Attachment 32

Air Quality Assessment prepared by Tonkin & Taylor

REPORT

Tonkin+Taylor

New Bledisloe North Wharf and Fergusson North Wharf extension

Air quality assessment

Prepared for
Port of Auckland Limited

Prepared by
Tonkin & Taylor Ltd

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Glossary

Term	Definition
BC	Black carbon
BN	Bledisloe North Wharf
BOPRC	Bay of Plenty Regional Council
CO	Carbon monoxide
FN	Fergusson North Wharf
IMO	International Maritime Organization
MARPOL	The International Convention for the Prevention of Pollution from Ships
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
PM_{10}	Fine particulate matter (diameter less than or equal to 10 microns)
$PM_{2.5}$	Fine particulate matter (diameter less than or equal to 2.5 microns)
RORO	Roll-on roll-off car carrier vessel
SO_2	Sulphur dioxide
teu	A teu (twenty-foot equivalent unit) is a measure of volume in units of twenty-foot long containers
WHO	World Health Organization

Executive summary

Port of Auckland Limited is seeking authorisation for a project at the Port of Auckland, described as:

- New Bledisloe North Wharf; and
- Fergusson North Wharf extension

This report assesses the potential changes in effects of discharges to air from shipping associated with this project.

While at berth, a ship's energy requirements for heating/cooling and electricity are met either by running auxiliary engines or generators or by running the main engines on low load. The emissions from these engines and/or generators are combustion products from burning of fuel. Boilers are also used to heat the marine fuel to keep it fluid.

The contaminants present in shipping emissions (combustion products) that are of most interest in relation to effects on human health and the environment are:

- Fine particulate matter (PM_{10} and $PM_{2.5}$).
- Oxides of nitrogen (NOx), of which nitrogen dioxide (NO_2) is the contaminant of interest. NO_2 typically makes up 5 to 10% of the NOx emitted from combustion sources.
- Sulphur dioxide (SO_2).

This assessment focuses on air quality effects of emissions of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 as the key contaminants relative to shipping emissions.

Numerous studies have been undertaken to characterise the effects of shipping emissions around the Auckland waterfront. These have generally shown that while shipping emissions will contribute to cumulative air pollution levels around the Auckland waterfront, the contribution is generally small compared to other sources and relevant air quality standards and guidelines.

Existing air quality around the Waterfront and Auckland CBD meets current New Zealand air quality standards and guidelines for all pollutants considered in this assessment. Concentrations of NO_2 and $PM_{2.5}$ are likely to be close to, or may exceed, the more stringent WHO 2021 air quality guidelines. However, while shipping emissions will contribute to cumulative air pollution levels, the contribution is generally small compared to other sources and relevant air quality standards and guidelines. In particular, NO_2 concentrations are largely related to land transport emissions and particulate concentrations include a significant component from naturally occurring marine aerosols.

The Fergusson North Wharf extension will enable a reduction in air pollution emissions intensity from increased efficiency in cargo handling associated with larger container ships. Subject to growth in container cargo volumes over time, the project is therefore expected to reduce emissions of contaminants to air.

The New Bledisloe North wharf will have the effect of relocating shipping emission sources. This will materially improve air quality at the Princes Wharf apartments/hotel by increasing the separation distance to large cruise ships, which represent 50 to 60% of cruise ships currently berthing at Princes Wharf. Even with ongoing increases over time in the number of cruise ships visiting the Port, as only small/medium cruise ships will berth at Princes Wharf, the air quality effects, particularly in terms of short-term concentrations of air pollutants, will be less than if large cruise ships continued to berth here.

For all other receptors considered, there will be no material change in air quality for NO_2, PM_{10} and $PM_{2.5}$ as the effects (positive or negative) of changes in separation distance are very small compared to background concentrations. As such, the New Bledisloe North wharf will not measurably

exacerbate existing air quality for contaminants where levels may currently exceed the WHO 2021 guidelines (i.e. $PM_{2.5}$ and NO_2). The reduction in separation distance to some sensitive receptors is likely to result in a very small increase in SO_2 concentrations at these locations. However, SO_2 concentrations are expected to remain well below the New Zealand air quality standards and guidelines and the WHO 2021 air quality guidelines.

1 Introduction

1.1 Background

Port of Auckland Limited (POAL) is seeking authorisation for a project at the Port of Auckland (**the Port**) described as:

- New Bledisloe North Wharf; and
- Fergusson North Wharf extension

This report assesses the potential changes in effects of discharges to air from shipping associated with this project.

1.2 Purpose and scope of assessment

The purpose of this report is to qualitatively assess the potential changes in effects of discharges to air, which are principally related to the geographical redistribution of berthage for ships that currently visit the Port and the ability to accommodate larger containers ships.

This report is structured as follows:

- A description of the baseline and proposed configurations for the new wharf and wharf extension, and the resulting changes to berth locations for different types of vessels.
- Identification of the contaminants of interest in discharges to air from shipping and factors influencing the emission and dispersion of these contaminants.
- Relevant New Zealand and international air quality standards and guidelines.
- A description of various air quality studies relevant to shipping emissions in Auckland
- Existing air quality in the vicinity of the Port for the contaminants of interest.
- A description of the receiving environment, including sensitive receptors.
- An assessment of air quality impacts and overall conclusions in relation to the change in air quality effects associated with the project.

2 Description of activity

This section briefly summarises the aspects of the projects relevant to changing patterns in the spatial distribution of discharges to air from ships at the Port.

New Bledisloe North Wharf (BN)

The BN will be a dual-purpose cruise and roll-on roll-off car carrier (RORO) wharf.

The Port is currently struggling to cater for large cruise ships over 300 m. Measures to accommodate large cruise ships, such as the Ovation of the Seas (348 m long) have included:

- The ship holding position in the Harbour and transferring passengers by tender, which means the ships have to operate their main engines (with associated discharges to air) the entire time; or
- Berthing at the Fergusson Container terminal, which creates a number of conflicts with other Port activities and road users.

The BN will provide for large cruise ships (300 to 350 m long). This will mean that large cruise ships will not need to berth at Fergusson North and approximately half (50 to 60 %) of the cruise ships currently using Princes Wharf will be relocated to BN.

The RORO car carriers will be relocated from Captain Cook Wharf to BN. This will enable the Captain Cook and Marsden Wharves to be used for an alternative purpose.

Fergusson North Wharf extension (FN)

Internationally, there is a trend of increasing size in container ships. The size of container ships is typically expressed in “twenty-foot equivalent units” (teu). This is a measure of volume in units of twenty-foot-long containers.

Currently most container ships visiting the Port are in the range between 2,500 and 5,700 teu. Shipping lines want to bring 6,000 to 8,000 teu ships to New Zealand in the next two to three years, with future plans to accommodate ‘New Panamax’ ships capable of carrying 10,000 teu. Fergusson North can currently accommodate these large (up to 10,000 teu, 360 m long) container ships using the existing dolphins, however the quay cranes cannot access full length. The FN wharf extension is required to enable quay crane access to the full length of ship, which will increase operational efficiency.

Figure 2.1 identifies the existing wharves at the Port and indicative locations of the BN and FN project.

Figure 2.1 Existing wharves at the Port of Auckland and indicative locations of the BN and FN projects.

3 Nature of discharges to air from ships at berth

3.1 Overview

While at berth, a ship's energy requirements for heating/cooling and electricity are met either by running auxiliary engines or generators or by running the main engines on low load. The emissions from these engines and/or generators are combustion products from burning of fuel. Boilers are also used to heat the marine fuel to keep it fluid.

The contaminants present in shipping emissions (combustion products) that are of most interest from in relation to effects on human health and the environment are:

- Fine particulate matter (PM_{10} and $PM_{2.5}$).
- Oxides of nitrogen (NOx), of which nitrogen dioxide (NO_2) is the contaminant of interest. NO_2 typically makes up 5 to 10% of the NOx emitted from combustion sources.
- Sulphur dioxide (SO_2).

This assessment focuses on air quality effects of emissions of PM_{10}, $PM_{2.5}$, NO_2 and SO_2 as the key contaminants relative to shipping emissions.

The emission rates of combustion products from the ships' exhausts are related to the rate of fuel consumption (i.e. the energy requirement of the vessel) and, in the case of SO_2, to the sulphur content of the fuel. The physical dimensions of the ship's exhaust and the exit velocity and temperature of the exhaust emissions are relevant to the dispersion characteristics of the plume.

3.2 Changes in the global marine fuel sulphur limit

SO_2 emissions from shipping are proportional to the sulphur content in the fuel burnt in the ship's engines. Under Regulation 14 of Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL), the global sulphur limit in marine heavy fuel oil was reduced from 3.5% (on a weight basis) to 0.5% (on a weight basis) from 1 January 2020. Some ships, particularly cruise ships, have chosen to install scrubbers (exhaust gas cleaning systems) as an alternative way to meet the equivalent reduction in SO_2 emissions.

New Zealand acceded to MARPOL Annex VI on 26 August 2022. However, the Ministry of Transport had previously identified that all of New Zealand's seaborne imports and exports are carried on ships that are flagged to countries that are parties to MARPOL Annex VI. Therefore, it can be assumed that all ocean-going vessels, including container ships and cruise ships, visiting the Port were operating in compliance with the requirements of MARPOL Annex VI from 1 January 2020 onwards.

3.3 Changes in NOx emissions controls

NOx emissions are generated from the combustion of fossil fuels in the ship's engine. MARPOL Annex VI – Regulation 13 sets out NOx control requirements for installed marine diesel engines of over 130 kilowatt output power (except for engines solely used for emergency purposes). Different levels (Tiers) of NOx emission control apply based on the ship construction date. The Tier dates are shown in Table 3.1.

Table 3.1: MARPOL Annex VI Regulation 13 ship Tier construction dates and emission limits (assumed rated engine speed less than 130 rpm)

Tier	Ship construction date on or after	Total weighted cycle NOx emission limit (g/kWh)
I	1 January 2000	17.0
II	1 January 2011	14.4
III	1 January 2016	3.4

The typical lifespan for a container ship is 20 to 30 years, and the current oldest container ship in service (of any of the top ten container carrier operators worldwide) is 42 years old[1].

Information supplied by POAL indicates that ships servicing New Zealand are typically older vessels, as newer vessels are reserved for servicing more lucrative tradelines. Based on the Regulation 13 Tier categories and the relatively old age of the container fleet visiting New Zealand, the ships visiting the Port are likely to have NOx emission controls no greater than Tier I.

[1] AXS Alphaliner newsletter. 2024-41.

4 Ambient air quality standards and guidelines

4.1 Introduction

The following sections describe relevant New Zealand and international air quality standards and guidelines and more recent guidelines published by the World Health Organization (WHO). Existing air quality in the vicinity of the Port, described in Section 5, is compared to these standards and guidelines for context.

4.2 New Zealand ambient air quality standards and guidelines

The current New Zealand air quality standards and guidelines are as follows:

- The National Environmental Standards for Air Quality (NESAQ). (Resource Management (National Environmental Standards for Air Quality) Regulations 2004 amended on 1 June 2011)
- Proposed changes to the NESAQ (Ministry for the Environment, 2020) - although it is noted these are unlikely to be formally adopted.
- The Ministry for the Environment Ambient Air Quality Guidelines (AAQG). (Ministry for the Environment, Ministry of Health, 2002)

In accordance with Ministry of the Environment good practice guidance, air quality effects are evaluated against these criteria at off-site locations where a person could reasonably be exposed over the relevant time period. In this instance:

- For 1-hour averages, locations where people can be exposed include footpaths and outdoor entertainment areas. It does not include enclosed spaces (indoors/inside vehicles) and roadways or over-water areas where occupation by people is likely to be transient.
- The 24-hour and annual averages are principally considered for residential locations, where people could be present continuously.

The relevant New Zealand ambient air quality standards and guidelines are presented in Table 4.1.

Table 4.1: New Zealand ambient air quality standards and guidelines

Pollutant	Time average	NZ standard/guideline	
		Value (µg/m³)	Source
SO_2	1-hour	350 (570)[a]	NESAQ
	24-hour	120	AAQG
PM_{10}	24-hour	50[b]	NESAQ
	Annual	20	AAQG
$PM_{2.5}$	24-hour	25	Proposed NESAQ
	Annual	10	Proposed NESAQ
NO_2	1-hour	200	NESAQ
	24-hour	100	AAQG

a Nine allowable exceedances per year of 350 µg/m³ (1-hour average) and no exceedances of 570 µg/m³ (1-hour average).

b One allowable exceedance per year.

4.3 World Health Organization guidelines and European limits

In September 2021, the World Health Organization published an updated suite of ambient air quality guidelines ('WHO 2021 guidelines'), including updated 24-hour average SO_2 and 24-hour and annual average PM_{10} concentrations (World Health Organization, 2021). The guidelines are defined as a level where "*it is assumed that adverse health effects do not occur or are minimal below this concentration level*".

The WHO 2021 guidelines are intended to be used as science-based recommendations to policymakers at a national or local level for consideration in setting their own standards and frameworks for managing air pollution. They have not yet been formally evaluated in New Zealand for adoption as New Zealand air quality guidelines or standards. In a recent decision, the Environment Court[2] agreed with the position that it would be premature to adopt the WHO 2021 guidelines as assessment criteria, but that they should be considered to provide a complete assessment.

Air quality at many urban locations in New Zealand does not (or is unlikely to) meet the WHO 2021 guidelines for NO_2 and annual average $PM_{2.5}$. In the case of $PM_{2.5}$, natural sources of particulate, such as marine aerosols, which cannot be managed provide a significant background contribution. The most recent consideration of the WHO 2021 guidelines in setting ambient air quality standards is by the Council of the European Union (EC). The review by the EC highlighted the challenges that would be experienced in Europe in meeting the WHO guidelines, where they found that 71% of monitoring sites would be unable to meet the guidelines with currently available technology. The EC undertook a cost benefit analysis of options from partial to full alignment with the WHO 2021 guidelines by 2030 to inform a new Directive on ambient air quality and cleaner air for Europe, which was adopted in October 2024. The Directive includes air quality limits based on "closer" alignment with the WHO 2021 guidelines. These are presented in Table 4.2 for comparison with the WHO 2021 guidelines.

As with the New Zealand ambient air quality standards and guidelines, these guidelines/limits are intended to manage exposure to air pollutants and therefore apply in locations where a person could reasonably be exposed over the relevant time period.

[2] Decision [2024] NZEnvC 247.

Table 4.2: WHO 2021 ambient air quality guidelines and EU air quality limits

Pollutant	Time average	WHO 2021 guideline (µg/m³)	EU air quality limits (µg/m³)
SO_2	1-hour		350
	24-hour	40[a]	50[b]
	Annual	-	20
PM_{10}	24-hour	45[a]	45[b]
	Annual	15	20
$PM_{2.5}$	24-hour	15[a]	25[b]
	Annual	5	10
NO_2	1-hour	200	200[c]
	24-hour	25[a]	50[b]
	Annual	10	20

a 3 to 4 allowable exceedances per calendar year.

b 18 allowable exceedances per calendar year.

c 3 allowable exceedances per calendar year.

5 Air quality studies relevant to shipping emissions in Auckland

5.1 Overview

Auckland Council has carried out several investigations into the impacts of shipping emissions on air quality in Auckland. These include:

- Auckland air emissions inventory 2016 – sea transport (Peeters, 2018); and
- A review of research into the effects of shipping on air quality in Auckland: 2006-2016 (Auckland Council, 2017)

These studies were carried out prior to the reduction in marine fuel sulphur content in January 2020 (see Section 3.2) and will therefore overstate the current impact of shipping emissions.

A number of studies have also been commissioned by POAL on the effects of shipping emissions on air quality in Auckland. These include:

- Ambient air quality monitoring for SO_2, NO_2 and fine particulate matter at Parnell and for SO_2 at Devonport. The purpose of these studies was to investigate the influence of shipping emissions and to compare cumulative concentrations (i.e. the impact of all sources, including shipping) with relevant air quality standards and guidelines.
- A study of the changes in SO_2 concentrations in Central Auckland during the SARS COVID-19 pandemic lockdowns. This report built on a larger study considering a wider range of pollutants at monitoring sites across Auckland, which also provided some insights into the impact of shipping emissions.
- Short-term air quality monitoring studies in 2023 and 2024 to evaluate the spatial distribution of key pollutants, including black carbon and metals (vanadium and nickel) that are indicators of shipping emissions. The purpose of these studies was to identify and characterise the influence of shipping emissions.

In addition to these studies by Auckland Council and POAL, a paper on long-term trends and source apportionment of fine particulate matter ($PM_{2.5}$) and gaseous pollutants in Auckland was recently published (Boamponsem, Hopke, & Davy, 2024). This study used source apportionment data collected by Auckland Council between 2006 and 2022 to estimate the relative contribution of different air pollution sources at various locations around Auckland.

A brief summary of each of the studies identified above is set out in the following sub-sections.

5.2 Ambient air quality monitoring for sulphur dioxide, nitrogen dioxide and fine particulate matter at Parnell, and for sulphur dioxide at Devonport

5.2.1 Introduction

POAL has commissioned two ambient air quality monitoring studies to investigate the influence of shipping emissions and to compare cumulative concentrations (i.e. the impact of all sources, including shipping) with relevant air quality standards and guidelines. These studies are briefly summarised below and the results are presented in more detail in Section 6 to characterise existing air quality (noting that these studies were carried out prior to the reduction in marine fuel sulphur).

5.2.2 Sulphur dioxide monitoring at Parnell and Devonport

POAL commissioned an ambient air quality monitoring programme at two locations around the Waitemata Port (Tonkin & Taylor Limited, 2020a). The ambient air quality monitoring programme included:

- Continuous monitoring of sulphur dioxide (SO_2) at Gladstone Park, Parnell, from 27 January 2018 to 17 February 2019. Gladstone Park is located approximately 200 m south of the POAL boundary at the eastern end of the Port, and 500 m south of the nearest wharf (Fergusson container wharf); and
- Continuous monitoring of SO_2 at Devonport from 1 October 2018 to 30 September 2019. The Devonport monitoring station was situated close to a residential area so is representative of air quality in an area where people could be exposed to air pollutants. It was located approximately 1,200 m north of the Fergusson container wharf and approximately 450 m west of the Devonport ferry wharf.

The main source of SO_2 across the study area was expected to be shipping emissions. This is because there is no significant industry in the area that would generate SO_2 emissions and oceangoing ships generally burn heavy fuel oil, which has a much higher sulphur content than land transport fuels (diesel or petrol).

Evaluation of SO_2 concentrations and wind patterns was consistent with the main source(s) of SO_2 emissions being shipping activities at the eastern end of the Port. Although SO_2 concentrations were generally low, the impact of emissions from shipping can be observed in the data. Both the mean and 99th percentile hourly SO_2 concentrations showed a positive correlation with number of ships in Port and total gross tonnage (a measure of the size of the ships).

The highest measured concentrations for SO_2 are summarised in Table 5.1.

Table 5.1: Highest measured SO_2 concentrations compared to air quality standards

Averaging period	Highest measured concentration (µg/m^3)		Guideline (µg/m^3)
	Devonport (Oct 2018 – Sep 2019)	Gladstone Park (Jan 2018 – Feb 2019)	
1-hour	79.6	136.3	350 (NESAQ)
24-hour	19.2	33.7	40[a] (WHO 2021)

a 3 to 4 allowable exceedances per calendar year.

5.2.3 Monitoring for nitrogen dioxide and particulate matter at Parnell

Continuous monitoring for NO_2 and fine particulate matter (PM_{10} and $PM_{2.5}$) was carried out at Gladstone Park, Parnell, from 27 January 2018 to 17 February 2019.

There were no recorded exceedances of the ambient air quality standards and Auckland ambient air quality targets for any of the pollutants. The majority of the time, air pollutant concentrations at Gladstone Park was classed as excellent (less than 10% of the criteria) or good (between 10% and 33% of the criteria). The pollutant with the 'poorest' air quality was PM_{10}, although the vast majority of measurements were between 10% and 66% of the criteria (i.e. they could be described as "Acceptable" or better).

Although pollutant levels were generally low, the impact of emissions of NO_2 and, to a lesser extent, $PM_{2.5}$ from shipping could be observed in the data. Traffic emissions appeared to be the main source of NO_2, based on diurnal and weekday/weekend patterns.

The PM_{10} and $PM_{2.5}$ data also showed the influences of a source (or sources) to the north and northeast of the monitoring location, particularly under high wind speed conditions. This may be attributable to windborne marine aerosols (salt spray).

This monitoring programme demonstrates that while emissions of NO_2 and $PM_{2.5}$ were discernible in the monitoring data, shipping emissions were a small contributor relative to other sources.

5.3 Investigations of changes in air quality during the 2020 COVID lockdown period

On 21 March 2020, a four-level alert system was introduced in New Zealand in response to the COVID-SARS epidemic. A ‘Level 3’ alert was introduced on Tuesday 25 March 2020, which restricted travel to local movements only. From midnight on 25 March until on midnight 27 April a Level 4 alert, commonly referred to as ‘lockdown,’ was in place. The country remained in Level 3 until 13 May 2020, when the alert level shifted to Level 2.

Many of the activities that give rise to anthropogenic emissions of air pollution, particularly road transport, were significantly reduced during the COVID lockdown period in Auckland. However, freight-related shipping activity at the Port of Auckland continued through this period, which provided an opportunity to investigate the effects of shipping emissions during a period of lower background air quality (Tonkin & Taylor Limited, 2020b). This period also coincided with the reduction in marine fuel sulphur content (from January 2020).

The study commissioned by POAL built on a separate study that investigated ambient concentrations of NO_2, black carbon, $PM_{2.5}$, and PM_{10} during the lockdown period in Auckland, and compared them to the same date periods in the historical air pollution record, while considering changes in the local meteorology (Patel, et al., 2020).

Black carbon (BC) (also called soot) is a measurement property of atmospheric aerosols derived from combustion associated activities (primarily fossil fuel and biomass burning) due to incomplete combustion (Patel, Baynham, Wells, Martin, & Davy, 2024). There are no health-based guidelines for BC, however it is of increasing interest for both human health and environmental impacts. Trends in BC concentrations are indicative of trends in combustion-related emissions.

The reduction in pollutant levels in central Auckland estimated in the study by Patel et al are shown in Table 5.2. The authors attribute the relatively smaller reduction in levels of particulate matter to the contribution of natural sources, such as sea salt and secondary sulphate from surrounding oceans.

Table 5.2: Central Auckland ambient air contaminant concentrations pre- and during lockdown (reproduced from (Patel, et al., 2020) p 7)

Contaminant	24-hour average concentration (µg/m³)			
	Historical	Lockdown (26 March– 17 April 2020)	Variation	Percentage variation
PM_{10}	15.3	12.2	-3.1	-20.1%
$PM_{2.5}$	6.1	5.1	-1.0	-17.0%
NO_2	35.7	23.5	-12.2	-34.1%
BC	1.9	0.5	-1.4	-75.4%

The POAL study built on the study by Patel et al but had an emphasis on SO_2, given its known correlation to shipping, and focussed on the downtown area (Auckland Council monitoring sites at Customs Street and Queen Street) given their proximity to the Port. The mean SO_2 concentrations over the monitoring periods are shown in Table 5.3.

Table 5.3: Central Auckland SO_2 concentrations pre- and during lockdowns

Contaminant	Mean concentration over monitoring period (µg/m³)			
	Historical	Level 2 lockdown	Level 3 lockdown	Level 4 lockdown
SO_2	5.0	6.0	4.0	3.5

The key findings from these studies relative to this proposal are that:

- There was a marked reduction in concentrations of combustion-related contaminants over the COVID lockdown period, likely due to the significant reduction in land transport activity.
- NO_2 concentrations even during Alert level periods were dominated by traffic emissions.
- During the level 4 and level 3 periods there appeared to be a common source of both SO_2 and BC under easterly winds. This is likely to reflect the impacts of freight-related port activity (as there were no cruise ships over this period).
- There was no obvious pattern in SO_2 concentrations between the historical data and alert level periods, which would be expected given the reduction in fuel sulphur content in January 2020. As the lockdown periods were relatively short (periods of weeks), the measurements will be influenced by the frequency of winds from the direction of the Port over those short periods compared to the longer-term impact shown in the historical data.

5.4 Investigations into spatial distribution of air contaminants around the Auckland waterfront

5.4.1 Introduction

POAL has commissioned two studies into the spatial distribution of air contaminants around central Auckland to investigate the influence of shipping emissions. The contaminants investigated are not unique to shipping emissions, but the purpose of the study was to identify if there was a pattern of higher concentrations close to the Port.

5.4.2 Black carbon and metals from December 2022 to February 2023

The spatial distribution of BC concentrations around the Auckland waterfront over the period December 2022 to February 2023 (Talbot, 2023) was investigated. The study also included measurements of $PM_{2.5}$ and metals speciation of the collected particulate matter.

The purpose of the metals speciation was to investigate spatial patterns in the concentrations of vanadium and nickel. Historically, vanadium and nickel have been used as an indicator of shipping emissions because they are associated with heavy fuel oil combustion. The greater degree of refining required to achieve the lower marine fuel sulphur limit means that emissions of vanadium and nickel (associated with particulate matter) are lower from low sulphur marine fuels. A study at Guangzhou port measured the composition of freshly emitted particles from ship exhausts before and after a clean fuel policy (0.5% w/w fuel sulphur) was mandated for shipping on 1 January 2017 (Zhou, et al., 2020). This study found that although there was a sharp decrease in vanadium-containing particles from shipping emissions after the implementation of the clean fuel policy, the presence of vanadium in low sulphur particles was still effective as a tracer for source apportionment to indicate shipping emissions.

Monitoring was carried out at three locations (Customs Street, the corner of Quay and Tinley Street and Ngaoho Place, as shown in Figure 5.1) over a 7-week period between December 2022 - February 2023.

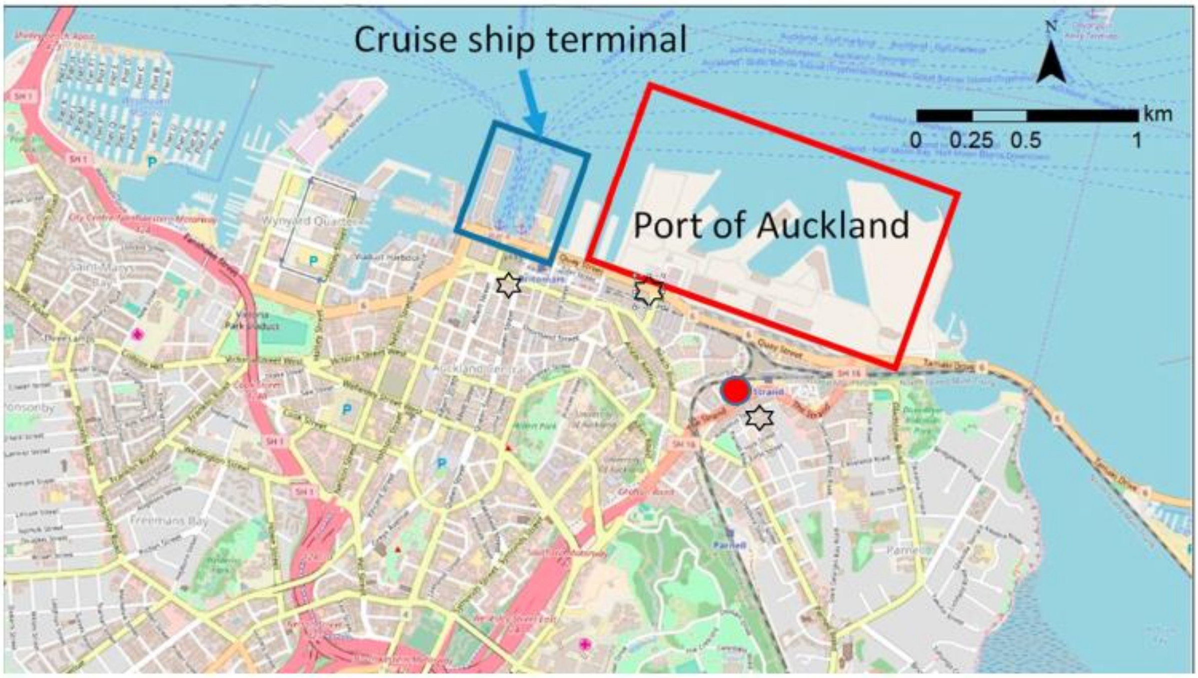

Figure 5.1: Map of the 3 different sites across the Auckland waterfront area – Denoted by black stars (Source: (Talbot, 2023).

The particulate samples were collected using a low-volume sampling method that collected each sample over a 7-day period (i.e. seven samples were collected at each site). The overall average BC concentration at each site is shown in Table 5.4. The concentration of BC showed little variation between the sites, which did not indicate a measurable influence of Port-related emissions.

Table 5.4: Black carbon percentage in particulate matter samples

Location	Approximate distance to nearest wharf	Average black carbon concentration	Average black carbon as a percent of total particulate (range)
Customs Street	240 m	1.5 µg/m³	10% (5% - 17%)
Quay and Tinley Street	300 m	1.3 µg/m³	10% (5% - 14%)
Ngaoho Place	550 m	1.3 µg/m³	9% (6% - 14%)

The study also measured levels of vanadium and nickel in the collected particulate matter. Nickel and vanadium are trace metals associated with heavy fuel oil and a positive linear relationship between these contaminants is indicative of a pollutant contribution from combustion of heavy fuel oil. The samples collected as part of this study did not show a positive linear relationship between vanadium and nickel indicating that particulate matter from combustion of heavy fuel oil use was not significant in the samples. This implies that shipping emissions from the combustion of heavy fuel oil were not detectable during the study.

The overall conclusions of this study were that there was no influence of shipping emissions in the monitoring data. This does not mean that port-related activities do not contribute to the overall air pollution load but that the individual pollutants are well-mixed, with only the total loading of all pollutants being evident in the dataset.

5.4.3 Particulate, black carbon and sulphur dioxide from March to April 2024

A further study was commissioned by POAL in early 2024 to investigate the relative contribution of various sources to air pollutant concentrations in downtown Auckland (Talbot, 2024). Monitoring was undertaken at 10 locations surrounding the Waitemata Harbour up to 1.1 km from the central Auckland waterfront. Seven monitoring sites were in downtown Auckland and three sites were in Devonport. The following sampling was undertaken:

- Continuous PM_{10} and $PM_{2.5}$ sampling at each of the 10 monitoring sites.
- Continuous black carbon and SO_2 sampling at the Custom Street monitoring site.
- Four 7-day average particulate matter samples were collected at each of the 10 monitoring sites. These samples were then analysed for black carbon.
- Two 14-day average SO_2 diffusion tube samples were collected at each of the 10 monitoring sites.

The key findings from this study were that:

- The 14-day average SO_2 diffusion tube samples at all sites were below the detection limit of 2.85 $\mu g/m^3$.
- There was no statistical difference in $PM_{2.5}$ and PM_{10} concentrations between the sites monitored in downtown Auckland and Devonport and no gradient in the concentration values was observed with increasing distance from the Port. Consistent with earlier studies, this indicates that emissions from the Port are well-mixed within a short distance and/or the contribution from the port activities to total PM_{10} and $PM_{2.5}$ concentration is small.
- For the 7-day average particulate samples, the BC component was 8 to 12% for all sites. The highest BC concentrations were observed closest to the Port, however the relative contributions of shipping and traffic emissions could not be differentiated.
- Elevated concentrations of SO_2 were measured at Customs Street during overnight cruise ship hotelling at Queens Wharf, however there was not an associated increase in BC. This increase was not apparent when cruise ships were hotelling at other wharves.
- BC concentrations measured at the Queen Street monitoring site have continued to decrease over time.

5.5 Source apportionment for $PM_{2.5}$ in Auckland (2006 – 2022)

A study of air quality monitoring and source apportionment data collected by Auckland Council between 2006 and 2022 evaluated the temporal trends in $PM_{2.5}$, NO_2, SO_2, CO and black carbon concentrations and the relative contribution of different sources at various location around Auckland (Boamponsem, Hopke, & Davy, 2024).

The overall changes (reduction) in contaminant concentrations for an aggregated data set across all the monitoring stations are summarised in Table 5.5.

Table 5.5: Change in ambient air concentration of key contaminants for aggregated data from Auckland monitoring stations

Contaminant	Monitoring period	Annual average change
$PM_{2.5}$	2006 – 2022	Reduction of 0.08 µg/m³
NO_2	2006 – 2022	Reduction of 0.56 µg/m³
CO	2006 – 2015	Reduction of 0.12 µg/m³
SO_2	2006 – 2015	Reduction of 0.13 µg/m³
BC	2006 – 2015	Reduction of 0.17 µg/m³

The statistically significant decrease in concentrations of all contaminants over the monitoring periods were primarily attributed to decreases in emissions from motor vehicle sources due to improvements in fuel formulation and advancement in engine technology.

The Queen Street monitoring site was the closest monitoring site to the Port where source apportionment data was available. The contributions of the key identified sources of air pollutants at Queen Street and at the more distant Penrose monitoring sites are illustrated in Figure 5.2 and Figure 5.3, respectively.

The largest source contributions to $PM_{2.5}$ at both sites were diesel vehicles (which may include diesel combustion in generators at the Penrose site). The Queen Street site showed a significant contribution from sea salt. It is interesting to note that shipping emissions (sulphate/marine diesel) were estimated to contribute a similar proportion of identifiable $PM_{2.5}$ at both locations. This suggests that shipping emissions are not having a strong influence on localised pollutant concentrations but that emissions are well-mixed and contribute to background concentrations of pollutants.

It is important to note that the monitoring reflects source contributions prior to the lower marine fuel sulphur limit coming into effect and therefore the relative contribution of shipping emissions (sulphate/marine diesel) is expected to be significantly lower post-2020.

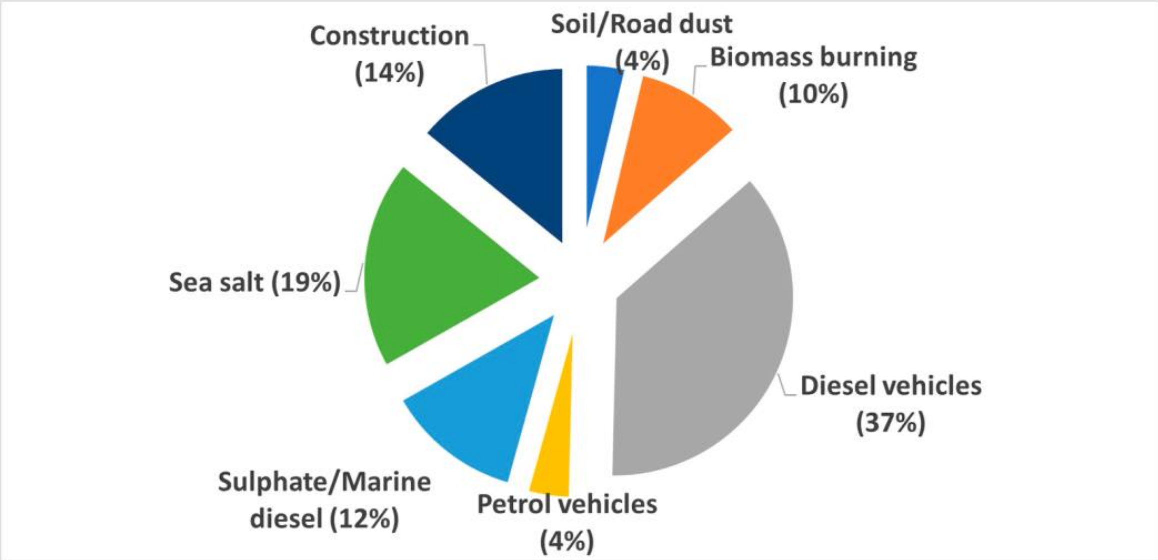

Figure 5.2: Profiles of the sources resolved by the PMF analysis of the Queen Street site data collected during 2005–2015 (Source: (Boamponsem, Hopke, & Davy, 2024) p 6.

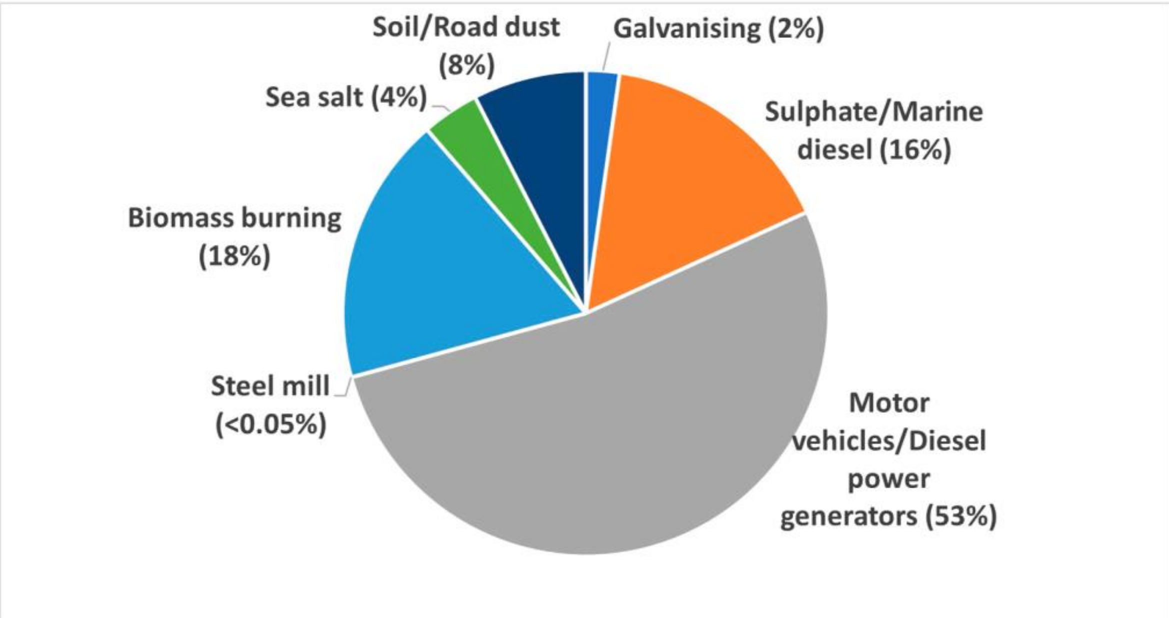

Figure 5.3: Profiles of the sources resolved by the PMF analysis of the Penrose site data collected during 2006–2016 (Source: (Boamponsem, Hopke, & Davy, 2024) p 13.

6 Existing air quality

6.1 Introduction

Air quality around the Port, which includes the effects of shipping emissions and other sources, can be characterised using monitoring data collected by POAL (see Section 5.2) and from the Auckland Council monitoring network.

Ambient air quality monitoring has been carried out by Auckland Council for various contaminants using reference methods at the following locations in the vicinity of the Port:

- Customs Street between 2020 and 2023.
- Quay Street (sometimes referred to by Auckland Council as the Port of Auckland monitoring site) between 2011 and 2014. A full year of monitoring data is available for 2012 and 2013.
- Queen Street, where a full year of monitoring data is available for 2019, 2020 and 2021.

The available data for each pollutant of interest is summarised in the following sub-sections. The locations of the Auckland Council air quality monitoring sites relative to the Project are shown in Figure 6.1.

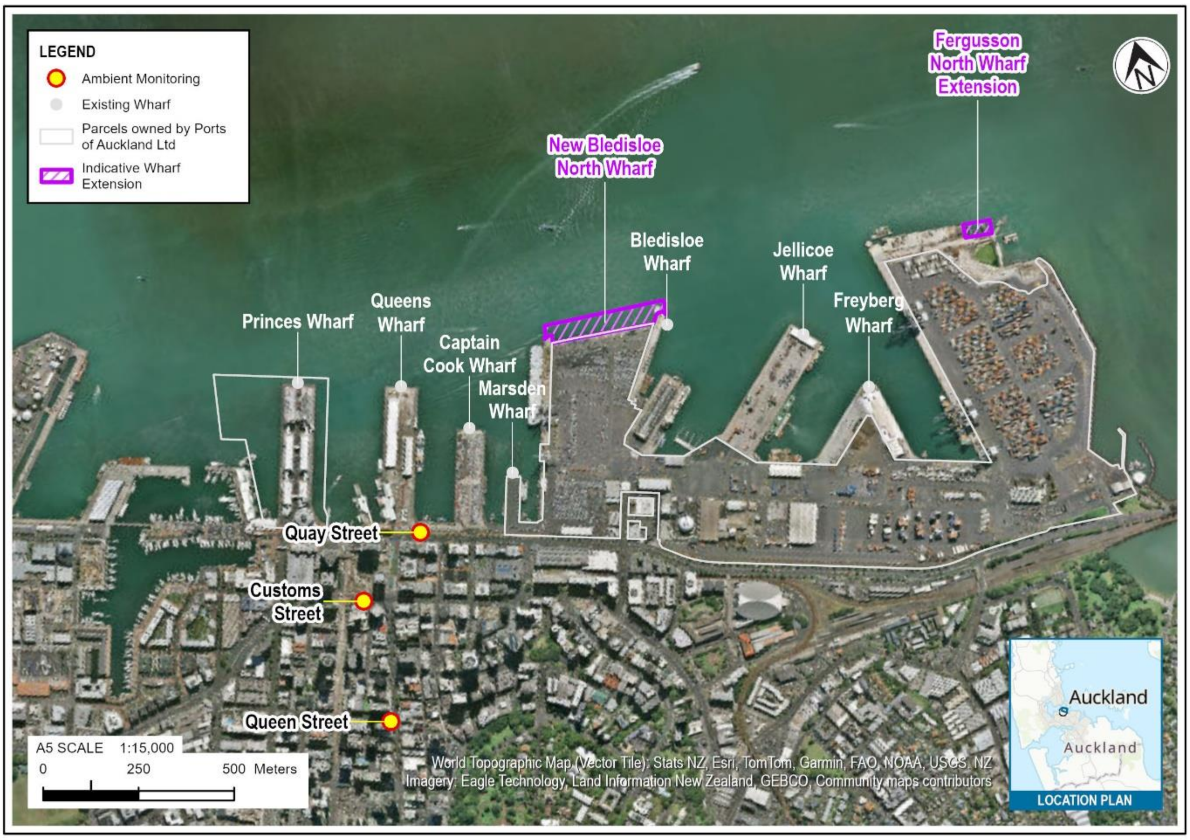

Figure 6.1: Location of ambient air quality monitors.

The Queen Street and Customs Street monitoring sites are in urban street canyons, which will affect the dispersion and dilution of pollutants.

Most of the available monitoring data pre-dates the reduction in marine fuel sulphur content described in Section 3.2. The reduction in fuel sulphur has significantly reduced SO_2 emissions and will also have reduced emissions of particulate matter (PM_{10} and $PM_{2.5}$). Consequently, the results of monitoring carried out prior to January 2020 will overstate the current air quality impacts of shipping.

When evaluating the monitoring data for particulate matter and NO_2, it is also important to note that there are a number of sources of these contaminants in the urban environment, in addition to shipping emissions. The studies described in Section 5 demonstrate that motor vehicle emissions are the most significant contributor to NO_2 concentrations. In addition to anthropogenic sources, particulate matter concentrations are also strongly influenced by natural sources, such as marine aerosols.

The following sub-sections describe the available information to characterise air quality for the contaminants of interest in shipping emissions.

6.2 Sulphur dioxide

Shipping emissions are expected to be the main sources of SO_2 in the vicinity of the Port. There will be a small contribution from diesel combustion in road and rail transport, however the sulphur content of land transport fuel is orders of magnitude lower than in the marine fuel used by ocean-going vessels.

As outlined in Section 5.2.2, POAL commissioned continuous monitoring of SO_2 at Gladstone Park, Parnell, from 27 January 2018 to 17 February 2019. The measured concentrations were below the relevant NESAQ/AAQG and WHO 2021 guidelines

SO_2 has been monitored at the following locations in the vicinity of the Port:

- Quay Street from 2011 to 2014 (Auckland Council monitoring network).
- Customs Street from 2020 to 2024 (Auckland Council monitoring network).

None of these SO_2 monitoring datasets spans the 2019/2020 period when the marine fuel sulphur content was reduced. However, monitoring in the vicinity of the Port of Tauranga has confirmed that ambient SO_2 concentrations have reduced by approximately 75% compared to prior to January 2020, consistent with the magnitude of reduction in the fuel sulphur limit. Similar trends would be expected in relation to SO_2 concentrations around the Port of Auckland, given the same or similar vessels are berthing at each port and the need for all ships to use compliant fuel (or exhaust gas scrubbers to achieve the same effect).

The monitoring results for the Customs Street site are summarised in Table 6.1.

Table 6.1: SO_2 concentrations at Customs Street

Year	SO_2 ($\mu g/m^3$)			
	Maximum 1-hour average	Percentage of standard/ guideline	4th highest 24-hour average	Percentage of standard/ guideline
2021	20.8	6%	5.6	14%
2022	51.0[a]	15%	23.4[a]	59%
2023	23.9	7%	7.7	19%
Assessment criteria	350 (NESAQ)		40 (WHO 2021)[b]	

a Unusually high SO_2 concentrations were recorded between the 9th and 18th June 2022.

b NZAAQG for SO_2 is 120 $\mu g/m^3$ as a 24-hour average.

Between the 9th and 18th June 2022, all of the measured concentrations were 13.5 $\mu g/m^3$ or greater. Auckland Council has noted this but does not have an explanation for the high measured SO_2

concentrations. Unusually high NO_2 concentrations were also recorded at Customs Street in 2022 (see Figure 6.5). It is possible that the elevated SO_2 (and NO_2) concentrations are related to a localised source located near to the monitor, such as a diesel generator or heavy machinery.

Even with the unusually high measurements in June 2022, 1-hour and 24-hour average SO_2 concentrations in all three years are well below the NESAQ and WHO 2021 guidelines.

6.3 PM_{10} and $PM_{2.5}$ air quality

6.3.1 Introduction

There is a wide variety of anthropogenic and natural sources of particulate matter (PM_{10} and $PM_{2.5}$) that will contribute to air quality in the vicinity of the Port. The reduction in marine fuel sulphur content will have also reduced particulate emissions from ships because a proportion of the particulate emitted is in the form of sulphate. However, this improvement is likely to be modest and unlikely to be discernible in the monitoring data because of the large number of different sources of PM_{10} and $PM_{2.5}$.

6.3.2 Monitoring at Gladstone Park

Ambient air quality monitoring for PM_{10} and $PM_{2.5}$ was commissioned by POAL at Gladstone Park, Parnell between 27 January 2018 and 17 February 2019. The monitoring results at Gladstone Park are summarised in and a pollution rose illustrating the PM_{10} concentrations recorded under different wind directions is shown in Figure 6.2. The pollution rose illustrates that concentrations recorded when the wind is blowing from the direction for the Port are not materially different to concentrations under other wind directions.

Table 6.2: Maximum PM_{10} concentrations at Gladstone Park (January 2018 to February 2019)

Averaging period	Concentration ($\mu g/m^3$)	Air quality standard/guideline	Percentage of standard/guideline
24-hour	29.4	50[a] (NESAQ)	59%
	26.8[b]	45[b] (WHO 2021)	60%
Annual	13.4	20 (AAQG)	67%
		15 (WHO 2021)	89%

a One allowable exceedance per year.

b Three to four allowable exceedances, so compared to fourth highest value.

Figure 6.2: 10-minute average PM_{10} pollution rose for Gladstone Park monitoring station (Jan 2018 to Feb 2019).

Table 6.3: Maximum $PM_{2.5}$ concentrations at Gladstone Park (January 2018 to February 2019)

Averaging period	Concentration (µg/m³)	Air quality standard/guideline	Percentage of standard/guideline
24-hour	12	25 (Proposed NESAQ)	48%
	10.5[a]	15 (WHO 2021)	70%
Annual	5.2	10 (Proposed NESAQ)	52%
		5 (WHO 2021)	104%

a Fourth highest.

Figure 6.3: 10-minute average $PM_{2.5}$ pollution rose for Gladstone Park monitoring station (Jan 2018 to Feb 2019).

6.3.3 Auckland Council monitoring network

Ambient air quality monitoring for PM_{10} and $PM_{2.5}$ has been carried out by Auckland Council using reference methods at the following locations in the vicinity of the Port:

- Quay Street between 2011 and 2014. A full year of monitoring data is available for 2012 and 2013.
- Queen Street, where a full year of monitoring data is available for 2019, 2020 and 2021.
- Customs Street between 2019 to 2023. A full year of monitoring data is available for $PM_{2.5}$ for 2023.

Measured concentrations are summarised in Table 6.4. The fourth highest measured 24-hour average concentrations are presented to enable a comparison with the WHO 2021 guidelines.

Table 6.4: Measured PM_{10} concentrations

Monitor name	Year	PM_{10}	
		4th highest 24-hour average	Annual average
Quay Street	2012	29.2	15.5
	2013	31.4	16.2
Queen Street	2018	30.1	15.8
	2019	35.6	16.6
	2020	30.9	15.5
	2021	38.7	18.9
Customs Street	2023	-	-
Assessment criteria		50[a] (NESAQ) 45[b] (WHO 2021)	20 (NESAQ) 15 (WHO 2021)

a One allowable exceedance per year.

b Three to four allowable exceedances per year, so compared to fourth highest value.

Table 6.5: Measured $PM_{2.5}$ concentrations

Monitor name	Year	$PM_{2.5}$	
		4th highest 24-hour average	Annual average
Quay Street	2012	16.1	6.6
	2013	14.7	6.8
Queen Street	2018	13.0	6.5
	2019	15.0	7.1
	2020	12.4	6.2
	2021	16.3	7.6
Customs Street	2023	9.0	4.1
Assessment criteria		25 (Proposed NESAQ) 15[a] (WHO 2021)	10 (Proposed NESAQ) 5 (WHO 2021)

a 3 to 4 allowable exceedances per year.

This data shows that:

- Although the monitoring data are for different years, there is not a pattern of higher PM_{10} or $PM_{2.5}$ concentrations near the Port. This is consistent with the findings of source apportionment studies, which suggest shipping emissions are a relatively minor contributor to particulate matter concentrations (see Section 5.5).
- PM_{10} concentrations (24-hour and annual average) are lower than the NESAQ and AAQG, and the 24-hour concentrations are lower than the WHO 2021 guidelines.
- There are no New Zealand standards or guidelines for $PM_{2.5}$. The data suggests that 24-hour and annual average $PM_{2.5}$ concentrations, and annual average PM_{10} concentrations, are likely to be close to, or exceed the WHO 2021 guidelines. Marine aerosols are a significant contributor to $PM_{2.5}$ and PM_{10} concentrations around the waterfront.

6.4 Nitrogen dioxide air quality

6.4.1 Introduction

The main source of nitrogen dioxide concentrations in urban areas of New Zealand is motor vehicle emissions. Waka Kotahi operates an extensive monitoring network using a non-reference method (passive samplers). This monitoring suggests that most sites near busy roads in New Zealand would not meet the annual average WHO 2021 guideline.

6.4.2 Monitoring at Gladstone Park

Ambient air quality monitoring for NO_2 was commissioned by POAL at Gladstone Park, Parnell between 27 January 2018 and 17 February 2019. The monitoring results at Gladstone Park are summarised in Table 6.6 and a pollution rose illustrating the concentrations recorded under different wind directions is shown in Figure 6.4. The pollution rose illustrates that concentrations recorded when the wind is blowing from the direction of the Port are not materially different to concentrations under other wind directions.

Table 6.6: NO_2 concentration at Gladstone Park (January 2018 to February 2019)

Averaging period	Concentration (µg/m³)	Air quality standard/guideline	Percentage of standard/guideline
1-hour	71.5	200 (WHO 2021 and NESAQ)	36%
24-hour	43.2	100 (AAQG)	43%
	38.9[a]	25 (WHO 2021)	156%
Annual	14.7	10 (WHO 2021)	147%

a Fourth highest.

Figure 6.4: 10-minute average NO_2 pollution rose for Gladstone Park monitoring station (Jan 2018 to Feb 2019).

6.4.3 Auckland Council monitoring

Ambient air quality monitoring for NO_2 has been carried out by Auckland Council using reference methods in the vicinity of the Port. The 1-hour average NO_2 concentrations are summarised in Figure 6.5. The 4^{th} highest 24-hour average NO_2 concentrations are summarised in Figure 6.6.

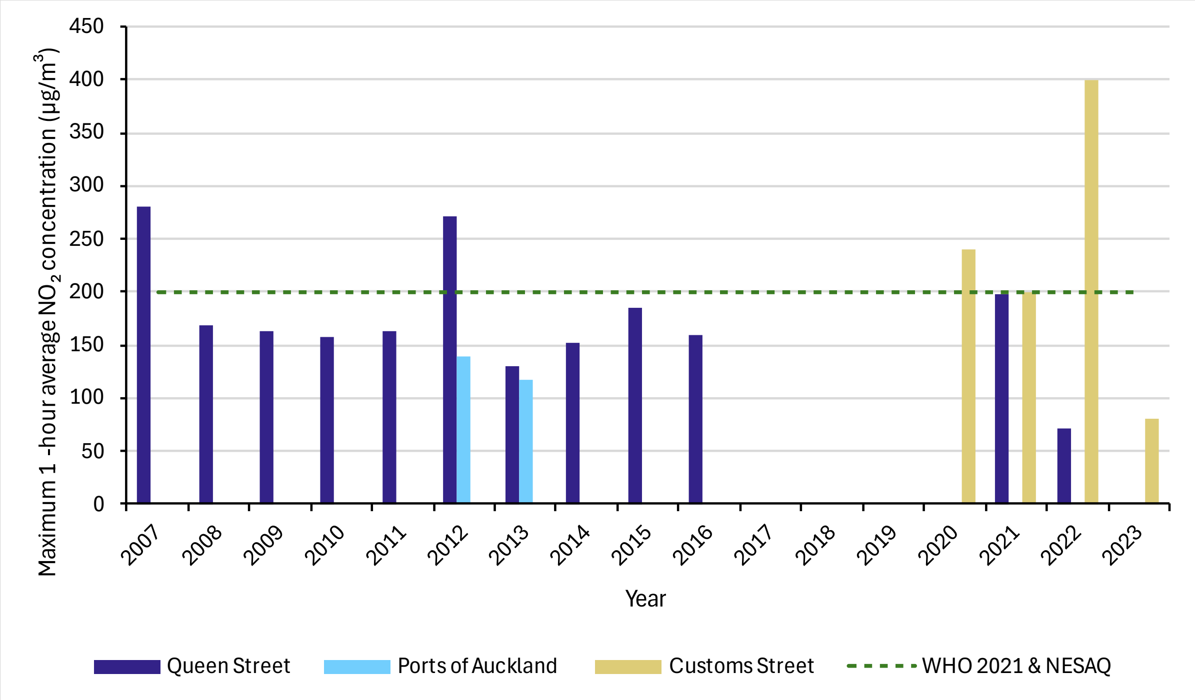

Figure 6.5: Maximum measured 1-hour average NO_2 concentration.

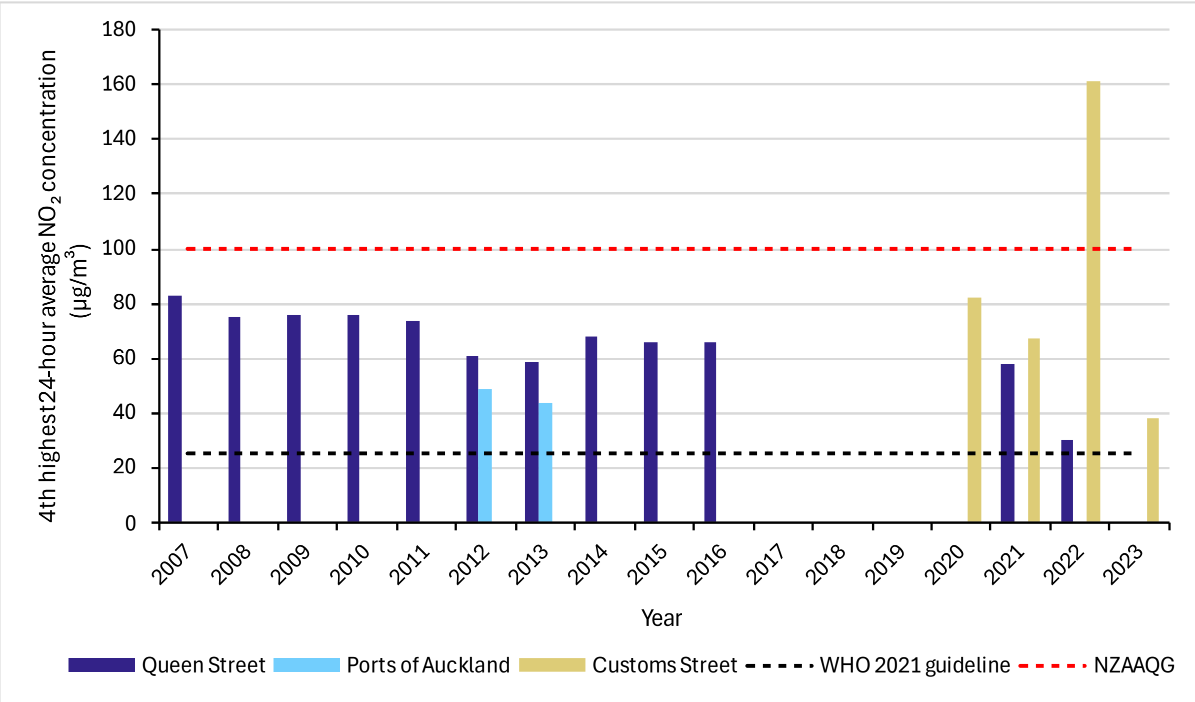

Figure 6.6: 4^{th} highest measured 24-hour average NO_2 concentration.

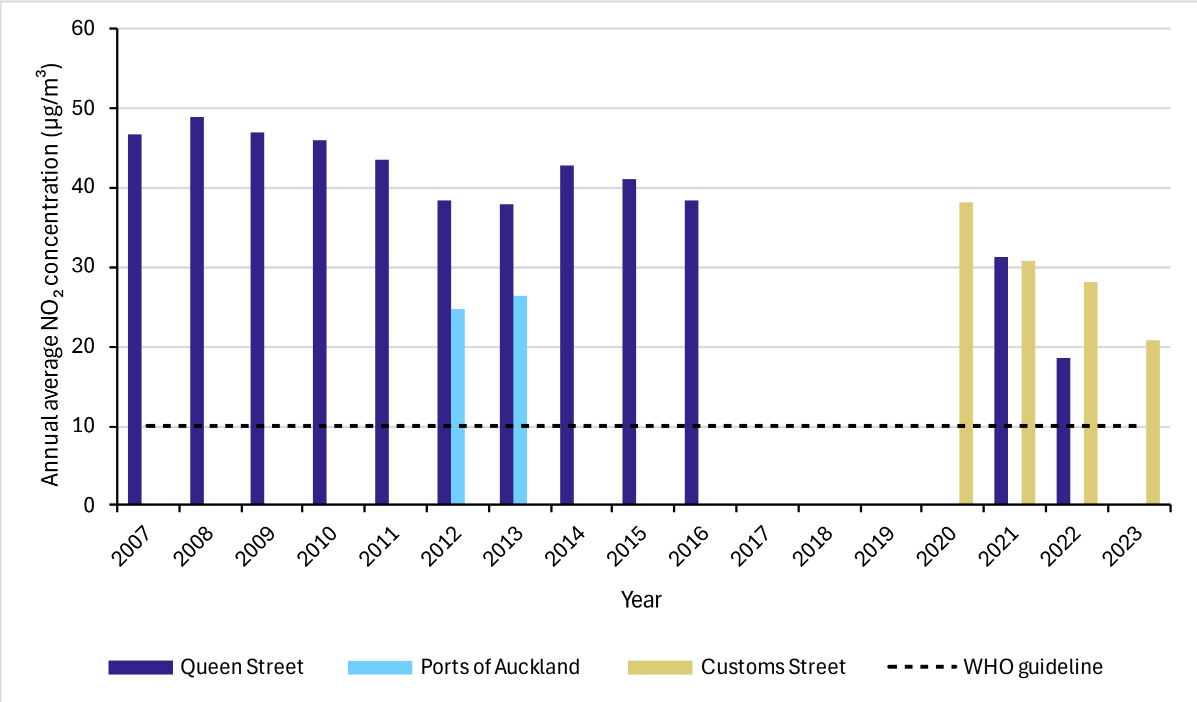

Figure 6.7: Measured annual average NO_2 concentration.

The long-term trend of generally reducing 24-hour and annual average NO_2 concentrations at Queen Street and Customs Street is consistent with the pattern seen at most traffic-impacted sites in New Zealand and illustrates the gradual reduction in NOx emissions from road transport over time. The much lower concentrations at Queen Street in 2022 are likely to reflect the restrictions on private car traffic on Queen Street. The high values at Customs Street from both 24-hour average and 1-hour average are likely to be due to a nearby source (discussed in Section 6.2), as the annual average concentration shows a decreasing trend.

The NO_2 concentrations at the Port of Auckland monitor were lower than measured at Queen Street in the same years. This difference is likely to be mainly due to urban street canyon effects in Queen Street (which restrict dispersion) and differences in traffic volumes past the monitors.

6.5 Conclusions in relation to existing air quality and influences of shipping

The key conclusions in relation to existing air quality around the Port are that:

- The effects of shipping emissions on PM_{10}, $PM_{2.5}$ and NO_2 air quality around the Port is small compared to background air quality from other sources.
- Shipping emissions are likely to be the main source of SO_2 emissions in the vicinity of the Port. Monitoring in the vicinity of the Port (at Gladstone Park) in 2018/2019 showed that air quality met the NESAQ/AAQG and WHO 2021 air quality guidelines. There was a significant reduction in the marine fuel sulphur limit in January 2020, which is expected to have reduced SO_2 emissions of the order of 75%. Monitoring for SO_2 at Customs Steet over 2021 to 2023 (accounting for a brief period of unusually high SO_2 concentrations in 2022, likely to be unrelated to shipping emissions) demonstrates that air quality is well below the WHO 2021 guidelines.
- Existing levels of NO_2 around the Port and elsewhere in the CBD are likely to exceed the WHO 2021 guidelines, principally due to the influence of road transport emissions.

- PM_{10} and $PM_{2.5}$ air quality around the waterfront is influenced by a range of sources, including a significant contribution from marine aerosols.

7 Receiving environment

The Port is located in the Auckland CBD and the local environment includes a mix of activities including shopping, entertainment and short- and long-term residential activities. As a key impact of the project is to spatially redistribute existing shipping emissions, the assessment considers the magnitude of change (increases and decreases) in separation distance to sensitive receptors. Given the large number of sensitive receptors that could be considered, a group of representative receptors have been selected. The effects at these receptors can be extrapolated to other receptors at similar or greater distances.

The representative sensitive receptors considered in this assessment are shown in Figure 7.1. These include:

- Princes Wharf apartments/hotel.
- The Docks Apartments.
- Ngaoho Place townhouses.
- Navy barracks, Devonport.
- Stanley Point, Devonport.
- Queens Parade, Devonport.

Figure 7.1: Identified sensitive receptors in the vicinity of the Port.

8 Assessment of air quality impacts

8.1 Fergusson North wharf extension

8.1.1 Introduction

The FN project will facilitate the international trend of increasing size of container ships. This means that the same amount of cargo can be transported with fewer ships visits (although it is likely that there will be modest growth in container volumes over time). The at-berth (sometimes referred to as hotel) load for container ships is most commonly provided by generators.

There are efficiencies associated with larger container ships that contribute to a lower at-berth fuel consumption per teu for larger ships compared to smaller ships. As pollutant emissions are directly related to fuel consumption, this will translate into a reduced pollutant emissions intensity (pollutant emissions per teu) for larger ships.

8.1.2 Assessment of effects

To illustrate the magnitude of potential change in fuel consumption and associated pollutant emissions, at-berth fuel consumption has been estimated for two hypothetical scenarios shown in Table 8.1. These scenarios represent the current baseline using the “average” size of container ships currently visiting the Port (4,100 teu) and a hypothetical “lower bound” future scenario of the same cargo volume being transported using large container ships (10,000 teu). This future scenario is not intended to be realistic as there will continue to be a mix of container ships of varying sizes visiting the Port, and varying degrees of cargo exchange, with a long-term trend of larger container ships.

Table 8.1: Comparative ship visit per year

Parameter	Unit	Current scenario	Hypothetical future scenario
Cargo volume	teu/year	1,100,000	1,100,000
Ship size	teu	4,100	10,000
Calls to port	ships/year	268	110

Larger ships have a higher loading and unloading efficiency due to more quay cranes being able to be allocated per ship and less time moving cranes due to wider ships (beam). Therefore, while the energy use (generator fuel consumption on an hourly basis) is higher for a larger ship, the faster loading/unloading rate results in a lower fuel consumption per teu transported by the ship. The time at berth and the associated fuel usage for the current and hypothetical future scenarios are shown in Table 8.2.

Table 8.2: Comparative fuel usage

Parameter	Unit	Current scenario	Hypothetical future scenario
Ship size	teu	4,100	10,000
Loading/unloading rate	teu/hour	80	112
Time at berth	hours/ship	51	89
	hours/year	13,750	9,820
Fuel usage (generator for hotelling)	tonne/hour[a]	0.15	0.17
	tonne/year	2,005	1,637
Decrease in fuel usage for larger ships (for same amount of cargo)			**18%**

a Indicative values provided by POAL.

8.1.3 Conclusions in relation to air quality effects of FN project

Although precise numbers for the average and maximum ship sizes for the current and future scenarios cannot be determined, the analysis shows that by providing the facilities for larger ships to berth at the Port, emissions to air (which are directly related to fuel consumption) are likely reduce over time for the same volume of cargo handled.

8.2 New Bledisloe North wharf

8.2.1 Introduction

The BN project will re-distribute the berth locations for existing ships visiting the Port. In particular:

- Relocating very large cruise ships from the Fergusson north wharf to BN.
- Relocating large cruise ships currently using Princes Wharf to BN. Large cruise ships currently make up approximately 50 to 60 % of the cruise ships berthing at Princes wharf.
- Relocating RORO car carriers from Captain Cook Wharf to BN.

The ability of very large cruise ships to berth at BN will avoid the situation that has occurred in the past where ships need for to hold position in the harbour closer to Devonport and Stanley Point. Avoiding this will reduce emissions these ships, which need to operate their main engines to hold position. The positive effects of this change will be relatively small as very large cruise ship visits are relatively infrequent (but could increase over time).

The air quality effects of the project are mainly related to changes in separation distance between ships at berth and sensitive receptors, which will have different impacts (positive and negative) at different receptors. A reduction in the size of ships berthing at Princes wharf, relatively close to sensitive receptors, will have a positive air quality effect.

8.2.2 Assessment of effects

The distance between the representative sensitive receptors described in Section 7 and current and proposed berth locations are shown in Table 8.3.

Table 8.3: Distance to nearest sensitive receptors

Description	Nearest receptors	Current configuration	Proposed configuration
		Distance (m)	Distance (m)
Medium to large cruise ships move from Princes Wharf to BN	Princes Wharf apartments/hotel	10	630
	The Docks Apartments	810	650
Large cruise ships move from FN to BN	Ngaoho Place townhouses	990	1,040
	The Docks Apartments	1,000	650
	Queens Parade, Devonport	1,090	1,630
	Stanley Point, Devonport	1,320	1,060
RORO from Captain Cook Wharf to BN	Princes Wharf apartments/hotel	340	630
	The Docks Apartments	480	650
Very large cruise ship holding position in the harbour to BN	Devonport residential area	670	1,100
	The Docks Apartments	1,190	650
	Queens Parade, Devonport	900	1,630
	Stanley Point, Devonport	680	1,060

The BN project will increase the separation distance between the closest receptors (within 500 m) to existing ship berths, particularly for the relocation of RORO from Captain Cook. There is likely to be a material improvement in air quality (particularly for SO_2) at the Princes Wharf apartments/hotel from the relocation of large cruise ships. Even with ongoing increases over time in the number of cruise ships visiting the Port, as only small/medium cruise ships will berth at Princes Wharf, the air quality effects, particularly in terms of short-term concentrations of air pollutants, will be less than if large cruise ships continued to berth here.

Separation distances to berths are reduced for some receptors, such as the Docks Apartments. However, the minimum separation distance will be at least 630 m. As shown by the monitoring of air quality in the vicinity of the Port, particularly at Gladstone Park, shipping emissions are well-dispersed and diluted at distances of the order of 500 m and are likely to be negligible compared to background levels for particulate and NO_2.

Shipping emissions are the main source of SO_2 around the Port and therefore there will be a small increase in SO_2 concentrations at some receptors associated with a reduction in separation distance. However, monitoring at the Port of Tauranga (and at Gladstone Park taking into account the reduction in marine fuel sulphur content) shows that concentrations are well below the WHO 2021 air quality guidelines at distances of the order of 250 m. Consequently, the change in SO_2 concentrations at receptors located more than 500 m from the new Bledisloe North Wharf will be very low compared to these guidelines.

8.2.3 Conclusions in relation to effects of BN project

Emissions to air from cruise ships are generally proportional to fuel consumption, which increases with ship size. Therefore, the BN project will materially improve air quality at the Princes Wharf apartments/hotel by relocating large cruise ships (which currently make up 50 to 60% of the cruise ships berthing at Princes Wharf) further away. Princes wharf will continue to serve smaller ships. Even with ongoing increases over time in the number of cruise ships visiting the Port, as only small/medium cruise ships will berth at Princes Wharf, the air quality effects, particularly in terms of short-term concentrations of air pollutants, will be less than if large cruise ships continued to berth here.

For all other receptors, there will be no material change in PM_{10}, $PM_{2.5}$ and NO_2 air quality as the effects (positive or negative) of changes in separation distance are very small compared to background concentrations. Existing levels of NO_2 and $PM_{2.5}$ at receptors close to the Port (and elsewhere in the CBD) are likely to exceed the WHO 2021 guidelines. The BN project will not exacerbate existing air quality for these contaminants.

The reduction in separation distance to some receptors will result in a small increase in SO_2 concentrations at these locations. However, concentrations are expected to remain well below the WHO 2021 air quality guidelines.

9 Conclusions

Numerous studies have been undertaken to characterise the effects of shipping emissions around the Auckland waterfront. These have generally shown that while shipping emissions will contribute to cumulative air pollution levels around the Auckland waterfront, the contribution is generally small compared to other sources and relevant air quality standards and guidelines.

The Fergusson North Wharf extension will enable a reduction in air pollution emissions intensity from increased efficiency in cargo handling associated with larger container ships. Subject to growth in container cargo volumes over time, the project is therefore expected to reduce emissions of contaminants to air.

The New Bledisloe North wharf will have the effect of relocating shipping emission sources. This will materially improve air quality at the Princes Wharf apartments/hotel by increasing the separation distance to large cruise ships, which represent 50 to 60% of cruise ships currently berthing at Princes Wharf. Even with ongoing increases over time in the number of cruise ships visiting the Port, as only small/medium cruise ships will berth at Princes Wharf, the air quality effects, particularly in terms of short-term concentrations of air pollutants, will be less than if large cruise ships continued to berth here.

For all other receptors, there will be no material change in air quality for NO_2, PM_{10} and $PM_{2.5}$ as the effects (positive or negative) of changes in separation distance are very small compared to background concentrations. The New Bledisloe North wharf will not measurably exacerbate existing air quality for contaminants where levels may currently exceed the WHO 2021 guidelines (e.g. $PM_{2.5}$ and NO_2). The reduction in separation distance to some receptors is likely to result in a very small increase in SO_2 concentrations at these locations. However, concentrations are expected to remain well below the WHO 2021 air quality guidelines.

10 References

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11 Applicability

This report has been prepared for the exclusive use of our client Port of Auckland Limited, with respect to the particular brief given to us and in accordance with our letter of engagement dated 9 October 2024. It may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

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