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9 October 2015

Kurt Robinson
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C/O Tiberius Holroyd Pty Ltd
Via email: Kurt.Robinson@acequity.com.au

RE: Air Quality Impact Study for Mixed Use Development at 1 Crescent Street, Holroyd

Dear Kurt,
Todoroski Air Sciences has completed an air quality impact study on behalf of Tiberius Holroyd Pty Ltd, for the mixed use development at 1 Crescent St, Holroyd (hereafter referred to as the Project). This study applies air dispersion modelling to predict the potential air quality impacts at the Project arising from traffic emissions at nearby roadways.

Introduction
The Project location is presented in **Figure 1**. It is immediately bounded by Woodville Rd to the east, Crescent St to the south, an M4 on-ramp to the north, Holroyd Sportsground open field to the north and northwest, and commercial or light industrial buildings to the west. The M4 is located (at its closest) approximately 60 metres north of the proposed site and Parramatta Road begins approximately 75 metres to the east.

Due to the proximity of the proposed development to these roads, Council have requested that air quality is considered in the development of the Project and that potential air quality impacts within the Project area are addressed.

The focus of the study is to identify the potential for air quality impacts at the Project location which may arise from surrounding land uses, in this case the emissions produced by motor vehicles travelling on nearby roads (as presented in **Figure 1**).

The assessment has been conducted in accordance with Section 4 of the 2008 guidelines continued in NSW Department of Planning and Environment "Development near Rail Corridors and Busy Roads – Interim Guideline".

Assessment Approach

The study applies air dispersion modelling to assess the potential worst case impacts at the Project using one-year of meteorological data.

Project Background

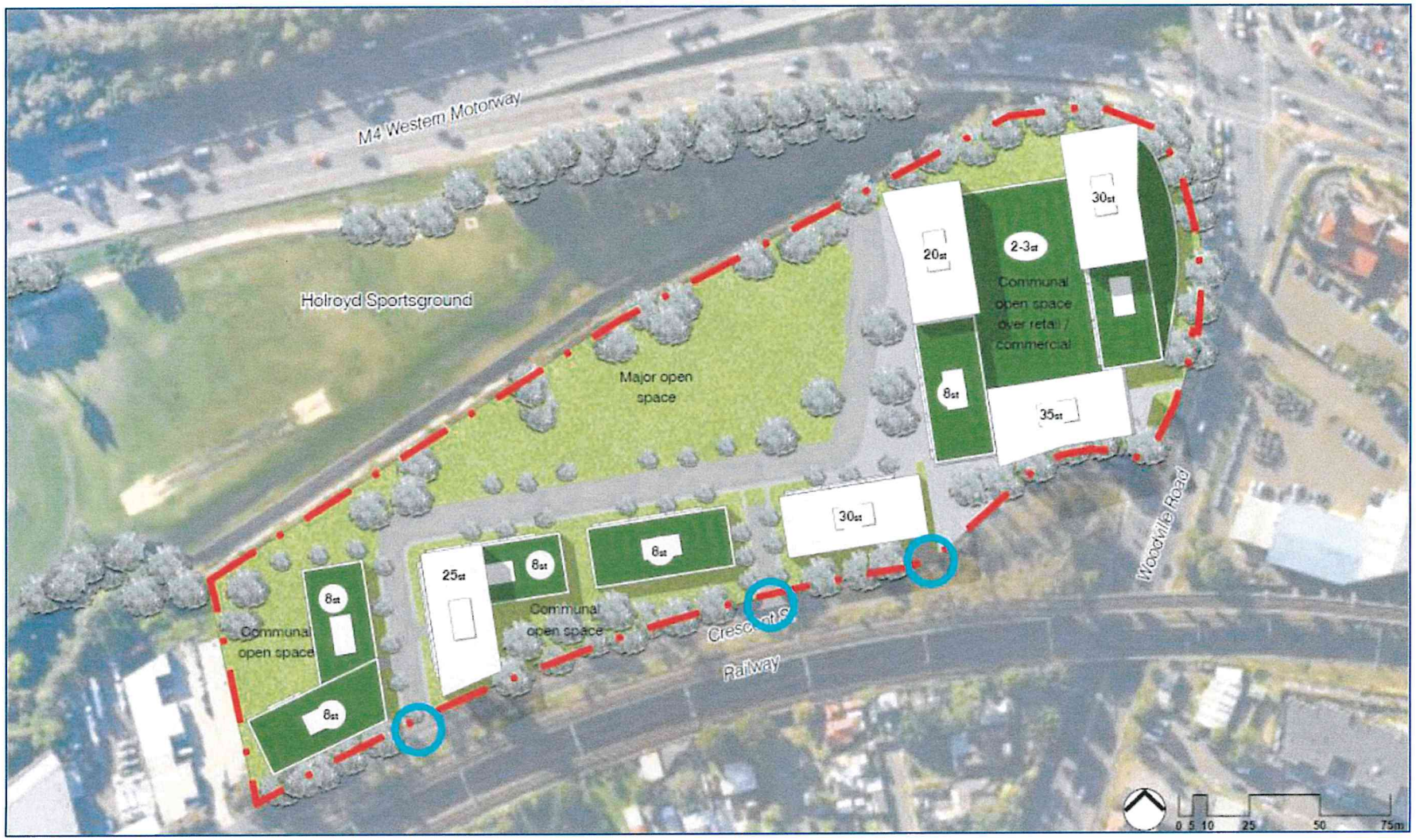
The site is currently operating an industrial facility. The Project would include demolition of the existing industrial facility and construction of a mixed use development which would consist of residential dwellings, and retail and commercial facilities (**GTA Consultants, 2015**).

Figure 2 presents the masterplan layout of the Project consisting of buildings and open spaces. The area to the northeast is considered to be the location which would be most susceptible to air quality impacts due to the close proximity to the M4, Parramatta Rd, Woodville Rd and Church St.

Land Use Investigation

The area surrounding the site is primarily comprised of residential and light industrial land uses which are unlikely to generate significant air emissions which may cause adverse air quality impacts at the site. The only nearby significant source of air emissions would be from motor vehicles travelling on the nearby roads.

Figure 1: Location of the Project



Source: **GTA Consultants, 2015**

Figure 2: Project masterplan layout

Applicable Air Quality Impact Assessment Criteria

Table 1 summarises the air quality goals as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**NSW DEC, 2005**).

Table 1: Applicable air quality impact assessment criteria

Pollutant	Averaging Period	Impact Assessment Criteria		Source
		pphm	µg/m³	
Sulfur Dioxide (SO_2)	1 hour	20	570	NEPM, NEPC (1998)
	24 hour	8	228	NEPM, NEPC (1998)
	Annual	2	60	NEPM, NEPC (1998)
Nitrogen Dioxide (NO_2)	1 hour	12	246	NEPM, NEPC (1998)
	Annual	3	62	NEPM, NEPC (1998)
Particulate Matter ≤ 10µm (PM_{10})	24 hour	-	50	NEPM, NEPC (1998)
	Annual		30	EPA (1998)
Particulate Matter ≤ 2.5µm ($PM_{2.5}$)*	24 hour	-	25	NEPC (2003)
	Annual	-	8	NEPC (2003)
Total Suspended Particulates (TSP)	Annual	-	90	NHMRC (1996)
Lead	Annual	-	0.5	NEPM, NEPC (1998)
		ppm	µg/m³	
Carbon Monoxide	1 hour	25	30,000	WHO (2000)
Carbon Monoxide	8 hour	9	10,000	NEPC (1998)
Benzene	1 hour	0.009	29	VGG (2001)
Toluene	1 hour	0.09	36	VGG (2001)

Source: **NSW DEC, 2005**
*NEPM Advisory Reporting Standard

It is noted that there are no criteria in NSW for $PM_{2.5}$ that are applicable to impact assessments at present. The National Environmental Protection Measure (NEPM) advisory reporting standards for $PM_{2.5}$ do exist, however these standards apply to NEPM population monitoring, which is conducted well away from "hot spots" such as industry or roads.

We note that the composition of traffic emissions is relatively fixed and that where compliance can be demonstrated for NO_2, Benzene and PM_{10}, it is unlikely that impacts from other pollutants caused by road traffic would arise. As detailed below, we have applied a US EPA traffic model, combined with Tool for Roadside Air Quality (TRAQ), US EPA Idling Vehicle Emissions (**US EPA, 1998**) and Australian National Pollutant Inventory (NPI) emissions factors for road traffic to examine the likely impacts that may occur.

Modelling Methodology

Air dispersion modelling for the Project was undertaken using the CAL3QHCR roadway pollution model. CAL3QHCR includes the CALINE-3 line source dispersion model which is designed to predict air pollutant concentrations near roadways from motor vehicle emissions operating under free flow and queue traffic conditions. The model setup included hourly varying traffic data and vehicle emissions which were estimated for each of the modelled road sections.

The dispersion modelling has been set up using the 2012 calendar year of meteorology extracted from The Air Pollution Model (TAPM). TAPM is a prognostic air model used to simulate the meteorological data. The meteorological component of TAPM is an incompressible, non-hydrostatic, primitive equation model with a terrain-following vertical coordinate for three-dimensional simulations. The model predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analysis.

The 2012 calendar year was chosen as it is a representative year based on a long-term weather analysis of the nearest Bureau of Meteorology weather station with available long term weather data.

Figure 3 shows the annual and seasonal windroses of the meteorological data used in the model.

Analysis of the windroses shows that on an annual basis, winds were varied from all directions but predominantly from the west-southwest and southwest. In summer, winds were generally from the directions ranging from northeast to south-southeast clockwise, with most dominant winds from the northeast and southeast. In autumn, winds are varied and are typically from the west-southwest. In winter, winds typically occur from the west-southwest. During spring, winds are similar to the annual distribution.

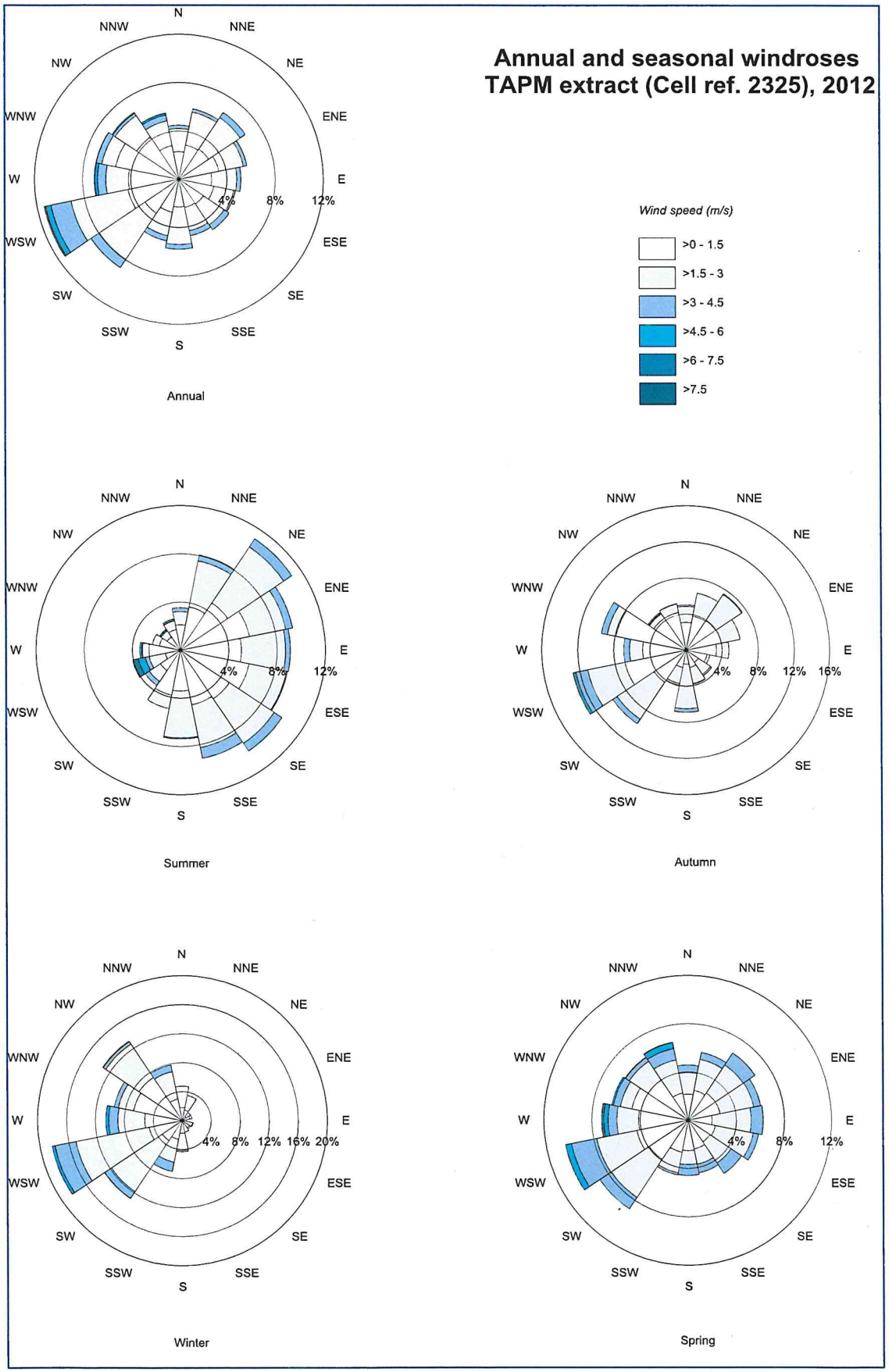


Figure 3: Annual and seasonal windroses extracted from TAPM (Cell ref. 2325)

The modelled traffic numbers are based on the transport impact assessments for the Project (**GTA Consultants, 2015**) and the M4 Westconnex widening (**SKM, 2013**). The peak afternoon traffic volumes from the transport impact assessment of the Project were scaled using the closest available diurnal traffic profiles for Great Western Highway (for east and west bound) and for Church St (for north and south bound) (**RTA, 2012**). Similarly, the daily traffic volume from the M4 Westconnex widening transport impact assessment were scaled using the diurnal traffic profile for Great Western Highway (**RTA, 2012**).

Table 2 presents the daily traffic volumes applied in the modelling on each of the nearby roads. **Figure 4** presents the road sections as identified in **Table 2**.

Table 2: Traffic volumes on nearby roads

Road name (Direction)	Section ID as presented in Figure 4	Daily traffic number (vpd)
Crescent St (Eastbound)	1	7010
Crescent St (Eastbound)	2	8026
Crescent St (Eastbound)	3	8991
Crescent St (Westbound)	1	6801
Crescent St (Westbound)	2	6507
Crescent St (Westbound)	3	4857
Walpole St (Eastbound)	4	10162
Walpole St (Westbound)	4	4743
M4 (Eastbound)	5	61902
M4 (Westbound)	5	61915
M4 on-ramp	6	14779
Parramatta Rd (Eastbound)	7	27248
Parramatta Rd (Westbound)	7	17710
Woodville Rd (Northbound)	8	35765
Woodville Rd (Northbound)	9	30076
Woodville Rd (Southbound)	8	24759
Woodville Rd (Southbound)	9	32780
Church St (Northbound)	10	15738
Church St (Northbound)	11	18512
Church St (Northbound)	12	17108
Church St (Southbound)	10	35155
Church St (Southbound)	11	16290
Church St (Southbound)	12	13707

Figure 4: Modelled road sections and line of receptors

To assess the concentration of pollutants at the Project site from the most significant roads, pollutant levels were predicted along three cross-sectional axes running through the site, as shown in **Figure 4**. These axes were chosen as they are deemed most susceptible to air quality impacts from the roads.

Emission Estimation

Free-flow traffic pollutant emission estimates were calculated using the Roads and Maritime Services Tool for Roadside Air Quality (TRAQ) (**RMS, 2012**) using an assessment year of 2016 with the worst-case season. The traffic speeds were estimated to be 80kph for the M4 and 60kph for the other roads. Queue traffic pollution emissions were estimated using the idling vehicle emissions factors (**US EPA, 1998**). The assessment used the worst-case idling vehicle CO and PM_{10} emission factors which correspond to emissions from heavy-duty gasoline-fuelled vehicles during summer and light/medium heavy-duty diesel vehicles, respectively. These estimates for PM_{10} and CO were used as inputs to the CAL3QHCR model.

The predicted impacts for SO_2 , NO_2 and Benzene were estimated from the model predicted impacts for CO using the NPI emission factors (**NPI, 1998**).

Modelling Results

The maximum 1-hour average air dispersion modelling results over a distance of 85m from the kerb are presented in **Figure 5** to **Figure 10**. The maximum hourly concentration of the pollutants drops sharply within 10m from the kerb. The maximum concentrations along the axis L1 however shows less decline as the kerb is already separated by a larger distance from the main traffic flow due to the turning lane and a traffic island.

The results in **Figure 5** show that the predicted maximum hourly average concentrations for CO would be well below the relevant criteria of 30,000 at the Project.

Figure 6 shows the predicted maximum 24-hour average PM_{10} concentrations would be well below the relevant criteria of 50µg/m^3 at the Project.

Figure 7 shows the predicted maximum 24-hour average $PM_{2.5}$ concentrations would be well below the relevant criteria of 25µg/m^3 at the Project.

Figure 8 shows the predicted concentrations of NO_2 would be well below the relevant criteria of 246µg/m^3 at the Project.

Figure 9 shows the predicted concentrations of SO_2 would be well below the relevant criteria of 570µg/m^3 at the Project.

Figure 10 shows that the predicted concentration for Benzene exceed the relevant criteria of 29µg/m^3 at the kerb along the line of receptors L3, the concentration drops sharply within 10m from the kerb and goes below the relevant criteria within the Project boundary.

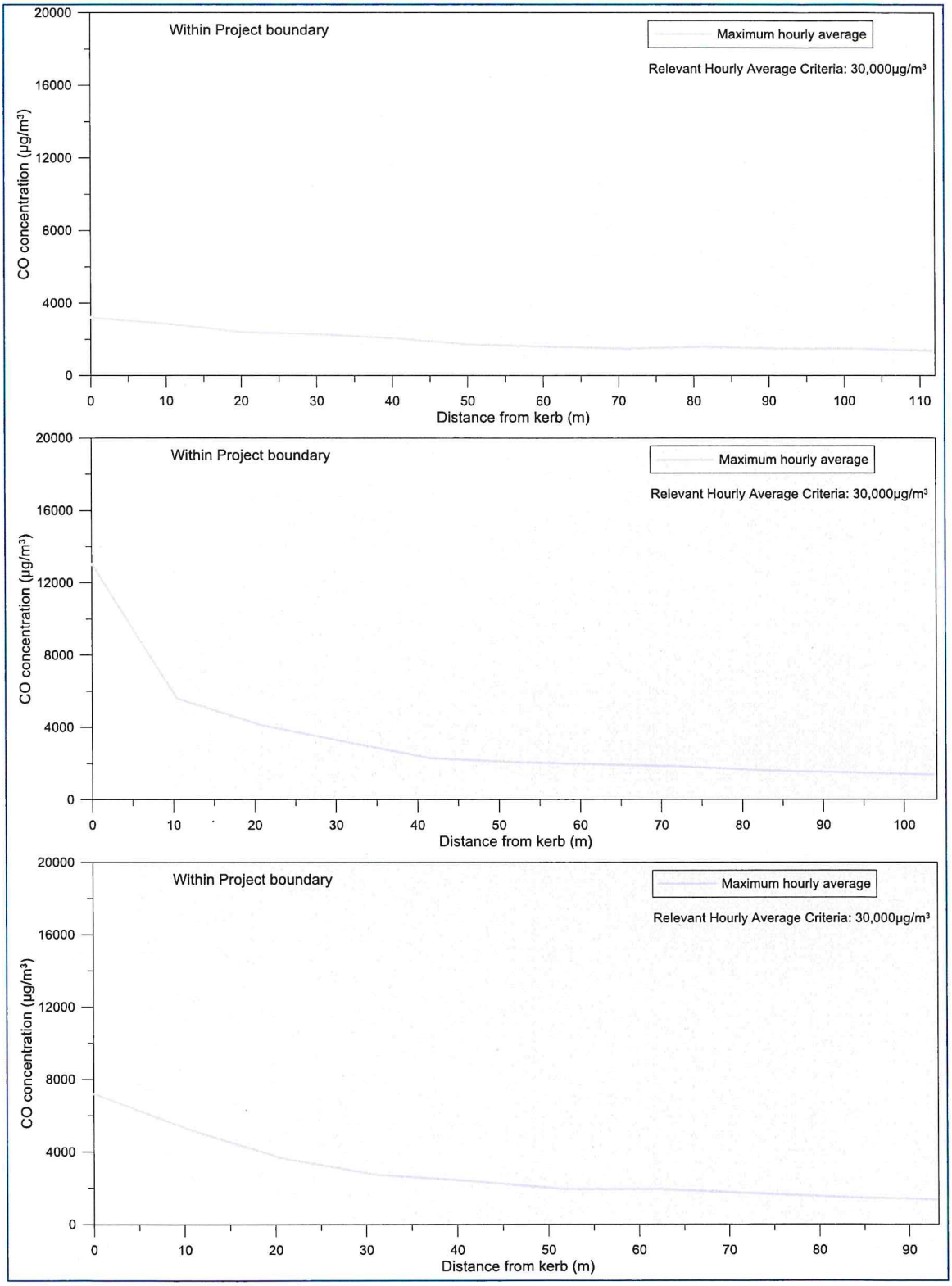


Figure 5: Modelled CO concentration for line of receptors L1 (top), L2 (middle) and L3 (bottom)

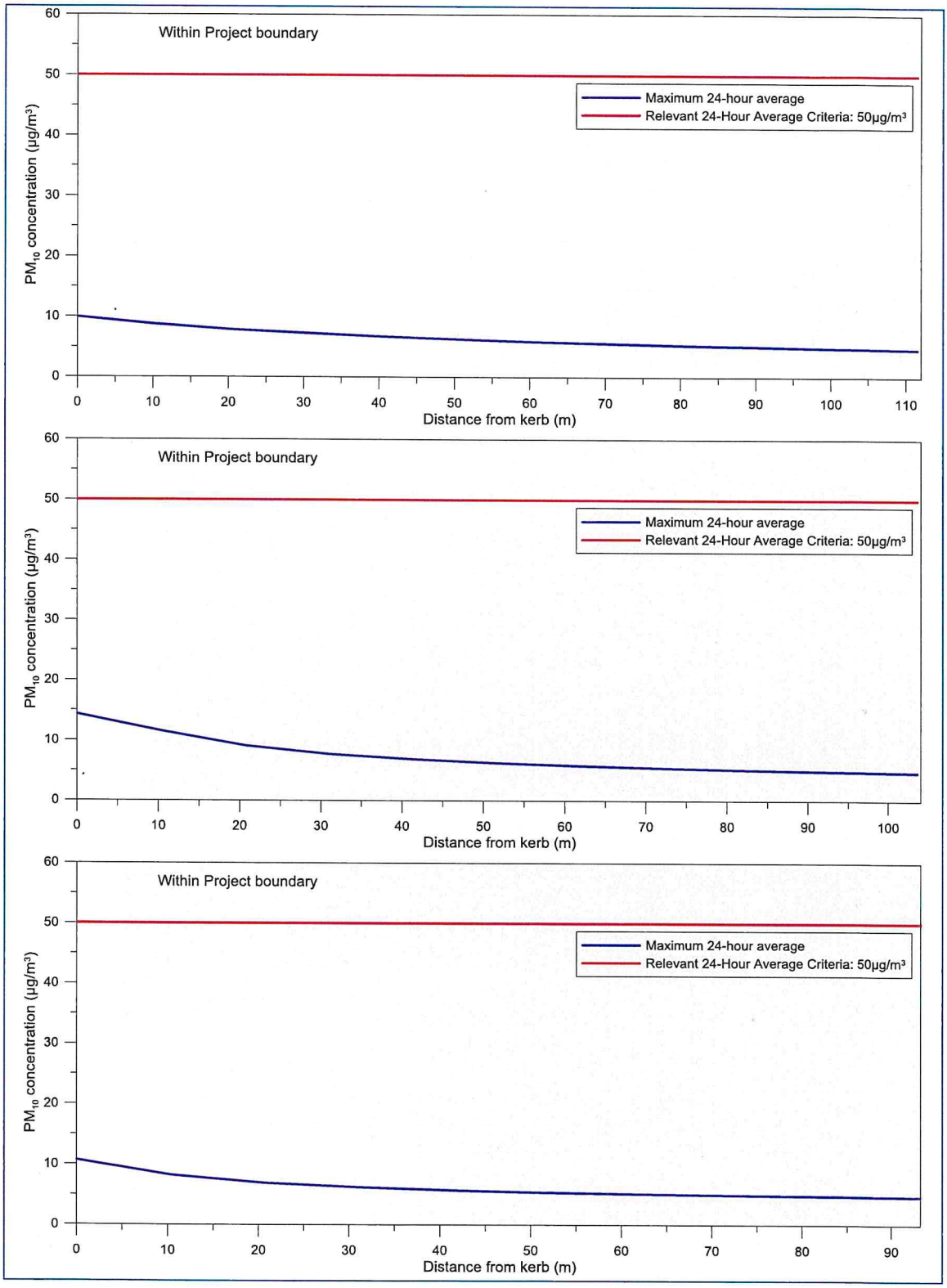


Figure 6: Modelled PM_{10} concentration for line of receptors L1 (top), L2 (middle) and L3 (bottom)

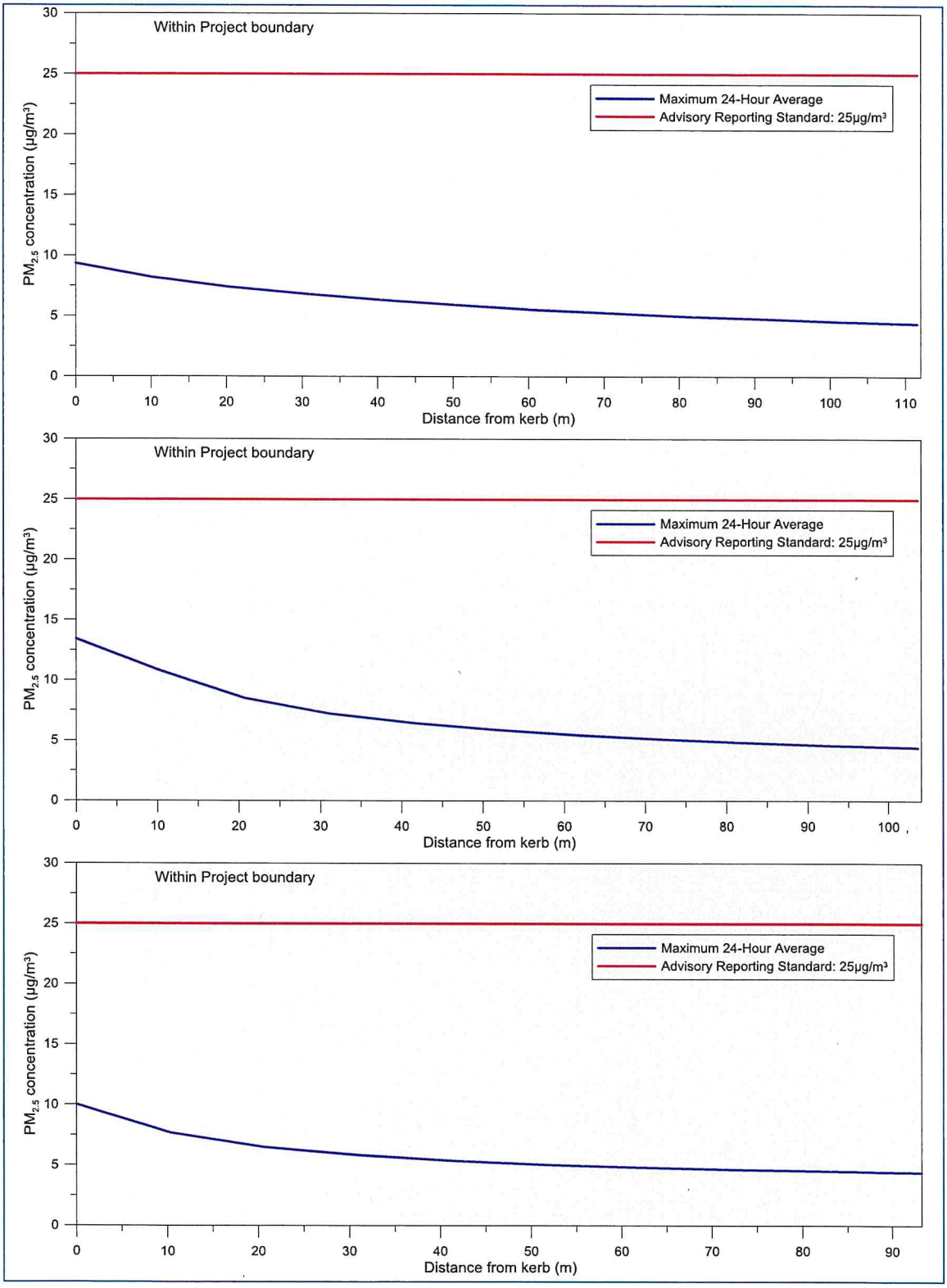


Figure 7: Modelled $PM_{2.5}$ concentrations for line of receptors L1 (top), L2 (middle) and L3 (bottom)

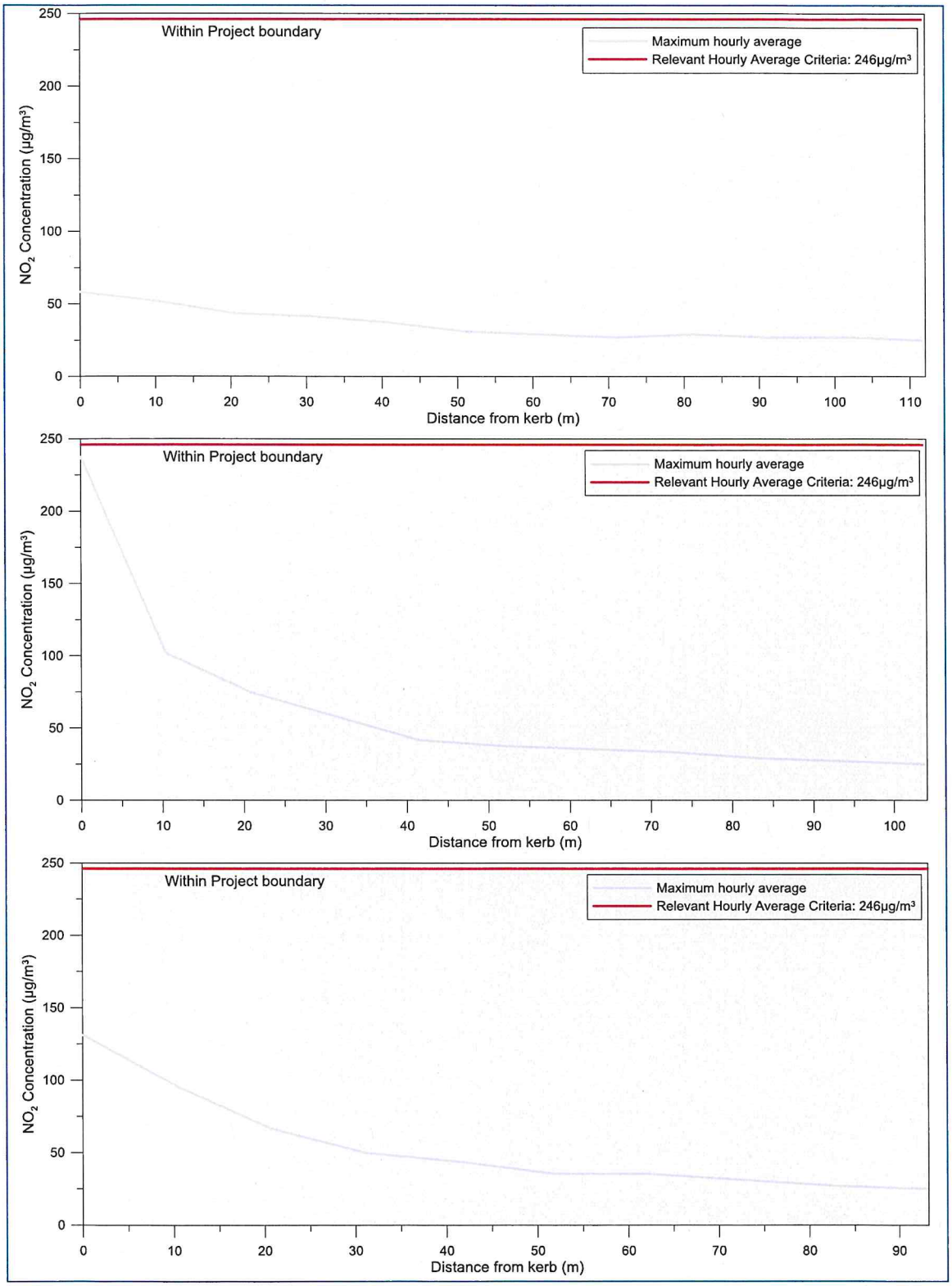


Figure 8: Modelled NO_2 concentrations for line of receptors L1 (top), L2 (middle) and L3 (bottom)

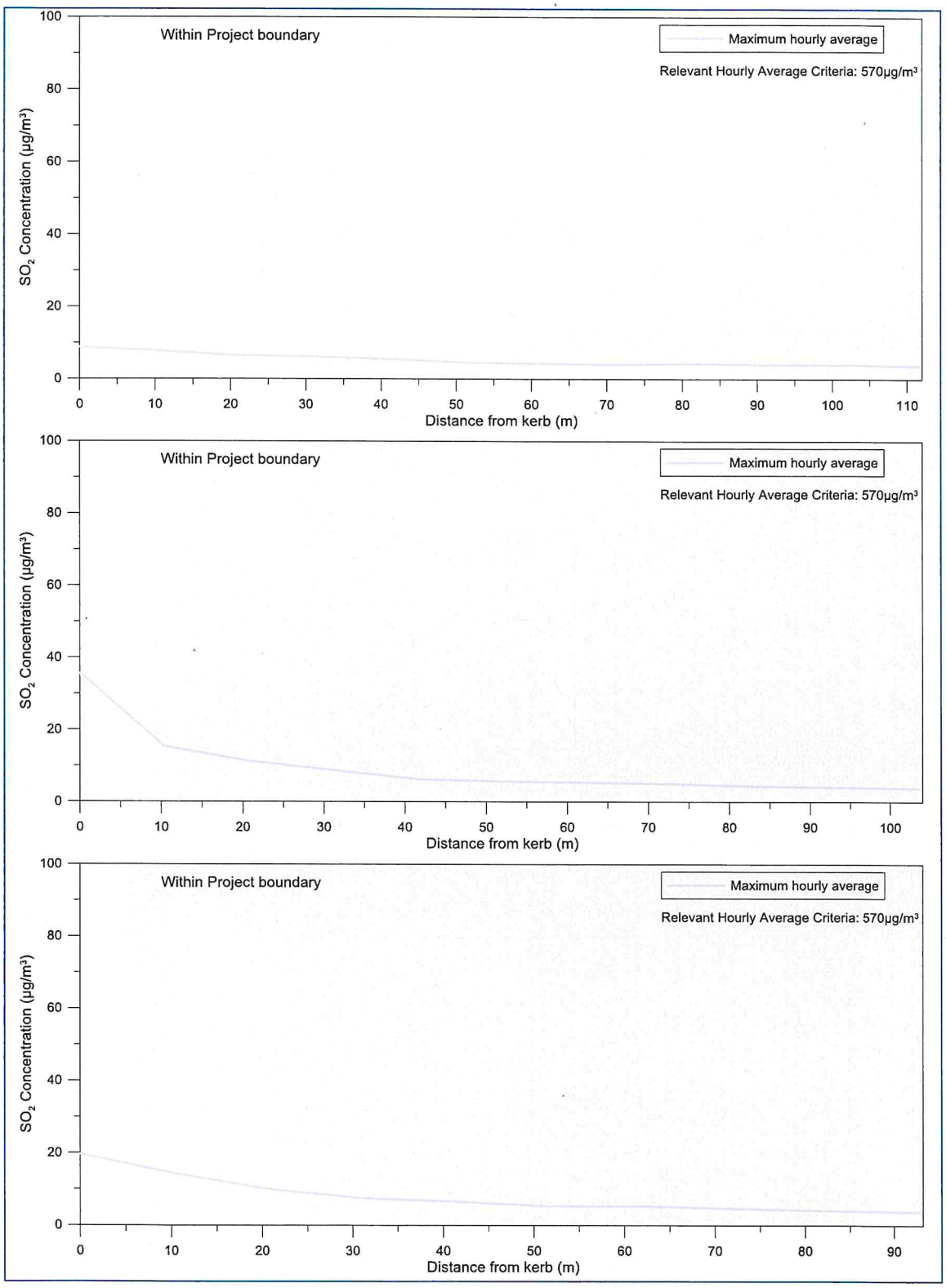


Figure 9: Modelled SO_2 concentrations for line of receptors L1 (top), L2 (middle) and L3 (bottom)

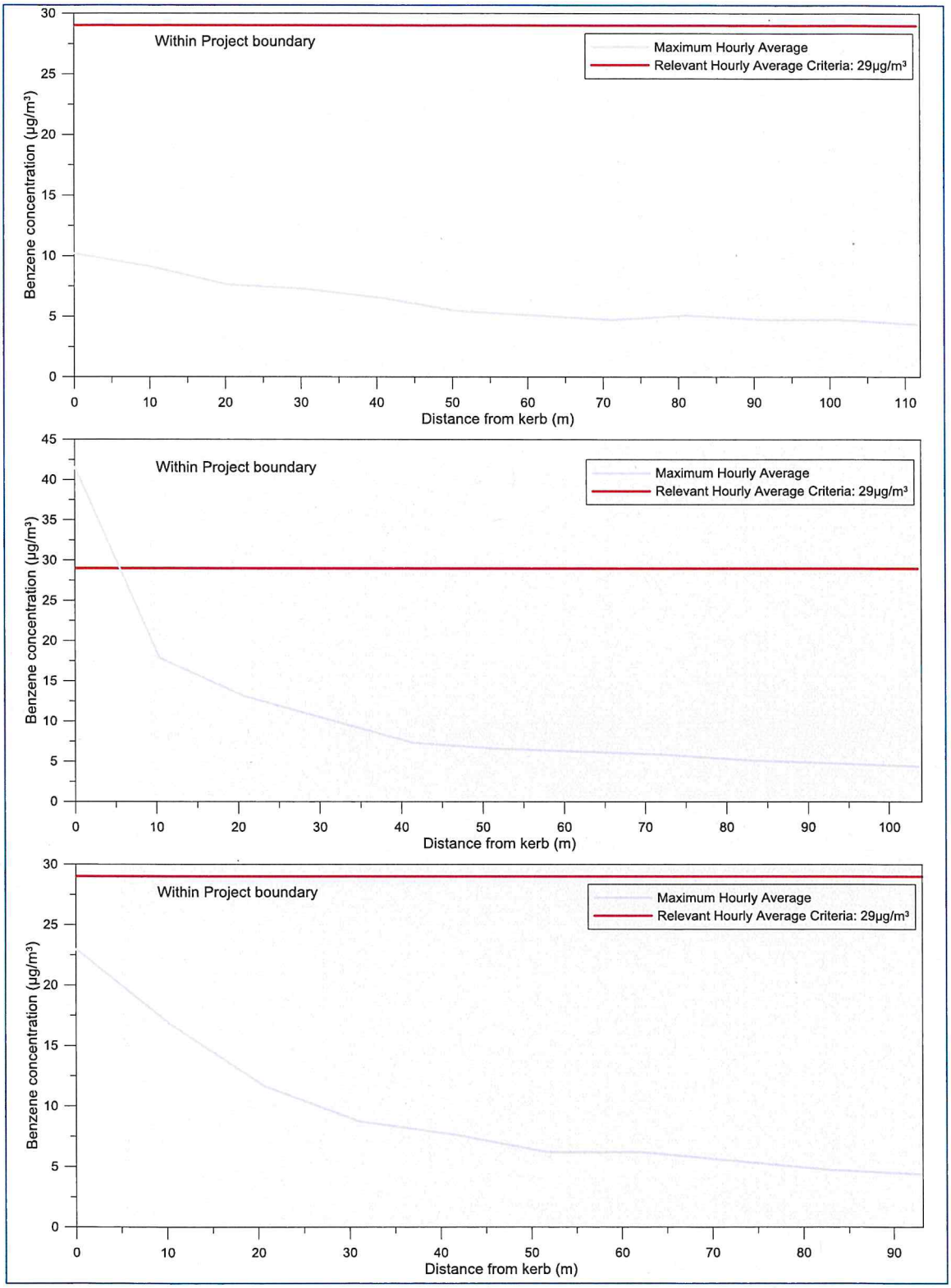


Figure 10: Modelled benzene concentration for line of receptors L1 (top), L2 (middle) and L3 (bottom)

Background Air Quality Monitoring Data

To assess for potential cumulative levels of ambient dust and pollutants in the general area of the Project, monitoring data were taken from nearby NSW EPA ambient monitoring stations for the contemporaneous 2012 calendar year. Data from the Chullora site were chosen as the most representative monitoring location due to its similar setting and land use and proximity to the Project.

Figure 11 presents the 24-hour average PM_{10} monitoring data from the nearest NSW EPA monitoring sites. The data show that the criterion of 50µg/m^3 was exceeded on one occasion at the Chullora site in 2012.

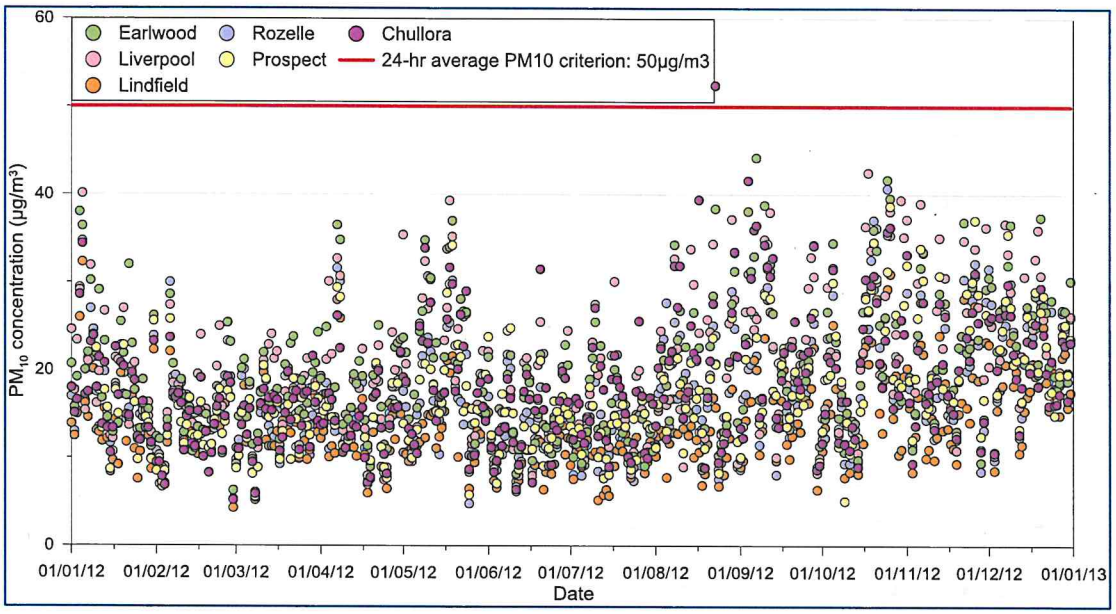


Figure 11: NSW EPA 24-hour average PM_{10} concentrations – 2012

Figure 12 presents the 24-hour average $PM_{2.5}$ monitoring data from the nearest NSW EPA monitoring sites. The data show that the levels were below the advisory reporting standard of 25µg/m^3 in 2012. On one occasion, the level recorded at the Liverpool site was very close to the advisory reporting standard.

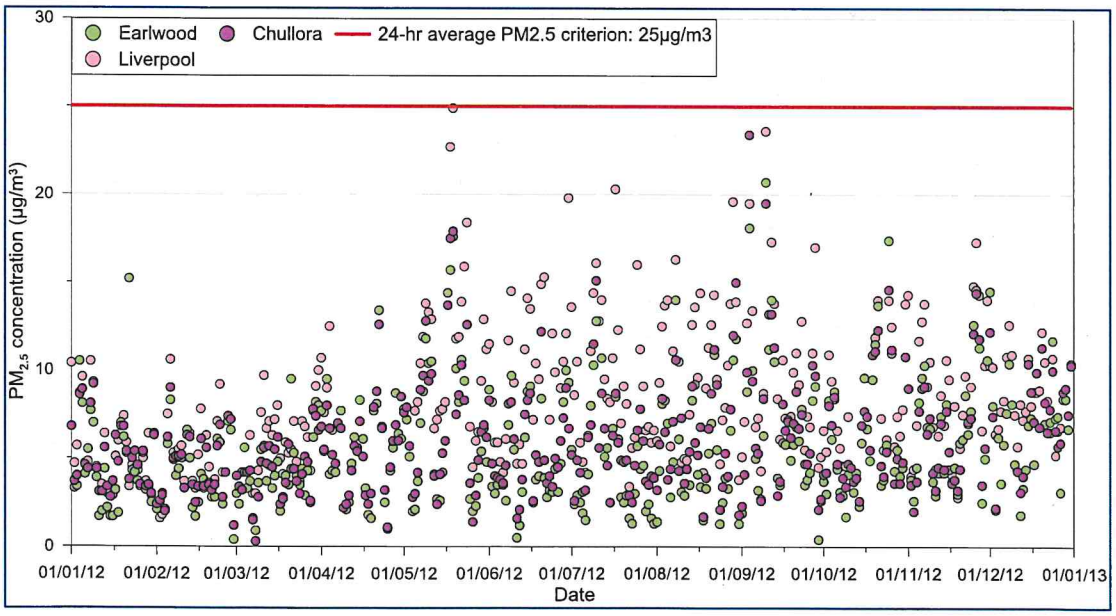


Figure 12: NSW EPA 24-hour average $PM_{2.5}$ concentrations – 2012

Discussion

The results shown consider increased future traffic volumes and are based on modelling of traffic impacts for each hour of a year using site representative meteorological data, and conservative estimates of traffic emissions per RMS guidelines.

The results show that concentrations of pollutants from the nearby roads would be well below the NSW EPA impact assessment criteria.

An examination of the background pollutant levels at the nearest monitoring location at Chullora, indicates that air quality levels would meet acceptable levels within the site, noting that on one day in 2012 the 24-hour PM_{10} criteria were exceeded. It is common and normal for short term particulate levels to exceed criteria in Sydney due to bushfires, dust storms etc. When this sort of event occurs it affects most of the Sydney basin, which is why the National Environment Protection Measure (NEPM) criteria permit 5 days of exceedances per annum. The currently proposed update to the NEPM criteria proposes to apply a natural events rule, which would allow all such elevated levels to be excluded for compliance purposes.

The results indicate that the on-site levels of pollutants from the roads surrounding the site are generally low. The buildings on site would be set back off the property boundary, and as a result traffic pollutant levels would be lower at the buildings than at the boundary. When considering this, in combination with the background levels air quality levels, it is clear that air quality at potential residences and offices on the site would be within acceptable criteria.

The indicative Project Masterplan layout accords with the general design principles outlined in Part 4 of the Development near Rail Corridors and Busy Roads – Interim Guideline. Todoroski Air Sciences has been engaged to assist with the detailed design of the Project, including on measures to minimise air pollution within the Project site, and as required to meet acceptable guidelines and criteria at all proposed residences.

On this basis it can be concluded that the development would meet the air quality requirements contained in the Development near Rail Corridors and Busy Roads – Interim Guideline, and could proceed at this location as is would be able to be developed without causing any adverse impacts above criteria, subject to any recommendations in the detailed design assessment.

Yours faithfully,

Todoroski Air Sciences

Aleks Todoroski

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