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Volume 4

Environmental Impact Statement

Submissions and Preferred Infrastructure Report
Chapters 9 - 12 and Appendices

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Roads and Maritime Services

NorthConnex

Submissions and preferred infrastructure report

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9 Preferred Infrastructure Report

9.1 Overview

During and subsequent to the exhibition of the environmental impact statement, five changes have been made to the project described in the environmental impact statement. These changes are a result of ongoing design development, refinement of construction methods or in response to concerns raised in public submissions and other community and stakeholder engagement mechanisms. These five changes are:

- Increase in the height of the northern and southern ventilation outlets by five metres based on the outcome of further consideration of alternative ventilation design configurations documented in **Section 3.2** of this report.
- Increase in bus movements per hour from the Pioneer Avenue compound (C8), to maximise use of this facility and to minimise potential construction employee traffic and parking impacts on the road network surrounding the other construction compounds.
- Amended construction haulage routes for the southern interchange compound (C5), the Trelawney Street compound (C7) and the northern interchange compound (C9) to reduce impacts on local residential roads.
- Inclusion of additional uses at the Junction Road compound (C11), to allow for construction materials laydown and improve construction phase management.
- Additional property acquisition at the Wilson Road compound (C6) to provide safe access arrangements.

Bracketed references to construction compounds are consistent with those used throughout the environmental impact statement.

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9.2 Increased height of the ventilation outlets (plus five metres)

9.2.1 Description of changes

Based on further analysis of ventilation system design options and alternatives presented in **Section 3.2** of this report, an increase in the height of the northern and southern ventilation outlets by five metres has been identified as a feasible and reasonable measure to optimise the ventilation systems and further reduce the ambient air quality impacts and associated human health risks as a result of operation of the project.

As such, the project is proposed to be amended to increase the ventilation outlet heights by five metres.

9.2.2 Environmental overview of changes

The increase in ventilation outlet height from that presented in the environmental impact statement has been reviewed to identify relevant potential environmental impacts for further, more detailed assessment. This review has concluded that an increase in the height of the ventilation outlets would result in changes to:

- Ambient air quality. Further assessment of ambient air quality impacts has therefore been conducted, and is included in **Section 9.2.3**.
- Human health impacts. Further assessment of human health impacts has therefore been conducted, and is included in **Section 9.2.4**.
- Operational visual impacts. Further assessment of operational visual impacts has therefore been conducted, and is included in **Section 9.2.5**.

The change in ventilation outlet height would not affect other environmental and land use impacts. In particular, the noise and vibration performance of the ventilation outlets is not anticipated to change as a result of the increase in ventilation outlet height.

9.2.3 Ambient air quality

The increased height of the ventilation outlets would alter the potential ambient air quality impacts of the project. As part of the revised air quality impact assessment, changes have been made to the assessment methodology to address relevant issues raised in submissions, including those from the Environment Protection Authority, NSW Health and various members of the community. Key changes have included:

- Increased resolution in the receiver grid applied around each ventilation outlet (ie reduced receiver grid spacing).
- Application of higher resolution topographic data.
- Revision of future projections of vehicle fleet fuel mix, to reflect an increased use of diesel fuel in the future).
- Amendment to the ozone limiting method equation to take into account a NO_2:NO_x ratio of 16 per cent, as recommended by the Environment Protection Authority.

A summary of how these changes have been made to the air quality impact assessment is provided in **Table 9-1**. Full details of the methodology, assumptions and inputs that have been applied to this air quality impact assessment are provided in **Chapter 2** of this report.

Table 9-1 Changes to dispersion model inputs

Issue raised with the EIS assessment	Change made to the assessment approach
Receiver grid spacing of 150 metres may be too coarse.	The receiver grid has been recalculated for the following refined spacings: • 25 metre spacing for an area of 500 metres by 500 metres centred on each ventilation outlet. • 50 metre spacing for an area of 1,000 metres by 1,000 metres centred on each ventilation outlet. • 100 metre spacing for an area of 4,000 metres by 4,000 metres centred on each ventilation outlet.
The 90 metre SRTM topographic data used to determine the receiver grid elevations may be too coarse or may not reflect local conditions.	The topographic data have been re-extracted using five metre resolution Land and Property Information (LPI) data. The elevations of the discrete receivers and the ventilation outlet locations have been identified using this revised data.
Vehicle fleet composition data was based on 2013 Australia Bureau of Statistics data. This may potentially underestimate the future percentage of diesel vehicles as sales trends show an increase in diesel passenger vehicles.	2008 and 2013 Australian Bureau of Statistics data have been used to extrapolate predicted fleet compositions for 2019 and 2029. The data have then been used when calculating vehicle emissions to inform the project's emissions inventory. The emission rates in the air quality dispersion model have been adjusted accordingly.
Ozone limiting method (OLM) equation does not reflect the ratio of NO_2:NO_x identified from the NSW vehicle fleet by the Environment Protection Authority.	The ozone limiting method calculation has been amended to reflect a NO_2:NO_x of 16 per cent, as detailed in the response to the submission made by the Environment Protection Authority (refer to **Section 7.1.1.3** of this report).

Table 9-2 summarises the outcomes of the revised air quality dispersion modelling, under forecast traffic volumes in 2019 and 2029, and for 'design analysis A' (the worst case traffic scenario). Modelling outputs are presented as project contributions (without the addition of background pollutant concentrations), for direct comparison with modelling outcomes for the original ventilation outlet heights (as presented in the environmental impact statement).

Table 9-3 presents the outcomes of the air quality modelling included in the environmental impact statement and compares them with the outcomes of the revised air quality dispersion modelling. As expected with an increase in ventilation outlet height, most ground level concentrations of emissions would decrease by a significant percentage (up to 60 per cent reduction in some cases), although it is recognised that the concentrations were originally very low and remain very low. However, counterintuitively, some peak ground level concentrations of emissions are predicted to increase, despite the increase in ventilation outlet heights. This would only occur for one hour in three years and is still within the applicable impact assessment criteria.

Further analysis has identified the cause of this increase in some peak ground level concentrations as the same rare meteorological conditions that produced the infrequent elevated NO_2 concentrations presented in the environmental impact statement. This issue has been discussed in response to the submission received from the Environment Protection Authority (refer to **Section 7.1.1.3** of this report) and is analysed in more detail below.

Table 9-2 Revised predicted air quality outcomes for project operation in 2019, 2029 and design analysis A (increased ventilation outlet height)

Pollutant	Averaging period	Value	Predicted maximum project contributions (μg/m^3)						Impact assessment criteria/ standards (μg/m^3)
			With project – forecast traffic in 2019		With project – forecast traffic in 2029		Design analysis A		
			Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	
PM_{10}	24 hour maximum	Peak project contribution	1.0	0.6	1.3	1.2	1.8	1.9	50
		% of criterion	2.0%	1.3%	2.6%	2.4%	3.6%	3.9%	-
	Annual average	Peak project contribution	0.05	0.05	0.08	0.06	0.12	0.11	30
		% of criterion	0.2%	0.2%	0.3%	0.2%	0.4%	0.4%	-
$PM_{2.5}$	24 hour maximum	Peak project contribution	1.0	0.6	1.2	1.1	1.7	1.8	25
		% of reporting standard	2.5%	4.8%	4.5%	6.8%	7.3%	2.5%	-
	Annual average	Peak project contribution	0.05	0.04	0.08	0.05	0.11	0.11	8
		% of reporting standard	0.6%	0.5%	1.0%	0.7%	1.4%	1.3%	-
NO_2	1 hour maximum	Peak project contribution	54.3	69.0	58.3	76.0	70.4	91.8	246
		% of criterion	22.1%	28.0%	23.7%	30.9%	28.6%	37.3%	-
	Annual average	Peak project contribution	0.6	0.8	0.8	1.3	1.3	1.8	62
		% of criterion	1.0%	1.3%	1.3%	2.0%	2.1%	2.9%	-
CO	1 hour maximum	Peak project contribution	181.8	48.4	217.5	57.9	172.0	114.5	100,000
		% of criterion	0.18%	0.05%	0.22%	0.06%	0.17%	0.11%	-

Pollutant	Averaging period	Value	Predicted maximum project contributions (μg/m^3)						
			With project – forecast traffic in 2019		With project – forecast traffic in 2029		Design analysis A		Impact assessment criteria/ standards (μg/m^3)
			Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	
	8 hour maximum	Peak project contribution	36.0	17.2	45.5	31.5	59.0	51.5	30,000
		% of criterion	0.12%	0.06%	0.15%	0.10%	0.20%	0.17%	-
Total VOC	1 hour 99.9th percentile	Peak project contribution	2.6	1.7	3.5	2.3	5.4	4.2	29*
		% of criterion	9.1%	5.8%	12.2%	8.0%	18.5%	14.6%	-
PAHs	1 hour 99.9th percentile	Peak project contribution	0.0005	0.0003	0.0006	0.0004	0.0011	0.0008	0.4**
		% of criterion	0.12%	0.08%	0.15%	0.10%	0.27%	0.21%	-

* as benzo(a)pyrene ** as benzene

Table 9-3 Comparison of revised air quality modelling results against EIS modelling results

Pollutant	Averaging period	Design	Predicted maximum project contributions (μg/m^3)						Impact assessment criteria (μg/m^3)
			With project – forecast traffic in 2019		With project – forecast traffic in 2029		Design analysis A		
			Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	
PM_{10}	24 hour maximum	+5 metre ventilation outlet	1.02*	0.65	1.28	1.18	1.80	1.93	50
		EIS predictions	0.95	1.39	1.37	2.14	2.23	3.13	
		% change	**7%***	**-53%**	**-7%**	**-45%**	**-19%**	**-38%**	
	Annual average	+5 metre ventilation outlet	0.05	0.05	0.08	0.06	0.12	0.11	30
		EIS predictions	0.09	0.11	0.11	0.13	0.17	0.26	
		% change	**-41%**	**-60%**	**-25%**	**-58%**	**-32%**	**-57%**	
$PM_{2.5}$	24 hour maximum	+5 metre ventilation outlet	0.96*	0.62	1.20	1.13	1.70	1.82	25
		EIS predictions	0.90	1.34	1.30	2.01	2.11	2.97	
		% change	**7%***	**-54%**	**-7%**	**-44%**	**-19%**	**-39%**	
	Annual average	+5 metre ventilation outlet	0.05	0.04	0.08	0.05	0.11	0.11	8
		EIS predictions	0.08	0.11	0.10	0.13	0.16	0.25	
		% change	**-41%**	**-60%**	**-25%**	**-59%**	**-31%**	**-57%**	
NO_2	1 hour maximum	+5 metre ventilation outlet	54.3	69.0**	58.3	76.0**	70.4	91.8	246
		EIS predictions	68.9	61.8	74.6	65.0	114.8	98.2	
		% change	**-21%**	**12%****	**-22%**	**17%****	**-39%**	**-7%**	

Pollutant	Averaging period	Design	Predicted maximum project contributions (μg/m^3)						Impact assessment criteria (μg/m^3)
			With project – forecast traffic in 2019		With project – forecast traffic in 2029		Design analysis A		
			Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	Northern ventilation outlet	Southern ventilation outlet	
CO	Annual average	+5 metre ventilation outlet	0.6	0.8	0.8	1.3	1.3	1.8	62
		EIS predictions	1.4	1.2	1.7	1.4	2.5	2.4	
		% change	**-55%**	**-31%**	**-53%**	**-10%**	**-47%**	**-24%**	
	1 hour maximum	+5 metre ventilation outlet	181.8**	48.4	217.5**	57.9	172.0	114.5	100,000
		EIS predictions	86.6	70.1	107.4	90.3	179.3	166.7	
		% change	**110%****	**-31%**	**103%****	**-36%**	**-4%**	**-31%**	
	8 hour maximum	+5 metre ventilation outlet	36.0**	17.2	45.5	31.5	59.0	51.5	30,000
		EIS predictions	32.4	33.1	54.2	57.9	80.3	81.7	
		% change	**11%****	**-48%**	**-16%**	**-46%**	**-27%**	**-37%**	
Total VOC	1 hour 99.9th percentile	+5 metre ventilation outlet	2.63	1.67	3.53	2.33	5.35	4.24	29***
		EIS predictions	4.07	3.72	5.38	5.36	7.40	8.96	
		% change	**-35%**	**-55%**	**-35%**	**-56%**	**-28%**	**-53%**	
PAHs	1 hour 99.9th percentile	+5 metre ventilation outlet	0.0005	0.0003	0.0006	0.0004	0.0011	0.0008	0.4****
		EIS predictions	0.0007	0.0007	0.0009	0.0009	0.0015	0.0018	
		% change	**-34%**	**-54%**	**-31%**	**-56%**	**-28%**	**-53%**	

* Occurs 1 day in three years ** Occurs 1 hour in three years *** as benzo(a)pyrene **** as benzene

When compared to the concentrations presented in the environmental impact statement, the increase in ventilation outlet heights by five metres generally results in a decrease in ground level concentrations. For the forecast traffic volumes, these decreases are:

- Annual average PM_{10} and $PM_{2.5}$ concentrations, up to 60 per cent at the southern ventilation outlet and up to 41 per cent at the northern ventilation outlet.
- Annual average nitrogen dioxide concentrations, up to 31 per cent at the southern ventilation outlet and up to 55 per cent at the northern ventilation outlet.
- Eight hour maximum carbon monoxide concentrations, up to 48 per cent at the southern ventilation outlet and up to 16 per cent at the northern ventilation outlet.
- Total volatile organic compounds, up to 56 per cent at the southern ventilation outlet and up to 35 per cent at the northern ventilation outlet.
- Polycyclic aromatic hydrocarbons, up to 56 per cent at the southern ventilation outlet and up to 34 per cent at the northern ventilation outlet.

There is, however, an increase in some pollutants for some averaging periods. As identified above some changes have been made to the dispersion modelling inputs and, therefore, the revised concentrations are not directly comparable with those presented in the environmental impact statement. These changes to the dispersion modelling input may explain some of these increases in pollutants. The meteorological conditions during these modelling outcomes have also been investigated. The period of this increase is limited to one day over three years (in the case of particulate matter) or one hour over three years (in the case of nitrogen dioxide and carbon monoxide).

A detailed analysis of the rare and infrequent meteorological conditions that cause predicted peak concentrations of some pollutants to increase is provided in **Section 2.15.2** of this report. This analysis demonstrates that these predicted peak pollutant concentrations are rare and not typical of normal conditions experienced during operation of the project.

Rare peak concentrations have been identified as being caused by predicted strong winds. As wind speed increases with height above the ground, the wind speeds occurring at the top of the increased ventilation outlets are higher than experienced at the top of the ventilation outlets as presented in the environmental impact statement.

When the ambient winds are higher than the exit velocity of the plume, such as occurs during the predicted peak concentrations, outlet tip downwash is more likely to occur (where the plume is quickly brought down towards ground level before any substantial dispersion can occur). Such conditions occur rarely (refer to **Section 2.15.2**), and while the ambient wind speeds calculated by the meteorological model are likely to be overestimates of actual conditions, it is possible for these conditions to occur. As such, the meteorological conditions and the associated pollutant predictions are considered to be valid, but conservative.

This issue can be further contextualised by considering the relative contributions of the project to ambient pollutant concentrations, as distinct from the contributions made by background air quality. A review of the pollutants which show increased concentrations is provided below (NO_2, CO and particulate matter (PM_{10} and $PM_{2.5}$).

Nitrogen dioxide

Figure 9-1 shows the frequency distribution for predicted nitrogen dioxide (one hour average) contributions at the most affected receiver location. The figure shows predictions for ventilation heights as presented in the environmental impact statement and with an increase in ventilation outlet height by five metres. Data are presented for 2019, being the year in which modelling outcomes have been identified as increasing above the predictions presented in the environmental impact statement.

Data presented in **Figure 9-1** are also provided numerically in **Table 9-4**.

Figure 9-1 and **Table 9-4** show:

- The maximum project contribution of nitrogen dioxide (one hour average) at the most affected location in 2019 (69 µg/m^3) for the increased ventilation height configuration would be an unusual and infrequent event. Nitrogen dioxide concentrations of this level are only expected to occur for one hour in three years (around 0.004 per cent of the time).
- The peak value is nearly twice the second highest concentration, confirming the anomalous nature of the peak value.
- For all but four hours in the three year period assessed, the project contributions are expected to be less than 30 µg/m^3 (12 per cent of the applicable criterion).
- Over a three year period, the contribution from the project is expected to represent less than four per cent of the applicable ambient air quality criterion for NO_2 (one hour average) (20 µg/m^3) for 98 per cent of the time.
- The predicted concentrations for the increased ventilation outlet height configuration are clearly lower than the environmental impact statement predictions for the vast majority of the hours ranked between the third highest and 500th highest predicted concentrations. Beyond this, predicted concentrations for all scenarios (original ventilation outlet height and increased ventilation height are all very low (less than 10 µg/m^3)
- Overall, with the exception of the singular peak concentration (one hour in three years), the project contribution of nitrogen dioxide to the airshed would be minor and less than that predicted in the environmental impact statement.

Table 9-4 Frequency of NO_2 (one hour average) project contributions at the most affected location (2019 forecast traffic, increased ventilation outlet height)

Project contribution (NO_2, one hour) (µg/m^3)	Number of hours in three years	Percentage of hours in three years	Percentage of ambient air quality criterion
Maximum – 68.96 µg/m^3	1	0.004%	28%
35 µg/m^3 to 68.96 µg/m^3	2	0.008%	14% to 28%
30 µg/m^3 to 35 µg/m^3	1	0.004%	12% to 14%
20 µg/m3 to 30 µg/m^3	95	0.36%	8% to 12%
10 µg/m^3 to 20 µg/m^3	439	1.67%	4% to 8%
Total	**538**	**2.0%**	**> 4%**

Carbon monoxide

Figure 9-2 shows the frequency distribution for predicted carbon monoxide (one hour average) contributions at the most affected receiver location. The figure shows predictions for ventilation heights as presented in the environmental impact statement and with an increase in ventilation outlet height by five metres. Data are presented for 2019, being the year in which modelling outcomes have been identified as increasing above the predictions presented in the environmental impact statement.

Data presented in **Figure 9-2** are also provided numerically in **Table 9-5**. The figure and the table show:

- The maximum project contribution of carbon monoxide (one hour average) at the most affected location in 2019 (181.8 µg/m^3) for the increased ventilation outlet height configuration would be an unusual and infrequent event. This peak concentration is predicted to occur for only one hour in three years (around 0.004 per cent of the time).
- The peak value is more than twice the second highest predicted concentration, confirming the anomalous nature of the peak value.
- Project contributions of less than 1 µg/m^3 (ie less than 0.003 per cent of the applicable criterion) are predicted to occur more than 99 per cent of the time.
- The predictions for the increased ventilation outlet height configuration are clearly lower than the environmental impact statement predictions for the hours ranked between the fifth and 400th highest prediction concentration.
- Overall, the predicted project contribution of carbon monoxide to the airshed is considered would be minor and less than that predicted in the environmental impact statement.

Table 9-5 Frequency of CO (one hour average) project contributions at the most affected location (2019 forecast traffic, increased ventilation outlet height)

Project contribution (CO, one hour) (µg/m^3)	Number of hours in three years	Percentage of hours in three years	Percentage of ambient air quality criterion
Maximum – 181.8 µg/m^3	1	0.004%	0.6%
100 µg/m^3 to 181.8 µg/m^3	0	0%	0.3% to 0.6%
30 µg/m^3 to 100 µg/m^3	2	0.008%	0.1% to 0.3%
5 µg/m^3 to 30 µg/m^3	13	0.05%	0.02% to 0.1%
1 µg/m^3 to 5 µg/m^3	185	0.7%	0.003% to 0.02%
Total	**201**	**0.8%**	**> 0.003%**

Particulate matter

Analysis of particulate matter has focused on $PM_{2.5}$, given its significance in terms of human health risks. The outcomes would be very similar for PM_{10}, noting the similarity in mass emissions of PM_{10} and $PM_{2.5}$ from the project's ventilation outlets.

Figure 9-3 shows the frequency distribution for predicted $PM_{2.5}$ (24 hour average) contributions at the most affected receiver location. The figure shows predictions for ventilation heights as presented in the environmental impact statement and with an increase in ventilation outlet height by five metres. Data are presented for 2019, being the year in which modelling outcomes have been identified as increasing above the predictions presented in the environmental impact statement.

Data presented in **Figure 9-3** are also provided numerically in **Table 9-6**. The figure and the table show:

- The maximum project contribution of $PM_{2.5}$ (24 hour average) at the most affected location in 2019 (0.96 µg/m^3) would be an unusual and infrequent event. This peak concentration is predicted to occur for only one day in three years (around 0.09 per cent of the time).
- The peak value is more than twice the second highest concentration, confirming the anomalous nature of the peak concentration.
- The project contributions of $PM_{2.5}$ (24 hour) are expected to be less than 0.05 µg/m^3 (0.002 per cent of the advisory reporting standard) for more than 99 per cent of the time.
- The predicted project contributions for the increased ventilation outlet height configuration are clearly lower than the environmental impact statement predictions for the days ranked between third and 200th highest predicted concentrations.
- The project contribution of $PM_{2.5}$ would be minor and less than that predicted in the environmental impact statement.

Table 9-6 Frequency of $PM_{2.5}$ (24 hour average) project contributions at the most affected location (2019 forecast traffic, increased ventilation outlet height)

Project contribution (PM_{10}, 24 hour) (µg/m^3)	Number of days in three years	Percentage of days in three years	Percentage of reporting standard
Maximum – 0.96 µg/m^3	1	0.09%	2%
0.4 µg/m^3 to 0.96 µg/m^3	0	0%	1% to 2%
0.1 µg/m^3 to 0.4 µg/m^3	2	0.18%	0.% to 1%
0.05 µg/m^3 to 0.1 µg/m^3	2	0%	0.02% to 0.2%
0.01 µg/m^3 to 0.05 µg/m^3	144	13%	0.002% to 0.02%
Total	**149**	**14%**	**> 0.002%**

Conclusion

The outcome of this investigation into the peak concentrations is supported by the modelling predictions for total volatile organic compounds and polycyclic aromatic hydrocarbons, which are reported as 99.9th percentile concentrations (which exclude the peaks). The increased ventilation outlet height configuration results for these pollutants are between 28 per cent and 55 per cent lower than the environmental impact statement predictions. Furthermore, the predicted annual average concentrations for the increased ventilation outlet height configuration, which represent longer term trends, are all much lower than presented in the environmental impact statement.

Based on the analysis presented in **Section 2.15.2** of this report, the meteorological conditions that cause predicted peak ground level concentrations are rare events that would not be characteristic of typical conditions during operation of the project.

The analysis presented in **Section 2.15.2** has identified a number of factors affecting predicted short term average concentrations of emissions around the northern and southern

ventilation outlets. These include rare and infrequent meteorological conditions leading to outlet tip downwash, and conditions associated with onshore-offshore winds.

Based on the results provided, the increase in ventilation outlet heights results in an overall decrease in concentrations with the exception of a very small number of hours that are characterised by outlet tip downwash conditions. These downwash conditions are not common and can be considered a rare event and not likely to result in regular ongoing elevated pollutant concentrations. The analysis presented above also demonstrates that although onshore-offshore wind switch occur regularly, the frequency of these conditions leading to an elevated ground level concentration is very low (so as to be an extreme outlier in the data set).

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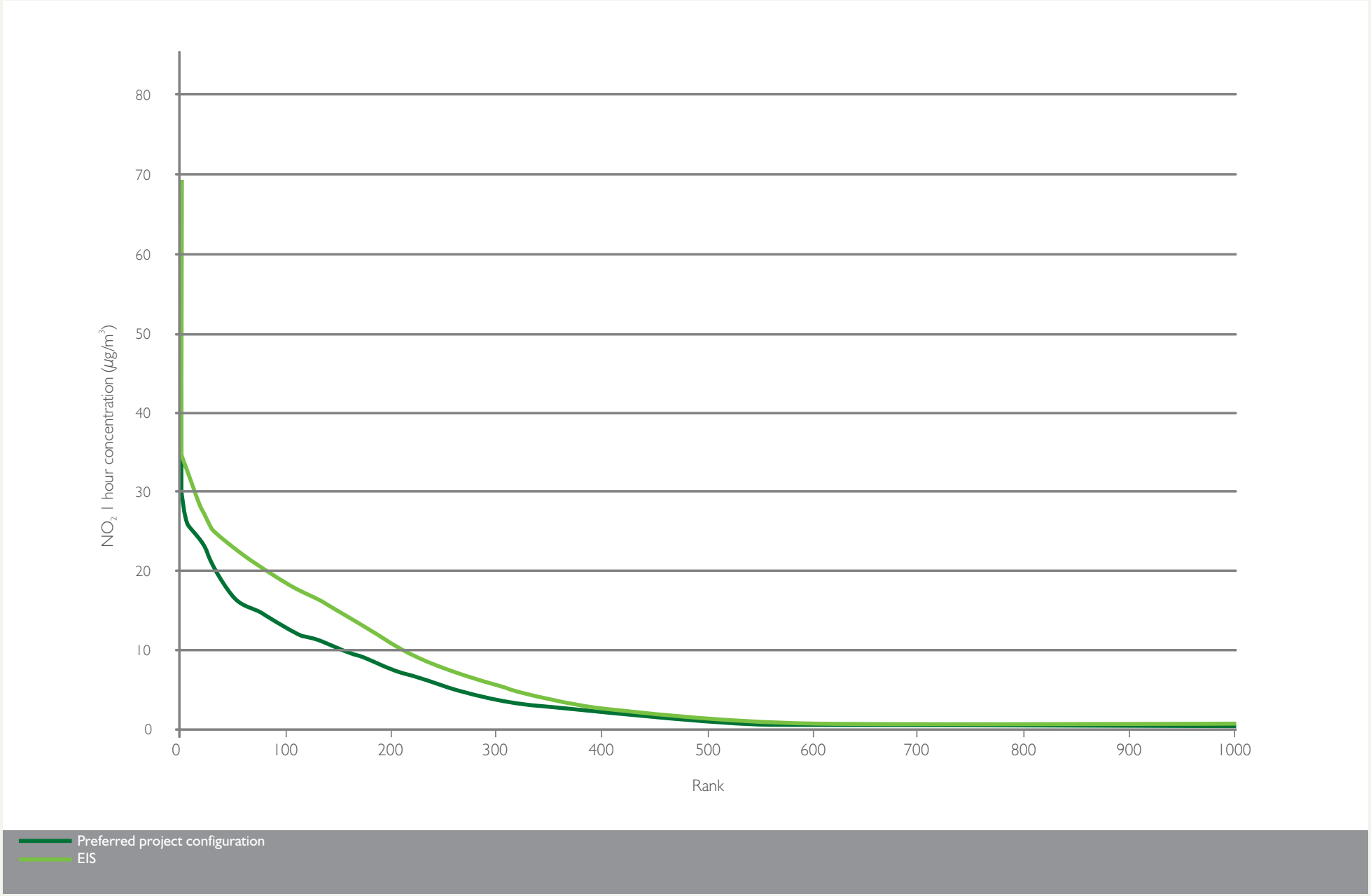

Figure 9-1 Comparison of ranked values – preferred project and EIS configurations – with project, expected traffic flows 2019 (scenario 2a) – NO_2 1 hour average

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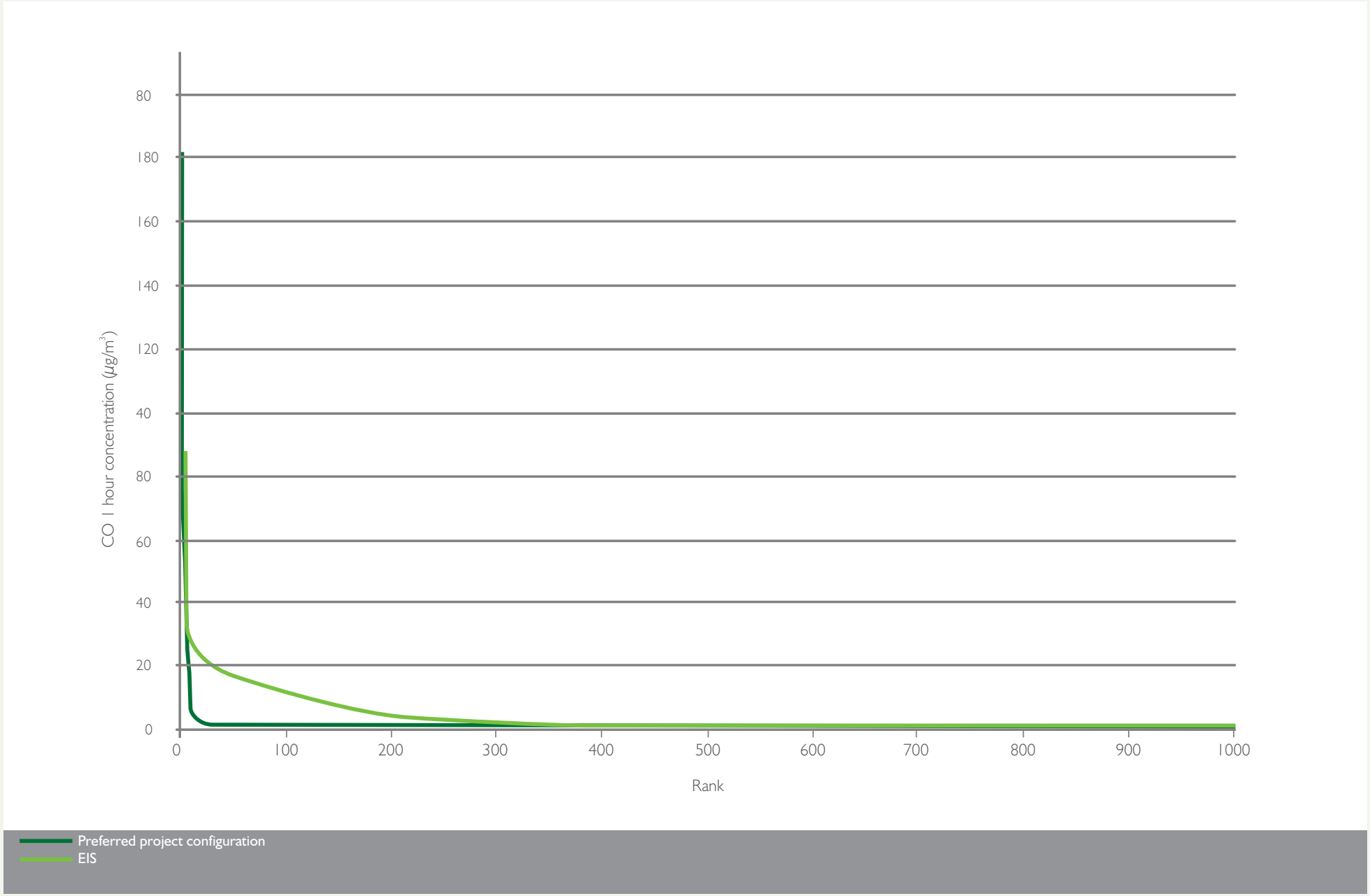

Figure 9-2 Comparison of ranked values – preferred project and EIS configurations – with project, expected traffic flows 2019 (scenario 2a) – CO 1 hour average

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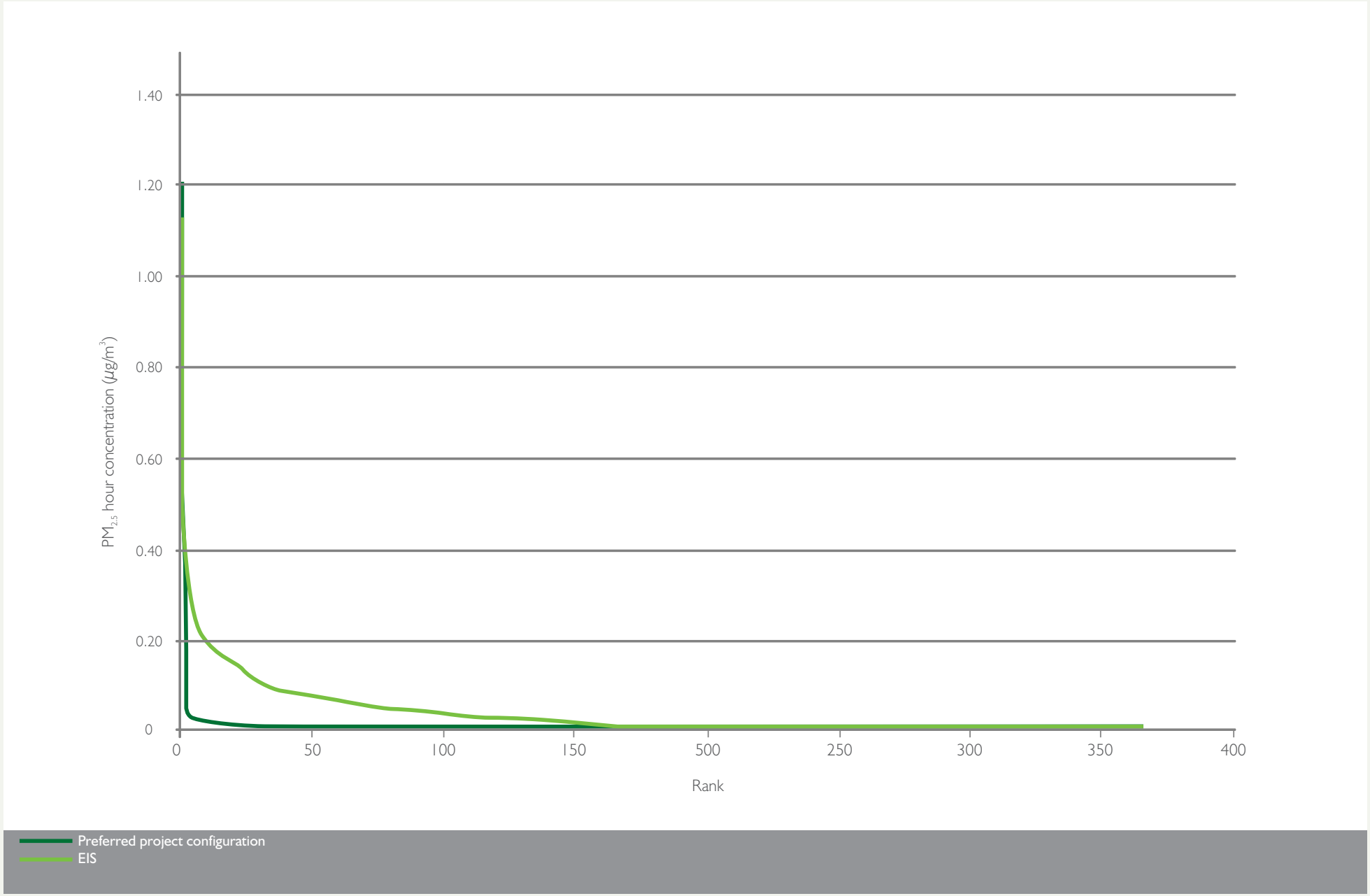

Figure 9-3 Comparison of ranked values – preferred project and EIS configurations – with project, expected traffic flows 2019 (scenario 2a) – $PM_{2.5}$ 24 hour average

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9.2.4 Human health

As shown above, the relevant concentration levels for oxides of nitrogen, carbon monoxide, volatile organic compounds and polycyclic aromatic hydrocarbons all decrease as a result of the increased ventilation outlet height and, as such, all remain below the level at which adverse health outcomes are expected to occur. Consistent with the approach for the environmental impact statement, these pollutants have not been carried forward for more detailed assessment. As the human health risk assessment is concerned with long term (or chronic) exposures to pollutants, the short term (or acute) increases in pollutants over those presented in the environmental impact statement would not result in increased health risks and have, therefore, not been considered further.

Human health risks associated with emissions from the project's ventilation outlets are principally a function of chronic (longer term) exposure to $PM_{2.5}$. Changes in human health risks as a consequence of increasing the height of the ventilation outlets would therefore be similar to the predicted reductions in annual average $PM_{2.5}$ concentrations.

Table 9-7 summarises estimated increases in incidence of primary health indicators as a result of increasing the ventilation outlet height by five metres and includes a comparison with the same data presented in the environmental impact statement for 15 metre ventilation outlets. Similar changes in health outcomes would be expected for the other health indicators examined as part of the environmental impact statement (secondary health indicators, exposure to diesel particulate matter and asthma).

The results show a decrease in annual incidence for all primary health indicators by between 25 per cent and 50 per cent when compared to the health indicators presented in the environmental impact statement. These health effects are very low and significantly less than the normal variability in cases per year in the population.

Table 9-7 Estimated increases in incidence of primary health effects (per year) – increased ventilation outlet heights

Primary health indicator	Baseline incidence per year (per 100,000)	Normal incidence variability (cases per year)	Increased incidence (cases per year) - EIS		Increased incidence (cases per year) – increased ventilation outlet height	
			2019	2029	2019	2029
Northern ventilation outlet						
Mortality from all causes (≥ 30 years of age)	1,087	1	0.03	0.04	0.02	0.03
Rate of hospitalisation with cardiovascular disease (≥ 65 years of age)	23,352	40	0.02	0.03	0.01	0.02
Rate of hospitalisation with respiratory disease (≥ 65 years of age)	8,807	17	0.005	0.005	0.003	0.004
Southern ventilation outlet						
Mortality from all causes (≥ 30 years of age)	1,087	1	0.03	0.03	0.01	0.01
Rate of hospitalisation with cardiovascular disease (≥ 65 years of age)	23,352	40	0.02	0.02	0.01	0.01
Rate of hospitalisation with respiratory disease (≥ 65 years of age)	8,807	17	0.004	0.004	0.002	0.002

9.2.5 Operational visual impacts

The increased height of the ventilation outlets would alter the extent of visual impacts associated with these facilities. The urban design and landscaping treatments of these facilities are not proposed to be altered, although it is noted that this would be subject to the future development of the Urban Design and Landscape Plan for the project. As identified in Appendix D of the environmental impact statement, this plan would be developed in consultation with the local community and the relevant local council(s).

A revised assessment of the potential visual impacts from the two ventilation outlets is provided below.

Northern ventilation facility

Figure 9-4 illustrates the theoretical visibility (the visual envelope) of the northern ventilation facility from the surrounding area. This figure shows the visibility based on the ventilation outlet height within the environmental impact statement, and the increased visibility based on an increased height of five metres. This shows the increased height results in a marked increase in the visibility of the ventilation outlet as the new outlet height would be visible above screening features such as vegetation and existing noise walls.

This increased visibility, however, is of a discrete raised element of the facility and, for the majority of receivers, would be viewed as a relatively small component within the broader landscape.

Revised artist's impressions of the facility from surrounding residential areas and from the M1 Pacific Motorway are provided in **Figure 9-5** to **Figure 9-7**. Revised visual impact ratings are presented in **Table 9-8**.

As the increased ventilation outlet height only affects a discrete component of the facility, it would not result in a significant change in the visual impacts for the most affected receivers. The overall visual impact rating would be consistent with that described in the environmental impact statement.

Southern ventilation facility

Figure 9-8 illustrates the theoretical visibility of the southern ventilation facility from the surrounding area. This figure shows the visibility based on the ventilation outlet height within the environmental impact statement, and the increased visibility based on an increased height of five metres. This shows the increased height results in a slight increase in the visibility of the operational infrastructure.

This increased visibility is of a discrete raised element of the broader motorway operations complex and, for the majority of receivers, would be viewed as a small component within the broader landscape.

Revised artist's impressions of the facility from surrounding residential areas and from Pennant Hills Road are provided in **Figure 9-9** to **Figure 9-11**. Revised visual impact ratings are presented in **Table 9-8**.

As the increased height only affects a discrete component of the larger motorway operations complex, it would not result in a significant change in the visual impacts for the most affected receivers. The overall visual impact rating would be consistent with that described in the environmental impact statement.

Table 9-8 Operational visual impact assessment – increased ventilation outlet height

Receiver number	Receiver	EIS			+5 metres		
		Sensitivity of receivers	Magnitude of change	Overall rating	Sensitivity of receivers	Magnitude of change	Overall rating
Northern ventilation facility							
1	Residential – Woonona Avenue and Bareena Avenue	High to moderate	High to moderate	High to moderate	High to moderate	High to moderate	High to moderate
2	Motorists – M1 Pacific Motorway	Moderate to low	Moderate to low	Moderate to low	Moderate to low	Moderate to low	Moderate to low
Southern ventilation facility/ motorway operations complex							
1	Residential – Gum Grove Place	High to moderate	High to moderate	High to moderate	High to moderate	High to moderate	High to moderate
2	Residential – Karloon Road/ Eaton Road intersection	High	High	High	High	High	High
3	Residential – Coral Tree Drive	Moderate	High to moderate	High to moderate	Moderate	High to moderate	High to moderate
4	Motorists – Pennant Hills Road/ Hills M2 Motorway interchange	Low	Low	Low	Low	Low	Low
5	Motorists – Copeland Road/ Pennant Hills Road intersection	Low	Low	Low	Low	Low	Low

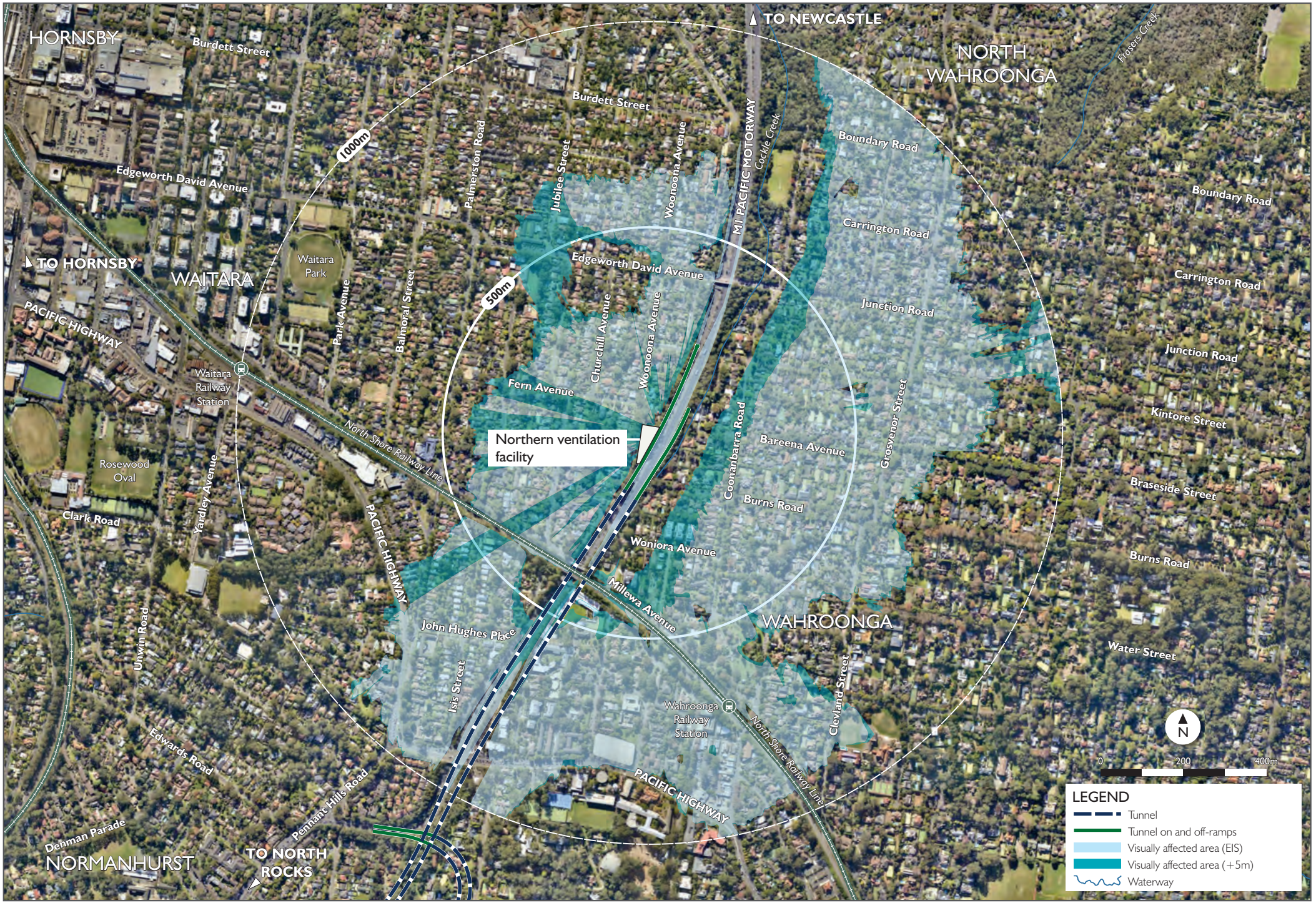

Figure 9-4 Northern ventilation facility visual envelope map

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Figure 9-5 Artists impression - M1 Pacific Motorway

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

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Figure 9-7 Artists impression - Woonoona Avenue North

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Figure 9-8 Southern ventilation facility visual envelope map

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Figure 9-9 Artists impression - corner Eaton Road and Karloon Road

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

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

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9.3 Bus movements from the Pioneer Avenue compound (C8)

9.3.1 Description of changes

In the environmental impact statement, the indicative number of buses accessing and egressing the Pioneer Avenue compound was identified as four per hour. A more detailed analysis of the workforce numbers and work shift patterns has found that 12 buses per hour would be required at the Pioneer Avenue compound during construction. Additional bus trips would allow greater construction employee transfers and minimise potential construction employee traffic impacts on the surrounding road network.

The route to and from the compound would remain unaltered. Access and egress routes would continue to be examined in consultation with Roads and Maritime and the Transport Management Centre during the development of Traffic Management Plan and Traffic Control Plans to ensure that potential impacts on the surrounding road network and the local community are minimised.

9.3.2 Environmental overview of changes

Changes to the bus movements presented in the environmental impact statement have been reviewed to identify relevant potential environmental impacts for further, more detailed assessment. This review has identified the following issues:

- An increase in the frequency of bus movements may affect the performance of the surrounding road network. Further assessment of construction traffic impacts has therefore been conducted, and is included in **Section 9.3.3**.
- An increase in the frequency of bus movements may change construction traffic noise levels. Further assessment of construction traffic noise has therefore been conducted, and is included in **Section 9.3.4**.

The change in bus movements would not affect other environmental and land use issues.

9.3.3 Construction traffic and transport

The change from four buses per hour to twelve buses per hour to and from the Pioneer Avenue compound (C8) would result in eight additional buses per hour accessing and egressing the site. In total there would be an average of one bus every five minutes. As detailed in Section 5.3.12 of the environmental impact statement, construction working parking and bus transfers at the Pioneer Avenue compound could occur up to 24 hours per day, and seven days per week.

Table 7-17 and Table 7-19 of the Technical Working Paper: Traffic and Transport (Appendix E to the environmental impact statement) indicates that the section of Pennant Hills Road near the Pioneer Avenue compound would experience the following traffic volumes in 2016 (at the anticipated commencement of construction), including other construction traffic from the project:

- For northbound spoil disposal:
  - Around 3,200 to 3,660 vehicles (320 to 340 heavy vehicles) northbound in the AM peak.
  - Around 2,410 to 3,280 vehicles (240 to 320 heavy vehicles) southbound in the AM peak.

- Around 2,940 to 3,640 vehicles (210 to 230 heavy vehicles) northbound in the PM peak.
- Around 2,990 to 3,040 vehicles (360 to 370 heavy vehicles) southbound in the PM peak.

- For southbound spoil disposal:
  - Around 2,300 to 3,560 vehicles (300 to 340 heavy vehicles) northbound in the AM peak.
  - Around 2,380 to 3,280 vehicles (240 to 290 heavy vehicles) southbound in the AM peak.
  - Around 2,910 to 3,640 vehicles (200 to 210 heavy vehicles) northbound in the PM peak.
  - Around 2,980 to 3,010 vehicles (340 to 350 heavy vehicles) southbound in the PM peak.

An additional eight buses in either the AM or the PM peak would represent a negligible increase in total traffic volumes.

Table 7-18 and Table 7-20 of the Technical Working Paper: Traffic and Transport presents the anticipated performance of the Pennant Hills Road / Duffy Road and Pennant Hills Road/ Dartford Road intersections. This data is summarised in **Table 9-9**.

Table 9-9 shows that while the Duffy Road and Dartford Road intersections would be constrained during both the AM and PM peak periods, the addition of a further eight buses in either of these periods is unlikely to lead to a significant change in traffic volumes or intersection performance.

The performance of these intersections without construction is:

- Pennant Hills Road / Duffy Avenue LoS F in both the AM and PM peak.
- Pennant Hills Road / Dartford Road LoS F in the AM peak and LoS C in the PM peak.

This indicates that the poor intersection performance is mainly associated with background traffic growth and is not a result of the project contribution alone.

Table 9-9 Predicted intersection performance (2016)

Intersection/Peak	2016 – With Construction			
	Light Vehicles	Heavy Vehicles	Average Delay (s)	Level of Service
Pennant Hills Road / Duffy Road – northbound spoil disposal				
AM Peak	3,620	770	>100	F
PM Peak	4,950	590	>100	F
Pennant Hills Road / Duffy Road – southbound spoil disposal				
AM Peak	3,620	680	>100	F
PM Peak	4,980	500	88.3	F
Pennant Hills Road / Dartford Road – northbound spoil disposal				
AM Peak	3,460	730	>100	F
PM Peak	4,670	560	66.5	E
Pennant Hills Road / Dartford Road – southbound spoil disposal				
AM Peak	3,470	640	>100	F
PM Peak	4,690	470	51.8	D

9.3.4 Construction traffic noise

The increased frequency of buses accessing and egressing the site has also been considered in relation to potential traffic noise impacts. As identified in the traffic assessment above, this would result in an average of one bus every five minutes. As construction traffic noise is considered over a fifteen minute period, the addition of three buses in any fifteen minute period would not result in an increase in road traffic noise of greater than 2 dB(A). The change in bus numbers is therefore unlikely to generate a noticeable traffic noise impact.

9.3.5 Summary and justification

The assessment of the increased frequency of bus movements at the Pioneer Avenue compound (C8) has shown that there would be no material difference in impacts from those described in the environmental impact statement. Maximising the use of buses to transfer construction workers from the Pioneer Avenue compound to construct sites would minimise the potential impacts of construction worker vehicles on the surrounding road network, particularly in terms of road network capacity and efficiency, and the need for car parking to accommodate those workers (especially in relation to reducing on-street parking by construction workers around each construction compound).

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9.4 Amended construction haulage routes

9.4.1 Description of changes

Based on concerns raised in public submissions and through other community and stakeholder engagement mechanisms (refer to **Chapter 5** of this report), access arrangements to certain construction compounds have been reviewed with the aim of reducing the use of local streets, thereby reducing the potential impacts to the local community in relation to construction traffic, noise and safety.

As a result of this review, changes have been made to the construction haulage routes identified in the environmental impact statement for the southern interchange compound (C5), the Trelawney Street compound (C7) and the northern interchange compound (C9). Due to the complexities of gaining access to these sites, the need for flexibility in spoil disposal sites and the different phases of construction activities at each of these sites during the construction period, a number of construction haulage routes have been identified for each site.

Access and egress routes would continue to be examined in consultation with Roads and Maritime and the Transport Management Centre during the development of Traffic Management Plans and Traffic Control Plans to ensure that potential impacts on the surrounding road network and the local community are minimised where feasible and reasonable.

Southern interchange compound (C5)

The construction haulage routes for the southern interchange compound (C5) identified in the environmental impact statement included an access and egress point at Eaton Road. The inbound route from the north involved a right turn at Aiken Road then via Oakes Road, Eaton Road and Karloon Road.

The review of access arrangements has identified five potential alternatives for the southern interchange compound. Some of these arrangements would still require the use of small sections of local roads and, as such, there would be restrictions on the use of these access arrangements outside of standard construction hours. **Table 9-10** identifies the access arrangements and restrictions to use. Each access arrangement is shown separately on **Figure 9-12** to **Figure 9-16**.

Table 9-10 Southern interchange compound (C5) access arrangements

Access arrangement	Description	Use outside standard construction hours
C5-1	New temporary signalised intersection from Pennant Hills Road about midway between the Hills M2 Motorway and the Eaton Road intersections (refer to **Figure 9-12**). This access arrangement is feasible for haulage of spoil to a northern or a southern disposal site.	Yes
C5-2	Left in, left out access from the Hills M2 Motorway off-ramp (refer to **Figure 9-13**). This access arrangement is feasible for haulage of spoil to a southern disposal site.	Yes
C5-3	Left in, left out access from Pennant Hills Road (refer to **Figure 9-14**). This access arrangement is feasible for haulage of spoil to a southern disposal site.	Yes
C5-4	Left in, left out access from Pennant Hills Road, right-out onto Eaton Road (refer to **Figure 9-15**). This access arrangement is feasible for haulage of spoil to a southern disposal site.	No
C5-5	Left in, right out from Eaton Road via an all movements intersection at Pennant Hills Road / Eaton Road (refer to **Figure 9-16**). This access arrangement is feasible for haulage of spoil to a northern or a southern disposal site.	No

Access arrangement C5-1

Access arrangement C5-1 involves the provision of a new temporary signalised intersection from Pennant Hills Road about midway between the Hills M2 Motorway and the Eaton Road intersections. This new intersection would provide for all traffic movements (left and right in, and left and right out). This arrangement could be used for haulage and disposal of spoil in a northern direction and / or a southern / western direction. This access arrangement is shown on **Figure 9-12**.

Access arrangement C5-2

Access arrangement C5-2 involves the provision of a left in, left out access from the Hills M2 Motorway off-ramp via a new access road. Spoil disposal trucks to the south or west would be able to perform a u-turn at the Hills M2 Motorway / Pennant Hills Road intersection to travel westbound on the Hills M2 Motorway. This access arrangement is shown on **Figure 9-13**.

Access arrangement C5-3

Access arrangement C5-3 involves the provision of a left in, left out access from Pennant Hills Road. Outside of peak traffic periods, heavy vehicles would be able to turn around at Beecroft Road (around Observatory Park) to travel to a southern / western spoil disposal site. This access arrangement is shown on **Figure 9-14**.

Access arrangement C5-4

Access arrangement C5-4 also involves the provision of a left in, left out access from Pennant Hills Road. This arrangement also includes a right out egress onto Eaton Road to be able to turn right from Eaton Road onto Pennant Hills Road to travel to a southern / western spoil disposal site. The use of Eaton Road would not occur outside of standard construction hours, when all access would be directly from Pennant Hills Road or the Hills M2 Motorway. This access arrangement is shown on **Figure 9-15**.

Access arrangement C5-5

Access arrangement C5-5 involves the provision of a right turn at the existing Pennant Hills Road / Eaton Road intersection. Heavy vehicles would then access the site at the access point identified in the environmental statement (off Eaton Road). Heavy vehicles leaving the site would be able to turn either left or right from Eaton Road onto Pennant Hills Road to utilise either a northern or a southern / western spoil disposal site. The use of Eaton Road would not occur outside of standard construction hours, when all access would be directly from Pennant Hills Road or the Hills M2 Motorway. This access arrangement is shown on **Figure 9-16**.

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Figure 9-12 Southern interchange compound access arrangement C5-1

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Figure 9-13 Southern interchange compound access arrangement C5-2

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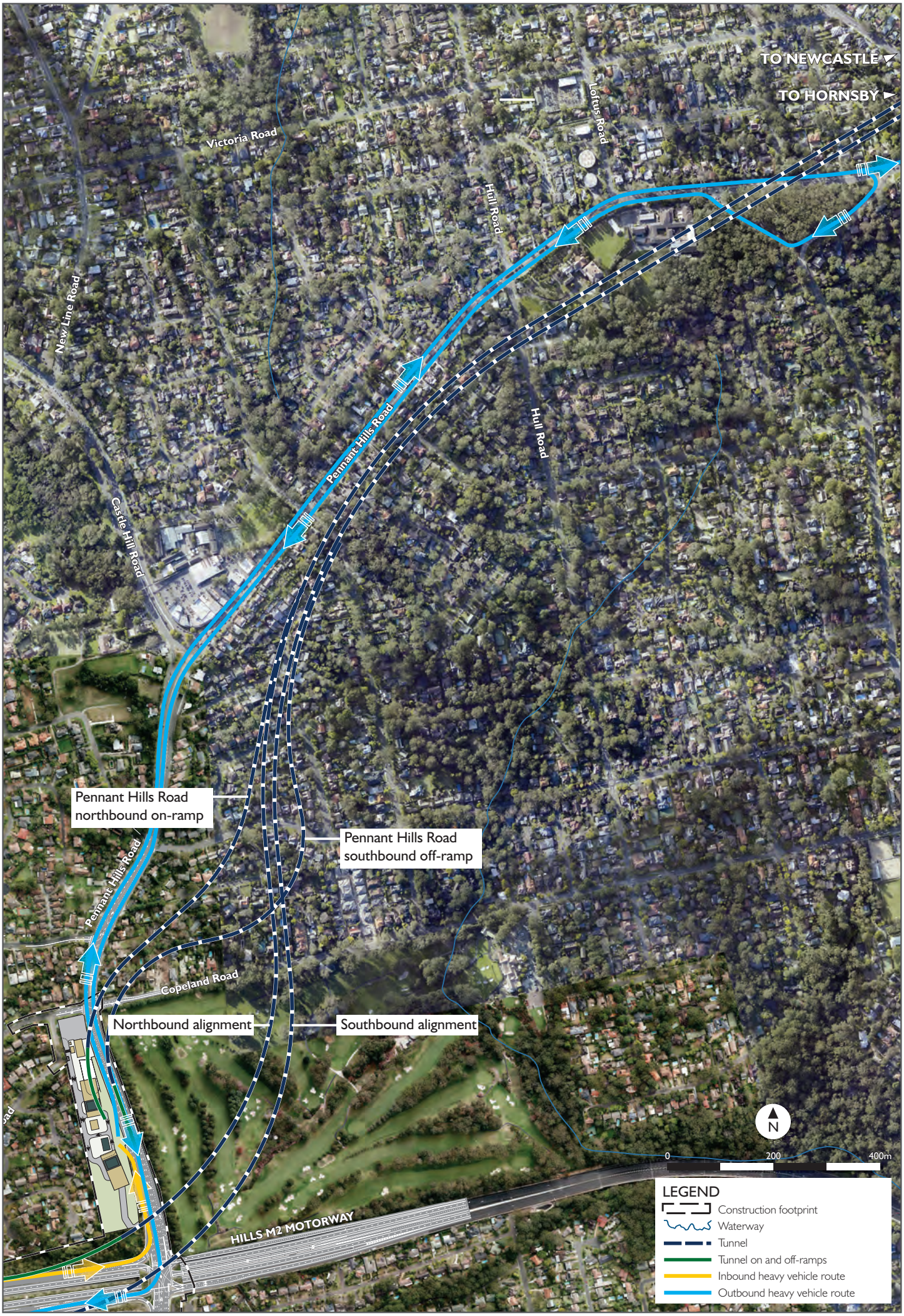

Figure 9-14 Southern interchange compound access arrangement C5-3

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Figure 9-15 Southern interchange compound access arrangement C5-4

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Figure 9-16 Southern interchange compound access arrangement C5-5

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Trelawney Street compound (C7)

The construction haulage routes for the Trelawney Street compound (C7) identified in the environmental impact statement included a left in access from Loch Maree Avenue and a left out egress onto Pennant Hills Road. The inbound route involved either a left turn or right turn into Loch Maree Avenue prior to entering the site. The outbound route to travel to a northern spoil disposal site involved a right turn at Phyllis Avenue, a u-turn at the Phyllis Avenue / Central Avenue round-a-bout followed by a left turn onto Pennant Hills Road.

The review of access arrangements has identified two potential alternatives for the Trelawney Street compound. Some of these arrangements would still require the use of small sections of local roads and, as such, there would be restrictions on the use of these arrangements outside of standard construction hours. **Table 9-11** identifies the access arrangements and restriction to use. Each access arrangement is shown separately on **Figure 9-17** and **Figure 9-18**.

Table 9-11 Trelawney Street compound (C7) access arrangements

Access arrangement	Description	Use outside standard construction hours
C7-1	Left in, right out onto Loch Maree Avenue. This would be facilitated by the all movements intersection at Pennant Hills Road / Loch Maree Avenue (refer to **Figure 9-17**). This access arrangement is feasible for haulage of spoil to a northern or a southern disposal site.	No
C7-2	Left in, left out from Pennant Hills Road (refer to **Figure 9-18**). This access arrangement is feasible for haulage of spoil to a northern or a southern disposal site.	Yes

Access arrangement C7-1

Access arrangement C7-1 involves a left in from and right out to from Loch Maree Avenue. This would be facilitated by the use of the all movements Pennant Hills Road / Loch Maree Avenue intersection. This would allow heavy vehicles to travel to either a northern or southern / western spoil disposal site. The use of Loch Maree Avenue would not occur outside of standard construction hours, when all access would be directly from Pennant Hills Road. This access arrangement is shown on **Figure 9-17**.

Access arrangement C7-2

Access arrangement C7-2 involves a left in, left out access from Pennant Hills Road. Heavy vehicles travelling to a southern / western spoil disposal site would continue along Pennant Hills Road to the Hills M2 Motorway. Heavy vehicles travelling to a northern spoil disposal site would be able to turn around at Beecroft Road (around Observatory Park) to travel north along Pennant Hills Road to the M1 Pacific Motorway. This arrangement is shown on **Figure 9-18**.

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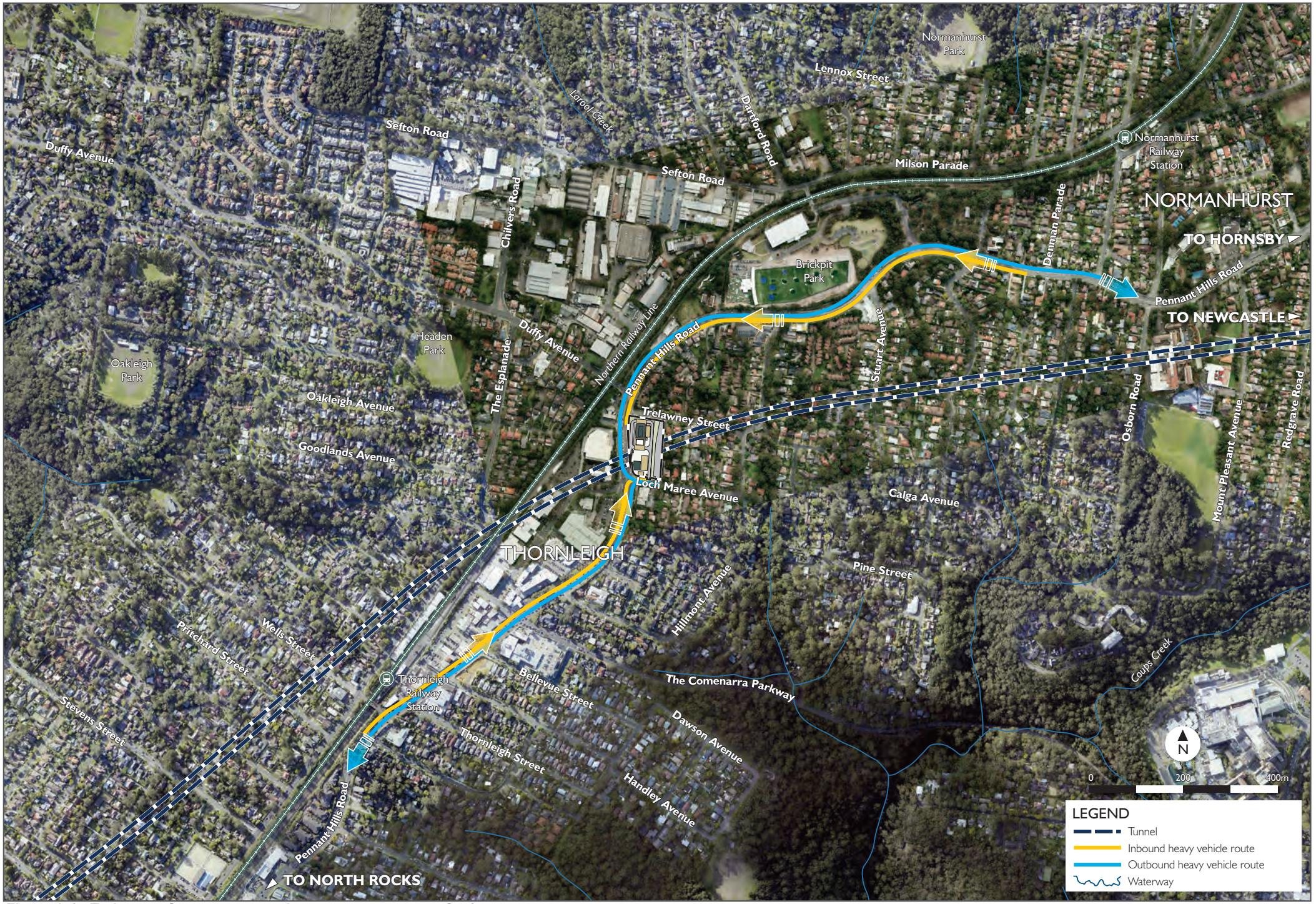

Figure 9-17 Trelawney Street compound access arrangement C7-1

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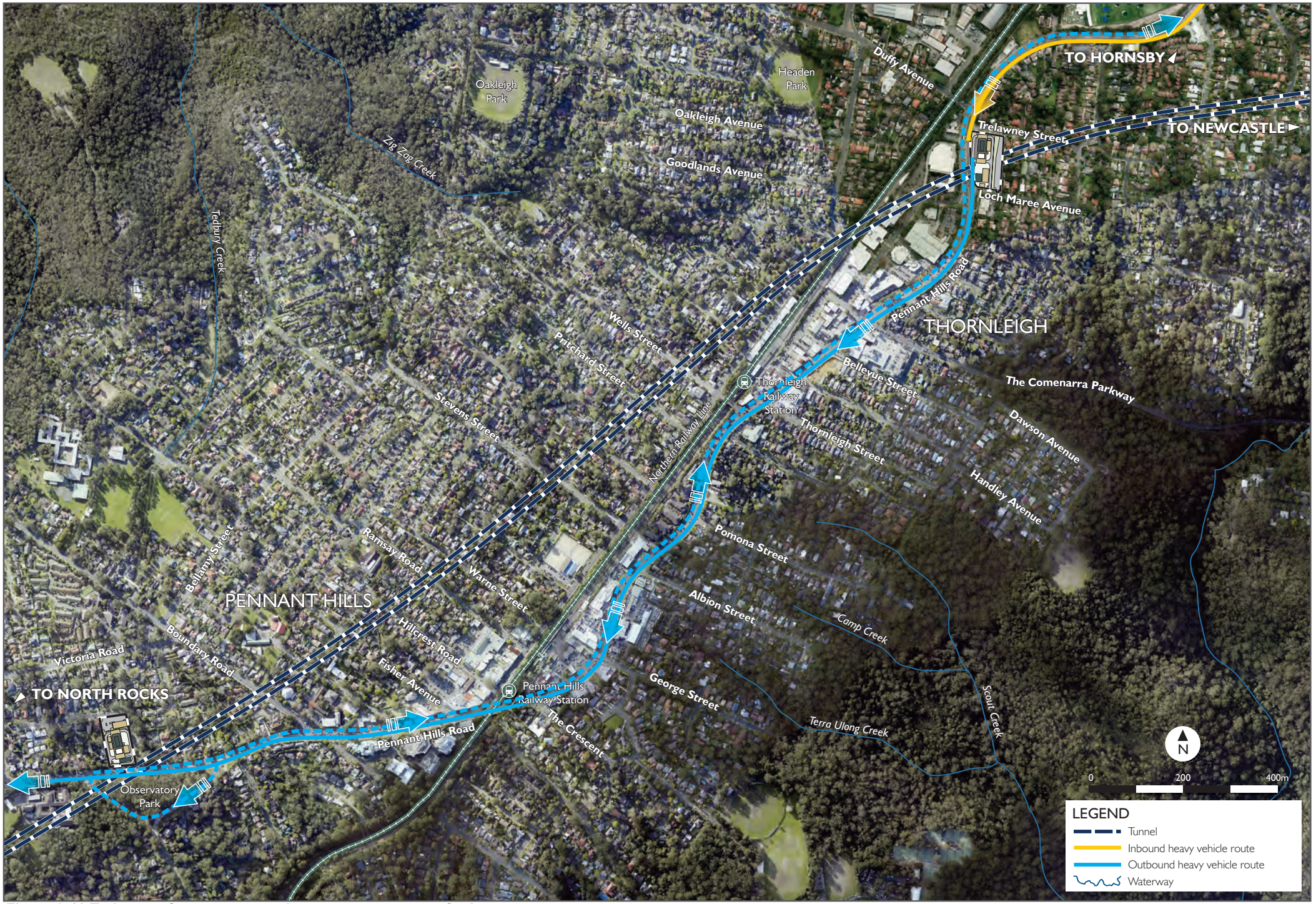

Figure 9-18 Trelawney Street compound access arrangement C7-2

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Northern interchange compound (C9)

The construction haulage routes for the northern interchange compound (C9) identified in the environmental impact statement included a left in from and a left out to the M1 Pacific Motorway. The outbound route to travel to a northern spoil disposal site involved a right turn at Phyllis Avenue, a u-turn at the Phyllis Avenue / Central Avenue round-a-bout followed by a left turn onto Pennant Hills Road.

The review of access arrangements has identified two potential alternatives for the northern interchange compound. Neither of these arrangements would require the use of local roads and, as such, there would be no restrictions on the use of these arrangements outside of standard construction hours. **Table 9-12** identifies the access arrangements. Each access arrangement is shown separately on **Figure 9-19** and **Figure 9-20**. Further details of each access arrangement are provided following the table.

Table 9-12 Northern interchange compound (C9) access arrangements

Access arrangement	Description	Use outside standard construction hours
C9-1	Left in, left out onto the M1 Pacific Motorway (as detailed in the environmental impact statement) (refer to **Figure 9-19**). This access arrangement is feasible for haulage of spoil to a northern or a southern disposal site.	Yes
C9-2	Left in, right out onto the M1 Pacific Motorway at a new temporary signalised intersection (refer to **Figure 9-20**). This access arrangement is feasible for haulage of spoil to a northern or a southern disposal site.	Yes

Access arrangement C9-1

Access arrangement C9-1 involves the same arrangement as identified in the environmental impact statement. This arrangement is reproduced here for completeness an avoidance of potential confusion. Heavy vehicles travelling to a southern / western spoil disposal site would continue along Pennant Hills Road to the Hills M2 Motorway. Heavy vehicles travelling to a northern spoil disposal site would be able to turn around at Beecroft Road (around Observatory Park) to travel north along Pennant Hills Road to the M1 Pacific Motorway. This access arrangement is shown on **Figure 9-19**.

Access arrangement C9-2

Access arrangement C9-2 involves a left in, left out, right out access to and from the M1 Pacific Motorway at a new temporary signalised intersection. This new signalised intersection would stop southbound traffic on the M1 Pacific Motorway to allow heavy vehicles to egress the site. Heavy vehicles travelling to a southern / western spoil disposal site would continue along Pennant Hills Road to the Hills M2 Motorway. Heavy vehicles travelling to a northern spoil disposal site would be able to turn right out of the site directly onto the M1 Pacific Motorway to travel north. This access arrangement is shown on **Figure 9-20**.

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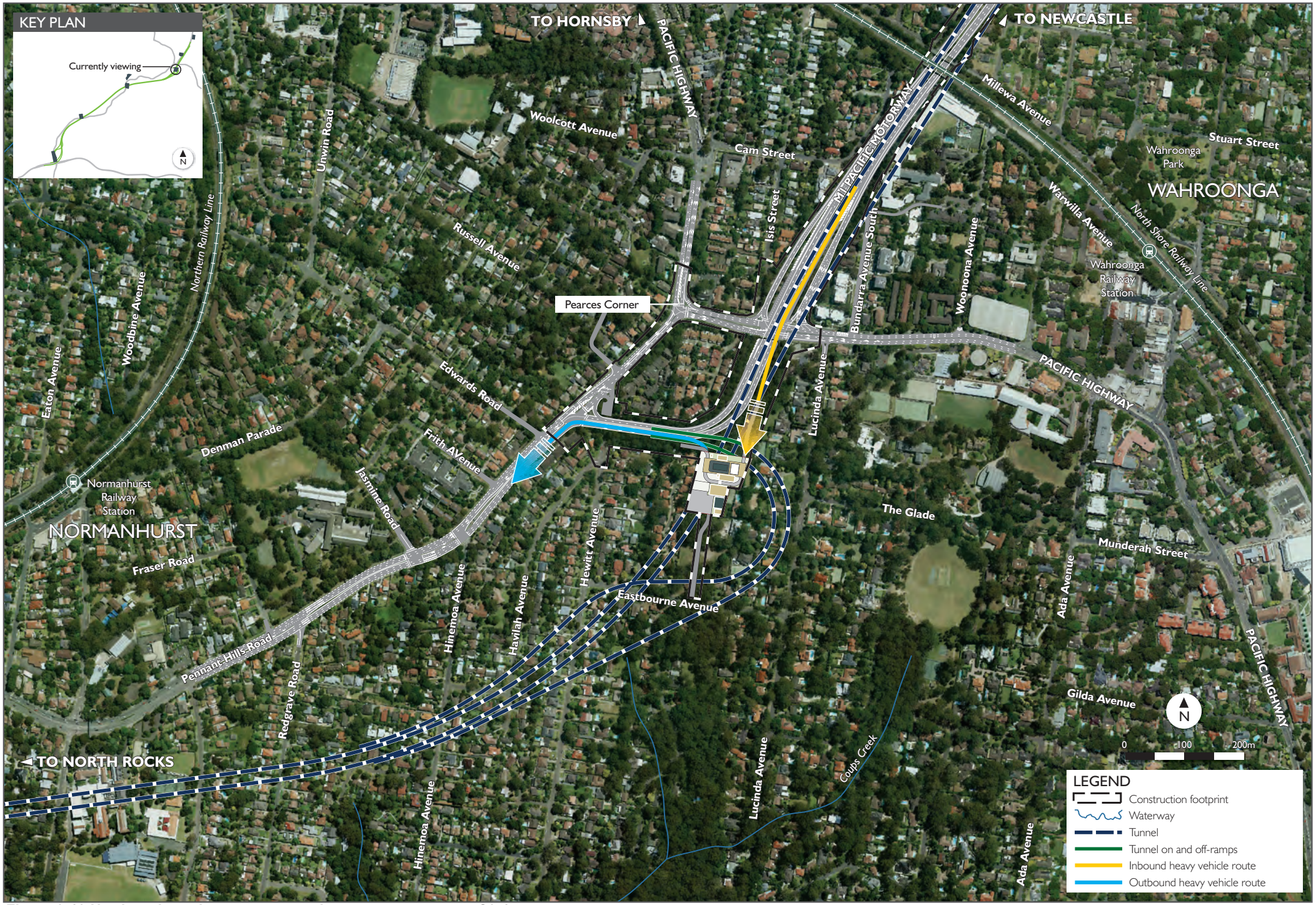

Figure 9-19 Northern interchange compound access arrangement C9-1

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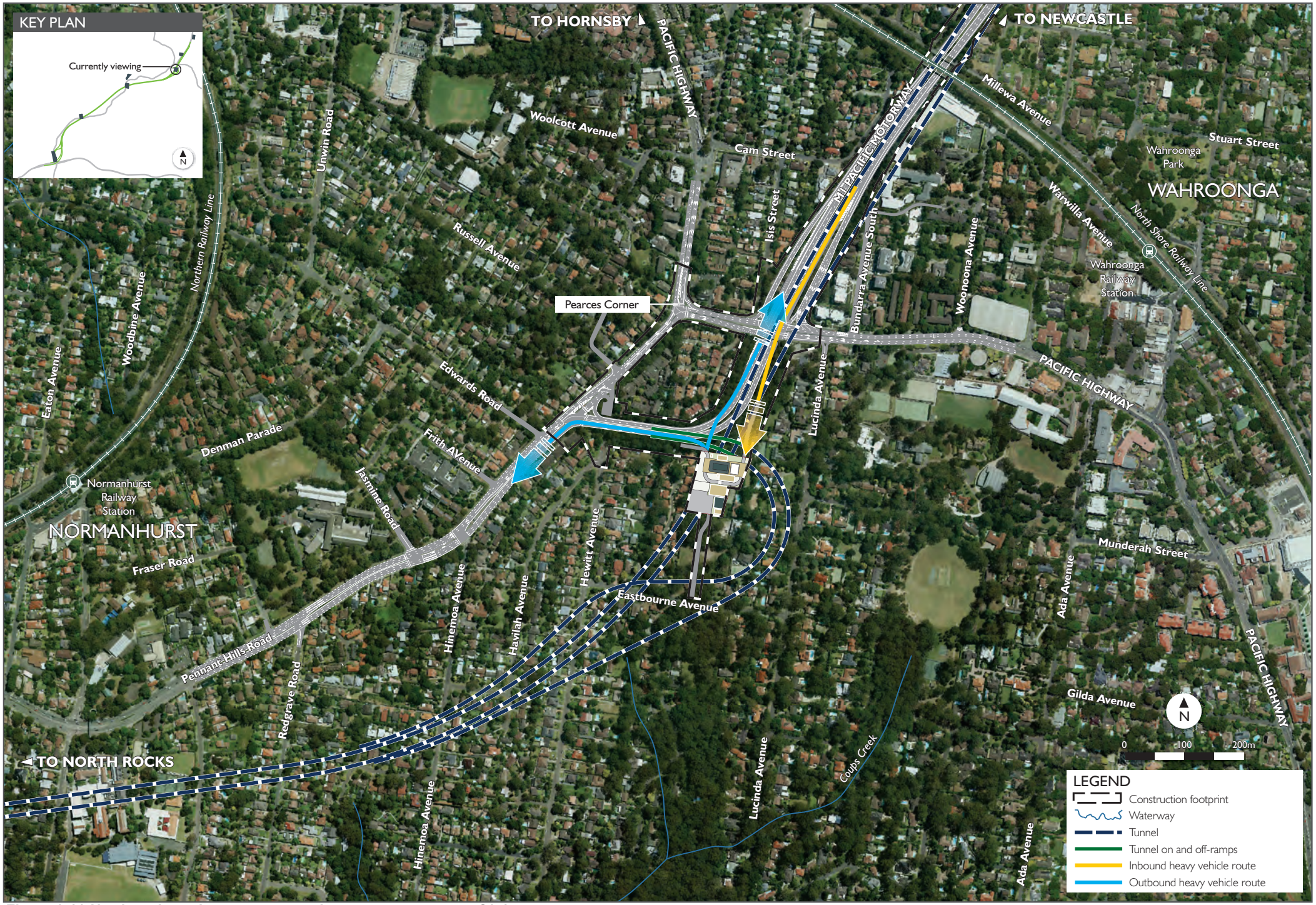

Figure 9-20 Northern interchange compound access arrangement C9-2

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9.4.2 Environmental overview of changes

Changes to the construction haulage routes for the southern interchange compound (C5), the Trelawney Street compound (C7) and the northern interchange compound (C9) from those included in the environmental impact statement have been reviewed to identify relevant potential environmental impacts for further, more detailed assessed. This review has identified the following issues:

- Changes in construction traffic movements which may affect the performance of the surrounding road network. Further assessment of construction traffic impacts has therefore been conducted, and is included in **Section 9.4.3**.
- Changes in construction traffic movements which may change construction traffic noise levels. Further assessment of construction traffic noise has therefore been conducted, and is included in **Section 9.4.4**.

The changed construction haulage routes would not affect other environmental and land use issues.

9.4.3 Construction traffic and transport

The proposed change in construction traffic movements may affect the performance of the surrounding road network. Consistent with the approach undertaken in the environmental impact statement, where the movements are possible, the revised access arrangements have been examined for two scenarios with all spoil being transported to a northern disposal site and all spoil being transported to a southern disposal site. This provides a worst-case assessment as it is feasible that spoil disposal locations in each direction may be utilised which would reduce these potential impacts.

Northern spoil disposal site

Not all of the proposed construction compound access routes are feasible to transport spoil to and from a northern disposal site. The following sections present the potential impacts as described in the environmental impact statement, and the potential impacts from the revised haulage routes for options which are feasible to transport spoil to and from the north. These routes are:

- Access arrangements C5-1 and C5-5 from the southern interchange compound.
- Access arrangements C7-1 and C7-2 from the Trelawney Street compound.
- Access arrangements C9-1 and C9-2 from the northern interchange compound.

Of these access arrangements, the following would not affect the construction traffic assessment presented in the environmental impact statement:

- Access arrangement C9-1 from the northern interchange compound would not alter the predicted intersection performance presented in Table 7-20 of the Technical Working Paper: Traffic and Transport for haulage to a southern spoil disposal site.

As described in the environmental impact statement, the Pennant Hills Road corridor ‘without construction’ would operate at or above capacity during the 2016 AM and PM peak periods. Background growth alone accounts for the majority of the deterioration in the performance and capacity of the road network. The additional construction traffic patterns contribute to deterioration of the corridor during the construction period.

The intersection performance results for the revised haulage routes are generally similar to those described in the environmental impact statement. This outcome has been achieved through traffic intersection modelling which include re-allocation of 'green time' for each movement at signalised intersections to produce the most efficient intersection and network performance overall. Further consultation would be conducted with the Transport Management Centre during detailed design about giving effect to this re-allocation of 'green time' as part of construction works.

There are some minor changes to performance at intersections which are not directly impacted by project-related construction traffic. This is as a result of the expected redistribution of background traffic volumes to avoid the influence of project construction traffic, particularly along Pennant Hills Road.

Outcomes of traffic modelling for the new access arrangements are presented in **Table 9-13** to **Table 9-15** for access arrangements involving spoil haulage to a northern disposal site, and described below.

Southern interchange access arrangement C5-1

The introduction of a new signalised construction access intersection on Pennant Hills Road around 200 metres to the south of Eaton Road would result in a slight improvement in the local road network. As the new intersection would cater for all movements, construction traffic would be able to remain on the prioritised Pennant Hills Road movement at the Copeland Road and Aitken Road intersections rather than use the surrounding residential road network (as was the case with the proposed route within the environmental impact statement). With less construction traffic turning on and off Pennant Hills Road, both Eaton Road and Aiken Road would improve from LoS E to LoS D and from LoS D to LoS C in the PM peak respectively.

The new signalised construction access intersection is predicted to operate with no worse than a LoS B in 2016. This is the result of upstream intersections operating over capacity. Once capacity is reached, upstream intersections would behave as bottlenecks, reducing traffic flow to downstream intersections. It is this throttling of traffic flows that would allow the new access intersection to operate with good performance and low delays.

However, it is predicted that queuing on the southern approach to the Eaton Road intersection and queuing on the northern approach to the Hills M2 Motorway interchange would likely reach this new construction access. This widespread queuing predicted along Pennant Hills Road in peak hours is likely to make access and egress into the compound difficult. Special linemarking and signage would be implemented to prevent traffic queuing from restricting construction vehicle movements. The predicted widespread queuing and congestion along Pennant Hills Road are principally the result of existing traffic volumes, with some limited contribution from project construction traffic.

Southern interchange access arrangement C5-5

The introduction of a new right turn southbound on Pennant Hills Road at the Eaton Road intersection would result in an overall deterioration in performance of the local road network in this area. The new right turn movement would require new traffic light phasing that would reduce available green time for the prioritised Pennant Hills Road northbound movement. As a result, the Eaton Road intersection performance would decrease from LoS E to LoS F in the PM peak.

The introduction of the right turn at Eaton Road would reduce the turning movement at the Aiken Road intersection from that described in the environmental impact statement. The Aiken Road intersection would improve under the new access arrangement and would operate at LoS B in both peaks.

Trelawney Street access arrangement C7-1

Compared to the construction traffic route described in the environmental impact statement, this option would remove the use of the Phyllis Avenue round-a-bout for construction vehicles travelling to a northern spoil disposal site. As a result, fewer vehicles would use the southbound right turn into Phyllis Avenue and instead use the right turn out from Loch Maree Avenue. This arrangement would include a reassignment of green time at the intersection of Pennant Hills Road / Loch Maree Avenue and would result in similar network performance when compared to the assessment presented in the environmental impact statement.

Trelawney Street access arrangement C7-2

The change to a left-in, left-out arrangement at the Trelawney Street compound would impact a portion of the Pennant Hills Road corridor. The positive gain of removing the use of the roundabout on Phyllis Avenue would be offset by the need for construction vehicles to travel south to u-turn at Beecroft Road (around Observatory Park). This arrangement would force additional construction traffic onto intersections along the Pennant Hills Road corridor south of the Trelawney Street compound. This would result in a slight deterioration in the performance of the intersections from Phyllis Avenue to Beecroft Road (south) when compared to the assessment presented in the environmental impact statement.

Northern interchange access arrangement C9-2

The introduction of a new signalised construction access on the M1 Pacific Motorway around 180 metres to the east of the Pennant Hills Road / M1 Pacific Motorway intersection would result in a slight improvement in the local road network. Under this proposed arrangement, construction vehicles egressing the compound that are travelling to a northern spoil site would no longer require the use of the Beecroft Road u-turn and would be removed from the Pennant Hills Road corridor. Hence, the intersections from the M1 Pacific Motorway to Beecroft Road (south) would improve slightly when compared to the assessment presented in environmental impact statement.

Due to relatively low construction traffic demands and subsequent short green time required, the new signalised intersection would operate with low delay at LoS A in both peaks. However, during the AM peak, queuing on the eastern approach of the downstream intersection of M1 Pacific Motorway / Pennant Hills Road is predicted to be on the threshold of impeding on this new construction access. This queuing combined with the curved nature of the approach emphasises the need for appropriate construction traffic management and control to be developed and implemented in consultation with the Transport Management Centre. This may include measures such as ‘advanced signal warnings’ and ‘queuing ahead’ signage along the M1 Pacific Motorway to safely cater for this construction access.

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Table 9-13 Southern interchange compound (C5) intersection performance – northern spoil disposal site

Intersection	Peak	2016 – environmental impact statement				2016 – amended haulage routes			
		Light vehicles	Heavy vehicles	Average delay (s)	Level of service	Light vehicles	Heavy vehicles	Average delay (s)	Level of service
Access arrangement C5-1									
Pennant Hills Road / North Rocks Road	AM peak	4,290	290	94.2	F	4,290	290	90.3	F
	PM peak	4,680	190	>100	F	4,680	190	>100	F
Hills M2 Motorway / Pennant Hills Road interchange	AM peak	5,610	620	44.7	D	5,610	620	49.1	D
	PM peak	5,930	490	>100	F	5,930	490	>100	F
Pennant Hills Road / Eaton Road	AM peak	5,530	620	>100	F	5,530	640	>100	F
	PM peak	5,870	510	58.8	E	5,870	530	55.1	D
Pennant Hills Road / Aiken Road	AM peak	5,180	620	23.7	B	5,180	640	24.3	B
	PM peak	6,220	530	42.6	D	6,220	550	37.5	C
Pennant Hills Road / new construction access (between the Hills M2 Motorway and Eaton Road)	AM peak	-	-	-	-	4,630	640	6.7	A
	PM peak	-	-	-	-	4,590	550	18.7	B
Access arrangement C5-5									
Pennant Hills Road / North Rocks Road	AM peak	4,290	290	94.2	F	4,290	290	87.3	F
	PM peak	4,680	190	>100	F	4,680	190	>100	F
Hills M2 Motorway / Pennant Hills Road interchange	AM peak	5,610	620	44.7	D	5,610	620	44.5	D
	PM peak	5,930	490	>100	F	5,930	490	>100	F
Pennant Hills Road / Eaton Road	AM peak	5,530	620	>100	F	5,530	640	>100	F
	PM peak	5,870	510	58.8	E	5,870	530	>100	F
Pennant Hills Road / Aiken Road	AM peak	5,180	620	23.7	B	5,180	640	25.0	B
	PM peak	6,220	530	42.6	D	6,220	550	21.6	B

Table 9-14 Trelawney Street compound (C7) intersection performance – northern spoil disposal site

Intersection	Peak	2016 – environmental impact statement				2016 – amended haulage routes			
		Light vehicles	Heavy vehicles	Average delay (s)	Level of service	Light vehicles	Heavy vehicles	Average delay (s)	Level of service
Access arrangement C7-1									
Pennant Hills Road / Comenarra Parkway	AM peak	4,720	760	92.0	F	4,720	760	90.1	F
	PM peak	5,210	610	>100	F	5,210	610	>100	F
Pennant Hills Road / Phyllis Avenue / Loch Maree Avenue	AM peak	4,030	830	>100	F	4,030	830	59.8	E
	PM peak	4,770	690	66.8	E	4,770	690	62.4	E
Access arrangement C7-2									
Pennant Hills Road / Beecroft Road (south)	AM peak	5,310	590	78.4	F	5,310	610	91.4	F
	PM peak	5,630	520	>100	F	5,630	540	>100	F
Pennant Hills Road / Beecroft Road (north)	AM peak	6,330	640	>100	F	6,330	660	>100	F
	PM peak	6,030	560	14.0	A	6,030	580	13.5	A
Pennant Hills Road / Boundary Road	AM peak	6,310	700	38.7	C	6,310	720	39.9	C
	PM peak	6,580	620	35.6	C	6,580	640	35.9	C
Pennant Hills Road / Yarrara Road	AM peak	5,690	700	49.0	D	5,690	720	55.9	D
	PM peak	6,000	620	59.5	E	6,000	640	65.5	E
Pennant Hills Road / Comenarra Parkway	AM peak	4,720	760	92.0	F	4,720	780	>100	F
	PM peak	5,210	610	>100	F	5,210	630	>100	F
Pennant Hills Road / Phyllis Avenue / Loch Maree Avenue	AM peak	4,030	830	>100	F	4,030	830	>100	F
	PM peak	4,770	690	66.8	E	4,770	690	68.6	E

Table 9-15 Northern interchange compound (C9) intersection performance – northern spoil disposal site

Intersection	Peak	2016 – environmental impact statement				2016 – amended haulage routes			
		Light vehicles	Heavy vehicles	Average delay (s)	Level of service	Light vehicles	Heavy vehicles	Average delay (s)	Level of service
Access arrangement C9-2									
Pennant Hills Road / Beecroft Road (south)	AM peak	5,310	590	78.4	F	5,310	580	76.5	F
	PM peak	5,630	520	>100	F	5,630	515	>100	F
Pennant Hills Road / Beecroft Road (north)	AM peak	6,330	640	>100	F	6,330	630	>100	F
	PM peak	6,030	560	14.0	A	6,030	555	14.0	A
Pennant Hills Road / Boundary Road	AM peak	6,310	700	38.7	C	6,310	690	38.7	C
	PM peak	6,580	620	35.6	C	6,580	615	35.6	C
Pennant Hills Road / Yarrara Road	AM peak	5,690	700	49.0	D	5,690	690	47.0	D
	PM peak	6,000	620	59.5	E	6,000	615	57.6	E
Pennant Hills Road / Comenarra Parkway	AM peak	4,720	760	92.0	F	4,720	750	92.3	F
	PM peak	5,210	610	>100	F	5,210	605	>100	F
Pennant Hills Road / Phyllis Avenue / Loch Maree Avenue	AM peak	4,030	830	>100	F	4,030	820	92.5	F
	PM peak	4,770	690	66.8	E	4,770	685	66.3	E
Pennant Hills Road / Duffy Avenue	AM peak	3,620	770	>100	F	3,620	760	>100	F
	PM peak	4,950	590	>100	F	4,950	585	96.8	F
Pennant Hills Road / Dartford Road	AM peak	3,460	730	>100	F	3,460	720	>100	F
	PM peak	4,670	560	66.5	E	4,670	555	64.0	E
M1 Pacific Motorway / Pennant Hills Road	AM peak	4,180	700	33.1	C	4,180	690	34.8	C
	PM peak	4,660	590	>100	F	4,660	585	>100	F
Pennant Hills Road / Pacific Highway	AM peak	2,990	320	78.2	F	2,990	320	83.2	F
	PM peak	3,420	250	47.1	D	3,420	250	45.1	D
M1 Pacific Motorway / Pacific Highway	AM peak	4,530	390	72.3	F	4,530	390	79.8	F
	PM peak	5,020	270	>100	F	5,020	270	>100	F
M1 Pacific Motorway / Construction Access	AM peak	-	-	-	-	2,240	700	10.2	A
	PM peak	-	-	-	-	2,580	590	3.6	A

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Southern spoil disposal site

Not all of the proposed construction compound access routes are feasible to transport spoil to and from a southern disposal site. The following sections present the potential impacts as described in the environmental impact statement, and the potential impacts from the revised haulage routes for arrangements which are feasible to transport spoil to and from the south. These routes are:

- Access arrangements C5-1, C5-2, C5-3, C5-4 and C5-5 from the southern interchange compound.
- Access arrangements C7-1 and C7-2 from the Trelawney Street compound.
- Access arrangement C9-1 from the northern interchange compound.

Of these access arrangements, the following would not affect the construction traffic assessment presented in the environmental impact statement:

- Access arrangement C5-3 (left-in, left-out) from the southern interchange compound to and from Pennant Hills Road could be used with a u-turn being performed at Beecroft Road (around Observatory Park). Due to the likely constraints in performing this u-turn, this arrangement is considered appropriate for use during the night-time only. As this would occur outside the usual traffic peak periods, the impact of this movement is unlikely to significantly affect the operation of Pennant Hills Road.
- Access arrangements C5-4 and C5-5 from the southern interchange compound would not alter the predicted intersection performance presented in Table 7-20 of the Technical Working Paper: Traffic and Transport for haulage to a southern spoil disposal site.
- Access arrangement C9-1 from the northern interchange compound would not alter the predicted intersection performance presented in Table 7-20 of the Technical Working Paper: Traffic and Transport for haulage to a southern spoil disposal site.

As described in the environmental impact statement, the Pennant Hills Road corridor 'without construction' would operate at or above capacity during the 2016 AM and PM peak periods. Background growth alone accounts for the majority of the deterioration in the performance and capacity of the road network. The additional construction traffic patterns contribute to deterioration of the corridor during the construction period.

The intersection performance results for the revised haulage routes are generally similar to those described in the environmental impact statement. This outcome has been achieved through traffic intersection modelling which include re-allocation of 'green time' for each movement at signalised intersections to produce the most efficient intersection and network performance overall. Further consultation would be conducted with the Transport Management Centre during detailed design about giving effect to this re-allocation of 'green time' as part of construction works.

There are some minor changes to performance at intersections which are not directly impacted by project-related construction traffic. This is as a result of the expected redistribution of background traffic volumes to avoid the influence of project construction traffic, particularly along Pennant Hills Road.

Outcomes of the traffic modelling for the new access arrangements are presented in **Table 9-16** and **Table 9-17** (where access arrangements alter the assessment presented in the environmental impact statement) for access arrangements involving spoil haulage to a southern disposal site, and described below.

Southern interchange access arrangement C5-1

The introduction of a signalised construction access intersection on Pennant Hill Road around 200 metres to the south of Eaton Road would result in a slight improvement at the Aiken Road intersection. As the new intersection would cater for all movements, the reduced turning construction traffic at Aiken Road (from that described in the environmental impact statement) would improve the intersection operation from LoS C to LoS B in the PM peak and would maintain similar performance in the AM peak.

The new signalised construction access intersection is predicted to operate at a LoS A. This is the result of upstream intersections operating over capacity. Once capacity is reached, upstream intersections would behave as bottlenecks, reducing traffic flow to downstream intersections. It is this throttling of flows that would allow this new access to operate with good performance and low delay.

However, it is predicted that queuing on the southern approach to the Eaton Road intersection and queuing on the northern approach to the Hills M2 Motorway interchange would likely reach this new construction access. This widespread queueing predicted along Pennant Hills Road in peak hours is likely to make access and egress into the compound difficult. Special linemarking and signage would be implemented to prevent traffic queuing from restricting construction vehicle movements. The predicted widespread queuing and congestion along Pennant Hills Road are principally the result of existing traffic volumes, with some limited contribution from project construction traffic.

Southern interchange access arrangement C5-2

The new priority controlled construction access onto the Hills M2 Motorway eastbound off-ramp at Pennant Hills Road would operate at LoS C and LoS B during AM and PM peaks respectively. The assessment assumes that the egress location for site traffic from the compound would be directly east of the proposed single lane off-ramp, ie before the off-ramp diverges into its multiple lane configuration. Hence, egressing construction vehicles would only need to give way to a single lane off-ramp.

Although the traffic modelling indicates that this intersection would operate with an acceptable level of service, loaded vehicles egressing the site are likely to experience a high level of delay while waiting for a sufficient gap in off-ramp traffic to allow movement from a standing stop and acceleration to overcome the grade of the ramp and reach an acceptable speed to join the off-ramp traffic flow.

Considering the limited gaps in off-ramp traffic, the grade of the off-ramp and the loaded nature of the construction vehicles, suitable traffic control would need to be implemented to safely cater for this access arrangement. This would be developed through consultation between the construction contractor, Roads and Maritime and the Transport Management Centre.

Trelawney Street access arrangement C7-1

When compared to the assessment presented in the environmental impact statement this access arrangement would allow construction vehicles leaving the Trelawney Street compound to left turn from Loch Maree Avenue. This new left turn movement would be accommodated within the available green time for the Loch Maree Avenue approach. A reassignment of green time at the intersection of Pennant Hills Road / Loch Maree Avenue would result in similar network performance when compared to the environmental impact statement.

Trelawney Street access arrangement C7-2

During the AM and PM peak hours, a reassignment of green time to cater for left-in, left-out movements would result in similar intersection performance to that presented in the environmental impact statement. The additional green time that was required for the right turn into Phyllis Avenue as part of the routes described within the environmental impact statement would be able to be returned to the Pennant Hills Road movement.

During the night shift, this access arrangement would require construction vehicles to avoid the right turn access movement into Loch Maree Avenue. Consequently, the construction vehicles accessing the site from a southern spoil location would need to make use of the strategic road network (non-local roads) and a suitable u-turn facility to the north of the Trelawney Street compound. As this would occur outside the usual traffic peak periods, the impact of this movement would not impact the operation of the strategic road network.

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Table 9-16 Southern interchange compound (C5) intersection performance – southern spoil disposal site

Intersection	Peak	2016 – environmental impact statement				2016 – amended haulage routes			
		Light vehicles	Heavy vehicles	Average delay (s)	Level of service	Light vehicles	Heavy vehicles	Average delay (s)	Level of service
Arrangement C5-1									
Pennant Hills Road / North Rocks Road	AM peak	4,290	290	96.2	F	4,290	290	99.6	F
	PM peak	4,680	190	>100	F	4,680	190	>100	F
Hills M2 Motorway / Pennant Hills Road interchange	AM peak	5,610	780	49.5	D	5,610	780	49.0	D
	PM peak	5,930	650	>100	F	5,930	650	>100	F
Pennant Hills Road / Eaton Road	AM peak	5,530	750	>100	F	5,530	735	>100	F
	PM peak	5,870	640	63.4	E	5,870	625	57.5	E
Pennant Hills Road / Aiken Road	AM peak	5,180	720	29.3	C	5,180	720	30.1	C
	PM peak	6,220	630	31.0	C	6,220	630	25.7	B
Pennant Hills Road / New Construction Access	AM peak	-	-	-	-	4,630	720	6.8	A
	PM peak	-	-	-	-	4,590	720	11.1	A
Arrangement C5-2									
Pennant Hills Road / North Rocks Road	AM peak	4,290	290	96.2	F	4,290	290	97.9	F
	PM peak	4,680	190	>100	F	4,680	190	>100	F
Hills M2 Motorway / Pennant Hills Road interchange	AM peak	5,610	780	49.5	D	5,610	780	48.9	D
	PM peak	5,930	650	>100	F	5,930	650	>100	F
Pennant Hills Road / Eaton Road	AM peak	5,530	750	>100	F	5,530	735	>100	F
	PM peak	5,870	640	63.4	E	5,870	625	57.5	E
Pennant Hills Road / Aiken Road	AM peak	5,180	720	29.3	C	5,180	720	29.3	C
	PM peak	6,220	630	31.0	C	6,220	630	27.6	B
New construction access (Hills M2 Motorway off-ramp)	AM peak	-	-	-	-	1290	170	34.6	C
	PM peak	-	-	-	-	1190	150	14.7	B

Table 9-17 Trelawney compound (C7) intersection performance – southern spoil disposal site

Intersection	Peak	2016 – environmental impact statement				2016 – amended haulage routes			
		Light vehicles	Heavy vehicles	Average delay (s)	Level of service	Light vehicles	Heavy vehicles	Average delay (s)	Level of service
Arrangement C7-1									
Pennant Hills Road / Comenarra Parkway	AM peak	4,720	730	>100	F	4,720	730	>100	F
	PM peak	5,410	580	>100	F	5,410	580	>100	F
Pennant Hills Road / Phyllis Avenue / Loch Maree Avenue	AM peak	4,030	750	23.3	B	4,030	750	23.4	B
	PM peak	4,770	610	50.4	D	4,770	610	46.9	D
Arrangement C7-2									
Pennant Hills Road / Comenarra Parkway	AM peak	4,720	730	>100	F	4,720	730	>100	F
	PM peak	5,410	580	>100	F	5,410	580	>100	F
Pennant Hills Road / Phyllis Avenue / Loch Maree Avenue	AM peak	4,030	750	23.3	B	4,030	750	23.6	B
	PM peak	4,770	610	50.4	D	4,770	610	47.0	D

Conclusion

The alternative access arrangements identified and proposed for the southern interchange compound (C5), the Trelawney Street compound (C7) and the northern interchange compound (C9) will remove most of the potential impacts on the local residential road network around these compounds (as detailed in the environmental impact statement). This will result in a significant improvement in road capacity, efficiency and safety on these local residential roads, compared with the construction haulage routes assessed in the environmental impact statement. This change to the project has been proposed as a key response to issues raised in feedback and submissions about the use of residential streets during the construction period.

The potential impacts of the alternative access arrangements on intersection performance have been demonstrated through the preceding intersection analysis to be generally similar to those described in the environmental impact statement.

9.4.4 Construction traffic noise

The proposed change in construction traffic movements may result in changes to construction traffic noise levels. Consistent with the approach undertaken in the environmental impact statement, the revised access arrangements routes have been examined for two scenarios with all spoil being transported to a northern disposal site and all spoil being transported to a southern disposal site. This provides a worst-case assessment as it is feasible that spoil disposal locations in each direction may be utilised which would reduce these potential impacts.

The construction traffic noise assessment has been completed for the alternative access arrangements in the AM and PM peak periods, as well as the AM and PM off-peak periods in order to assess the potential impacts from night time spoil haulage.

As identified in the construction traffic assessment in **Section 9.4.3** of this report, not all of the proposed access arrangements are feasible for the haulage of spoil to disposal sites in each direction. Additionally, as the project has imposed a restriction on the access and egress arrangements during night time works, not all of the proposed routes are suitable for use at night. A summary of the feasible arrangements during each period and in each direction for the assessment of potential construction noise impacts is provided in **Table 9-18**.

Table 9-18 Summary of construction traffic noise assessment scenarios

Period	Spoil disposal location	Haulage arrangement								
		Southern interchange compound (C5)					Trelawney Street compound (C7)		Northern interchange compound (C9)*	
		C5-1	C5-2	C5-3	C5-4	C5-5	C7-1	C7-2	C9-1	C9-2
AM peak period	Northern	✓				✓	✓	✓	✓	✓
	Southern	✓	✓		✓	✓	✓	✓	✓	✓
PM peak period	Northern	✓				✓	✓	✓	✓	✓
	Southern	✓	✓		✓	✓	✓	✓	✓	✓
AM off-peak period	Northern	✓						✓	✓	✓
	Southern	✓	✓	✓				✓	✓	✓
PM off-peak period	Northern	✓						✓	✓	✓
	Southern	✓	✓	✓				✓	✓	✓

* Northern interchange access arrangement C9-1 is identical to the haulage route assessed as part of the environmental impact statement and has not been re-assessed. Table 47 to Table 54 of the Technical Working Paper: Noise and Vibration summarise the construction traffic noise impacts predicted for the northern interchange and Bareena Avenue compounds, which would remain unchanged for access arrangement C9-1.

Southern interchange compound (C5)

Daytime heavy vehicle movements

Table 9-19 and **Table 9-20** present the revised construction traffic noise assessment for the southern interchange compound during the AM and PM peak periods for a northern and southern spoil disposal site respectively. The tables identify that there is minimal change in construction traffic noise compared with the assessment presented in the environmental impact statement.

All access arrangements result in either no change or negligible change to construction traffic noise impacts along Pennant Hills Road. For all access arrangements, potential construction noise impacts are completely removed from Aiken Road. Similarly, construction traffic noise impacts are removed from Eaton Road for access arrangements C5-1 and C5-2. A slight reduction in construction traffic noise would be experienced on Eaton Road under access arrangement C5-4.

Access arrangement C5-5 shows a slight increase in traffic noise on Eaton Road. This is associated with the new right turn from Pennant Hills Road resulting in inbound heavy vehicles using a short section of Eaton Road. When considering this minor increase, it is also important to recognise that the previous inbound haulage route impacted around 88 houses on Eaton Road, whereas the new arrangement would only impact around 12 houses.

Table 9-19 Construction traffic noise in AM and PM peak periods – southern interchange compound with northern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))		
	EIS	C5-1	C5-5
AM peak period			
Pennant Hills Road – north of Aiken Road	0.3	0.3	0.3
Pennant Hills Road – between Aiken Road and Eaton Road	0.1	0.2	0.2
Pennant Hills Road – between Eaton Road and the Hills M2 Motorway	0.0	0.0	0.0
Aiken Road	1.1	0.0	0.0
Eaton Road	1.6	0.0	2.4
Hills M2 Motorway	0.0	0.0	0.0
PM peak period			
Pennant Hills Road – north of Aiken Road	0.2	0.2	0.2
Pennant Hills Road – between Aiken Road and Eaton Road	0.1	0.2	0.2
Pennant Hills Road – between Eaton Road and the Hills M2 Motorway	0.0	0.0	0.0
Aiken Road	1.0	0.0	0.0
Eaton Road	2.5	0.0	4.1
Hills M2 Motorway	0.0	0.0	0.0

Table 9-20 Construction traffic noise in AM and PM peak periods – southern interchange compound with southern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))				
	EIS	C5-1	C5-2	C5-4	C5-5
AM peak period					
Pennant Hills Road – north of Aiken Road	0.6	0.6	0.5	0.5	0.6
Pennant Hills Road – between Aiken Road and Eaton Road	0.5	0.5	0.5	0.5	0.5
Pennant Hills Road – between Eaton Road and the Hills M2 Motorway	0.6	0.6	0.4	0.5	0.6
Aiken Road	1.1	0.0	0.0	0.0	0.0
Eaton Road	1.4	0.0	0.0	1.1	2.4
Hills M2 Motorway	1.2	1.2	1.3	1.1	1.2
PM peak period					
Pennant Hills Road – north of Aiken Road	0.5	0.5	0.4	0.4	0.5
Pennant Hills Road – between Aiken Road and Eaton Road	0.5	0.5	0.5	0.5	0.5
Pennant Hills Road – between Eaton Road and the Hills M2 Motorway	0.8	0.8	0.5	0.8	0.8
Aiken Road	1.0	0.0	0.0	0.0	0.0
Eaton Road	2.6	0.0	0.0	1.8	4.1
Hills M2 Motorway	1.2	1.2	1.4	1.2	1.2

Out of hours heavy vehicle movements

Table 9-21 and **Table 9-22** present the revised construction traffic noise assessment for the southern interchange compound during the AM and PM off-peak periods for a northern and southern spoil disposal site respectively. The tables show a significant reduction in traffic noise levels on Aiken Road and Eaton Road due to the elimination of the inbound traffic route along these local roads.

For a northern disposal site scenario, all affected roads are expected to increase background noise levels by less than 2 dB(A). For a southern disposal site scenario, there are some areas along Pennant Hills Road and the Hills M2 Motorway where existing noise levels are expected to increase by up to around 3 dB(A) and around 5 dB(A), respectively. However, these predicted increases in noise levels are generally consistent with the assessment presented in the environmental impact statement.

Table 9-21 Construction traffic noise in AM and PM off-peak periods – southern interchange compound with northern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C5-1
AM off-peak period		
Pennant Hills Road – north of Aiken Road	1.6	1.6
Pennant Hills Road – between Aiken Road and Eaton Road	0.9	1.5
Pennant Hills Road – between Eaton Road and the Hills M2 Motorway	0.1	0.1
Aiken Road	5.6	0.0
Eaton Road	9.4	0.0
Hills M2 Motorway	0.0	0.0
PM off-peak period		
Pennant Hills Road – north of Aiken Road	0.6	0.6
Pennant Hills Road – between Aiken Road and Copeland Rd	0.4	0.7
Pennant Hills Road – between Copeland Road and the Hills M2 Motorway	0.1	0.1
Aiken Road	2.2	0.0
Eaton Road	4.9	0.0
Hills M2 Motorway	0.0	0.0

Table 9-22 Construction traffic noise in AM and PM off-peak periods – southern interchange compound with southern disposal site

Route and direction	Relative increase over existing noise levels (dB(A)) EIS	C5-1	C5-2	C5-3
AM off-peak period				
Pennant Hills Road – north of Aiken Road	3.0	3.0	2.9	3.4
Pennant Hills Road – between Aiken Road and Eaton Road	3.1	2.9	2.8	3.2
Pennant Hills Road – between Eaton Road and the Hills M2 Motorway	3.3	3.3	2.8	3.2
Aiken Road	5.6	0.0	0.0	0.0
Eaton Road	9.4	0.0	0.0	0.0
Hills M2 Motorway	5.1	5.1	5.5	6.2
Pennant Hills Road – south of Beecroft Road West[1]	3.5	-	-	4.1
Pennant Hills Road – between Beecroft Road East and West[1]	2.9	-	-	3.3
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	2.6	-	-	2.6
Pennant Hills Road – north of Boundary Road[1]	2.5	-	-	2.5
Beecroft Road West[1]	5.5	-	-	7.6
Beecroft Road East[1]	4.4	-	-	6.2
PM off-peak period				
Pennant Hills Road – north of Aiken Road	1.3	1.3	1.2	1.4
Pennant Hills Road – between Aiken Road and Copeland Road	1.4	1.3	1.3	1.5
Pennant Hills Road – between Copeland Road and the Hills M2 Motorway	1.9	1.9	1.2	1.9
Aiken Road	2.3	0.0	0.0	0.0
Eaton Road	5.0	0.0	0.0	0.0
Hills M2 Motorway	3.1	3.1	3.4	3.9
Pennant Hills Road – south of Beecroft Road West[1]	1.6	-	-	2.0
Pennant Hills Road – between Beecroft Road East and West[1]	6.8	-	-	7.3
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	4.2	-	-	4.2
Pennant Hills Road – north of Boundary Road[1]	1.1	-	-	1.1
Beecroft Road West[1]	1.5	-	-	2.3
Beecroft Road East[1]	2.6	-	-	3.8

Note 1: these sections were reported in the environmental impact statement against the Wilson Road compound (C6). These sections are shown here due to potential cumulative traffic noise increases from the Wilson Road compound and the southern interchange access arrangement C5-3 associated with the proposed u-turn at Beecroft Road.

Trelawney Street compound (C7)

Daytime heavy vehicle movements

Table 9-23 and **Table 9-24** present the revised construction traffic noise assessment for the Trelawney Street compound during the AM and PM peak periods for a northern and southern spoil disposal site respectively. The tables identify that there is minimal change from the assessment presented in the environmental impact statement.

Access arrangement C7-1 would result in a potential increase in traffic noise (up to 7 dB(A)) along Loch Maree Avenue during the AM peak period associated with the proposed use of a short section of this road to egress the site. This should be considered against the significant reduction in noise from eliminating the use of this road during the night time period, and the reduction in noise along this section of road under arrangement C7-2.

With the exception of two areas along Pennant Hills Road, all other predicted noise increases are less than 2 dB(A).

Table 9-23 Construction traffic noise in AM and PM peak periods – Trelawney Street compound with northern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))		
	EIS	C7-1	C7-2
AM peak period			
Pennant Hills Road – south of Comenarra Parkway	0.5	0.5	0.6
Pennant Hills Road – between Comenarra Parkway and Boundary Road	0.5	0.5	0.6
Pennant Hills Road – north of Boundary Road	0.7	0.7	0.5
Phyllis Avenue	2.8	0.0	0.0
Loch Maree Avenue	4.7	6.7	0.0
Pennant Hills Road – south of Beecroft Road West[1]	0.4	-	0.4
Pennant Hills Road – between Beecroft Road East and West[1]	0.4	-	0.4
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	0.4	-	0.6
Pennant Hills Road – north of Boundary Road[1]	0.4	-	0.6
Beecroft Road West[1]	0.8	-	1.5
Beecroft Road East[1]	0.4	-	0.9
PM peak period			
Pennant Hills Road – south of Comenarra Parkway	0.5	0.5	0.6
Pennant Hills Road – between Comenarra Parkway and Boundary Road	0.5	0.5	0.7
Pennant Hills Road – north of Boundary Road	0.7	0.7	0.6
Phyllis Avenue	2.1	0.0	0.0
Loch Maree Avenue	3.3	4.8	0.0
Pennant Hills Road – south of	0.3	-	0.3

Route and direction	Relative increase over existing noise levels (dB(A))		
	EIS	C7-1	C7-2
Beecroft Road West[1]			
Pennant Hills Road – between Beecroft Road East and West[1]	3.1	-	3.7
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	2.2	-	3.0
Pennant Hills Road – north of Boundary Road[1]	0.4	-	0.6
Beecroft Road West[1]	0.6	-	1.2
Beecroft Road East[1]	1.2	-	2.1

Note 1: these sections were reported in the environmental impact statement against the Wilson Road compound (C6). These sections are shown here due to potential cumulative traffic noise increases from Wilson Road compound and the Trelawney Street access arrangement C7-2 associated with the proposed u-turn at Beecroft Road.

Table 9-24 Construction traffic noise in AM and PM peak periods – Trelawney Street compound with southern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))		
	EIS	C7-1	C7-2
AM peak period			
Pennant Hills Road – south of Comenarra Parkway	0.4	0.4	0.4
Pennant Hills Road – between Comenarra Parkway and Boundary Road	0.4	0.4	0.4
Pennant Hills Road – north of Boundary Road	0.3	0.3	0.4
Phyllis Avenue	0.9	0.1	0.0
Loch Maree Avenue	4.4	6.5	0.0
Pennant Hills Road – south of Beecroft Road West1	0.7	-	0.7
Pennant Hills Road – between Beecroft Road East and West1	0.5	-	0.6
Pennant Hills Road – between Beecroft Road East and Boundary Road1	0.4	-	0.5
Pennant Hills Road – north of Boundary Road1	0.4	-	0.5
Beecroft Road West1	0.8	-	0.9
Beecroft Road East1	0.4	-	0.6
PM peak period			
Pennant Hills Road – south of Comenarra Parkway	0.5	0.5	0.5
Pennant Hills Road – between Comenarra Parkway and Boundary Road	0.5	0.5	0.5
Pennant Hills Road – north of Boundary Road	0.5	0.5	0.5
Phyllis Avenue	0.8	0.0	0.0
Loch Maree Avenue	1.2	5.1	0.0
Pennant Hills Road – south of Beecroft Road West[1]	0.6	-	0.6

Route and direction	Relative increase over existing noise levels (dB(A))		
	EIS	C7-1	C7-2
Pennant Hills Road – between Beecroft Road East and West[1]	3.8	-	4.4
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	2.2	-	2.7
Pennant Hills Road – north of Boundary Road[1]	0.4	-	0.5
Beecroft Road West[1]	0.6	-	0.8
Beecroft Road East[1]	1.2	-	1.4

Note 1: these sections were reported in the environmental impact statement against the Wilson Road compound (C6). These sections are shown here due to potential cumulative traffic noise increases from Wilson Road and Trelawney Street access arrangement C7-2 associated with the proposed u-turn at Beecroft Road.

Out of hours heavy vehicle movements

Table 9-25 and **Table 9-26** present the revised construction traffic noise assessment for the Trelawney Street compound during the AM and PM off-peak periods for a northern and southern spoil disposal site respectively. The tables identify that there is a significant reduction in traffic on Loch Maree Avenue and Phyllis Avenue relative to the assessment presented in the environmental impact statement. This is associated with the removal of the use of these roads during the night time period.

There are some predicted noise increases along Pennant Hills Road and Beecroft Road due to the requirement to perform a u-turn at Beecroft Road.

Table 9-25 Construction traffic noise in AM and PM off-peak periods – Trelawney Street compound with northern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C7-2
AM off-peak period		
Pennant Hills Road – south of Comenarra Parkway	2.5	3.3
Pennant Hills Road – between Comenarra Parkway and Boundary Road	2.5	3.3
Pennant Hills Road – north of Boundary Road	3.2	2.9
Phyllis Avenue	10.8	0.0
Loch Maree Avenue	17.2	0.0
Pennant Hills Road – south of Beecroft Road West[1]	1.8	1.8
Pennant Hills Road – between Beecroft Road East and West[1]	2.2	2.7
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	2.7	3.5
Pennant Hills Road – north of Boundary Road[1]	2.6	3.4
Beecroft Road West[1]	5.5	7.9
Beecroft Road East[1]	4.4	6.5
PM off-peak period		
Pennant Hills Road – south of	1.3	1.6

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C7-2
Comenarra Parkway		
Pennant Hills Road – between Comenarra Parkway and Boundary Road	1.4	1.7
Pennant Hills Road – north of Boundary Road	1.8	1.4
Phyllis Avenue	4.4	0.0
Loch Maree Avenue	6.4	0.0
Pennant Hills Road – south of Beecroft Road West[1]	0.8	0.8
Pennant Hills Road – between Beecroft Road East and West[1]	5.7	6.5
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	4.3	5.4
Pennant Hills Road – north of Boundary Road[1]	1.1	1.5
Beecroft Road West[1]	1.5	2.5
Beecroft Road East[1]	2.6	4.2

Note 1: these sections were reported in the environmental impact statement against the Wilson Road compound (C6). These sections are shown here due to potential cumulative traffic noise increases from Wilson Road compound and Trelawney Street access arrangement C7-2 associated with the proposed u-turn at Beecroft Road.

Table 9-26 Construction traffic noise in AM and PM off-peak periods – Trelawney Street compound with southern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C7-2
AM off-peak period		
Pennant Hills Road – south of Comenarra Parkway	2.4	2.4
Pennant Hills Road – between Comenarra Parkway and Boundary Road	2.4	2.4
Pennant Hills Road – north of Boundary Road	1.8	2.4
Phyllis Avenue	5.3	0.0
Loch Maree Avenue	12.3	0.0
Pennant Hills Road – south of Beecroft Road West[1]	3.5	3.5
Pennant Hills Road – between Beecroft Road East and West[1]	2.9	3.4
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	2.6	3.1
Pennant Hills Road – north of Boundary Road[1]	2.5	3
Beecroft Road West[1]	5.5	6.1
Beecroft Road East[1]	4.4	4.9
PM off-peak period		
Pennant Hills Road – south of Comenarra Parkway	1.2	1.2
Pennant Hills Road – between	1.3	1.3

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C7-2
Comenarra Parkway and Boundary Road		
Pennant Hills Road – north of Boundary Road	1.2	1.3
Phyllis Avenue	1.7	0.0
Loch Maree Avenue	2.8	0.0
Pennant Hills Road – south of Beecroft Road West[1]	1.6	1.6
Pennant Hills Road – between Beecroft Road East and West[1]	6.8	7.6
Pennant Hills Road – between Beecroft Road East and Boundary Road[1]	4.2	5
Pennant Hills Road – north of Boundary Road[1]	1.1	1.4
Beecroft Road West[1]	1.5	1.7
Beecroft Road East[1]	2.6	3.0

Note 1: these sections were reported in the environmental impact statement against the Wilson Road compound (C6). These sections are shown here due to potential cumulative traffic noise increases from Wilson Road compound and Trelawney Street access arrangement C7-2 associated with the proposed u-turn at Beecroft Road.

Northern interchange compound (C9)

Daytime heavy vehicle movements

Table 9-27 and **Table 9-28** present the revised construction traffic noise assessment for the northern interchange compound during the AM and PM peak periods for a northern and southern spoil disposal site respectively. The tables identify that there is minimal change from the assessment presented in the environmental impact statement. All affected roads would experience noise increases of less than 2 dB(A).

Table 9-27 Construction traffic noise in AM and PM peak periods – northern interchange compound with northern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C9-2
AM peak period		
Pennant Hills Road – north of Pacific Highway	0.3	0.3
Pennant Hills Road – between Pacific Highway and Aaron Place	1.1	1.1
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	1.1	1.1
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	0.6	0.6
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	0.7	0.6
Pennant Hills Road – south of Jasmine Road	0.7	0.6
Pacific Highway – east of M1 Pacific Motorway	0.2	0.2
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	1.3	1.3
M1 Pacific Motorway – north of Pacific Highway Exit	0.7	0.7
M1Pacific Motorway – south of M1 Pacific Motorway Portal	0.6	0.5
PM peak period		
Pennant Hills Road – north of Pacific Highway	0.3	0.3
Pennant Hills Road – between Pacific Highway and Aaron Place	1.2	1.2
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	1.2	1.2
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	0.7	0.7
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	0.7	0.7
Pennant Hills Road – south of Jasmine Road	0.7	0.7
Pacific Highway – east of M1 Pacific Motorway	0.2	0.2
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	1.5	1.5
M1 Pacific Motorway – north of Pacific Highway Exit	0.7	0.7
M1Pacific Motorway – south of M1 Pacific Motorway Portal	0.6	0.5

The noise increases are associated with heavy vehicles travelling past this site from a northern disposal site to the other sites.

Table 9-28 Construction traffic noise in AM and PM peak periods – northern interchange compound with southern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C9-2
AM peak period		
Pennant Hills Road – north of Pacific Highway	0.3	0.3
Pennant Hills Road – between Pacific Highway and Aaron Place	0.7	0.7
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	0.7	0.7
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	0.3	0.3
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	0.3	0.3
Pennant Hills Road – south of Jasmine Road	0.3	0.3
Pacific Highway – east of M1 Pacific Motorway	0.2	0.2
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	0.4	0.4
M1 Pacific Motorway – north of Pacific Highway Exit	0.0	0.1
M1 Pacific Motorway – south of M1 Pacific Motorway Portal	0.0	0.1
PM peak period		
Pennant Hills Road – north of Pacific Highway	0.3	0.3
Pennant Hills Road – between Pacific Highway and Aaron Place	0.8	0.8
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	0.8	0.8
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	0.3	0.4
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	0.4	0.4
Pennant Hills Road – south of Jasmine Road	0.4	0.4
Pacific Highway – east of M1 Pacific Motorway	0.2	0.2
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	0.5	0.5
M1 Pacific Motorway – north of Pacific Highway	0.0	0.1
M1 Pacific Motorway – south of M1 Pacific Motorway Portal	0.0	0.1

Out of hours heavy vehicle movements

Table 9-29 and **Table 9-30** present the revised construction traffic noise assessment for the northern interchange compound during the AM and PM off-peak periods for a northern and southern spoil disposal site respectively. The tables identify that there is minimal change (no more than ±0.1 dB(A)) in predicted noise levels increases from the assessment presented in the environmental impact statement.

Table 9-29 Construction traffic noise in AM and PM off-peak periods – northern interchange compound with northern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C9-2
AM off-peak period		
Pennant Hills Road – north of Pacific Highway	2.2	2.2
Pennant Hills Road – between Pacific Highway and Aaron Place	5.5	5.5
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	5.5	5.5
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	3.3	3.3
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	3.4	3.4
Pennant Hills Road – south of Jasmine Road	3.4	3.4
Pacific Highway – east of M1 Pacific Motorway	1.6	1.6
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	6.6	6.6
M1 Pacific Motorway – north of Pacific Highway	4.7	4.7
M1 Pacific Motorway – south of M1 Pacific Motorway Portal	3.0	2.9
PM off-peak period		
Pennant Hills Road – north of Pacific Highway	0.8	0.8
Pennant Hills Road – between Pacific Highway and Aaron Place	2.8	2.8
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	2.8	2.8
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	1.7	1.7
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	1.7	1.7
Pennant Hills Road – south of Jasmine Road	1.7	1.7
Pacific Highway – east of M1 Pacific Motorway	0.6	0.6
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	3.2	3.2
M1 Pacific Motorway – north of Pacific Highway Exit	1.6	1.6
M1 Pacific Motorway – south of M1 Pacific Motorway Portal	1.5	1.4

Table 9-30 Construction traffic noise in AM and PM off-peak periods – northern interchange compound with southern disposal site

Route and direction	Relative increase over existing noise levels (dB(A))	
	EIS	C9-2
AM off-peak period		
Pennant Hills Road – north of Pacific Highway	2.1	2.1
Pennant Hills Road – between Pacific Highway and Aaron Place	4.0	4.0
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	4.0	4.0
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	1.8	1.8
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	1.8	1.9
Pennant Hills Road – south of Jasmine Road	1.8	1.9
Pacific Highway – east of M1 Pacific Motorway	1.6	1.6
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	3.1	3.1
M1 Pacific Motorway – north of Pacific Highway Exit	0.3	0.5
M1 Pacific Motorway – south of M1 Pacific Motorway Portal	0.2	0.3
PM off-peak period		
Pennant Hills Road – north of Pacific Highway	0.8	0.8
Pennant Hills Road – between Pacific Highway and Aaron Place	1.9	1.9
Pennant Hills Road – between Aaron Place and the M1 Pacific Motorway	1.9	1.9
Pennant Hills Road – between M1 Motorway and Hinemoa Avenue	0.9	0.9
Pennant Hills Road – between Hinemoa Avenue and Jasmine Road	0.9	0.9
Pennant Hills Road – south of Jasmine Road	0.9	0.9
Pacific Highway – east of M1 Pacific Motorway	0.6	0.6
Pacific Highway – between the M1 Pacific Motorway and Pennant Hills Road	1.3	1.3
M1 Pacific Motorway – north of Pacific Highway Exit	0.1	0.1
M1 Pacific Motorway – south of M1 Pacific Motorway Portal	0.1	0.1

The noise increases are associated with heavy vehicles travelling past this site from a northern disposal site to the other sites.

Conclusion

The revised haulage routes result in a significant reduction in traffic noise levels along local roads from those presented in the environmental impact statement, particularly during the night-time periods. There would be some minor increases in traffic noise along certain sections of arterial roads, especially Pennant Hills Road.

9.4.5 Summary and justification

Changes to access arrangements around the southern interchange compound (C5), the Trelawney Street compound (C7) and the northern interchange compound (C9) have been made in response to significant feedback raised in public submissions about potential impacts on local residential streets. Submissions have raised concerns relating to heavy vehicle movements on local residential streets leading to reduced amenity (both traffic and noise), road safety, and the capacity and efficiency of residential streets.

The assessment of the revised heavy vehicle haulage routes for the southern interchange compound (C5), the Trelawney Street compound (C7) and the northern interchange compound (C9) has shown that, compared to the impacts described in the environmental impact statement, there would be:

- No material change in the potential construction traffic impacts to the surrounding road network.
- Some minor increases in road traffic noise along major arterial roads, especially Pennant Hills Road, and on some short sections of local roads during the daytime period only.
- A significant reduction in road traffic noise along local roads, particularly during the night-time period around the southern interchange compound (C5) and on Loch Maree Avenue near the Trelawney Street compound (C7).

Overall, the changes made to access arrangements at these construction compounds reduce the overall impacts of the project relative to the assessment presented in the environmental impact statement.

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9.5 Additional construction use at the Junction Road compound (C11)

9.5.1 Description of changes

In the environmental impact statement, the Junction Road compound (C11) was identified as a parking and site office facility. Ongoing design refinement and construction planning has identified a need for a construction materials storage and laydown area within this site compound. The overall footprint of the compound would be unchanged. A revised indicative construction site layout for the Junction Road compound is shown in **Figure 9-21**.

The provision of a storage and laydown area at the Junction Road compound would also change the number of heavy vehicles accessing the site per day. The environmental impact statement identified that there would be one heavy vehicle accessing the Junction Road compound per day. With the provision of construction materials storage and laydown, this would be increased to five heavy vehicles per day. There would be no change to the proposed access routes or the number of light vehicles accessing this compound.

9.5.2 Environmental overview of changes

Addition of construction materials storage and laydown at the Junction Road compound (C11) compared to site uses as presented in the environmental impact statement has been reviewed to identify relevant potential environmental impacts for further, more detailed assessed. This review has identified the following issues:

- Changes in construction traffic movements which may affect the performance of the surrounding road network. Further assessment of construction traffic impacts has therefore been conducted, and is included in **Section 9.5.3**.
- Changes in activities undertaken on the site may change construction noise levels. Further assessment of construction noise has therefore been conducted, and is included in **Section 9.5.4**.
- Changes in construction traffic movements which may change construction traffic noise levels. Further assessment of construction traffic noise has therefore been conducted, and is included in **Section 9.5.4**.

The addition of construction materials storage and laydown would not affect other environmental and land use issues.

9.5.3 Construction traffic and transport

The introduction of five heavy vehicles to and from the Junction Road compound (C11) would result in an average of around one heavy vehicle movement per hour across the day. This would not affect the performance of the local road network. As such, the potential change in traffic impacts associated with the increase from one heavy vehicle per day to five heavy vehicles per day is anticipated to be negligible.

9.5.4 Construction noise and vibration

The construction noise assessment for the Junction Road compound (C11) presented in the environmental impact statement was undertaken for site establishment and earthworks only. As the compound was proposed to be used as a car parking and office facility, a construction noise assessment for the ongoing use of this compound during construction was not necessary.

As a materials storage and laydown area is now proposed within this site compound, a construction noise assessment has been completed and is presented in **Table 9-31**. This activity would ordinarily occur during the standard daytime construction hours (7 am to 6 pm Monday to Friday; 8 am to 1 pm Saturday). As such, the assessment has been undertaken for the daytime construction period only.

This compound may be required from time to time to support other construction works outside of these hours. The use of the compound outside of standard construction hours would be subject the requirements described in Section 5.2.15 of the environmental impact statement.

This assessment shows that the use of the Junction Road compound for materials storage and laydown would comply with the noise management levels at all receivers.

Table 9-31 Junction Road compound storage and laydown (standard construction hours)

NCA	Noise management level (L_{Aeq} dB(A))	Predicted noise level (L_{Aeq} dB(A))	Number of receivers where NMLs are exceeded	Number of highly noise affected receivers
NCA01	66	61	0	0
NCA02	66	61	0	0

The increased frequency of heavy vehicles accessing and egressing the site associated with the material storage and laydown area has also been considered in relation to potential traffic noise impacts. As identified in the traffic assessment above, the introduction of five heavy vehicles to and from the Junction Road compound (C11) would result in an average of around one heavy vehicle movement per hour across the day. This would result in an increase in noise levels of less than 2 dB(A).

9.5.5 Summary and justification

The assessment of the additional construction use of the Junction Road compound (C11) has shown that there would be no material difference in impacts from those described in the environmental impact statement.

Figure 9-21 Indicative Junction Road construction compound revised layout C11

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9.6 Additional property acquisition at the Wilson Road compound (C6)

9.6.1 Description of changes

In the environmental impact statement, a total of 46 properties were identified as requiring full permanent acquisition. Ten of these properties were located within the footprint of the Wilson Road tunnel support facility. Ongoing design refinement and construction planning has identified a need to acquire an additional property at the Wilson Road tunnel support facility in order to provide safe access to the Wilson Road compound (C6) off Pennant Hills Road. The existing buildings located within this property would be retained.

The revised property acquisition list for the Wilson Road compound (C6) is provided in **Table 9-32**. The additional property acquisition is highlighted in grey.

The additional property is located adjacent to the operational footprint of the Wilson Road tunnel support facility. On completion of the works, Road and Maritime would consider the ongoing requirements for this property. This is likely to involve the sale of this property for use in line with the applicable zoning provisions.

Table 9-32 Revised property acquisition – Wilson Road tunnel support facility

Lot number	DP / SP number	Lane use	Full / partial
15	11685	Residential	Full
14	35528	Residential	Full
13	35528	Residential	Full
12	35528	Residential	Full
-	41944	Residential	Full
112	1001146	Residential	Full
111	1001146	Residential	Full
22	1010137	Residential	Full
21	1010137	Residential	Full
20	1010137	Residential	Full
131	862034	Residential	Full

Further design development across the project site may lead to additional refinement of the property acquisition requirements identified in Section 8.1 of the environmental impact statement. For the most part, additional property acquisitions identified in the future are likely to be required to provide safe access and egress arrangements and would not be expected to alter the impacts as described within the environmental impact statement.

9.6.2 Environmental overview of changes

The additional property acquisition at the Wilson Road compound (C6) compared to the environmental impact statement has been reviewed to identify if any relevant potential environmental impacts require further, more detailed assessed. The additional property acquisition at the Wilson Road compound (C6) would not affect environmental and land use impacts as described and assessed within the environmental impact statement.

9.7 Conclusion

This section has provided an assessment of the four proposed project changes and has shown:

- The increase in the frequency of bus movements at the Pioneer Avenue compound (C8) would not result in any material difference from the impacts as described in the environmental impact statement.
- The amended construction haulage routes would reduce the overall impacts of the project relative to the assessment presented in the environmental impact statement
- The additional construction use at the Junction Road compound (C11) would not result in any material difference from the impacts as described in the environmental impact statement.
- The additional property acquisition at the Wilson Road compound (C5) would provide a safer access arrangement and would not result in any material difference from the impacts as described in the environmental impact statement.

10 Revised summary of mitigation measures

The environment impact statement for the project identified a range of management and mitigation measures that would be required to avoid or reduce the environmental impacts.

These measures have been revised on the basis of the submissions received and the proposed changes to the project. In some cases new measures have been added, while in others, the wording of existing measures has been adjusted. Should the project be approved, the revised summary of mitigation measures in **Table 10-1** would guide the subsequent phases of the project.

Additions to mitigation measures are shown in ***bold italic text*** and deletions are shown in ~~strikethrough text~~.

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Table 10-1 Revised summary of mitigation measures

Impact	ID	Environmental management measure	Timing
Traffic and transport			
Construction			
General	TT1	A traffic management plan(s) (TMP) would be prepared as part of the construction environmental management plan(s) (CEMP). The TMP would include: • Signage requirements (eg temporary speed restrictions, changes to the road environment, traffic management controls deployed). • Lane possession and approval process during periods of online construction (eg line marking and temporary barriers). • Traffic control devices such as temporary traffic signals. • A local and regional communications strategy. This would include methods to provide advanced notice of any major or prolonged impacts (eg leaflets and local media), and real-time information regarding current impacts (eg variable message signs, radio traffic news). • Details of both the general approach to be used for access and egress to worksites (with consideration of minimum sight distances, maximum grade allowances, etc), and the specific controls required at selected locations (signage, barriers, signalling requirements). • Any specific provisions required to manage potential impacts to sensitive users such as schools, child care centres, health facilities, etc).	Pre-construction
Impacts to road network performance (delays) and safety	TT2	Construction methods and staging would be designed to minimise road closures, subject to other project constraints, and ensure that disruptions to existing traffic are minimised as much as feasible and reasonable.	Construction
	TT3	Offline construction would be carried out wherever feasible and reasonable.	Construction
	TT4	Works which would significantly reduce the performance of the road network would be scheduled for periods of typically lower traffic volumes where feasible and reasonable.	Construction
	TT5	Where offline construction is not practical, and for tie-ins between online and offline sections of the project, construction sequencing and any temporary works identified would aim to minimise user delay while providing sufficient flexibility for the selected contractor to safely and efficiently construct the project.	Construction

Impact	ID	Environmental management measure	Timing
	TT6	Signage would be used to clearly indicate the traffic controls in use. This could also include temporary speed restrictions and passing constraints if required to maintain road safety levels.	Construction
	TT7	In some instances lane closures would be implemented to remove road traffic from construction zones altogether. Where practical this is proposed to occur outside of peak periods including at night to maintain network capacity.	Construction
	TT8	Access to local roads / streets and properties would be maintained. If local roads / streets need to be closed (short or long term), arrangements would be made to provide access to properties of affected residents and their visitors.	Construction
	TT9	Road occupancy licences would be obtained for work that impacts traffic on existing roads.	Construction
Impacts to emergency services	TT10	The TMP would be developed in consultation with local emergency services and procedures would be implemented to maintain priority access and a safe environment for emergency vehicles to travel through construction areas.	Construction
	TT11	Local emergency services would be frequently updated on the staging and progress of construction works.	Construction
	TT12	Communication systems would be in place with traffic controllers to provide appropriate access and routes (eg gaps in concrete barriers, side-tracks, wide verges etc) for emergency vehicles to bypass queued traffic.	Construction
Operation			
Impacts to road safety	OpTT1	A road safety audit would be undertaken by qualified auditors as part of the detailed design, and again immediately prior to project opening, to examine the design from a road safety perspective and identify potential safety issues. This process would be undertaken in accordance with the Roads and Maritime Accident Reduction Guide Part 2: Road Safety Audits (RTA, 2005a).	Detailed design and prior to operation
Noise and vibration			
Construction			
General	NV1	A Construction Noise and Vibration Management Plan(s) would be prepared and implemented, and would include the following: • Identification of nearby residences and other sensitive land uses. • Description of approved hours of work.	Pre-construction

Impact	ID	Environmental management measure	Timing
		• Description and identification of all construction activities, including work areas, equipment and duration. • Description of what work practices (generic and specific) would be applied to minimise noise and vibration. • A complaints handling process. • Noise and vibration monitoring procedures. • Overview of community consultation required for identified high impact works. ***Receiver specific mitigation measures would be developed consistent with measures described in Section 4.5 of the submissions and preferred infrastructure report.***	
Construction noise	NV2	Induction and training would be provided to relevant staff and sub-contractors outlining their responsibilities with regard to noise.	Construction
	NV3	Work would be undertaken during standard construction hours as far as feasible and reasonable.	Construction
	NV4	Noisy activities that cannot be undertaken during standard construction hours would be scheduled as early as possible during the evening and / or night-time periods.	Construction
	NV5	Particularly noisy activities such as the use of impact piling rigs, road and concrete saws, rockbreakers, would be scheduled around times of high background noise where feasible and reasonable to provide masking.	Construction
	NV6	Deliveries would be carried out during standard construction hours where feasible and reasonable.	Construction
	NV7	A protocol would be developed to identify the need for and provision of respite measures for residential receivers in accordance with the Interim Construction Noise Guidelines. Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as rock breaking, rock hammering, pile driving), or other appropriate measures agreed between the contractor and residential receiver such as alternative accommodation.	Construction
	NV8	Appropriate plant would be selected for each task.	Construction
	NV9	Alternative works methods such as use of hydraulic or electric-controlled units in place of diesel units would be considered and implemented where feasible and reasonable.	Construction
	NV10	Equipment would be regularly inspected and maintained to ensure it is in good working	Construction

Impact	ID	Environmental management measure	Timing
		order.	
	NV11	The distance between construction plant and noise sensitive receivers would be maximised as much as feasible and reasonable.	Construction
	NV12	Site access and egress points would be located as far as feasible and reasonable from noise sensitive receivers.	Construction
	NV13	Noisy equipment would be orientated away from residential receivers.	Construction
	NV14	Acoustic sheds would be erected at the ancillary construction facilities that would support 24 hour tunnelling activities, being: • Southern interchange compound (C5). • Wilson Road compound (C6). • Trelawney Street compound (C7). • Northern interchange compound (C8). The attenuation level of the acoustic sheds would be reviewed and optimised during the construction planning phase.	Construction
	NV15	Permanent noise barriers would be scheduled for completion as early as possible in order to mitigate construction noise.	Construction
	NV16	Where feasible and reasonable, the use of temporary noise hoardings would be considered where ancillary construction facilities are in proximity to sensitive receivers.	Construction
	NV17	Noise monitoring would be conducted at the commencement of construction activities and periodically during the construction program.	Construction
	NV18	A protocol would be developed to identify the need for and provision of respite measures for residential receivers in accordance with the Interim Construction Noise Guidelines. Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as rock breaking, rock hammering, pile driving), or other appropriate measures agreed between the contractor and residential receiver such as alternative accommodation.	Construction
Construction traffic noise	NV19	Truck drivers would be advised of designated vehicle routes, parking locations, acceptable delivery hours and other relevant practices (ie minimising the use of engine brakes, and no extended periods of engine idling).	Construction
	NV20	Deliveries and spoil removal would be planned to avoid queuing of trucks around	Construction

Impact	ID	Environmental management measure	Timing
		construction sites.	
	NV21	Construction sites would be arranged to limit the need for reversing movements.	Construction
	NV22	Non-tonal reversing alarms would be used where feasible and reasonable, and taking into account the requirements of the Workplace Health and Safety legislation.	Construction
	NV23	The use of local roads for night-time spoil transport would be reviewed during construction planning.	Construction
Vibration impacts	NV24	Prior to the commencement of tunnelling or other vibration intensive works at each site, existing condition surveys would be undertaken on properties and structures within the preferred project corridor (the zone on the surface equal to 50 metres from the outer edge of the tunnels) and within 50 metres of surface works.	Construction
	NV25	The safe working distances would be complied with where feasible and reasonable. This would include the consideration of smaller equipment when working in close proximity to existing structures.	Construction
	NV26	In the event that vibration intensive equipment would be used within the safe working distances for cosmetic damage, vibration monitoring would be undertaken to warn operators when vibration levels are approaching the peak particle velocity objective.	Construction
Operation			
Road noise impact	OpNV1	Feasible and reasonable mitigation measures would be developed and implemented to minimise noise impacts consistent with the requirements of the NSW Road Noise Policy and the Environmental Noise Management Manual. Specific noise mitigation measures for the project may include, where feasible and reasonable: • Low noise road surfaces. • Noise barriers. • At property acoustic treatments.	Detailed design
	OpNV2	Operational traffic noise would be monitored at sensitive receivers between six months and one year after opening. If the traffic noise levels are above the predicted levels, consideration of additional feasible and reasonable mitigation measures would be undertaken.	Operation
Operational ancillary facilities	OpNV3	Operational ancillary facilities would be designed to meet project specific noise criteria	Detailed design

Impact	ID	Environmental management measure	Timing
		derived in accordance with the NSW Industrial Noise Policy.	
Air quality			
Construction			
General	AQ1	Site inductions and ongoing toolbox talks would be provided to make construction works aware of air quality control practices and responsibilities.	Construction
	AQ2	Construction activities would be modified, reduced or controlled during high or unfavourable wind conditions if they would potentially increase off-site dust emissions.	Construction
	AQ3	Measures would be implemented to control dust emissions, such as the use of water carts, sprinklers, sprays and dust screens. The frequency of use would be modified in response to weather conditions.	Construction
	AQ4	Dust extraction and filtration systems would be installed for tunnel excavation works.	Construction
	AQ5	Should odour emissions arise from the groundwater treatment plant or stockpiles, a management plan would be developed to identify and implement appropriate mitigation measures.	Construction
	AQ6	Disturbed areas would be stabilised as soon as practicable to prevent or minimise windblown dust.	Construction
	AQ7	Cutting of materials such as concrete or bricks would be undertaken in a manner that minimises the generation of dust, such as the wetting of the cutting face.	Construction
	AQ8	Controls, such as rumble grids or wheel wash facilities, would be implemented to minimise the tracking of dirt onto public roads.	Construction
	AQ9	Hardstand areas and surrounding public roads would be cleaned, as required.	Construction
	AQ10	Speed limits would be posted and observed by all construction vehicles on the construction site.	Construction
	AQ11	Loaded haulage trucks would be covered at all times on public roads and on-site where there is a risk of release of dust or other materials.	Construction
	AQ12	Haul trucks, plant and equipment would be switched off when not in operation for periods of greater than 15 minutes.	Construction
	AQ13	Construction plant, vehicles and machinery would be maintained in good working order and in accordance with manufacturers' specifications.	Construction

Impact	ID	Environmental management measure	Timing
Monitoring	AQ14	A formal dust observation program would be implemented during construction, involving daily reviews of weather forecasts, observations of meteorological conditions and on site dust generation. This would inform mitigation measures or alterations to construction activities to be implemented during unfavourable weather conditions (such as dry weather and strong winds).	Construction
Operation			
In-tunnel air quality monitoring	OpAQ1	A management framework would be developed and implemented to ensure that significant congestion is effectively managed and that acceptable in-tunnel air quality is maintained. The framework would include: • In-tunnel monitoring of carbon monoxide, nitrogen dioxide and / or visibility (extinction coefficient). • Monitoring of traffic conditions and traffic speeds within the main alignment tunnels, and upstream and downstream of the project. • Measures to limit and manage traffic entering the project tunnels in the event of significant congestion conditions that may lead to unacceptable in-tunnel air quality. This may include measures such as lane closures, rapid responses to incidents / breakdowns, and broader traffic network management. • Operational requirements to ensure that operation of the project's ventilation system reflects traffic volumes and in-tunnel air quality requirements. • Provision for the review of the management framework after a period of operation, once sufficient actual in-tunnel air quality and traffic data have been gathered. • Contingency measures in the event of elevated, unexpected in-tunnel air quality (including measures to manage emergency situations). • Provision for publication of relevant in-tunnel air quality performance data. • Review of the performance of smoky vehicle regulation / enforcement and whether additional or amended measures may be required.	Operation

Impact	ID	Environmental management measure	Timing
Local air quality monitoring	OpAQ2	***A comprehensive operational air quality monitoring plan would be developed including provision for undertaking monitoring in nearby schools.*** Air quality in the vicinity of the project would be monitored for a specified time period following project opening. If pollutant concentrations contributed by the project are above predicted levels, additional feasible and reasonable mitigation measures would be considered to meet applicable predicted limits.	Operation
Research funding	***OpAQ3***	***Funding would be provided to research into in-tunnel air quality conditions for motorists. The terms of reference for the study would be approved by the Advisory Committee on Tunnel Air Quality.***	***Operation***
Health			
• Operational air quality mitigation and monitoring identified in Section 7.3 (Air quality) of the environmental impact statement. • Construction and operational noise and vibration mitigation measures identified in Section 7.2 (Noise and vibration) of the environmental impact statement.			
Urban design, landscape character and views			
Construction			
Visual amenity	V1	Existing vegetation around the perimeter of construction sites would be retained where feasible and reasonable.	Construction
	V2	The early implementation of noise walls and landscape planting around ancillary facilities would be investigated in order to provide visual screening and minimise noise impacts during the construction phase.	Construction
	V3	Elements within construction sites would be located to minimise visual impacts as far as feasible and reasonable, eg locating equipment back from site boundaries.	Construction
	V4	The design of acoustic sheds would aim to blend into the background where feasible and reasonable.	Pre-construction / construction
	V5	Design of site hoardings would consider the use of artwork or project information.	Pre-construction / construction
	V6	Regular maintenance would be undertaken of site hoardings and perimeter areas including the prompt removal of graffiti.	Construction
	V7	Revegetation / landscaping would be undertaken progressively.	Construction
Construction lighting	V8	Cut-off and directed lighting would be used and lighting location considered to ensure glare and light spill are minimised.	Construction

Impact	ID	Environmental management measure	Timing
Landscaping	V9	Opportunities would be investigated to provide passive irrigation of landscaped areas at the operational ancillary facilities through use of directed overland flow paths.	Pre-construction / construction
	V10	Opportunities would be investigated to flatten landscape batters at the operational ancillary facilities to maximise plant response and maintainability.	Pre-construction / construction
Signage	V11	A signage strategy would be developed during detailed design. Potentially affected receivers would be consulted on the final signage in relation to the location and associated impacts.	Pre-construction / construction
Operation			
Visual amenity	OpV1	Street tree plantings and landscaping would be used to visually soften operational ancillary facilities.	Construction / post-construction
	OpV2	The urban design and landscaping along the Hills M2 Motorway integration works would be consistent with the recently completed Hills M2 Motorway Upgrade project.	Detailed design
	OpV3	The visual impact of noise walls would be reduced through high quality urban design treatments in accordance with *Noise Wall Design Guideline* (RTA, 2006a).	Construction / post-construction
Landscaping	OpV4	Landscaped areas would be maintained.	Operation
Operational lighting	OpV5	Cut-off and directed lighting would be used at the interchanges, Hills M2 Motorway integration, motorway operations complex and M1 Pacific Motorway tie-in to minimise glare and light spill to surrounding receivers.	Detailed design
Biodiversity			
Construction			
General	B1	A Flora and Fauna Management Plan would be developed for the construction phase of the project to identify potential impacts and mitigation measures.	Pre-construction
Clearing of native vegetation	B2	The disturbance and clearance of established vegetation would be minimised as far as feasible and reasonable.	Pre-construction and construction
	B3	Areas of vegetation to be retained would be protected from accidental damage.	Construction
	B4	Pre-clearing surveys would be undertaken by a suitably qualified ecologist to identify to presence of: • Hollow-bearing trees and other habitat features. • Threatened flora and fauna.	Construction
	B5	Where feasible and reasonable, topsoil and habitat elements (such as woody debris and bushrock) would be stored and reused onsite or in adjacent bushland. Cuttings or seed material may also be gathered from the construction footprint for landscaping plant stock.	Construction

Impact	ID	Environmental management measure	Timing
Adverse impacts to riparian zones and aquatic habitats	B6	Temporary watercourse crossings would be designed in accordance with relevant guidelines including Fish and Fauna Friendly Waterway Crossing (Fairfull and Witheridge, 2003).	Construction
	B7	Viaduct and bridge structural elements would be located out of the waterway where feasible and reasonable.	Construction
	B8	Creeks, riparian zones or vegetated buffers disturbed by the project would be revegetated with the restoration to pre-disturbance conditions.	Construction
Spread of weeds and pathogens	B9	Weeds within the construction footprint would be actively managed prior to vegetation clearing. Cleared weed material would be disposed of to a facility licensed to receive green waste.	Construction
	B10	Machinery would be is cleaned prior to entering the project construction sites.	Construction
	B11	The identification of pathogens would be undertaken as part of pre-clearing inspections. In the event that pathogens are identified within the construction footprint, appropriate mitigation measures would be identified and implemented.	Construction
Loss of Epacris purpurascens	B12	Relocation of *Epacris purpurascens* species where identified within disturbance footprints, ideally to areas identified as a biodiversity offset and / or where future disturbance is unlikely.	Construction
Loss of hollow bearing trees	B13	The loss of hollow bearing trees would be mitigated by: • Relocation / replacement of existing nest boxes impacted by construction. • Nest boxes would be provided as replacement for hollow bearing trees impacted by construction.	Construction
Impact on culverts or buildings with potential threatened bat habitat	B14	A microbat management plan would be developed and implemented including: • Conduct monitoring of existing culverts and buildings commencing at least six months prior to construction / demolition commencing at each relevant culvert or building. • Maintaining appropriate exclusion zones and managing night works through the breeding and lactation period in the vicinity of identified microbat habitat. • Filling pipe joins in culverts identified as not being microbat habitat prior to passive exclusion (eg installation of one-way flaps at potential grab hole locations) to ensure alternative roosting locations are not created in culverts. • Minimising light spill and noise impacts into surrounding native vegetation.	Construction

Impact	ID	Environmental management measure	Timing
Impacts on fauna due to draining of stormwater basins	B15	Surveys of stormwater basins would be undertaken by a suitably qualified ecologist prior to draining works to identify the potential presence of fauna. Appropriate fauna handling and release protocols would be established to remove fauna from waterbodies prior to draining works.	Construction
Operation			
General	OpB1	A management plan would be developed and implemented to identify and mitigate potential ongoing impacts including procedures for: • Management of weeds. • Management of riparian areas associated with the discharge of treated water. • Maintenance of nest boxes.	Operation
Social and economic			
Construction			
Traffic delays and road closures	SEc1	A community involvement plan would be developed and implemented to provide timely, regular and transparent information about changes to access and traffic conditions, details of future work programs and general construction progress throughout the construction phase of the project. Information would be provided in a variety of ways including letter box drops, media releases, internet site, signage and a hotline.	Pre-construction and construction
Reduced parking availability	SEc2	Where feasible and reasonable construction parking would be limited to facility sites to minimise the impact on public parking.	Construction
	SEc3	The need for parking restrictions around the Trelawney Street compound (C7) would be monitored and discussed with Hornsby Shire Council.	Construction
Reduced access to businesses	SEc4	Appropriate signage would be provided to ensure motorists' understanding of access to local businesses adjacent to construction works, including signage relating to parking for stopping motorists.	Construction
Impacts to business	SEc5	A business impact risk register would be maintained to identify and manage the specific impacts associated with construction related works for individual businesses.	Construction
	SEc6	The business stakeholder forum would continue to run throughout the detailed design and construction stages to ensure business concerns are addressed.	Construction
Hydrogeology and soils			
Construction			
General	HS1	A Construction Soil and Water Quality Management Plan would be prepared to manage surface and groundwater impacts during construction of the project.	Pre-construction and construction

Impact	ID	Environmental management measure	Timing
Acid sulfate soils	HS2	If acid sulfate soils are encountered, they would be managed in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998).	Construction
Contamination	HS3	A Construction Environmental Management Plan prepared for the project would include provisions to manage unexpected finds and hazardous materials identified during site preparation and / or construction works.	Pre-construction
	HS4	Potentially contaminated areas directly affected by the project would be investigated and managed in accordance with the requirements of the *Contaminated Land Management Act 1997* and Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (EPA, 1997).	Pre-construction
	HS5	Appropriate mitigation measures including stockpiling and management of potentially contaminated material would be undertaken at building demolition sites to prevent movement of material into receiving waters.	Construction
	HS6	If excavation and off-site disposal of soil is to take place in an area of potential contamination, further delineation and / or waste classification would be undertaken.	Construction
	HS7	Hazardous Materials Assessments would be undertaken, and Hazardous Materials Management Plans implemented, prior to and during the demolition of buildings. Demolition works would be undertaken in accordance with Australian and NSW WorkCover Standards.	Pre-construction and construction
Groundwater management	HS8	A groundwater monitoring plan would be prepared for the duration of the construction period. Parameters to be monitored would include groundwater levels and groundwater quality with field parameters, laboratory parameters and sample frequency to be developed prior to construction.	Pre-construction and construction
	HS9	A groundwater monitoring network to monitor groundwater levels and groundwater quality would be established during the construction phase. The groundwater monitoring network would contain monitoring wells along the project corridor intersecting groundwater in both Ashfield Shale and Hawkesbury Sandstone.	Construction
	HS10	Groundwater captured during construction would be tested, treated and discharged to meet the requirements of the project EPL.	Construction
	HS11	The management of groundwater and surface water inflow into the tunnels, including the design of capture, treatment and discharge methods would be undertaken in consultation with the Environment Protection Authority.	Construction

Impact	ID	Environmental management measure	Timing
	HS12	Where available, and of appropriate chemical and biological quality, subject to a health risk assessment, stormwater, recycled water, groundwater inflows to tunnels or other water sources would be used in preference to potable water for construction activities, including concrete mixing and dust control.	Construction
	HS13	Compliance records of groundwater monitoring undertaken would be retained.	Construction
Ground movement	HS14	Further assessments would be undertaken during detailed design to determine the level of potential impact on structures and to identify feasible and reasonable mitigation and management measures required to minimise potential ground movement impacts.	Construction
Operation			
General	OpHS1	Operations personnel would be competent and trained in systems and procedures.	Operation
Contamination	OpHS2	Procedures to address spills, leaks and tunnel washing would be developed and implemented during operation of the project.	Operation
Groundwater management	OpHS3	The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines. The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase taking into consideration the current water quality of the receiving watercourses.	Detailed design
	OpHS4	Feasible and reasonable opportunities would be identified for the reuse of captured groundwater.	Operation
	OpHS5	***A three dimensional numerical groundwater model would be developed to verify that the extent of groundwater drawdown would be within or less than the predictions within the environmental impact statement.***	***Detailed design***
Surface water			
Construction			
General	SW1	A Construction Soil and Water Quality Management Plan would be prepared to manage surface and groundwater impacts during construction of the project.	Pre-construction and construction
Erosion and sedimentation	SW2	Progressive erosion and sediment control plans (ESCPs) would be prepared and implemented in advance of construction, including earthworks and stockpiling. ESCPs would be updated as required.	Pre-construction and construction

Impact	ID	Environmental management measure	Timing
	SW3	Erosion and sediment controls, including sedimentation basins, would be designed, installed and managed in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Managing Urban Stormwater: Soils and Construction Volume 2D, Main Road Construction (DECC, 2008).	Pre-construction and construction
	SW4	A project soil conservationist would be engaged and consulted during construction to provide advice on erosion and sediment control design, installation and maintenance.	Pre-construction and construction
	SW5	Works would be programmed to minimise the extent and duration of disturbance to vegetation.	Pre-construction and construction
	SW6	Cleared native vegetation would be mulched for use in erosion and sediment control where feasible and reasonable, in accordance with the Environmental Direction Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012b).	Pre-construction and construction
	SW7	Site induction and ongoing toolbox talks would be provided to project personnel, including relevant sub-contractors on soil erosion and sediment control requirements and practices and their responsibilities.	Construction
	SW8	Erosion and sediment control structures would remain installed and maintained until sufficient stabilisation is achieved.	Construction
	SW9	Soil and land rehabilitation would occur as soon as practicable following construction. This would include rehabilitation in stages as the construction process allows.	Construction and post construction
	SW10	Temporary stockpile locations for both site establishment and earthworks would be specified prior to the commencement of construction activities in that area. Diversion drains and erosion and sediment control measures would be in place prior to the commencement of any stockpiling activities. Material would only be stockpiled in designated stockpiling areas.	Pre-construction and construction
Protection of riparian areas	SW11	Scour protection and erosion protection measures would be implemented downstream of the watercourse crossings and surface water discharge points.	Pre-construction
	SW12	Where water is released into local creeks, outlet scour protection and energy dissipation would be implemented. The discharge point would be at the upstream end of a large pool where feasible and reasonable, to allow for slowing of water.	Pre-construction
Water efficiency	SW13	Water efficiency measures would be implemented with a focus on achieving water savings and targeting water recycling and re-use.	Pre-construction and construction

Impact	ID	Environmental management measure	Timing
Dewatering	SW14	A specific Work Method Statement for dewatering and discharging from open exposed excavations and sediment controls would be prepared, in accordance with the Technical Guideline Environmental Management of Construction Site Dewatering (Roads and Maritime, 2011d).	Construction
	SW15	Water discharge quality would comply with the requirements of an environmental protection licence issued for the project.	Construction
Refuelling and storage of chemicals and fuels on-site	SW16	Where refuelling on-site is required, a Work Method Statement would be prepared and the following management practices would be implemented: • Refuelling would be undertaken on level ground and away from drainage lines, waterways and / or environmentally sensitive areas. • Refuelling would be undertaken within the designated refuelling areas with appropriate bunding and / or absorbent material. • Refuelling activities would be attended at all times. • Spill kits would be readily available and personnel trained in their use. A spill kit would be kept on the refuelling truck at all times.	Construction
Localised flooding of receiving watercourses	SW17	The discharge of treated groundwater would be managed to ensure that discharge does not exceed the capacity of the downstream system.	Construction
Blocking of fish passage	SW18	Maintain the flow along the current Cockle Creek and Darling Mills Creek alignment through appropriate design.	Construction
	SW19	Design waterway crossings, structures, bridges and culverts to maintain fish passage with reference to the guidelines contained in Guidelines and Policies for Aquatic Habitat Management and Fish Conservation' (Smith and Pollard 1999), Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull and Witheridge, 2003) and Fish and Fauna Friendly Waterway Crossings (Fairfull & Witheridge, 2003).	Pre-construction and construction
Monitoring	SW20	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring program would commence prior to commencement of any construction works and would build on available water quality data.	Pre-construction and construction
	SW21	Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance.	Construction

Impact	ID	Environmental management measure	Timing
Operation			
Operational Environmental Management Plan	OpSW1	The management of potential surface water impacts during the operation of the project would be detailed as part of an OEMP.	Operation
Contaminant spill	OpSW2	Procedures to quickly address any contaminant spill or accident would be developed prior to operation and implemented during operation project.	Operation
Water treatment and discharge	OpSW3	Treated tunnel water would be discharged to the local stormwater system. The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines (ANZECC & ARMCANZ, 2000). The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase taking into consideration the current water quality of the receiving watercourses.	Detailed design
Water re-use	OpSW4	All feasible and reasonable opportunities for captured surface water reuse would be utilised in the first instance.	Operation
Increased water flow	OpSW5	On-site detention would be provided where required to mitigate impacts associated with increased impervious areas. This would involve the augmentation of existing basins and the construction of new basins.	Operation
	OpSW6	The exact location of discharge to Blue Gum Creek or Darling Mills Creek would be further investigated during the detailed design phase. Additional mitigation measures such as stream bed and bank stabilisation, or re-sizing of existing drainage infrastructure would be determined at this stage based on the location of discharge.	Detailed design
Water quality	OpSW7	Water Sensitive Urban Design principles would be incorporated into the design to minimise impacts on the existing hydrologic regime. Such measures would include: Minimising increases in peak flows through the use of detention and retention measures as appropriate. Treating stormwater through a range of at source and end point measures that are integrated with the urban landscape.	Detailed design
Drainage maintenance	OpSW8	Operational drainage infrastructure would be regularly inspected and maintained.	Operation
Non-Aboriginal heritage			
Construction			
General	NAH1	In the event of an unexpected cultural heritage find, the Standard Management Procedure – Unexpected Archaeological Finds (Roads and Maritime, 2012d) would be followed. This would include notification to the NSW Heritage Branch.	Pre-construction and construction

Impact	ID	Environmental management measure	Timing
	NAH2	Construction personnel would be made aware of non-Aboriginal heritage sites as part the site induction. These sites would be identified on sensitive area plans and in the CEMP.	Pre-construction and construction
Removal of heritage listed vegetation	NAH3	Feasible and reasonable options for the relocation of the two mature Canary Island Palms (I762) would be investigated. If the trees cannot be relocated: • Archival samples would be collected in accordance with NSW Royal Botanic Gardens collection procedures. • Options would be investigated to collect seed samples for later propagation. • Oral histories (if relevant) would be obtained.	Detailed design
	NAH4	Feasible and reasonable options to avoid direct impacts to identified heritage listed vegetation along Woonona Ave, Wahroonga (I769) would be investigated during detailed design. If impacts cannot be avoided: • The street frontage would be revegetated in consultation with the landowner (Hornsby Shire Council). • Plantings that are representative species of the Blue Gum High Forest ecological community would be considered.	Detailed design
Construction vibration and / or ground settlement	NAH5	Where non-Aboriginal heritage items have been identified as having the potential to be impacted by construction vibration or ground settlement, the following would be implemented: • A ground settlement assessment would be undertaken during detailed design to confirm predicted impacts on heritage structures. • Completion of existing condition surveys prior to the commencement of construction for heritage items within the project corridor or that have been identified during detailed design to be within recommended safe working distances to surface works. A post-construction condition survey would also be undertaken of these items to identify if impacts have occurred. Additional feasible and reasonable mitigation and management measures to be	Pre-construction, construction and post-construction

Impact	ID	Environmental management measure	Timing
		implemented would be identified based on the above assessments. This would include the use of vibration monitoring where recommended maximum levels are predicted to be exceeded. The placement of vibration monitors would consider the heritage fabric of the item.	
Impacts to North Wahroonga heritage conservation area and Beecroft Cheltenham heritage conservation area	NAH6	Landscaping of ancillary infrastructure sites would be undertaken with consideration of the heritage values of the Wahroonga North heritage conservation area and Beecroft Cheltenham heritage conservation area.	Detailed design
Impacts to heritage values due to changes in views (construction)	NAH7	The heritage values of items I771, I953, I956, I957 (including views and vistas from the items) would be considered during the detailed design of built elements of the project and the development of the landscaping plan.	Pre-construction
Removal of heritage listed structures	NAH8	The germination building at the Thornleigh Maltworks (A66) would be conserved. Prior to demolition of other structures: • A structural assessment of the germination structure would be conducted to ascertain the possible impact of the demolition of adjacent structures and to identify suitable mitigation methods to ensure the germination structure remains intact. Additional measures would be identified and implemented, if required, to treat the newly exposed surfaces of the germination structure to protect it from the elements as a result of the demolition of adjacent structures. • An archival recording of the industrial site would be undertaken to record the connection of the original structures to the modern upgraded structures. • An archaeological test excavation program would be undertaken to assess the archaeological potential of identifying evidence of the early malting industry in this area, and the relationship of the industrial to the urban site and evidence of the occupation of the Manager's house by the Chilvers family.	Pre-construction
Operation			
Impacts to heritage values due to changes in views (operation)	OpNAH1	The heritage values of items I771, I953, I956, I957 (including views and vistas from the items) would be considered during the detailed design of built elements of the project and the development of the landscaping plan.	Detailed design / Pre-construction

Impact	ID	Environmental management measure	Timing
Aboriginal heritage			
Construction			
Impacts on culturally sensitive Aboriginal sites	AH1	The detailed design of the project would be developed to avoid direct impacts on ASA1 or ASA2 management zones. If direct impacts to ASA1 or ASA2 management zones cannot be avoided, a Stage 3 assessment would be conducted with reference to the Roads and Maritime PACHCI process (Roads and Maritime, 2011c).	Pre-construction and construction
	AH2	In the event that the project is required to extend outside the assessed construction footprint or study area, these additional areas would be assessed in accordance with PACHCI prior to the commencement of construction within those identified areas.	Pre-construction and construction
Impacts on rockshelter sites	AH3	The identified rockshelter sites and overhangs located within 200 metres of the Hills M2 Motorway integration works should be clearly delineated prior to construction works.	Construction
Indirect impacts on rockshelter sites	AH4	During construction, vibration monitoring would be conducted for vibration intensive works within 50 metres of rockshelter sites and associated overhangs within management zone ASA2. The need for vibration monitoring would be informed by a preliminary screening of activities at this location to identify activities which have the potential for vibration at these areas of sensitivity.	Construction
Unexpected discovery of Aboriginal objects	AH5	If an Aboriginal object(s) is discovered during construction it would be managed in accordance with the standard management procedure: Unexpected Archaeological Finds (Roads and Maritime, 2012d), including: • Relevant works in the vicinity of the object(s), with the potential to directly or indirectly impact on the object(s), would cease. • The construction Environmental Representative, OEH and Registered Aboriginal Parties (RAPs) would be notified of the discovery. • A qualified archaeologist would be engaged to determine the nature, extent and scientific significance of the object(s). • Management recommendations would be developed in consultation with the qualified archaeologist, OEH and RAPs.	Construction

Impact	ID	Environmental management measure	Timing
Unexpected discovery of human remains	AH6	If human remains are discovered during construction would be managed in accordance with the standard management procedure: Unexpected Archaeological Finds (Roads and Maritime, 2012d), including: • Relevant works in the vicinity of the remains, with the potential to directly or indirectly impact on the remains, would cease. • The construction Environmental Representative, OEH and NSW Police would be notified of the discovery. • Directions from the NSW Police and / or OEH, as relevant, would be followed depending on the nature of the remains and the outcomes of forensic investigations.	Construction
Land use and property			
Construction			
Property access	LP1	Affected property owners would be consulted where temporary property access would be required.	Pre-construction and construction
	LP2	Affected property owners would be provided with advanced notification of relevant project schedules, construction works and changes to access arrangements.	Construction
	LP3	Community updates would be provided on changes to the local road network within the project area during construction.	Construction
Temporary lease or acquisition of property required for the project	LP4	Consultation would occur with the relevant property owners in relation to temporary land leases and acquisition of properties required temporarily for the construction of the project. Where acquisition is identified as the preferred option, this would be undertaken in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012c) and the *Land Acquisition (Just Terms Compensation) Act 1991.*	Construction
Community facilities	LP5	Appropriate signage would be provided advising of walking track closures and alternative walking routes.	Construction
Operation			
Acquisition of property required for the project	OpLP1	Land acquisition for the project would be undertaken in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012c) and the *Land Acquisition (Just Terms Compensation) Act 1991*.	Detailed design / pre-construction
Loss of land use and property access	OpLP2	Property accesses that are affected as a result of the project would be reinstated in consultation with the affected landowners including relocation if required.	Detailed design / construction

Impact	ID	Environmental management measure	Timing
Hazards and risks			
Construction			
General	HR1	Site-specific hazard and risk management measures would be included within the Construction Environmental Management Plan (CEMP), which may include items such as: • Details of the hazards and risk associated with construction activities for both surface and subsurface works. • Procedures to comply with legislative and industry standard requirements. • Contingency plans, as required. • Site-specific Work Health and Safety plans and Safe Work Method Statements. • Training for relevant personnel (including subcontractors) and site inductions, including the recognition and awareness of site hazards and locations of relevant equipment.	Pre-construction / construction
Storage of dangerous goods and hazardous substances	HR2	Storage of dangerous goods and hazardous materials would occur in accordance with supplier's instructions and relevant Australian Standards and may include bulk storage tanks, chemical storage cabinets / containers or impervious bunds.	Construction
	HR3	Storage, handling and use of dangerous goods and hazardous substances would be in accordance with the *Occupational Health and Safety Act 2000* and the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005).	Construction
	HR4	Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids. Impervious bunds would be of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container.	Construction
	HR5	Bunds would be provided around activities such as vehicle refuelling, servicing, maintenance or wash-down, where there is a potential for spills and contamination.	Construction
	HR6	Material Safety Data Sheets would be obtained for dangerous goods and hazardous substances stored on-site prior to their arrival.	Construction
Transportation of dangerous goods and hazardous substances	HR7	Transport of dangerous goods and hazardous substances would be conducted in accordance with relevant legislation and codes, including the *Road and Rail Transport (Dangerous Goods) (Road) Regulation 1998* and the Australian Code for the Transport of Dangerous Goods by Road and Rail (National Transport Commission, 2008).	Construction
Operation			
Fire and life safety	OpHR1	The fire and safety systems and measures adopted for the project would be equivalent to or exceed the fire safety measures recommended by NFPA502 (American), PIARC (European), AS4825 (Australian) and Roads and Maritime standards.	Detailed design

Impact	ID	Environmental management measure	Timing
Storage of dangerous goods and hazardous substances	OpHR2	Storage of dangerous goods and hazardous materials would occur in accordance with supplier's instructions and relevant Australian standards and may include bulk storage tanks, chemical storage cabinets / containers or impervious bunds.	Operation
	OpHR3	Storage, handling and use of dangerous goods and hazardous substances would be in accordance with the *Occupational Health and Safety Act 2000* and the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005).	Operation
	OpHR4	Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids. Impervious bunds would be of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container.	Operation
	OpHR5	Bunds would be provided around activities such as vehicle refuelling, servicing, maintenance or wash-down, where there is a potential for spills and contamination.	Operation
	OpHR6	Material Safety Data Sheets would be obtained for dangerous goods and hazardous substances stored on-site prior to their arrival.	Operation
Transportation of dangerous goods and hazardous substances	OpHR7	The transport of dangerous goods and hazardous substances would be prohibited through the main alignment tunnels and on and off-ramp tunnels.	Operation
Incident response	OpHR8	An Incident Response Plan would be developed and implemented in the event of an accident or incident.	Operation
	OpHR9	The response to incidents within the motorway would be managed in accordance with the memorandum of understanding between Roads and Maritime and the NSW Police Service, NSW Rural Fire Service, NSW Fire Brigade and other emergency services	Operation
Electric and magnetic fields	OpHR10	The detailed design of the project substations would ensure that the exposure limits for the general public suggested by the Draft Radiation Standard (Australian Radiation Protection and Nuclear Safety Agency, 2006) would not be exceeded at the boundary of the substation sites.	Detailed design
Resources and waste			
Construction			
Resource consumption	RW1	Wherever feasible and reasonable, construction material would be sourced from within the Sydney region.	Pre-construction and construction
	RW2	Unnecessary resource consumption would be avoided by making realistic predictions on the required quantities of resources, such as construction materials.	Construction

Impact	ID	Environmental management measure	Timing
	RW3	Resource recovery, which includes re-use, recycling and reprocessing, would be applied to the management of construction waste and would include: • Recovery of resources for reuse. Waste materials generated by the project would be re-used either on-site or off-site where possible, including the re-use of top soil in landscape works, and the use of mulch for erosion and sediment controls. • Recovery of resources for recycling. Resources would be segregated for recycling such as paper, plastic, glass, aluminium cans and other recyclable materials generated during construction. These materials would then be sent to an appropriate recycling facility for processing. • Recovery of resources for reprocessing. Cleared vegetation would be mulched or chipped on-site and used for landscaping, in the absence of a higher beneficial use being identified.	Construction
Management of waste	RW4	Wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Protection of the Environment Operations Act 1997, Waste Avoidance and Resource Recovery Act 2001,* Waste Avoidance and Resource Recovery Strategy 2007 (DECC, 2007c) and the Waste Reduction and Purchasing Policy (RTA, 2009).	Pre-construction and construction
	RW5	A Waste Management Plan would be prepared as part of the Construction Environmental Management Plan detailing appropriate procedures for waste management.	Pre-construction and construction
	RW6	Wastes would be managed using the waste hierarchy principles of: • Avoidance of unnecessary resource consumption to reduce the quantity of waste being generated • Recover of resources for re-use on-site or off-site for the same or similar use, without reprocessing. • Recover of resources through recycling and reprocessing so that waste can be processed into a similar non-waste product and re-used. • Disposal of residual waste.	Construction
	RW7	Residual waste would be disposed of to a suitably licensed landfill or waste management facility where there are no other feasible and reasonable options for waste avoidance, re-use or recycling. Waste materials requiring removal from the site would be classified, handled and stored on-site in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) until collection by a contractor for disposal.	Prior to / during construction

Impact	ID	Environmental management measure	Timing
	RW8	Off-site re-use of waste would comply with relevant EPA resource recovery exemptions and requirements.	Construction
	RW9	An asbestos survey would be undertaken of buildings to be demolished as part of the project. The survey would be conducted by a suitably qualified person.	Construction
	RW10	Asbestos handling and management would be undertaken in accordance with: • Work Health and Safety Act 2011. • Code of Practice for the Safe Removal of Asbestos 2nd Edition (NOHSC, 2005a). • Code of Practice for the Management and Control of Asbestos in Workplaces (NOHSC, 2005b). • Protection of the Environment Operations (Waste) Regulation 2005 – section 42 special requirements relating to asbestos waste. • AS2601:1991 Demolition of Structures.	Construction
Excess spoil	RW11	A spoil management strategy would be developed prior to the commencement of construction and implemented during construction. The strategy would identify spoil disposal site and describe the management of spoil on -site and during off-site transport.	Pre-construction
	RW12	Where possible and fit for purpose, spoil would be beneficially re-used within the project before off-site re-use or disposal options are pursued.	Construction
	RW13	Before being transported from construction sites, excavated spoil would be classified in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) to ensure appropriate reuse or disposal.	Construction
Wastewater	RW14	Feasible and reasonable opportunities for wastewater re-use on-site or for construction purposes would be pursued (such as dust suppression both in the tunnels and for surface works).	Construction
	RW15	Wastewater not used on-site would be discharged into the local stormwater system in accordance with the requirements of an environment protection licence issued for the project.	Construction
Contaminated soil	RW16	In the event of discovery of previously unidentified area(s) of potentially contaminated material, all relevant work would cease in the vicinity of the discovery. Relevant works would not recommence until the need for and scope of remedial action(s), if required, are identified in accordance with the requirements of the *Contaminated Land Management Act 1997*.	Construction

Impact	ID	Environmental management measure	Timing
Operation			
Management of waste	OpRW1	Wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Protection of the Environment Operations Act 1997, Waste Avoidance and Resource Recovery Act 2001,* Waste Avoidance and Resource Recovery Strategy 2007 (DECC, 2007c) and the Waste Reduction and Purchasing Policy (RTA, 2009).	Operation
	OpRW2	Any mercury containing light globes used for the operation of the tunnel and operational ancillary facilities would be recycled at an accredited recycling facility.	Operation
Operational water requirements	OpRW3	Opportunities for re-use of wastewater would be considered including irrigation of landscapes within the project, irrigation of Pennant Hills Golf Club and / or local parks in preference to discharge to the local stormwater system.	Operation
	OpRW4	In order to reduce demand on local water supplies, investigate options for providing water required for operation of the deluge system from wastewater produced through the tunnel drainage system where it meets appropriate quality parameters.	Operation
Greenhouse gas and climate change			
Construction			
GHG emissions	GHG1	Emissions intensity of construction materials would be considered during procurement.	Procurement
	GHG2	Where feasible, recycled content road construction and maintenance materials such as recycled aggregates in road pavement and surfacing would be used.	Procurement
	GHG3	The fuel efficiency of the construction plant and equipment would be considered during selection.	Procurement / pre-construction
	GHG4	Project planning would be aim to minimise double handling of materials, long haulage distances and additional fuel use.	Prior to construction
	GHG5	Locally produced goods and services would be procured where feasible and cost effective to reduce transport fuel emissions.	Procurement / pre-construction
Climate change impacts	CC1	The risks of future climate change would be further considered during detailed design.	Detailed design
	CC2	Where high or medium risks to project infrastructure have been identified, the construction contractor would review existing design policies, specifications or practices to consider the impacts of climate change.	Detailed design

Impact	ID	Environmental management measure	Timing
Operation			
GHG emissions	OpGHG1	The tunnel would be designed to minimise fuel use associated with motorist use of the road through the optimisation of design, for example the provision of a vertical alignment that allows consistent vehicle speeds to be maintained.	Detailed design
	OpGHG2	Low carbon energy generation options would be investigated as part of the design process in order to reduce the demand on mains electricity where feasible.	Detailed design
	OpGHG3	A life cycle assessment would be undertaken as part of the detailed design in order to select mechanical and electrical systems with increased energy efficiencies, such as the tunnel ventilation system, water treatment systems and electronic toll and surveillance systems.	Detailed design
Climate change impacts	OpCC1	A stop work threshold (eg for extreme heat, storm events) for operation and maintenance activities would be implemented in line with current workplace health and safety practices.	Operation
	OpCC2	Emergency planning and management controls would be implemented during operation to reduce the risk of adverse climate impacts, maintain public safety and minimise congestion. For example, bushfire management would include measures to ensure safety such as reduced speed limits and temporary tunnel closures where required (refer to Section 8.2 of the environmental impact statement - Hazards and risk).	Operation
	OpCC3	Maintenance regimes for road surface and other ancillary infrastructure would be developed to accommodate accelerated rates of asset degradation.	Operation
	OpCC4	The motorway operator would develop emergency response management plans in consultation with emergency management services, local governments and other relevant agencies to ensure better disaster management during extreme climate events.	Operation
	OpCC5	The motorway operator would monitor and review the performance of structures and materials in response to climate change related events. Where possible, the most cost-effective response would be to include adaptive measures in the regular maintenance of the project.	Operation

11 Conclusion and next steps

The Department of Planning and Environment will, on behalf of the Minister for Planning, review the environmental impact statement and this submissions and preferred infrastructure report. Once the Department of Planning and Environment has completed its assessment, a draft assessment report will be prepared for the Secretary of the Department of Planning and Environment, which may include recommended conditions of approval.

The assessment report will then be provided to the Minister for Planning, who may then approve the project (with any conditions considered appropriate) or refuse to give approval.

The Minister for Planning's determination and the Secretary's report will be published on the Department of Planning and Environment's website immediately following determination with a copy of the submissions and preferred infrastructure report.

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Appendix A Stakeholder Identification numbers

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Issue	Report section	Stakeholder identification numbers	Count
Strategic justification and project need			
Need for the project	8.1.1	39, 75, 122, 157, 197, 209, 234, 239, 241, 284, 285, 306, 362, 367, 418, 473, 637, 645, 654, 661, 669, 675, 716, 718, 719, 720, 721, 722, 723, 724, 734, 737, 740, 742, 743, 750, 766, 773, 776, 785, 807, 828, 831, 847, 970, 992, 1012, 1027, 1102, 1153, 1156, 1180, 1217, 1225, 1226	55
Justification	8.1.2	8, 39, 40, 362, 471, 587, 592, 686, 725, 731, 732, 733, 736, 828, 1145, 1156, 1195, 1217, 1225, 1226	20
Project funding	8.1.3	6, 8, 39, 40, 64, 148, 153, 154, 187, 209, 248, 279, 280, 303, 308, 319, 345, 350, 354, 362, 364, 366, 370, 383, 386, 388, 400, 402, 403, 411, 414, 415, 417, 420, 422, 440, 458, 459, 460, 471, 472, 473, 485, 486, 506, 513, 514, 527, 528, 550, 551, 560, 562, 567, 574, 593, 601, 613, 614, 615, 619, 640, 648, 654, 656, 658, 659, 662, 663, 664, 665, 671, 681, 692, 700, 701, 702, 704, 705, 710, 739, 745, 765, 768, 828, 836, 844, 854, 873, 888, 946, 959, 1004, 1026, 1042, 1056, 1059, 1103, 1104, 1105, 1106, 1145, 1156, 1195, 1196, 1198, 1217, 1225, 1226, 1227	110
Tolling and heavy vehicle regulation	8.1.4	19, 33, 39, 40, 66, 71, 74, 97, 350, 425, 440, 554, 659, 680, 831, 847, 1192, 1195, 1227	19
Project development and alternatives			
Strategic alternatives	8.2.1	19, 27, 39, 40, 64, 73, 84, 100, 106, 119, 123, 131, 146, 148, 155, 160, 161, 162, 164, 169, 176, 178, 184, 190, 192, 195, 205, 208, 211, 221, 237, 238, 244, 261, 263, 265, 268, 279, 280, 288, 290, 305, 307, 318, 321, 322, 324, 328, 329, 331, 339, 346, 348, 350, 355, 356, 360, 361, 362, 365, 366, 371, 372, 373, 380, 385, 387, 390, 395, 398, 403, 404, 405, 406, 412, 413, 426, 427, 431, 440, 443, 460, 467, 468, 471, 475, 480, 482, 492, 494, 495, 498, 507, 512, 514, 530, 549, 552, 555, 559, 560, 563, 568, 571, 572, 578, 580, 581, 583, 584, 594, 596, 597, 602, 606, 607, 610, 611, 616, 633, 636, 645, 648, 654, 661, 665, 671, 675, 683, 685, 686, 689, 693, 707, 708, 709, 731, 732, 741, 744, 747, 752, 755, 757, 763, 765, 767, 768, 772, 777, 778, 779, 780, 782, 787, 788, 789, 791, 792, 798, 799, 800, 801, 803, 804, 805, 807, 809, 810, 811, 818, 826, 828, 829, 832, 840, 841, 843, 849, 850, 853, 867, 868, 873, 876, 877, 878, 879, 881, 882, 883, 884, 885, 914, 939, 940, 984, 1027, 1033, 1042, 1049, 1065, 1068, 1089, 1090, 1110, 1116, 1118, 1123, 1152, 1156, 1162, 1163, 1164, 1177, 1181, 1189, 1190, 1195, 1196, 1199, 1217, 1219, 1225, 1226, 1238, 1239, 1248, 1251, 1253	230
Options development	8.2.2	39, 40, 61, 75, 83, 86, 87, 88, 89, 90, 95, 96, 101, 105, 111, 114, 116, 117, 120, 124, 132, 134, 137, 138, 142, 147, 148, 149, 150, 151, 165, 166, 169, 171, 174, 183, 185, 193, 194, 196, 199, 207, 209, 213, 214, 216, 218, 220, 222, 223, 224, 227, 228, 230, 231, 232, 240, 242, 243, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 272, 273, 274, 275, 276, 283, 284, 285, 289, 292, 294, 295, 296, 297, 298, 299, 300, 301, 302, 312, 313, 323, 325, 335, 336, 337, 340, 341, 342, 343, 344, 349, 350, 351, 352, 353, 362, 369, 374, 376, 380, 381, 382, 384, 386, 388, 391, 393, 394, 412, 419, 421, 423, 429, 430, 431, 432, 433, 434, 436, 437, 438, 440, 445, 446, 448, 450, 452, 453, 454, 456, 457, 461, 463, 464, 470, 476, 477, 478, 479, 481, 483, 487, 488, 489, 490, 491, 493, 496, 497, 499, 500, 501, 503, 504, 505, 508, 509, 511, 522, 528,	376

Issue	Report section	Stakeholder identification numbers	Count
		529, 531, 533, 536, 537, 538, 539, 540, 541, 543, 544, 545, 547, 557, 565, 566, 573, 575, 585, 586, 588, 589, 595, 598, 606, 608, 612, 617, 618, 623, 625, 626, 627, 629, 630, 631, 632, 635, 638, 639, 640, 641, 642, 647, 649, 650, 655, 661, 670, 672, 673, 677, 678, 679, 682, 684, 687, 690, 691, 696, 697, 700, 711, 712, 713, 718, 719, 720, 721, 722, 723, 724, 729, 733, 734, 735, 738, 740, 742, 743, 758, 759, 760, 761, 762, 763, 765, 771, 781, 790, 793, 794, 795, 816, 819, 828, 834, 835, 844, 848, 851, 852, 856, 864, 869, 871, 873, 875, 887, 895, 896, 897, 898, 900, 906, 907, 915, 916, 917, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 933, 941, 942, 943, 944, 945, 947, 948, 949, 950, 953, 954, 955, 956, 958, 960, 961, 964, 966, 969, 972, 974, 975, 981, 999, 1004, 1012, 1017, 1019, 1020, 1025, 1035, 1041, 1043, 1044, 1045, 1051, 1053, 1073, 1077, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1112, 1115, 1117, 1121, 1122, 1165, 1167, 1188, 1191, 1193, 1195, 1208, 1210, 1216, 1225, 1226, 1229, 1235, 1238, 1246	
Tender process and alternative tender design	8.2.3	22, 24, 40, 41, 51, 64, 206, 261, 263, 265, 268, 279, 280, 350, 366, 391, 426, 512, 522, 534, 560, 591, 659, 700, 745, 758, 844, 870, 1000, 1037, 1145, 1156, 1211, 1227	34
Preferred tender design refinements	8.2.4	2, 4, 11, 13, 18, 24, 28, 43, 46, 48, 49, 50, 51, 52, 53, 57, 58, 60, 64, 77, 84, 86, 97, 98, 99, 100, 125, 148, 153, 159, 180, 188, 189, 192, 193, 206, 221, 248, 279, 280, 288, 291, 307, 319, 321, 323, 345, 350, 354, 362, 364, 365, 366, 377, 387, 391, 399, 400, 411, 414, 415, 416, 417, 420, 422, 425, 440, 445, 446, 458, 459, 471, 486, 506, 512, 513, 517, 522, 524, 531, 548, 549, 550, 551, 554, 562, 567, 574, 587, 590, 591, 593, 600, 601, 613, 619, 640, 645, 646, 652, 654, 655, 656, 658, 659, 661, 662, 663, 664, 681, 695, 701, 702, 704, 705, 709, 710, 711, 718, 719, 720, 721, 722, 723, 724, 733, 740, 742, 743, 748, 749, 765, 773, 775, 779, 785, 807, 817, 824, 825, 838, 845, 851, 852, 854, 858, 863, 866, 888, 942, 946, 1000, 1004, 1012, 1026, 1049, 1056, 1059, 1062, 1102, 1103, 1104, 1105, 1106, 1145, 1147, 1149, 1150, 1151, 1158, 1160, 1177, 1187, 1198, 1199, 1218, 1227, 1235, 1240	179
Selection of surface infrastructure locations	8.2.5	3, 14, 16, 18, 24, 28, 29, 32, 36, 39, 49, 51, 53, 56, 58, 59, 62, 64, 65, 67, 68, 69, 76, 78, 79, 83, 84, 86, 87, 88, 89, 90, 91, 93, 95, 96, 98, 99, 100, 101, 104, 105, 106, 110, 111, 113, 114, 116, 117, 119, 120, 122, 123, 124, 130, 132, 133, 134, 137, 138, 139, 141, 142, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 159, 160, 161, 162, 163, 164, 165, 166, 168, 169, 171, 174, 175, 178, 179, 181, 182, 183, 184, 185, 187, 188, 190, 192, 193, 194, 195, 196, 198, 199, 201, 203, 204, 205, 206, 207, 208, 209, 211, 212, 213, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 226, 227, 228, 229, 230, 231, 232, 237, 238, 240, 242, 243, 244, 245, 247, 248, 249, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 267, 268, 270, 271, 272, 273, 274, 275, 276, 279, 280, 282, 283, 284, 285, 288, 289, 290, 291, 292, 294, 295, 296, 297, 298, 299, 300, 301, 302, 304, 305, 306, 307, 308, 310, 311, 312, 313, 314, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 348, 349, 350, 351, 352, 353, 354, 356, 357, 359, 360, 361, 362, 363, 364, 365, 366, 367, 369, 371,	930

Issue	Report section	Stakeholder identification numbers	Count
		372, 373, 374, 375, 376, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 393, 394, 396, 397, 398, 399, 400, 404, 405, 406, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 427, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 440, 441, 442, 445, 446, 447, 448, 450, 451, 452, 453, 454, 456, 457, 458, 459, 460, 461, 463, 464, 467, 468, 469, 470, 471, 472, 474, 475, 476, 477, 478, 479, 481, 482, 483, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 503, 504, 505, 506, 508, 509, 511, 512, 513, 514, 515, 516, 517, 520, 522, 524, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 550, 551, 552, 553, 555, 557, 559, 562, 563, 565, 566, 567, 568, 569, 571, 572, 573, 574, 575, 576, 577, 578, 580, 581, 584, 585, 586, 587, 588, 589, 590, 591, 593, 594, 595, 596, 597, 598, 599, 601, 602, 603, 604, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 622, 623, 624, 625, 626, 627, 629, 630, 631, 632, 634, 635, 637, 638, 639, 640, 641, 642, 643, 645, 646, 647, 648, 649, 650, 651, 652, 654, 655, 656, 658, 659, 661, 662, 663, 664, 666, 667, 668, 670, 672, 673, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 687, 688, 689, 690, 691, 692, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 718, 719, 720, 721, 722, 723, 724, 725, 728, 729, 730, 733, 734, 735, 736, 738, 739, 740, 741, 742, 743, 744, 745, 747, 749, 750, 752, 753, 754, 755, 757, 758, 759, 760, 761, 762, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 775, 776, 777, 778, 779, 780, 781, 782, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 808, 809, 810, 811, 812, 813, 814, 817, 818, 819, 820, 823, 824, 825, 826, 828, 829, 833, 834, 835, 837, 838, 839, 840, 841, 843, 844, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 864, 867, 869, 870, 871, 872, 873, 875, 876, 877, 878, 879, 881, 882, 883, 884, 885, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 900, 901, 902, 903, 906, 907, 909, 910, 911, 912, 913, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 932, 933, 934, 935, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 958, 960, 961, 962, 963, 964, 965, 966, 968, 969, 970, 971, 972, 973, 974, 975, 976, 979, 980, 981, 982, 983, 985, 986, 987, 988, 991, 992, 993, 994, 995, 997, 998, 999, 1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1014, 1015, 1017, 1019, 1020, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1031, 1033, 1035, 1037, 1038, 1039, 1041, 1042, 1043, 1044, 1045, 1047, 1049, 1050, 1051, 1053, 1054, 1055, 1056, 1057, 1059, 1060, 1061, 1062, 1063, 1066, 1067, 1070, 1071, 1072, 1073, 1074, 1075, 1076, 1077, 1078, 1079, 1080, 1081, 1082, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1112, 1113, 1114, 1115, 1116, 1117, 1118, 1119, 1120, 1121, 1122, 1123, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, 1132, 1133, 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143, 1144, 1145, 1149, 1150, 1151, 1152, 1154, 1157, 1159, 1161, 1162, 1163, 1164, 1165, 1167, 1168, 1177, 1181, 1183, 1187, 1188, 1189, 1190, 1191, 1193, 1198, 1199, 1201, 1203, 1204, 1205, 1206, 1208, 1210, 1211, 1216, 1218, 1219, 1220, 1224, 1225,	

Issue	Report section	Stakeholder identification numbers	Count
		1226, 1227, 1229, 1231, 1233, 1234, 1235, 1236, 1238, 1239, 1240, 1246, 1248, 1249, 1253	
Out of scope	8.2.6	8, 15, 31, 33, 35, 38, 39, 40, 44, 53, 64, 71, 74, 84, 100, 102, 103, 108, 118, 122, 131, 140, 153, 154, 158, 176, 178, 186, 187, 191, 192, 209, 225, 235, 236, 248, 261, 263, 265, 268, 303, 308, 345, 347, 350, 354, 362, 364, 370, 379, 383, 392, 400, 411, 414, 415, 417, 418, 420, 422, 443, 458, 459, 462, 469, 485, 486, 506, 513, 515, 519, 521, 523, 525, 526, 527, 528, 550, 551, 554, 555, 562, 567, 574, 583, 593, 600, 601, 613, 614, 615, 619, 653, 654, 656, 658, 659, 661, 662, 663, 664, 665, 680, 681, 686, 689, 692, 694, 695, 701, 702, 704, 705, 710, 748, 763, 774, 827, 828, 844, 847, 854, 862, 888, 959, 978, 984, 990, 1004, 1026, 1056, 1059, 1062, 1145, 1146, 1147, 1178, 1184, 1186, 1195, 1199, 1218, 1227, 1232, 1235, 1240, 1247, 1251	148
Project			
Construction program	8.3.1	40, 202, 246, 633, 693, 773, 785	7
Construction methods	8.3.2	40, 246, 601, 866, 1237	5
Location and layout of construction compounds	8.3.3	30, 39, 127, 202, 234, 246, 279, 280, 293, 360, 366, 449, 558, 570, 579, 653, 746, 830, 847, 861, 1030, 1192	22
Operational design criteria	8.3.4	40, 391, 425, 469, 485, 515, 519, 521, 522, 523, 525, 526, 532, 554, 600, 640, 648, 693, 694, 700, 828, 1103, 1104, 1105, 1106, 1184, 1232	27
Planning and statutory requirements			
Approval process	8.4.1	22, 24, 28, 39, 40, 41, 59, 69, 70, 75, 83, 84, 86, 87, 88, 89, 90, 95, 96, 101, 105, 106, 111, 114, 116, 117, 119, 120, 123, 124, 130, 132, 134, 137, 138, 142, 146, 147, 148, 149, 150, 151, 160, 161, 162, 164, 165, 166, 169, 171, 174, 176, 177, 178, 183, 185, 190, 193, 194, 195, 196, 199, 204, 205, 206, 207, 208, 209, 211, 213, 214, 216, 218, 222, 223, 224, 227, 228, 230, 231, 232, 237, 238, 243, 244, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 270, 271, 272, 273, 274, 275, 276, 283, 284, 285, 289, 290, 291, 292, 294, 295, 296, 297, 298, 299, 300, 301, 302, 305, 307, 311, 312, 313, 314, 316, 317, 318, 321, 322, 323, 324, 325, 328, 329, 331, 335, 336, 337, 339, 340, 341, 342, 343, 344, 346, 348, 349, 350, 351, 352, 353, 356, 360, 362, 365, 367, 369, 371, 372, 373, 374, 376, 380, 381, 382, 384, 385, 386, 387, 388, 389, 391, 393, 394, 398, 399, 404, 405, 406, 412, 416, 419, 421, 423, 424, 426, 427, 429, 430, 431, 432, 433, 434, 436, 437, 438, 440, 445, 446, 448, 450, 452, 453, 454, 456, 457, 460, 461, 463, 464, 467, 468, 469, 470, 471, 472, 475, 476, 477, 478, 479, 480, 481, 482, 483, 487, 488, 489, 490, 491, 493, 494, 495, 496, 497, 498, 499, 500, 501, 503, 504, 505, 508, 511, 512, 515, 519, 521, 522, 523, 524, 525, 526, 528, 529, 530, 532, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 547, 549, 552, 557, 559, 563, 565, 566, 571, 572, 573, 575, 576, 578, 580, 581, 584, 585, 586, 587, 588, 589, 590, 592, 594, 595, 596, 597, 598, 599, 601, 602, 604, 606, 607, 608, 610, 611, 612, 616, 617, 618, 622, 624, 625, 626, 627, 629, 630, 631, 632, 634, 635, 636, 638, 639, 640, 641, 643, 647, 649, 650, 652, 654, 655, 659, 661, 665, 666, 667, 670, 672, 673, 677, 678, 679, 682, 683, 684, 685, 687, 688, 690, 691, 696, 697, 698, 699, 700, 703, 706, 707,	620

Issue	Report section	Stakeholder identification numbers	Count
		708, 709, 711, 712, 713, 714, 718, 719, 720, 721, 722, 723, 724, 725, 729, 733, 734, 735, 736, 738, 739, 740, 741, 742, 743, 744, 745, 747, 752, 753, 755, 757, 758, 759, 760, 761, 762, 765, 768, 770, 771, 772, 777, 778, 779, 780, 781, 782, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 797, 798, 799, 800, 801, 802, 804, 805, 806, 807, 808, 809, 810, 811, 813, 814, 818, 819, 826, 828, 829, 833, 834, 835, 836, 841, 843, 846, 848, 849, 850, 851, 852, 853, 856, 857, 864, 867, 869, 870, 871, 873, 875, 876, 887, 894, 895, 896, 897, 899, 902, 904, 908, 915, 916, 917, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 936, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 956, 958, 960, 961, 962, 963, 964, 968, 971, 975, 976, 979, 980, 981, 982, 986, 992, 993, 995, 998, 999, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1009, 1011, 1012, 1017, 1019, 1020, 1025, 1027, 1028, 1033, 1035, 1041, 1043, 1044, 1045, 1047, 1051, 1053, 1061, 1063, 1064, 1066, 1067, 1069, 1071, 1072, 1074, 1075, 1076, 1078, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1107, 1108, 1109, 1113, 1122, 1123, 1128, 1131, 1135, 1138, 1139, 1143, 1145, 1161, 1162, 1163, 1164, 1165, 1168, 1177, 1181, 1188, 1189, 1190, 1191, 1193, 1195, 1199, 1201, 1205, 1206, 1210, 1216, 1219, 1225, 1226, 1227, 1229, 1235, 1238, 1239, 1246, 1253	
Adequacy / independence of the EIS	8.4.2	40, 45, 47, 56, 64, 72, 73, 74, 75, 84, 102, 103, 107, 110, 153, 154, 159, 164, 170, 177, 187, 198, 209, 229, 245, 248, 261, 263, 265, 268, 303, 308, 319, 320, 330, 345, 350, 354, 362, 364, 370, 383, 396, 400, 410, 411, 414, 415, 416, 417, 420, 422, 440, 445, 446, 458, 459, 485, 486, 489, 506, 512, 513, 519, 521, 523, 525, 526, 527, 550, 551, 562, 567, 574, 585, 586, 592, 593, 601, 606, 613, 614, 615, 619, 637, 640, 645, 653, 654, 656, 658, 659, 661, 662, 663, 664, 665, 681, 692, 695, 701, 702, 704, 705, 710, 746, 749, 758, 763, 807, 832, 838, 843, 844, 854, 868, 888, 899, 959, 1000, 1004, 1026, 1031, 1037, 1056, 1059, 1062, 1195, 1199, 1200, 1202, 1218, 1227, 1240, 1251	135
Statutory requirements / other approvals	8.4.3	40, 64, 153, 154, 187, 248, 261, 263, 265, 268, 306, 308, 345, 354, 362, 364, 383, 400, 403, 411, 414, 415, 417, 420, 422, 424, 458, 459, 485, 486, 506, 513, 524, 550, 551, 562, 567, 574, 593, 601, 613, 614, 615, 619, 640, 654, 656, 658, 662, 663, 664, 681, 701, 702, 704, 705, 710, 725, 736, 854, 888, 1004, 1026, 1055, 1056, 1059, 1062, 1218, 1240	69
Consultation			
Level / quality of consultation	8.5.1	22, 24, 40, 41, 50, 51, 59, 64, 68, 69, 80, 85, 100, 153, 154, 159, 187, 193, 248, 261, 263, 265, 268, 303, 308, 319, 345, 350, 354, 362, 364, 370, 379, 380, 383, 391, 400, 411, 414, 415, 416, 417, 420, 422, 458, 459, 485, 486, 506, 507, 513, 519, 521, 522, 523, 525, 526, 527, 532, 550, 551, 562, 567, 574, 593, 613, 614, 615, 619, 637, 640, 645, 652, 654, 656, 658, 659, 661, 662, 663, 664, 681, 689, 692, 701, 702, 704, 705, 710, 728, 730, 739, 763, 807, 844, 854, 864, 888, 959, 1000, 1004, 1026, 1029, 1056, 1059, 1227	106
Consultation during exhibition	8.5.2	22, 24, 40, 41, 56, 58, 64, 75, 83, 86, 87, 88, 89, 90, 95, 96, 99, 101, 105, 110, 111, 114, 116, 117, 118, 120, 124, 132, 134, 137, 138, 142, 147, 148, 149, 150, 151, 154, 165, 166, 169, 170, 171, 174, 185, 190, 193, 194, 196, 199, 213, 214, 216, 218, 222, 223, 224, 227, 228, 229, 230, 231, 232, 251, 252, 253, 254,	430

Issue	Report section	Stakeholder identification numbers	Count
		257, 258, 260, 261, 263, 265, 268, 270, 271, 272, 273, 274, 275, 276, 283, 284, 285, 289, 292, 295, 296, 297, 298, 299, 300, 301, 302, 312, 313, 317, 319, 320, 323, 325, 335, 336, 337, 340, 341, 342, 343, 344, 349, 350, 351, 352, 353, 362, 364, 367, 369, 374, 376, 380, 381, 382, 384, 386, 388, 389, 391, 393, 394, 396, 399, 410, 411, 412, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 429, 430, 431, 432, 433, 434, 436, 437, 438, 448, 450, 452, 453, 454, 456, 457, 458, 459, 461, 463, 464, 469, 470, 471, 472, 476, 477, 478, 479, 481, 483, 487, 490, 491, 493, 496, 497, 499, 500, 501, 503, 504, 505, 508, 509, 511, 513, 519, 521, 522, 523, 525, 526, 527, 528, 529, 532, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 547, 551, 557, 562, 565, 566, 567, 573, 574, 575, 576, 585, 586, 588, 589, 593, 595, 598, 606, 608, 612, 613, 617, 618, 624, 625, 626, 627, 629, 630, 631, 632, 635, 638, 639, 641, 647, 649, 650, 654, 655, 656, 658, 659, 661, 662, 663, 664, 670, 672, 673, 677, 678, 679, 682, 684, 687, 690, 691, 692, 696, 697, 700, 701, 702, 704, 705, 710, 712, 713, 714, 718, 719, 720, 721, 722, 723, 724, 725, 729, 733, 734, 735, 736, 738, 740, 742, 743, 745, 758, 759, 760, 761, 762, 763, 765, 771, 773, 781, 785, 790, 793, 794, 795, 817, 819, 834, 835, 836, 844, 848, 851, 852, 854, 858, 862, 864, 869, 870, 871, 873, 875, 887, 888, 895, 896, 897, 915, 916, 917, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 956, 958, 960, 961, 964, 981, 986, 992, 999, 1000, 1004, 1012, 1017, 1019, 1020, 1025, 1026, 1027, 1035, 1041, 1043, 1044, 1045, 1047, 1051, 1053, 1056, 1059, 1062, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1122, 1161, 1167, 1188, 1190, 1191, 1193, 1195, 1201, 1210, 1216, 1222, 1224, 1225, 1226, 1227, 1228, 1229, 1235, 1238, 1246	
Future consultation	8.5.3	56, 64, 81, 110, 152, 153, 154, 159, 187, 226, 229, 248, 261, 263, 265, 268, 282, 307, 308, 320, 350, 362, 364, 396, 399, 410, 411, 415, 417, 420, 422, 440, 458, 459, 513, 527, 551, 562, 567, 574, 585, 593, 613, 640, 648, 654, 656, 658, 659, 662, 663, 664, 692, 701, 702, 704, 705, 710, 764, 769, 784, 830, 844, 846, 847, 854, 866, 868, 872, 888, 910, 911, 912, 1004, 1026, 1047, 1056, 1059, 1062, 1079, 1080, 1081, 1145, 1227	84
Endorsements of other submissions	8.5.4	64, 133, 153, 154, 187, 259, 262, 264, 266, 269, 307, 308, 345, 350, 354, 362, 380, 400, 409, 411, 414, 415, 416, 417, 418, 420, 422, 433, 440, 458, 459, 486, 506, 513, 527, 550, 551, 562, 567, 569, 574, 593, 595, 604, 613, 614, 615, 619, 630, 635, 637, 640, 646, 654, 656, 657, 658, 661, 662, 663, 664, 678, 679, 681, 692, 700, 701, 702, 704, 705, 710, 714, 726, 773, 783, 785, 796, 828, 844, 851, 852, 854, 871, 877, 878, 879, 881, 882, 883, 884, 885, 888, 956, 1000, 1021, 1022, 1032, 1040, 1048, 1058, 1060, 1168, 1207, 1209, 1212, 1213, 1214, 1224, 1225, 1226, 1227, 1229, 1230, 1233, 1242, 1243, 1244, 1245	118
Construction traffic			
Traffic numbers and routes	8.6.1	10, 39, 40, 44, 45, 46, 54, 55, 56, 64, 77, 79, 84, 85, 100, 110, 113, 126, 127, 128, 144, 152, 153, 154, 156, 158, 163, 167, 173, 175, 181, 182, 187, 192, 200, 202, 203, 212, 221, 226, 229, 234, 235, 246, 248, 255, 256, 279, 280, 282, 287, 288, 293, 308, 319, 320, 347, 350, 357, 360, 362, 364, 366, 396, 401, 408, 410, 411, 415, 417, 420, 422, 426, 428, 439, 444, 449, 455, 458, 459, 465, 466, 467, 471, 492, 506, 513,	182

Issue	Report section	Stakeholder identification numbers	Count
		527, 550, 551, 558, 562, 567, 574, 591, 593, 601, 605, 613, 633, 637, 640, 645, 651, 653, 654, 656, 658, 659, 662, 663, 664, 689, 692, 701, 702, 704, 705, 710, 717, 728, 730, 746, 748, 756, 764, 769, 776, 784, 821, 827, 830, 837, 838, 846, 847, 854, 855, 861, 865, 866, 868, 872, 886, 888, 910, 911, 912, 913, 942, 970, 984, 1004, 1026, 1055, 1056, 1059, 1062, 1079, 1080, 1081, 1147, 1148, 1151, 1154, 1166, 1170, 1181, 1184, 1185, 1192, 1211, 1215, 1221, 1223, 1224, 1227, 1231, 1234, 1236, 1247, 1248	
Network performance	8.6.2	20, 25, 39, 40, 56, 64, 110, 154, 173, 181, 182, 229, 246, 248, 287, 320, 362, 364, 396, 410, 411, 417, 420, 422, 449, 455, 458, 459, 466, 513, 527, 551, 556, 562, 567, 574, 593, 601, 605, 613, 651, 653, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 710, 717, 746, 776, 830, 847, 854, 855, 865, 866, 886, 888, 970, 1004, 1026, 1056, 1059, 1062, 1170, 1215	73
Public transport and emergency services	8.6.3	56, 64, 110, 154, 203, 229, 287, 320, 362, 364, 396, 410, 411, 417, 420, 422, 458, 459, 513, 527, 550, 551, 562, 567, 574, 593, 613, 653, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 710, 718, 719, 720, 721, 722, 723, 724, 740, 742, 743, 854, 888, 1004, 1026, 1055, 1056, 1059, 1062, 1234	59
Pedestrians and cyclists	8.6.4	20, 56, 64, 85, 110, 154, 200, 229, 246, 248, 320, 347, 362, 364, 396, 410, 411, 417, 420, 422, 458, 459, 513, 527, 551, 558, 562, 567, 574, 593, 613, 653, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 710, 746, 748, 847, 854, 888, 913, 1004, 1026, 1056, 1059, 1062, 1147, 1178, 1184	58
Traffic safety	8.6.5	39, 54, 55, 85, 115, 127, 144, 156, 175, 181, 182, 200, 202, 246, 248, 255, 287, 293, 360, 399, 426, 439, 444, 455, 465, 466, 471, 492, 527, 550, 551, 558, 576, 605, 651, 653, 693, 717, 728, 730, 746, 748, 776, 830, 846, 847, 888, 913, 970, 1055, 1147, 1148, 1170, 1192, 1211, 1221	56
Operational traffic			
Traffic forecasts and methodology	8.7.1	39, 40, 64, 84, 97, 131, 153, 192, 235, 248, 261, 263, 265, 268, 298, 315, 345, 350, 354, 362, 364, 368, 386, 388, 400, 401, 403, 411, 414, 415, 417, 420, 422, 440, 458, 459, 486, 506, 513, 549, 550, 551, 560, 562, 567, 574, 593, 601, 611, 613, 616, 619, 632, 640, 653, 654, 655, 656, 658, 659, 660, 662, 663, 664, 665, 671, 677, 681, 701, 702, 704, 705, 710, 822, 828, 836, 845, 854, 866, 888, 1004, 1026, 1056, 1059, 1062, 1195, 1196, 1218, 1227, 1240, 1251	91
Network performance	8.7.2	1, 19, 30, 38, 39, 40, 56, 64, 66, 74, 77, 84, 102, 109, 110, 129, 154, 158, 159, 221, 229, 235, 288, 315, 320, 347, 350, 362, 364, 368, 396, 399, 410, 411, 417, 420, 422, 425, 443, 458, 459, 467, 513, 527, 528, 548, 551, 562, 567, 574, 576, 593, 613, 645, 654, 656, 658, 661, 662, 663, 664, 665, 671, 692, 694, 701, 702, 704, 705, 710, 748, 774, 775, 828, 845, 854, 863, 888, 1004, 1026, 1052, 1056, 1059, 1062, 1145, 1147, 1184	87
Pedestrians and cyclists	8.7.3	118, 173, 176, 347, 576, 748, 803, 830, 1147, 1178, 1184	11
Traffic safety	8.7.4	6, 15, 60, 118, 315, 347, 350, 440, 671, 748, 828, 1147, 1184, 1195	14
Incident response	8.7.5	1, 350, 374, 440, 485, 565, 566, 629, 630, 635, 672, 673, 679, 739, 1229	15
Construction noise and vibration			

Issue	Report section	Stakeholder identification numbers	Count
Airborne noise impacts	8.8.1	10, 46, 76, 84, 85, 112, 127, 128, 148, 167, 181, 187, 192, 212, 219, 221, 234, 246, 261, 263, 265, 268, 287, 288, 293, 307, 319, 347, 350, 357, 360, 389, 391, 399, 455, 561, 570, 591, 605, 634, 645, 654, 659, 678, 728, 730, 748, 776, 807, 821, 830, 832, 838, 847, 864, 866, 913, 914, 973, 1046, 1055, 1147, 1157, 1184, 1192, 1203, 1215, 1223, 1227, 1234, 1236	71
Ground-borne noise impacts	8.8.2	107, 145, 187, 350, 471, 522, 659, 868, 914, 1227	10
Vibration from surface works	8.8.3	357, 561, 678, 1223	4
Vibration from tunnelling works	8.8.4	82, 107, 350, 391, 399, 471, 522, 659, 868, 1227	10
Traffic noise	8.8.5	10, 44, 45, 56, 64, 85, 110, 126, 127, 128, 144, 145, 154, 159, 181, 200, 212, 229, 255, 256, 287, 293, 320, 347, 350, 357, 362, 364, 389, 396, 410, 411, 417, 420, 422, 439, 458, 459, 513, 527, 551, 562, 567, 570, 574, 593, 613, 653, 654, 656, 658, 659, 662, 663, 664, 678, 689, 692, 701, 702, 704, 705, 710, 717, 728, 730, 746, 748, 773, 776, 785, 807, 846, 847, 854, 861, 866, 888, 1004, 1026, 1030, 1055, 1056, 1059, 1062, 1147, 1181, 1184, 1223, 1227	90
Noise from out of hours works	8.8.6	40, 219, 246, 261, 263, 265, 268, 304, 307, 350, 357, 399, 401, 449, 570, 579, 659, 694, 776, 809, 830, 839, 847, 866, 970, 1023, 1024, 1148, 1223, 1227	30
Traffic noise from out of hours works	8.8.7	40, 85, 182, 399, 401, 444, 449, 455, 591, 651, 748, 776, 809, 830, 1023, 1024, 1147, 1192, 1215	19
Cumulative noise impacts	8.8.8	40, 84, 112, 350, 659, 1227	6
Property damage and existing condition surveys	8.8.9	360, 399, 522, 669, 967, 990, 1211	7
Operational noise and vibration			
Traffic noise	8.9.1	38, 43, 46, 47, 58, 78, 84, 107, 145, 148, 186, 187, 192, 193, 225, 347, 518, 591, 748, 807, 824, 827, 832, 836, 967, 978, 990, 1147, 1184, 1200, 1211, 1251	32
Vibration	8.9.2	145, 518, 561	3
Noise attenuation	8.9.3	7, 148, 694, 807, 978	5
Provision of and location of noise barriers	8.9.4	6, 10, 16, 35, 40, 56, 64, 110, 154, 159, 186, 225, 229, 320, 347, 350, 358, 362, 363, 364, 396, 399, 410, 411, 417, 420, 422, 458, 459, 513, 519, 521, 523, 525, 526, 527, 551, 562, 567, 574, 582, 593, 613, 620, 653, 654, 656, 658, 659, 662, 663, 664, 692, 694, 701, 702, 704, 705, 710, 748, 807, 844, 854, 888, 1004, 1026, 1056, 1059, 1062, 1145, 1147, 1184, 1227	73
At-property acoustic	8.9.5	159, 186, 219, 225, 519, 521, 523, 525, 526, 807, 864	11

Issue	Report section	Stakeholder identification numbers	Count
treatment			
Noise from ancillary facilities	8.9.6	9, 84, 136, 357, 472, 640, 653, 725, 736, 828, 832, 844, 847, 865, 913, 1145, 1223	17
Noise modelling and assessment methodology	8.9.7	107, 187, 261, 263, 265, 268, 350, 399, 518, 621, 652, 653, 659, 694, 695, 706, 836, 844, 1200, 1227, 1251	21
Construction air quality			
Dust generation	8.10.1	40, 43, 44, 46, 76, 127, 145, 192, 219, 246, 293, 319, 347, 350, 357, 360, 389, 391, 455, 471, 522, 561, 570, 579, 605, 609, 618, 634, 645, 654, 659, 689, 746, 748, 803, 821, 828, 830, 832, 838, 844, 847, 1055, 1121, 1147, 1148, 1157, 1181, 1184, 1203, 1211, 1215, 1223, 1227, 1234, 1235, 1236, 1251	58
Emissions from plant and equipment	8.10.2	44, 56, 64, 110, 126, 144, 154, 156, 187, 200, 229, 246, 287, 293, 320, 347, 357, 360, 362, 364, 396, 410, 411, 417, 420, 422, 458, 459, 467, 471, 513, 527, 551, 561, 562, 567, 574, 593, 613, 654, 656, 658, 662, 663, 664, 692, 693, 701, 702, 704, 705, 710, 717, 746, 830, 832, 838, 854, 888, 1004, 1026, 1055, 1056, 1059, 1062, 1148, 1157, 1184, 1211, 1223, 1234	71
Odour impacts during construction	8.10.3	246, 357, 1223	3
Operational air quality			
Assessment methodology	8.11.1	32, 36, 39, 40, 56, 58, 60, 63, 64, 65, 83, 84, 86, 87, 88, 89, 90, 95, 96, 101, 105, 110, 111, 114, 116, 117, 120, 122, 124, 132, 134, 135, 137, 138, 142, 147, 148, 149, 150, 151, 153, 154, 159, 165, 166, 169, 171, 174, 183, 185, 187, 193, 194, 196, 199, 201, 206, 207, 209, 213, 214, 216, 218, 220, 222, 223, 224, 227, 228, 229, 230, 231, 232, 239, 241, 243, 245, 246, 248, 250, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 270, 271, 272, 273, 274, 275, 276, 283, 284, 285, 288, 289, 292, 294, 295, 296, 297, 298, 299, 300, 301, 302, 307, 308, 310, 311, 312, 313, 314, 316, 317, 318, 319, 320, 321, 323, 325, 332, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 349, 350, 351, 352, 353, 354, 355, 362, 364, 367, 369, 374, 376, 379, 380, 381, 382, 383, 384, 386, 388, 389, 390, 391, 393, 394, 396, 399, 400, 403, 410, 411, 412, 414, 415, 416, 417, 419, 420, 421, 422, 423, 424, 427, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 440, 445, 446, 448, 450, 452, 453, 454, 456, 457, 458, 459, 461, 463, 464, 469, 470, 471, 472, 476, 477, 478, 479, 480, 481, 483, 485, 486, 487, 488, 489, 490, 491, 492, 493, 496, 497, 499, 500, 501, 503, 504, 505, 506, 508, 509, 511, 512, 513, 515, 516, 520, 522, 524, 527, 528, 529, 530, 531, 532, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 547, 550, 551, 557, 562, 565, 566, 567, 573, 574, 575, 576, 583, 585, 586, 588, 589, 591, 592, 593, 595, 598, 601, 606, 608, 609, 611, 612, 613, 614, 615, 616, 617, 618, 619, 623, 624, 625, 626, 627, 629, 630, 631, 632, 633, 634, 635, 637, 638, 639, 640, 641, 642, 645, 646, 647, 648, 649, 650, 652, 654, 655, 656, 658, 659, 660, 661, 662, 663, 664, 670, 671, 672, 673, 677, 678, 679, 681, 682, 684, 687, 689, 690, 691, 692, 695, 696, 697, 700, 701, 702, 704, 705, 706, 709,	565

Issue	Report section	Stakeholder identification numbers	Count
		710, 711, 712, 713, 714, 716, 718, 719, 720, 721, 722, 723, 724, 725, 726, 729, 731, 732, 733, 734, 735, 736, 738, 739, 740, 741, 742, 743, 744, 745, 749, 752, 758, 759, 760, 761, 762, 765, 766, 768, 771, 773, 781, 785, 790, 793, 794, 795, 806, 808, 809, 814, 819, 823, 828, 830, 832, 833, 834, 835, 836, 844, 848, 851, 852, 854, 856, 857, 858, 860, 861, 864, 868, 869, 870, 871, 873, 875, 877, 878, 879, 881, 882, 883, 884, 885, 887, 888, 890, 895, 896, 897, 899, 904, 908, 909, 915, 916, 917, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 936, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 956, 958, 960, 961, 964, 981, 986, 992, 999, 1004, 1012, 1017, 1019, 1020, 1025, 1026, 1028, 1035, 1041, 1043, 1044, 1045, 1047, 1051, 1053, 1056, 1057, 1059, 1061, 1062, 1083, 1084, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1122, 1161, 1167, 1179, 1181, 1185, 1188, 1190, 1191, 1193, 1198, 1199, 1200, 1201, 1203, 1204, 1210, 1211, 1216, 1217, 1218, 1220, 1222, 1224, 1225, 1226, 1227, 1228, 1229, 1235, 1238, 1239, 1240, 1246, 1251	
Ventilation system	8.11.2	1, 8, 14, 17, 23, 26, 28, 34, 36, 39, 40, 46, 49, 50, 53, 56, 58, 59, 60, 62, 63, 64, 65, 67, 69, 70, 75, 76, 79, 83, 84, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 101, 102, 105, 110, 111, 114, 116, 117, 120, 122, 124, 129, 131, 132, 133, 134, 135, 137, 138, 142, 143, 145, 147, 148, 149, 150, 151, 152, 153, 154, 155, 157, 159, 161, 162, 163, 164, 165, 166, 167, 168, 169, 171, 172, 174, 175, 179, 182, 183, 184, 185, 187, 190, 192, 194, 196, 199, 200, 201, 203, 204, 206, 207, 208, 209, 210, 212, 213, 214, 215, 216, 218, 221, 222, 223, 224, 226, 227, 228, 229, 230, 231, 232, 239, 241, 243, 247, 248, 250, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 271, 272, 273, 274, 275, 276, 278, 282, 283, 284, 285, 289, 291, 292, 295, 296, 297, 298, 299, 300, 301, 302, 303, 306, 307, 308, 310, 311, 312, 313, 314, 319, 320, 325, 333, 334, 335, 336, 337, 340, 341, 342, 343, 344, 345, 349, 350, 351, 352, 353, 354, 355, 362, 363, 364, 367, 369, 370, 373, 374, 376, 378, 379, 380, 381, 382, 383, 384, 386, 387, 388, 389, 390, 391, 393, 394, 395, 396, 397, 399, 400, 403, 409, 410, 411, 412, 413, 414, 415, 416, 417, 419, 420, 421, 422, 423, 424, 425, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 440, 443, 445, 446, 447, 448, 450, 451, 452, 453, 454, 456, 457, 458, 459, 460, 461, 462, 463, 464, 467, 468, 469, 470, 471, 472, 476, 477, 478, 479, 480, 481, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 496, 497, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 513, 515, 516, 520, 522, 524, 527, 528, 529, 530, 531, 532, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 549, 550, 551, 552, 553, 557, 562, 563, 565, 566, 567, 568, 573, 574, 575, 576, 577, 583, 585, 586, 587, 588, 589, 591, 592, 593, 595, 598, 599, 600, 601, 603, 606, 608, 611, 612, 613, 614, 615, 616, 617, 618, 619, 622, 624, 625, 626, 627, 629, 630, 631, 632, 634, 635, 638, 639, 640, 641, 642, 643, 646, 647, 648, 649, 650, 652, 654, 655, 656, 658, 659, 660, 661, 662, 663, 664, 666, 667, 670, 671, 672, 673, 676, 677, 678, 679, 681, 682, 684, 687, 688, 690, 691, 692, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 710, 712, 713, 714, 716, 718, 719, 720, 721, 722, 723, 724, 725, 729, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 742, 743, 745, 749, 750, 751, 752, 753, 755, 756, 758, 759, 760, 761, 762, 764, 765, 766, 768, 769, 771, 781, 784, 786, 790, 793, 794, 795, 803,	691

Issue	Report section	Stakeholder identification numbers	Count
		808, 809, 813, 814, 816, 817, 819, 820, 823, 825, 827, 828, 830, 832, 833, 834, 835, 836, 838, 840, 841, 842, 844, 845, 846, 848, 849, 851, 852, 854, 855, 856, 858, 859, 860, 863, 864, 867, 868, 869, 870, 871, 872, 873, 875, 876, 877, 878, 879, 881, 882, 883, 884, 885, 886, 887, 888, 895, 896, 897, 899, 904, 910, 911, 912, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 956, 958, 959, 960, 961, 964, 965, 977, 981, 986, 992, 996, 999, 1000, 1004, 1012, 1017, 1019, 1020, 1025, 1026, 1028, 1035, 1036, 1037, 1039, 1041, 1042, 1043, 1044, 1045, 1047, 1051, 1053, 1054, 1056, 1059, 1061, 1062, 1079, 1080, 1081, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1103, 1104, 1105, 1106, 1122, 1145, 1148, 1151, 1156, 1166, 1167, 1179, 1180, 1181, 1183, 1185, 1188, 1190, 1191, 1192, 1193, 1197, 1198, 1199, 1200, 1203, 1208, 1210, 1211, 1216, 1217, 1218, 1222, 1224, 1225, 1226, 1227, 1228, 1229, 1231, 1232, 1235, 1236, 1238, 1239, 1240, 1241, 1246, 1248, 1251	
Impacts around the northern ventilation outlet	8.11.3	6, 18, 29, 36, 42, 53, 58, 59, 60, 64, 72, 96, 99, 100, 115, 122, 136, 139, 145, 148, 153, 161, 162, 177, 179, 193, 207, 209, 215, 220, 240, 242, 248, 261, 263, 265, 268, 284, 285, 307, 311, 316, 321, 323, 345, 354, 362, 364, 373, 387, 395, 400, 411, 414, 415, 417, 420, 422, 445, 446, 458, 459, 471, 475, 485, 486, 506, 511, 512, 513, 515, 516, 517, 522, 524, 534, 550, 551, 552, 555, 562, 564, 567, 568, 574, 576, 577, 593, 601, 613, 619, 634, 636, 647, 652, 654, 656, 658, 660, 662, 663, 664, 681, 689, 695, 700, 701, 702, 704, 705, 710, 716, 725, 726, 734, 736, 739, 749, 753, 756, 765, 768, 787, 809, 818, 824, 825, 840, 842, 846, 854, 867, 870, 888, 965, 1004, 1007, 1009, 1011, 1017, 1026, 1027, 1028, 1030, 1033, 1034, 1036, 1039, 1054, 1056, 1059, 1060, 1061, 1062, 1145, 1148, 1160, 1181, 1199, 1203, 1204, 1206, 1218, 1240	164
Impacts around the southern ventilation outlet	8.11.4	22, 41, 56, 64, 78, 79, 84, 110, 128, 153, 154, 159, 167, 229, 240, 242, 248, 291, 304, 320, 345, 354, 362, 364, 379, 395, 396, 400, 410, 411, 414, 415, 417, 420, 422, 458, 459, 485, 486, 506, 513, 517, 527, 530, 550, 551, 562, 567, 574, 593, 601, 613, 619, 654, 656, 658, 660, 662, 663, 664, 681, 689, 692, 694, 701, 702, 704, 705, 706, 710, 716, 725, 726, 736, 749, 756, 827, 840, 842, 846, 854, 867, 888, 899, 913, 1004, 1026, 1028, 1039, 1046, 1056, 1059, 1062, 1121, 1148, 1200, 1211, 1218, 1240, 1251	100
Tunnel support facilities	8.11.5	39, 181, 246, 357, 374, 466, 471, 485, 776, 830, 847, 970, 1025, 1223, 1232, 1236	16
In-tunnel air quality	8.11.6	39, 64, 83, 86, 87, 88, 89, 90, 95, 96, 101, 105, 111, 114, 116, 117, 120, 124, 132, 134, 137, 138, 142, 147, 149, 150, 151, 153, 159, 165, 166, 169, 171, 174, 185, 194, 196, 199, 207, 213, 214, 216, 218, 222, 223, 224, 227, 228, 230, 231, 232, 240, 242, 248, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 272, 273, 274, 275, 276, 283, 284, 285, 289, 291, 292, 296, 299, 300, 301, 302, 311, 312, 321, 325, 335, 336, 337, 339, 340, 341, 342, 343, 344, 345, 349, 350, 351, 352, 353, 354, 362, 364, 367, 369, 374, 376, 381, 382, 383, 384, 391, 393, 394, 395, 400, 411, 412, 414, 415, 417, 419, 420, 421, 422, 423, 427, 429, 430, 431, 432, 433, 434, 436, 437, 438, 445, 446, 448, 450, 452, 453, 454, 456, 457, 458, 459, 461, 463, 464, 467, 470, 472, 476, 477, 478, 479, 481, 483, 485, 486, 487, 490, 491, 493, 496, 497, 499, 500, 501, 503, 504, 505, 506, 508, 509, 511, 513, 522, 528, 529, 530, 533, 534, 536, 537, 538, 539, 540, 541, 543,	399

Issue	Report section	Stakeholder identification numbers	Count
		544, 545, 547, 550, 551, 552, 557, 562, 565, 566, 567, 573, 574, 575, 585, 586, 588, 589, 592, 593, 595, 598, 601, 606, 608, 612, 613, 617, 618, 619, 624, 626, 627, 629, 630, 631, 635, 638, 639, 640, 641, 642, 647, 649, 650, 654, 655, 656, 658, 661, 662, 663, 664, 670, 672, 673, 678, 679, 681, 682, 684, 687, 690, 691, 696, 697, 700, 701, 702, 704, 705, 710, 712, 713, 718, 719, 720, 721, 722, 723, 724, 725, 726, 729, 733, 734, 735, 736, 740, 742, 743, 745, 749, 758, 759, 760, 761, 762, 765, 771, 781, 790, 793, 794, 795, 819, 834, 835, 842, 848, 851, 852, 854, 856, 858, 864, 869, 870, 871, 873, 875, 887, 888, 895, 896, 897, 905, 915, 916, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 934, 941, 942, 943, 944, 945, 947, 948, 949, 950, 956, 958, 960, 961, 964, 981, 986, 999, 1004, 1012, 1017, 1019, 1020, 1025, 1026, 1028, 1035, 1041, 1043, 1044, 1045, 1051, 1053, 1056, 1059, 1062, 1083, 1084, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1122, 1145, 1188, 1191, 1193, 1210, 1216, 1218, 1225, 1226, 1229, 1235, 1238, 1240, 1246	
Air quality improvements along Pennant Hills Road	8.11.7	60, 64, 75, 153, 197, 248, 345, 354, 362, 364, 400, 411, 414, 415, 417, 420, 422, 458, 459, 486, 506, 513, 550, 551, 562, 567, 574, 593, 601, 613, 619, 654, 656, 658, 662, 663, 664, 681, 695, 701, 702, 704, 705, 710, 808, 854, 888, 1004, 1026, 1056, 1059, 1062, 1217, 1218, 1225, 1226, 1240	57
Air Quality monitoring	8.11.8	64, 83, 84, 86, 87, 88, 89, 90, 95, 96, 100, 101, 105, 111, 114, 116, 117, 120, 124, 132, 134, 137, 138, 141, 142, 147, 149, 150, 151, 153, 154, 165, 166, 169, 171, 174, 185, 187, 192, 194, 196, 199, 200, 207, 213, 214, 215, 216, 218, 222, 223, 224, 227, 228, 230, 231, 232, 243, 248, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 270, 271, 272, 273, 274, 275, 276, 283, 284, 285, 288, 289, 292, 294, 295, 296, 297, 299, 300, 301, 302, 307, 308, 310, 311, 312, 313, 314, 317, 323, 325, 335, 336, 337, 340, 341, 342, 343, 344, 345, 349, 350, 351, 352, 353, 354, 355, 362, 364, 367, 369, 374, 376, 380, 381, 382, 383, 384, 386, 388, 389, 390, 391, 393, 394, 399, 400, 403, 411, 412, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 429, 430, 431, 432, 433, 434, 436, 437, 438, 440, 445, 446, 448, 450, 452, 453, 454, 456, 457, 458, 459, 461, 463, 464, 467, 470, 471, 472, 476, 477, 478, 479, 481, 483, 485, 486, 487, 488, 489, 490, 491, 492, 493, 496, 497, 499, 500, 501, 503, 504, 505, 506, 508, 509, 511, 513, 515, 516, 522, 528, 529, 530, 531, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 547, 550, 551, 557, 562, 565, 566, 567, 568, 573, 574, 575, 576, 585, 586, 588, 589, 592, 593, 595, 598, 601, 606, 608, 609, 612, 613, 614, 615, 617, 618, 619, 622, 624, 625, 626, 627, 629, 630, 631, 632, 635, 637, 638, 639, 640, 641, 646, 647, 648, 649, 650, 652, 654, 655, 656, 658, 659, 660, 662, 663, 664, 666, 667, 670, 672, 673, 677, 678, 679, 681, 682, 684, 687, 688, 690, 691, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 710, 711, 712, 713, 714, 718, 719, 720, 721, 722, 723, 724, 725, 729, 733, 734, 735, 736, 738, 740, 742, 743, 745, 758, 759, 760, 761, 762, 765, 766, 771, 773, 781, 785, 790, 793, 794, 795, 803, 809, 819, 820, 834, 835, 836, 844, 848, 851, 852, 854, 855, 858, 864, 869, 870, 871, 873, 875, 887, 888, 895, 896, 897, 915, 916, 917, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 956, 958, 960, 961, 964, 981, 986, 992, 999, 1004, 1012, 1017, 1019, 1020, 1025, 1026, 1035, 1041, 1043,	467

Issue	Report section	Stakeholder identification numbers	Count
		1044, 1045, 1047, 1051, 1053, 1056, 1057, 1059, 1061, 1062, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1122, 1161, 1181, 1185, 1188, 1191, 1193, 1199, 1208, 1210, 1216, 1218, 1222, 1224, 1225, 1226, 1227, 1228, 1229, 1235, 1238, 1240, 1241, 1246	
Odour impacts	8.11.9	84, 261, 263, 265, 268, 350, 659, 830, 1199, 1227	10
Surface roads	8.11.10	43, 347, 591, 967, 978, 990, 1184	7
Health			
Assessment methodology	8.12.1	36, 40, 56, 60, 64, 83, 86, 87, 88, 89, 90, 95, 96, 101, 105, 110, 111, 114, 116, 117, 120, 124, 132, 134, 137, 138, 142, 147, 149, 150, 151, 153, 154, 165, 166, 169, 171, 174, 183, 185, 187, 194, 196, 198, 199, 207, 209, 213, 214, 216, 218, 222, 223, 224, 227, 228, 229, 230, 231, 232, 245, 248, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 272, 273, 274, 275, 276, 283, 284, 285, 286, 289, 292, 295, 296, 297, 299, 300, 301, 302, 303, 307, 308, 311, 312, 313, 314, 320, 323, 325, 335, 336, 337, 338, 340, 341, 342, 343, 344, 345, 349, 350, 351, 352, 353, 354, 362, 364, 367, 369, 370, 374, 376, 381, 382, 383, 384, 386, 388, 389, 390, 391, 393, 394, 396, 399, 400, 410, 411, 412, 414, 415, 416, 417, 419, 420, 421, 422, 423, 429, 430, 431, 432, 433, 434, 436, 437, 438, 440, 445, 446, 448, 450, 452, 453, 454, 456, 457, 458, 459, 461, 463, 464, 469, 470, 472, 476, 477, 478, 479, 481, 483, 485, 486, 487, 488, 490, 491, 493, 496, 497, 499, 500, 501, 503, 504, 505, 506, 508, 509, 511, 512, 513, 514, 515, 516, 522, 524, 527, 528, 529, 530, 531, 533, 534, 536, 537, 538, 539, 540, 541, 543, 544, 545, 547, 550, 551, 557, 562, 565, 566, 567, 573, 574, 575, 576, 583, 585, 586, 588, 589, 591, 593, 595, 598, 599, 601, 606, 608, 609, 612, 613, 614, 615, 617, 618, 619, 624, 625, 626, 627, 629, 630, 631, 632, 635, 637, 638, 639, 640, 641, 647, 648, 649, 650, 654, 655, 656, 658, 659, 660, 661, 662, 663, 664, 670, 672, 673, 677, 678, 679, 681, 682, 684, 687, 690, 691, 692, 696, 697, 700, 701, 702, 704, 705, 710, 711, 712, 713, 714, 718, 719, 720, 721, 722, 723, 724, 725, 729, 733, 734, 735, 736, 738, 740, 742, 743, 745, 758, 759, 760, 761, 762, 765, 771, 773, 781, 785, 790, 793, 794, 795, 806, 814, 816, 819, 828, 830, 832, 834, 835, 836, 844, 848, 851, 852, 854, 857, 864, 869, 870, 871, 873, 875, 887, 888, 895, 896, 897, 905, 915, 916, 917, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 939, 940, 941, 943, 944, 945, 946, 947, 948, 949, 950, 956, 958, 959, 960, 961, 962, 963, 964, 981, 986, 992, 999, 1004, 1012, 1017, 1019, 1020, 1025, 1026, 1028, 1030, 1031, 1035, 1041, 1043, 1044, 1045, 1047, 1051, 1053, 1056, 1059, 1062, 1083, 1084, 1085, 1086, 1087, 1088, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1102, 1122, 1167, 1181, 1185, 1188, 1191, 1193, 1199, 1201, 1208, 1210, 1216, 1218, 1225, 1226, 1227, 1229, 1235, 1238, 1239, 1240, 1246	468
Impacts around the northern ventilation outlet	8.12.2	3, 18, 29, 30, 58, 59, 69, 86, 91, 93, 96, 104, 115, 130, 139, 145, 148, 155, 174, 179, 184, 188, 190, 207, 209, 210, 213, 214, 219, 239, 241, 245, 247, 261, 263, 265, 267, 268, 277, 286, 307, 310, 316, 359, 387, 489, 564, 569, 576, 603, 622, 632, 655, 677, 716, 718, 719, 720, 721, 722, 723, 724, 739, 740, 742, 743, 749, 765, 772, 797, 856, 861, 864, 1012, 1102, 1145, 1160, 1190, 1203, 1248	80
Impacts around the	8.12.3	56, 64, 110, 128, 133, 153, 154, 167, 192, 221, 229, 291, 304, 307, 320, 362, 364, 396, 410, 411, 417,	59

Issue	Report section	Stakeholder identification numbers	Count
southern ventilation outlet		420, 422, 458, 459, 467, 513, 527, 551, 562, 567, 574, 593, 613, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 706, 710, 749, 854, 888, 1004, 1026, 1056, 1059, 1062, 1200, 1211, 1228, 1251	
In-tunnel	8.12.4	39, 350, 485, 511, 768, 842, 870, 1145, 1156, 1181	10
Asthma	8.12.5	43, 46, 56, 59, 64, 65, 69, 83, 86, 87, 88, 89, 90, 95, 96, 101, 105, 106, 110, 111, 114, 116, 117, 119, 120, 123, 124, 132, 134, 137, 138, 142, 144, 146, 147, 149, 150, 151, 154, 155, 160, 165, 166, 167, 169, 171, 174, 178, 185, 190, 194, 195, 196, 199, 204, 205, 207, 208, 211, 212, 213, 214, 216, 218, 222, 223, 224, 227, 228, 229, 230, 231, 232, 237, 238, 240, 242, 244, 249, 250, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 272, 273, 274, 275, 276, 283, 284, 285, 289, 290, 291, 292, 294, 296, 298, 299, 300, 301, 302, 305, 307, 311, 312, 313, 314, 320, 322, 324, 325, 328, 329, 331, 335, 336, 337, 340, 341, 342, 343, 344, 346, 348, 349, 350, 351, 352, 353, 356, 361, 362, 364, 365, 367, 369, 371, 372, 373, 374, 376, 381, 382, 384, 385, 389, 391, 394, 396, 398, 404, 405, 406, 410, 411, 412, 417, 419, 420, 421, 422, 423, 424, 426, 429, 430, 431, 432, 433, 434, 436, 437, 438, 445, 446, 448, 450, 452, 453, 454, 456, 457, 458, 459, 461, 463, 464, 467, 468, 470, 472, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 485, 487, 490, 491, 493, 494, 495, 496, 497, 498, 499, 500, 501, 503, 504, 505, 508, 509, 511, 513, 514, 522, 524, 527, 528, 529, 530, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 547, 550, 551, 557, 559, 562, 565, 566, 567, 568, 571, 572, 573, 574, 575, 576, 578, 580, 581, 584, 585, 586, 588, 589, 593, 594, 595, 596, 597, 599, 602, 606, 607, 608, 610, 611, 612, 613, 616, 617, 618, 623, 625, 626, 627, 629, 630, 631, 632, 635, 636, 638, 639, 640, 641, 642, 646, 649, 650, 654, 656, 658, 659, 662, 663, 664, 666, 667, 670, 672, 673, 677, 678, 679, 682, 683, 684, 685, 687, 688, 690, 692, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 708, 709, 710, 712, 713, 715, 725, 729, 731, 732, 733, 734, 735, 736, 745, 747, 750, 757, 758, 759, 760, 761, 762, 765, 767, 771, 772, 777, 778, 780, 781, 782, 786, 787, 788, 790, 791, 792, 793, 794, 795, 798, 799, 800, 801, 802, 804, 806, 810, 811, 818, 819, 820, 823, 826, 829, 833, 834, 835, 841, 843, 844, 848, 849, 850, 851, 852, 853, 854, 856, 857, 859, 861, 864, 867, 869, 870, 871, 873, 875, 876, 887, 888, 895, 896, 897, 902, 915, 916, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 932, 937, 939, 940, 941, 943, 944, 945, 946, 947, 948, 949, 950, 952, 956, 958, 960, 961, 964, 981, 986, 992, 997, 999, 1004, 1017, 1019, 1020, 1025, 1026, 1027, 1028, 1033, 1035, 1041, 1043, 1044, 1045, 1051, 1053, 1056, 1059, 1062, 1085, 1086, 1087, 1088, 1089, 1090, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1122, 1123, 1127, 1129, 1130, 1133, 1134, 1151, 1157, 1162, 1163, 1164, 1166, 1177, 1181, 1183, 1188, 1189, 1191, 1193, 1201, 1210, 1219, 1225, 1226, 1227, 1229, 1231, 1233, 1235, 1236, 1238, 1239, 1246, 1248, 1251, 1253	537
Benefits along Pennant Hills Road	8.12.6	261, 263, 265, 268	4
Noise and vibration	8.12.7	159, 217, 307, 439, 440, 455, 561, 591, 748, 836, 861, 1147, 1237	13
General health impacts	8.12.8	5, 8, 9, 17, 21, 23, 34, 36, 39, 40, 47, 52, 64, 65, 81, 83, 84, 86, 87, 88, 89, 90, 95, 96, 99, 101, 105, 106,	801

Issue	Report section	Stakeholder identification numbers	Count
		111, 114, 116, 117, 119, 120, 123, 124, 130, 132, 134, 136, 137, 138, 142, 145, 146, 147, 149, 150, 151, 153, 154, 159, 160, 161, 162, 164, 165, 166, 168, 169, 171, 174, 175, 176, 178, 183, 185, 187, 190, 193, 194, 195, 196, 198, 199, 200, 204, 205, 206, 207, 208, 209, 211, 212, 213, 214, 216, 218, 220, 222, 223, 224, 227, 228, 230, 231, 232, 233, 237, 238, 240, 242, 243, 244, 248, 249, 250, 251, 252, 253, 254, 257, 258, 260, 261, 263, 265, 268, 270, 271, 272, 273, 274, 275, 276, 283, 284, 285, 289, 290, 291, 292, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 310, 311, 312, 313, 314, 317, 319, 322, 323, 324, 325, 328, 329, 331, 332, 333, 334, 335, 336, 337, 338, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 360, 361, 362, 364, 365, 367, 369, 370, 371, 372, 373, 374, 376, 378, 379, 380, 381, 382, 383, 384, 385, 386, 388, 389, 390, 391, 393, 394, 397, 398, 399, 400, 402, 403, 404, 405, 406, 409, 411, 412, 413, 414, 415, 416, 417, 419, 420, 421, 422, 423, 424, 426, 427, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 440, 445, 446, 447, 448, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 461, 463, 464, 468, 469, 470, 471, 472, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 493, 494, 495, 496, 497, 498, 499, 500, 501, 503, 504, 505, 506, 508, 509, 511, 512, 513, 514, 515, 516, 520, 522, 524, 527, 528, 529, 530, 531, 532, 533, 534, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 550, 551, 552, 557, 559, 562, 563, 565, 566, 567, 570, 571, 572, 573, 574, 575, 576, 578, 580, 581, 583, 584, 585, 586, 588, 589, 590, 592, 593, 594, 595, 596, 597, 598, 599, 601, 602, 604, 606, 607, 608, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 645, 647, 648, 649, 650, 652, 654, 655, 656, 658, 659, 660, 661, 662, 663, 664, 666, 667, 670, 671, 672, 673, 674, 676, 677, 678, 679, 681, 682, 683, 684, 685, 687, 688, 689, 690, 691, 692, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 718, 719, 720, 721, 722, 723, 724, 725, 729, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 765, 766, 767, 768, 770, 771, 772, 773, 777, 778, 779, 780, 781, 782, 783, 785, 786, 787, 788, 790, 791, 792, 793, 794, 795, 798, 799, 800, 801, 802, 803, 804, 805, 806, 808, 809, 810, 811, 812, 813, 814, 818, 819, 820, 823, 826, 828, 829, 832, 833, 834, 835, 836, 837, 838, 840, 841, 842, 843, 844, 848, 849, 850, 851, 852, 853, 854, 856, 857, 858, 859, 864, 865, 867, 869, 870, 871, 873, 875, 876, 877, 878, 879, 881, 882, 883, 884, 885, 887, 888, 895, 896, 897, 901, 902, 903, 904, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 927, 928, 929, 930, 931, 932, 937, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 956, 958, 959, 960, 961, 963, 964, 965, 967, 968, 971, 975, 976, 979, 980, 981, 982, 986, 990, 992, 993, 995, 996, 997, 998, 999, 1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1009, 1011, 1012, 1016, 1017, 1019, 1020, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1033, 1035, 1037, 1041, 1043, 1044, 1045, 1047, 1049, 1051, 1053, 1055, 1056, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1068, 1069, 1071, 1072, 1074, 1075, 1076, 1078, 1085, 1086, 1087, 1088, 1089, 1090, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099,	

Issue	Report section	Stakeholder identification numbers	Count
		1100, 1102, 1107, 1108, 1109, 1113, 1122, 1123, 1127, 1128, 1129, 1130, 1131, 1133, 1134, 1135, 1138, 1139, 1143, 1145, 1147, 1150, 1156, 1157, 1161, 1162, 1163, 1164, 1165, 1166, 1167, 1168, 1177, 1181, 1183, 1184, 1185, 1187, 1188, 1189, 1191, 1193, 1198, 1199, 1200, 1201, 1203, 1205, 1206, 1208, 1210, 1216, 1217, 1218, 1219, 1220, 1223, 1225, 1226, 1227, 1228, 1229, 1232, 1233, 1234, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1246, 1251, 1253	
Urban design, landscape character and visual amenity			
Construction light spill	8.13.1	112, 653, 1023, 1024	4
Construction visual impact	8.13.2	56, 64, 110, 154, 167, 182, 229, 246, 320, 357, 362, 364, 396, 410, 411, 417, 420, 422, 458, 459, 513, 527, 551, 561, 562, 567, 574, 593, 613, 653, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 710, 807, 830, 854, 866, 888, 1004, 1026, 1056, 1059, 1062, 1223, 1236	54
Operational landscape character impacts	8.13.3	42, 56, 64, 110, 121, 152, 153, 154, 187, 226, 229, 248, 282, 308, 320, 362, 364, 396, 410, 411, 415, 417, 420, 422, 458, 459, 513, 527, 551, 562, 567, 574, 593, 613, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 710, 764, 769, 784, 854, 872, 888, 910, 911, 912, 1004, 1026, 1056, 1059, 1062, 1079, 1080, 1081, 1236	64
Operational visual impact	8.13.4	56, 64, 76, 79, 84, 109, 110, 128, 153, 154, 159, 182, 186, 225, 229, 246, 248, 261, 263, 265, 268, 289, 304, 320, 345, 347, 354, 357, 362, 364, 396, 399, 400, 410, 411, 414, 415, 417, 418, 420, 422, 458, 459, 486, 506, 513, 527, 550, 551, 562, 567, 574, 591, 593, 601, 613, 619, 640, 653, 654, 656, 658, 662, 663, 664, 681, 692, 694, 701, 702, 704, 705, 710, 728, 730, 748, 754, 807, 847, 852, 854, 888, 913, 967, 978, 990, 1004, 1026, 1029, 1046, 1055, 1056, 1057, 1059, 1062, 1121, 1147, 1184, 1218, 1223, 1234, 1236, 1240	103
Operational urban design / landscaping	8.13.5	7, 56, 64, 99, 110, 148, 154, 186, 225, 229, 248, 261, 263, 265, 268, 289, 320, 347, 350, 358, 362, 364, 396, 410, 411, 417, 418, 420, 422, 458, 459, 513, 519, 521, 523, 525, 526, 527, 551, 562, 567, 574, 593, 601, 613, 640, 653, 654, 656, 658, 659, 662, 663, 664, 692, 694, 701, 702, 704, 705, 710, 728, 730, 748, 807, 828, 854, 866, 868, 888, 1004, 1026, 1046, 1056, 1059, 1062, 1145, 1147, 1166, 1184, 1192, 1227, 1231, 1247	84
Operational light spill	8.13.6	128, 315, 347, 368, 653, 748, 1147, 1184	8
Biodiversity			
Vegetation clearing	8.14.1	43, 46, 47, 49, 56, 64, 78, 79, 110, 128, 154, 186, 225, 229, 320, 347, 362, 364, 389, 396, 410, 411, 417, 420, 422, 458, 459, 513, 527, 551, 562, 567, 574, 591, 593, 613, 640, 654, 656, 658, 662, 663, 664, 692, 701, 702, 704, 705, 710, 748, 771, 832, 844, 854, 861, 888, 904, 967, 978, 990, 1004, 1026, 1055, 1056, 1059, 1062, 1145, 1147, 1184, 1192, 1231, 1234, 1251	73
Impacts to endangered ecological communities	8.14.2	49, 64, 79, 128, 153, 192, 248, 261, 263, 265, 268, 345, 354, 360, 362, 364, 389, 399, 400, 411, 414, 415, 417, 420, 422, 458, 459, 486, 506, 513, 550, 551, 562, 567, 574, 593, 601, 613, 619, 637, 640, 654, 656, 658, 662, 663, 664, 681, 701, 702, 704, 705, 710, 828, 844, 854, 888, 1004, 1026, 1056, 1059, 1062,	64

Issue	Report section	Stakeholder identification numbers	Count
		1218, 1240	
Aquatic environment and changes to hydrology	8.14.3	64, 79, 153, 180, 187, 248, 345, 354, 362, 364, 400, 411, 414, 415, 417, 420, 422, 458, 459, 486, 506, 513, 550, 551, 562, 567, 574, 593, 601, 613, 619, 654, 656, 658, 662, 663, 664, 681, 701, 702, 704, 705, 710, 803, 824, 854, 888, 1004, 1026, 1056, 1059, 1062, 1145, 1218, 1240	55
Other / indirect biodiversity impacts	8.14.4	76, 373, 475, 550, 652, 691, 867	7
Biodiversity management and offsets	8.14.5	118, 399, 640, 844	4
Social and economic			
Social and community impacts	8.15.1	59, 62, 64, 69, 79, 95, 153, 154, 187, 248, 307, 308, 345, 354, 362, 364, 383, 400, 402, 411, 414, 415, 417, 420, 422, 440, 458, 459, 469, 471, 486, 506, 511, 513, 515, 519, 521, 522, 523, 524, 525, 526, 528, 534, 550, 551, 562, 567, 574, 576, 593, 601, 613, 614, 615, 619, 640, 654, 656, 658, 662, 663, 664, 671, 681, 691, 701, 702, 704, 705, 710, 745, 854, 864, 865, 870, 888, 914, 1004, 1017, 1026, 1036, 1047, 1056, 1059, 1062, 1145, 1148, 1181, 1199, 1211, 1218, 1223, 1240	94
Construction amenity and traffic	8.15.2	39, 40, 56, 64, 77, 109, 110, 112, 154, 167, 173, 181, 182, 203, 229, 234, 240, 242, 261, 263, 265, 268, 287, 293, 320, 347, 357, 360, 362, 364, 383, 396, 399, 410, 411, 417, 420, 422, 428, 440, 444, 458, 459, 471, 513, 527, 529, 551, 558, 561, 562, 567, 570, 574, 579, 593, 613, 637, 640, 654, 656, 658, 662, 663, 664, 689, 692, 693, 694, 701, 702, 704, 705, 710, 717, 728, 730, 746, 776, 821, 847, 854, 865, 888, 914, 970, 1004, 1026, 1055, 1056, 1059, 1062, 1121, 1151, 1154, 1181, 1184, 1192, 1211, 1223, 1234	101
Operational amenity and traffic	8.15.3	39, 56, 58, 64, 110, 153, 154, 167, 229, 315, 320, 349, 357, 362, 364, 368, 396, 397, 401, 410, 411, 417, 420, 422, 458, 459, 469, 513, 527, 551, 562, 567, 574, 576, 593, 613, 654, 656, 658, 662, 663, 664, 671, 692, 701, 702, 704, 705, 710, 854, 865, 888, 1004, 1026, 1056, 1059, 1062, 1145, 1223	59
Impacts to economic output	8.15.4	1170	1
Hydrogeology and soils			
Construction erosion and sedimentation	8.16.1	866	1
Construction groundwater impacts	8.16.2	350, 391, 471, 518, 522, 659, 1227	7
Settlement	8.16.3	37, 51, 81, 112, 145, 177, 279, 280, 350, 366, 389, 391, 399, 471, 561, 640, 659, 844, 868, 1202, 1227	21
Operational groundwater impacts	8.16.4	350, 471, 558, 640, 659, 828, 844, 1202, 1227	9
Surface water			

Issue	Report section	Stakeholder identification numbers	Count
Construction water quality, treatment and discharge	8.17.1	170, 1145, 1235	3
Construction hydrology and flooding	8.17.2	347, 748, 1147, 1184	4
Operational drainage infrastructure	8.17.3	118, 248	2
Operational water quality, treatment and discharge	8.17.4	37, 64, 84, 153, 154, 170, 187, 192, 221, 248, 288, 308, 345, 354, 362, 364, 383, 400, 411, 414, 415, 417, 420, 422, 458, 459, 467, 486, 506, 513, 550, 551, 562, 567, 574, 593, 601, 613, 614, 615, 619, 654, 656, 658, 662, 663, 664, 681, 701, 702, 704, 705, 710, 854, 888, 1004, 1026, 1056, 1059, 1062, 1218, 1240	62
Operational hydrology and flooding	8.17.5	64, 84, 153, 154, 187, 248, 308, 345, 354, 362, 364, 383, 400, 411, 414, 415, 417, 420, 422, 458, 459, 467, 486, 506, 513, 550, 551, 562, 567, 574, 593, 601, 613, 614, 615, 619, 654, 656, 658, 662, 663, 664, 681, 701, 702, 704, 705, 710, 854, 888, 1004, 1026, 1056, 1059, 1062, 1218, 1240	57
Non-Aboriginal heritage			
Direct impacts to heritage items	8.18.1	261, 263, 265, 268, 399, 469, 515, 652, 828, 844, 1000, 1055, 1057, 1199, 1234	15
Impacts to heritage conservation areas	8.18.2	121, 139, 148, 261, 263, 265, 268, 284, 285, 350, 367, 380, 399, 416, 418, 469, 488, 515, 637, 652, 659, 734, 828, 838, 864, 1000, 1145, 1199, 1227	29
Potential impacts and indirect impacts	8.18.3	121, 139, 350, 380, 399, 469, 489, 515, 640, 659, 828, 1145, 1199, 1227	14
Aboriginal heritage			
Potential impacts to Aboriginal heritage items	8.19.1	350, 659, 844, 1055, 1145, 1227, 1234	7
Land use and property			
Property acquisition	8.20.1	40, 43, 47, 51, 53, 56, 64, 78, 79, 110, 118, 148, 153, 154, 187, 229, 248, 308, 320, 345, 354, 357, 359, 362, 364, 383, 396, 400, 410, 411, 414, 415, 417, 420, 422, 443, 458, 459, 486, 506, 513, 524, 527, 550, 551, 558, 562, 567, 574, 593, 601, 613, 614, 615, 619, 654, 656, 658, 662, 663, 664, 681, 692, 701, 702, 704, 705, 710, 733, 844, 854, 888, 1004, 1026, 1056, 1059, 1062, 1145, 1148, 1218, 1223, 1237, 1240	83
Utility and local road impacts	8.20.2	44, 64, 79, 145, 153, 156, 202, 248, 256, 345, 347, 350, 354, 362, 364, 399, 400, 411, 414, 415, 417, 420, 422, 440, 458, 459, 465, 486, 506, 513, 550, 551, 562, 567, 574, 593, 601, 613, 619, 653, 654, 656, 658, 659, 662, 663, 664, 681, 701, 702, 704, 705, 710, 748, 854, 888, 1004, 1026, 1056, 1059, 1062, 1147, 1184, 1218, 1227, 1240	66

Issue	Report section	Stakeholder identification numbers	Count
Future development impacts and opportunities	8.20.3	261, 263, 265, 268, 350, 512, 640, 659, 803, 828, 1227	11
Property values	8.20.4	12, 40, 43, 46, 47, 51, 59, 69, 76, 78, 136, 139, 145, 159, 167, 175, 177, 182, 200, 209, 220, 240, 242, 261, 263, 265, 268, 279, 280, 307, 313, 347, 350, 357, 366, 389, 391, 416, 440, 469, 471, 489, 515, 518, 522, 531, 532, 561, 634, 637, 652, 654, 659, 678, 694, 695, 748, 749, 767, 803, 807, 813, 817, 832, 838, 844, 864, 913, 946, 967, 978, 990, 1029, 1031, 1147, 1157, 1184, 1199, 1200, 1205, 1211, 1223, 1227, 1251	84
Compensation	8.20.5	46, 64, 100, 135, 153, 159, 167, 177, 194, 200, 248, 261, 263, 265, 268, 279, 280, 307, 345, 350, 354, 357, 360, 362, 364, 366, 390, 400, 411, 414, 415, 416, 417, 420, 422, 453, 458, 459, 486, 506, 512, 513, 532, 550, 551, 561, 562, 567, 574, 593, 601, 613, 618, 619, 648, 652, 654, 656, 658, 659, 662, 663, 664, 669, 681, 695, 701, 702, 704, 705, 710, 718, 719, 720, 721, 722, 723, 724, 740, 742, 743, 758, 803, 807, 817, 836, 844, 854, 858, 870, 888, 970, 1000, 1004, 1012, 1026, 1056, 1059, 1062, 1102, 1157, 1218, 1223, 1224, 1227, 1237, 1240, 1251	108
Property damage	8.20.6	192, 221	2
Hazards and risk			
Construction tunnelling risks	8.21.1	357, 485, 1223	4
Electric and magnetic fields	8.21.2	37, 40, 58, 108, 131, 136, 145, 161, 162, 184, 319, 350, 374, 379, 431, 440, 443, 485, 565, 566, 629, 630, 632, 635, 672, 673, 677, 679, 700, 739, 767, 768, 803, 832, 1049, 1229, 1232	3
Incidents in the tunnel	8.21.3	77	37
Bushfires	8.21.4	357, 485, 1223	1
Resources and waste			
Construction spoil generation and management	8.22.1	39, 40, 109, 182, 248, 425, 462, 492, 633, 640, 844, 846, 847, 914, 970, 1055, 1145, 1185, 1234	19
Other construction waste	8.22.2	347, 1184	2
Construction resource use	8.22.3	44, 803, 828	3
Operational resource use	8.22.4	350, 440, 828	3
Peak oil	8.22.5	665, 671	2
Greenhouse gas and climate change			

Issue	Report section	Stakeholder identification numbers	Count
Construction greenhouse gas emissions	8.23.1	665	1
Operational greenhouse gas emissions	8.23.2	395	1

Appendix B Wind roses

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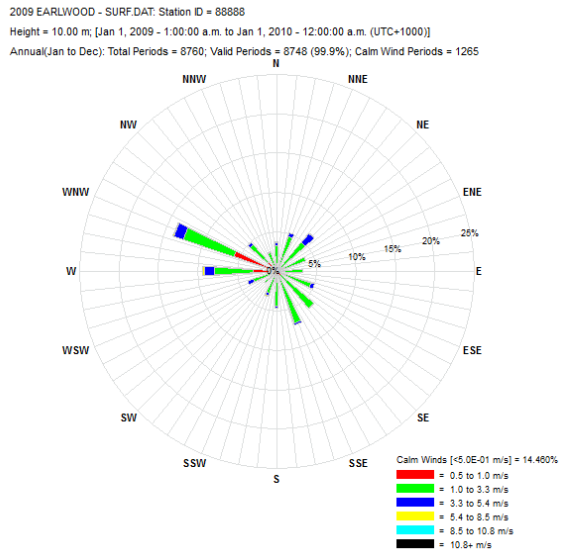
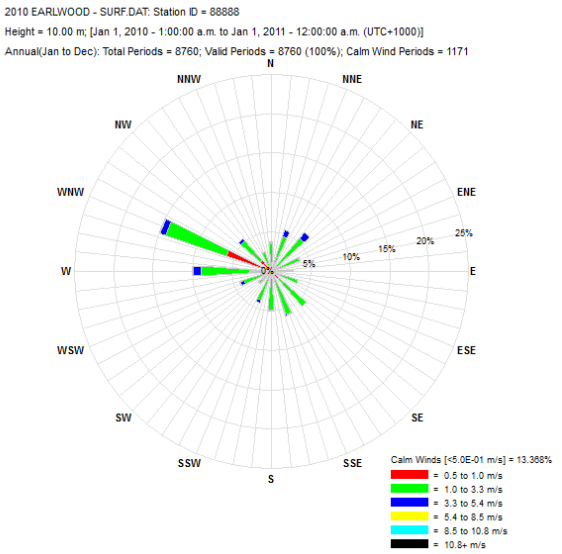
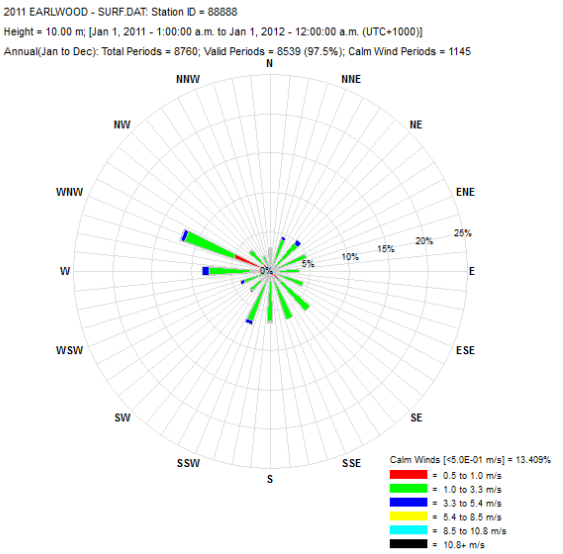
Wind Roses for Earlwood Monitoring Station and CALMET Outputs (refer to Section 2.10.3 of this report)



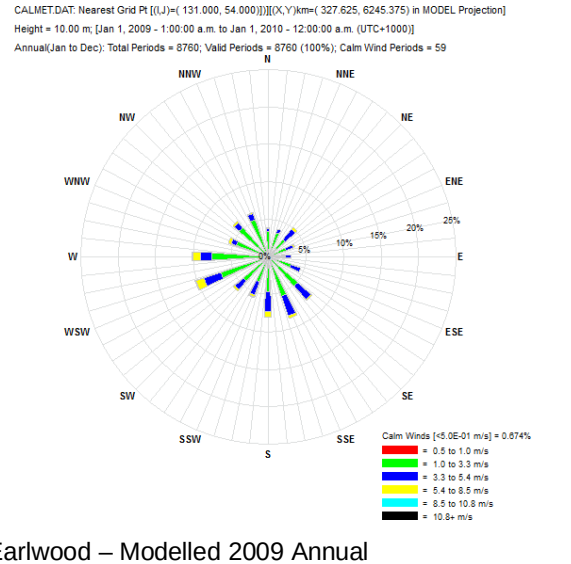
Earlwood – Observation 2009 Annual



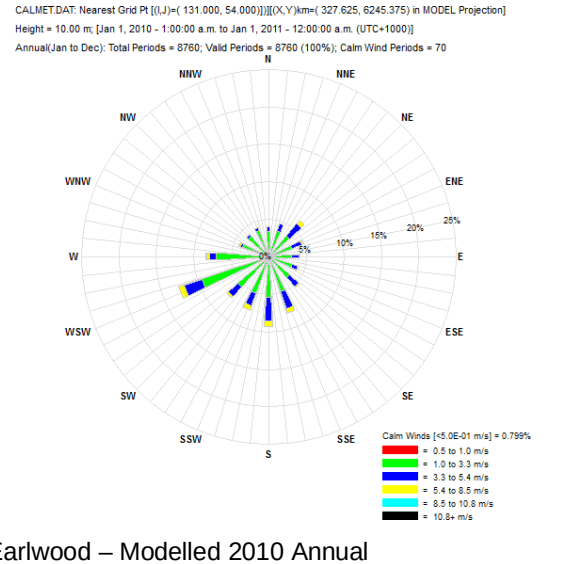
Earlwood – Observation 2010 Annual



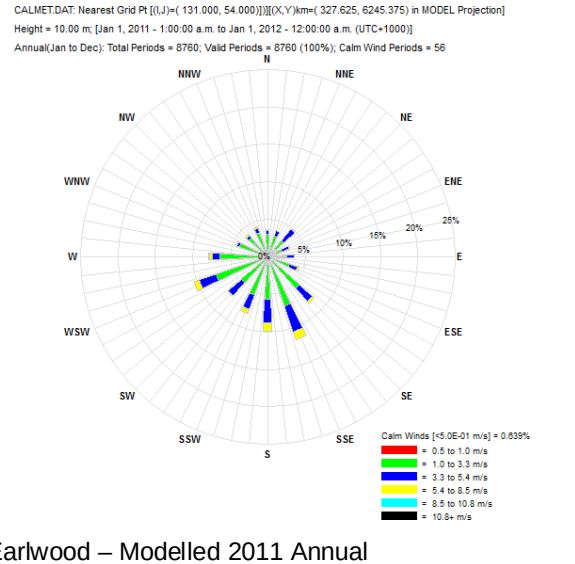
Earlwood – Observation 2011 Annual



Earlwood – Modelled 2009 Annual

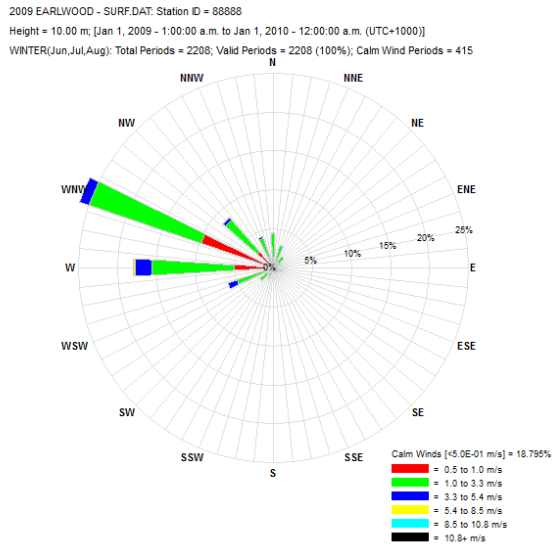


Earlwood – Modelled 2010 Annual

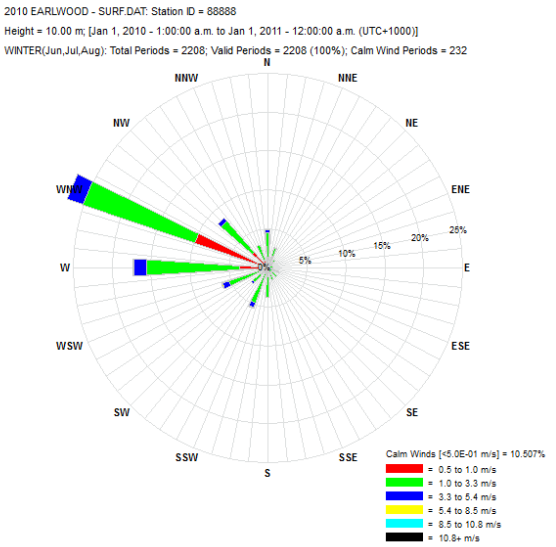


Earlwood – Modelled 2011 Annual

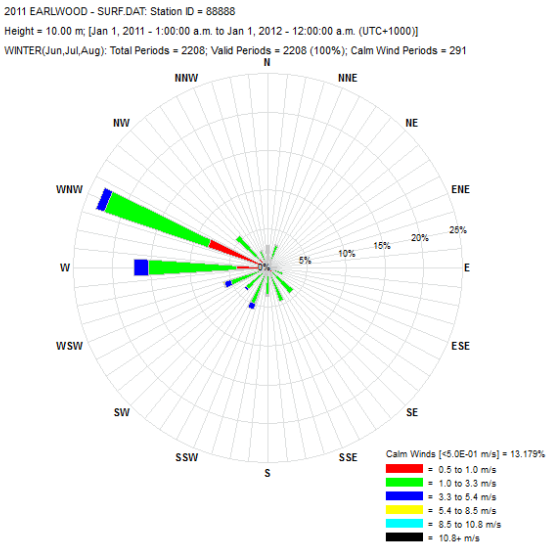
Wind Roses for Earlwood Monitoring Station and CALMET Outputs (refer to Section 2.10.3 of this report)



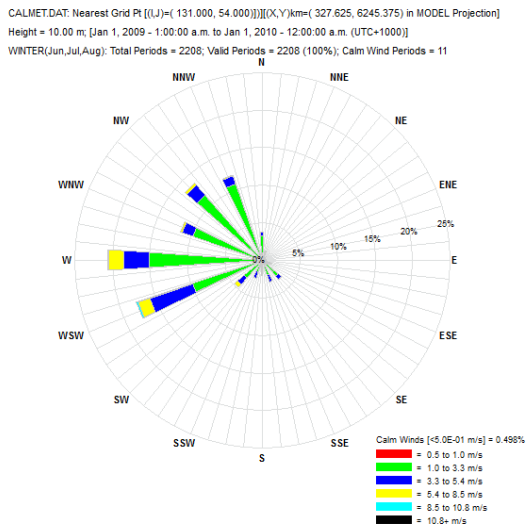
Earlwood – Observation 2009 Winter



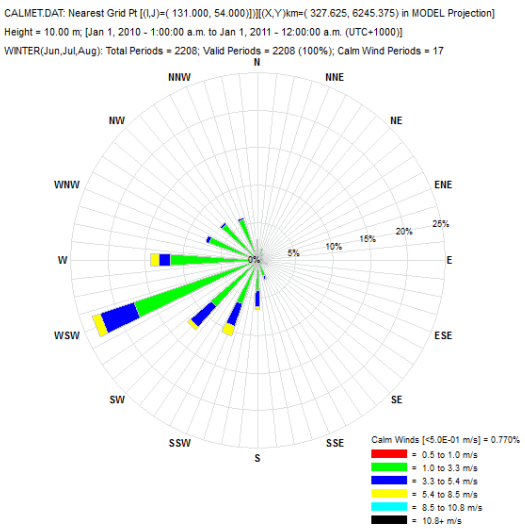
Earlwood – Observation 2010 Winter



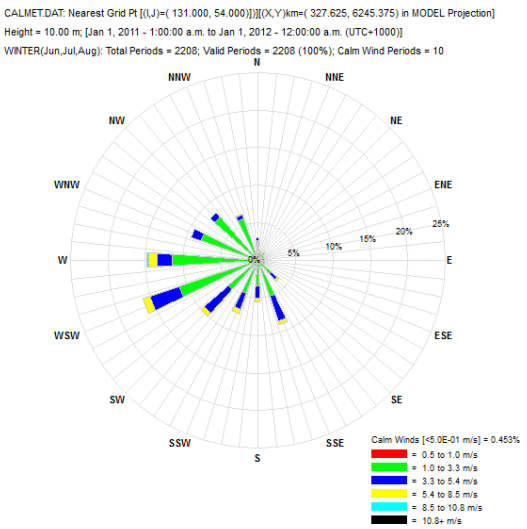
Earlwood – Observation 2011 Winter



Earlwood – Modelled 2009 Winter

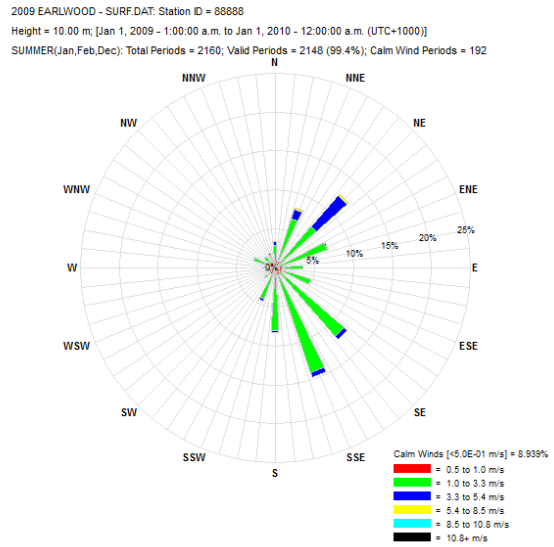


Earlwood – Modelled 2010 Winter

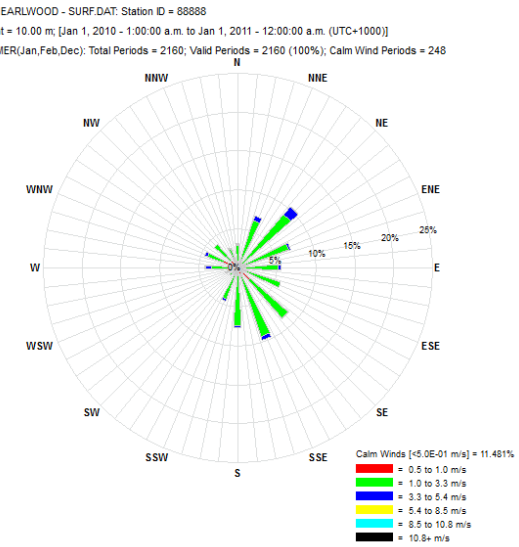


Earlwood – Modelled 2011 Winter

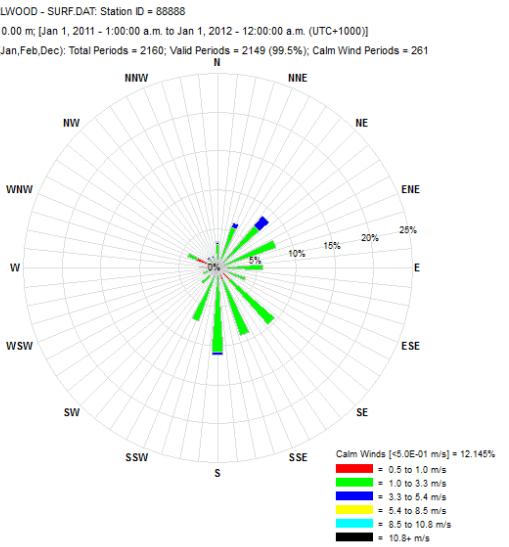
Wind Roses for Earlwood Monitoring Station and CALMET Outputs (refer to Section 2.10.3 of this report)



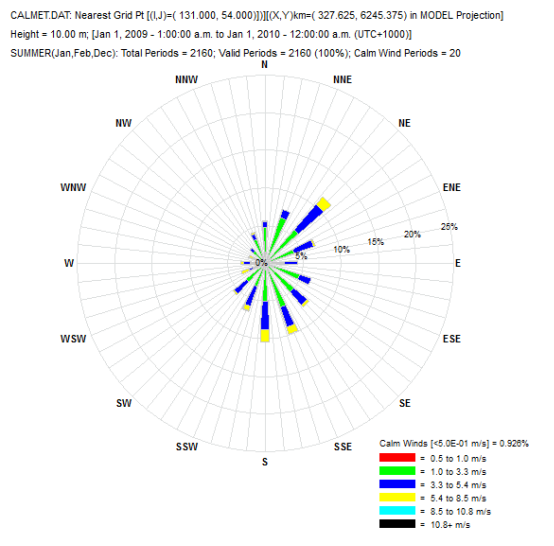
Earlwood – Observation 2009 Summer



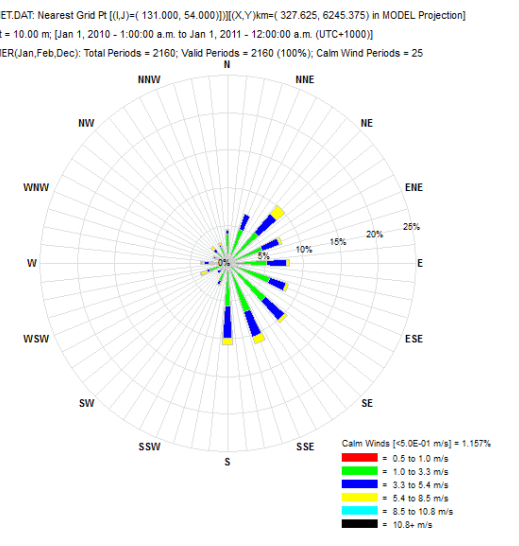
Earlwood – Observation 2010 Summer



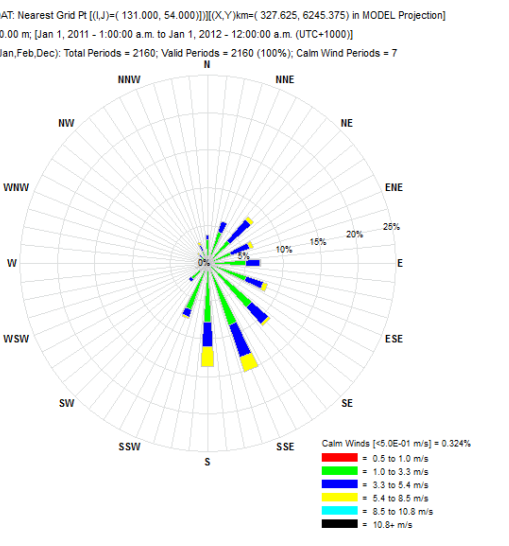
Earlwood – Observation 2011 Summer



Earlwood – Modelled 2009 Summer

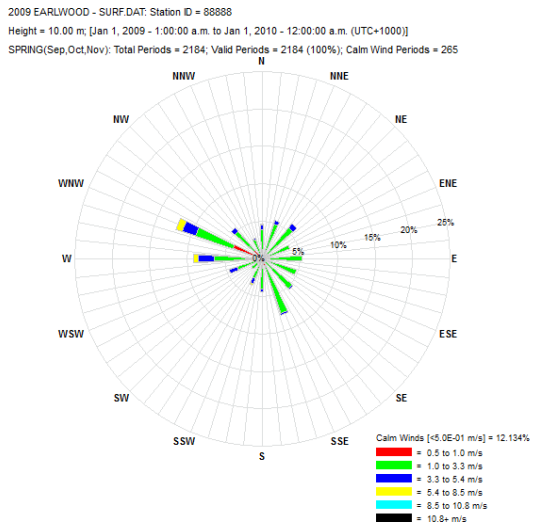


Earlwood – Modelled 2010 Summer

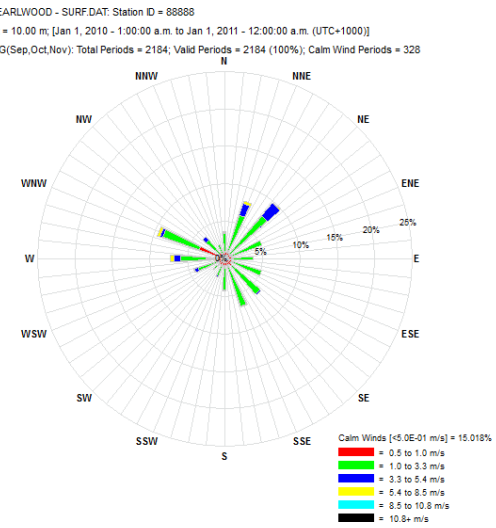


Earlwood – Modelled 2011 Summer

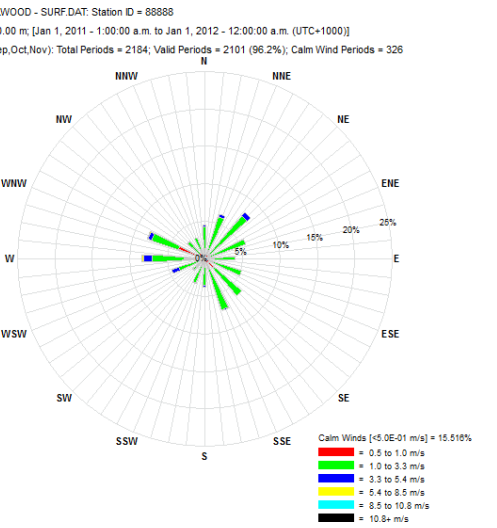
Wind Roses for Earlwood Monitoring Station and CALMET Outputs (refer to Section 2.10.3 of this report)



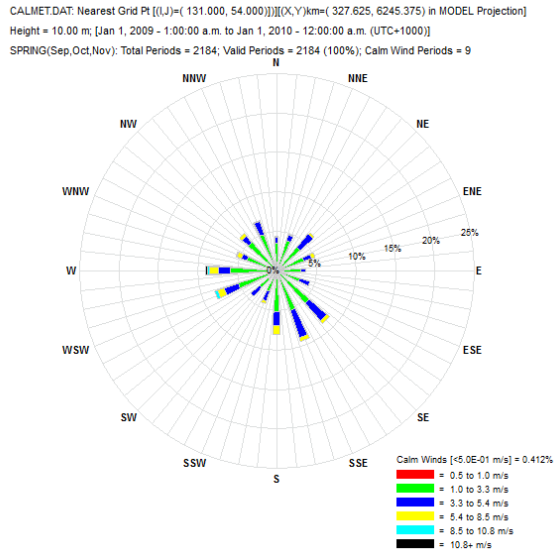
Earlwood – Observation 2009 Spring



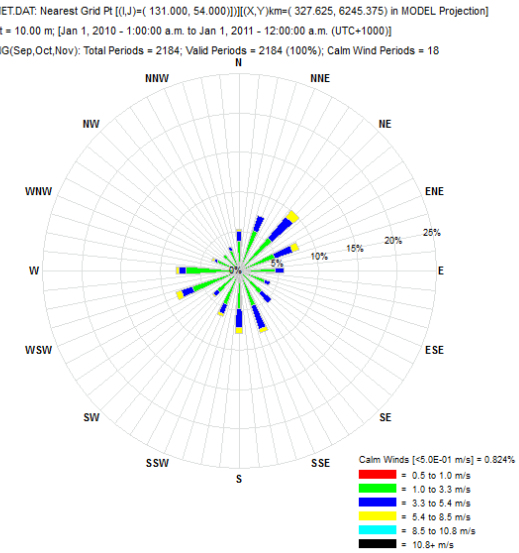
Earlwood – Observation 2010 Spring



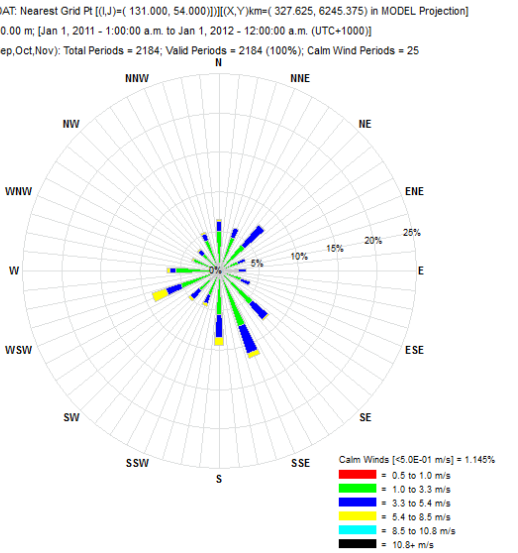
Earlwood – Observation 2011 Spring



Earlwood – Modelled 2009 Spring

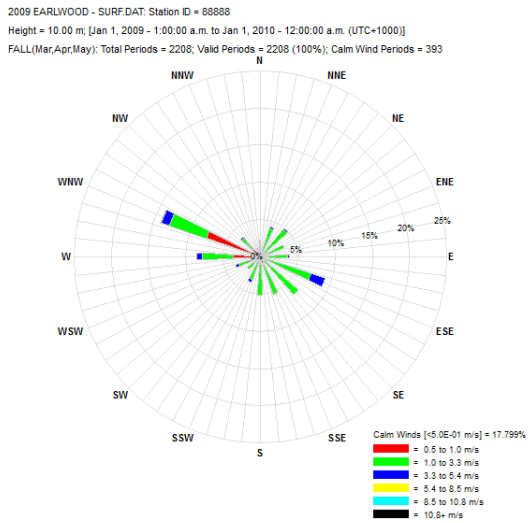


Earlwood – Modelled 2010 Spring

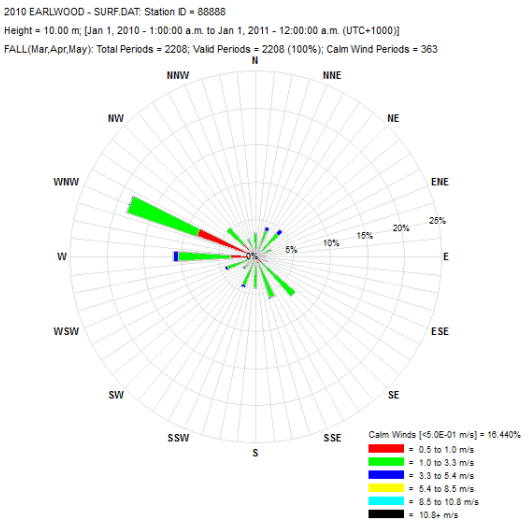


Earlwood – Modelled 2011 Spring

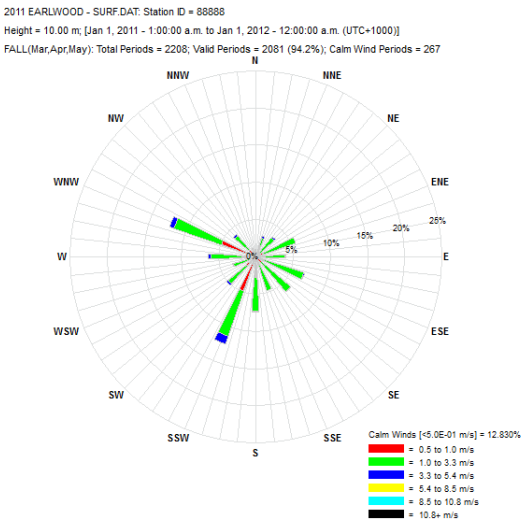
Wind Roses for Earlwood Monitoring Station and CALMET Outputs (refer to Section 2.10.3 of this report)



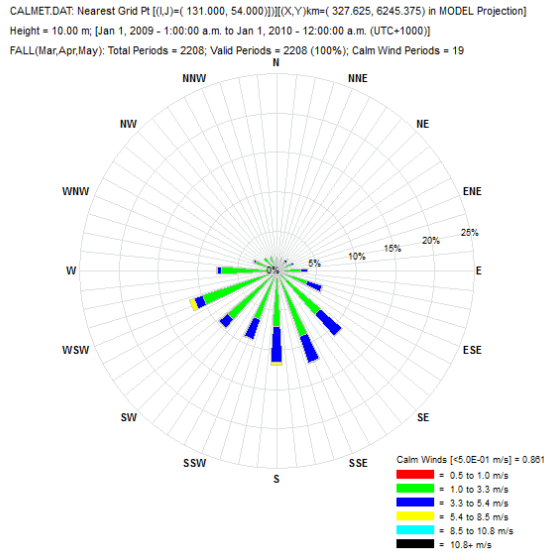
Earlwood – Observation 2009 Autumn



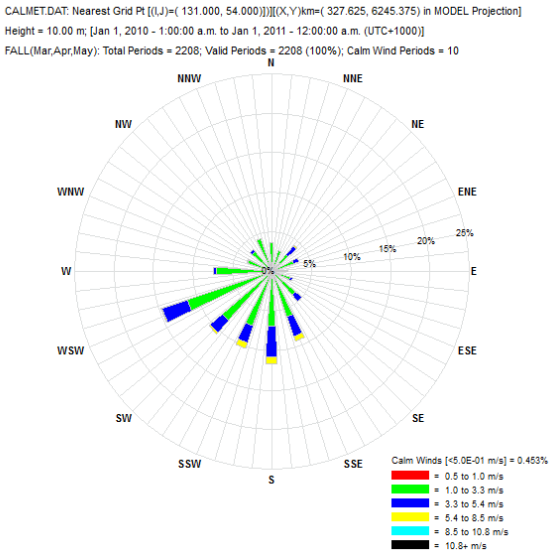
Earlwood – Observation 2010 Autumns



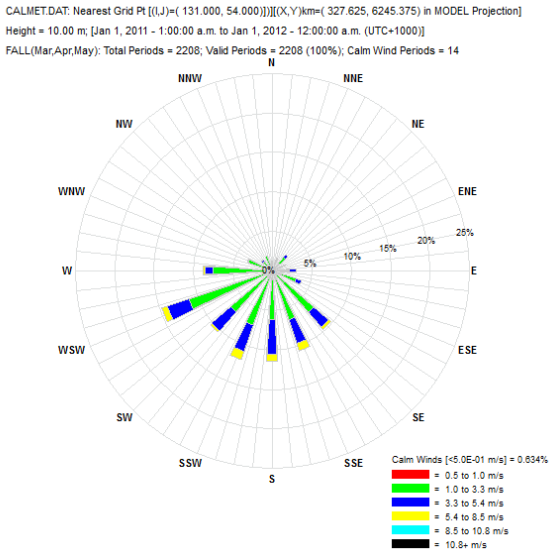
Earlwood – Observation 2011 Autumn



Earlwood – Modelled 2009 Autumn

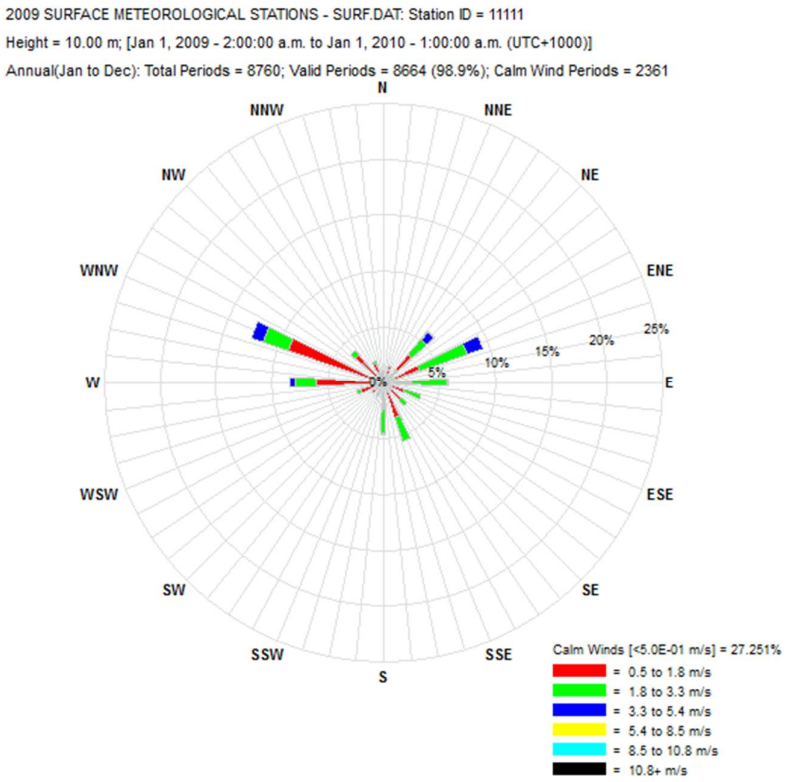


Earlwood – Modelled 2010 Autumn

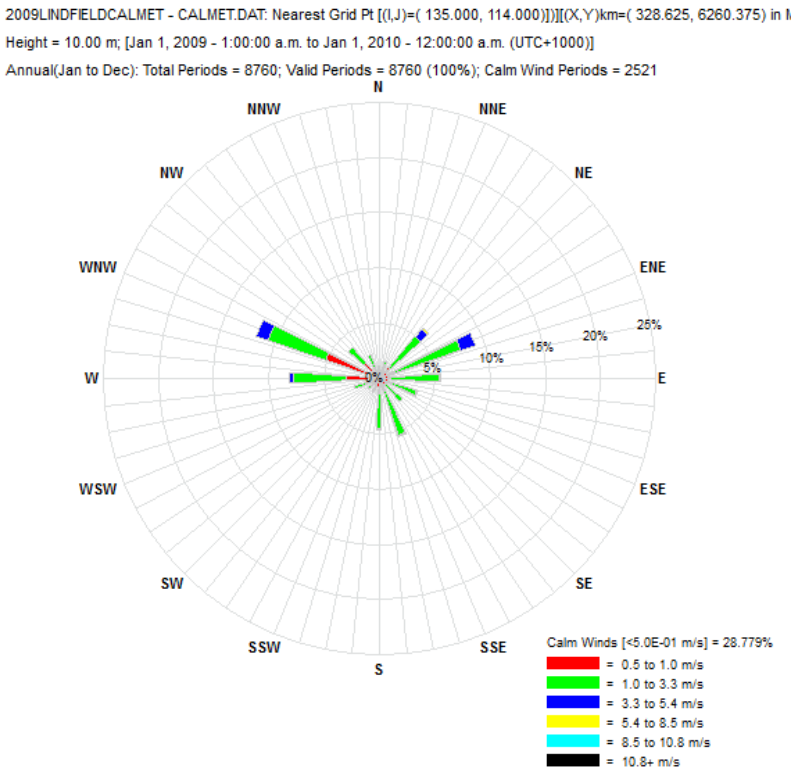


Earlwood – Modelled 2011 Autumn

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)

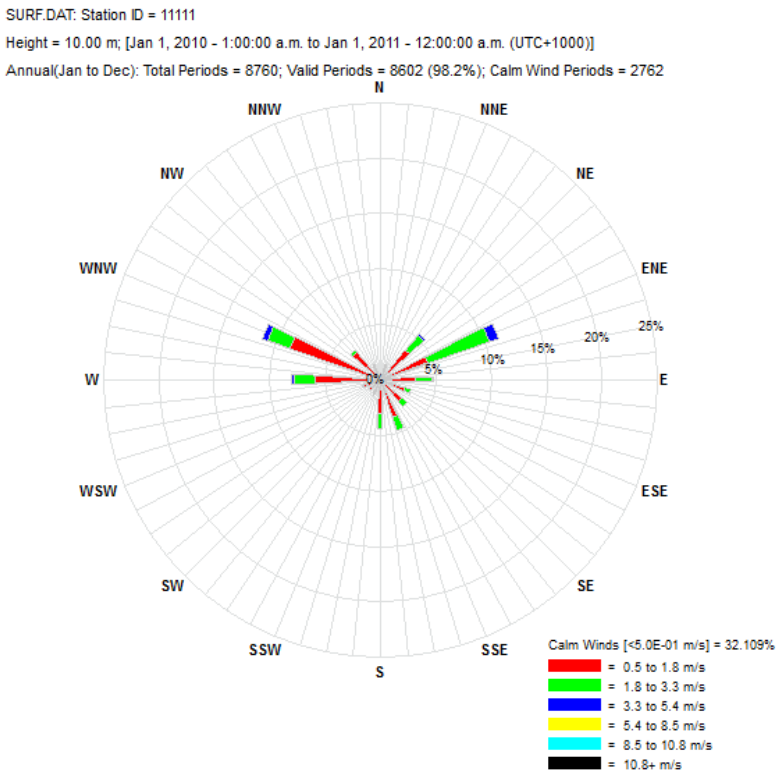


Lindfield Observed 2009

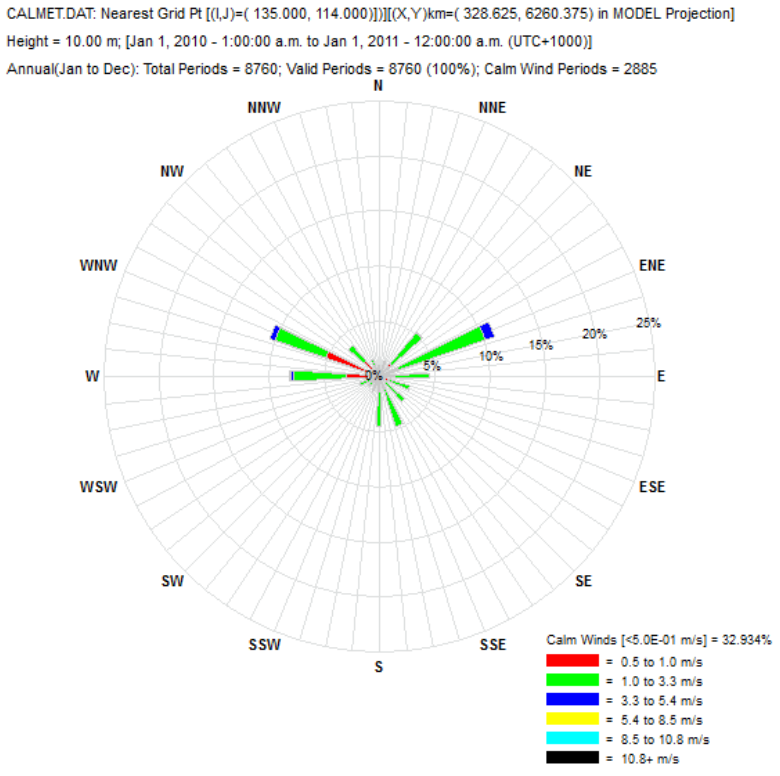


Lindfield Modelled 2009

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)

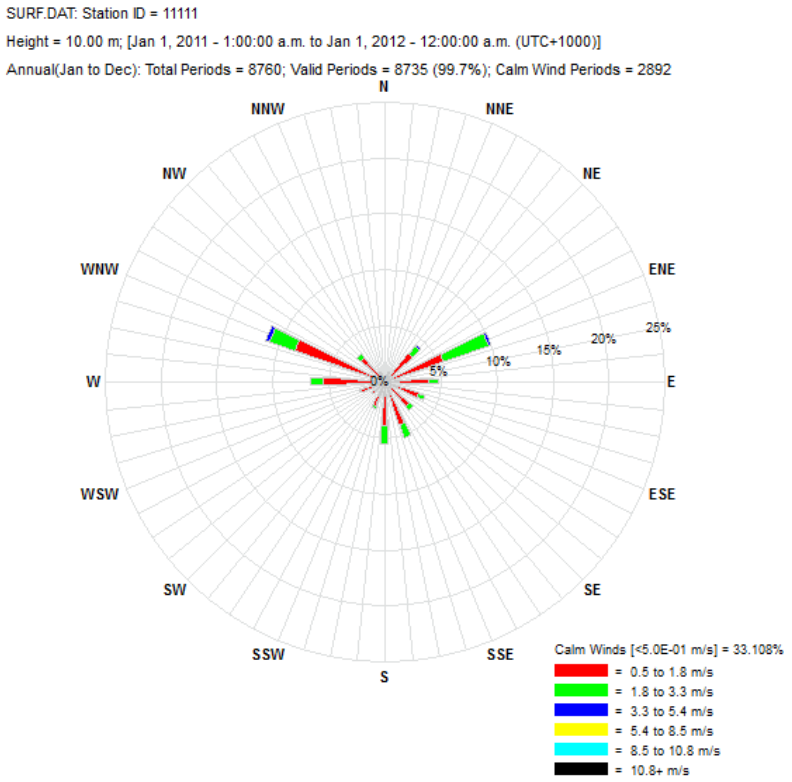


Lindfield Observed 2010



Lindfield Modelled 2010

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)



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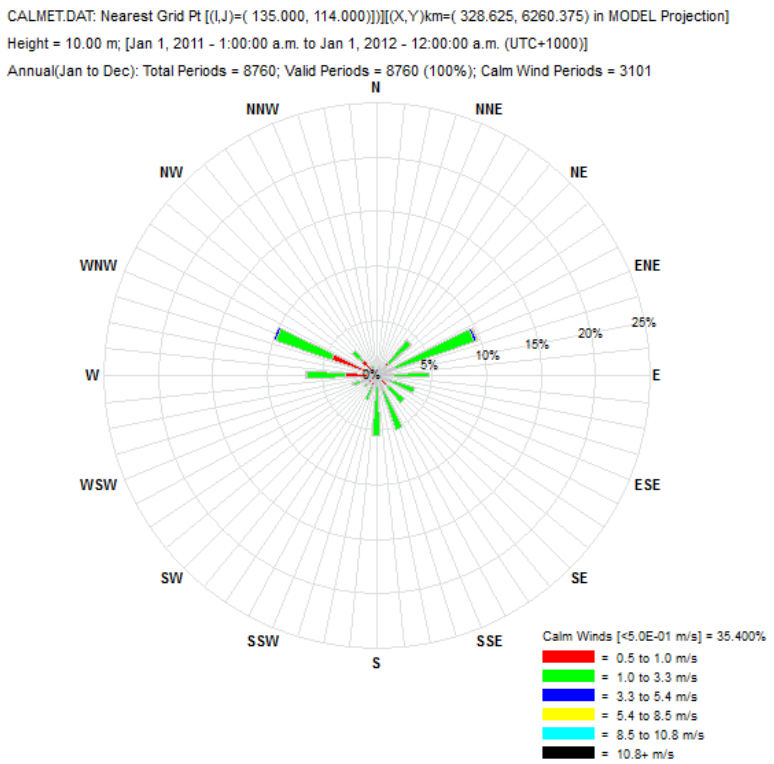
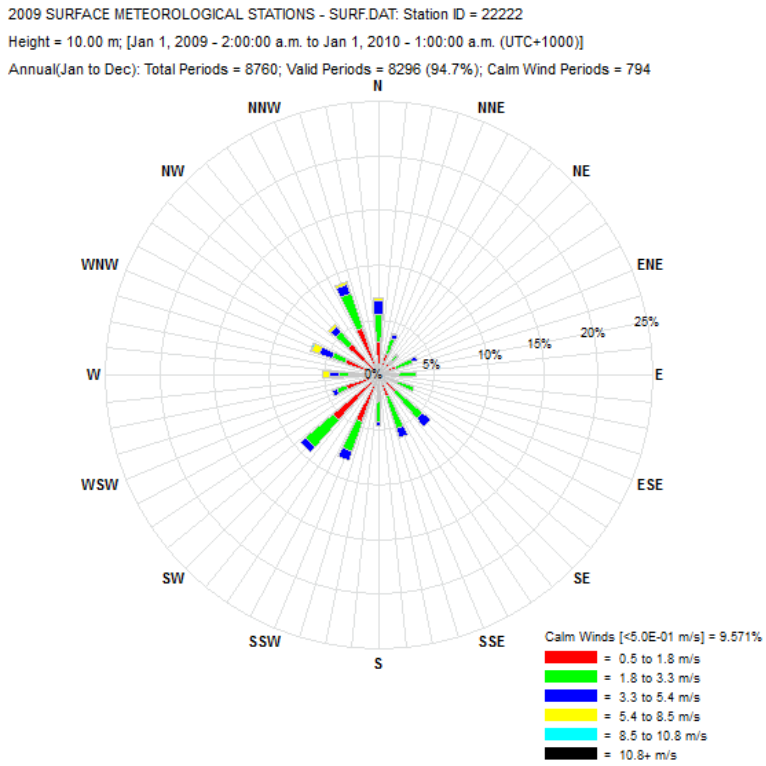
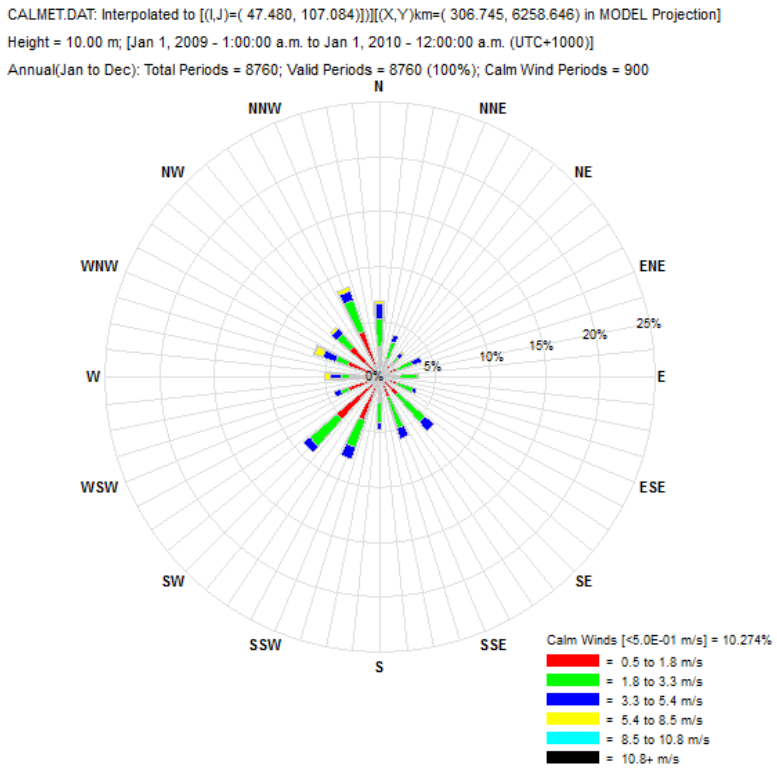


Lindfield Modelled 2011

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)

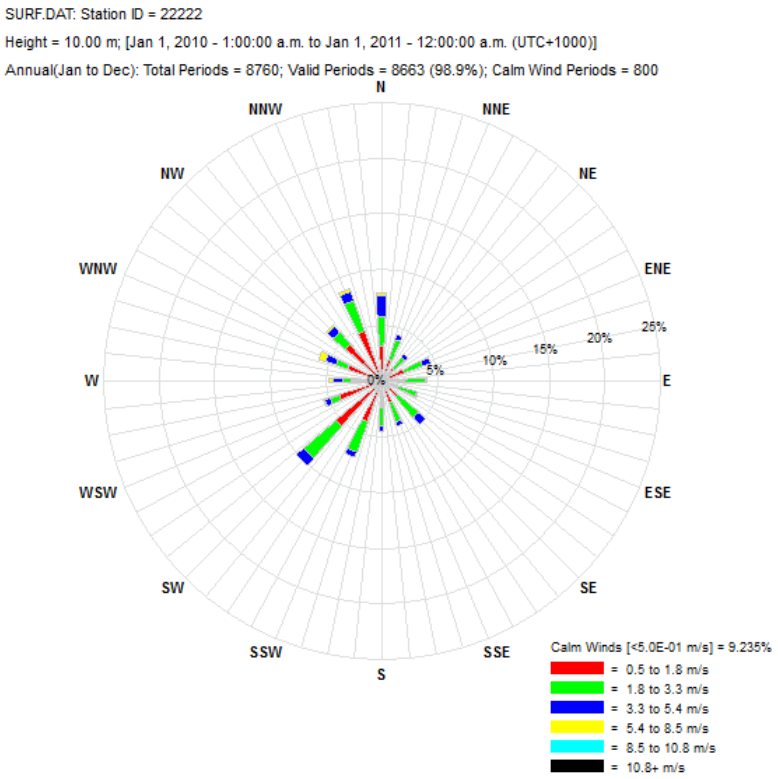


Prospect Observed 2009



Prospect Modelled 2009

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)



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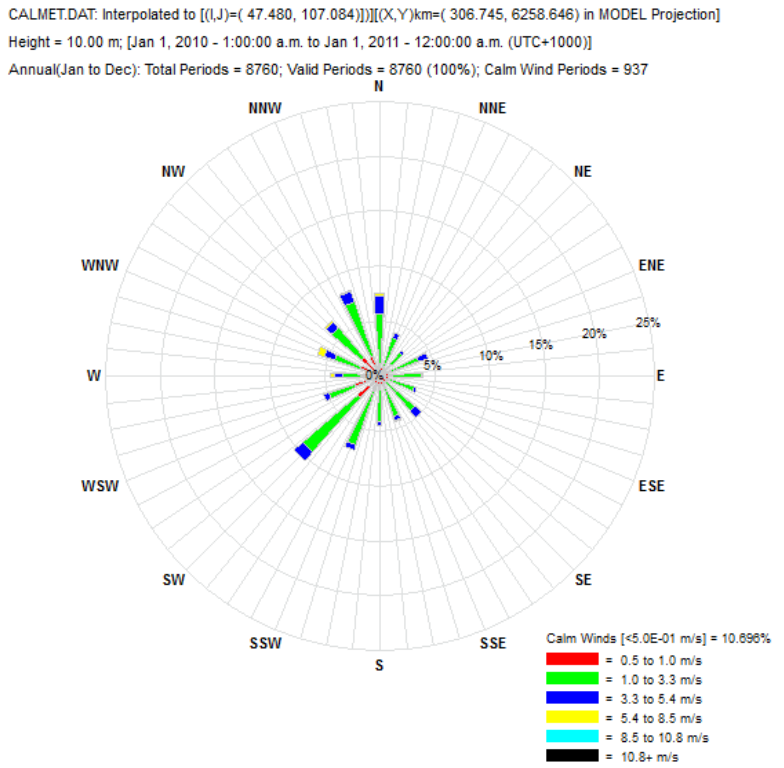
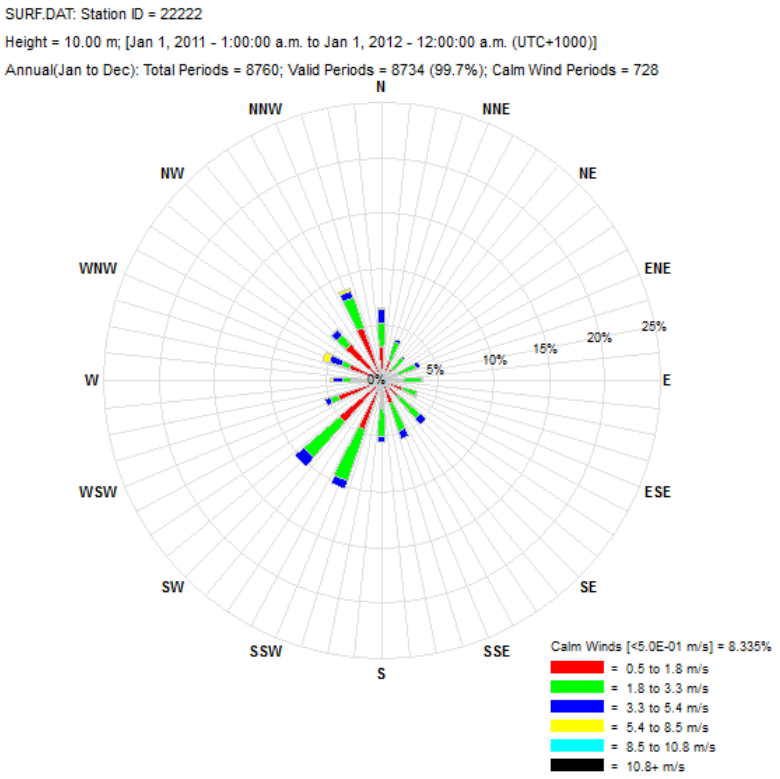


Prospect Modelled 2010

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)



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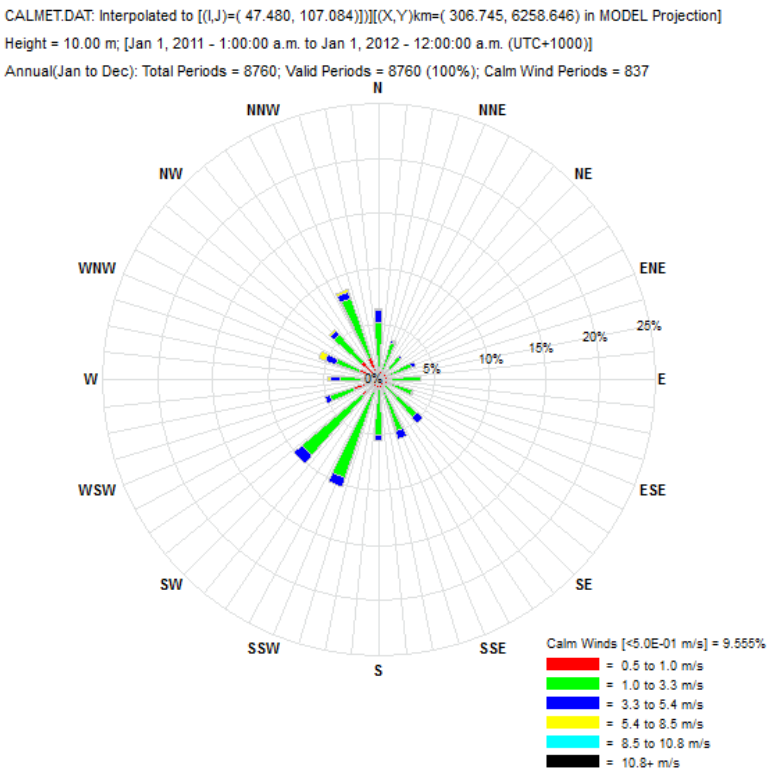
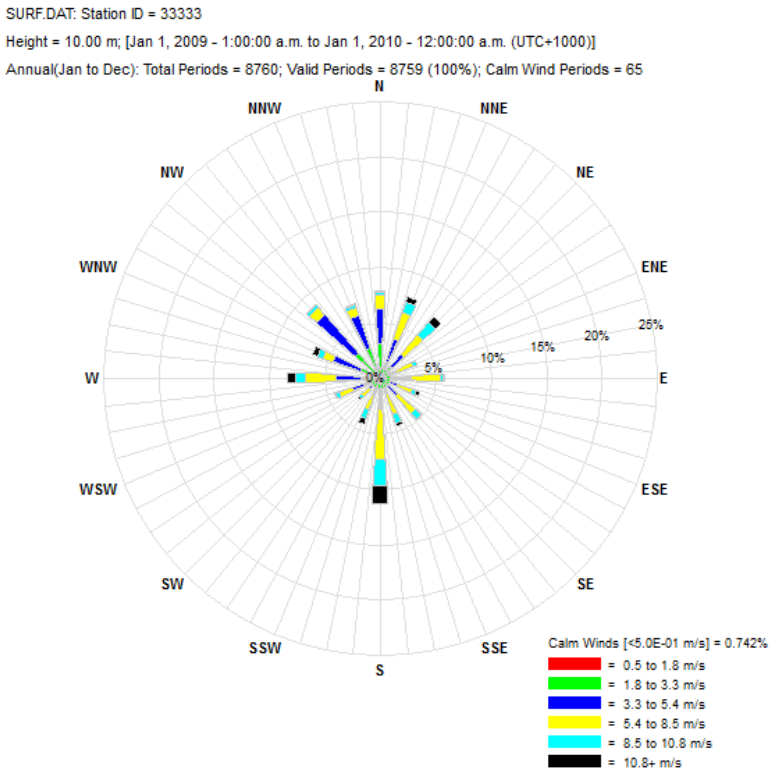
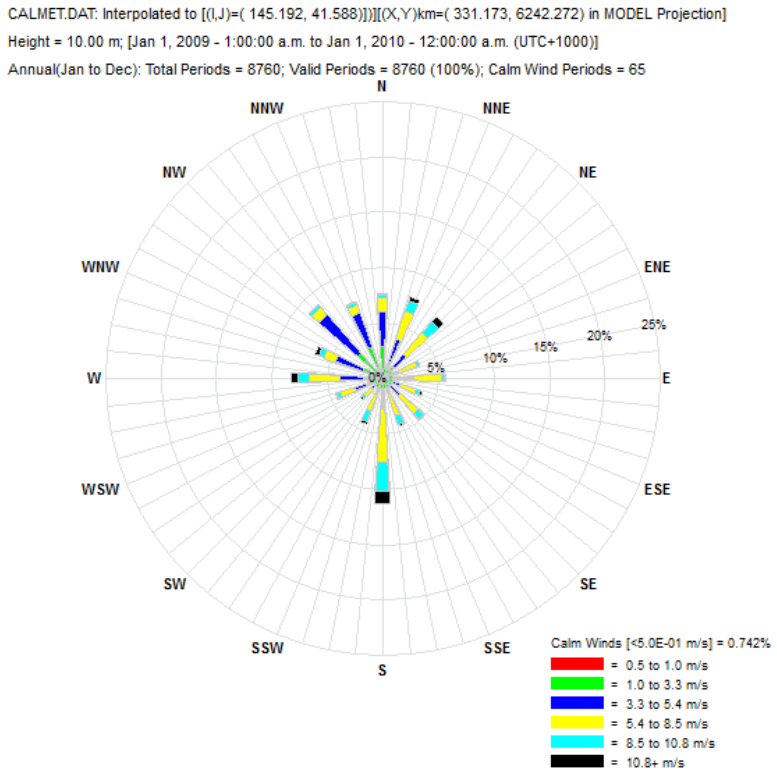


Prospect Modelled 2011

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)

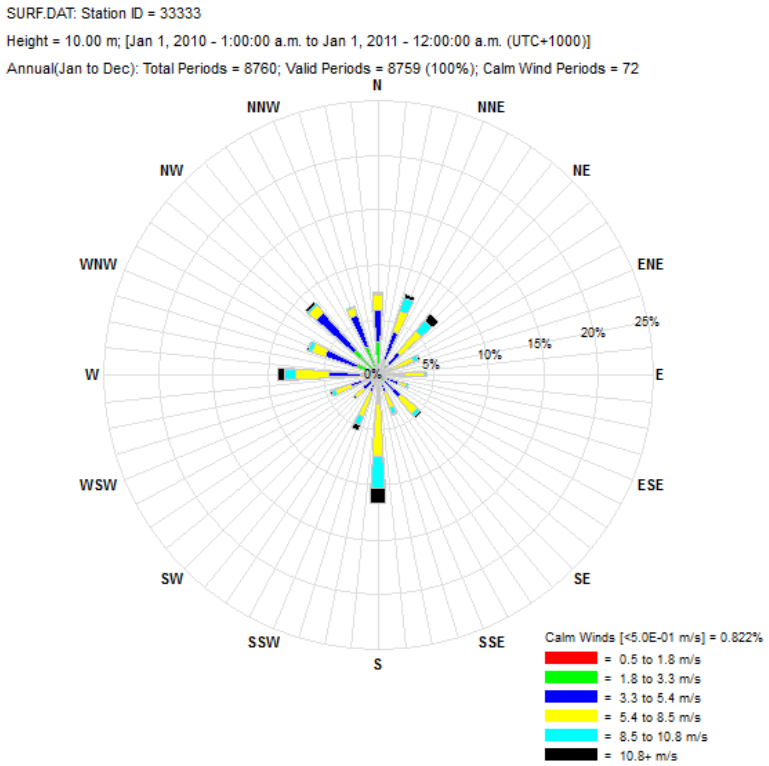


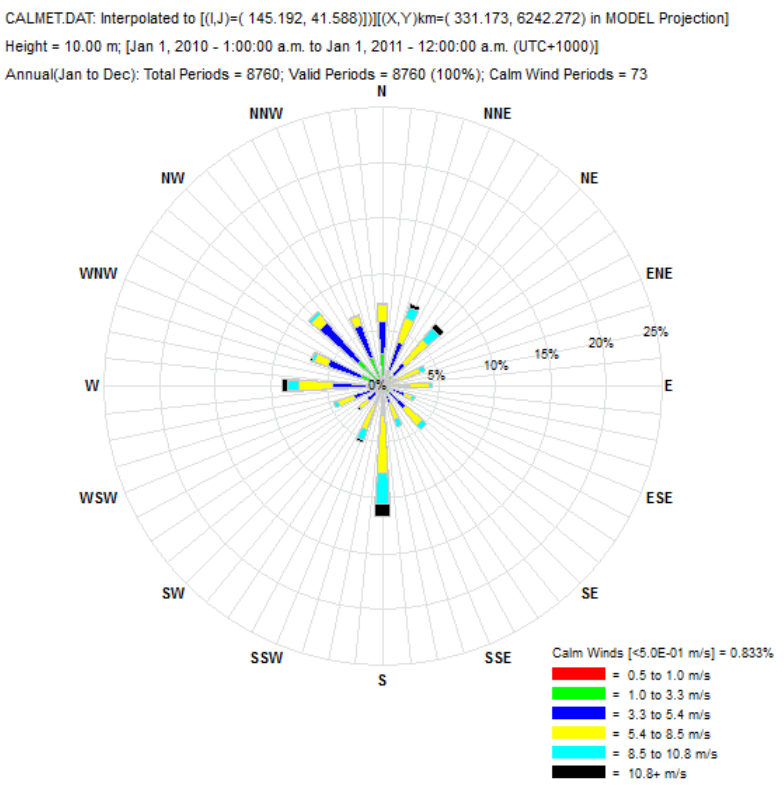
Sydney Observed 2009



Sydney Modelled 2009

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)

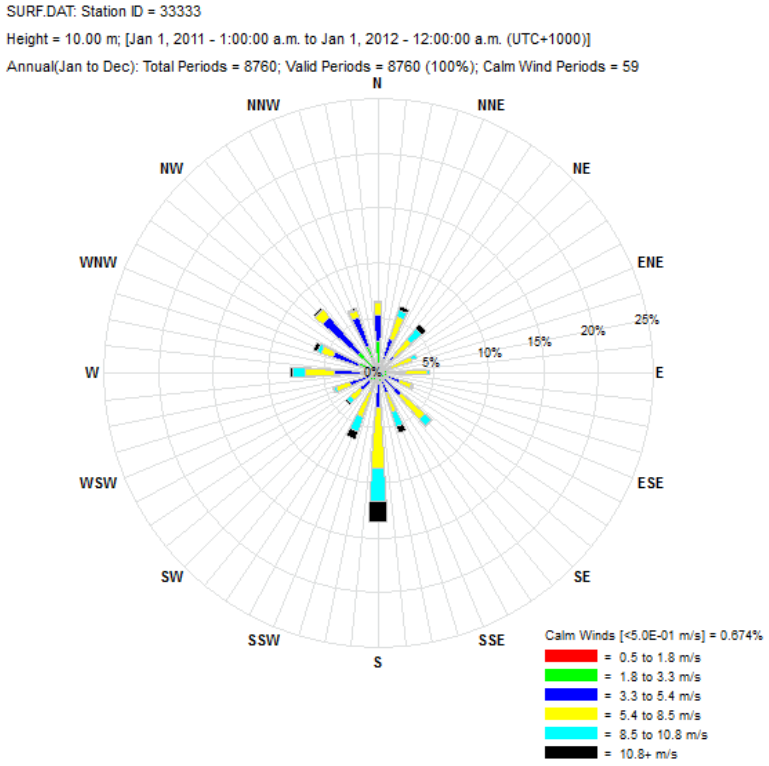




Sydney Observed 2010

Sydney Modelled 2010

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)



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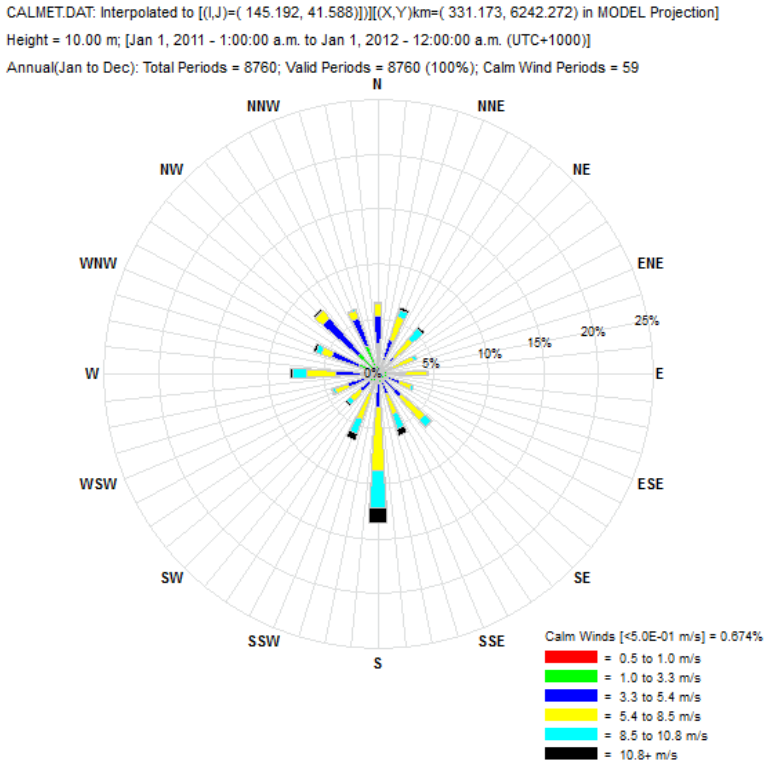
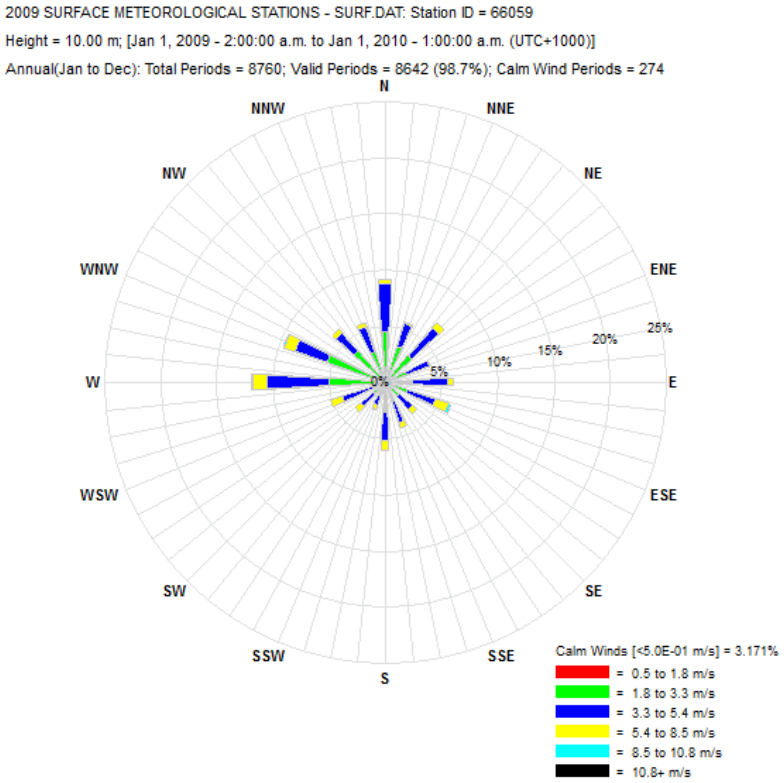
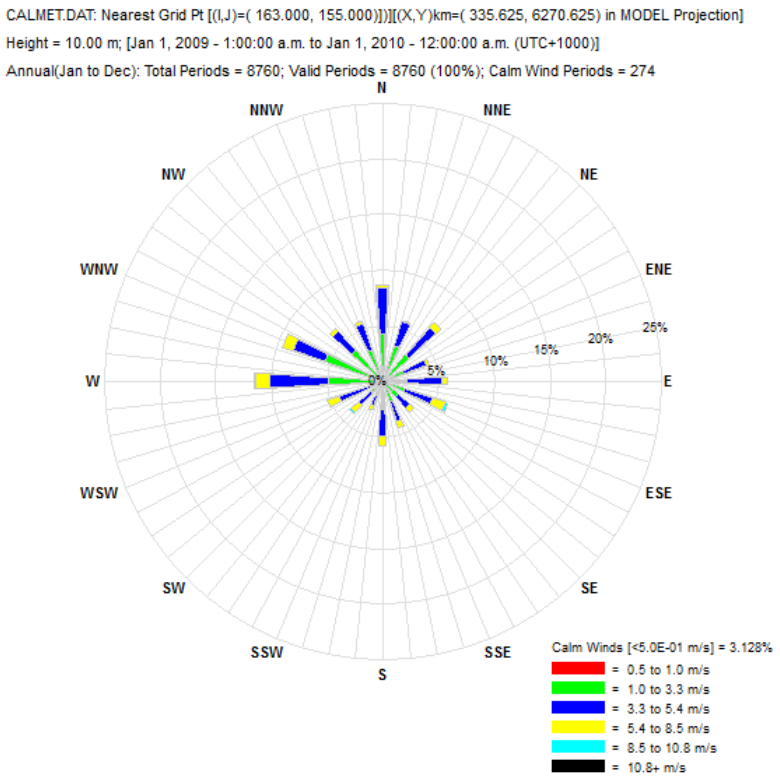


Sydney Modelled 2011

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)

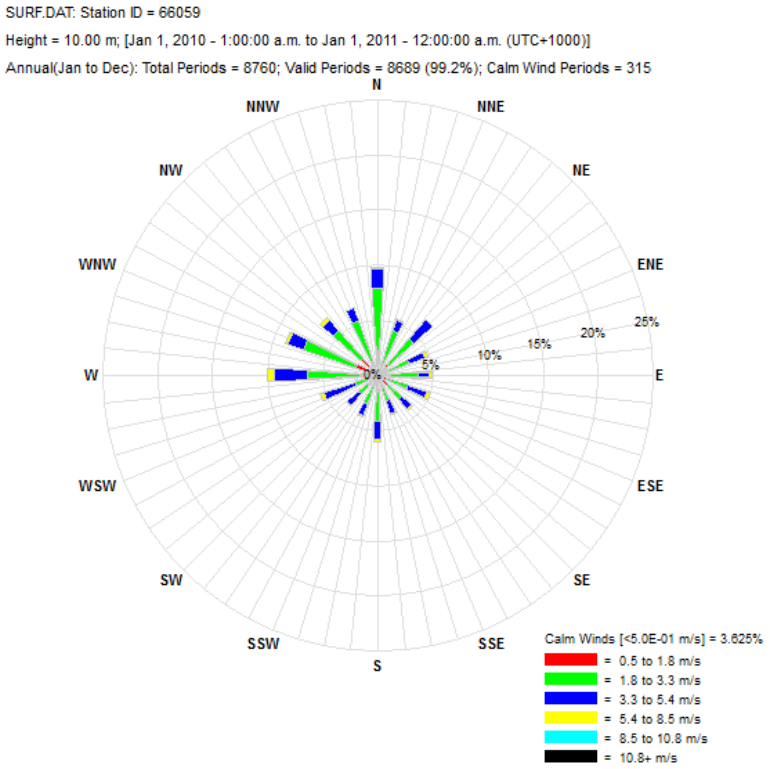


Terrey Hills Observed 2009



Terrey Hills Modelled 2009

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)



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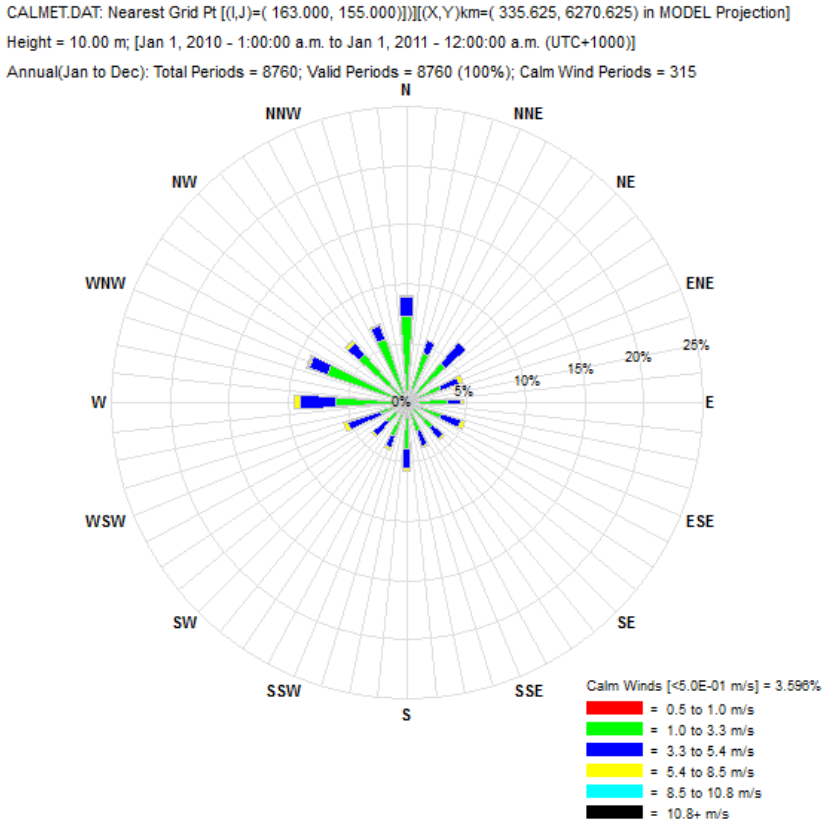
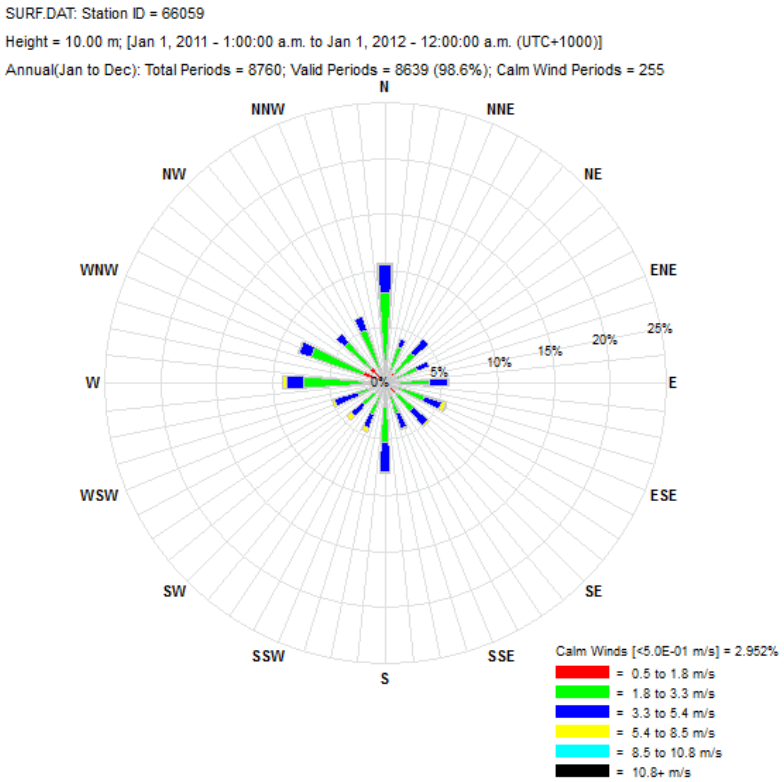
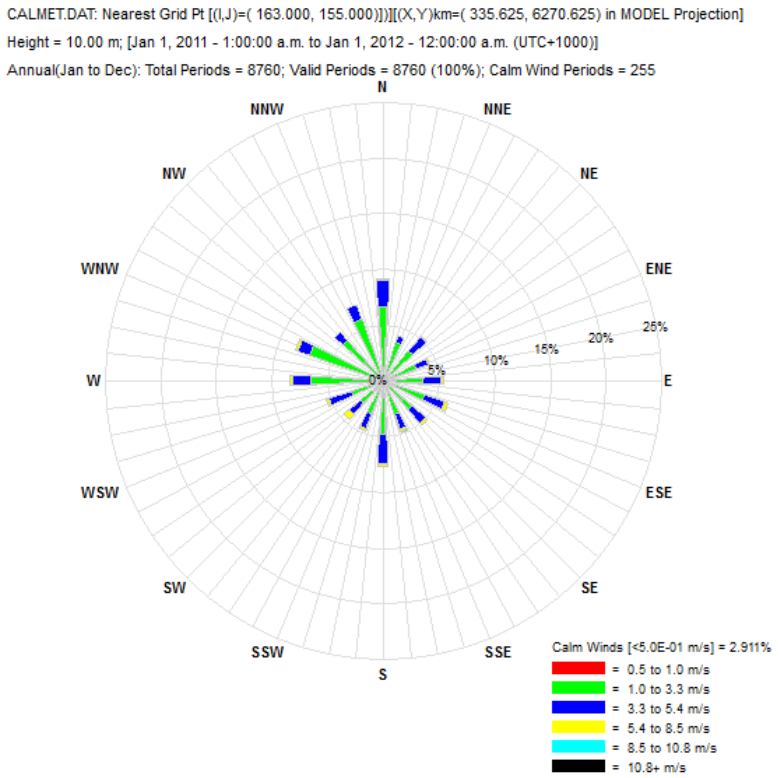


Terrey Hills Modelled 2010

Wind Roses for Regional Monitoring Stations and CALMET Outputs (refer to Section 7.1.3 of this report)



Terrey Hills Observed 2011



Terrey Hills Modelled 2011

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carbon
neutral


australian
made


recycled