New England Highway bypass of Muswellbrook

Chapter 6.9 Air quality

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6.9 Air quality

This chapter presents the methodology and results of the construction and operational air quality impact assessment for the proposal. Further detail regarding the methodology and the results for the assessment is provided in Appendix N.

6.9.1 Methodology

Construction impacts

Potential impacts from dust generation during construction have been assessed using the UK Institute of Air Quality Management (IAQM), 2014 *Guidance on the assessment of dust from demolition and construction*. The IAQM methodology assesses the risk of impacts associated with demolition and construction without the application of any mitigation measures. The assessment provides a classification of the risk of dust impacts which then allows the identification of appropriate mitigation measures commensurate with the level of risk.

The IAQM guidance process is a four-step risk-based assessment of dust emissions associated with demolition, land clearing and earth moving, and construction activities. The IAQM assessment process is described in detail in Appendix N and a summary of the process is described in the following sections.

Step 1 – Screening assessment

A screening assessment is undertaken to identify both 'human' and 'ecological receptors' within close proximity to the construction footprint and the routes used by construction vehicles on public roads.

Step 2 – Dust risk assessment

Step 2 in the IAQM methodology is a risk assessment tool designed to appraise the potential for dust impacts due to unmitigated dust emissions during construction. The key components of the risk assessment are defining the dust emission magnitudes (Step 2A) and the surrounding area sensitivity (Step 2B) which are combined in a risk matrix (Step 2C), to determine an overall unmitigated risk of dust impacts.

Step 2A – Dust emission magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken and are classified as either Small, Medium or Large.

Step 2B – Sensitivity of surrounding area

The "sensitivity" component of the risk assessment is determined by defining the surrounding area's sensitivity to dust soiling, human health effects and ecological impacts. Here the sensitivity of the surrounding area is rated high, medium, or low.

Step 2C – Unmitigated risks of impacts

The dust emission magnitudes determined in Step 2A are combined with the sensitivities in Step 2B to ascertain the risk of impacts with no mitigation applied. Table 6-45, reproduced from the IAQM guidance, provides the risk of dust impacts from demolition, earthworks, construction and track-out for each scale of activity listed.

Table 6-45: Risk of dust impacts

Activity	Surrounding Area Sensitivity	Dust Emission Magnitude		
		Large	Medium	Small
Demolition	High	High	Medium	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Negligible
Earthworks	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Construction	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Track out	High	High	Medium	Low
	Medium	Medium	Low	Negligible
	Low	Low	Low	Negligible

Step 3 – Management strategies

The outcome of Step 2C is used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level. A high or medium-level risk rating means that suitable management measures must be implemented during construction.

Step 4 – Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from the proposal.

Operational impacts

To assess operational air quality impacts, a Level 1 Screening Assessment was undertaken in accordance with the NSW Approved Methods (EPA 2017) using the Tool for Roadside Air Quality (TRAQ) (Version 1.3) developed by Transport. TRAQ is considered a conservative approach to estimate pollutant concentrations near roadways.

Traffic forecast data from the traffic modelling was used to estimate vehicle emissions to enable the quantification of potential air quality impacts attributed to operation of the proposal. Average Annual Daily Traffic (AADT) volumes forecast for the design opening year (2027) and the years 2034 and 2044 were used as the basis for the estimate of vehicle emissions for daily average traffic (taking into account the traffic volume, traffic mix, speed, number of lanes and road grade). Both a 'Build' and 'No Build' option were assessed for the modelled years also to assess the potential air quality impact along the New England Highway both with and without the proposed bypass.

Details of the construction and operational impacts from the proposal are provided in Section 6.9.3.

6.9.2 Existing environment

Climate and weather

The climate and weather at Muswellbrook are affected by several factors such as terrain and land use. Wind speed and direction are largely affected by topography on a small scale, while factors such as regional scale winds affect wind speed and direction on a larger scale. Wind speed and direction are important variables in assessing potential air quality impacts, as they dictate the direction and distance air pollutants travel.

DPIE operates two ambient air quality monitoring stations in proximity to the proposed road corridor that collect wind speed and wind directional data. DPIE monitoring stations include the:

- Muswellbrook northwest station located about 2.5 kilometres southwest of where the northern end of the proposed bypass re-joins the New England Highway
- Muswellbrook station located about 2.7 kilometres south southwest of where the northern end of the proposed bypass re-joins the New England Highway.

A review of 2018 hourly wind speed and wind direction data for the Muswellbrook northwest and Muswellbrook DPIE monitoring stations found annual average wind patterns are relatively similar between the two locations, with predominant wind directions from the southeast (which follows the axis of the of the Hunter Valley). Annual average wind speeds are relatively low for both stations ranging from 2.1 metres per second at Muswellbrook northwest and 2.0 metres per second at Muswellbrook. A 2018 annual wind rose for Muswellbrook monitoring station is shown in Figure 6-29.

Given the relatively low wind speeds observed at the monitoring stations, there would be the potential for periods during the year when low wind speeds and calm conditions may result in higher pollution levels (as these conditions commonly correspond to poor dispersion conditions). The screening assessment in Section 6.9.3 adopts a conservative approach through the use of unfavourable weather conditions typically not conducive to rapid dispersion of air pollutants. Weather conditions are based on a wind speed of one metre per second, temperature of 15 degrees Celsius and pascal stability class F (typical of stable night-time conditions).

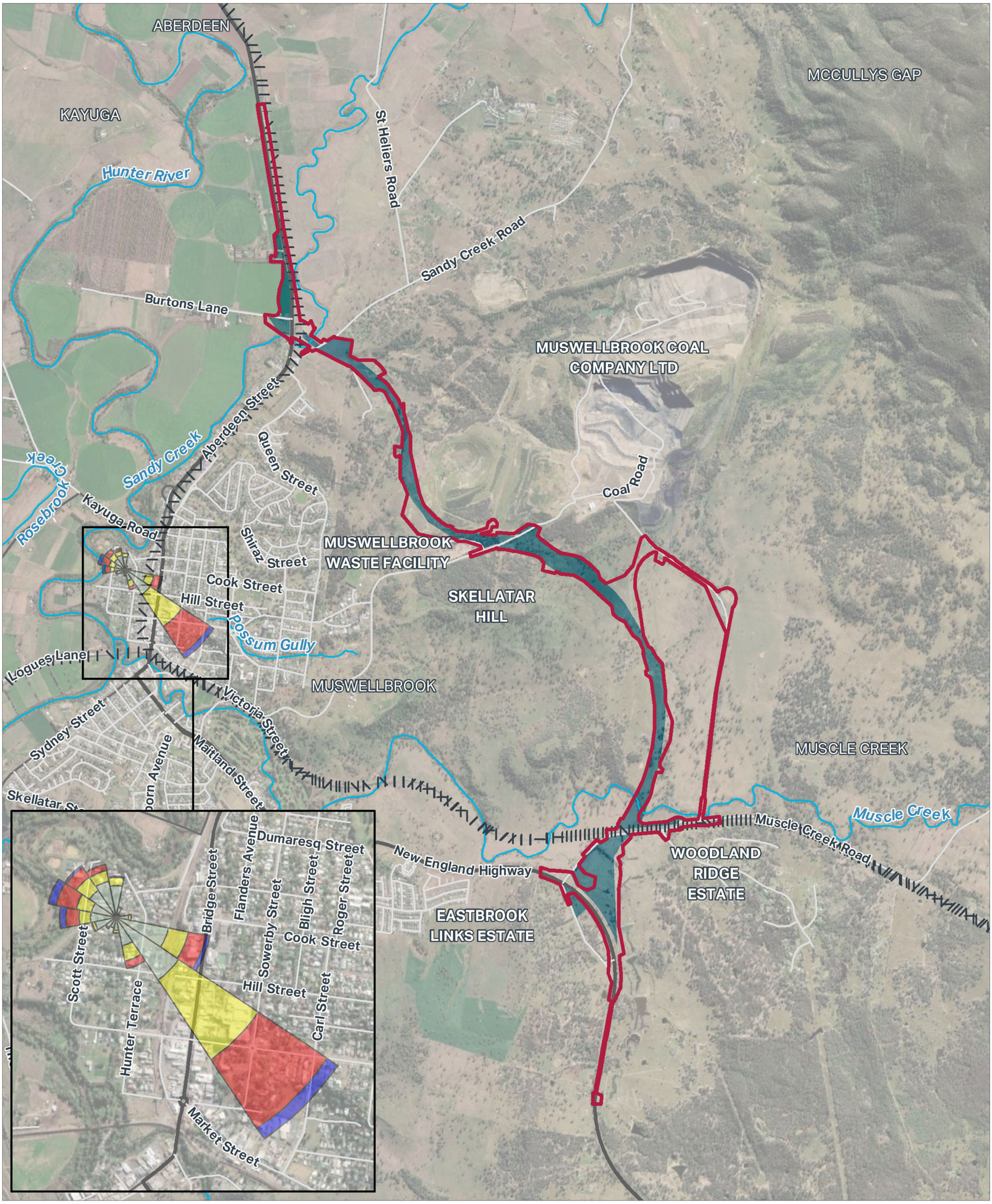

FIGURE 6-29: ANNUAL 2018 WIND ROSE FOR DPIE MUSWELLBROOK MONITORING STATION (DPIE 2020)

AECOM

Legend
- Construction footprint
- Proposed road corridor
- State Road
- Regional Road
- Local Road
- Railway
- Watercourse

Wind Speed (m/s)
- >=11.10
- 8.80 - 11.10
- 5.70 - 8.80
- 3.60 - 5.70
- 2.10 - 3.60
- 0.50 - 2.10

N

0 0.5 1 km

Ambient air quality

Ambient air refers to atmospheric air in its natural state. For ambient air quality within and around the proposed road corridor, pollutants of concern include carbon monoxide (CO), oxides of nitrogen (NOx) and particulate matter equal to or less than 10 microns in diameter (PM_{10}) and less than 2.5 microns in diameter ($PM_{2.5}$)

The Muswellbrook air shed can be considered one of the most sensitive areas to air pollution; especially particulates within the Hunter Region due to the high level of sources of air emissions within the air shed including mining operations, coal-fired power generation, diesel vehicle emissions, road and rail transport emissions and use of solid fuel heaters. Both ambient air quality monitoring stations operated by DPIE monitor for PM_{10}. Nitrogen dioxide (NO_2) and $PM_{2.5}$ are only monitored at the Muswellbrook monitoring station.

Monitoring data for 2018 at each monitoring station is shown in Table 6-46 against the appropriate ambient air quality criteria as stated under the NSW *Approved Methods for Modelling and Assessment of Air Pollutants* (EPA 2017) (the Approved Methods) for the appropriate averaging periods. The year 2018 has been chosen as the most recent complete data set that is representative of typical background air quality concentrations. The years 2019 and 2020 data are not considered representative of existing background concentrations. This is due to extreme particulate concentrations recorded over the 2019-2020 'Black Summer' period characterised by an unprecedented and catastrophic bushfire season, followed by potentially lower than average levels of NO_2; PM_{10} and $PM_{2.5}$ concentrations due to reduced activity (including vehicle movements) and as a consequence of Covid-19.

Ambient air quality criterion set by NSW EPA under the Approved Methods for NOx and particulates mirror the ambient air quality standards set by National Environmental Protection Council (NEPC) under the *National Environmental Protection (Ambient Air Quality) Measure* (Ambient Air Quality NEPM). The NEPC is currently proposing changes to the 1-hour maximum and annual average NO_2 standards which have also been provided in Table 6-46. Taking a conservative approach, predicted ground level NO_2 concentrations in Section 6.9.3. have been assessed against the more stringent ambient air quality standards proposed by the NEPC.

TRAQ utilises 90th percentile background data to calculate potential cumulative impacts from vehicle emissions (as discussed in Section 6.9.3). Table 6-46 shows the 90th percentile concentration for NO_2, PM_{10} and $PM_{2.5}$ as in the absence of local CO data at Muswellbrook, default CO background concentrations from the TRAQ database have been used in this assessment.

Table 6-46 shows that both the 1-hour maximum and annual average NO_2 concentrations recorded at the Muswellbrook station for 2018 were under the relevant EPA criteria and the proposed NEPM standard.

The PM_{10} 24 hour maximum concentrations were well above the EPA criterion at all stations in the Muswellbrook area. These concentrations are attributed to dust storms occurring in November 2018, however the 90th percentile concentrations used in TRAQ are below the maximum 24 hour EPA criterion at both stations. Annual average PM_{10} concentrations for the area were above the criterion at both monitoring stations and are likely attributed to both local mining activities and vehicle emissions based on the proximity to the existing New England Highway. Similarly, the maximum 24-hour $PM_{2.5}$ concentration was above the EPA criteria; however, the 90th percentile concentration at Muswellbrook was below the criterion. The record annual average $PM_{2.5}$ concentration was also elevated, slightly exceeding the ambient air quality criterion.

Table 6-46: Ambient air quality data at EPA monitoring stations at Muswellbrook, NSW (EPA 2020)

Pollutant	Averaging Period	Concentration (µg/m^3)		EPA Criteria (µg/m^3)	Proposed NEPM Standard (µg/m^3)
		Muswellbrook Northwest	Muswellbrook		
NO_2	1-hour (maximum)	No data	96.4	246	185
	1-hour (90th percentile)	No data	43.1	Not applicable	Not applicable
	Annual Average	No data	21.5	62	40
PM_{10}	24-hour (maximum)	195.4	185.9	50	Not applicable
	24-hour (90th percentile)	39.0	42.5	Not applicable	Not applicable
	Annual Average	25.3	27.3	25	Not applicable
$PM_{2.5}$	24-hour (maximum)	No data	26.5	25	20
	24-hour (90th percentile)	No data	16.9	Not applicable	Not applicable
	Annual Average	No data	9.5	8	7

µg/m^3 = Micrograms per metre cubic metre

Sensitive receptors and land use

Land use surrounding the study area is comprised of low density rural residential and agriculture, mining activities and associated infrastructure and remnant vegetation. Residential sensitive receptors adjacent to the proposed road corridor are generally more than 50 metres from the kerb.

Several properties have been identified that lie within 50 metres including:

- Properties off Muscle Creek Road and along Koolbury Flats Row (within 40 metres)
- Residential receptors at Sandy Creek on the New England Highway near the on and off ramps at the northern end of the proposed alignment (within 50 metres).

The nearest sensitive receptor[2] is located about 36 metres from the kerb of the proposal.

Higher density residential and commercial properties follow the New England Highway through the township of Muswellbrook; west of the proposal. The residential area contains a mix of sensitive land uses including houses, schools and sporting fields. Sensitive receptors along the New England Highway generally lie within 10 metres of the existing kerb.

The TRAQ model calculates pollutant concentrations directly downwind of vehicle emissions from the proposed road corridor at pre-specified distances. Typically, the nearest sensitive or commercial receptor is located at least 10 metres or more from the kerb of the road; noting that both higher density and close proximity receptors are generally limited to the existing New England Highway. For most of the proposed road alignment sensitive receptors are generally over 50 metres from the kerb. For this assessment the

[2] Properties acquired as part of the project have been excluded from the list of identified sensitive receptors

modelled concentrations directly downwind of the proposal have been modelled at discrete receptor locations at 10 metres, 20 metres, 30 metres and 50 metres from the kerb.

6.9.3 Potential impacts

Construction

Step 1 – Screening assessment

An initial screening assessment in accordance with the IAQM method identified several sensitive 'human' receptors located within 350 metres of the study area; and within 50 metres of construction haulage routes Sensitive 'ecological' receptors are located within a disturbed landscape with only fragmented and modified vegetation remnants as discussed in the Biodiversity Impact Assessment provided in Section 6.1. As detailed in Section 6.1, there are EEC listed under the BC Act and EPBC Act within 50 metres of the construction footprint and 50 metres of construction haulage routes. The Muswellbrook region is also home to a population of Striped Legless Lizard which is listed as vulnerable under the BC Act and EPBC Act.

Based on the proximity of both residential and ecological receptors to the construction footprint, a Stage 2 assessment was triggered.

Step 2 – Risk assessment of unmitigated impacts

A Stage 2 assessment considers the construction footprint as shown in Figure 6-29. Construction of the proposal is anticipated to take about 36 months. Potential dust impacts during the construction period have been determined based on the IAQM construction dust assessment guidance documentation and the expected scale of the construction activities outlined in Section 3.3.

Step 2A – Dust emission magnitude

Potential dust emission magnitudes for the proposal were estimated based on the indicative construction work methodology described in Section 3.3. Potential dust generating activities and associated magnitudes are included in Table 6-47. The magnitude of the unmitigated emissions from the construction footprint activities are rated as large for demolition, earthworks, construction and trackout activities due to the expected extent of construction activities.

Table 6-47: Dust emissions magnitude

Activity	Potential dust generating activities	Magnitude
Demolition	• Two existing buildings owned by Transport within the construction footprint would require removal. Progressive demolition of building structures would occur using modified excavators. Details of building removal and demolition works are outlined in Section 3.3.1	Large
Earthworks	• Large scale earthworks would be required as part of the proposal with most earthworks associated with filling for the new road and embankments and excavation where the proposed road alignment is lower than the existing ground level. The estimated quantities of materials associated with earthworks are provided in Section 3.3.5 • Other earthworks would be associated with utility adjustment or relocation, including electricity, water and sewerage, gas and telecommunications, boring for bridge structural supports and landscaping works • Stockpiling would occur at several locations as described in Section 3.4 including: o Northern Connection main site construction compound	Large

Activity	Potential dust generating activities	Magnitude
	◦ Southern Connection main site construction compound ◦ Skellatar Ridge cutting satellite compound ◦ Coal Road satellite compound ◦ Sandy Creek and Main North railway line laydown area • A number of heavy earth moving vehicles would be required during earthworks. An indicative list of plant and equipment is provided in Section 3.3.4	
Construction	• The construction footprint area is shown in Figure 6-29 • Construction activities are described in detail in Section 3.3 and would include construction of about nine kilometres of new highway; bridges, connections to existing road infrastructure, utility adjustments or relocation, drainage infrastructure and urban design and landscaping works • Construction of ancillary facilities would include construction compounds and laydown/stockpiling areas as described in Section 3.4 • Crushing and concrete batching activities would occur at the Southern Connection main site and Sandy Creek construction compounds • A number of dust generating materials would be required for construction including aggregates, sand, concrete and fly ash. Estimated quantities of construction materials are provided in Section 3.3.6 • A range of plant and equipment would be used during construction. An indicative list of plant and equipment is provided in Section 3.3.4	Large
Trackout	• Construction would generate a large number of light and heavy vehicles movements. Estimated heavy vehicle movements are provided in Section 3.3.7 • Construction vehicle activities would include the movement of construction workers, delivery of construction materials, spoil movement and waste removal and delivery of construction equipment and machinery • Temporary unsealed access roads would be built to facilitate the movements of construction vehicles and construction materials to key construction work areas for bridges and bypass connection points within the construction footprint. Construction vehicle and light vehicle access routes are shown in Figure 3-6	Large

Step 2B – Sensitivity of surrounding area

The sensitivities of receptors to unmitigated dust emissions for the various construction activities are provided in Table 6-48. Due to the rural nature of the area there are few residential properties located within 50 metres of the proposed road corridor with the exception of:

- Where additional property access roads are required off Muscle Creek Road and along Koolbury Flats Row
- Existing receptors on the New England Highway near the on and off ramps at the northern end of the proposal alignment.

Given the residential nature of these landuses, where members of the public are likely to be exposed to dust impacts for more than eight hours a day, a receptor sensitivity rating of 'High' applies. When taking into account the low housing density within 50 metres of the construction footprint, the surrounding area sensitivity to dust spoiling effects on people and property was rated 'Medium'. Based on the elevated annual average concentrations of PM_{10} within the Muswellbrook Airshed, the sensitivity to human health effects was rated 'High'.

With regard to ecological receptors the study is located within a disturbed landscape with only fragmented and modified vegetation remnants. The Biodiversity Impact Assessment as summarised in Section 6.1 found that despite the presence of biodiversity values listed under the BC Act and the EPBC Act, the proposal is considered unlikely to have significant impacts on any vulnerable or threatened species or EEC as most of the vegetation is already disturbed, modified and/or fragmented in nature by existing and past land uses. As such the ecological sensitivity of the area was considered 'Low'.

Step 2C – Unmitigated risks of impacts

The potential risks for the overall construction footprint were found to be "medium" to "high" for construction activities as shown in Table 6-48 in relation to potential unmitigated impacts relating to dust soiling and human health within 50 metres of the proposal. The majority of residential receptors are situated over 50 metres from the proposal and would have a medium to low risk given their offset distance from the proposal. The potential unmitigated ecological risks from the proposal were found to range from "low" to "medium".

Table 6-48: Summary of dust emission risk assessment for construction footprint

Activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of dust impacts		
		Dust soiling	Human health	Ecological	Dust soiling	Human health	Ecological
Demolition	Large	Medium	High	Low	High	High	Medium
Earthworks	Large	Medium	High	Low	Medium	High	Low
Construction	Large	Medium	High	Low	Medium	High	Low
Trackout	Large	Medium	High	Low	Medium	High	Low

Step 3 – Mitigation strategies

The outcome of Step 2C was used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level. A high or medium-level risk rating suggests that suitable management measures must be implemented during construction. A range of mitigation strategies aimed at reducing the likelihood of air quality impacts to off-site sensitive receptors are included in Section 6.9.4.

Step 4 – Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from the proposal. The guidance states:

"For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect would normally be 'not significant'."

It is anticipated that, with the implementation of the recommended mitigation strategies provided in Section 6.9.4 which are consistent with the standard dust mitigation measures used on large road construction projects, the residual effect (impacts) of the proposal would be 'not significant' at all locations for dust soiling, human health and ecological impacts.

Operation

Traffic Forecast Data

Traffic movements along the proposed road corridor have the potential to result in motor vehicle emissions from fuel combustion, fluid evaporation, brake and tyre wear, and re-suspended road dust.

Emissions from motor vehicles would comprise mainly hydrocarbons, CO, NO_x and PM_{10}. Traffic activity including the number of vehicles, the vehicle type mix and vehicle speeds can directly influence the near roadside air pollutant concentrations. Vehicle emissions would vary based on the vehicle type mix or ratio of light to heavy vehicles, fuel type mix (for example, petrol and diesel), and the distribution of vehicles by age of manufacture. Traffic forecast data as detailed in Section 6.5 have been used to estimate vehicle emissions and to quantify air quality impacts attributed to operation of the proposal.

The AADT volumes discussed earlier in section 6.9.1 were then used to estimate vehicle emissions for daily average traffic considering the traffic volume, vehicle mix, speed, number of lanes and road grade. Peak hourly traffic speed has been based on an average of measured weekday morning (7am to 9am) and afternoon (4pm to 6pm) peak traffic volumes for the New England Highway. The proposed road grades would be highly variable throughout the proposed road alignment with a maximum grade of eight per cent. For each section of road modelled, an average positive and negative road grade has been estimated for both the north and southbound lanes based on local terrain information. The traffic data used for this assessment is provided in Appendix K.

Dispersion Calculations

For the purpose of this assessment, a Level 1 Screening Assessment has been carried out in accordance with the Approved Methods using the TRAQ (Version 1.3) developed by Transport. Air emissions from key sections along the proposal that would experience changes in traffic have been generated using the total traffic volume with percentages of vehicles in each age bracket and type category. Road grade and speed information was also included in the calculations.

Vehicle emission factors from the World Road Association, referred to as PIARC (formerly the Permanent International Association of Road Congress) are used by TRAQ to estimate emissions from relevant roads in the vicinity of Muswellbrook bypass. In 2004, PIARC (2004) published a document with comprehensive vehicle emissions factors for different road gradients, vehicle speeds and for vehicles conforming to different European emission standards. The emission data in TRAQ have been modified to take into account the age, vehicle mix and emission control technology of the Australian vehicle fleet using DPIE data.

To assess air quality impacts, 90th percentile background data for CO (one hour and eight hour), NO_2 (one hour) and PM_{10} (24 hour) in the Lower Hunter as well as annual averages were obtained from the TRAQ database. In the absence of local data at Muswellbrook for CO (one and eight hour), 90th percentile, background concentrations for the Lower Hunter have been adopted for CO. Local air quality data for NO_2 and PM_{10} was added to the TRAQ background air quality database and incorporated into the dispersion model.

Carbon Monoxide

Predicted 2027 and 2037 incremental and cumulative maximum one hour and eight hour CO concentrations are presented in Appendix N and show that predicted CO concentrations comply with EPA criteria both incrementally and cumulatively for the design opening year (2027) and ten years after opening (2037). The proposal would also result in a reduction in maximum 1-hour and 8-hour CO_2 ground level concentrations along the New England Highway through Muswellbrook due to both reduced total traffic volumes and the proportion of heavy vehicles.

Nitrogen Dioxide

Predicted 2027 and 2037 incremental and cumulative maximum one hour and annual average NO_2 concentrations are presented in Appendix N and show that predicted NO_2 concentrations comply with both the EPA criteria and the proposed more stringent NEPM standards both incrementally and cumulatively for 2027 and 2037. The Proposal also would result in a reduction in maximum 1-hour and annual average NO_2 ground level concentrations along the New England Highway through Muswellbrook due to both reduced total traffic volumes and the proportion of heavy vehicles.

Particulate Matter

Predicted 2027 and 2037 incremental and cumulative maximum 24-hour and annual average PM_{10} concentrations presented in Appendix N indicate the potential for maximum 24 hour average exceedances along the main alignment. Predicted cumulative 24-hour exceedances are limited to the area within 20-30 metres of the proposed kerb; while annual average exceedances are attributed to measured background concentration's which exceed the PM criterion in isolation. Predicted exceedances are largely due to existing high background concentrations as follows:

- Background data from the Muswellbrook station has been used for the calculation of all cumulative concentrations. Muswellbrook station has generally higher particulate concentrations than the station at Muswellbrook north west attributed to its proximity to the New England Highway and as such the use of this station provides a worst-case indication of background particulate concentration. A degree of double counting must also be taken into consideration as existing background concentrations would include vehicle emissions from existing operations along the New England Highway.
- Predicted emission concentrations consider both the emissions that come out of a car on a cold morning whilst it is warming up and worst-case meteorological conditions typical of winter nights. These assumptions are also considered worst case and result in a conservative estimation of the pollutant concentrations.
- The nearest sensitive receptors adjacent to the proposed road corridor is about 36 metres from the road kerb; with the majority of sensitive receptors in excess of 50 metres from the kerb. Given that estimated maximum ground level 24-hour PM^{10} concentrations are only predicted to be exceeded within 20 to 30 metres of the kerb, emissions at the nearest sensitive receptors are likely to be compliant with the EPA criterion.

The proposal is designed to improve the network efficiency of the New England Highway; particularly with regards to network efficiency and travel times for long haul freight vehicles. A comparison of predicted ground level concentrations for the Build and No Build scenarios show a reduction in incremental PM_{10} maximum 24-hour concentrations and annual averages with inclusion of the bypass. Without the bypass, maximum 24-hour cumulative concentrations are in exceedance of the EPA criteria within 50 metres from the kerb. With the introduction of the proposal, these exceedances along the New England Highway at both east of Bimbadeen Drive and South of Sandy Creek Road are reduced to 20 metres from the curb for 2027 and 2037. This would notably reduce the number of sensitive receptors subjected to elevated concentrations of particulates.

The TRAQ is limited to the assessment of PM_{10} emissions. These PM_{10} emissions from vehicles however are predominantly made up of the finer $PM_{2.5}$ particle fraction (about 95 per cent). To enable an estimate of potential $PM_{2.5}$ impacts, predicted PM_{10} have been scaled to provide an indicative estimate of $PM_{2.5}$ contributions from the proposal and provided in Appendix N).

Predicted $PM_{2.5}$ concentrations for the proposal yield similar results to those reported for PM_{10}. Here the maximum 24-hour $PM_{2.5}$ concentrations along the alignment would exceed the EPA criteria within 20 metres of the kerb. The nearest sensitive receptor adjacent to the proposed bypass however is about 36 metres of the road kerb; with most sensitive receptors in excess of 50 metres from the kerb. Predicted cumulative annual average $PM_{2.5}$ concentrations were above the EPA criteria; however, this is largely attributed to the elevated background concentrations within the air shed that are already in exceedance of the recommended guidelines.

Despite the exceedances in the ambient air quality criteria for $PM_{2.5}$, the redistribution of traffic and improved network efficiency as a result of the proposal would reduce incremental $PM_{2.5}$ ground level concentrations along the New England Highway. As a result of the proposal predicted exceedances adjacent to the New England Highway would be limited to within about 20 metres of the kerb. This is less than predicted exceedances under the ‘no build scenario’ which are predicted to extend up 40 to 50 metres from the kerb.

6.9.4 Safeguards and management measures

Given the background particulate concentration in the region surrounding the proposal, careful consideration of the design and implementation of the mitigation measures is needed. The measures outlined below are recommended to minimise the potential for generation of dust during construction.

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air Quality	An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will identify: • Potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction • Air quality management objectives consistent with relevant published EPA and/or DPIE guidelines including: o No Dust, No Fuss – Guidelines for controlling dust from construction sites. NSW EPA o Best Practice Erosion and Sediment Control. IECA, November 2008 o The “Blue Book” - Managing Urban Stormwater: Soils and Construction, Landcom (2004) 4th Ed • Mitigation and suppression measures to be implemented, such as spraying or covering exposed surfaces, provision of vehicle clean down areas, covering of loads, road cleaning, use of dust screens, maintenance of plant in accordance with manufacturer's instructions • Methods to manage works during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces • When the air quality, suppression and management measures need to be applied, who is responsible, and how the effectiveness of measures will be assessed • Community notification and complaint handling procedures	Construction contractor	During construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air Quality	As part of the AQMP, a monitoring program will be developed to monitor construction dust from the proposal. The monitoring plan will be implemented prior to construction and during the construction period, to assess effective implementation of air quality safeguards, identify any unexpected or inadvertent impacts, and identify recommended revisions or improvements	Construction Contractor	During Construction	Additional safeguard