2nd December 2014

Prof Mary O'Kane
NSW Chief Scientist & Engineer
Chair: Advisory Committee on Tunnel Air Quality

Dear Prof O'Kane

Please find below our review of the revised Submissions and Preferred Infrastructure Report (version received by us on 30th November 2014).

Yours sincerely

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Review of the NorthConnex EIS

Written by Ian Longley and Peter Sturm on behalf of the Advisory Committee on Tunnel Air Quality

2nd December 2014

The following review is based on the document "NorthConnex Submissions and Preferred Infrastructure Report, Chapter 2" delivered on Nov 30th 2014.

0 Main findings of the review

Compared to the EIS, and an early draft of the Submissions and Preferred Infrastructure Report (SPIR), we find that the document under review is much better presented. We find that most of the information, explanation and data required to enable an informed review are now present. The material is logically presented and assumptions are generally stated and justified.

In particular we find that the description of how in-tunnel air quality is to be assessed and maintained is now consistent and clear. Although some details of how a ventilation strategy is to be implemented are not explained, we believe such details are not necessary for an EIS. More significantly, we find that the ventilation design incorporates sufficient spare capacity to provide the operators with sufficient flexibility to meet in-tunnel exposure standards.

We find that the SPIR, together with the EIS, fulfils the purpose of describing the 'worst-case' air quality impact of the project with appropriate conservatism. The documentation is less comprehensive in terms of describing the spatial variation in effects and long-term (annual average) impacts. However, satisfactory indicative information is provided (e.g. three cross-road transects) and sufficient modelling and analysis has been conducted to extract such information at a future date.

Earlier criticisms regarding traffic, emission and meteorological modelling, data sources and assumptions have been addressed to our satisfaction.

Nevertheless the changing in wording supported by better explanations does not eliminate all of the problems mentioned in our original review. The major weaknesses of the assessment have been the relatively weak investigation of the current status of air quality in the project area (largely related to the late deployment of local project air quality monitoring), and a weak and poorly verified modelling strategy concerning cumulative concentrations (correct background concentration description and a proper modelling of surface road emissions). The efforts that have been taken to address these weaknesses are adequate given the timeframe set.

A few remaining issues are highlighted. Although we recommend that these issues are addressed we do not believe that this is critical to the satisfactory completion of the assessment.

Based on the SPIR chapter 2 and the experience with similar projects it can be concluded that – although not fully proved in the EIS and SPIR – the project will bring a net improvement of the local air quality along substantial parts of the Pennant Hills Road corridor. In the areas where additional pollution can be expected – particularly along M1 north of the tunnel portal, and to a lesser degree near M2 southwest of the interchange, and areas of possible impact due to ventilation buildings – the change in air quality is likely to be very small and air quality standards for NSW will not be violated due to the additional project emissions. However, the likelihood of a predicted increase in PM10 breaches when a higher background for roadside receptors was incorporated (table 2-63) should be investigated further.

We find that the EIS and SPIR now provide sufficient analysis for us to be confident that the air quality impacts of the project has been satisfactorily assessed.

1 Introduction: The process leading to this review

On the 10th October 2014 we (Drs Longley and Sturm) received a request from NSW Chief Scientist & Engineer, Mary O'Kane, to provide a report on behalf of the Advisory Committee on Tunnel Air Quality. This report was to provide advice on the appropriateness of the air quality modelling and the predicted air quality outcomes contained in the EIS for the NorthConnex proposal. Through subsequent email exchanges it was agreed that our scope could include an early draft (20 Oct 2014) of the Submissions and Preferred Infrastructure Report. Our review was delivered to the Committee in early November 2014.

In order to expedite a satisfactory response to our review, we were invited to attend two workshop-style meetings hosted by RMS on 14th November 2014 and 24th November 2014. Dr Longley attended both meetings in full in person, whereas Dr Sturm attended part of both meetings by telephone. The purpose of the first meeting was

1. for the proponents to explain their understanding of the criticisms presented in our review,
2. to correct any misunderstandings,
3. for the proponents to present proposed remedies,
4. for Drs Longley and Sturm to identify any problems with the proposed remedies.

At this meeting we were informed that the general approach being taken was to re-draft the Submissions and Preferred Infrastructure Report. It was also presented to us that, due to limited timeframe, no change in modelling methodology would be implemented. This is significant because one of our main recommendations was the re-modelling of background air quality and cumulative assessment.

We received an updated draft of the Submissions and Preferred Infrastructure Report on 22nd November 2014.

The purpose of the second meeting was for us to feedback on the updated draft, to identify any outstanding problems and to help the proponents prioritise the remaining work.

We received a final draft of the Submissions and Preferred Infrastructure Report on 30th November 2014.

The rest of this report constitutes our review of this final draft.

2 Section 2.5 Ventilation system design criteria

Page 55: CO and NO2 have now clearly been stated as 15 min exposure standard for the tunnel ventilation design. This is a clear statement - a reference to the ventilation control system or a statement for the need of implementing these criteria in the ventilation should be added.

As mentioned in the EIS the pollutant concentration used as a background/intake value (for ventilation design only) of 1 ppm (NO_x) is quite high and its choice is only briefly discussed. It should be noted that while this value provides significant spare capacity in the ventilation system, there is a risk that it could also lead to an oversized ventilation system. This should be re-visited as the ventilation operating protocols are developed.

3 Section 2.6.2 Assumptions and conservatism

3.1 Background air quality (reference to section 2.11)

On page 66 it is stated that the comparison between data from Project and Linfield/Prospect OEH monitoring station shows a good correlation with the project monitoring stations. This is an imprecise and potentially misleading statement which requires qualification. When looking at Table 2-52 the following statements can be made (maximum values are excluded as they are a product of unpredictable situations):

- PM10 average and 95 percentile: OEH is weakly conservative relative to project monitoring stations
- PM2.5 average and 95 percentile: OEH values are quite **below** all other stations
- NO2 95 average and 95 percentile: OEH values are higher than Headen Sports Park and James Park but lower than Rainbow Farm Reserve; OEH is much lower than roadside sites Observatory Park and Brickpit Park. This is understandable if it is appreciated that Observatory Park and Brickpit Park stations were located within 40 m of Penant Hills Road and are thus likely to be influenced by traffic emissions from that busy road (whereas Prospect and Lindfield are not). It is also plausible that Rainbow Farm is influenced by emissions from the motorways which lie ~180 m and 300 m away. If these three stations are disregarded as 'roadside' then it is reasonable to claim that NO2 concentrations at the OEH stations are comparable to those at the background project stations (Headen Sports Park and James Park). Remark: a comparison of NOx values would have been more appropriate.

As a result of this comparison it can be concluded that the use of the OEH sites to represent background air quality is appropriate and conservative for PM10, provides an under-estimate for PM2.5 and is appropriate but not conservative for NO2 if considering non-roadside receptors only.

3.2 Summary of assumptions and conservatism (page 65 ff)

Table 2.4 issue "Particulate matter ration (PM10:PM2.5)" regarding emissions (2nd page of this table): The anticipated reduction between PM10 and PM2.5 is wrong as the emission factors used for road traffic are already given as PM2.5 values.

Table 2.4 issue "surface road PM calculations" (3rd page of this table): see above, in addition as this unjustified reduction is already made at the emission part, it is now not clear if this done a second time at the dispersion part?

Table 2.4 issue "background PM10 to PM2.5 ratio" (5th page of this table): a ratio of 35% of PM2.5 in PM10 is anticipated. As the project air quality monitoring stations data at Headen Peak, Rainbow Farms Reserve and James Park show this ratio is much more than 50% for both average and 95 percentile value.

As a result of this the PM2.5 fraction is underestimated rather than overestimated in the background values. For the project contribution values (road traffic) the approach chosen would also underestimate the PM2.5 contributions, however, the PM2.5 tunnel emission factors from PIARC tend to overestimate the real situation, hence an overestimation for the PM2.5 project contribution is likely. The effects of this are partly handled in section 2.11.2 of the document

4 Adjustment of fleet contribution to the increased share of diesel cars

Table 2-47 and 2-48: The increased share of diesel cars has been taken into account and a sensitivity analysis has been performed. According to table 2-47 the in-tunnel air quality criteria can be fulfilled even with the increased NOx and PM values for the southbound peak hour traffic. For northbound traffic the max. NO2 concentration amounts to 1.54 mg/m³. Assuming still fluent traffic (~60 km/h) the 15 min exposure value for NO2 is also met.

Remark: concerning PM10/PM2.5 see remarks above.

5 Section 2.11.2 Approach to PM2.5

The issue of the above criticised PM2.5 to PM10 ratio (see topic 2.2 above) has been addressed in section 2.11.2 on page 211 ff and Table 2-53. As shown in that table the average 24 hour mean value will rise considerably. Nevertheless, according to the document the advisory reporting standards (25 µg/m³) is met, except on those locations in 2009 where the violations can be clearly attributed to the general background concentrations. Unfortunately no information is given on the impact on the yearly average value.

Conclusion: The issue has been addressed; the impact of an increased PM2.5 share is considerable. However, at least for the few receptor points indicated in the “Submission and preferred infrastructure report” Chapter 2.11.2, the overall statement concerning the conformity with the 24 hour advisory reporting standard is given. A statement concerning the overall impact on all project related receptors for the 24 hour mean value and the annual average value is missing.

6 Section 2.11.3 Representativeness of background air quality data

The comparison is based on the OEH data and the project monitoring data from the stations Rainbow Park Reserve, James Park and Headen Sports Park.

The format of figures 2-13 and 2-14 is unfortunate as it is hard to make any general conclusions. Given that these are contemporaneous data a correlations plot would facilitate much clearer comparison than times series. The statement “Overall, the maximum Prospect/ Lindfield data are considered to be representative of NO2 levels in the project area, and slightly higher than data collected from monitoring stations along the project corridor in most cases” cannot be verified from the material provided. However, we agree that large deviations between OEH and project site data are not apparent and we find that the use of OEH data to represent background NO_2 levels at non-roadside sites in the project area is appropriate. For PM10 data figure 2-14 indicates that concentrations between OEH and project sites are of similar magnitude on average, but there are clearly periods when there is significant deviation. We find that the use of non-local data in this way is not ideal, but given that the OEH PM10 data is weakly conservative on average we find that it is acceptable in this case, and that use of entirely local data is unlikely to have made a material difference to the outcomes of the assessment.

The usage of OEH data for defining the background concentrations without surface road contributions is justified.

7 Section 2.13.3 Surface road modelling (CAL3QHCR)

Our major methodological criticism of the original EIS related to the combined use of non-local observational data and surface road modelling to provide an estimate of background air quality. Compared to the original EIS, the documentation of the surface road modelling has improved substantially and is now more amenable to critique. It should be noted that our recommendation to re-conduct the modelling was not implemented on the basis of limited time available.

Substantial additional analysis has been conducted regarding the surface roads modelling. This has largely been required because the original methodology was found to not be conservative within close proximity to existing significant surface roads. This was important because much of the impact of the stacks was found to lie within this 'roadside corridor'. The additional work undertaken is adequate given the timeframe set, but may not have been necessary had a better approach, and timely local monitoring data, been available from the start.

The 'verification' of the model is based on a comparison of 2014 monitoring data with 2019 fleet and emission data. The claim that the error in traffic data (volume and fleet 2019) is compensated by the error in emission data (usage of 2019) is plausible but unsubstantiated.

Figures 2-15 to 2-18 show comparisons between model output and monitoring data.

Figs. 2-15 or Fig. 2-16 contain very little information – it is not possible to tell from these whether the model is performing well or poorly, other than the range of values predicted and observed are similar. However, we agree with the statement "These comparisons results demonstrate that the surface road modelling predictions do not account for 100 per cent of the background pollutant concentrations measured at the Brickpit Park and Observatory Park monitoring stations."

Figures 2-17 and 2-18 concern PM2.5. Here it is visible that there is in general at least a 2-fold difference between calculation and measurement, i.e. the calculation is giving 50% and less of the monitoring data (except during one period mid-March to mid-June at Brickpit Park).

Table 2-60 and Table 2-61 show the monitored values at roadside Observatory Park and Brickpit Park, compared to the background station Headen Sports Park. The difference between roadside and ambient background is attributed to the contribution from emissions on Penant Hills Road. This road contribution is then compared to estimated (calculated CAL3QHCR) road contribution. There seems to be a quite reasonable correlation between these two data sets (calculation and monitored).

There are two things to be questioned. Vehicle exhaust contributes already to 100 % to PM2.5, however monitoring data provides a ratio of 24%. This would mean that a large amount of PM10-PM2.5 emissions derive from non-exhaust sources. This would contradict the assumption within the emission calculation that the PIARC emission factor for PM10 (exhaust and non-exhaust) is already identical to PM2.5.

Based on this comparison a further sensitivity analysis was conducted comparing different regimes for background concentrations (Table 2-63). This approach results in higher cumulative concentrations, but does not change the status of compliance with the NEPM for NO2 and PM2.5. On the other hand four additional exceedances for PM10 are calculated.

Remark to last paragraph page 244: no data is presented to justify why the additional roadside increment in concentrations is only applicable within 30 m from kerbside. This statement should be adjusted.

An increased background contribution has been calculated to account for shortcomings in the original methodology. The results from this sensitivity analysis do not alter the general statement about the compliance with the air quality standard made in the EIS.

8 Section 2.14.1 Cumulative impacts – consideration of background air quality

Page 248 and Figure 2-19 deal with an alternative approach. The alternative approach uses the OEH ambient monitoring data as background, the change in surface road pollutants as ‘surface road’ contribution and the ventilation outlet contribution to end up with the ‘total cumulative pollutants concentration’. Such an approach can only be taken when the ‘background’ is the real ‘status quo’ description of the air quality at that receptor point. The OEH station values do not describe the ‘real status quo situation’ in the project area. Hence it must fail in describing properly any project related cumulative situation. Hence any further discussion about this method is not productive.

9 Concentration values at transects north (M1) and south-west (M2) of the NorthConnex tunnel

Pages 252 ff deal with the impact of project related additional traffic on air quality. Three so called transects are considered. One in the north at a location of increased traffic, one in the middle where traffic reduction on surface roads is predicted and one in the south, west of the interchange with the M2 where additional traffic is forecast. The results for the receptor points using the project method (with all its problems) show that the air quality standards are met for NO2 and PM10.

Conclusion: the additional traffic on the M1 and M2 south west and north of the tunnel project do not result in inacceptable air quality concentrations at the chosen receptor points

10 Section 2.15 Operational impact assessment

Table 2-78 and associated text page 304: in the text to Table 2-78 it is written that "…with an increase in ventilation outlet height, most ground level concentrations would decrease by a significant percentage (..): However, counterintuitively, some peak ground level concentrations of emissions are predicted to increase, despite increase in ventilation outlet height". Further on it is stated that this is "still within the applicable impact assessment criteria".

Such explanations are curious. It is in the nature of a model which does the impact calculation on a receptor grid, that it does not necessarily always predict the maximum value, if the algorithm is not programmed in a way to change the receptor grid until the maximum ground-level contribution is found. It seems that in the 15 m height case the maximum concentration at ground level was not depicted and now in the 20 m case this is more likely. Nevertheless it could be still the case that the maximum ground level contribution is not calculated. Such results show clearly that the receptor grid points were not set densely enough during the EIS. Section 2.15.2 tries to explain this and some other issues. However, it doesn't influence the overall result as the absolute values are quite small.

11 Overall conclusion

Considering the short timeframe given for the review of the document "Submission and preferred infrastructure report, Chapter 2 (pages 45 to 362)" the following conclusions can be made:

- Most of our original criticisms of the EIS have now been addressed. The document is more comprehensive and easier to read.
- Nevertheless the changing in wording supported by better explanations does not eliminate all of the problems mentioned in our original review. The major weaknesses of the assessment have been the relatively weak investigation of the current status of the air quality in the project area (largely caused by the late deployment of local project air quality monitoring), and a clear and verified modelling strategy concerning cumulative concentrations (correct background concentration description and a proper modelling of surface road emissions). The efforts taken to address these weaknesses are adequate given the timeframe set.
- The issues of changes in diesel fleet contributions as well as their impact on NO2 concentrations have been addressed.
- The issue of a change in the PM2.5 to PM10 ratio in the project area has been addressed.
- The issue of the impact of additional traffic on the M1 north and the M2 southwest of the tunnel project has been addressed.

Based on the SPIR chapter 2 and the experience with similar projects it can be concluded, that – although not fully proved in the EIS and SPIR – the project will bring a net improvement of the local air quality along substantial parts of the Pennant Hills Road corridor. In the areas where additional pollution can be expected – particularly along M1 north of the tunnel portal, and to a lesser degree near M2 southwest of the interchange, and areas of possible impact due to ventilation buildings – the change in air quality is likely to be very small and air quality standards for NSW will not be violated due to the additional project emissions.