Australian Institute
of Landscape Architects

A response to the

Working towards a National Clean Air Agreement

Discussion Paper, March 2015

Submission prepared by

Australian Institute of Landscape Architects

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1. Introduction

The Australian Institute of Landscape Architects (AILA) is the peak body for the landscape architecture profession in Australia. Representing over 2000 members, we champion a landscape of liveability and quality design for our streetscapes, public open spaces, stronger communities and greater environmental stewardship.

Air quality is critical to the liveability of towns and cities. As our urban populations continue to grow, and even with improvements in quality of motor vehicle emissions, the negative impact on human health and wellbeing will increase from pollutants such as ozone and fine particulate matter. It is therefore essential that the design and planning of our towns and cities seek to improve air quality and to reduce emissions through measures such as green infrastructure provision, reducing car dependency and Ecologically Sustainable Development (ESD) techniques.

The potential damage caused by air pollution to agriculture is also considered to be a food security issue. AILA recognises that there is an increasing national interest in the growing and sharing of local food (i.e. food grown close to where people live such as urban agriculture). Growing and sharing local food is an important component of resilient and sustainable local food systems and has a wide range of potential benefits for community health and wellbeing, the environment and the local economy. However the health and well-being impacts of pollution and associated contamination of locally grown food is of concern.

These are the principle reasons for AILA's interest in, and support for, the development of a National Clean Air Agreement.

ASPECT Studios with CHROFI for the Sydney Harbour Foreshore Authority

2. Response to Discussion Paper Questions

AILA provides the following response to questions posed in the **Working towards a National Clean Air Agreement Discussion Paper** Commonwealth of Australia 2015 (Discussion Paper).

2.1 Do you agree with the proposed goal, purpose, principles and scope as a basis for the National Clean Air Agreement? If not, please explain and provide alternatives if appropriate.

AILA generally agrees with the proposed goal, purpose, principles and scope as a basis for the National Clean Air Agreement. We support the Discussion Paper's focus on the importance of emission control measures but seek more emphasis on the importance of complementary measures, especially a National Environmental Science Programme, which is proposed to include $8.88 million in funding for a clean air and urban landscapes hub to support environmental quality in urban areas.

AILA believes that there should be a dual focus, on emission controls and mitigation. A robust evidence base for decision making is essential. This demands research, in particular, into:

- contribution of green infrastructure to air quality, including pollutant removal,
- the impact of air pollution on food sources, as a food security issue, and
- planning for sustainable transport to reduce pollution emissions and improve liveability.

The scope of the National Clean Air Agreement illustrated in the Discussion Paper (Figure 3) provides the opportunity for this dual focus. Co-operation & Partnerships and Knowledge, Education & Awareness are essential streams for activity, supporting and providing an evidence base for Standards and Emission Reduction Measures.

2.2 What, in your view, do you consider as a high priority air quality issue(s) that could be considered under the National Clean Air Agreement? Please provide evidence.

High priority issues that the AILA believes should be considered under the National Clean Air Agreement include the contribution of green infrastructure to improving air quality, the impact of air quality on food production, and supporting alternative modes of transports to support reduced car use.

These issues are discussed in more detail following.

High Line (NYC)
by Field Operations

Green infrastructure and air quality

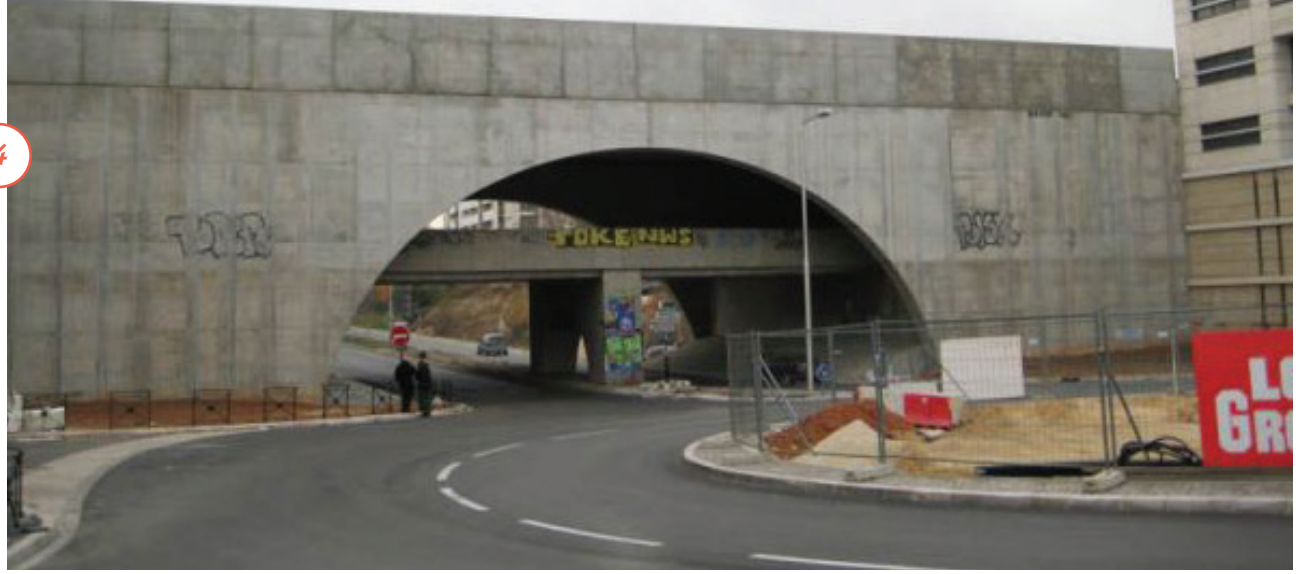
The Discussion Paper recognises the impact of air pollution to the environment:

> *"In addition to health impacts, air pollution may have significant impacts on the environment, either directly or indirectly. Impacts may include damage to crops and other vegetation through impaired growth (for example, through the direct deposition and accumulation of particles on leaf surfaces; reduced photosynthesis); acidification of soils and freshwater, which depletes essential nutrients that support flora and fauna; eutrophication which depletes oxygen levels and can lead to a change in species diversity; and chronic health problems in wildlife from heavy metals and organic pollutants, meaning that the impacts from exposure may be seen even when current air quality standards are being met.*
>
> *While Australia's overall levels of PM are low compared with many countries in our region, PM pollution from vehicles, industrial facilities, and heating sources is of concern to some ommunities.[6,7]. Research has identified that secondary PM 2.5 [8] makes an important contribution to sulfur and nitrogen deposition, leading to the acidification and eutrophication of natural ecosystems[9]. Though seemingly subtle and isolated, such impacts on ecosystems may, in turn, have consequences for human health due to our reliance on their many services, including food."*

However, the Discussion Paper fails to acknowledge the potential contribution of natural systems, including vegetation and soils, to the mitigation of air pollution. The National Clean Air Agreement should promote the myriad benefits of green infrastructure in ameliorating air pollution and reducing greenhouse gases. AILA believes that management of air pollution not only requires the control of emissions, but also measures to reduce the pollutants in the atmosphere. One way to mitigate the impacts of air pollution is through the incorporation and management of green infrastructure in our urban environments.

"*Green infrastructure is the network of natural landscape assets which underpin the economic, sociocultural and environmental functionality of our cities and towns—i.e. the green spaces and water systems which intersperse, connect and provide vital life support for humans and other species within our urban environments*" **Adapting to Climate Change 'Green Infrastructure', AILA.**

Green infrastructure includes the networks of planted green spaces and water systems that deliver multiple environmental, social and economic benefits to our towns and cities. Green infrastructure assets include green walls, facades and roofs, trees, parks and reserves, wetlands and waterways, vegetated green areas, etc. Green infrastructure delivers services and benefits similar to natural processes (known as 'ecosystem services'). Ecosystem services are the environmental services provided by healthy landscape systems from which humans benefit, such as plant pollination, air filtration, pollution treatment, stormwater management and carbon sequestration.



Pont Max Juvenal by Patrick Blanc (FRA) (before)

The vegetation component of green infrastructure has been shown to reduce air pollution, air-borne particulates and greenhouse gas emissions[1]. It does so by processes of deposition and dispersion[2]. The plant foliage absorbs gaseous pollutants, and collects and traps particulate matter (such as smoke and dust), which, with rainfall, passes ultimately into the soil where it is degraded or stored[3]. Leaf area determines filtering capacity: plants with a larger leaf area are more effective filters. Hence, trees have a higher filtering capacity than shrubs or grasslands[4]. Urban trees have an important role in removing air pollutants and improving air quality). Trees remove carbon dioxide, nitrous oxides, sulphur dioxide, carbon monoxide and ozone from the atmosphere via the process of photosynthesis. Carbon dioxide is a greenhouse gas associated with trapping heat in the atmosphere and driving climate change. The effectiveness with which many trees sequester and store carbon is considered a key mitigation strategy for reducing levels of atmospheric carbon dioxide.

Computer simulations suggest that trees and forests in the United States removed 17.4 million tonnes of air pollution in 2010, with a value to human health of US$6.8 billion[5]. This estimate of the value of improved air quality is conservative as it does not include value of improved visibility and protection of animals, crops, vegetation and buildings. New York's urban forest removed 1,821 metric tonnes of air pollution at an estimated value to society of $9.3 million annually. In addition, studies show a typical mature tree can store as much as 10 tonnes of carbon.[6]

Vegetation, including trees, and plants on green walls and facades, in street canyons can reduce street-level concentrations in those canyons by as much as 40% for NO_2 and 60% for particulate matter. Substantial street-level air quality improvements can be gained through action at the scale of a single street canyon or across city-sized areas of canyons. Moreover, vegetation will continue to offer benefits in the reduction of air pollution even if the traffic source is removed from city centres. Thus, judicious use of vegetation can create an efficient urban pollutant filter, yielding rapid and sustained improvements in street-level air quality in dense urban areas. [7]

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1. Nowak, D.J., Crane, D.E., and Stevens, J.C. (2006) Air pollution removal by urban trees and shrubs in the United States. Urtban Forestry & Urban Greening, 4, 115-123.
2. Janhall, S. (2015) Review on urban vegetation and particle air pollution – Deposition and dispersion. Atmospheric Environment, 105, 130-137.
3. Nowak, D 2000. The Effects of urban trees on air quality. USDA Forest Service, Northeastern Research Station 5 Moon Library, SUNY-CESF, Syracuse, NY 13210. http://www.nrs.fs.fed.us/units/urban/local-resources/downloads/Tree_Air_Qual.pdf
4. Boland, P., and Hunhammar, S. (1999) Ecosystem services in urban areas. Ecological Economics, 29, 293-301.
5. Nowak, D., Hirabayashi, S., Bodine, A., and Greenfield, E. (2014) Tree and forest effects on air quality and human health in the United States. Environmental Pollution, 193, 119-129.
6. Nowak, D 2000. The Effects of urban trees on air quality. USDA Forest Service, Northeastern Research Station 5 Moon Library, SUNY-CESF, Syracuse, NY 13210. http://www.nrs.fs.fed.us/units/urban/local-resources/downloads/Tree_Air_Qual.pdf
7. Source: Pugh TAM, Mackenzie AR, Whyatt JD, Hewitt CN (2012) Effectiveness of green infrastructure for improvement of air quality in urban street canyons, Environmental Science and Technology 46:7692-7699.

Pont Max Juvenal (FRA) by Patrick Blanc (after)

Green infrastructure within our urban environments also assists in alleviating the Urban Heat Island (UHI) effect, by which urban areas are slightly warmer than the surrounding suburbs or rural areas. UHI effect can contribute to air pollution in our cities[8]. The association demonstrated in Melbourne, between 1991 and 1996, between elevated nitrogen dioxide, carbon monoxide, ozone and particulate air pollutants (such as smoke and dust) and mortality due to cardiorespiratory disease, including asthma, was strongest in warm weather, when ozone levels were high due to increased production at higher temperatures and stable weather conditions that reduced mixing of air[9].

Trees will reduce urban temperatures, particularly in the summer. Through the process of evapo-transpiration and the provision of shade, trees act as 'nature's air conditioners'. In Chicago, increasing tree cover by 10% could reduce total energy for heating and cooling by US $50-90 per dwelling per year. Present value of long-term benefits of trees has been estimated to be double the costs[10]. This cooling effect of trees in our cities delivers air quality benefits through energy savings (e.g. avoided CO2 emission due to building energy savings), and also by reducing the emission of temperature-dependant pollutants. In 2000, Brisbane's residential tree cover was estimated to be absorbing the equivalent amount of CO2 emitted by 30,000 cars per year and to cool surface temperatures in the relatively mild month of October 1999 by up to 5°C.

Vegetated green roofs and walls also provide significant opportunities to reduce gaseous and particulate pollutants and improve air quality. This is achieved by direct capture of pollutants, and by reducing building heat gain and associated localised warming of the environment. These contribute to the creation of urban heat islands and the generation of photochemical smog.

Green infrastructure in Australian cities clearly has much to contribute to improving air quality. The National Clean Air Agreement should recognise this contribution explicitly and encourage and support the implementation of green infrastructure for this purpose. To do so, also demands support for research into green infrastructure designed for air quality improvement. Much of the available research has been conducted in the Northern Hemisphere. It is generally accepted that trees remove air pollutants, and the greater the pollutant removal and population density, the greater the financial value in terms of human health[11]. However, there are interactions between tree structure, function and configuration, urban geometry and local climate. These interactions must be understood to ensure benefits to air quality from green infrastructure. Research in the Australian context is essential.

8. Beckett, K.P., Freer-Smith, P.H., and Taylor, G. (1998) Urban woodlands: their role in reducing the effects of particulate pollution. Environmental Pollution, 99, 347-360.
9. EPA (2000) Melbourne Mortality Study: Effects of ambient air pollution on daily mortality in Melbourne 1991-1996, EPA publication 709; EPA (2013) Future Air Quality in Victoria – Final Report, EPA publication 1535.
10. Boland, P., and Hunhammar, S. (1999) Ecosystem services in urban areas. Ecological Economics, 29, 293-301.
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Food production and air quality

Air pollution is a significant threat to food production. In particular, a recent study has demonstrated the importance of management of ozone levels and increased temperatures from climate change to ensure food security[12]. With global warming, it is postulated that global crop production will decrease by >10% by 2050, potentially contributing to increased global malnutrition. The impact of increased ozone levels, as a result of global warming, was shown to be positive or negative, depending on the crop cultivar and the region. Nevertheless, ozone regulation strategies were effective in countering the negative effects of global warming, reducing the decrease in crop production. Wheat in all major producing regions of the world was mostly sensitive to ozone management: increased temperature had less effect on crop production than increased ozone. In contrast, maize and soya bean were mostly sensitive to temperature. Interestingly, Australia was not included in this study but its wheat production is also likely to be reduced by increased ozone levels. Control measures for methane and particulate matter to reduce projected global warming by about 0.5°C by 2050 suggest that 0.7-4.7 x 106 premature deaths from air pollution could be avoided and annual crop yields increased by 30-135 x 106 tonnes due to ozone reductions in 2030 and beyond[13].

Urban agriculture can contribute to food production, with benefits for food security, especially in cities in developed countries[14]. Strategies to reduce global warming and ozone levels are likely to enhance crop production of urban agriculture. In addition, urban agriculture can contribute to improved air quality[15]. As another form of green infrastructure, the crops will support the processes of deposition and dispersion to remove gaseous pollutants and particulate matter.

Research into the impact of air pollution on rural and urban agriculture in Australia is essential. In addition, research should be undertaken to explore how urban agriculture might have a positive impact on air quality.

One Central Park (NSW) by OCULUS and ASPECT Studios for Frasers Property Australia and Sekisui House Australia / Watpac.

12. Tai, A.P.K., Martin, M.V., and Heald, C.L. (2014) Threat to future global food security from climate change and ozone air pollution. Nature Climate Change, 4, 817-821.
13. Shindell, D., Kuylenstierna, J.C.I., Vignatti, E., van Dingenen, R., Amann, M., Klimont, Z., Anenberg, S.C., Muller, N., Janssens-Maenhout, G., Raes, F., Schwartz, J., Faluvegi, G., Pozzoli, L., Kupiainen, K., Hoglund-Isaksson, L., Emberson, L., Streets, D., Ramanthan, V., Hicks, K., Oanh, N.T.K., Milly, G., Williams, M., Demkine, V., and Fowler, D. (2012) Simultaneously mitigating near-term climate change and improving human health and food security. Science, 335, 183-189.
14. Badami, M.G., and Ramankutty, N. (2015) Urban agriculture and food security: A critique based on an assessment of urban land constraints. Global Food Security, 4, 8-15.
15. Lin, B.B., Philpott, S.M., and Jha, S. (2015) The future of urban agriculture and biodiversity-ecosystem services: Challenges and nest steps. Basic and Applied Ecology, 16, 189-201.

Sustainable transport and air quality

With population growth, increasing numbers of car registrations, and nearly 90% of Australians living in urban areas[16], our dependency on cars for travel brings a number of challenges for a clean air future. This vehicle dependency is reflected by a significant proportion of our urban spaces being dominated by traffic, and with infrastructure funding being heavily weighted towards road infrastructure. AILA believes there will be significant air quality and associated health and wellbeing benefits by reducing our community's over-reliance on cars through supporting sustainable and healthier modes of transport such as walking, bicycling and public transport.

A study by the EPA showed that ambient air pollution in Melbourne is associated with increases in daily mortality. Although all the air pollutants under consideration, ozone, nitrogen dioxide, fine particles and carbon monoxide, were found to be associated with daily mortality, the strongest associations were observed for ozone and nitrogen dioxide. The main sources of these pollutants in Melbourne are from motor vehicles and industry.[17]

These results suggest that strategies to reduce these pollutants are important to reduce the risk of adverse health effects arising from exposure. It is also believed that motor vehicle air pollution probably causes a similar order of magnitude of premature deaths as traffic crashes; although air pollution deaths tend to involve older people, while traffic crashes are more likely to harm people during the prime of life.[18]

To reduce the focus on vehicles, it is crucial that the planning and design of our towns and cities focus on creating 'places for people' rather than cars, with well-connected and high quality bicycle and walking infrastructure. Transit-oriented development can promotes public transport use (which tends to produce less pollution per passenger-mile) and reduce the need for car ownership[1920]. Transit-orientated development is development that includes a mixture of housing, office, retail and/or other amenities integrated into a walkable neighbourhood and located within close proximity to quality public transport.

16. 4102.0 - Australian Social Trends, April 2013 Australian Bureau of Statistics
17. Melbourne Mortality Study Effects of Ambient Air Pollution On Daily Mortality in Melbourne 1991-1996, EPA http://www.epa.vic.gov.au/~/media/Publications/Melbourne%20Mortality%20Study.pdf
18. Litman, T (2003), "Integrating Public Health Objectives in Transportation Decision-Making," American Journal of Health Promotion, Vol. 18, No. 1 (www.healthpromotionjournal.com), Sept./Oct. 2003, pp. 103-108 http://www.vtpi.org/AJHP-litman.pdf
19. ICF (2008), The Broader Connection between Public Transportation, Energy Conservation and Greenhouse Gas Reduction, American Public Transportation Association (www.apta.com); www.apta.com/research/info/online/documents/land_use.pdf
20. Belzer, Dena and Gerald Autler. 2002. Transit Oriented Development: Moving from Rhetoric to Reality. Brookings Institution Center on Urban and Metropolitan Policy and the Great American Station Foundation.

AILA strongly supports high quality public transportation (convenient, comfortable, fast rail and bus transport) and well-designed transit oriented urban development (with supporting infrastructure) as a measure to reduce pollution emissions and improve liveability.

2.3 Can you provide any suggestions for cooperation/partnerships and/or knowledge, education and awareness for the purpose of assisting governments to manage air quality?

As outlined previously, green infrastructure including urban agriculture may contribute significantly to a clean air future.

In the document **Adapting to Climate Change**[21] prepared by AILA, the value of landscape and green infrastructure in strategic planning may be prioritised through the following:

1. Map regional and local opportunities for existing/potential green infrastructure networks. This should be done via a collaborative process involving regional and local planning authorities, together with local communities, as a matter of urgency. Incorporate opportunity maps into planning documents to influence land management decisions—including scope for integrated national spatial framework for landscape-scale conservation and regeneration.
2. Design and plan green infrastructure before development and build in capacity for improving environmental connectivity and resilience in existing urban environments via setting priorities for acquisition and regeneration as retrofitting and redevelopment opportunities occur.
3. Establish environmental limits to development—by using opportunity maps to help establish capacity for sustainable development which is in balance with natural resources and processes.
4. Draw from a broad range of science and theory, engaging expertise from a diversity of disciplines (e.g. landscape architecture and ecology, conservation biology, urban and regional planning, GIS, landscape visualisation modelling, etc.) to inform design and management strategies for green infrastructure planning.
5. Provide leadership for local community involvement—by using community-based planning and capacity building to engage and inspire local participation and ownership of landscape-based solutions.

Chattanooga Tennessee

21. Adapting to Climate Change, Green infrastructure planning increasing connectivity, multifunctionality, and landscape performance in the built environment, AILA

In addition, AILA notes there are other green infrastructure opportunities including:

- Education (community, developers, practitioners and authorities) on the benefits and goals of green infrastructure in order to promote collaboration and a willingness to invest.
- Development of policy, legislative and statutory provisions to support the implementation and maintenance of green infrastructure. For example France has recently introduced environmental legislation requiring all new buildings in commercial zones across the country to be partially covered in plants or solar panels.
- Development of sector handbooks and guidelines for green infrastructure, and the development of a national framework for Australian Green Infrastructure by Standards Australia.
- Support for Local Governments in the development and implementation of green infrastructure and urban forest strategies.

Improving air quality through reducing car dependency requires a combination of research, education (community, politicians and practitioners), changes to standards and to funding. Some sustainable transport opportunities include:

- Statutory provisions to support transit-oriented development.
- Policy, legislative, statutory and funding support for sustainable and active modes of transport such as:
  - Pedestrian and cycling infrastructure funding.
  - Support for safe routes and amenity initiatives to stations, schools and activity centres.
  - Investigation of more sustainable alternatives to the increasing use of heavy trucks which emit diesel pollution and adversely impact liveability.
  - Legislation that requires all major road and rail projects to accommodate cyclists and pedestrians (along transport routes and also to allow crossing) to ensure pedestrian desire lines are met and that walking or cycling is a desirable option.
  - Legislation that better protects footpaths and bicycle routes from road capacity enhancements, vehicular parking and temporary works.

Conclusion

In conclusion, AILA strongly supports a robust, evidence base to assist with decision making, and acknowledges that further research, education and guidance are needed to assist the government, communities and practitioners in understanding the:

- contribution of green infrastructure to improving air quality and the full cost benefits of green infrastructure
- impact of air quality on food production
- full cost of car use and the full analysis of cost and benefits of public transport, walking and cycling.

We thank you for taking the time to review our submission and welcome the opportunity to discuss any elements of this with you further.

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