



Summary Report of Waterview Tunnel Operation - July 2017 to June 2018

Review of compliance with operational air quality conditions

Prepared for Waterview Tunnel Joint Operation

19 October 2018

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Executive Summary

The Waterview Connection is a motorway section through west/central Auckland, New Zealand. It connects State Highway 20 in the south at Mt Roskill to State Highway 16 in the west at Point Chevalier, and is a part of the Western Ring Route. The connection is 4.5 kilometres long, of which 2.5km are in the form of twin tunnels - known collectively as the Waterview Tunnel.

The NZ Transport Agency was granted consent for the project, subject to conditions, by a Board of Enquiry in June 2011. A suite of conditions were developed for operational air quality to address concerns raised in the hearing (conditions OA.1 to OA.8).

One condition of consent is that a Peer Review Panel reviews all ambient monitoring, relevant traffic data and tunnel emissions and provides a summary report with any recommendations to the NZ Transport Agency, Auckland Council and the Community Liaison Group.

This report is the first annual report prepared by us - the Panel - and focuses on the first 12 months of operation since the tunnel was opened on 2 July 2017. It covers the:

- Design of the tunnel ventilation system (OA.1)
- Equipment and location of the air quality monitoring (OA.2)
- Equipment and location of the meteorological monitoring (OA.3)
- Results of the ambient air quality monitoring for July 2017 to June 2018 (OA.4)
- Exceedances of any relevant air quality limits incurred for the same period (OA.5)
- Compliance of the monitoring in accordance with the Assessment of Effects requirements (OA.6)
- Role and outputs of the Peer Review Panel (OA.7)
- Air quality near the tunnel portals (OA.8)

For the first 12 months of operation, the Peer Review Panel is satisfied that the air quality conditions of consent are being met and that the tunnel operation is not resulting in any adverse air quality effects.

Our next review is due in October 2019 and will cover the second 12 month period of operation (1 July 2018 to 30 June 2019).

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1 Tunnel ventilation system design (OA.1)

1.1 Requirement

Condition OA.1 requires that:

OA.1 *The vents used to discharge emissions in the tunnels shall discharge vertically into air at a height of 15m, as follows:*

(a) The northern ventilation stack will be at a height of 15m. This height shall be calculated from the lowest existing ground level along the Great North Road boundary, adjacent to the ventilation stack; and

*(b) The southern ventilation stack will be at a height of 15m calculated from the post-construction ground level of the Alan Wood Reserve averaged at a distance of 10m from the exterior walls the ventilation stack location and shall not be impeded by any obstruction that may in the opinion of the **Peer Review Panel** (Condition OA. 7) decrease the vertical efflux velocity (in other words, the average velocity of material emitted into the atmosphere).*

1.2 Review process

The Peer Review Panel reviewed the construction drawings for both ventilation stacks contained in the following documents:

- WCA (2013a). *Northern Ventilation Building - Architecture and Above Ground Structure - Stage 2 Report*, Document #400-RPT-02603 prepared by the Well Connected Alliance, 20 September 2013
- WCA (2013b). *Southern Ventilation Building Structure and Architecture - Stage 2 Report*, Document #400-RPT-02237 prepared by the Well Connected Alliance, 9 August 2013

We also undertook a site visit on 14 July 2016 and inspected both ventilation stacks. The southern stack was essentially complete but the northern stack was still under construction.

1.3 Conclusions/recommendations

From the construction drawings provided by the Well Connected Alliance (**WCA**), we confirm that the design for both ventilation stacks meets the requirements for a height of 15m from the relevant datum. We did not specifically request measurements or survey data to confirm the as-built heights but did receive advice from WCA that the structures were built as per the design.

From the site visit, we also confirm that there were no obstructions that would impact on the vertical efflux velocity from either of the ventilation stacks.

While the vents are strictly in compliance with Condition OA.1, we have discussed the potential impacts of the tall trees adjacent to the northern ventilation stack with the Waterview Tunnel Joint Operation (**WTJO**). These trees, should they continue to grow unchecked, could cause plume downwash in future and increase ground level concentrations of pollutants under certain weather conditions. Auckland Council Community Facilities has recently taken responsibility for landscaping maintenance of the trees around the northern ventilation stack and WTJO will monitor the trees and liaise with Auckland Council if any issues arise. Currently, both stacks are not in use daily and are only anticipated to be used for emergency events.

We consider that condition OA.1 is satisfied and we, as Peer Review Panel, do not need to undertake any further review of this condition.

2 Air quality monitoring equipment/locations (OA.2)

2.1 Requirement

Condition OA.2 requires that:

OA.2 *Prior to the tunnels becoming operational, the NZTA shall establish two ambient air quality monitoring stations and one portal air quality monitoring station. The location and types of these monitoring stations shall be selected by the NZTA in consultation with the Auckland Council and Peer Review Panel (Condition OA.7), providing that one ambient monitoring station will be located within the Waterview Primary School (subject to agreement by the School).*

*Ambient air quality shall be monitored continuously in real time, to monitor potential effects associated with the operation of the ventilation system from the tunnels. Ambient monitoring shall include fine particulates (**PM₁₀** and **PM_{2.5}**) and nitrogen dioxide (**NO₂**). Portal monitoring shall include nitrogen dioxide. Results shall be compared with the relevant National Environmental Standards for air quality and Auckland Regional air quality targets (as identified in Chapter 4 of the Auckland Regional Plan: Air, Land and Water, 2010). Monitoring shall be undertaken at each site until the Peer Review Panel recommends that monitoring is no longer necessary. The locations, operation and maintenance schedules of the continuous monitors shall, as far as practicable, comply with the requirements of AS/NZ 3580.1.1: 2007 Method for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment, and with methods specified in the National Environment Standards.*

2.2 Review process

The Peer Review Panel was initially provided with details on the proposed locations and equipment for the air quality monitoring stations in the following document:

- WCA (2016). *Waterview Connection Project: Operational Air Quality Conditions OA.2 and OA.3*, letter to the Peer Review Panel prepared by the Well Connected Alliance, 26 October 2016

2.2.1 Ambient air quality monitoring

Northern ambient monitoring location

OA.2 requires that one ambient air quality monitoring station be located at Waterview Primary School near the Northern portal (subject to agreement by the School). However, WCA was unable to secure agreement with the School Board to locate the air quality station there.

Following discussions with the NZ Transport Agency (Greg Haldane), Auckland Council (Paul Crimmins) and the Peer Review Panel (Gerda Kuschel and Jenny Simpson), WCA investigated an alternative location as near as practicable to the original baseline air quality monitoring station at Cowley Street.

We agreed that the proposed alternative location (shown in Figure 1) of the northern ambient air monitoring station was the most practicable siting that could be established in this area, given the constraints for this area. We noted that the closer separation of the northern station from the nearest building (less than 10 times the height of the building) did not meet the minimum siting criteria in AS/NZ 3580.14-2011 but considered this discrepancy would have a negligible impact on the results.



Figure 1: The proposed location of the northern air quality monitoring station

Southern ambient monitoring location

WCA proposed that the second ambient air quality monitoring station be located in the southern area near the Southern portal in Alan Wood Reserve, at the surface section of SH20. This was to meet Condition OA.6 that required the southern monitoring to be undertaken close to the location which was used to assess the project baseline air quality.

We agreed that the proposed location of the southern ambient air monitoring station (shown in Figure 2) was the nearest practicable location to the baseline monitoring station, given the constraints for this area.



Figure 2: The proposed location of the southern air quality monitoring station

Ambient monitoring equipment

WCA proposed to install the following equipment at both sites:

- BAM-1020 continuous particulate monitor for PM₁₀
- BAM-1020 continuous particulate monitor for PM_{2.5}
- Serinus 4- oxides of nitrogen (NO_x) analyser (chemiluminescence technology)
- Data logger and modem

We confirmed that the all of the monitoring methods used by the proposed equipment complied with Schedule 2 of the National Environmental Standards (NES) for Air Quality¹, reproduced below, and therefore agreed with their deployment.

Schedule 2 Monitoring methods for ambient air quality standards

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Contaminant	Monitoring method
Carbon monoxide	Australian Standard AS 3580.7.1:1992, Methods for sampling and analysis of ambient air—Determination of carbon monoxide—Direct-reading instrumental method
Nitrogen dioxide	Australian Standard AS 3580.5.1:1993, Methods for sampling and analysis of ambient air—Determination of oxides of nitrogen—Chemiluminescence method
Ozone	Australian Standard AS 3580.6.1:1990, Methods for sampling and analysis of ambient air—Determination of ozone—Direct-reading instrumental method
PM ₁₀	United States Code of Federal Regulations, Title 40—Protection of Environment, Volume 2, Part 50, Appendix J—Reference method for the determination of particulate matter as PM ₁₀ in the atmosphere; or Australian/New Zealand Standard AS/NZS 3580.9.6:2003, Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM ₁₀ high volume sampler with size-selective inlet—Gravimetric method; or Australian Standard AS 3580.9.8:2008, Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM ₁₀ continuous direct mass method using a tapered element oscillating microbalance analyser; or Australian/New Zealand Standard AS/NZS 3580.9.11:2008, Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM ₁₀ beta attenuation monitors
Sulphur dioxide	Australian Standard AS 3580.4.1:2008, Methods of sampling and analysis of ambient air—Determination of sulfur dioxide—Direct reading instrumental method

2.2.2 Portal air quality monitoring

OA.2 requires the establishment of one portal air quality monitoring station to confirm that any emissions escaping the tunnel portals (as opposed to being vented by the stacks) do not cause the concentration of NO₂ in ambient air to exceed 200µg/m³, expressed as a rolling 1-hour average, at any point beyond the designation boundary that borders an air pollution sensitive land use as required under OA.8. The original air quality assessment of tunnel portal emissions² concluded that residential properties near the tunnel openings were the most likely sensitive receptors to be impacted by portal emissions due to their proximity to the portals and potential duration of exposure.

Portal emissions are expected to occur at night or early in the morning when sensitive receptors, such as students/teachers at Waterview School, are less likely to be exposed. The nearest residence to the northern portal is approximately 100m west of the portal (at 20 Herdman Street), while the nearest residential properties to the southern portal are approximately 50m to the north (on Hendon Avenue).

Portal monitoring location

Given its close proximity to the northern portal, WCA considered that the northern ambient air quality station (shown in Figure 1) was likely to provide representative results to assess effects at the nearest residential receptors to the portal. Consequently, WCA proposed installing the separate portal emissions

¹ MfE (2011). *Resource Management (National Environmental Standards for Air Quality) Regulations 2004*, plus 2011 amendments, administered by the Ministry for the Environment, June 2011

² Beca/NIWA (2010a). *Assessment of Air Quality Effects of the Western Ring Route - Waterview Connection, Appendix I. Air Quality Assessment of Tunnel Portal Emissions*, prepared for the NZ Transport Agency by Beca and NIWA, July 2010

monitoring site as close as practicably possible to the worst case modelled receptor at the southern end of the tunnel.

We agreed that the proposed location of the portal air monitoring station (shown in Figure 3) was the best practicable location for capturing worst case portal emissions effects, given the constraints for this area.

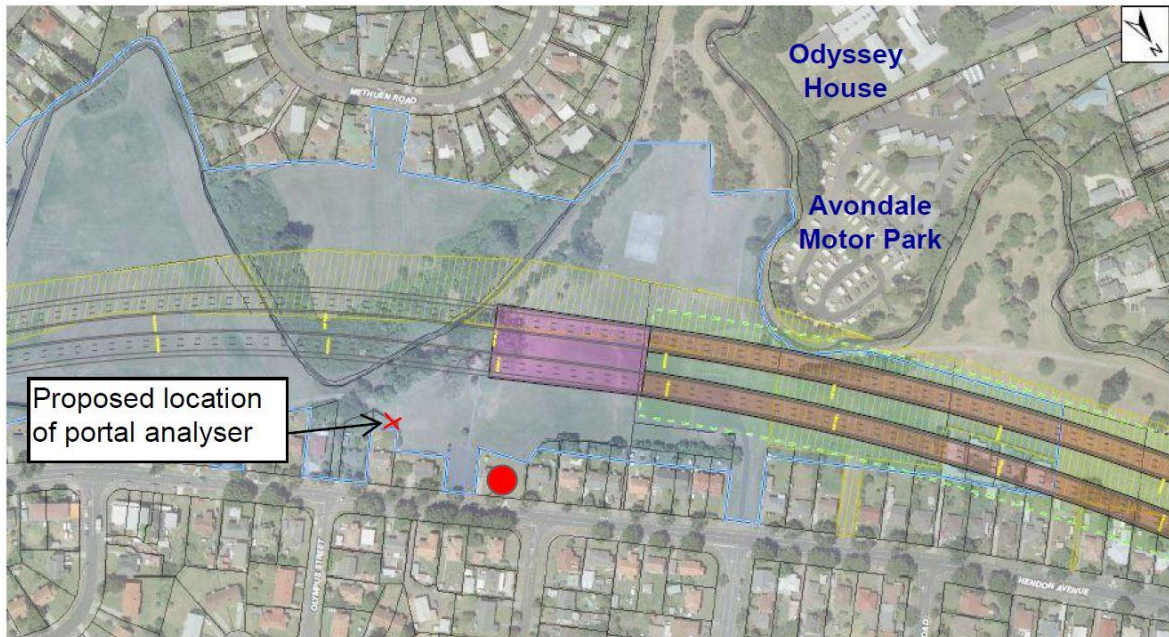


Figure 3: The proposed location of the portal air quality monitoring station (marked by X) relative to the worst case modelled receptor at the southern portal (marked by the red dot)

WCA proposed locating the analyser at the southern end for a minimum period of a year and then, depending on the monitoring results, potentially shifting it to the northern end at a site closer to the Waterview School (if a unit with a smaller siting footprint could be sourced).

From our review of the monitoring results to date (see section 4) we do not consider shifting the portal monitor to the north to be necessary as we consider that northern ambient air quality monitoring station is likely capturing the worst case effects of any northern portal emissions.

Portal monitoring equipment

WCA initially proposed installing a 'low cost analyser' for measuring NO₂ at the portal site. However, we expressed reservations about the use of a non-reference method at the portal monitoring station. We acknowledged the ambiguity in Condition OA.2 in relation to the type of monitoring that needed to be conducted for the portal monitoring and had further discussions with the NZ Transport Agency, WCA and Auckland Council.

Following those discussions, WCA proposed using a Serinus 60 CAPS NO₂ analyser which could be accommodated in the small footprint available at the southern portal site but utilised more robust measurement technology.

While the CAPS analyser did not strictly meet the requirements of Schedule 2 of the NES, we agreed to its deployment provided it was co-located with a reference (chemi-luminescent) analyser for several months to demonstrate comparability.

Figures 4 and 5 compare the NO₂ daily averages recorded by the two analysers - a Serinus 40 chemi-luminescent (NES compliant) analyser versus the Serinus 60 CAPS analyser - for the co-location period which ran from 18 May 2017 to 18 December 2017 (inclusive).

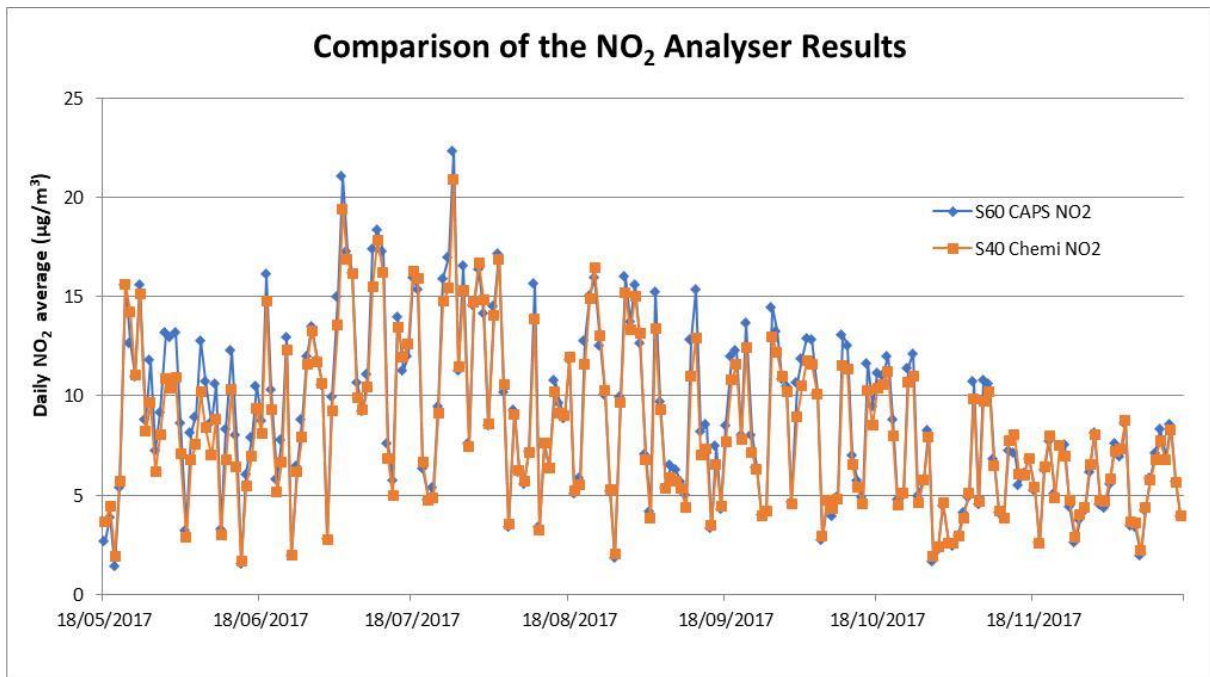


Figure 4: Comparison of the daily NO₂ averages recorded by the two analysers over the co-location period

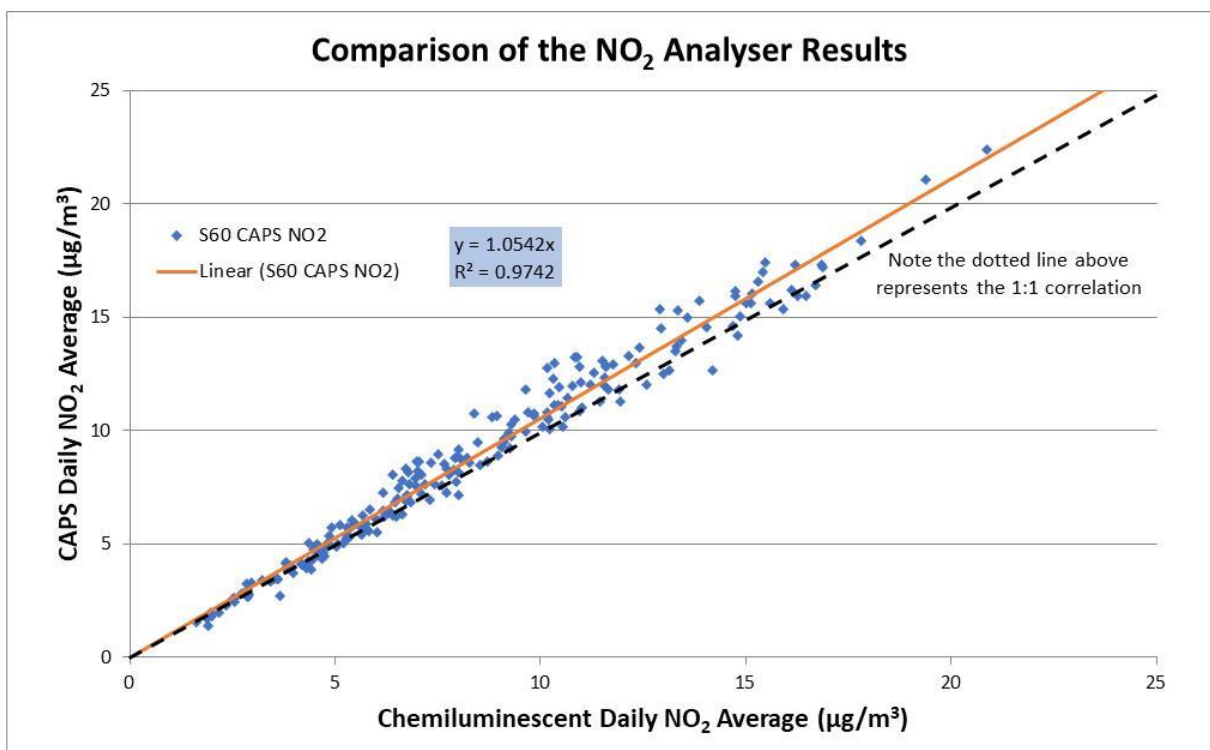


Figure 5: Correlation between the daily NO₂ averages measured by the CAPS analyser versus those measured by the chemiluminescent analyser

Figure 4 shows the results of the two different analysers track each other well, which is further confirmed in Figure 5 with a high degree of correlation ($R^2 = 0.9742$). The CAPS analyser, if anything, appears to be more responsive to NO₂ (reading 5% higher on average than the chemi-luminescent analyser).

From these results, we agreed that the CAPS NO₂ analyser was appropriate for monitoring worst case portal emissions.

2.3 Conclusions/recommendations

We agree with all three locations where air quality monitoring is being undertaken and confirm that the equipment being deployed either meets or is comparable with NES requirements for methods used to assess compliance with ambient air standards.

While WCA have offered to shift the portal monitor from the south to the north, we do not consider shifting the monitor to be necessary as we consider that northern ambient air quality monitoring station is likely capturing the worst case effects of any northern portal emissions.

We consider that condition OA.2 is satisfied and we, as Peer Review Panel, do not need to undertake any further review of this condition.

3 Meteorological monitoring equipment/locations (OA.3)

3.1 Requirement

Condition OA.3 requires that:

OA.3 *Continuous monitoring of wind speed and direction shall be undertaken at each ambient air quality monitoring location as required by Condition OA.2. The locations of wind speed and direction monitors shall, as far as practicable, comply with the requirements of AS 2923:1987 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications.*

3.2 Review process

WCA proposed measuring wind speed and wind direction at 5m at all three monitoring locations.

While AS/NZ 3580.14.2011 requires meteorology to be measured at 10m, we appreciated that the additional footprint required for the guy wires posed problems, given site space requirements. Regardless, we considered measurements at 5m were likely to be comparable and would have a negligible impact on any overall conclusions.

3.3 Conclusions/recommendations

We agree with all three locations where meteorological monitoring is being undertaken and confirm that the equipment being deployed either meets or is comparable with siting requirements.

We consider that condition OA.3 is satisfied and we, as Peer Review Panel, do not need to undertake any further review of this condition.

4 Air quality monitoring results (OA.4)

4.1 Requirement

Condition OA.4 requires that:

OA.4 *For the first 12 months of tunnel operation, the results of the ambient air quality monitoring shall be reported via validated reports and issued for information via the Project website (monthly). Following this period, and for a period of at least 12 months, reporting shall take place quarterly as follows: Quarter 1 (December to February) by 31 March, Quarter 2 (March to May) by 30 June, Quarter 3 (June to August) by 30 September and Quarter 4 (September to November) by 31 December.*

4.2 Review process

Air quality monitoring commenced at the two ambient and one portal site in May 2017, approximately two months before the Waterview Tunnel was officially opened on 2 July 2017. Since then WTJO has been posting the monthly monitoring reports on the publically available Waterview projects website below:

<https://www.nzta.govt.nz/projects/the-western-ring-route/waterview-tunnel/technical-reports/>

Typically these reports appear within one month after the end of the relevant month which is usual for air quality monitoring reports, due to calibration and data processing requirements.

The Peer Review Panel reviewed the following documents:

- WTJO (2017a). *Waterview Operational Air Quality Monitoring Report July 2017*, prepared by the Waterview Tunnel Joint Operation, 30 August 2017
- WTJO (2017b). *Waterview Operational Air Quality Monitoring Report August 2017*, prepared by the Waterview Tunnel Joint Operation, 29 September 2017
- WTJO (2017c). *Waterview Operational Air Quality Monitoring Report September 2017*, prepared by the Waterview Tunnel Joint Operation, 27 October 2017
- WTJO (2017d). *Waterview Operational Air Quality Monitoring Report October 2017*, prepared by the Waterview Tunnel Joint Operation, 27 November 2017
- WTJO (2017e). *Waterview Operational Air Quality Monitoring Report November 2017*, prepared by the Waterview Tunnel Joint Operation, 18 December 2017
- WTJO (2018a). *Waterview Operational Air Quality Monitoring Report December 2017*, prepared by the Waterview Tunnel Joint Operation, 21 January 2018
- WTJO (2018b). *Waterview Operational Air Quality Monitoring Report January 2018*, prepared by the Waterview Tunnel Joint Operation, 27 February 2018
- WTJO (2018c). *Waterview Operational Air Quality Monitoring Report February 2018*, prepared by the Waterview Tunnel Joint Operation, 28 March 2018
- WTJO (2018d). *Waterview Operational Air Quality Monitoring Report March 2018*, prepared by the Waterview Tunnel Joint Operation, 27 April 2018
- WTJO (2018e). *Waterview Operational Air Quality Monitoring Report April 2018*, prepared by the Waterview Tunnel Joint Operation, 28 May 2018
- WTJO (2018f). *Waterview Operational Air Quality Monitoring Report May 2018*, prepared by the Waterview Tunnel Joint Operation, 29 June 2018

- WTJO (2018g). *Waterview Operational Air Quality Monitoring Report June 2018*, prepared by the Waterview Tunnel Joint Operation, 8 August 2018

We note that the reports have evolved since July 2017 to incorporate additional information and since September 2017 now include:

- The monthly results, analyses and conclusions
- A suite of appendices covering:
 - the air quality conditions of consent
 - maps of the monitoring location
 - valid data exception report
 - previous monthly data (particularly useful for indicating seasonal and long term trends)
 - pollution roses for the month
 - the original baseline monitoring results for comparison

Table 1 shows the summary statistics for the full 12 months of monitoring post tunnel opening. The results are colour-coded **green** if they fall below 33% of the relevant criteria, **yellow** if they fall between 33% and 67% of the criteria, **orange** if they fall between 67% and 100% of the criteria and **red** if they exceed the criteria.

Table 1: Summary of the Waterview operational air quality monitoring results for July 2017 to June 2018

AQ Station	Parameter	Pre Tunnel Opening ($\mu\text{g}/\text{m}^3$)		Post Tunnel Opening ($\mu\text{g}/\text{m}^3$)												Criteria ($\mu\text{g}/\text{m}^3$)
		May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	
Northern ambient	Max 1-hr NO ₂	65.5	58.2	96.8	93.2	91.3	77.9	62.1	57.8	53.6	62.9	62.1	69.8	83.5	87.5	200
	Max 24-hr NO ₂	30.2	36.9	46.4	54.1	44.8	39.4	26.5	31.7	24.7	30.2	34.3	42.7	46.4	45.0	100
	Max 24-hr PM _{2.5}	32.7	24.9	24.8	16.9	14.0	10.5	11.3	10.8	16.0	13.1	11.3	14.4	21.8	27.0	25
	Max 24-hr PM ₁₀	35.7	33.3	31.0	26.4	26.9	31.3	35.1	24.4	36.0	27.6	31.0	32.8	29.9	36.8	50
Southern ambient	Max 1-hr NO ₂	64.1	70.3	73.3	63.5	73.4	61.9	50.5	44.7	32.8	51.7	41.1	57.0	64.8	62.4	200
	Max 24-hr NO ₂	30.0	30.8	38.2	34.7	27.4	25.5	20.7	16.9	18.5	17.9	22.8	29.6	36.5	38.8	100
	Max 24-hr PM _{2.5}	23.2	19.1	26.5	12.6	12.1	13.3	9.8	8.1	14.0	9.8	11.0	15.9	21.9	26.4	25
	Max 24-hr PM ₁₀	35.8	31.8	31.8	28.8	31.6	37.9	22.0	20.1	34.0	26.7	23.9	27.3	26.5	34.1	50
Portal	Max rolling 1-hr NO ₂	70.8	80.6	86.9	73.6	84.9	62.6	63.5	51.2	46.7	46.0	51.0	67.4	78.7	87.8	200

Note that construction activities on site in the vicinity of the stations, including vehicle movements on haul roads, will have contributed to particulate concentrations pre-tunnel opening. Baseline measurements of PM_{2.5} were also elevated in May 2017 during the night time due to domestic smoke from adjacent residential properties.

As a cross-check we requested the traffic data to review any trends in average daily traffic numbers over the same 12-month period. Figure 6 shows the change in monthly average daily traffic since the tunnel opened in July 2017. Traffic numbers have steadily increased in both directions over time and for July 2018 are now approximately 12% higher than those recorded in July 2017. Figure 6 shows some month to month variation - e.g. October, January and April are below the overall trend, possibly due to school holidays - but the variability is only a matter of a few percentage points.

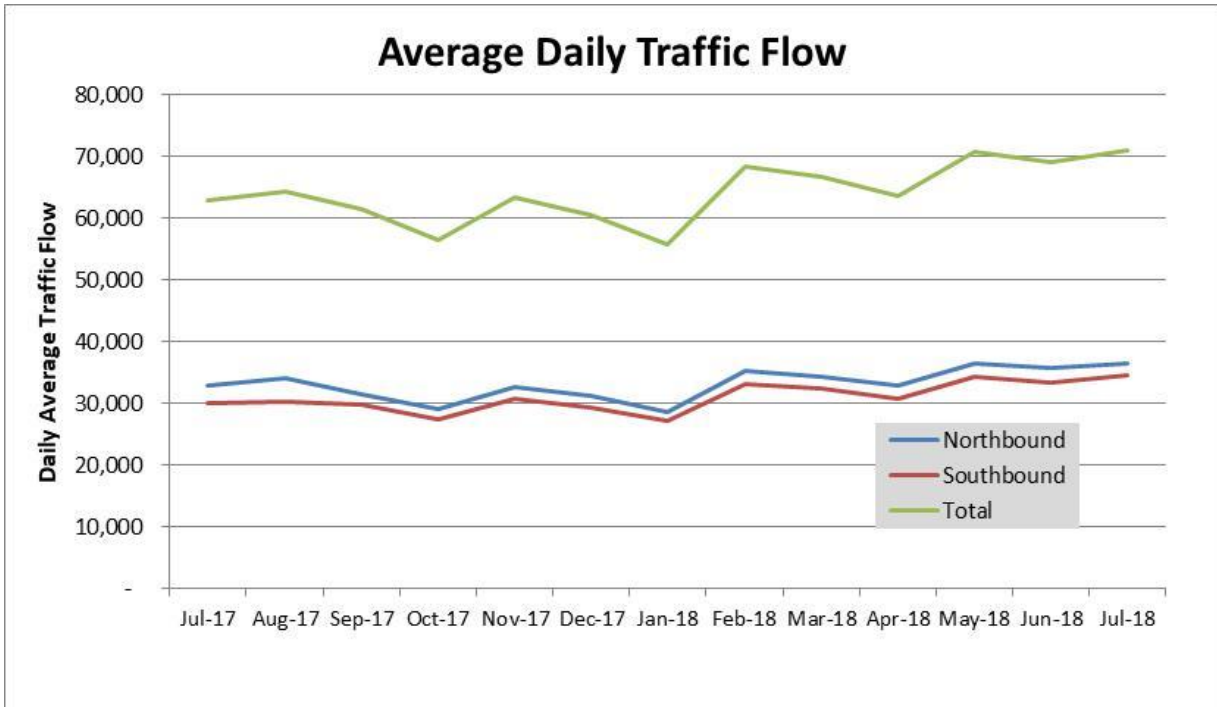


Figure 6: Trends in monthly average daily traffic since the tunnel opened

This means that the ambient air quality monitoring results to date capture the realistic operating conditions in the tunnel with respect to traffic numbers.

WTJO are currently developing a procedure to extract % heavy vehicle traffic based on small, medium and large vehicles using the video count system. This will be included in the next annual report.

4.3 Conclusions/recommendations

The monthly monitoring reports are made available in a timely and easily accessible manner. The commentary is well written and clearly presented, making it easily understood by interested parties.

As expected, the NO₂ results correlate strongly with traffic but the particulate (PM₁₀ and PM_{2.5}) concentrations are influenced by other non-traffic sources, such as home heating emissions in winter time. All results show seasonality with concentrations being elevated in the winter or colder months.

We consider that condition OA.4 is satisfied and we, as Peer Review Panel, do not need to undertake any further review of this condition.

We note that because monitoring has now been underway for 12 months, future ambient air quality reporting will be quarterly, which is reasonable given no issues have been raised in the monitoring results to this point.

5 Air quality exceedances (OA.5)

5.1 Requirement

Condition OA.5 requires that:

OA.5 *If the monitoring required by Condition OA.2 shows that concentrations of contaminants in ambient air at the monitoring locations exceeds the relevant National Environmental Standards for air quality, or Regional Air Quality Targets (as identified in Chapter 4 of the Auckland Regional Plan: Air, Land and Water), the NZTA shall undertake an investigation into the cause of the exceedance and report this to the **Peer Review Panel** (Condition OA.7) and the Major Infrastructure Team Manager, Auckland Council.*

5.2 Review process

The tunnel monitoring equipment has recorded two exceedances of ambient air quality guidelines in the 12 months since opening.

The Peer Review Panel reviewed the following documents:

- WTJO (2017f). *Waterview 16/07/2017 PM_{2.5} Exceedance Report*, prepared by the Waterview Tunnel Joint Operation, 25 July 2017
- WTJO (2018h). *Waterview 30/06/2018 PM_{2.5} Exceedance Report*, prepared by the Waterview Tunnel Joint Operation, 09 August 2018

The exceedance reports are well-written and include:

- detailed maps showing the locations of the monitoring sites
- pollution and wind roses for the exceedance day/s
- relevant (unvalidated) monitoring data on and around the days of exceedance for all pollutants of concern (PM_{2.5}, PM₁₀ and NO₂)
- a robust assessment of the likely cause of the exceedance

The first exceedance of ambient guidelines occurred on 16 July 2017 (when the southern ambient air quality station recorded a PM_{2.5} 24-hour average of 26µg/m³ versus the Regional Air Quality Target of 25µg/m³). This exceedance was investigated and reported to the Peer Review Panel and Auckland Council. We and Council agreed that the most likely cause was domestic home heating (i.e. woodburners), given the time of year and the coincidental drop in ambient temperature below 10°C.

Another exceedance of ambient guidelines occurred on 30 June 2018 (when the northern and southern ambient air quality stations recorded PM_{2.5} 24-hour averages of 27 and 26µg/m³ respectively versus the Regional Air Quality Target of 25µg/m³). This exceedance was investigated and reported to the Peer Review Panel and Auckland Council. We and Council agreed that the most likely cause was also domestic home heating, as the reading corresponded with the coldest week of the 2018 winter.

While we appreciate the prompt notice of potential exceedances, we wonder whether a better approach might be for WTJO to notify us (the Peer Review Panel) and Auckland Council of the possible exceedance and then prepare the formal exceedance report for review once the validated data are available and can be incorporated.

5.3 Conclusions/recommendations

From the exceedance reporting and actions to date, we consider that the intent of condition OA.5 is being met. However, we recommend changing the process slightly so that verbal notice of a possible exceedance is given and then the report is prepared once the validated data are available. We also recommend posting the reports on the project website for public transparency.

Regardless, we re-iterate that we agree with the finding that both of the exceedances to date of the PM_{2.5} 24-hour average guideline have most likely been as a result of the added burden of pollution from domestic home heating (i.e. woodburners) rather than the tunnel operation.

We, as Peer Review Panel, will continue to receive any future exceedance reports (if they arise) and will review compliance with this condition again in our next annual report (due around September/October 2019).

6 Compliance with air quality assessment (OA.6)

6.1 Requirement

Condition OA.6 requires that:

OA.6 The air quality monitoring shall be undertaken in general accordance with the Operational Air Quality Management Procedure (Appendix O of Technical Report G.1 Assessment of Air Quality Effects) submitted with this application.

6.2 Review process

The Peer Review Panel reviewed the following document:

- Beca/NIWA (2010b). *Assessment of Air Quality Effects of the Western Ring Route - Waterview Connection, Appendix O. Operational Air Quality Monitoring*, prepared for the NZ Transport Agency by Beca and NIWA, July 2010

Appendix O states that the objectives of the post-project monitoring are to:

- achieve compliance with in-tunnel air quality standards
- demonstrate compliance with ambient air quality standards
- minimise impacts on ambient air quality adjacent to the project

This appendix was presented in the original assessment of effects to the Board of Enquiry and then used as a basis to develop the final agreed conditions of consent. The operational air quality conditions OA.1 to OA.8 relate to outdoor (ambient) air quality effects so therefore only cover the last two objectives.

The final agreed conditions of consent retain assessment criteria for PM₁₀, PM_{2.5} and NO₂ only (carbon monoxide and benzene are not included). However, all other major aspects of the procedure - such as the location of monitoring stations, duration of monitoring and reporting frequency - are captured in the final conditions.

We note that the original table of assessment criteria in Appendix O includes annual standards, such as the World Health Organization annual average guideline for NO₂ of 40µg/m³. Now that monitoring has been underway for 12 months, it would be possible to report against the proposed annual guidelines for PM₁₀, PM_{2.5} and NO₂. WTJO has agreed to include rolling annual averages in the future ambient air quality monitoring reports.

6.3 Conclusions/recommendations

Overall, we consider that condition OA.6 is satisfied and we, as Peer Review Panel, do not need to undertake any further review of this condition. Rolling annual averages for PM₁₀, PM_{2.5} and NO₂ will be included in the ambient air quality monitoring reports from June 2018 onwards.

7 Peer review role and outputs (OA.7)

7.1 Requirement

Condition OA.7 requires that:

***OA.7** A **Peer Review Panel** shall be appointed by NZTA with the agreement of Major Infrastructure Team Manager, Auckland Council for the purpose of reviewing the ambient air quality monitoring programme and results. The **Peer Review Panel** shall consist of two independent experts in air quality with experience in ambient air quality monitoring and emissions from motor vehicles. The **Peer Review Panel** shall review all ambient monitoring, relevant traffic data and tunnel emissions and provide a summary report including any interpretation and recommendations to NZTA, Auckland Council and the Community Liaison Group(s) within 6 months of the tunnels becoming operational and annually thereafter.*

7.2 Review process

The timeline for involvement of the Peer Review Panel to date is as follows:

- The confirmation and appointment of Peer Review Panel members was completed on 3 June 2016.
- Our initial task was a site visit on 14 July 2016 to review the ventilation stack design/locations and potential locations of ambient monitoring.
- Further discussions were had later in 2016 confirming the final locations of the monitoring (especially the northern ambient air quality monitoring site) and actual equipment to be installed (especially the use of a CAPS NO₂ analyser for portal emissions monitoring).
- The monitoring equipment went live in May 2017, two months before the tunnel was officially opened on 2 July 2017.
- The first exceedance of ambient guidelines occurred on 16 July 2017 (when the southern ambient air quality station recorded a PM_{2.5} 24-hour average of 26µg/m³ versus the Regional Air Quality Target of 25µg/m³). This exceedance was investigated and reported to the Peer Review Panel and Auckland Council. We and Council agreed that the most likely cause was home heating, given the time of year, the coincidental drop in ambient temperature below 10°C and the fact that the traffic numbers were relatively low.
- Another exceedance of ambient guidelines occurred on 30 June 2018 (when the northern and southern ambient air quality stations recorded PM_{2.5} 24-hour averages of 27 and 26µg/m³ respectively versus the Regional Air Quality Target of 25µg/m³). This exceedance was investigated and reported to the Peer Review Panel and Auckland Council. We and Council agreed that the most likely cause was also home heating, as the reading corresponded with the coldest week of the 2018 winter.
- In September 2018, with a full 12 months of validated monitoring (post-opening) results, the Peer Review Panel was engaged to prepare the first annual report (this report).

7.3 Conclusions/recommendations

We consider that condition OA.7 is being met and we, as Peer Review Panel, will be following up this first annual report with a second one in 12 months' time which will determine whether the air quality monitoring needs to be extended.

8 Tunnel portal emissions (OA.8)

8.1 Requirement

Condition OA.8 requires that:

OA.8 *The tunnel ventilation system shall be designed and operated to ensure that any air emitted from the tunnel portals does not cause the concentration of nitrogen dioxide (NO₂) in ambient air to exceed 200 micrograms per cubic metre, expressed as a rolling 1-hour average, at any point beyond the designation boundary that borders an air pollution sensitive land use.*

Advice Note: *The above standard reflects the National Environmental Standard for Nitrogen Dioxide (NO₂) concentration in ambient air.*

8.2 Review process

Portal emissions monitoring is undertaken at a separate site as close as practicably possible to the worst case modelled receptor at the southern end of the tunnel (shown in Figure 3). However, it is likely that the northern ambient air quality station (shown in Figure 1) provides representative results to assess effects at the nearest residential receptors to the northern portal. Consequently results from those two sites were used to assess compliance with this condition.

The Peer Review Panel reviewed the following documents:

- WTJO (2017a). *Waterview Operational Air Quality Monitoring Report July 2017*, prepared by the Waterview Tunnel Joint Operation, 30 August 2017
- WTJO (2017b). *Waterview Operational Air Quality Monitoring Report August 2017*, prepared by the Waterview Tunnel Joint Operation, 29 September 2017
- WTJO (2017c). *Waterview Operational Air Quality Monitoring Report September 2017*, prepared by the Waterview Tunnel Joint Operation, 27 October 2017
- WTJO (2017d). *Waterview Operational Air Quality Monitoring Report October 2017*, prepared by the Waterview Tunnel Joint Operation, 27 November 2017
- WTJO (2017e). *Waterview Operational Air Quality Monitoring Report November 2017*, prepared by the Waterview Tunnel Joint Operation, 18 December 2017
- WTJO (2017f). *Waterview Operational Air Quality Monitoring Report December 2017*, prepared by the Waterview Tunnel Joint Operation, 21 January 2018
- WTJO (2018a). *Waterview Operational Air Quality Monitoring Report January 2018*, prepared by the Waterview Tunnel Joint Operation, 27 February 2018
- WTJO (2018b). *Waterview Operational Air Quality Monitoring Report February 2018*, prepared by the Waterview Tunnel Joint Operation, 28 March 2018
- WTJO (2018c). *Waterview Operational Air Quality Monitoring Report March 2018*, prepared by the Waterview Tunnel Joint Operation, 27 April 2018
- WTJO (2018d). *Waterview Operational Air Quality Monitoring Report April 2018*, prepared by the Waterview Tunnel Joint Operation, 28 May 2018
- WTJO (2018e). *Waterview Operational Air Quality Monitoring Report May 2018*, prepared by the Waterview Tunnel Joint Operation, 29 June 2018

- WTJO (2018f). *Waterview Operational Air Quality Monitoring Report June 2018*, prepared by the Waterview Tunnel Joint Operation, 8 August 2018

Table 2 shows the summary statistics for the two sites indicative of portal emissions effects for the full 12 months of monitoring post tunnel opening. The results are colour-coded **green** if they fall below 33% of the relevant criteria, **yellow** if they fall between 33% and 67% of the criteria, **orange** if they fall between 67% and 100% of the criteria and **red** if they exceed the criteria.

Table 2: Summary of the Waterview portal emissions monitoring results for July 2017 to June 2018

AQ Station	Parameter	Pre Tunnel Opening ($\mu\text{g}/\text{m}^3$)		Post Tunnel Opening ($\mu\text{g}/\text{m}^3$)												Criteria ($\mu\text{g}/\text{m}^3$)
		May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	
		Northern ambient	Max 1-hr NO_2	65.5	58.2	96.8	93.2	91.3	77.9	62.1	57.8	53.6	62.9	62.1	69.8	
Portal	Max rolling 1-hr NO_2	70.8	80.6	86.9	73.6	84.9	62.6	63.5	51.2	46.7	46.0	51.0	67.4	78.7	87.8	200

No exceedances of the 1-hour NO_2 criteria were recorded at either site for the first 12 months of tunnel operation (post-opening).

As a cross-check we requested the ventilation records to check the fan operating conditions over the same 12-month period. The Waterview Tunnel ventilation system consists of 62 jet fans (30 in the southbound tunnel and 32 in the northbound tunnel) and eight axial fans (four each for each ventilation stack). The axial fans are the ones used to control portal emissions and to date they have not been triggered/utilised for tunnel air quality control - they have only been run for short periods as part of routine maintenance. The jet fans operate to assist achieving a minimum air velocity of 2-3m/s in the tunnel and to manage in-tunnel air quality during peak periods. They have also only typically been operated in maintenance mode. As a consequence, Table 2 shows that even without the axial fans being triggered (which would direct the emissions away from the portals and to the stacks) the effect of the portal emissions on the surrounding locations is well within acceptable air quality criteria.

8.3 Conclusions/recommendations

We consider that condition OA.8 is being met and we, as Peer Review Panel, will review compliance with this condition again in our next annual report (due around September/October 2019).

References

- Beca/NIWA (2010a). *Assessment of Air Quality Effects of the Western Ring Route - Waterview Connection, Appendix I. Air Quality Assessment of Tunnel Portal Emissions*, prepared for the NZ Transport Agency by Beca and NIWA, July 2010
- Beca/NIWA (2010b). *Assessment of Air Quality Effects of the Western Ring Route - Waterview Connection, Appendix O. Operational Air Quality Monitoring*, prepared for the NZ Transport Agency by Beca and NIWA, July 2010
- MfE (2011). *Resource Management (National Environmental Standards for Air Quality) Regulations 2004*, plus 2011 amendments, administered by the Ministry for the Environment, 1 June 2011
- WCA (2013a). *Northern Ventilation Building - Architecture and Above Ground Structure - Stage 2 Report*, Document #400-RPT-02603 prepared by the Well Connected Alliance, 20 September 2013
- WCA (2013b). *Southern Ventilation Building Structure and Architecture - Stage 2 Report*, Document #400-RPT-02237 prepared by the Well Connected Alliance, 9 August 2013
- WCA (2016). *Waterview Connection Project: Operational Air Quality Conditions OA.2 and OA.3*, letter to the Peer Review Panel prepared by the Well Connected Alliance, 26 October 2016
- WTJO (2017a). *Waterview Operational Air Quality Monitoring Report July 2017*, prepared by the Waterview Tunnel Joint Operation, 30 August 2017
- WTJO (2017b). *Waterview Operational Air Quality Monitoring Report August 2017*, prepared by the Waterview Tunnel Joint Operation, 29 September 2017
- WTJO (2017c). *Waterview Operational Air Quality Monitoring Report September 2017*, prepared by the Waterview Tunnel Joint Operation, 27 October 2017
- WTJO (2017d). *Waterview Operational Air Quality Monitoring Report October 2017*, prepared by the Waterview Tunnel Joint Operation, 27 November 2017
- WTJO (2017e). *Waterview Operational Air Quality Monitoring Report November 2017*, prepared by the Waterview Tunnel Joint Operation, 18 December 2017
- WTJO (2017f). *Waterview 16/07/2017 PM_{2.5} Exceedance Report*, prepared by the Waterview Tunnel Joint Operation, 25 July 2017
- WTJO (2018a). *Waterview Operational Air Quality Monitoring Report December 2017*, prepared by the Waterview Tunnel Joint Operation, 21 January 2018
- WTJO (2018b). *Waterview Operational Air Quality Monitoring Report January 2018*, prepared by the Waterview Tunnel Joint Operation, 27 February 2018
- WTJO (2018c). *Waterview Operational Air Quality Monitoring Report February 2018*, prepared by the Waterview Tunnel Joint Operation, 28 March 2018
- WTJO (2018d). *Waterview Operational Air Quality Monitoring Report March 2018*, prepared by the Waterview Tunnel Joint Operation, 27 April 2018
- WTJO (2018e). *Waterview Operational Air Quality Monitoring Report April 2018*, prepared by the Waterview Tunnel Joint Operation, 28 May 2018
- WTJO (2018f). *Waterview Operational Air Quality Monitoring Report May 2018*, prepared by the Waterview Tunnel Joint Operation, 29 June 2018
- WTJO (2018g). *Waterview Operational Air Quality Monitoring Report June 2018*, prepared by the Waterview Tunnel Joint Operation, 8 August 2018

WTJO (2018h). *Waterview 30/06/2018 PM_{2.5} Exceedance Report*, prepared by the Waterview Tunnel Joint Operation, 09 August 2018