12. Following the completion of expert evidence, provide a brief final report to the IAC no later than the end of Week 4 of the Hearing which complies with the PPV Practice Note – Expert Evidence and sets out:
  - a. any changes of opinion since your interim report (if any) and the reason for that change in opinion; and
  - b. your opinion on the latest version of the Proponent's proposed approval documents (if any) and any other party's suggested changes to the approval documents.
13. Other activities by agreement.

**(v) The identity of the person who carried out any tests or experiments upon which the expert has relied on and the qualifications of that person.**

N/A

**(vi) Reference to those documents and other materials the expert has been instructed to consider or take into account in preparing his or her report, and the literature or other material used in making the report.**

EES Volume 1 Summary Document

EES Technical Report G Air Quality Impact Assessment Report

EES Technical Report J Human Health Risk Assessment

Expert Witness Statements:

- Frank Fleer
- Dr Jackie Wright
- Dr Iain Cowan
- Dr Graeme Stark
- Dr Dianne Keogh
- Professor Louis Irving
- Professor Gary Anderson
- EPA Submission to EES
- Department of Health and Human Services Submission to the EES
- Public submissions
- EES Works Approval Application

- Environmental Performance Requirements for the project
- WHO REVIHHAP Report (2013)
- WHO HRAPIE Report (2013)
- COMEAP Report Health Effects of Nitrogen Dioxide (2015)
- USEPA ISA Oxides of Nitrogen (2016)
- USEPA ISA Particulate Matter (2014)
- Golder Associates Exposure Assessment and Risk Characterisation Ambient Air Quality NEPM Review (2012)
- Jalaludin and Cowie (2012), Concentration Response Functions for Use in Health Risk Assessment for Ambient Air Quality NEPM Review
- NEPC (2011) Methodology for Setting Ambient Air Quality Standards in Australia
- UK Health and Safety Executive, Reducing Risks Protecting People, HSE Decisions Making Process

**(vii) A summary of the opinion or opinions of the expert.**

In reviewing the EES documentation including Technical Appendices G and J, the submissions received through the public consultation process and the expert witness statements provided in relation to air quality and health I have formed the following opinions.

- The air quality impacts as presented do not comply with the requirements of SEPP (AQM)
- The emission factors used in the air dispersion modelling for both surface and tunnel emissions have excluded key sources and are likely to underestimate the impacts at sensitive receptors
- The impact of the redirected flow of trucks on Miller's Road and Blackshaw's Road have not been adequately assessed and further work should be conducted to inform the optimal design of the project
- The HIA does not adequately deal with some of the broader determinants of health such as stress, lower health status in some LGA's within the project area and impacts on the elderly
- The assessment of the health effects of PM<sub>10</sub>, PM<sub>2.5</sub> and NO<sub>2</sub> does not take into account the most recent information on the health effects of these pollutants, especially NO<sub>2</sub>, and does not provide a complete picture of the health impacts and benefits of the project across the whole community.
- Additional EPRs should be included for air quality and noise that relate to minimising the impact on health and also identify mitigation measures that could be implemented if air quality and noise standards are exceeded.

- (viii) A statement identifying any provisional opinions that are not fully researched for any reason (identifying the reason why such opinions have not been or cannot be fully researched).**

The reports of the Conclaves were not available at the time of writing this advice so have not been considered at this time. Additional modelling of surface roads being conducted by Golder Associates and to be tabled at the hearing has not been considered.

- (ix) A statement setting out any questions falling outside the expert's expertise, and whether the report is incomplete or inaccurate in any respect.**

N/A

- (x) Declaration**

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the IAC.

## 2 Further Information

**(i) Question**

Has the information that you previously requested in your letter dated 11 July 2017 been provided? (Noting that some responses are not due until the commencement of the Hearing).

**(ii) Response**

Responses have been provided by Mr Fleer and Dr Wright.

### 3 Key Issues

#### (i) Question

Please list the issues that you consider to be the key issues arising from the proposed West Gate Tunnel project relevant to your expertise and falling within the scope of the IAC's Terms of Reference.

#### (ii) Response

##### Air Quality

- Compliance with Policy
- Impacts of emissions from the Ventilation Stacks
- Impacts of changes to traffic flows on surface roads

##### Health Impact Assessment

- Compliance with guidance in conducting HIA in Australia
- Assessment of the health impacts of PM<sub>10</sub>, PM<sub>2.5</sub> and NO<sub>2</sub>
- Assessment of health impacts of noise
- Acceptable risk criteria

## 4 Air Quality

### 4.1 Compliance with Legislation

The State Environment Protection Policy Ambient Air Quality [SEPP(AAQ)] establishes ambient air quality standards and associated monitoring and reporting protocols to be applied in the assessment of air quality in Victoria. It adopts the national air quality standards established in the National Environment Protection Measure (Ambient Air Quality) [AAQ NEPM]. The NEPM and SEPP (AAQ) was revised in 2016 to adopt new standards for PM<sub>10</sub> and PM<sub>2.5</sub>. The standards for the other pollutants in the NEPM are currently under review but have not currently been updated since 1998.

The State Environment Protection Policy Air Quality Management [SEPP(AQM)] provides the Statutory Framework for the management of emissions to the air environment. The Policy Aims as specified in the SEPP(AQM) are to:

- Ensure that the environmental quality objectives of the State Environment Protection Policy (Ambient Air Quality) [SEPP(AAQ)] are met;
- Drive continuous improvement in air quality and achieve the cleanest air possible having regard to the social and economic development of Victoria; and
- Support Victorian and National measures to address the enhanced greenhouse effects and depletion of the ozone layer.

The SEPP (AQM) contains design criteria to be applied in the assessment of modelling of point sources, such as the Westgate Tunnel ventilation stacks, and intervention levels that are to be applied in hot-spot locations, such as close to major roads, to assess air quality monitoring data. In the past, the intervention levels have been used to assess air quality modelling in near road investigations. This approach has been applied in the assessment of the impact from surface roads for the Westgate Tunnel Project.

The SEPP[AQM] requires that emissions to the air environment must be controlled by the application of best practice emission controls or to the maximum extent achievable for Class 3 indicators such as benzene and PAHs.

The SEPP(AQM) also requires that assessment against the design criteria be done for the worst case emission scenario under normal operating conditions.

#### (i) Issues Raised by Submitters

A number of issues have been raised by submitters in regard to compliance with policy. One key issue is the lack of pollution control equipment on the ventilation stack emissions and whether that demonstrates best practice. Submission 458 provides examples of recent road tunnels internationally that have installed pollution control equipment to protect ambient air quality not just in-tunnel air quality. These projects are not discussed in the EES or Technical Appendix G.

A further issue is the contribution of the project emissions to exceedances of the PM<sub>10</sub> criteria and whether the project should be able to worsen air quality in some locations such as areas

within the 1km radius from the ventilation stacks, Millers Road, Geelong Road and Blackshaws Road. Dr Keogh in her expert witness statement raises some issues with the transparency of the air quality assessment conducted as part of the EES in regard to the identification of the project contribution to air quality within the project area in absolute terms and how many additional exceedances of the air quality criteria are caused by the addition of the project contribution, in particular to PM<sub>10</sub> and PM<sub>2.5</sub>. This issue was also raised by EPA and Maribyrnong City Council in their submissions.

Dr Keogh also raised concern about the validity of the emission factors used in the modelling which has subsequently been used to assess compliance with the air quality criteria. Several submitters raised concern about the non-inclusion of brake and tyre wear and re-entrained road dust in the emission factors for PM<sub>10</sub> and PM<sub>2.5</sub> and the potential for underestimation of the impact of increased vehicle traffic on some roads.

The use of the EPA Footscray air monitoring data from 2009-2013 as background air quality data across the whole project area has also been questioned by several submitters. It has been suggested that the data from the Brooklyn air monitoring station should have been used as background for the air quality assessment in the Brooklyn area. Concern about the appropriate background data has also been raised by EPA.

Maribyrnong City Council Submission raises concerns in regard to the model used and the possible under prediction of air pollutants. It also raises the issue that the AQIA shows that the Project does not comply with SEPP(AQM) and the need to ensure that the statutory policy requirements are met prior to approval being given for the project.

Some submitters also raised concern that the current air quality standards, apart from those for particles, have not been reviewed for many years and currently lag behind international standards.

The Air Quality Assessment (AQA) concludes that the main reason for the exceedances of the PM<sub>10</sub> standards are due to existing background data. Mr Fler in his expert witness statement supports this conclusion. However, the AQA also notes that there are 32 additional exceedances of the PM<sub>10</sub> criteria (p122 Technical Report G) due to the contribution of the project to existing background levels with project contributions up to 23 µg/m<sup>3</sup>. This is for the 'normal' scenario with two lanes operational. Dr Cowan also notes that the exceedances of the design criteria are largely driven by background air quality.

A number of submitters raised concerns about the motor vehicle fleet in Victoria and the fact that the emission controls established through motor vehicle design rules lag behind the US and Europe. The EES Technical Appendix G identifies that improvements in Australian Design Standards for vehicles and associated in fuel quality and the most effective way of reducing emissions from motor vehicles rather than requiring project specific design aspects, such as the installation of pollution control equipment in the ventilation stacks. Technical Appendix G also discusses the banning of smoky vehicles from entering the tunnels.

### **(ii) Response**

The SEPP(AQM) requires modelling of emissions to be conducted after the application of best practice (or MEA) emission controls. The question of whether not installing pollution control

equipment in ventilation stacks is relevant to this point. There is a review of tunnel ventilation systems provided in Technical Appendix G however it is based on dated information and does not include the more recent road tunnel projects internationally such as those discussed in Submission 458. Given that there are an additional 32 exceedances of the PM<sub>10</sub> design criteria under 'normal' operation with 2 lanes occupied with the project compared to the no project option suggests that the impact of introducing pollution control equipment should be assessed quantitatively. The 'normal' scenario is not the worst case situation as required under SEPP(AQM). Worst case would be 3 lanes occupied and congested traffic. The EES argues that this situation would not occur for 24-hours a day which is correct. However, this situation is likely to occur within peak periods and does occur currently within the Citylink tunnels. The design criteria are for a 1-hour averaging period therefore compliance with SEPP should have been assessed against the worst case situation not the 'normal' scenario.

As discussed above, the SEPP(AQM) policy aim is to drive continuous improvement in air quality and in several areas, including the impact of changed traffic flow onto roads such as Millers Road and the predicted increase in PM<sub>10</sub> levels at some sensitive receptors is not consistent with this policy aim. Options to reduce this impact should be considered. For surface roads mitigation measures are very difficult in established areas as the main response would be to introduce setbacks from the road eg., service lanes. As the areas impacted by the redistribution of traffic flow are well established, this is not a viable option for mitigation of the impact.

Although the background data is a large contributor to the predicted ground level concentrations, as identified by Mr Fler and Dr Cowan, the project has the opportunity to be designed to minimise the impact on existing air quality. I am of the opinion that because air quality is already poor in some locations, the project should be designed so that this situation is not worsened where this is possible. It is easier to address this issue in the design stage than trying to rectify the situation once built especially for surface roads. This approach is consistent with SEPP(AQM).

The issue raised by Dr Keogh in her expert statement regarding emission factors used in the modelling should be addressed. There have been several recent air quality assessments conducted through the Commonwealth Department of Environment to support potential changes to the Fuel Quality Act and the Motor Vehicle Design Rules that contain vehicle emission factors. The emission factors used in this study should be compared with these studies as well as those used for the East West Link EES to provide some validation that they are consistent with other factors being used in Australia. The non-inclusion of brake and tyre wear and re-entrained road dust in the emission factors as identified by many submitters is likely to significantly underestimate the predicted PM<sub>10</sub> levels. Mr Fler noted in his expert witness statement that additional modelling would be undertaken for selected roads and provided at the hearing. It is important that this modelling be undertaken for roads where a significant increase in traffic, in particular truck traffic, is predicted such as Millers Road and Blackshaws Road. As observed on the site visit conducted by WDA Millers Road has residential properties in close proximity to the road and there is no service road separating the residences from the road. The potential impact at this location needs to be carefully considered.

A further question in relation to the emission factors is how the chemical conversion of NO to NO<sub>2</sub> has been taken into account in predicting ambient ground level concentrations. Although this will be low within the tunnel, external to the tunnel, it may be significant. If it hasn't been included the NO<sub>2</sub> concentrations may be underestimated. This issue was also raised in the Maribyrnong City Council submission (submission 158) and in the expert witness statement of Dr Cowan. Dr Cowan undertook additional modelling at a wider range of receptors that used by Golder in Technical Appendix G and found that there were a number of exceedances of the NO<sub>2</sub> design criteria predicted. Dr Cowan noted that he believed that these were largely driven by existing background levels but would provide further analysis of this at the Panel Hearing.

The use of the Footscray air monitoring data as background data has been questioned by a large number of submitters. PM<sub>10</sub> data has been collected in Brooklyn for many years. Although the Footscray data is applicable to a large part of the project area, modelling using the Brooklyn PM<sub>10</sub> data should be undertaken. The Brooklyn data set shows high levels of PM<sub>10</sub> much higher than measured at other EPA monitoring stations. This indicates that the existing air environment in Brooklyn differs from Footscray and the impact of the project should be considered in context of the existing conditions. A sensitivity analysis should be conducted using the Brooklyn data for that area.

Dr Keogh raised concerns about the transparency of the results presented in Technical Appendix G. In a number of places in the EES the increases/decreases in pollutant levels have been presented as percentages of the background concentration rather than absolute concentrations. It would be beneficial to have this data presented in absolute numbers so that the actual increase in pollutant levels and how they contribute to additional exceedances of the assessment criteria is understood. This can help identify mitigation strategies if required. This is particularly important for the service roads where there is significant redistribution of traffic. The EES documentation does not provide sufficient information on the surface roads where increases in traffic are predicted to be able to assess compliance with policy and the potential contribution from the project.

The question of how to reduce motor vehicle emissions has been raised. The discussion around the introduction of tighter emission controls on vehicles through the adoption of new Australian Design Rules is valid however is outside the scope of this project. That is a broader National Government action that is currently under evaluation but cannot be considered as a mitigation measure through this specific project. The ban on smoky vehicles entering the tunnel would also require further evaluation as to how that could be implemented and enforced. These measures however put the responsibility for the impact from the proposed WGTP back on individual motorists rather than incorporating design features in the road development that would minimise the impact. These design features should be considered as part of the WGTP evaluation.

### **(iii) Question**

Where your opinion(s) materially differ from the relevant circulated evidence statements, please briefly outline the difference and reasons for it.

### **(iv) Response**

As presented in the EES there is a strong argument that given that there are elevated levels of PM<sub>10</sub> and PM<sub>2.5</sub> already in the project area that the additional exceedances caused by the project are not significant. Dr Cowan also considers that the exceedances are largely driven by existing background concentrations. However, the SEPP(AQM) states that one of the aims of the policy is to *'Drive continuous improvement in air quality and achieve the cleanest air possible having regard to the social and economic development of Victoria'*. Given that the design criteria and ambient air quality standards are derived to protect human health, additional exceedances of the standards pose an increase in risk to the health of the exposed population. Allowing additional exceedances of the standards from the project is not consistent with SEPP(AQM). The uncertainty around the emission factors used, in particular the non-inclusion on non-tailpipe emissions of PM<sub>10</sub> and PM<sub>2.5</sub> are likely to significantly underestimate the predicted increment from the project and there may be more exceedances than discussed in the EES documentation.

The surface road modelling has been compared to the intervention levels in the SEPP(AQM). It is important to note that the intervention levels are 'not to be exceeded numbers' and if they are exceeded then actions to improve air quality in that area need to be implemented. The EES does not identify any management or mitigation measures that could be put in place for the surface roads to ensure that the intervention levels are not exceeded. If air quality in the area already exceeds these values, as is the case of Brooklyn where the EPA monitoring data shows regular exceedances of both the ambient air quality standards and the intervention levels, then alternative designs should be considered to ensure that there is no further deterioration of air quality in that area.

The questions around the emission factors used in the modelling are significant and impact on the assessment of compliance with policy. The omission of re-entrained road dust, tyre and brake wear for PM and no consideration of the conversion of NO to NO<sub>2</sub> for the modelling of NO<sub>2</sub> emissions will lead to an underestimate of predicted ground level concentrations and the assessment of compliance with policy.

The presentation of the results in the EES and Technical Appendix G make it difficult to determine the actual impact of the project from both the ventilation stacks and the surface roads and implications for policy compliance. The IAC should be provided with the data presented in such a way that the impact of the project can be easily evaluated.

### **(v) Question**

Please discuss the magnitude, likelihood and significance of adverse and beneficial environmental effects.

### **(vi) Response**

I am of the opinion that based on the modelling results presented in the EES documentation including Technical Appendix G that the project has not demonstrated that it complies with the relevant legislation in Victoria – SEPP (AQM). The assessment that has been conducted has focussed largely on whether the numbers can be met rather than the broader policy aims

and requirements for control of emissions. The discussion on best practice and MEA for the ventilation stack emissions does not consider some of the more recent road tunnels in the world as discussed in submission 458. The more recent data on performance of pollution control systems should be considered in the design of the ventilation stacks given that the emissions of PM<sub>10</sub> contribute to additional exceedances of the design criteria in the SEPP.

Given that there is no threshold for the health effects of the air pollutants considered in the EES any increase in air pollution levels will pose an increase in risk to the health of the exposed community. Given the lack of information on the actual levels of PM<sub>10</sub> attributable to the project, especially for the surface roads assessed, it is not possible to assess the magnitude or significance of any improvement or worsening of air pollution attributable to the project. Provision of the actual data, the incremental increases in concentration not percentages, would assist in the assessment of any potential impact and whether the project can comply with Policy.

**(vii) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

**(viii) Response**

I am of the opinion that the current EPRs focussed on monitoring can be implemented. However, the question of what can be done if there are exceedances of the air quality standards to ensure that compliance with policy is achieved. Compliance with policy should consider measures that reflect best practice or MEA for emission controls. The EPRs do not actually define the air quality standards against which the air quality monitoring data are to be assessed. These need to be defined and I am of the opinion that the Ambient Air Quality Standards in the NEPM should be applied to assess ambient air monitoring data to ensure the protection of human health. The impact statement does not discuss the options, especially for the surface roads, for mitigation which is a significant omission from the EES documentation.

EPR AQ1 requires the design and implementation of the tunnel ventilation system to be done to meet the requirements of SEPP (AQM) and the requirements of the EPA Works Approval. This EPR should be strengthened to include a requirement in the design to include provision for the retrofitting of pollution control equipment.

**(ix) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

**(x) Response**

I am of the opinion that as the WAA draws solely from the information provided in Technical Appendix G the issues raised above equally apply to the assessment of the WAA. Compliance

with SEPP (AQM) has not been demonstrated within Technical Appendix G and the modelling potentially underestimates the predicted ground level concentrations of PM and NO<sub>2</sub> which introduces further uncertainty in assessing compliance with SEPP (AQM). The question of whether installation of pollution control equipment within the stacks represents best practice and would bring the emissions from the stack into compliance with policy, no additional exceedances of the design criteria, has not been adequately assessed in either the WAA or the EES documentation.

**(xi) Question**

Please address the adequacy of the impact assessment and whether the proposed environmental performance requirements are capable of being met.

**(xii) Response**

As discussed above I am of the opinion that there are significant issues with the EES documentation, including Technical Appendix G, and the demonstration of compliance with Policy. The uncertainty of the emission factors used and potential underestimation of the impacts on local air quality are significant. The EPRs are focussed on monitoring with the exception of EPRs AQ1-3 which relate to design of the ventilation system. They do not define the air quality standards to be used to assess the air quality data being collected nor do they include mitigation measures should the monitoring data show exceedances of the adopted standards. The EPRs should be modified to include the air quality standards to be applied in the assessment of the air quality data and mitigation measures to ensure they are met including at the surface roads. The EPRs for monitoring can be met.

**(xiii) Question**

Please address the question of feasible modifications to the design of the Project within or reasonably proximate to the project boundary that could offer demonstrably overall superior outcomes.

I am of the opinion that further assessment of the impact of installing pollution control equipment in the ventilation stacks or increasing the height of the stacks to improve dispersion of the emissions and reduce impacts at ground level to ensure compliance with SEPP (AQM) should be further assessed. Alternative routes to the use of Miller's Road and Blackshaw's Road, where there are existing residential properties without setback from the road, should be assessed to minimise the impact on these communities.

## 5 Air Quality

### 5.1 Impacts of Tunnel Emissions

#### (i) Question

The main issue raised by submitters in relation to the ventilation stacks is the lack of pollution control equipment and whether that complies with best practice. Submission 458 provides recent examples of road tunnel projects internationally that have installed air pollution control equipment to reduce impacts on ambient air quality.

In-tunnel air quality has been raised by several submitters. The EPA in its submission has proposed that in addition to the requirement for in-tunnel monitoring for CO, that the NSW in-tunnel standard for NO<sub>2</sub> also be adopted. This value has been used as the basis of the air quality modelling for NO<sub>2</sub> to predict the impact on ambient air quality rather than emission factors even though it is not currently a requirement of the project.

The location of sensitive receptors has also been raised by several submitters. The limit of a 1km radius from the ventilation stacks for assessment of sensitive receptors has not been justified in Technical Appendix G. There is also concern that key residential redevelopment projects such as The Don's in Precinct 15 Kingsville South have not been assessed. This is a significant housing development in close proximity to the proposed location for the Southern Portal.

As discussed in the previous section the accuracy of the emission factors used in the modelling was raised by submitters. Dr Keogh raised concern about the validity of the emission factors used in the modelling which has subsequently been used to assess compliance with the air quality criteria. Several submitters raised concern about the non-inclusion of brake and tyre wear and re-entrained road dust in the emission factors for PM<sub>10</sub> and PM<sub>2.5</sub> and the potential for underestimation of the impact of increased vehicle traffic on some roads. Dr Cowan raised concerns about the emission factors used for NO<sub>2</sub> only considering primary emissions from the tailpipe and not the conversion of NO to NO<sub>2</sub> which may be significant.

The scenario used for assessment of the worst case scenario within the tunnel has assumed that there will be two lanes occupied for 24 hours per day travelling at 80km/hr. This scenario does not take into account congestion within the tunnel which may lead to times within the tunnel that all three lanes are congested and travelling well below 80 km/hr which is more likely to represent worst case emission scenario as required for assessment under SEPP (AQM).

Dr Cowan in his expert witness statement also raised concerns that the modelling had been undertaken assuming constant speed and had not taken into account the influence of grades within the tunnel within. Both speed and grade impacts on the emissions from vehicles.

Technical Appendix G shows that there are additional exceedances of design criteria in SEPP (AQM) with the addition of emissions from the tunnel ventilation stacks on existing background levels. This shows non-compliance with SEPP (AQM).

### (ii) Response

The restriction for the selection of sensitive receptors to within 1 km of the ventilation stack is questionable. There is no justification provided within Technical Appendix G for this assumption or in Mr Fleeer's expert witness statement. For a stack of the height proposed for the WGTP there is potential for the plume to impact beyond the 1 km radius. In other assessments of the impact from tunnel ventilation stacks such as East West Link and City Link, the sensitive receptors that may be impacted were determined from contour plots of the maximum contribution from the stack across the whole model domain. Such plots were not presented in the AQIA for WGTP and therefore whether there is impact beyond the 1 km radius cannot be assessed. Further justification on the area defined for the selection of sensitive receptors should be provided to ensure that additional receptors beyond the 1km radius have not been missed. As this is an elevated source the impact is likely to be greater further away from the stack rather than adjacent to it.

Given that there are large urban redevelopment projects planned or underway within the project area these need to be assessed for impact from the ventilation stack emissions as well as from surface roads. In particular, The Dons development in Kingsville South is in close proximity to the Southern ventilation stack and should be assessed as it is a significant housing development within the project area.

The issue of what constitutes worst case under normal operating conditions is a key issue to the assessment of the impact of the emissions from the ventilation stacks. Although the issue raised in Technical Appendix G that no tunnel would operate under fully congested conditions for 24 hours a day is correct, there are hours during peak periods where fully congested conditions within the tunnel would occur. This currently happens within the CityLink tunnels and is a likely occurrence for the operation of the WGT. The assumption that worst case normal operating is 2 lanes free flowing traffic is not correct. The worst case scenario should be the fully congested situation that occurs during peak periods where the traffic is not free flowing. The emission during these periods are higher than in a free flow traffic situation. It is acknowledged that a sensitivity analysis has been conducted where three lanes in the tunnel are full, however it is still assumed under this scenario that the traffic is still relatively free flowing. The assessment of compliance with SEPP needs to be conducted for the fully congested scenario. Even under the sensitivity analysis scenario included in Technical Appendix G there are more additional exceedances of the design criteria compared to the adopted normal scenario used for the main assessment in the EES.

The modelling of NO<sub>2</sub> being based on a proposed in-tunnel air quality standard which has not been adopted in the EPRs is questionable. Modelling should have been done on emission factors for vehicles not in-tunnel standard for NO<sub>2</sub> to enable appropriate design of the ventilation system to enable the in-tunnel standards to be met. It would also have provided a more accurate prediction of the potential impacts on ambient air quality based on the vehicle fleet using the tunnel to be assessed. The approach used for the modelling of NO<sub>2</sub> impacts together with the exclusion of consideration of conversion of NO to NO<sub>2</sub> introduces significant uncertainty into the modelling of NO<sub>2</sub> which flows through to the HIA.

**(iii) Question**

Where your opinion(s) materially differ from the relevant circulated evidence statements, please briefly outline the difference and reasons for it.

**(iv) Response**

Given that there are an additional 32 exceedances of the PM<sub>10</sub> design criteria under 'normal' operation with 2 lanes occupied with the project compared to the no project option suggests that the impact of introducing pollution control equipment should be assessed quantitatively. The 'normal' scenario is not the worst case situation as required under SEPP(AQM). Worst case would be 3 lanes occupied and congested traffic. The EES argues that this situation would not occur for 24-hours a day which is correct. However, this situation is likely to occur within peak periods and does occur currently within the Citylink tunnels. The design criteria are for a 1-hour averaging period therefore compliance with SEPP should have been assessed against the worst case situation not the 'normal' scenario as defined in the EES.

**(v) Question**

Please discuss the magnitude, likelihood and significance of adverse and beneficial environmental effects.

**(vi) Response**

I am of the opinion that the scenarios modelled in the AQIA to assess normal operating are not representative of the worst case situation under normal operating conditions and are likely to underestimate the potential impacts of the emissions from the ventilation stacks. The approach to modelling NO<sub>2</sub> is also likely to underestimate the impact of emissions to ambient air. The underestimation will flow through to the HIA and the potential impact on the health of the local communities. The restriction of the selection of sensitive receptors to 1km from the ventilation stack needs further justification and evaluation to ensure that other impacted receptors have not been missed.

**(vii) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

**(viii) Response**

I am of the opinion that the current EPRs that focus on monitoring can be implemented. I am also of the view that EPR AQ1 should be strengthened to require the ventilation stack to be designed to enable the retrofitting of pollution control equipment if required. This would be one mitigation measure that could be implemented if there are exceedances of the air quality standards to ensure that compliance with policy is achieved. Consideration should also be given to the introduction of an EPR to require periodic review of available air pollution control

equipment for road tunnels and the effectiveness in reducing the impact of emissions on ambient air quality.

The EPRs do not actually define the air quality standards against which the air quality monitoring data are to be assessed. These need to be defined and I am of the opinion that the Ambient Air Quality Standards in the NEPM should be applied to assess ambient air monitoring data to ensure the protection of human health.

**(ix) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

**(x) Response**

The Works Approval application only has been prepared based on the modelling conducted for the EES. The Works Approval application states that there would only be an additional 6 and 9 exceedances of the PM<sub>10</sub> criteria under scenarios A and B, however the EES (p122) states that there would be an additional 32 exceedances. This inconsistency needs to be addressed. In neither situation does the predicted ground level concentration meet the design criteria.

The modelling has shown additional exceedances of the design criteria but the effects of increasing the height of the stacks or installation of pollution control equipment has not been investigated. This should be explored to determine if the additional exceedances can be avoided.

In-tunnel monitoring only recommended for CO even though modelling has assumed that NO<sub>2</sub> would be regulated. This is a flaw in the approach to the modelling of NO<sub>2</sub> which should have been done on emission factors as used for other pollutants not a proposed limit within the tunnel that may or may not be adopted for the project. This is likely to underestimate the potential impact of NO<sub>2</sub>. Modelling using emission factors would have provided information that would have assisted in the optimal design of the ventilation system to avoid both in-tunnel and external impacts on air quality and human health.

The focus of the EPRs is on monitoring not what can be done if the standards are exceeded. This is a significant omission in the WAA and EES.

**(xi) Question**

Please address the adequacy of the impact assessment and whether the proposed environmental performance requirements are capable of being met.

**(xii) Response**

I am of the opinion that the approach to modelling conducted for the AQIA is likely to underestimate the impacts of emissions from the road tunnels. Further assessment of NO<sub>2</sub> is required and justification for the area defined for the selection of sensitive receptors also needs to be provided. The proposed EPRs for monitoring are capable of being met but as discussed above additional EPRs should be considered.

### (xiii) Question

Please address the question of feasible modifications to the design of the Project within or reasonably proximate to the project boundary that could offer demonstrably overall superior outcomes.

I am of the opinion that the impact of installation of pollution control equipment or increasing height of the stacks to improve dispersion to ensure that there are no additional exceedances of the design criteria in SEPP (AQM) should be quantitatively assessed. These options to the current design may provide a better outcome for the environment and the health of the local community.

## 5.2 Impacts on Surface Roads

The project is designed to redistribute traffic within the project boundary. The EES claims that 9,600 trucks daily will be removed from inner west roads including Francis St and Somerville Road. However, these trucks are not removed but are redistributed to onto other roads in particular Miller's Road, Geelong Road and Blackshaws Road. Of the 9,600 trucks taken off the other roads, 7,000 per day will be directed to Miller's Road. Although the benefits to residents in Francis St, Somerville Road and similar roads are to be welcomed the disbenefits to the residents on the roads that will experience an increase in truck traffic are significant. Many submitters raised concerns about the increases in air pollution (and noise) arising from the increase in traffic especially on Miller's Road and Blackshaw's Road and the potential impact on health. This has not been adequately addressed in the AQIA.

Increases in traffic on local roads in Spotswood, Altona, Yarraville and Kingsville South which will be used as feeder roads to the freeway and during construction and the potential increases in air pollution were raised by a number of submitters.

Many submitters also raised concerns about the location of the off-ramps, in particular the Hyde St off ramps, and the potential impacts on sensitive receptors including kindergartens and open space areas. This includes the Emma McClean Kindergarten in Spotswood and the Claire Court kindergarten near the corner of Francis St and Williamstown Road (which was not included as a sensitive receptor in the AQIA or health risk assessment). There is no assessment of the impacts of emissions from the off-ramps in the EES or Technical Appendix G. The impact of idling trucks on the off-ramps especially near sensitive receptors does not appear to have been assessed. This is a significant omission in the EES and the AQIA.

As with the in-tunnel modelling a number of submitters raised concerns about the emission factors that were used in the modelling. The exclusion of non-tailpipe emissions for PM<sub>10</sub> and PM<sub>2.5</sub> and conversion of NO to NO<sub>2</sub> is likely to underestimate the potential impacts on sensitive receptors on the surface roads.

### (i) Response

The AQIA predicts that there will be up to an 87% increase in PM<sub>10</sub> levels at sensitive receptors along Miller's Road. This is without the inclusion of non-tail pipe emissions such as brake and tyre wear and reintrained road dust. In Mr Fleeer's expert witness statement although he

stated that additional modelling including the non-tailpipe emissions would be undertaken prior to the hearing for Francis St and Williamstown Road there is no indication that such modelling would be undertaken for roads, such as Miller's Road and Blackshaw's Road, that are going to have a significant increase in truck traffic should the project as currently proposed be approved. This should be conducted to enable the IAC to have the most accurate information before them to be able to assess the overall benefits and disbenefits of the project as proposed. The discussion of the impacts on Miller's Road is less than 1 page in Technical Appendix G to the EES. A similar discussion is provided for Blackshaw's Road and other roads where a predicted increase in traffic is predicted to occur. There is no information of the number of additional exceedances of the intervention levels that have been used to assess the near road air quality or the actual contribution from the predicted increase in vehicles on PM<sub>10</sub> and PM<sub>2.5</sub> levels in any of the EES documentation. This is inadequate for the areas where a potential disbenefit is predicted and there are very limited mitigation measures that can be implemented to reduce the impact once the project has been approved and constructed. The air quality data should be presented in such a way that the impact of the project alone can be clearly identified.

There is no data presented in the AQIA on the impact of increased traffic on local streets being used as feeder roads to the freeway or for the impact of off-ramps on sensitive receptors. This information should be provided as the off-ramps and feeder roads are close to sensitive receptors. The off-ramps may also be congested which will increase emissions compared to the free flowing traffic conditions. The impact of emissions from idling trucks should also be assessed to ensure that the alignment of the off-ramps, including set backs from sensitive receptors are optimised to minimise impacts. This is an important consideration to be included in the design phase of the project as once the roads are built the mitigation measures for surface roads are very limited.

No assessment has been conducted for local roads for the impact of truck movements during construction. For some roads including Francis St, Yarraville, and New St, Kingsville South, the increase in truck movements over the 5 year construction period is significant and the impact on air quality in these areas should be assessed. Alternatively, other roads that are not residential streets should be used where practicable for the movement of construction vehicles.

**(ii) Question**

Please discuss the magnitude, likelihood and significance of adverse and beneficial environmental effects.

**(iii) Response**

I am of the opinion that there are significant omissions in the AQIA in particular in the assessment of the impacts of the off-ramps and increased traffic flows on local roads being used as feeder roads to the freeway. The issues related to the emission factors used are likely to underestimate the impacts on sensitive receptors close to the roads that are predicted to have a significant increase in truck traffic. The exclusion of non-tailpipe emissions will significantly underestimate the PM<sub>10</sub> impact from the project. The impacts of the emissions

from the surface roads associated with the project cannot be easily managed or mitigated once designed and built.

**(iv) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

**(v) Response**

The EPRs associated with surface roads are focussed on monitoring not what happens if standards are exceeded. The air quality standards to be used in the assessment of air quality monitoring data have not been defined in the EPRs and should be included. My opinion is that the ambient air quality standards in the AAQ NEPM should be used of this purpose. Mitigation measures need to be developed and included in the EPRs to identify actions could be taken to reduce the impact of the project if exceedances of the air quality standards are observed.

**(vi) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

**(vii) Response**

N/A – the WAA application only applies to the ventilation system for the tunnels.

**(viii) Question**

Please address the adequacy of the impact assessment and whether the proposed environmental performance requirements are capable of being met.

**(ix) Response**

I am of the opinion that the modelling conducted for the EES under predicts the impacts of changes to the surface roads on sensitive receptors. There is no discussion of the impacts of emissions from the off-ramps on sensitive receptors which needs to be addressed to ensure that the optimal design and location of the off-ramps to minimise the impacts on sensitive receptors is achieved. There is no assessment of the impacts of increased truck traffic on local roads during the 5 year construction period.

The current EPRs which are focussed on monitoring can be met but additional EPRs should be included as discussed above.

**(x) Question**

Please address the question of feasible modifications to the design of the Project within or reasonably proximate to the project boundary that could offer demonstrably overall superior outcomes.

I am of the opinion that consideration should be given to alternative options for the redistribution of truck traffic. For example, the benefits and disbenefits, including air quality and health, of utilising Grieve Parade rather than Miller's Road and Blackshaw's Road should be assessed. Appropriate setbacks of residential properties as well as sensitive receptors such as schools, aged care facilities and child care facilities should be assessed to minimise impacts of changes in traffic.

## 6 Human Health Impact Assessment

### 6.1 Framework for the Assessment of Human Health Risks

The Environmental Health Standing Committee (EnHealth), a standing committee of the Australian Health Protection Principal Committee<sup>1</sup>, has developed a framework to conduct HIAs in Australia - *Health Impact Assessment Guidelines 2001* (HIA Framework). Under this framework a HIA needs to consider the issues that are important to the community in terms of potential impacts on the health of the affected population which go beyond direct impacts on health and include the broader social determinants that can affect people's health and wellbeing. These include impacts of stress and anxiety and some broader issues including impacts on employment, community connectivity etc which are drawn from the Social Impact Assessment. The HIA process enables the overall benefits and disbenefits to be assessed and the overall impact of the project on community health identified. The Centre for Health Equity Training, Research and Evaluation<sup>2</sup> (CHETRE) has developed documentation (*Health Impact Assessment – A Practical Guide, 2007*) (CHETRE Guidelines) that provides guidance in how to apply the enHealth HIA framework in practice. These two documents guide the conduct of HIAs in Australia and are adopted by regulatory agencies for this purpose.

As part of a HIA, a health risk assessment (HRA) is usually conducted. The HRA aims to quantify the impacts of hazards, in this case environmental hazards, on human health. The Australian guidance for conducting HRAs is set out in the enHealth *Guidelines for Health Risk Assessment, 2012* (HRA Guidelines). For the assessment of health risks from air pollution the National Health and Medical Research Council (NHMRC) *Approach to Hazard Assessment for Air Quality, 2006* and the National Environment Protection Council (NEPC) *Methodology for Setting Air Quality Standards in Australia, 2011* provide detailed frameworks to assess health risks primarily via the inhalation pathway.

#### (i) Question

Please include a brief summary of the key issues raised by submitters. If you refer to a particular submission please refer to the submission by number and not by the name of the submitter.

A number of submissions raised concerns about the baseline health data used in the HRA. The baseline health data used in the HRA was for Melbourne as a whole. The general view of the submitters was that local data should have been used. Submitters raised increased asthma rates in the local government areas in the inner west compared to the rest of Melbourne as an issue. This was thought to underestimate the potential impact of air pollution from the project on asthma in children in the project area. The lower socioeconomic status of communities in the inner west and poorer health status in some locations compared to Melbourne as a whole were an issue of concern to many submitters.

---

<sup>1</sup> The Committee has the responsibility of providing agreed environmental health policy advice and implementing the National Environmental Health Strategy 2012-2015.

<sup>2</sup> Part of the University of New South Wales' Centre for Primary Health Care and Equity and also NSW Population Health.

Submitters raised concerns about the impacts of increased traffic on Miller's Road and Blackshaw's Road and concerns about road safety, isolation of community due to the increase in truck traffic and concerns about children attending school and kindergarten on Blackshaw's Roads. The HIA (page 158) states that there are no sensitive receptors in these areas which conflicts with the concerns of the local community. The HIA also states on p158 that there would be no measurable changes in health impacts in these areas due to air pollution and noise due to the project due to the absence of sensitive receptors.

The consideration of the impacts on low socioeconomic groups has been raised by a number of submitters. Concerns have been raised by submitters that these areas have not been adequately addressed in the HIA especially given that the low SES groups are known to be particularly vulnerable to the adverse effects of air pollution and noise. Table 5.3 in Technical Appendix J shows that there are a number of areas within the project area that fall in the most disadvantaged categories for socioeconomic status including Laverton North, Brooklyn, Altona North, North Melbourne and Footscray.

The project results in the redistribution of traffic from some to others in the project area. In areas where there is a reduction in traffic there are associated improvements in air quality and noise. Many submitters welcomed these improvements but raised concerns that the project had not resolved transport issues in the inner west but simply moved them to other locations. Although the submitters that gained the benefits were supportive of those changes they did not want the problems simply relocated. Other submitters who were in the more impacted areas raised concerns about the increased impact on their health and that these had not been adequately assessed in the HIA. The balancing of the benefits and disbenefits to health, including the broader determinants of health, have not been dealt except at a high level. There is a much greater focus on the positive aspects of the project rather than giving a balanced assessment of both the benefits and disbenefits.

Within the HIA framework broader health issues such as impacts on stress within the community due to the potential impacts of the project, impacts on mental health and broader wellbeing issues should be addressed. Some submitters raised concerns that these outcomes had not been considered in the HIA.

### **(ii) Response**

The HIA framework requires consideration of all factors associated with a project that can impact on people's health and wellbeing. This includes socioeconomic factors, stress and anxiety, impacts on mental health, community connectivity as well as the impacts of environmental factors such as air pollution and noise on health. The HIA touches on most of these issues however in many cases there is only brief high level discussion rather than an analysis of the key issues within the community. Only air pollution and noise have been assessed in detail. The discussion focusses on the benefits of the project with minimal discussion on the disbenefits. To provide a full assessment of the potential impacts of the project this discussion should be more balanced. Consideration of the stress being experienced in parts of the community, as shown in the number of submissions received, needs to be acknowledged.

The baseline health data is critical to the assessment of the potential risks of air pollution and noise on health. The HIA concludes that demography and the health of the broader community is generally consistent or better than Melbourne or Victoria as a whole. Further it was concluded based on this assumption that the community would not be particularly sensitive to short term changes due to the project. However, this conclusion conflicts with the data presented in Tables 5.4 and 5.5 of Technical Appendix J. The data in these tables show the baseline incidence rates for many of the health outcomes associated with air pollution are higher in the LGAs within the project area compared with Victoria. The data in Table 5.5 shows that the hospitalisation rates for asthma in children are significantly higher in all LGAs in the project area. The average rate of hospitalisations for asthma in children aged 0-8 years in Victoria is 778/100,000 population compared with 1180/100,000 in the Maribyrnong LGA. The data presented in Tables 5.4 and 5.5 support the issues raised by the submitters that the communities within the project area have higher baseline rates of health outcomes that can be impacted by air pollution and are therefore more susceptible to the impact of any changes in air pollution or noise associated with the project. This has been dismissed in the HIA although the data has been presented

People in low socioeconomic groups have been identified as a group that is particularly vulnerable to the effects of air pollution. This due to a number of factors including lower health status within these communities, poorer quality homes that are 'leaky' and allow infiltration of air pollution and noise into the home and the fact that people tend to live closer to sources of pollution such a major roads or industry as housing is generally more affordable in these areas. Although data is presented in the HIA shows that there are suburbs within the project area that fall within the most socioeconomic disadvantaged categories the HIA does not discuss the impact of changes to air quality and noise arising from the project and the increased vulnerability of these communities. Some of the areas that are predicted to have increased noise and air pollution levels from redistributed traffic flows such as Brooklyn and Altona North fall within these categories. The impacts on these communities needs to be considered taking into account the increased vulnerability of these communities rather than a general discussion that ignores this.

People over 65 years of age have also been identified as a group particularly sensitive to the health effects of air pollution. There is no discussion of the impacts of the project on people within this age group within the project area. The current epidemiological data shows that NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> impact on a range of health outcomes within this age group and concentration response functions have been recommended by WHO and other organisations that can be to assess the risk posed by these pollutants. However, the HIA only considers two health outcomes for this age group associated with PM<sub>2.5</sub> and none for the other pollutants. This does not provide a complete picture of the potential health impacts within this age group. Both Professor Irving and Professor Anderson in their expert witness statements have recommended that a broader range of health outcome need to be assessed in the HIA. I agree with the view of Professor Irving and Professor Anderson and am of the view that an assessment of the health impacts of all pollutants on the health of the elderly should be included to provide a more complete picture of the health impact – both positive and negative – of the project.

The elderly are also more likely to be impacted by changes to traffic on their local roads. In areas where there are reductions in traffic there may be benefits in greater social activities more active lifestyles due to improvements in their local environment. However, in areas with significant increases in truck traffic, such as Miller's Road, the increase in traffic may result in higher levels of stress and anxiety within this age group and may lead to greater social isolation due to concerns about road safety and loss of amenity which may lead to impacts on health. These issues have not been discussed in the HIA and should be in the consideration of broader health and wellbeing issues. The linkages with the Social Impact Assessment are not clear except for the section on changes to community.

Equity issues have not been considered in the HIA. There is a disproportionate increase in trucks on Millers Road with 7,000 of the trucks removed from other roads directed to Miller's Road. The HIA claims that there are no sensitive receptors such as schools, kindergartens and childcare centres in the area which conflicts with the community submissions which discuss concerns about children attending school and kindergarten on Blackshaw's Roads and the increase in traffic leading to road safety concerns as well as increases in potential health effects due to noise and air pollution in these areas. The impact on the areas where predicted increases in traffic occur have not been adequately assessed and should be to ensure that any disbenefits to the local community do not exceed the benefits of the project. The HIA is also silent on what actions could be taken to help mitigate any potential impacts on health in these areas. These actions should be identified and EPRs developed to ensure that any disbenefits are minimised as far as possible.

**(iii) Question**

Please discuss the magnitude, likelihood and significance of adverse and beneficial environmental effects.

**(iv) Response**

I am of the opinion that the HIA has not considered some issues that may have a significant impact on the health of the community. In particular the treatment of low SES groups, the lack of consideration of the impacts of the project on the elderly and impacts on stress and other mental health issues is a significant omission in the HIA and does not give a complete picture of the impact of the project on the health of the population within the project boundary.

**(v) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

**(vi) Response**

I am of the opinion that there is nothing within the EPRs that addresses the potential health impacts arising from the project. With respect to air quality the focus of the EPRs is on

monitoring not on what can be done to minimise the impacts of any exceedances of the relevant air quality standards and potential impacts on health. Inclusion of an EPR that relates to health and minimising the potential health impacts of the project should be considered.

**(vii) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

**(viii) Response**

The WAA has not considered the potential health impacts of the project. As discussed previously the WAA relates to the tunnel ventilation system not the project as a whole. As additional exceedances of the design criteria are predicted due to the addition of the emissions from the project, the impact on health and requirements to minimise these health effects should be considered in the decision on issuing the Works Approval.

**(ix) Question**

Please address the adequacy of the impact assessment and whether the proposed environmental performance requirements are capable of being met.

**(x) Response**

I am of the opinion that the current EPRs which focus on monitoring can be implemented. However, the question of what can be done if there are exceedances of the air quality standards to minimise the impact on the health of communities has not been addressed. The EPRs do not actually define the air quality standards against which the air quality monitoring data are to be assessed. These need to be defined and I am of the opinion that the Ambient Air Quality Standards in the NEPM should be applied to ensure the protection of human health. The impact statement does not discuss the options, especially for the surface roads, for mitigation is a significant omission from the EES documentation.

**(xi) Question**

Please address the question of feasible modifications to the design of the Project within or reasonably proximate to the project boundary that could offer demonstrably overall superior outcomes.

I am of the opinion that a requirement to include retrofitting of pollution control equipment in the design of the tunnel ventilation system should be included. The significant increase in truck traffic on Millers Road and Blackshaws Road will have a significant impact on air pollution and noise in these areas which will have adverse impacts on health in the affected communities. Consideration of alternative traffic routes to Millers Road and Blackshaw Road for example through the industrial part of Grieve Pde need to be carefully assessed to minimise the impacts on the health of the community. Removing trucks from residential areas provides significant health benefits which have been shown in many international studies. There is an opportunity at the design stage of the WGTP to minimise impacts on health.

### 6.2 Health Effects of PM<sub>10</sub> PM<sub>2.5</sub> and NO<sub>2</sub>

A large number of submitters raised concerns about the impact of PM<sub>10</sub> and PM<sub>2.5</sub> on the health of the community within the project area. Concerns about impacts on children with asthma and the carcinogenic effects of diesel were common across many submissions. Professor Irving in his expert witness statement questioned the health indicators used in the health risk assessment (HRA) and commented that the information used was outdated and did not reflect the current understanding of the effects of PM<sub>2.5</sub> and PM<sub>10</sub> on health. His view was that the more recent data from WHO and other key papers should have been used in the HRA. There was also concerns raised about the limited number of health effects that have been assessed and that this does not provide a complete picture of the potential health impacts from this project. This view was shared by Professor Anderson in his expert witness statement and the submission from the Lung Research Institute. Similar concerns were raised about the health effects of NO<sub>2</sub> and other gaseous pollutants. Dr Keogh also raised concerns that the information on which the HRA is based is outdated and did not reflect the current understanding of the health effects of particle pollution. Professor Irving stated that a full review of the current literature of the health effects should have been undertaken and recommended that the HRA be redone based on this most recent data.

Concerns were raised about the impact of PM<sub>10</sub> and PM<sub>2.5</sub> on the health of children living and going to school near surface roads that are predicted to have a significant increase in truck traffic including Miller's Road and Blackshaws's Road. Similar concerns were expressed for children attending kindergarten or child care centres close to the off ramps such as the Emma McClean kindergarten in Spotswood.

Dr Keogh in her expert witness statement recommended that the health effects of ultrafine particles should have been considered in the HRA. Other submitters shared that view.

Many submitters raised concerns that the HRA was based on the modelling conducted for the air quality impact assessment and therefore if that modelling was inaccurate then that would be carried across to the HRA.

#### (i) Response

Key part of the HRA is a hazard assessment to identify current knowledge on the health impacts of the pollutant of concern. This is well set out in the enHealth, NHMRC, and NEPC guidance documents. A detailed hazard assessment has not been conducted for this HIA. Although Dr Wright claims in several places within Technical Appendix J that the HRA reflects the current understanding of the health effects of air pollution, in her expert witness statement she states that a full literature review was not undertaken as part of the hazard assessment as it was out of scope. This is a flaw in the HRA and is inconsistent with the national guidance on conducting HRAs. For a project of the size of the WGT project a complete and current understanding of the health effects of the pollutants of concern for this project should be used as the basis of the assessment. Even if a quantitative assessment was not possible, a qualitative assessment should have been undertaken.

The health effects of PM<sub>10</sub>, PM<sub>2.5</sub> and NO<sub>2</sub> are the subject of considerable research worldwide. The WHO in 2013 published the Review of the Evidence on the Human Health Effects of Air Pollution (REVIHAP) study which identifies the key health effects associated with exposure to these pollutants. The USEPA conducted an integrated science assessment for PM<sub>10</sub> and PM<sub>2.5</sub> in 2014 and for NO<sub>2</sub> in 2016 to support the review of their air quality standards. These reviews identified a range of health effects associated with PM<sub>10</sub>, PM<sub>2.5</sub> and NO<sub>2</sub> which have not been considered in the HIA. The Golder report (2012) referred to by Dr Wright conducted a HRA for the review of the air quality standards in the NEPM. The review of the standards for PM<sub>10</sub> and PM<sub>2.5</sub> was finalised in 2016. A large range of health outcomes were assessed in the Golder HRA and that information used in the development of new air quality standards. Many of these have not been considered in the HIA for the WGTP.

The health effects used by Golder came from a report by Jalaludin and Cowie (2012) which was commissioned by NEPC to recommend the appropriate health outcomes and concentration response functions (CRFs) to be used in the assessment of the health effects of air pollution in Australia to support the setting of air quality standards protective of human health. Consistent with the recommendations of NHMRC (2006) and NEPC (2011) the recommendations from Jalaludin and Cowie (2012) are based on the results of studies conducted in Australia and internationally and the health effects identified in those studies. Only a subset of these health outcomes has been assessed in the HRA and are focussed primarily on mortality outcomes. Although mortality is the most serious health effect associated with air pollution the more sensitive indicators such as increases hospital admissions and emergency department attendances impact on a much greater proportion of the population. By focussing primarily on mortality outcomes understates the potential health impacts of air pollution and does not provide an accurate picture of the breadth of impacts that may be experienced within the population in the project area as a whole. The range of health effects identified by WHO, USEPA and Jalaludin and Cowie should have been assessed. In her expert witness statement in response to issues raised in submissions and the additional information request Dr Wright commented that the health used in the HIA had been accepted in NSW but did not comment on how they were selected initially or the views of the Victorian agencies.

The evidence on the association between PM<sub>10</sub> and PM<sub>2.5</sub> and cardiovascular outcomes in the elderly has been strengthened in recent years and biological mechanisms have been identified. This is discussed in Professor Irving's expert witness statement. Only one cardiovascular health outcome has been assessed in the HIA in relation to PM<sub>2.5</sub>. Other cardiovascular outcomes should have been assessed for all pollutants as CRFs are available, as recommended by Jalaludin and Cowie and would have provided a complete assessment of the potential impacts on health particularly in the elderly. Given the high rates of cardiovascular disease in the Australian population, this is a large susceptible population that has not been adequately assessed.

The long-term effects of PM<sub>2.5</sub> and PM<sub>10</sub> on health, in particular mortality outcomes, has been extensively studied. The WHO (2013 a and b) and USEPA (2014) have recommended that the CRF from a large American Cancer Society (ACS) study is the most robust and recent CRF to be used to assess the potential long-term effects of PM. This recommendation was also adopted

in the review of the PM standards in the AAQ NEPM. The HIA did not use this CRF but adopted a CRF from a study published in 2004. The reasoning for this is not clear. The CRF from the 2004 study does not include the information from the more recent studies and analyses on the long-term effects of PM and may underestimate the impacts of PM from the project on health.

Dr Keogh and other submitters raised the issue of ultrafine particles and the need to assess the potential impacts. Although there is some research in this area that shows an impact of ultrafine particles on health there are currently no available CRFs to enable quantitation of the health effects. I agree with Dr Wright that the relevant PM indicators are PM<sub>10</sub> and PM<sub>2.5</sub>.

The assessment of the health effects of NO<sub>2</sub> does not reflect the current understanding of the health effects of NO<sub>2</sub> in particular the long-term effects which were not assessed at all. Recent reviews by WHO (2013a), Committee on the Medical Effects of Air Pollution (COMEAP) (2015) and USEPA (2016) has found that there is an independent effect of NO<sub>2</sub> on health for both long-term and short-term health outcomes. Long-term exposure to NO<sub>2</sub> is linked increases in mortality and decreases in lung function growth in children which is a risk factor for chronic lung disease as adults. There is also evidence that exposure to NO<sub>2</sub> may increase the incidence of asthma not just exacerbate the symptoms in people, especially children, who already have asthma. None of these outcomes have been discussed or assessed in the HIA and is a significant omission. It understates the potential impacts of NO<sub>2</sub>, a key pollutant from motor vehicles, on health. In 2013 WHO published a report on the Health Risks of Air Pollution in Europe (HRAPIE) (WHO, 2013b) that recommended CRFs to be used in health impact assessments for PM and NO<sub>2</sub>. For NO<sub>2</sub> this included a CRF for long-term mortality. Several studies in Europe since that time have confirmed the long-term health effects associated with NO<sub>2</sub>. COMEAP in 2015 also recommended a CRF to assess the long-term impacts on NO<sub>2</sub> on mortality which takes into account more recent study findings. The HIA did not take this current information on the health effects into account and the long-term effects of the project have not been assessed either quantitatively or qualitatively. This is a significant omission in the HRA.

In addition, only a very limited number of health outcomes for short-term health effects have been assessed and these have focussed on mortality outcomes in the all ages group and emergency department attendances for children with asthma. None of the short-term impacts on hospital admissions for respiratory or cardiovascular disease in people over 65 years of age as recommended by Jalaludin and Cowie (2012), WHO (2013) or USEPA (2016) have been assessed again underestimating the potential impacts on the health of the community.

Throughout the HIA there is a lack of assessment of effects on the elderly and children, who have been identified as groups especially vulnerable to the effects of air pollution. As discussed above there was also no assessment for the more sensitive health outcomes, notably cardiovascular outcomes. The focus on all age groups rather than sensitive populations is inconsistent with the national and international guidance on health risk assessments and tends to average out the risk rather than assess the risk to the more vulnerable groups within the population again not providing a complete picture of the potential health effects.

**(ii) Question**

Please discuss the magnitude, likelihood and significance of adverse and beneficial environmental effects.

**(iii) Response**

I am of the opinion that the HIA does not provide a complete picture of the potential health impacts from air pollution from the project. The assessment has not been conducted using the most recent information on the health effects of the pollutants of concern, in particular NO<sub>2</sub>. It has not assessed the impacts on the more sensitive groups within the population, in particular the elderly, and has only assessed a limited set of health outcomes. Therefore, the IAC has only a limited assessment of the potential impacts on health which is likely to underpredict the impact, both positive and negative, on the community within the project area.

**(iv) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

**(v) Response**

As discussed above I am of the opinion that there is nothing within the EPRs that addresses the potential health impacts arising from the project. With respect to air quality the focus of the EPRs is on monitoring not on what can be done to minimise the impacts of any exceedances of the relevant air quality standards and potential impacts on health. Inclusion of an EPR that relates to health and minimising the potential health impacts of the project should be considered.

**(vi) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

**(vii) Response**

The WAA has not considered the potential health impacts of the project. As discussed previously the WAA relates to the tunnel ventilation system not the project as a whole. As additional exceedances of the design criteria are predicted due to the addition of the emissions from the project, the impact on health and requirements to minimise these health effects should be considered in the decision on issuing the Works Approval.

**(viii) Question**

Please address the adequacy of the impact assessment and whether the proposed environmental performance requirements are capable of being met.

### **(ix) Response**

The HIA in the EES has not addressed a number of key issues in relation to the health effects of air pollution and does not provide a complete picture of the potential impacts of air pollution on the health of the community. I am of the opinion that the current EPRs which focus on monitoring can be implemented. However, the question of what can be done if there are exceedances of the air quality standards to minimise the impact on the health of communities has not been addressed. The EPRs do not actually define the air quality standards against which the air quality monitoring data are to be assessed. These need to be defined and I am of the opinion that the Ambient Air Quality Standards in the NEPM should be applied to ensure the protection of human health. The impact statement does not discuss the options, especially for the surface roads, for mitigation is a significant omission from the EES documentation.

## **6.3 Health Effects of Noise**

### **(i) Question**

In relation to the health effects of noise the main concern raised by submitters was the potential for sleep disturbance and the project specific noise criteria that have been assessed.

### **(ii) Response**

The noise risk assessment considers the greatest increases and decreases in risk associated with noise from the project and shows on p 136 of Technical Appendix J that the maximum increase in noise is greater than the greatest decrease which occurs on Hudson's Road. The overall change in health effects attributed to noise across the areas with the greatest benefits and disbenefits are very small decreases, less than 1 person, with the exception of the incidence of hypertension where 17 cases are predicted to be avoided with the project. There are no estimates across the whole project area so the total benefits/disbenefits to health arising from noise cannot be assessed. This information should be provided so that the IAC can consider the health benefits and disbenefits across the whole population within the project area.

The HIA assesses the impact of project noise on sleep disturbance together with a range of other health indicators. The increase in noise levels on Miller's Road reaches the unacceptable risk level for some health outcomes. However, there is no discussion on what mitigation measures should be implemented to reduce the risk to human health in these areas. The noise indicators used in the HIA are not those that are usually associated with adverse health effects. For example, sleep disturbance is assessed using  $L_{night}$  as an annual average. However, the HIA has used  $L_{day}$  which has been adjusted by 5 dB to estimate a  $L_{night}$  value. The validity of this approach is unclear and the impact on the HRA is unknown. Further information and validation of the approach used should be provided.

The health effects of noise lead to a cascade of health effects. Sleep disturbance leads to other health effects such as stress which can then lead to hypertension and cardiovascular effects. These effects have been discussed in the HIA but have not been linked back to the

existing levels of hypertension and cardiovascular disease in the affected communities. As the assessment of baseline health status shows higher levels of hypertension and cardiovascular disease within the LGAs within the project area, this impact needs further discussion. Some of the noise risk estimates are at the unacceptable risk level.

The risk estimates have been calculated for total noise and do not identify the contribution from the project alone. This information would be useful in assessing the impact of the project on the local community.

It should be noted that the predicted noise levels exceed the WHO guidelines for community health – night-time noise guidelines which are lower than those adopted for this project.

**(iii) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

**(iv) Response**

There is nothing within the EPRs that addresses the potential health impacts arising from the project. Inclusion of an EPR that relates to health and minimising the potential health impacts of noise from the project should be considered. Mitigation measures should be identified that could be implemented if adverse impacts are identified within the communities in the project area.

**(v) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

**(vi) Response**

The WAA does not address the health effects of noise but focusses on compliance with policy.

## **6.4 Applicable Risk Levels for the Project**

**(i) Question**

One of the key issues that needs to be considered in the assessment of risk from the project is what level of risk is acceptable for the project. enHealth has defined an increase in risk of 1 in 100,000 ( $1 \times 10^{-5}$ ) as acceptable risk criteria in Australia. This has been adopted by many health and environment agencies. An increase in the risk of an adverse health outcome of 1 in 1 million level is considered negligible and greater than 1 in 10,000 unacceptable. For cancer risk, the enHealth HRA Guidelines and NEPC *Methodology for Setting Air Quality Standards* 2011 state that the cumulative cancer risk from all sources should not exceed a lifetime risk of 1/100,000. In the assessment of risk for the WGTP the HIA uses tolerable risk as an

acceptable level of risk. The HIA concludes that the risk levels for individual health outcomes, not cumulative impacts, are between the acceptable risk level and the tolerable risk level. The question is whether a project such as the WGTP should be designed to meet 'acceptable' or 'tolerable' levels of risk given that the measures to reduce exposure and the consequent risk especially for surface roads are very limited.

### **(ii) Response**

The concept of 'tolerable' risk comes from the occupational health and safety area. The application of tolerable risk levels takes into account management and mitigation measures that can reduce exposure of workers to a hazard. It is not generally applied to assess societal risk where such measures are difficult to implement and there are vulnerable groups within the community, such as children and the elderly, are exposed.

In the Big Hill Development Project in Stawell Panel Hearing the DoH noted that the use of a tolerable risk level of 1 in 10,000 was higher than was considered socially acceptable elsewhere. They referred to the UK Health and Safety Executives (HSE) framework on 'tolerability' and 'acceptability' of risk where it is considered that 1 death/100,000 is considered tolerable and more than 1/10,000 is considered unacceptable. A risk level of 1/1,000,000 is considered acceptable. The Panel noted that, where a 1/10,000 risk level is adopted, it is used as a 'maximum permissible' or 'maximum tolerable' risk where continuous measures must be implemented to reduce the risk to as low as reasonably practicable.

The UK HSE has published a document that sets out the tolerable risk framework applied in the UK OHS environment (HSE, 2001). Importantly in this document they state their approach to assessing risks during planning developments where a chemical industry (for example) is proposed to be built close to a residential area. In these situations, they apply an acceptable risk level for community risk of 1 in 1 million ( $1 \times 10^{-6}$ ) and an unacceptable risk level of greater than 1 in 100,000 ( $1 \times 10^{-5}$ ). These levels are lower than those used to assess the incremental risk posed by the WGTP.

There are cardiovascular health outcomes that are impacted by both noise and air pollution. These have been assessed independently for noise and  $PM_{10}/PM_{2.5}$ . However, the recent research in this area shows that the combined effect of noise and air pollution is greater than that found when considering only one of the environmental factors. It is my opinion that for the common health outcomes that the increase in risk from noise and air pollution should be added and should not exceed the acceptable risk level of 1 in 100,000 established by enHealth and NEPC. For health outcomes attributable to only air pollution (or only noise) the 1 in 100,000 acceptable risk level should also be applied.

Some of the increased risk levels predicted in the HIA exceed the 1 in 100,000 risk levels at sensitive receptors. The uncertainty in the air quality modelling, in particular the exclusion of non-tailpipe emissions in the surface road modelling, means that these risks could be higher than shown in the HIA in Technical Appendix J of the EES. As the WGTP is an infrastructure project with a lifetime of up to 100 years, the project should be designed such that the increase in risk attributable to the project does not exceed the acceptable risk levels established by enHealth at any sensitive receptor. The maximum predicted risk in the HIA from air pollution is  $9 \times 10^{-5}$  for  $PM_{2.5}$  for hospital admissions for cardiovascular disease in

people over 65 years of age in Miller's Road in 2031. This risk level is above the acceptable risk level adopted by enHealth and is close to the unacceptable risk level of 1 in 10,000. These calculations do not include non-tailpipe emissions associated with the project and are therefore underestimated. The highest risk associated with increases in noise is again for Miller's road for hospitalisations for ischemic heart disease and are at the unacceptable risk level of 1 in 10,000.

### **(iii) Question**

Please address the adequacy of the proposed environmental management framework, including the proposed environmental performance requirements and environmental management measures contained in the EES, with reference to applicable legislation and policy.

### **(iv) Response**

As discussed above I am of the opinion that there is nothing within the EPRs that addresses the potential health impacts arising from the project and nothing that identifies the acceptable risk levels that should be applied. The focus of the EPRs is on monitoring not on what can be done to minimise the impacts of any exceedances of the relevant standards and potential impacts on health. Inclusion of an EPR that relates to health and minimising the potential health impacts of the project should be considered. Acceptable risk criteria can be implemented through the adoption of agreed national standards for air quality that have been established through the NEPM. As the standards for the gaseous pollutants are currently under review it is recommended that an EPR be included that refers to the Ambient Air Quality NEPM standards generically rather than specifying the current numerical standards in the NEPM. This will ensure that any changes to the NEPM standards over time that have been introduced to protect human health can be applied to assess the monitoring data associated with the project.

### **(v) Question**

Please address the adequacy of WAA No. S0100269, with reference to applicable legislation and policy.

### **(vi) Response**

The WAA does not consider the results of the HIA but is focussed on the compliance with the SEPP(AQM). There is no discussion in the application of the outcomes of the HIA and the acceptable risk criteria. I am of the opinion that given that there are additional exceedances of the design criteria in the SEPP(AQM) from the emissions from the ventilation stacks that results of the HRA for air pollution and noise be considered in the assessment of the Works Approval application. This is consistent with Clause 16(5) of SEPP(AQM).

The acceptable risk levels adopted by enHealth should be used to assess the acceptability of the risk posed by the emissions from the ventilation stack. I am also of the opinion that the restriction of the selection of sensitive receptors to a 1km radius from the proposed ventilation stacks may miss a number of receptors that may be impacted by the emissions

from the ventilation stack. An assessment of additional receptors outside that 1km area should be undertaken. These could be identified by the inclusion on contour plots showing the extent of the plume impact across the local community.

**(vii) Question**

Please address the adequacy of the impact assessment and whether the proposed environmental performance requirements are capable of being met.

**(viii) Response**

There are no environmental performance requirements that relate to health.

**(ix) Question**

Please address the question of feasible modifications to the design of the Project within or reasonably proximate to the project boundary that could offer demonstrably overall superior outcomes.

I am of the opinion that consideration should be given to alternative options for the redistribution of truck traffic. For example, the benefits and disbenefits, including air quality and noise impacts on health, of utilising Grieve Parade rather than Miller's Road and Blackshaw's Road should be assessed. Appropriate setbacks of residential properties as well as sensitive receptors such as schools, aged care facilities and child care facilities should be assessed to minimise impacts of changes in traffic and ensure that the impacts at sensitive receptors are within acceptable risk levels.

## 7 Approval Documents

### (i) Question

Please list any recommended changes to the approval documents.

### (ii) Response

EPRs for air quality and noise should include the identification of potential mitigation strategies.

Define air quality standards to be used in assessment of air quality and noise in the EPRs. These should be included in the WA granted.

Include requirement in EPR for inclusion of space for retrofitting of air pollution control equipment in the tunnel ventilation system.

Include an EPR to minimise impact of noise and air pollution on health.