Public Health Association
AUSTRALIA

Public Health Association of Australia

submission to the NSW Government Planning & Environment Department on the NorthConnex M1 – M2 Project

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Introduction

The Public Health Association of Australia Incorporated (PHAA) is recognised as the principal non-government organisation for public health in Australia and works to promote the health and well-being of all Australians. The Association seeks better population health outcomes based on prevention, the social determinants of health and equity principles. The PHAA has a vision for a healthy region, a healthy nation and healthy people living in a healthy society and a sustaining environment while improving and promoting health for all.

Public Health

Public health includes, but goes beyond the treatment of individuals to encompass health promotion, prevention of disease and disability, recovery and rehabilitation, and disability support. This framework, together with attention to the social, economic and environmental determinants of health, provides particular relevance to, and expertly informs the Association's role.

The Public Health Association of Australia

PHAA is a national organisation comprising around 1900 individual members and representing over 40 professional groups concerned with the promotion of health at a population level.

Key roles of the organisation include the development of policy, capacity building and advocacy. Core to our work is an evidence base drawn from a wide range of members working in public health practice, research, administration and related fields who volunteer their time to inform policy, support advocacy and assist in capacity building within the sector. PHAA supports a preventive approach for better population health outcomes by championing appropriate policies and providing strong support for Australian governments and bodies such as the National Health and Medical Research Council in their efforts to develop and strengthen research and actions in public health. The PHAA is an active participant in a range of population health alliances including the *Australian Health Care Reform Alliance*, the *Social Determinants of Health Alliance*, the *National Complex Needs Alliance* and the *National Alliance for Action on Alcohol*.

PHAA has Branches in every State and Territory and a wide range of Special Interest Groups. The Branches work with the National Office in providing policy advice, in organising seminars and public events and in mentoring public health professionals. This work is based on the agreed policies of the PHAA. Our Special Interest Groups provide specific expertise, peer review and professionalism in assisting the National Organisation to respond to issues and challenges as well as a providing a close involvement in the development of policies. In addition to these groups the PHAA's Australian and New Zealand Journal of Public Health (ANZJPH) draws on individuals from within PHAA who provide editorial advice, and review and edit the Journal.

Advocacy and capacity building

In recent years PHAA has further developed its role in advocacy to achieve the best possible health outcomes for the community, both through working with all levels of governments and agencies, and promoting key policies and advocacy goals through the media, public events and other means.

Executive Summary

Over the last 20 years, a vast body of medical and scientific research in the area of air pollution and health has emerged. This published literature confirms a causal association between exposures to air pollutants and increased death rates, and increased incidence of heart disease. There is a substantive risk for respiratory problems, especially implications for lung growth in children, and exacerbating diseases for those with underlying chronic respiratory conditions.

The known health impacts of air pollution are serious. These include increases in heart disease, stroke, cardiac arrhythmias, lung cancer, poor lung development, asthma, and new research on peri-natal impacts. These effects occur both from short-term exposure to even low levels of pollutants, as well as diseases caused from long-term cumulative effects. Based on the existing research, diesel vehicular emissions have been classified as a Group 1A carcinogen by the World Health Organisation.

Diesel vehicular emissions are high in ultrafine particles. These particles, which are smaller than 1 micrometre in diameter, penetrate deep into lung tissue and cause inflammatory and thrombotic effects. The full extent of health impacts of ultrafine particles remains unknown at this stage and scientific research and understanding of these pollutants is evolving. There are, however, reasonable grounds to suggest associations between these particles and adverse health impacts, such as cardiopulmonary effects, through biological pathways.

The medical and scientific community has recently reviewed our national environmental protection measures for air pollutants in August 2014. The new guidelines confirm that we need to protect the public from the known and unknown health effects of air pollution. The research to date indicates that particulate matter is a non-threshold pollutant. This means that there is no safe limit below which health can be protected. There is, therefore, a shift in the medical and scientific community towards implementing an exposure reduction framework to safeguard public health.

This submission from the PHAA relates to the Environmental Impact Statement for the NorthConnex tunnel in Sydney. The NorthConnex tunnel will be the longest vehicular tunnel in Australia, measuring 9 kilometres. It is proposed to connect the M2 to M1 freeways in Sydney's North to reduce heavy freight vehicles on surface roads. The tunnel is designed to reduce congestion on Pennant Hills Rd. The tunnel will have two unfiltered ventilation stacks in residential areas in Sydney.

There are several issues that we highlight in this submission that need to be addressed in terms of the protection of public health. The concerns of the PHAA regarding the NorthConnex proposal relate to:

- The ventilation stacks will emit unfiltered emissions from heavy and light vehicles on a daily basis. Due to the insufficient height of these stacks and placement in valleys, these emissions are likely to impact on the quality of ambient air in the immediate surrounding radius of the stacks.
- The placement of unfiltered emission stacks in densely populated areas, with high numbers of preschool and school children, aged care facilities, residences and hospitals, is contrary to our new national environmental protection framework for population exposure reduction.
- Portal emissions along the highly populated tunnel route will expose the nearby population to vehicular emissions at ground levels.

- The predicted in-tunnel concentrations of particulate matter as calculated in the NorthConnex Environmental Impact Statement are very high, and may therefore have health impacts on tunnel users.
- Both emission stacks are located in valleys. The northern stack will be 23m high which is inadequate to achieve the necessary dispersion and dilution of pollutants due to low wind speeds and the local topography in these valley regions. This is likely to increase the exposure to vehicular pollution of the public in these areas.

Summary of recommendations and key points

1. The PHAA objects to the NorthConnex proposal in its current form.

2. The PHAA recommends the relocation of the ventilation stacks to higher ground and extending the height of the stacks such that adequate atmospheric dispersion occurs.

3. In addition, we recommend the installation of an efficient filtration system on the exhaust and portal stacks, and operating procedures that ensure the filtration remains switched on.

4. Mitigate the substantive health costs downstream from multi system health effects by placing the tunnel portals and stacks in non-residential and non-school areas.

5. Modelling accuracy depends on the assumptions and parameters used, and cannot be fully relied upon given the degree of uncertainty in meteorological assumptions, topography, and the projected amount of vehicular emissions. We recommend that local microclimate conditions be assessed prior to decisions regarding the placement of emission stacks.

6. Consider tunnel ventilation design options and freight transport alternatives such as surface orbital routes or railway transport that may assist in mitigation of risks to health, whilst ensuring efficient freight transport.

7. The PHAA urges intersectoral collaborative approaches between government planning departments, roads ministries, private developers, and the medical and scientific communities to ensure there is protection for public health.

8. Given the substantive known health risks, and emerging data on risks to health from ultrafine particulates, we urge policymakers to apply the precautionary principle to mitigate risks to public health.

Population Health Impacts of Air Pollution

It is well known from the medical literature that long-term exposure to air pollution results in significant cardiopulmonary risk in adults, lung cancer, increased all-cause mortality, and long term respiratory decline in children[1 2 3 4]. Studies also show exposure to high concentrations of particulate matter pollutants increases cardiac arrhythmias,[5] acute myocardial infarcts,[6] and stroke.[7] In addition, there is emerging evidence suggesting a steep risk for mortality from cardiac disease even at low levels of exposure to vehicular pollutants.[8]

In March 2014, the World Health Organization (WHO) reported latest estimates that in 2012 around 7 million people died as a result of air pollution exposure - or 1 in 8 global deaths, confirming that air pollution is now the world's largest single environmental health risk.[9] Diesel emissions have been classified by the WHO as carcinogenic, and are particularly toxic as they contain higher concentrations of ultrafine particulate matter as well as polycyclic aromatic hydrocarbons.

Recent OECD statistics suggest that the number of deaths from air pollution in Australia jumped from 882 in 2005 to 1483 in 2010, representing an increase in death of 68 percent.[10] Australia was one of the fourteen countries that saw death rates from air pollution increase. It is proposed air pollution related to road transport and a switch to diesel vehicles accounted for a large percentage of this increase.

Urban transport plays a large role in relation to 'new' pollutants, in particular ultrafine particles, with their concentrations elevated by up to one or two orders of magnitude in proximity to busy roads or tunnels, respectively.[11] There is growing evidence of an association between high concentrations of ultrafine particles and mortality.[12] These particles once emitted remain in the atmosphere for a short time, after which photochemical reactions tend to convert them into larger size secondary particulates. [13] It is therefore difficult to predict the behaviour of these emissions using standard modelling methods. In addition, the health effects of secondary particles remain unknown requiring further epidemiological study.

There appears to be no lower limit for exposure to particulates[14] below which populations are safe, especially for ultrafine particulates. This has particular implications for our national environmental protection standards, which guide industrial and vehicular infrastructure monitoring. Health effects can occur with levels of exposure below these standards, hence there is a shift in the scientific community towards ensuring the lowest possible population exposure to vehicle emissions.

Components of vehicular and industrial air pollutants

The types of vehicular emissions include particulate matter (PM) of different sizes (PM10, PM 2.5, PM1), ultra-fine particles, sulphur dioxide, nitrogen oxides, carbon monoxide, benzene (a carcinogen), formaldehyde, ground level ozone, and volatile organic compounds from diesel emissions.

Particulate matter includes airborne solid or liquid particles including dust, pollens, soot and aerosols arising from combustion. The particles known as PM10 (with a diameter less than 10 mm) are most commonly measured, however finer particles such as PM2.5 and below, are of considerable concern as they can penetrate deeper into the lungs and have the potential to be more damaging. It is important to note that diesel vehicles emit higher concentrations of ultrafine particulates. [15]

Evidence from cellular or toxicological experiments, controlled animal and human exposures and human panel studies have demonstrated several mechanisms by which particle exposure may both trigger acute events as well as prompt the chronic development of cardiovascular diseases. Particulate matter inhaled into the pulmonary tree may instigate remote cardiovascular health effects via three general pathways: instigation of systemic inflammation and/or oxidative stress, alterations in autonomic balance, and potentially by direct actions upon the vasculature by particle constituents capable of reaching the systemic circulation. In turn, these responses have been shown to trigger acute arterial vasoconstriction, endothelial dysfunction, arrhythmias and pro-coagulant or thrombotic actions.[16]

Research Summary

An important study in the American Heart Association Journal *Circulation* in 2010 found that even short exposures to PM 2.5 µm in diameter (PM2.5) (i.e. a few hours to weeks) can trigger cardiovascular deaths and illness, while longer-term exposure (i.e. over a few years) greatly increases the risk for cardiovascular mortality and reduces life expectancy among highly exposed groups by several months to a few years.[17]

In a study examining the exposure-response functions for mortality from cardiovascular disease, a steep increase in risk was found at low-levels of exposure to PM 2.5. A linear exposure-response was found between exposure to PM 2.5 and mortality from lung cancer.[18]

An additional study assessed long-term exposure to air pollution and lung cancer in 313,000 people from 17 cohorts in 9 European countries. [19] There were 2095 lung cancer cases diagnosed over a follow-up of 12.8 years. The meta-analyses showed a statistically significant association between risk for lung cancer and PM10 with a hazard ratio (HR) of 1·22 per 10 µg/m3. For PM2.5 the HR was 1·18 per 5 µg/m3. An increase in road traffic of 4000 vehicle-km per day within 100 metres of the residence was associated with a hazard ratio for lung cancer of 1·09. This risk therefore exists even when the levels of particulate matter air pollution are below the current European limit values.

Recent findings also suggest long-term exposure to PM2.5, even at low levels, is related to an increased risk of mortality attributable to diabetes. These findings have considerable public health importance given the billions of people exposed to air pollution and the worldwide growing epidemic of diabetes.[20]

The effect of air pollution on lung development in children 10 to 18 years of age was published In the New England Journal of Medicine in 2004.[21] In this Children's Health Study, 1759 children of an average age of 10 years, were monitored over 8 years using annual spirometry.

The results of this study provide robust evidence of an exposure dose relationship on impaired lung development from 10 to 18 years, with FEV1 being reduced in children exposed to higher levels of ambient air pollution. This effect was similar to those that have been reported for exposure to maternal smoking.[22] [23]

A case control study from California assessed the relationship between traffic related air pollution and autism. The study found that children with autism were more likely to live at residences that had the highest exposure to traffic-related air pollution during gestation, and the first year of life. The associations were found with exposure to nitrogen dioxide, PM2.5, and PM10 during these periods.[24]

There is increasing evidence of adverse health effects on babies and children from maternal exposure to air pollutants: exposure is associated with adverse pregnancy outcomes, risk of low birth weight, foetal growth restriction, and pre-term delivery.[25 26 27 28]

Outdoor air pollution is recognised as an asthma trigger, and early childhood exposure to air pollutants may play a role in the development of asthma. A study of 3,482 children from British Columbia showed a statistically significant increase in risk of asthma with increased early life exposure to CO, NO, NO2, and PM10 in addition to other pollutants.[29] Traffic-related pollutants were associated with the highest risks, for a 10 microgram.m-3 increase in NO and NO2.

Congenital anomalies may also be of concern.[30] In a metanalysis of several studies, NO2 and SO2 exposures were related to increased risks of coarctation of the aorta and tetralogy of Fallot, and PM10 exposure was related to an increased risk of atrial septal defects.

Populations with chronic disease such as diabetics, those with coronary artery disease, are particularly susceptible to the harmful effects triggered by particulate matter exposure.[31] A study of 141,000 residents of Montreal found consistent increases across exposure to most types of ambient particles for people who had cancer, acute lower respiratory diseases, any form of cardiovascular disease, chronic coronary artery diseases, and congestive heart failure.[32]

Concerns regarding ventilation design and emission stack placement

Tunnels concentrate the flow of vehicular traffic into their entry and exit areas, thereby increasing emissions at these points. Tunnels further concentrate vehicular emissions, at the points they are then pumped into the atmosphere. The dispersion of these concentrated emissions depends on the velocity of the emissions, as well as wind speeds and topography. The local microclimate has a significant impact on dispersion and has not been modelled in the NorthConnex EIS.

The dispersion effect of a ventilation stack is dependent on its height, meteorology, topography of the surrounding area, and the levels of in tunnel vehicular emissions.

A valley is the least ideal location for a ventilation stack because the height of valley will detract from the height of stack - this results in poorer dispersion and in accumulation of particulate matter. For example, the northern emission stack will be located in a valley 15 meters deep, surrounded by dense tree canopy approximately 20m high. The stack height of 23 meters will be inadequate to disperse pollutants away from this location.

If the air mass is stable there is no dispersion the emission plume will descend into the valley and remain there, leading to significant pollution episodes. Further compounded by topography, pollutants released in a valley would be more likely to be trapped under such conditions. In the case of the northern stack there is limited wind flow and predominantly stable air in the proposed valley location. Ventilation stacks located in this valley will therefore increase deposition of particulate matter in the immediate surrounds.

The Northconnex tunnel at present has no exhaust fan system to ensure outside air will be actively drawn into the tunnel entry. The design proposes to use a piston effect from the moving vehicles to propel the emissions along the tunnel. However the air flow from the piston effect may not be sufficient to propel emissions into the ventilation stacks. It is likely that emissions will pool at tunnel entry, within the tunnel and at ground level at the exits.

The models for predicting ambient air quality around ventilation stacks depend on multiple variables that are not easy to take into account. Emission levels vary dependent on time of day, traffic congestion and type of vehicles. The background monitoring of air quality data has to be collected at the site of the stack to have any meaningful comparisons in modelling scenarios.

In the case of the NorthConnex tunnel assessment, the background air quality data has been collected at sites remote from the emission stack locations at meteorological stations in Prospect and Lindfield, some 21 kilometres away. This data may not be representative of the local microclimates in which the emission stacks are being placed. The PHAA recommends that prior to a significant infrastructure project of this magnitude being approved that appropriate microclimate data be collected and assessed by the project proponents, to justify the site of the emission stacks and to ensure adequate dispersion occurs, above atmospheric inversion layers that are commonly present in stable microclimate areas such as valleys.

There are no models for estimating ultrafine particles in ambient air. Existing standards for air quality that rely purely on PM10 or PM 2.5 are insufficient to gauge the full risk to public health from finer particles. There are at present no WHO guidelines or Australian standards for ultrafine particles; however, there exists a reasonable understanding of the potential health consequences of exposure to these particles.

There is no validated understanding of interactions between air pollutants and their compounded harmful effects. Once emitted, air pollutants are modified by meteorological factors such as sunshine, temperature and humidity, as well as the interactions between the mixes of pollutants. These interactions lead to nucleation processes, which form particles of different sizes - which are more complex to investigate.

The plume effect of ventilation stacks results in short bursts of highly polluted air being released from the stack into its immediate vicinity. The plume effect is difficult to measure since most measurement devices estimate hourly ambient air quality or average ambient air quality over a period of time such as 12 months. Monitoring is generally averaged over 12 months hence plume effects are not accounted for in the Environmental Impact Statement for NorthConnex.

There exists no particle that can effectively be measured to indicate if ambient air pollution is from surface roads or from a ventilation stack. The source appointment of emissions in the case of NorthConnex stacks is very complex.

Finally, given the levels of direct increases in air pollutants in the immediate surrounds of a tunnel emission stack, difficulties in accurately predicting and modelling the dispersion of the particulate and gaseous pollutants from the stack, and the serious nature of potential health impacts on adults and children, this submission reaffirms that any decrease in ambient air quality below background levels in densely populated regions, represents a significant risk to the morbidity and mortality of the exposed population.

Ambient air quality modeling

The modelled air quality in the NorthConnex EIS predicts a negligible increase in pollutants above background levels. This prediction heavily relies on wind speed and terrain data that has been extrapolated from remote sites – these data may not be representative of the local microclimate.

Two air quality monitoring stations were used to establish ambient air quality for the modelling, one at Lindfield and the other Prospect. These air quality monitoring stations are both south of NorthConnex and are 9.7 km and 11 km respectively from the southern portal, and 9km and 21 km respectively from the northern portal. The stations are also located at 60 metres AHD whereas the northern stack is at 180 metres AHD. Both monitoring stations are also located in residential areas.

It is recognised that the methodology for the estimation of background ambient air concentrations complied with Standard Methods.[33] However, because of the difference in the distance, location, land-use context and height of these stations, the use of data from these air quality stations cannot be considered representative of air sheds in Wahroonga and Pennant Hills. This is particularly in relation to pollutants emitted in high concentrations by vehicles such as NO2 and PM2.5.

Also PM 2.5 is not measured at either air quality monitoring stations and had to be estimated from the PM10 concentrations. The Lindfield air quality monitoring station also does not meet the current Australian and international standards for the site of air quality and meteorological monitoring stations.

Due to these issues, the ambient air quality data used in the modelling cannot be guaranteed to be representative of actual air quality. For a 9km longitudinally ventilated tunnel such as NorthConnex, ambient air quality at either end of a tunnel is important as the local air sheds and associated air quality can be very different.

The PHAA recommends the collection of sufficient site-specific ambient air quality information for at least one year (as per the EPA's 2005 Standard Methods[34]) and repeat air quality modelling. We also recommend that the proponents undertake longer term ambient air quality monitoring at key project locations.

Additional concerns raised by modeling assumptions

In addition to potentially inaccurate meteorological and terrain assumptions, there are several further assumptions in the modelling for the EIS that the PHAA believes are questionable.

- First: an assumption that the tunnel intake is "fresh air" with no levels of pollutants has been made however, the intake areas are at busy surface roads.
- Second: there is an underestimation of the concentrations of pollutants that are emitted from heavy freight diesel vehicles.
- Third: increases in tunnel users over time will result in increases in emissions over time.

- Fourth: there is a reliance on low background levels of air pollution in Sydney compared with Beijing. While the overall air quality in Sydney may not be affected, there is no consideration of susceptible local populations.

As a result of these assumptions the actual amounts of pollutants discharged into local microclimates via stacks is likely to result in significantly higher pollutant concentrations than the "negligible" amounts that have been predicted in the EIS.

Revised Air Quality Guidelines

As stated, the medical and scientific community have recently revised our current National Environmental Protection Measures (NEPM) to better reflect the growing and substantive health impacts from vehicular air pollutants in the medical literature.

These changes are described in depth at:
http://www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/aaq-nepm-draft-variation-impact-statement-executive-summary.pdf

The new NEPM guidelines state:

> *"The need to reduce atmospheric concentrations of particulate matter (PM) derives principally from its well-recognised and quantified effects upon human health. The recent historical trend of decreasing ambient concentrations of PM10 and PM2.5 is expected to be reversed in the future due to growth in population, economic activity and emissions, with subsequent increases in population exposure and the incidence of adverse health outcomes, and increases in the monetary costs of air pollution to society.*
>
> *It is likely to be more difficult to meet the national air quality standards and goals for particulate matter in the future without proactive intervention, risking sufficient protection for Australian public health. Intervention is considered necessary to prompt and accelerate policies and measures to reduce population exposure to particulate air pollution. Updating the AAQ NEPM will reduce these adverse effects by highlighting potential problems and assisting jurisdictions in the formulation of air quality policies to reduce emissions from different sectors.*
>
> *The WHO numerical guideline for 24-hour PM10 of 50 µg/m3 has been adopted in Australia and elsewhere (but not in the United States), even though the number of permitted exceedances is greater in Australia than in the WHO guideline. However, fewer exceedances of the standard are provided for in Australia than in most other countries/regions (an exception being New Zealand).*
>
> *The annual advisory mean standard for PM2.5 of 8 µg/m3 in Australia is lower than the current WHO guideline. The current 24-hr PM2.5 advisory reporting standard of 25 µg/m3 is identical to the WHO 2005 guideline."*

Although the Australian PM standards are numerically lower than, or equivalent to, those in other countries and regions, it is not straightforward to interpret such comparisons and they do not necessarily mean that the Australian standards are more stringent. For example, the proponents state that the Australian guidelines are more stringent than other countries, and as long as the "average" levels over 24 hours and 12 months meet the standards the project will be safe. However, averages of pollutants over a given timeframe, do not account for exposures to emission plumes (large amounts of emissions) from emission stacks for the population in close proximity to the stacks.

As noted earlier, there would still be health benefits in Australia from setting the PM standards as low as reasonably achievable, given there is no safe threshold for particulate matter exposure. Also, there are differences in implementation of standards in Australia compared with other countries. For example, there are no sanctions associated with non- compliance with the standards and goals in Australia, whereas there are in other countries and regions.

Particulate Matter

Particulate Matter is a non-threshold pollutant. This means that adverse health impacts occur at levels below current standards. As stated below in the latest NEPM review:

> *"In Australia for non-threshold pollutants such as PM, overall health outcomes in a population are driven by large- scale exposure to the prevailing average concentrations, rather than by relatively small-scale exposure to higher concentrations. Where there are no exceedances of air quality standards there may be no impetuses to implement measures to further reduce exposure to PM. This has compelled a shift in the approach to air quality management, and in some countries and regions (notably the European Union) this has taken the form of an 'exposure-reduction framework'. The scientific support for the exposure-reduction approach to managing PM has been strengthened by the latest health findings".*

This articulates the current scientific thinking that infrastructure projects minimise population exposure to particulate matter, to below current standards, as significant health impacts occur even below current standards, especially when large populations are exposed, as is the case with the NorthConnex design.

The NEPM provides a guideline only to assist policymakers, and these guidelines should not be used as an absolute value against which to measure the safety of NorthConnex tunnel emission levels. Rather, the NorthConnex tunnel, ventilation stacks, and portal emissions sites should be designed to ensure there is an overall reduction of population exposures to particulate matter.

As stated in the NorthConnex EIS:

> *"Particulates that are derived from specific sources, such as diesel emissions, are known to comprise other compounds such as volatile organic compounds and polycyclic aromatic hydrocarbons that are known to also be associated with adverse health effects. The presence of these other compounds has been addressed separately however the presence of these (and likely other compounds) compounds and other co-pollutants (also derived from combustion sources) adds to the complexity of utilising data from urban air epidemiological studies for assessing health effects from particulate matter."*

As the epidemiological data is complex, and interactions between particulates and other compounds emitted are unknown, the PHAA questions the conclusion as stated in the EIS that there are negligible health impacts from such a long tunnel, with large amounts of diesel emissions, two ventilation stacks and no filtration.

Our concern is that the nature of health risks associated with the emissions is too serious to rely solely on the modelling and assumptions that predict negligible health risks in the proponent's EIS.

Government departments would be prudent in applying the precautionary principle, to safeguard public health from known and future health risks. The problems associated with the exposure to emissions from the placement of stacks and portals in residential areas should be considered now, and rectified in the design stages to ensure harm minimisation.

Specific Concerns related to ultrafine particles (< 1 micrometer diameter)

The EIS for NorthConnex states:

> *"Based on the available studies, there is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur.*
>
> *At present, at the population level, there is not enough evidence to identify differences in the effects of particles with different chemical compositions or emanating from various sources."*

However, whilst these factors pose difficulties in the assessment and specific modelling of ultrafine particulates, our current knowledge suggests that there are reasonable scientific grounds to believe ultrafine particles negatively impact health, and reductions in population exposure in the longer term is imperative to protect health. We cannot conclude that there is no risk from ultrafine particles to human health, merely because the medical research is evolving and that specific monitoring of ultrafine particles has not generally been performed in the available research to date. The precautionary principle needs to be applied.

Lack of Filtration

The NorthConnex EIS states that filtration is:

> *"Bulky and less cost-effective than conventional ventilation systems, both in terms of investment and operation. Generally-speaking, these systems are also energy-intensive given the surplus ventilation requirements. "*

The NorthConnex EIS also quotes from a French government international assessment of the air in road tunnels stating:

> *"Others emphasise the potential benefits of first optimising the various pollution dispersion factors linked to tunnels, such as the position of portal or the location of stacks enabling the displacement and dispersion of pollutants away from residential areas."*

The NorthConnex proposal primarily uses the costs and performance of the M5 East filtration trial[35] in Sydney as the main justification for not considering filtration of the tunnel emissions before discharge via emission stacks into residential precincts.

The M5 East filtration trial involved a retrofit of an in-tunnel air treatment system. To do this for additional tunnels, an underground cavern for the filtration equipment, additional auxiliary infrastructure (such power supply) and additional jet fans were required to be installed and operated. As this electrostatic precipitator system (ESP) was retrofitted, and it was not included in the original design, the filtration system was not able to be optimised.

The AMOG Consulting report on the M5 filtration trial[36] recognised that ESPs were significantly under capacity for the volume of air delivered to them. The report suggests that this was the reason for the relatively poor efficiency of the ESP in removing particulates and the reliability issues of the ESP. The poor efficiency and reliability of the ESP were also a major factor in relatively high operating costs of the M5 Filtration trial.

Despite this, the electrostatic precipitators removed 65% of particulate matter, and hence were effective in this regard. In addition this estimate was derived from the filtration of only 50% of the westbound tunnel and with the ESP only turned on for 4 hours a day. With these operating parameters of course the trial was only able to show removal of a small proportion of the total in tunnel particulate matter.

The costs and works required to install a filtration system for NorthConnex require consideration. The filtration system could be designed and installed in the proposed ventilation buildings during the design and development stages**.** Realistic cost estimates for installing filtration and an independent study on the costs and benefits of filtration, need to be undertaken.

Portal Emissions

Because of the reliance on the piston effect in the NorthConnex tunnel design it is more difficult to propel all emissions into the tunnel, successfully capture all the tunnel air, and discharge it via a ventilation stack. It is more likely that a proportion of the tunnel air will not be captured and will escape via the tunnel portals such as those for the M5 East tunnel.

Whilst this proposal does not seek approval for portal emissions, the proponents refuse to rule out future portal emissions, and the ability to discharge emissions via portals in residential areas is included in the tunnel design.

This poses specific risks to human health, as unfiltered emissions will be discharged at ground level, near residences and schools located close to portals. The PHAA suggests that the portals should be sited away from residential and educational precincts, and that emission stacks are designed with adequate dispersion to reduce the need to discharge emissions through portals.

Long-term Health Costs

In addition to the scientific arguments there are strong economic arguments to mitigate health risk.

The recent review of the NEPM guidelines states

> *"Any reduction in exposure to particle pollution will have public health benefits. The health cost of particle air pollution in the NSW Greater Metropolitan is estimated to be around $4.7 billion per year (NSW DEC 2005; Jalaludin et al. 2011). The greatest proportion (>99%) of the health costs accrue from avoiding premature deaths due to long-term exposure to PM2.5"*[37]

Health costs downstream from poorly designed infrastructure are a key motivation to ensure vehicle transport projects are well designed. Public and private sector infrastructure developers must also improve in their attitude to global citizenship. These companies should be accountable for the health effects on populations. Government should apply risk mitigation strategies. For example, this may include appropriate design of surface transport infrastructure, consideration of rail freight transport options which produce less diesel, appropriate placement of tunnel portal emissions and ventilation stacks in non-residential areas, and installation and continuous operation of filtration in tunnel emission stacks.

Given the substantive and emerging data on health risks posed by vehicular emissions, especially diesel vehicles, we call on policy makers to take action to promote clean air, reduce population exposure. Particularly as Australia is an advanced economy, cost limitations for these projects should not affect the protection of population health.

Proposal Health Impact Assessment for Susceptible Populations

The health impacts on the exposed population may be assessed using a large-scale prospective cohort study. This study would look at the health consequences of exposure to air pollutants on 9,300 school children. As found by Gaudermann et al in a study of school children in California, we could anticipate reduced lung growth in this susceptible age group. For a similar prospective cohort analysis we would enlist children in Grade 4 at all the local schools in Wahroonga in the year prior to the NorthConnex tunnel opening. Baseline pulmonary function values would be recorded for these children. Once the tunnel opens, these children would be followed up for a period of 8 years, with annual spirometric testing and recording of symptoms. A comparison cohort in Grade 4 from schools outside the 2 km radius of the stack would also be enlisted. If there is any decline in the exposed children's lung development, the PHAA would be concerned about the long term effects on mortality and morbidity of this subgroup, the long term health costs, opportunity costs to the economy and reduced productivity, and the impairment to the daily functioning of these children.

Concluding Comments

PHAA supports the broad directions of the proposal to reduce surface traffic congestion on Pennant Hills Rd and to improve ambient air quality in Sydney. However, we are keen to ensure that population health is protected, as detailed in this submission. We are particularly keen that the following points are noted and considered:

- There are serious risks to health from air pollutants, the full extent of which is under evaluation at present.
- Children, elderly and those with chronic diseases are more vulnerable to health impacts
- The medical and scientific community have promoted an exposure reduction framework as a strategy for safeguarding health.
- The NorthConnex tunnel as proposed has the potential to have a substantial adverse impact on health. This is due to the insufficient dispersion from emission stacks placement and design, the large numbers of children and dense population exposed, the lack of consideration of filtration, and high levels of pollutants within the tunnel (as predicted in the EIS).
- The project proponents should be required to collect local meteorological data and repeat the air quality assessment. This data should be collected onsite, over a reasonable length of time and adequately reflect the local microclimate.
- Consideration be given to alternative, lower emitting options for efficient freight transport in Australia to alleviate the need for road freight transport.

The PHAA appreciates the opportunity to make this submission and would welcome the opportunity for further consultation on the issues raised in this submission.

Please do not hesitate to contact me should you require additional information or have any queries in relation to this submission.

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12 September 2014

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