



Summary Report of Waterview Tunnel Operation - July 2018 to June 2019

Review of compliance with operational air quality conditions

Prepared for Waterview Tunnel Joint Operation

19 November 2019

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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.

Our first annual report¹ (prepared in October 2018) covered the period 1 July 2017 to 30 June 2018 and discussed compliance with the following conditions:

- 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)

We concluded in that report that conditions OA.1, OA.2 and OA.3 were fully satisfied.

This report is our second annual report covering the period 1 July 2018 to 30 June 2019 and reviews the following:

- Results of the ambient air quality monitoring for July 2018 to June 2019 (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 second 12 months of operation, we are 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. **We therefore consider that all conditions have now been fully satisfied and no further ambient air quality monitoring/reporting is required.**

¹ Kuschel & Simpson (2018). *Summary report of Waterview Tunnel operation - July 2017 to June 2018: Review of compliance with operational air quality conditions*, prepared by Gerda Kuschel and Jenny Simpson for Waterview Tunnel Joint Operation, 19 October 2018

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1 Air quality monitoring results (OA.4)

1.1 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.

1.2 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 Waterview Tunnel Joint Operation (WTJO) has been posting the 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.

For the first 12 months (1 July 2017 to 30 June 2018), the reports were produced monthly. From 1 July 2018, the frequency of reporting was reduced to quarterly but the parameters reported were extended to include rolling annual averages (as 12 months of data were now available for calculations).

For this second annual report, we reviewed the following documents:

- WTJO (2018a). *Waterview Operational Air Quality Monitoring Report July to September 2018*, prepared by the Waterview Tunnel Joint Operation, November 2018
- WTJO (2018b). *Waterview Operational Air Quality Monitoring Report October to December 2018*, prepared by the Waterview Tunnel Joint Operation, December 2018
- WTJO (2019a). *Waterview Operational Air Quality Monitoring Report January to March 2019*, prepared by the Waterview Tunnel Joint Operation, May 2019
- WTJO (2019b). *Waterview Operational Air Quality Monitoring Report April to June 2019*, prepared by the Waterview Tunnel Joint Operation, September 2019

Ambient monitoring data were compared against the relevant National Environmental Standards (NESAQ) for air quality (MfE, 2011) and Auckland Regional air quality targets (ARAQT), shown in Table 1.

Table 1. WTJO ambient air quality criteria

Pollutant	Threshold concentration	Averaging period	Criteria
Fine particles (PM ₁₀)	50 µg/m ³	24-hour	NESAQ
	20 µg/m ³	Annual	ARAQT
Fine particles (PM _{2.5})	25 µg/m ³	24-hour	ARAQT
	10 µg/m ³	Annual	ARAQT
Nitrogen dioxide (NO ₂)	200 µg/m ³	1-hour	NESAQ
	100 µg/m ³	24-hour	ARAQT
	40 µg/m ³	Annual	ARAQT

Table 2 shows the summary statistics for the full 24 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. This table includes rolling annual averages for PM₁₀, PM_{2.5} and NO₂ from 1 July 2018.

Data capture over the 24 months of monitoring was generally excellent - well above the 95% target recommended by the Ministry for the Environment (MfE, 2009). While there are gaps in the PM_{2.5} data record at the Southern ambient station for one month (January 2019) and the PM₁₀ data record also at the Southern ambient station for one month (February 2019), we do not consider that these missing averages impact any conclusions made based on the rest of the dataset. We would not expect to see significantly elevated concentrations or exceedances of those contaminants at those locations in the missing months.

While two days of exceedances were recorded in the first 12 months of monitoring (most likely due to domestic home heating as they occurred in the winter months), no further exceedances were recorded in the second 12 months of monitoring. The rolling annual averages for PM_{2.5} and PM₁₀ were above 67% of their respective guidelines/standards but tended to be stable and did not exceed the criteria.

Figure 1 shows the change in monthly average daily traffic since the tunnel opened in July 2017. Total daily traffic volumes have increased by 7% on average since opening but there is appreciable month to month variation. Average daily traffic flows are typically lower during school holiday periods, most especially around the Christmas/New Year break (December/January).

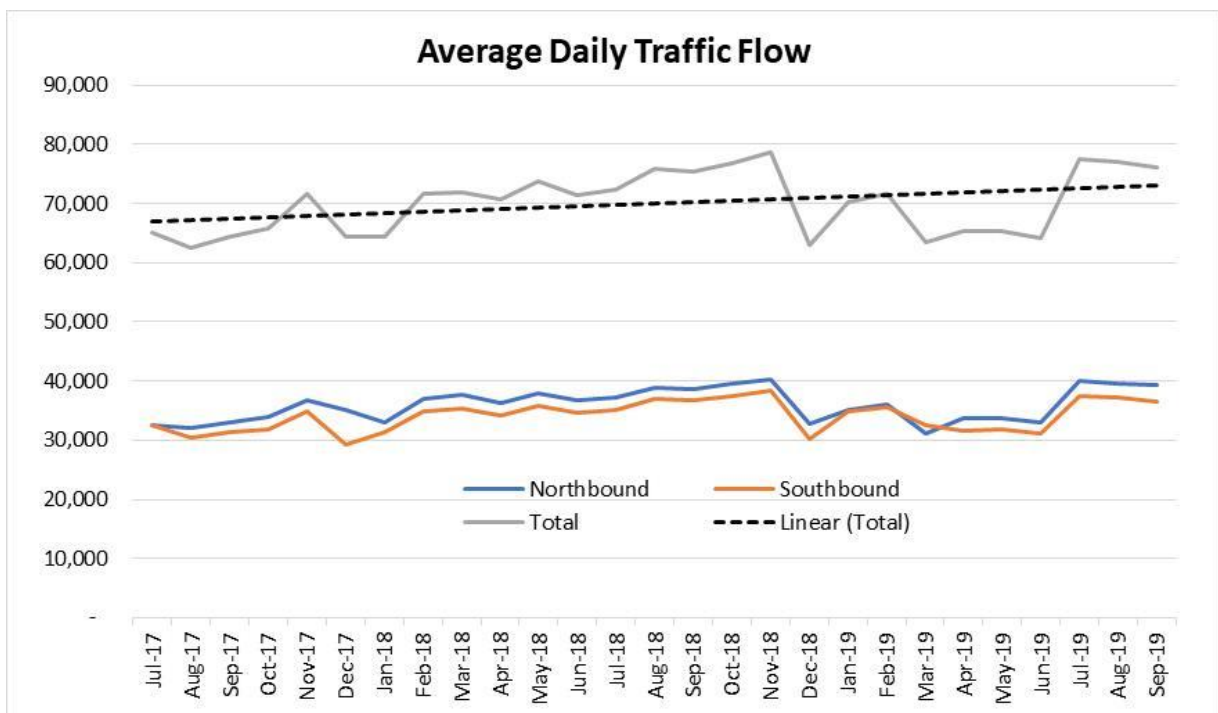


Figure 1: Trends in monthly average daily traffic since the tunnel opened

The monitoring results also show some seasonality with concentrations typically elevated in the winter or colder months. As expected, the NO₂ results correlate with traffic but the particulate (PM₁₀ and PM_{2.5}) concentrations show the influence of non-traffic sources, such as home heating emissions in winter time. This means that the ambient air quality monitoring results capture the realistic operating conditions in the tunnel with respect to traffic numbers.

Table 2: Summary of the Waterview operational air quality monitoring results for July 2017 to June 2019

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	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19		Jun-19	
		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	101.5	101.1	75.8	83.4	63.2	65.5	44.1	53.9	59.8		60.5	83.6
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	50.3	50.3	44.2	43.4	33.5	27.3	23.2	24.1	29.4	34.8	48.2	48.0	100	
Rolling Annual NO ₂																22.8	22.3	23.4	24.1	24.4	24.6	24.7	24.9	24.8	24.6	24.4	24.7	40	
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	19.0	14.8	11.2	10.3	12.8	11.7	14.8	12.2	11.0	9.8	11.9	20.0	25	
Rolling Annual PM _{2.5}																8.0	8.1	8.1	8.0	8.1	8.1	8.1	8.2	8.1	8.1	8.1	7.9	7.7	10
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	31.4	24.5	22.1	25.7	29.5	28.5	37.7	20.8	19.1	21.3	32.9	28.8	50	
Rolling Annual PM ₁₀																16.5	16.7	16.7	16.7	17.2	17.4	17.3	17.2	17.0	16.5	15.9	15.8	20	
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	73.5	72.7	56.9	61.1	50.7	41.3	38.1	44.4	46.9	52.8	68.4	74.7	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	39.7	38.9	27.7	25.9	26.0	17.1	14.6	20.8	28.1	32.9	35.5	40.4	100	
	Rolling Annual NO ₂															15.8	16.1	16.3	16.8	16.9	17.0	17.1	17.2	17.4	17.5	17.6	17.6	40	
	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	21.3	16.1	12.0	9.8	12.8	13.7	na	11.3	7.8	11.1	12.7	20.5	25	
	Rolling Annual PM _{2.5}															7.3	7.5	7.5	7.5	7.8	7.9	7.9	7.9	7.9	7.5	7.3	7.4	10	
	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	30.2	21.7	18.5	20.3	25.8	28.8	27.2	na	18.6	17.0	31.6	31.7	50	
	Rolling Annual PM ₁₀															14.3	14.4	14.1	13.8	14.1	14.3	14.2	14.2	14.3	14.1	13.7	13.9	20	
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	86.9	75.5	76.1	70.5	65.8	53.0	48.5	47.6	50.7	70.7	72.2	81.4	200	
	Rolling Annual NO ₂															15.5	16.0	16.1	16.7	17.0	16.9	17.1	17.3	17.5	17.6	18.0	18.0	40	

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	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19		Jun-19
		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	101.5	101.1	75.8	83.4	63.2	65.5	44.1	53.9	59.8		60.5
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	86.9	75.5	76.1	70.5	65.8	53.0	48.5	47.6	50.7	70.7	72.2	81.4	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.

1.3 Conclusions/recommendations

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

All results show some seasonality with concentrations typically elevated in the winter or colder months. As expected, the NO₂ results correlate with traffic but the particulate (PM₁₀ and PM_{2.5}) concentrations show the influence of non-traffic sources, such as home heating emissions in winter time.

We consider that condition OA.4 is now fully satisfied.

2 Air quality exceedances (OA.5)

2.1 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.*

2.2 Review process

While two days of exceedances were recorded in the first 12 months of monitoring (most likely due to domestic home heating as they occurred in the winter months), **no further exceedances were recorded in the second 12 months of monitoring** even with the inclusion of rolling annual averages.

Consequently, there were no exceedance reports that required our review.

As seen in Table 1, all results show some seasonality with concentrations typically elevated in the winter or colder months. As expected, the NO₂ results correlate strongly with traffic but the particulate (PM₁₀ and PM_{2.5}) concentrations show the influence of non-traffic sources, such as home heating emissions in winter time.

2.3 Conclusions/recommendations

We consider that condition OA.5 is now fully satisfied.

3 Compliance with air quality assessment (OA.6)

3.1 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.

3.2 Review process

We reviewed the following document:

- Beca/NIWA (2010). *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

In our previous review, we noted that the original table of assessment criteria in Appendix O included annual standards, such as the World Health Organization annual average guideline for NO₂ of 40µg/m³. We recommended that ambient air quality monitoring reports from 1 July 2018 (once monitoring had been underway for 12 months) include rolling annual averages to be compared with annual guidelines for PM₁₀, PM_{2.5} and NO₂. This was agreed by WTJO and actioned in the quarterly air quality monitoring reports from 1 July 2018.

The rolling annual averages are summarised in Table 1 (in section 1). While the annual averages for PM_{2.5} and PM₁₀ were above 67% of their respective guidelines/standards, the concentrations tended to be stable and did not exceed the criteria.

3.3 Conclusions/recommendations

We consider that condition OA.6 is now fully satisfied.

4 Peer review role and outputs (OA.7)

4.1 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.

4.2 Review process

The timeline for our involvement 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 the first full 12 months of validated monitoring (post-opening) results, the Peer Review Panel was engaged to prepare the first annual report (published in October 2018).
- In October 2019, with the second full 12 months of validated monitoring (post-opening) results, the Peer Review Panel was engaged to prepare the second annual report (this report).

4.3 Conclusions/recommendations

We consider that condition OA.7 is now fully satisfied.

5 Tunnel portal emissions (OA.8)

5.1 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.*

5.2 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. However, it is likely that the northern ambient air quality station 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.

For this second annual report, we reviewed the following documents:

- WTJO (2018a). *Waterview Operational Air Quality Monitoring Report July to September 2018*, prepared by the Waterview Tunnel Joint Operation, November 2018
- WTJO (2018b). *Waterview Operational Air Quality Monitoring Report October to December 2018*, prepared by the Waterview Tunnel Joint Operation, December 2018
- WTJO (2019a). *Waterview Operational Air Quality Monitoring Report January to March 2019*, prepared by the Waterview Tunnel Joint Operation, May 2019
- WTJO (2019b). *Waterview Operational Air Quality Monitoring Report April to June 2019*, prepared by the Waterview Tunnel Joint Operation, September 2019
- WTJO (2018f). *Waterview Operational Air Quality Monitoring Report June 2018*, prepared by the Waterview Tunnel Joint Operation, 8 August 2018

Table 1 (in section 1) shows the summary statistics for the two sites indicative of portal emissions effects for the full 24 months of monitoring post tunnel opening, including rolling annual averages. 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.

No exceedances of the 1-hour NO₂ criteria were recorded at either site for the second 12 months of tunnel operation (post-opening).

5.3 Conclusions/recommendations

We consider that condition OA.8 is now fully satisfied.

References

- Beca/NIWA (2010). *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
- Kuschel & Simpson (2018). *Summary report of Waterview Tunnel Operation - July 2017 to June 2018: Review of compliance with operational air quality conditions*, prepared by Gerda Kuschel and Jenny Simpson for Waterview Tunnel Joint Operation, 19 October 2018
- MfE (2009). *Good practice guide for air quality monitoring and data management 2009*, Ministry for the Environment, April 2009
- 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
- WTJO (2018a). *Waterview Operational Air Quality Monitoring Report July to September 2018*, prepared by the Waterview Tunnel Joint Operation, November 2018
- WTJO (2018b). *Waterview Operational Air Quality Monitoring Report October to December 2018*, prepared by the Waterview Tunnel Joint Operation, December 2018
- WTJO (2019a). *Waterview Operational Air Quality Monitoring Report January to March 2019*, prepared by the Waterview Tunnel Joint Operation, May 2019
- WTJO (2019b). *Waterview Operational Air Quality Monitoring Report April to June 2019*, prepared by the Waterview Tunnel Joint Operation, September 2019