

5 December 2017

Ref: A19366950

The Secretary
NSW Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

Attention: Kane Winwood
Copy to: Carl Dumpleton

Dear Kane,

Re: NorthConnex (SSI 13_6136) – Modification request – Correction and clarification of ventilation outlet elevations

I refer to the approval granted by the Minister for Planning for the NorthConnex project on 13 January 2015 (SSI 13_6136).

In carrying out the project, Roads and Maritime has identified that the design parameters for the project ventilation outlets specified under condition B2 of the Minister's approval do not correctly reflect the design of the project for which approval was sought. This correspondence constitutes a request to the Minister under section 115 of the *Environmental Planning and Assessment Act 1979* to modify the approval to reflect the correct ventilation outlet design.

The proposed change to Condition B2 is as follows:

B2 The ventilation outlets shall be constructed to achieve an outlet exit plane at a height of 20 metres above ground level. The ventilation outlets shall be constructed at an approximate height of:

- (a) the northern ventilation outlet tip height: ~~194~~ 200.8 metres (AHD); and*
- (b) the southern ventilation outlet tip height: ~~147~~ 148 metres (AHD).*

Details on the proposed modification are as per below.

Scope of the modification request

Roads and Maritime requests that the Minister modify condition B2 of the approval as follows:

- Correction of the tip height of both the northern ventilation outlet and the southern ventilation outlet; and
- Clarification of the reference point for measuring the specified 20 metre height of each ventilation outlet.

Table 1 summarises the base height and tip height for each of the project ventilation outlets:

- For which approval was originally sought (the '**Original Design**'). The original design is presented in the Technical working paper: Urban design in Appendix I of the Environmental Impact Statement;
 - As amended by the Submissions and Preferred Infrastructure Report to increase the tip heights by five metres (the '**Amended Design**'); and
 - As required by the current condition B2 of the Minister's approval (the '**Approved Design**').
- Roads and Maritime seeks to modify condition B2 to reflect the Amended Design heights.

Table 1 - Summary of ventilation outlet heights

Measurement	Original Design	Amended Design	Approved Design
Northern ventilation outlet			
Base height	172.0 m AHD	172.0 m AHD	174 m AHD ¹
Tip height	195.8 m AHD	200.8 m AHD	194 m AHD
Southern ventilation outlet			
Base height	118.5 m AHD	118.5 m AHD	127 m AHD ¹
Tip height	143.0 m AHD	148.0 m AHD	147 m AHD

Note 1: the Minister's conditions of approval do not specify a base height for the ventilation outlets, but instead require that each ventilation outlet be 20 metres above ground level. The base heights quoted in the table have been calculated based on this requirement and the tip heights specified in condition B2.

For simplicity, ventilation outlet heights included in the Environmental Impact Statement (15 metre ventilation outlets) for the project and the subsequent Submissions and Preferred Infrastructure Report (20 metre ventilation outlets) were quoted relative to the nearest adjacent local road. The nearest adjacent road is Woonona Avenue in the case of the northern ventilation outlet, and Gum Grove Place in the case of the southern ventilation outlet.

As can be seen from **Table 1**, the total physical height of each ventilation outlet for the Amended Design is:

- 28.8 metres for the northern ventilation outlet; and
- 29.5 metres for the southern ventilation outlet.

This difference is because the total physical ventilation outlet structure extends below both Woonona Avenue and Gum Grove Place.

Condition B2 of the Minister's approval currently requires that both ventilation outlets have an 'exit plane height [tip height] of 20 metres above ground level'. To ensure clarity in relation to the 'ground level' from which ventilation outlet heights are to be measured, Roads and Maritime seeks to modify condition B2 to specify a ventilation outlet base height, instead of the current relative ventilation outlet height of 20 metres.

The two components of the modification requested by Roads and Maritime could be achieved through amendment of condition B2 to reflect the base height and tip height for the two ventilation outlets as specified for the Amended design in **Table 1**.

Implications for the environmental impact assessment

The tip height of the two ventilation outlets may have implications for:

- The visual impact assessment;
- The noise and vibration assessment; and
- The air quality impact assessment (and to the extent that air quality impacts may change, the human health risk assessment).

Clarification of the base height of the ventilation outlets would not affect the impact assessments presented in the Environmental Impact Statement, and amended in the Submissions and Preferred Infrastructure Report.

The Environmental Impact Statement and Submissions and Preferred Infrastructure Report have been reviewed to confirm whether the assessments listed above were based on the Original Design/ Amended Design or the Approved Design (with respect to ventilation outlet tip heights). The outcomes of this review are summarised in **Table 2** and discussed in more detail in the following sections.

Table 2 - Summary of ventilation outlet tip height assumptions

Assessment component	Original Design	Amended Design	Approved Design
Northern ventilation outlet tip height	195.8 m AHD	200.8 m AHD	194 m AHD
Southern ventilation outlet tip height	143.0 m AHD	148.0 m AHD	147 m AHD
Visual impact assessment – artist’s impressions/ photomontages (both ventilation outlets)	✓	✓	
Visual impact assessment – visual catchment areas (northern ventilation outlet)			✓
Visual impact assessment – visual catchment areas (southern ventilation outlet)	✓	✓	
Noise and vibration impact assessment (both ventilation outlets)	N/A ¹	N/A ¹	N/A ¹
Air quality impact assessment (both ventilation outlets)			✓

Note 1: the noise and vibration impact assessment did not include ventilation outlet noise breakout as a significant noise source, as discussed in the noise and vibration impact assessment section of this modification request.

Visual impact assessment

The visual impact assessments presented in the Environmental Impact Statement and the Submissions and Preferred Infrastructure Report included:

- Artist’s impressions/ photomontages of major project infrastructure viewed from various vantage points; and
- Visual catchment mapping.

The artist’s impressions/ photomontages showing various surface components of the project were developed based on a three dimensional model constructed directly from the architectural plans for

the project. These architectural plans are provided in Appendix I of the Environmental Impact Statement (as amended by the Submissions and Preferred Infrastructure Report to increase the tip heights of the ventilation outlets by five metres). Likewise the overshadowing of the permanent project elements has been developed based on the three dimensional model and are shown in the Urban Design Landscape Management Plan (Part 2 August 2017). The artist's impressions/ photomontages therefore present an accurate depiction of the likely appearance of the project, including the ventilation outlets, at the elevations proposed to be constructed (ie the Amended Design). The artist's impressions/ photomontages do not require amendment as part of this modification request.

The visual catchment mapping presented in the Submissions and Preferred Infrastructure Report reflects:

- The Amended Design in the case of the southern ventilation outlet; and
- The Approved Design in the case of the northern ventilation outlet.

The visual catchment mapping presented in the Submissions and Preferred Infrastructure Report therefore accurately shows the potential visual catchment for the southern ventilation outlet. It should be noted that the mapping does not include shielding that may be provided by intervening buildings and vegetation, and therefore represents a conservative extent of potential visual impacts. Because the visual catchment mapping for the southern ventilation outlet included in the Submissions and Preferred Infrastructure Report was based on the Amended Design, no change to the mapping is required as part of this modification request.

In the case of the northern ventilation outlet, the visual catchment mapping included in the Submissions and Preferred Infrastructure Report was based on the Approved Design. It is therefore based on a ventilation outlet tip height around seven metres lower than the design of the project as proposed to be constructed (the Approved Design at 194 metres AHD compared with the Amended Design at 200.8 metres AHD).

The difference in visual catchment between the Approved Design and the Amended Design (ie showing the change sought as part of this modification request) for the northern ventilation outlet is shown in the updated visual mapping provided in Attachment 1.

The updated visual envelope mapping shows minor increases in the visual envelope at distances up to one kilometre from the northern ventilation outlet. The increased visual envelope beyond one kilometre is likely to be associated with reduced visibility as a consequence of distance, and a greater likelihood of masking through intervening structures and vegetation (which as noted above have not been included in visual envelope mapping). Taking these factors into account, the change in potential visual catchment is likely to be minor.

Noise and vibration impact assessment

The noise and vibration impact assessment for project included in the Environmental Impact Statement, and updated through the Submissions and Preferred Infrastructure Report, considered potential project noise sources in and around the two ventilation facilities, including:

- The substation located within the ventilation facility complex (transformer noise source);
- The ventilation outlet tip (axial fan breakout noise source); and
- The nearby tunnel portals (jet fan breakout noise source).

Based on a review of these potential noise sources, contributions to noise levels at surrounding receivers were identified as being dominated by noise from the ventilation facility substations, with some further contribution from tunnel portal noise breakout. Noise contributions from the ventilation outlet tip were concluded to represent a minor, insignificant noise contribution in this context. As a consequence, the noise and vibration impact assessment included noise contributions from the ventilation facility substations and tunnel portal breakout, but did not include ventilation outlet tip noise.

The noise and vibration impact assessment for the project was therefore independent of and not affected by the design elevations of the ventilation outlets. No change to the noise and vibration impact assessment is required as part of this modification request.

Air quality impact assessment and associated human health risks

Modelling of the Amended Design (northern ventilation outlet)

The air quality impact assessment for the project included in the Submissions and Preferred Infrastructure Report (taking into account the increase in ventilation outlet to heights by five metres) was based on the Approved Design. Compared with the project design as proposed to be constructed (the Amended Design), this means that the air quality impact assessment assumed ventilation outlet tip heights that were:

- Around seven metres lower than proposed to be constructed in the case of the northern ventilation outlet; and
- Around one metre lower than proposed to be constructed in the case of the southern ventilation outlet.

As discussed in detail in the Submissions and Preferred Infrastructure Report, increasing the height of a ventilation outlet generally results in a decrease in ground level concentrations of emissions from the outlet. On this basis, it could be expected that the air quality impacts of the project presented in the Submissions and Preferred Infrastructure Report overestimate the likely impacts of the project as proposed to be constructed. In other words, constructing and operating the ventilation outlets with the Amended Design tip heights would result in lower impacts than presented in the Submissions and Preferred Infrastructure Report (Approved Design).

To confirm this anticipated outcome, the air quality model used as the basis for the Environmental Impact Statement and Submissions and Preferred Infrastructure Report has been rerun. The model rerun has applied identical assumptions and employed the same input data (as summarised in chapter 2 of the Submissions and Preferred Infrastructure Report), with the only change being the modelled ventilation outlet tip height (ie 200.8 metres AHD consistent with the Amended Design). The model was rerun for 'Design Analysis A', being the theoretical 'worst case' scenario involving the project tunnels carrying the maximum design throughput of traffic.

Design analysis A – this design analysis has been conducted to ensure that the project's ventilation system is adequately sized to cater for tunnels full of traffic. It assumes that during peak hours, the maximum number of vehicles that can fit into the tunnel (4,000 passenger car units per two lane main alignment tunnel adjusted for speed). This design analysis represents the physical limit of the main alignment tunnels and is based on forecast traffic volumes that are unlikely to eventuate due to a range of factors including traffic management measures, projected land use, employment, demographics and constraints on the surrounding surface road network. Design Analysis A was the case presented in the NorthConnex EIS as an appropriate conservative worst case.

The results of the model rerun for each relevant pollutant and each meteorological year are shown in **Table 3**. Cells shaded grey indicate results for the Amended Design that are equal to or greater than the results presented in the Submissions and Preferred Infrastructure Report for the Approved Design.

Table 3 shows that in most cases (with the exception of those maximum ground level concentrations shaded grey), the Amended Design (northern ventilation outlet tip at 200.8 metres AHD) would result in lower maximum ground level concentrations of pollutants than for the Approved Design used as a basis for the air quality impact assessment in the Submissions and Preferred Infrastructure Report (northern ventilation outlet tip at 194.2 metres AHD).

Notwithstanding, it is relevant to note that the maximum ground level concentration for each pollutant in any meteorological modelling year based on the Amended Design does not exceed the maximum equivalent value for any of the meteorological monitoring years based on the Submissions and Preferred Infrastructure Report results. For example, although the predicted ground level

concentration for maximum CO (1-hour) for the 2010 meteorological year is higher for the Amended Design than for the Approved Design, it is still lower than the highest predicted value for the Approved Design (predicted for the 2009 meteorological year).

Please note that the applicable assessment criteria for PM₁₀, NO₂ and CO is determined by the Approved Methods for the Modelling and Assessment of Air Pollutants (DEC, 2005) and the applicable assessment criteria for PM_{2.5} was adopted from the National Environment Protection Measure for Ambient Air Quality (Air NEPM) (NEPC, 2003). The assessment criteria apply to the maximum predicted total pollutant concentrations contributing to the background pollution concentration (100th percentile of output).

Table 3 – Air dispersion modelling results for the Approved Design and Amended Design (northern ventilation outlet, Design Analysis A) (all results in $\mu\text{g}/\text{m}^3$)

Scenario	Approved Design (as presented in the Submissions and Preferred Infrastructure Report)			Amended Design		
Ventilation outlet tip elevation	194.2 m AHD			200.8 m AHD		
Meteorological modelling year	2009	2010	2011	2009	2010	2011
Maximum PM_{10} (24-hour)	1.929	1.340	1.801	1.929	1.153	1.356
Maximum PM_{10} (annual)	0.092	0.110	0.116	0.075	0.091	0.113
Maximum $\text{PM}_{2.5}$ (24-hour)	1.821	1.270	1.705	1.821	1.087	1.282
Maximum $\text{PM}_{2.5}$ (annual)	0.087	0.104	0.110	0.071	0.086	0.106
Maximum CO (1-hour)	172.0	87.28	112.3	114.5	128.3	112.3
Maximum CO (8-hour)	58.97	37.23	36.67	51.45	27.53	30.48
Maximum NO_x (1-hour)	264.5	125.3	164.6	150.0	184.2	136.3
Maximum NO_x (annual)	1.513	1.800	1.920	1.175	1.365	1.232

Where predicted maximum ground level concentrations of pollutants modelled for the Amended Design are equal to or higher than the concentrations modelled for the Approved Design, these predictions occur for short averaging periods (24 hours or less).

Interrogation of modelling outputs and meteorological conditions indicates that the ‘anomalous’ results shaded grey in **Table 3** are:

- The result of isolated, infrequent ‘peak’ events that tend to skew the maximum concentration values for some pollutants under short averaging periods. A similar effect is not seen for longer averaging periods because isolated, infrequent ‘peak’ events are masked by the averaging of a significantly greater number of concentration values; and
- Caused by the same rare and infrequent meteorological conditions identified and discussed in the Submissions and Preferred Infrastructure Report. These rare and infrequent meteorological conditions include ventilation outlet tip downwash, and atmospheric drainage ‘switchback’.

Nitrogen dioxide (northern ventilation outlet)

The results presented in Table 3 also show that for the northern ventilation outlet with tip elevation at 200.8 metres AHD (Amended Design):

- The maximum 24-hour PM10 concentration (1.9 µg/m³) remains well below the applicable criterion[#] of 50 µg/m³;
- The maximum annual PM10 concentration (0.09 µg/m³) remains well below the applicable criterion[#] of 30 µg/m³;
- The maximum 24-hour PM2.5 concentration (1.8 µg/m³) remains well below the applicable advisory reporting standard of 25 µg/m³;
- The maximum annual PM2.5 concentration (0.1 µg/m³) remains well below the applicable criterion^{*} of 8 µg/m³;
- The maximum one-hour CO concentration (128 µg/m³) remains well below the applicable criterion[#] of 100,000 µg/m³; and
- The maximum eight-hour CO concentration (51 µg/m³) remains well below the applicable criterion[#] of 30,000 µg/m³.

[#] *Approved Methods for the Modelling and Assessment of Air Pollutants (DEC, 2005)*

^{*} National Environment Protection Measure for Ambient Air Quality (Air NEPM) (NEPC, 2003).

A more detailed assessment of ambient conversion of NO_x to NO₂ has not been conducted with dispersion modelling data for a northern ventilation outlet with tip height of 200.8 metres AHD. However, it is noted that:

- The maximum one-hour NO_x concentration for the Amended Design (184.2 µg/m³ in 2010) is lower than the maximum one-hour NO_x concentration for the Approved Design (264.5 µg/m³ in 2009); and
- The maximum annual NO_x concentration for the Amended Design (1.4 µg/m³ in 2010) is lower than the maximum one-hour NO_x concentration for the Approved Design (1.9 µg/m³ in 2011).
- The air quality impact assessment presented in the Submissions and Preferred Infrastructure Report for the northern ventilation outlet (Approved Design) demonstrated that for Design Analysis A (theoretical 'worst case' scenario involving the project tunnels carrying the maximum design throughput of traffic) resulted in:
 - A maximum one-hour NO₂ concentration of 70.4 µg/m³ which is below the applicable criterion of 246 µg/m³; and
 - A maximum annual NO₂ concentration of 1.3 µg/m³ which is below the applicable criterion of 62 µg/m³.

By corollary, the maximum 24-hour and annual NO₂ concentrations for the northern ventilation outlet with the Amended Design would also meet the applicable NO₂ criteria.

Assessment of the Amended Design (southern ventilation outlet)

As with the northern ventilation outlet, the air quality model applied to the air quality impact assessment for the project included in the Submissions and Preferred Infrastructure Report has been rerun for the southern ventilation outlet assuming a ventilation outlet tip height consistent with the Amended Design (ie 148.0 metres AHD). The results of this modelling are summarised in **Table 4**. The table shows that ground level concentrations of all pollutants would remain well below applicable ambient air quality criteria.

Table 4 also shows that the Amended Design would not result in higher ground level concentrations of any pollutant compared with the predicted impacts from the Approved Design, with the exception of one-hour CO and one-hour NO_x under 2010 meteorological conditions.

Table 4 – Air dispersion modelling results for the Approved Design and Amended Design (southern ventilation outlet, Design Analysis A) (all results in $\mu\text{g}/\text{m}^3$)

Scenario	Approved Design (as presented in the Submissions and Preferred Infrastructure Report)			Amended Design		
Ventilation outlet tip elevation	147 m AHD			148.0 m AHD		
Meteorological modelling year	2009	2010	2011	2009	2010	2011
Maximum PM_{10} (24-hour)	1.93	1.15	1.36	1.80	1.10	1.29
Maximum PM_{10} (annual)	0.075	0.091	0.113	0.073	0.088	0.109
Maximum $\text{PM}_{2.5}$ (24-hour)	1.82	1.09	1.28	1.70	1.03	1.22
Maximum $\text{PM}_{2.5}$ (annual)	0.071	0.086	0.106	0.069	0.083	0.103
Maximum CO (1-hour)	114.5	77.2	112.3	104.34	84.91	99.32
Maximum CO (8-hour)	51.4	25.9	30.5	48.1	24.8	29.2
Maximum NO_x (1-hour)	131.24	88.65	128.7 1	119.36	97.36	113.87
Maximum NO_x (annual)	0.816	0.988	1.216	0.796	0.958	1.172

Further analysis of one-hour CO and one-hour NO_x results with 2010 meteorology has been carried out because of the unexpected increase in ground level concentrations of these pollutants. As noted in relation to the northern ventilation outlet results, an increase in ventilation outlet height would ordinarily be expected to result in lower ground level concentrations.

In the case of both CO and NO_x (one-hour) in 2010, the highest ten ground level concentrations have been reviewed for the two most affected receiver locations (refer to **Table 5**). The table demonstrates that maximum one-hour values for both CO and NO_x are driven by a single, high concentration with the second highest (and subsequent) ground level concentrations significantly lower (less than half in both cases). Interrogation of the meteorological data used in the air quality assessment indicates that maximum ground level concentrations are the result of the same hour of meteorology in both cases – 8:00am on day 191 (10 July 2010).

Taking into account the single unusual hour of meteorology in 2010, the Amended Design would result in lower air quality impacts than the Approved Design.

Table 5 – Ten highest ground level concentrations at the two most affected receiver locations for one-hour CO and one-hour NO_x (all results in µg/m³)

Rank (top ten)	CO (1-hour)		NO _x (1-hour)	
	Most affected receiver	Second most affected receiver	Most affected receiver	Second most affected receiver
1	84.9	80.7	97.4	92.5
2	34.4	38.6	40.0	44.9
3	31.6	30.1	36.3	34.6
4	31.6	30.1	31.2	26.6
5	27.2	23.2	25.8	23.8
6	27.2	23.2	23.3	22.0
7	27.2	23.2	23.2	22.0
8	27.2	23.2	22.5	21.9
9	27.2	23.2	22.4	20.0
10	27.2	23.2	22.0	18.9

Potential human health risks

As demonstrated through the Environmental Impact Statement and the Submissions and Preferred Infrastructure, the key potential human health risks as a result of air quality changes as a result of the project are principally a function of annual average PM_{2.5} concentrations. **Table 3** and **Table 4** show that the Amended Design would result in lower annual average ground level concentrations of PM_{2.5} and therefore reduced human health risks relative to the Approved Design.

Summary and conclusions

As detailed in this modification request, updating condition B2 of the Minister's approval to reflect the Amended Design for the southern and northern ventilation outlets would:

- Not change the potential visual impacts of the project, as illustrated in the artist's impressions/ photomontages presented in the Submissions and Preferred Infrastructure Report;
- Not change the extent of the visual catchment for the southern ventilation outlet and would have a minor effect (expansion) on the visual catchment for the northern ventilation outlet;
- Not change the predicted noise impacts of the project;
- Generally reduce ground level concentrations of vehicle emissions as a result of the operation of the project's ventilation outlets; and
- Reduce the human health risks calculated based on operation of the project's ventilation outlets.

On this basis, the request to modify condition B2 to accurately reflect the Amended Design for the project is justified and would result in negligible additional visual impacts, and a general reduction in air quality impacts and associated human health risks. Clarifying condition B2 through reference to the base elevation of the ventilation outlets would also avoid potential misinterpretation of the design requirements for the ventilation outlets in the future.

Further information

Please do not hesitate to contact Nicholas Francesconi Nicholas.FRANCESCONI@rms.nsw.gov.au should you wish to discuss or clarify any aspect of this modification request.

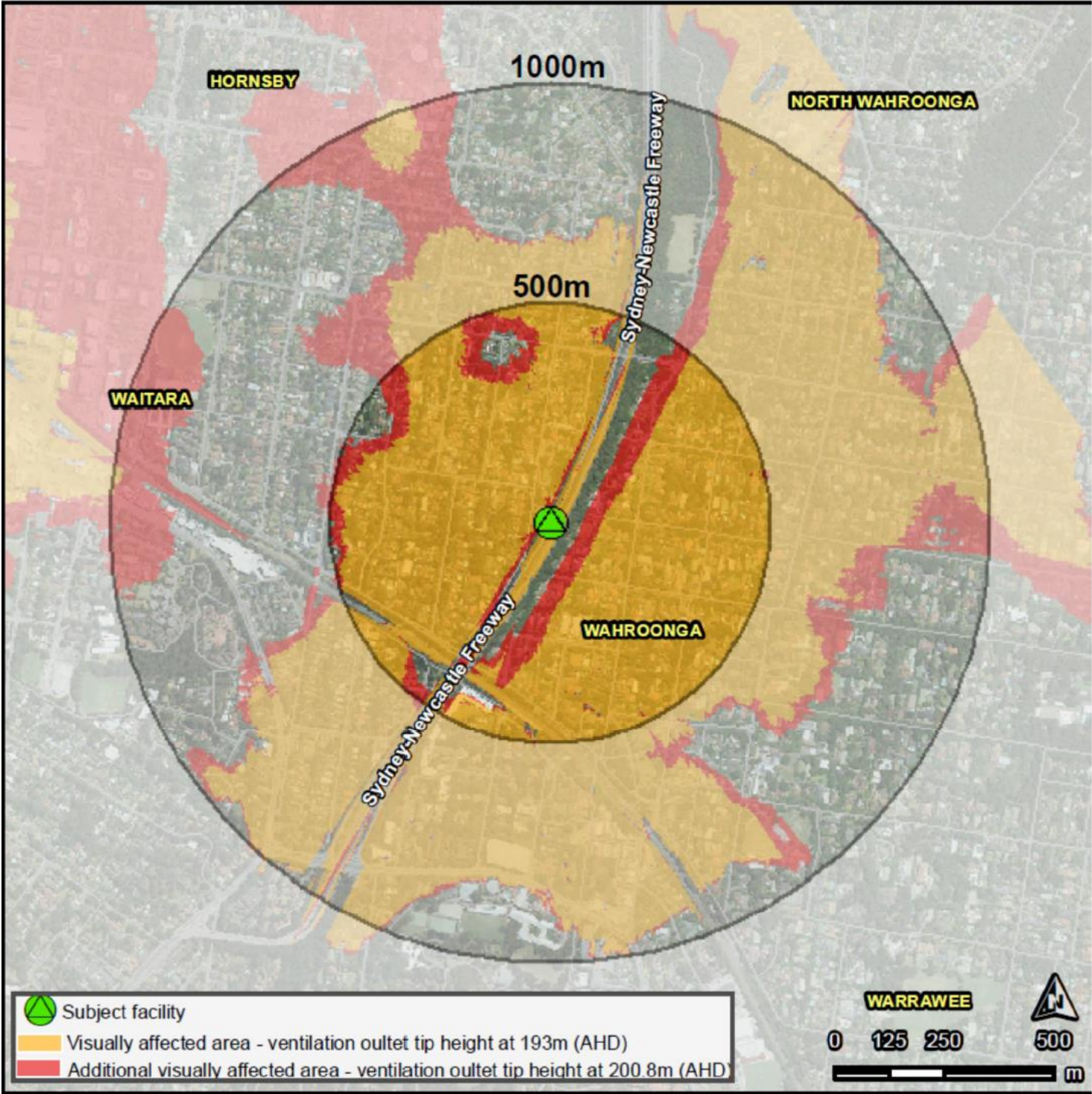
Yours sincerely,



SONJA SHAND

Senior Project Manager – NorthConnex

Attachment 1 – Updated visual catchment mapping (northern ventilation outlet)



Attachment 2 – NorthConnex – SSI 6136 – SPIR Extract (Artist Impressions of Ventilation Outlets)



Figure 9-5 Artists impression - M1 Pacific Motorway



Figure 9-6 Artists impression - end of Woonoona Avenue North



Figure 9-7 Artists impression - Woonoona Avenue North



Figure 9-10 Artists impression - Hills M2 Motorway and Pennant Hills Road Interchange



Figure 9-11 Artists impression - Pennant Hills Road and Copeland Road

**Attachment 3 – NorthConnex – SSI 6136 – Extracts from Urban Design Landscape Plan Stage 2
(Artist Impressions of Ventilation Outlets)**



Figure 6-20 Northern ventilation facility - view from M1 Pacific Motorway looking north



Figure 6-21 Northern interchange – M1 Pacific Motorway – aerial view looking southwest



Figure 6-22 Northern ventilation facility - view from M1 Pacific Motorway looking south



Figure 6-23 View from Woonona Avenue North looking southeast



Figure 6-24 Northern ventilation facility - view from Woonona Avenue North cul-de-sac



Figure 6-12: View of motorway operations complex - southern ventilation facility



Figure 6-14 View of motorway operations complex - maintenance centre - Pennant Hills Road looking west