Appendix F: Portal Emissions Procedure – Management of In-Tunnel Haze and Carbon Monoxide

M5 EAST MOTORWAY
PROCEDURE FOR TRIAL OF PORTAL EMISSIONS FOR MANAGEMENT OF IN-TUNNEL AIR QUALITY AND HAZE

PURPOSE

Management of in-tunnel carbon monoxide and haze by the Traffic Control Room Operator (TCRO) during:

- Incidents in the tunnel;
- Traffic congestion and/or network impacts; or
- Periods of visible haze

using a staged set of traffic management and portal emission responses to:

1. Ensure compliance with the in-tunnel carbon monoxide levels contained in the Planning Minister's Conditions of Approval for the M5 East;
2. Minimise impact on users of the network by reducing the probability of tunnel closures; and
3. Limit the level of visible haze in the tunnel whilst ensuring compliance with the ambient air quality goals as detailed in the Planning Minister's Conditions of Approval.

DEFINITIONS

Term	Detailed Description
W/B	Westbound
E/B	Eastbound
VH (Value)	Vehicle Per Hour (Rolling 3 minute average, updated every 30 seconds)
Vehicle Speed (kph)	Vehicle Speed (Rolling 3 minute average, updated every 30 seconds)
AQS	Air Quality Sensor located within the tunnel measuring extinction co-efficient, oxides of nitrogen and carbon monoxide
ACO	Air Quality Sensor located within the tunnel measuring carbon monoxide only
F1	Ambient air quality monitoring station located on the northern side of the Motorway in the vicinity of he Bexley Road tunnel portals
M1	Ambient air quality monitoring station located on the northern side of the Motorway in the vicinity of he Marsh Street mainline tunnel portals
Continuous Rolling Average	Real time monitoring data updated hourly and reported on the identified averaging period.

Term	Detailed Description
Congested traffic	In tunnel Stop start traffic <20 kph average trip speed
Network Congestion	Observed or TMC notified network issues with possible impact on traffic flow from the tunnel exits
Ventilation Plans	Ventilation responses incorporating controlled levels of portal emissions to manage atypical conditions
POPV	Partial ventilation controlled at 50 to 250m^3.
VP	Portal emissions involving 250m^3+ emissions at any portal
Auto/Manual Declaration	Auto/Manual declaration of the Ventilation System as per incident procedures
Visibility (m^{-1})	Coefficient of extinction "K" –in-tunnel visibility measured as a 15 minute average.
Traffic Management Responses **All changes to Traffic Management Responses will be confirmed with RTA Transport Management Centre**	**Stage 1 Traffic Management Response** Implement advisory messages via electronic signage to motorists relating to heavy traffic congestion. Speed Limit at the portal will also drop to 60kph. **Stage 2 Traffic Management Response** Implement, through RTA TMC, rephasing of the following Traffic Lights for the purpose of filtering traffic at: **Westbound:** Marsh Street On Ramp Box Number #3697 **Eastbound:** Kingsgrove Road On Ramp Box Number #2811 Kingsgrove Road Ramp Metering Box Number #3889 **Stage 3 Traffic Management Response** Close the eastbound and/or westbound tunnel in which the Air Quality/Visibility Sensor has identified high in-tunnel pollutant levels and provide advisory messages via electronic signage to motorists relating to tube closures..
Portal temperature differential for Haze Management	The differential between in-tunnel temperature and ambient temperature calculated as the difference between the in-stack temperature and the ambient temperature measured at F1 and M1.

PROCEDURE FOR TRIAL OF PORTAL EMISSIONS FOR MANAGEMENT OF IN-TUNNEL AIR QUALITY AND HAZE

The trial of portal emissions for the management of in-tunnel air quality and haze will include 2 protocols:

1. Haze Management Protocol
2. Carbon Monoxide Management Protocol.

It is proposed that the protocols be progressively modified as information from the trial becomes available to better satisfy the purpose of the procedure.

NOTE: Due to the safety issues associated with the Carbon Monoxide Management Protocol shall takes precedence over the Haze Management Protocol, including the meteorological and temperature differential controls which may prevent portal emissions for the management of in-tunnel haze.

HAZE MANAGEMENT PROTOCOL

Target Visibility Range	$0.002m^{-1}$ to $0.003m^{-1}$.	
CONTROLS TO BE OBSERVED		
Ambient Air Quality Controls for Haze Management	Ensure compliance with both of the **Controls** detailed in **Table 1** before commencing or continuing with portal emissions for management of in-tunnel haze.	
Meteorological and Temperature Controls for Haze Management		
PORTAL EMISSION DEFAULT SETTINGS		
5 am to 7 am	POPV 100 (portal emissions 100 m^3/s)	
7 am to 5 pm	POPV 250 (portal emissions 250 m^3/s)	
5 pm to 7 pm	POPV 100 (portal emissions 100 m^3/s)	
VISIBILITY MANAGEMENT		
Adjusting portal emission settings for actual visibility performance		
Monitored haze levels are above the **Target Visibility Range:**	Progressively increase portal emissions at the relevant portal to a maximum of 250 m^3/s.	Incremental changes: POPV100 to POPV250
Monitored haze levels are below the **Target Visibility Range:**	Progressively decrease portal emissions at the relevant portal until visibility stabilises within the target range.	

Table 1 : Controls for the Trial of Portal Emissions for Management of Haze

The following controls define conditions under which **portal emissions for management of haze will not be permitted**.

Ambient Air Quality Controls for Haze Management	Ambient air quality pollutant concentrations, measured at F1 or M1 above which portal emissions for the management of haze will not be permitted:
Particulate Matter (PM_{10}) Nitrogen Dioxide (NO_2) Carbon Monoxide (CO)	40 µg/m^3 (24 hour continuous rolling average) 200 µg/m^3 (1 hour continuous rolling average) 6 ppm (8 hour continuous rolling average)
Meteorological and Temperature Controls for Haze Management	Control sets of ambient meteorological conditions (measured at F1 and M1); and portal temperature differential during which portal emissions for the management of haze will not be permitted.

Control Set	**Wind direction range (degrees relative to TN)**	**Wind speed range (m/s)**	**Portal temperature differential (ºC)**
Bexley Road Portal (F1)			
Set 1	122 to 190 deg	< 1.5	> 10
Set 2	122 to 190 deg	> 1.5	< 10
Set 3	350 to 10 deg	< 5.0	> 10
Set 4	350 to 10 deg	> 5.0	< 10
Set 5	58 to 90 deg	< 3.0	> 10
Set 6	248 to 293 deg	1.5 to 3.0	all
Marsh Street Portal (M1)			
Set 1	113 to 157 deg	1.5 to 3.0	>10

Visibility (m^{-1})	**Coefficient of extinction "K"**
Level A	0.005 m^{-1}
Level B	0.007 m^{-1}
Level C	0.012 m^{-1} (Limiting value – tunnel closure))

TRIGGER DETECTED	CONTROLLER ACTIONS	COMMENTS
Level A **Visibility Alarm 0.005 m^{-1}**	**Ambient Air Quality Controls below Trigger Levels** **All Traffic Conditions** Activate POPV100. Operate until level falls below 0.003 Commencing a Stage 1 Traffic Management Response. Monitor in tunnel and portal air quality to ensure that acceptable levels are maintained.	Visibility warning alarms will be generated when the visibility reading reaches the following levels: 0.003 (haze threshold), 0.0050 (fluid peak level), 0.0070 (daily congested level) & 0.0120 (incident/closure level) as defined in PIARC guidelines If incident is not verified as above air quality goal, return to previous operating state and reset visibility alarms when below trigger levels.
	Ambient Air Quality Controls at or above Trigger Levels **All Traffic Conditions** Commence a Stage 1 and Stage 2 Traffic Management Response. Monitor in tunnel air quality to ensure that acceptable levels are maintained.	

Level B **Visibility Alarm 0.007 m^{-1}**	**Ambient Air Quality Controls below Trigger Levels** **All Traffic Conditions** Activate relevant VP for AQ monitor. Operate until level falls below 0.003 Advise the RTA-TMC that M5 East is commencing a Stage 1 Traffic Management Response. Activate the response via the TCMS Traffic Congestion Warning Plan for the effected tube. Monitor in tunnel and portal air quality to ensure that acceptable levels are maintained.	
	Ambient Air Quality Controls at or above Trigger Levels Commencing a Stage 3 Traffic Management Response. Monitor in tunnel and portal air quality to ensure that acceptable levels are maintained.	
Level C **Visibility alarm 0.012 m^{-1}**	**Ambient Air Quality Controls below Trigger Levels** **All Traffic Conditions** Declare an incident. Commencing a Stage 3 Traffic Management Response. Close the tube in which the Visibility Sensor has been activated. Initiate the response via the TCMS Traffic Congestion Warning Plan for the effected tube/s. Monitor in tunnel and portal air quality to ensure that acceptable levels are maintained.	

	Ambient Air Quality Controls at or above Trigger Levels Activate relevant VP for AQ monitor. Operate until level falls below 0.003 Monitor in tunnel and portal air quality to ensure that acceptable levels are maintained.	

CARBON MONOXIDE MANAGEMENT PROTOCOL	
In-tunnel Carbon Monoxide Goal	87 ppm averaged over 15 minutes
Note: In addition to the circumstances specified in this Procedure, portal emissions shall be permitted for the purpose of maintaining the in-tunnel carbon monoxide goal under those circumstances specified in Condition 71C(c) of the Conditions of Approval.	
CO Alarm Levels (ppm)	Carbon monoxide (CO) in parts per million measured at the AQS or ACO monitor.
Level 1	CO > 60ppm/5min TWA
Level 2	CO > 80ppm/instantaneous
Level 3	CO > 80ppm/5min TWA
Level 4	CO > 87ppm/5min TWA
Level 5	CO > 200ppm/3min TWA
OH&S Target Level	60 ppm (for a 30 minute excursion)
Ambient Air Quality Controls for Carbon Monoxide Management	Ambient air quality pollutant concentrations, measured at F1 or M1 at or above which portal emissions for the management of carbon monoxide will be limited:
Particulate Matter (PM_{10}) Nitrogen Dioxide (NO_2) Carbon Monoxide (CO)	50 µg/m^3 (24 hour continuous rolling average) 256 µg/m^3 (1 hour continuous rolling average) 9 ppm (8 hour continuous rolling average)
Note: Under circumstances where portal emissions for the management of in-tunnel carbon monoxide levels are undertaken, all practicable measures shall be taken to minimise air quality impacts and the period of portal emissions shall be limited to that necessary until normal traffic operations resume.	

TRIGGER DETECTED	CONTROLLER ACTIONS	COMMENTS
CO Level 1 Alarm (CO > 60ppm/5min)	**Ambient Air Quality Pollutant Concentrations below Goals** **All Traffic Conditions** Activate POPV100 Monitor in tunnel air quality to ensure that acceptable levels are maintained. **Congested Traffic** Commence a Stage 1 Traffic Management Response.	**Ventilation** Establishes forward airflow to reduce risk in case of an incident. **Traffic Management** A Stage 1 Traffic Management Plan will provide advisory messages via electronic signage to motorists relating to heavy traffic congestion. Speed Limit at the portal will also drop to 60kph.
	Ambient Air Quality Pollutant Concentrations at or above Goals **All Traffic Conditions** Commence a Stage 1 and Stage 2 Traffic Management Response. Monitor in tunnel air quality to ensure that acceptable levels are maintained.	

CO Level 2 Alarm (CO > 80ppm instantaneous)	**Ambient Air Quality Pollutant Concentrations below Goals** **All Traffic Conditions** Maintain POPV100. Monitor in tunnel air quality to ensure that acceptable levels are maintained. **Congested Traffic** Commence a Stage 2 Traffic Management Response	**Ventilation** Increased to manage air quality **Traffic Management** Activating the Stage 2 Traffic Management Response is **only** required when an average vehicle speed of **less than 20kph** in the vicinity of the AQS which has been triggered as noted on the TMCS.
	Ambient Air Quality Pollutant Concentrations at or above Goals Maintain Stage 1 and Stage 2 Traffic Management Response. Monitor in tunnel air quality to ensure that acceptable levels are maintained.	
CO Level 3 Alarm (CO > 80ppm/5min TWA)	**Under all Ambient Air Quality Pollutant Concentrations conditions** **All Traffic Conditions** Allow the CSCMS to Auto-declare a ventilation plan (VP200 or maximum) specific to the Air Quality Sensor that activated the alarm. Operate the plan until such time that the CO reduces to below 60 ppm/5min TWA. Return to Automatic Ventilation mode on the CSCMS. Monitor in-tunnel air quality to ensure that acceptable levels are maintained.	The CSCMS will automatically declare a ventilation incident 30 seconds after a CO Level 3 alarm is received. **Traffic Management** Activating the Stage 2 Traffic Management Response is **only** required when an average vehicle speed of **less than 20kph** in the vicinity of the AQS which has been triggered as noted on the TMCS.

	Ambient Air Quality Pollutant Concentrations at or above Goals Commencing a Stage 3 Traffic Management Response.	
CO Level 4 Alarm (CO > 87ppm/5min - Tunnel Closure)	**Ambient Air Quality Pollutant Concentrations Below Goals** **All Traffic Conditions** Commencing a Stage 3 Traffic Management Response. Close the tube in which the Air Quality Sensor has been activated. As ventilation is already at maximum level from the previous CO Level 3 alarm, no further ventilation options are available. Monitor in-tunnel air quality to ensure that acceptable levels are maintained.	A Stage 3 Traffic Management Plan will involve closing one or both tubes and provides advisory messages via electronic signage to motorists relating to tube closures.
	Ambient Air Quality Pollutant Concentrations at or above Goals Monitor in-tunnel air quality to ensure that acceptable levels are maintained.	
CO Level 5 Alarm (CO > 200ppm/3min – Tunnel Closure)	**Under all Ambient Air Quality Pollutant Concentrations conditions** **All Traffic Conditions** Monitor in tunnel and portal air quality to ensure that acceptable levels are maintained	