REPORT

Tonkin+Taylor

Air Quality Assessment

Proposed asphalt plant, Mt Maunganui

Prepared for
Allied Asphalt Limited

Prepared by
Tonkin & Taylor Ltd

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Summary

Allied Asphalt Limited (Allied) operates an existing asphalt manufacturing plant at 54 Aerodrome Road, Mt Maunganui (the 'Site'). Allied proposes to replace this existing plant with a modern vertical batching asphalt plant at the Site.

The proposed new plant will have a greater production capacity, reducing the number of operating hours required to produce asphalt for local projects.

The Site is located in the Mt Maunganui industrial area and is well separated from surrounding sensitive land uses, the nearest of which are the worker accommodation units within airport hangars located on De Havilland Way, approximately 400 m to the southeast and the preschool on 1 MacDonald Street, located approximately 440 m northeast of the Site. Other sensitive receptors in the vicinity include the residences and schools located further northeast in Omanu, and Whareroa Marae which is located approximately 1.4 km to the west of the Site.

The local meteorology recorded at Tauranga Airport 1.2 km southwest of the site shows that the prevailing wind direction is from the west-southwest. The Bay of Plenty Regional Council (BoPRC) operates seven air quality monitoring stations within the Mt Maunganui Airshed. The closest monitor is located at De Havilland Way to the southeast of the site, at a location heavily influenced by local stock food handling operations. The nearest ambient monitor that is expected to represent background industrial air quality is located 1.3 km northwest at Totara Street, which records ambient concentrations of particulate matter ($PM_{2.5}$ and PM_{10}) and sulphur dioxide (SO_2). These measurements were used to develop suitable background concentrations for assessment of impacts to air.

The existing parallel flow single drum hot mix asphalt plant is proposed to be replaced with a vertical batch-mix asphalt plant, which is expected to provide the following improvements:

- The batch-mix design separates the aggregate drying and bitumen blending facilities, ensuring bitumen cannot be exposed to high temperatures in the flame zone (which can result in odour). This will result in lower odour generation compared to a single drum plant.
- Improved particulate emission control equipment, including a primary dust collector (cyclone) and a secondary dust collector (reverse-air baghouse) for lower particulate emissions compared to the existing wet scrubber. As a result, the proposed consent limit for total suspended particulate (TSP) emissions from the baghouse is 30 mg/Nm^3 (equivalent to 1.25 kg/hour), compared to the consent limit for the discharges from the current asphalt plant of 250 mg/Nm^3 and 4.2 kg/hour.
- Treatment of emissions from the mixing unit and hotmix storage through a bluesmoke aerosol treatment system to remove condensables and odour prior to discharge to the combined stack.
- Emissions will be released from a taller stack (27.6 m) compared to the existing plant (18 m). The taller stack will result in improved dispersion and dilution of emissions compared to the existing plant.
- Ability to produce low-energy asphalt mixes, improving the fuel efficiency of the plant and reducing the potential for odour.

A range of contaminants are discharged to air from operation of the proposed asphalt plant including:

- Fine particulate matter (PM_{10} and $PM_{2.5}$).
- Sulphur dioxide (SO_2).
- Oxides of nitrogen (NO_X).

- Carbon monoxide (CO).
- Volatile organic compounds (VOCs)
- Trace contaminants from the combustion of used oil (trace metals).
- Odour.
- Dust.

Emissions from the existing and proposed plants were evaluated in an atmospheric dispersion modelling study, using a meteorological dataset for three modelling years (2014, 2015 and 2016). Given uncertainties about security of supply and cost, Allied needs to retain the ability to use a range of possible fuels (natural gas, diesel, biodiesel or used oil). Higher emissions of some contaminants will occur when the plant is burning used oil as a fuel compared to other fuels, particularly natural gas. Therefore, the worst-case scenario for the purposes of dispersion modelling was continuous operation using used oil as a fuel and assuming the sulphur and metals content of the used oil are at the proposed consent limits. The discharges to air from the plant will be lower when the plant uses other fuels.

The dispersion modelling, using conservative assumptions, predicts that the cumulative effects of emissions of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, VOCs and trace metals from both the existing and proposed plants are well below relevant air quality assessment criteria. For most contaminants, the predicted acute (1-hour average) air quality effects of the proposed asphalt plant are lower than the effects of the existing plant due to improved air pollution control and a taller stack, which will increase dispersion and dilution of emissions. Predicted 24-hour average concentrations of NO_2, SO_2 and CO and annual average concentrations of trace metals are slightly higher than predicted for the current plant (but still well below assessment criteria). This difference is largely due to the assumption of continuous operation of the plants, to represent the maximum envelope of effects that would be allowed by the consent. In practice, the proposed plant is likely to operate for fewer hours in the day compared to the existing smaller asphalt plant. Consequently, both 24-hour average and annual average concentrations of contaminants are likely, in practice, to be lower from the proposed plant than from the existing plant. The proposed emissions control system is considered to be the best practicable option to minimise discharges to air of PM_{10} and $PM_{2.5}$ and to mitigate the effects of emissions.

The Mt Maunganui Airshed is classified as 'polluted' with respect to PM_{10} concentrations under Regulation 17 of the NESAQ. However, due to improved particulate emission controls (a reverse air baghouse instead of a wet scrubber) and a taller stack, the incremental effect of PM_{10} emissions from the proposed asphalt plant are predicted to be small and are significantly lower than the existing asphalt plant. The decommissioning of the existing plant will more than offset the PM_{10} emissions to the airshed from the new plant, and will result in a net reduction in consented PM_{10} emissions. The predicted contribution from the proposed plant to ground level concentrations of PM_{10} at the most impacted sensitive location is less than 5% of the 2021 WHO air quality guideline value (which is lower than the ambient air quality standard set in the national Environmental Standards for Air Quality).

The existing asphalt plant has been the subject of a number of complaints to the BoPRC relating to odour in recent years, and BoPRC confirmed an incidence of offensive or objectionable odour from the existing plant in 2019. This is consistent with the results of odour dispersion modelling, which suggest the potential for odour effects in the residential area northeast of the site. The modelling also suggests that this area may be impacted by odour emissions from the nearby Higgins asphalt plant.

The proposed asphalt plant includes a number of improvements to minimise odour emissions. This includes the plant design, which reduces the temperature that the bitumen is exposed to and minimises the generate of odour, and the use of a bluesmoke aerosol filter system to reduce odour emissions from the mixing unit and hotmix storage bins. Odour stack emission testing from a comparable asphalt plant in Laverton, Australia, demonstrates that the odour emissions from the proposed asphalt plant will be significantly lower from the existing plant. Combined with the taller stack, the odour effects of the proposed plant are predicted to be significantly less than the current plant and well below odour modelling assessment criteria. Odour emissions from normal operation of the proposed plant are very unlikely to be detectable in residential areas and are very unlikely to cause odours that would be considered offensive or objectionable either in the neighbouring industrial area or the more distant residential area. The proposed plant design and control measures are considered to represent the best practicable option for managing odour emissions and mitigating odour impacts.

The proposed consent conditions will include a timeframe for decommissioning of the existing asphalt plant and there will be no overlap between the operation of the two asphalt plants.

1 Introduction

Allied Asphalt Limited (Allied) operates an existing asphalt manufacturing plant at 54 Aerodrome Road, Mt Maunganui (the 'Site'). Resource consent 62740 was granted in 2004 to authorise the discharges to air from the existing asphalt plant. In May 2020, Allied lodged application RM20-0301 with the Bay of Plenty Regional Council (BoPRC) to replace the existing resource consent. As this application was lodged six months prior to the expiry of the existing consent (30 November 2020), the plant may continue to operate under the terms of the existing consent in accordance with s124 of the Resource Management Act 1991 until the application is decided.

Allied proposes to install a modern vertical batching asphalt plant at the Site to replace the existing asphalt plant. Allied is lodging a new resource application to authorise the discharges to air from the existing plant for an interim period of no more than 2 years from the date consent is granted, and for the ongoing discharges to air from the proposed plant. The existing plant will be decommissioned once the new plant is operational. Therefore the existing and new plants will not be operated concurrently and the effects of discharges to air from the proposed plant will not be cumulative with the effects of the existing plant.

Tonkin & Taylor Ltd (T+T) has been engaged by Allied to prepare this air quality assessment to inform resource consent applications prepared by Cogito Consulting Ltd (Cogito) for the replacement asphalt plant[1].

[1] This report has been prepared in accordance with our letter of engagement dated 19 November 2021, T+T ref: 1018258.000.

2 Environmental setting

2.1 Site location and description

The proposed asphalt plant will be constructed and operated at Allied's existing site at 54 Aerodrome Road, Mt Maunganui (the 'Site') as shown in **Figure 2.1**. The Site is legally described as Lot 2 Deposited Plan South Auckland 36408.

The existing asphalt manufacturing activities are located near the northeastern boundary of the property. The proposed asphalt plant will be located south of the existing plant, near the southern boundary of the property, as indicated in in **Figure 2.1**.

The existing asphalt plant will be decommissioned and removed once the new asphalt plant has been commissioned.

The Site is located in the Mount Maunganui Airshed, which was gazetted in November 2019.

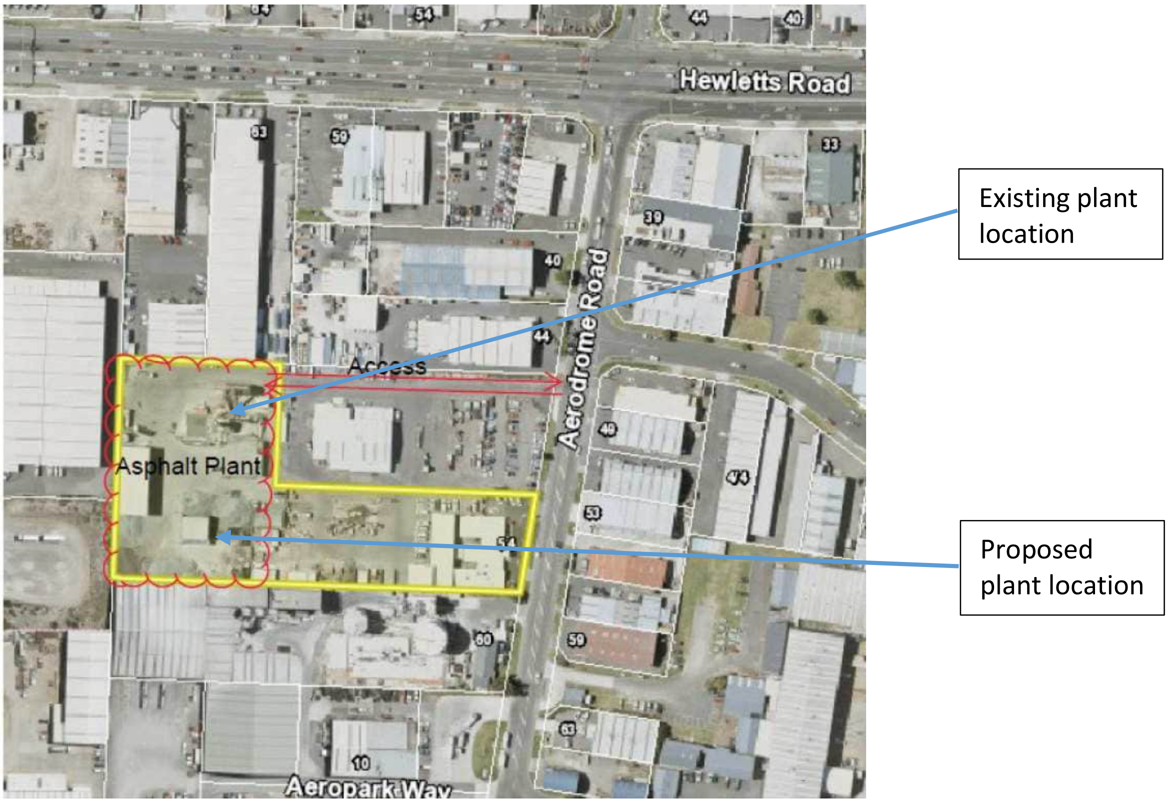


Figure 2.1: Site location (yellow), site access via red line

2.2 Receiving environment and sensitive receptors

The Site is located in the Industry zone under the operative Tauranga City Plan. The purpose of the Industry zone is to provide an area where industries can be grouped so that the effects of industrial activities do not impact on the enjoyment of other activities, and so they are not compromised by an expectation of protection from the effects of non-industrial activities. To manage the potential for reverse sensitivity effects, sensitive activities, such as residential activities and visitor accommodation, are non-complying activities in the Industry Zone[2].

[2] Table 18A.1: Industrial Zones Activity Status, Tauranga City Plan

A map showing the zoning of the immediate area is included as **Figure 2.2.**

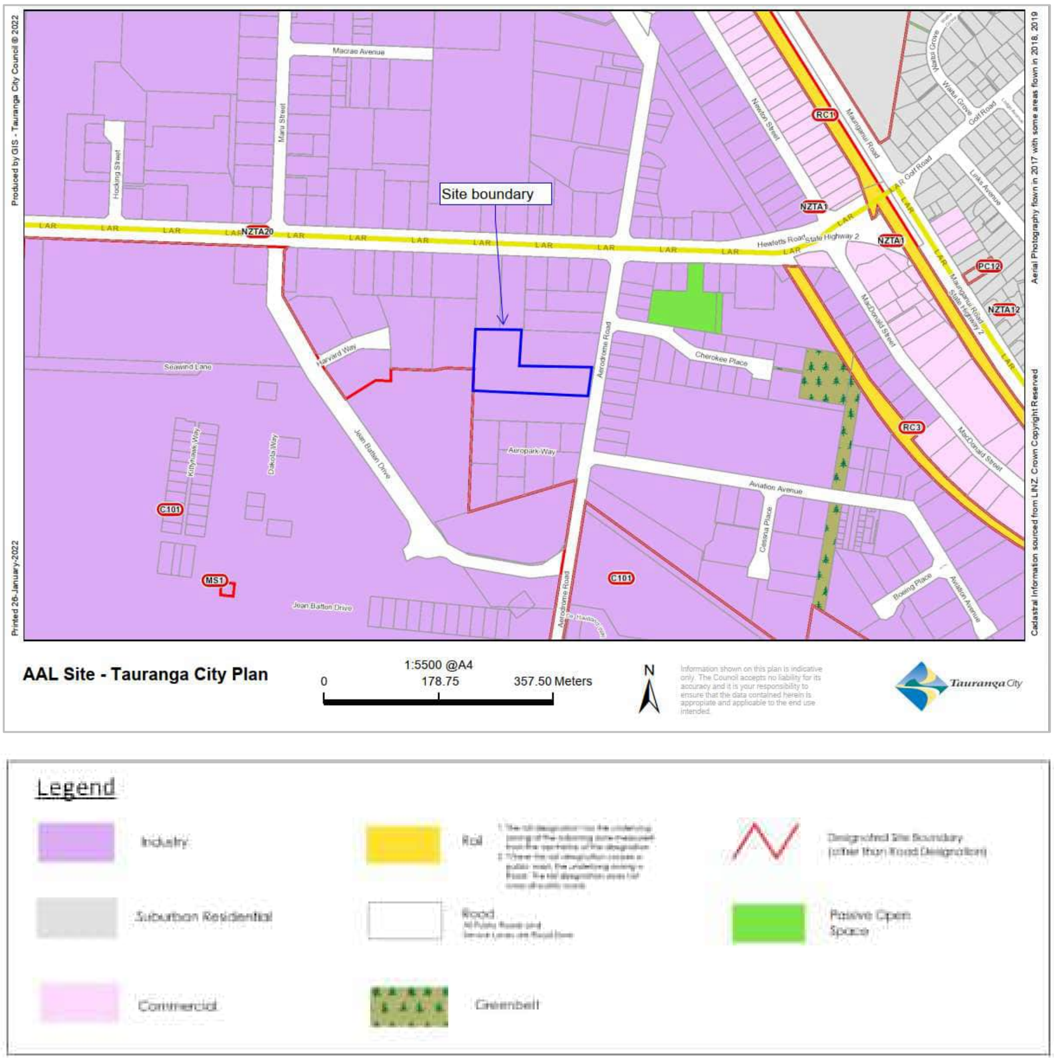


Figure 2.2: Tauranga City Plan map (Allied site in blue outline)

There are several industrial activities within 500 m of the Site that hold resource consents for discharges to air[3], including:

- HR Cement Limited, a cement manufacturer on the neighbouring lot on the southern boundary of the Site;
- Bay of Plenty Pet Cremations, across Aerodrome Road to the east of the Site;
- Nutrinza Limited animal feed store, at 101 Aerodrome Road approximately 150 m south of the Site;
- Metalco Recyclers Limited, a scrap metal processor located at 26 Aerodrome Road approximately 250 m northeast of the Site;
- Higgins Contractors Limited, another smaller scale asphalt plant (comparable to Allied's existing plant) located approximately 300 m northeast of the Allied site at 92 Hewletts Road (see **Appendix B** for further description of activities at this site);
- Firth Industries Limited, a ready-mix concrete supplier on Macrae Ave located approximately 450 m north of the Site.

[3] https://gis.boprc.govt.nz/ConsentViewer/, accessed June 2022

Activities within the Industry zone are likely to have a low sensitivity to air quality effects and are likely to have a relatively high tolerance to exposure to odour and dust.

Within the wider surrounding environment there are activities that have an increased sensitivity to air quality impacts ("sensitive receptors"). Sensitive receptors include locations where people could be located for more-than-transient periods of time and have an expectation of high amenity, such as residences, schools and medical facilities. Sensitive activities within 500 m of the Site have been identified and are described in **Table 2.1**, with the locations of these activities illustrated in **Figure 2.3**.

Sensitive activities within 500 m have been identified as this is the default separation distance between asphalt plants with a production rate greater than 100 tonnes per hour and sensitive receptors recommended by the Victoria (Australia) Environmental Protection Agency, for land use planning purposes.[4] This distance is based on Victoria EPA's experience of distances beyond which effects of odour or dust are unlikely to occur, even under abnormal operating conditions or particularly adverse weather conditions. This is a default recommendation that does not take into account the type of asphalt plant or nature of odour and dust controls used, and does not mean that adverse effects are expected to occur within this distance. The only sensitive activities identified within 500 m of the site are the Little Einstein's Montessori pre-school at 1 MacDonald Street and the worker accommodation at 1 – 11 De Havilland Way. The industrial area provides a considerable buffer zone to sensitive activities.

Table 2.1: Proximity of Allied's site to nearby sensitive receptors

Receptors	TCC Plan zoning	Distance from boundary and direction
Whareroa Marae	Urban Marae Community zone	1.4 km W
Mt Maunganui College	Suburban Residential	600 m NE
Mt Maunganui Intermediate	Suburban Residential	720 m E
Omanu School	Suburban Residential	860 m NE
Omanu residential area	Suburban Residential	540 NE
Little Einstein's Montessori	Commercial	440 m NE
BestStart MacDonald Street	Commercial	650 m E
De Havilland Way worker accommodation	Industry	400 m SE

[4] EPA Victoria. (2013). Recommended separation distances for industrial residual air emissions. Publication number 1518 March

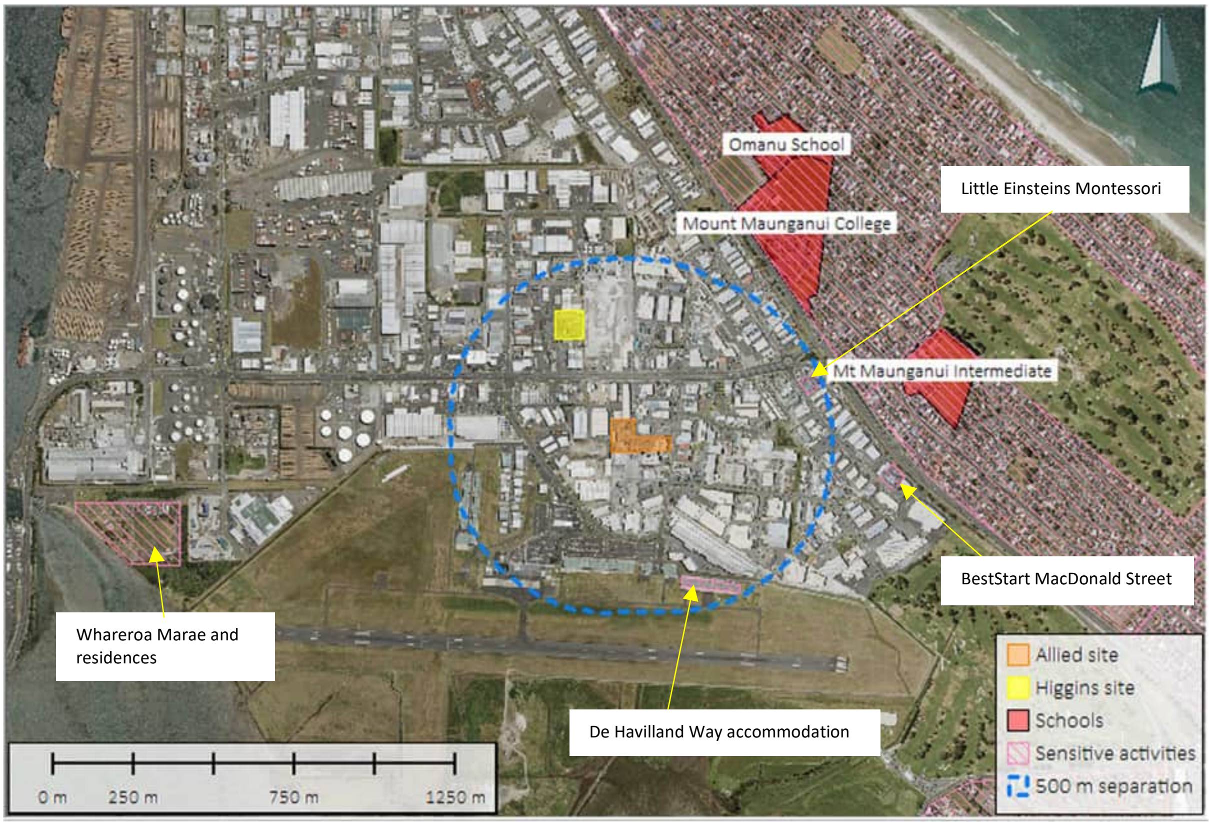


Figure 2.3: Location of sensitive receptors. Blue dashed line indicates 500 m from Allied property boundary.

2.3 Meteorology and topography

The dispersion of contaminants into air is influenced by meteorological conditions, in particular wind speed and wind direction. The nearest meteorological station to the Site is an Automatic Weather Station at Tauranga Airport operated by Metservice, which is located approximately 1.2 km to the southwest of the Site. The topography of the area surrounding the airport and the Site is largely flat with no significant terrain features between the two locations. Accordingly, the conditions measured at the airport are expected to be representative of those at the Site.

Figure 2.4 presents windroses, which illustrate the pattern of wind conditions (speed and direction) measured at Tauranga Airport from 2008 to 2012, including representations for different periods of the day. The wind rose for all hours shows that the prevailing wind direction is from the west-southwest and the average windspeed from all directions for the site is 3.9 ms^{-1}. The windroses for different times of the day illustrate that stronger winds from the west and southwest are more prevalent during the day and light winds from the south southwest are most prevalent overnight. The evening wind pattern is similar to the daytime winds, but with a higher incidence of westerlies and overall a lower prevalence of strong winds greater than 8 m/s.

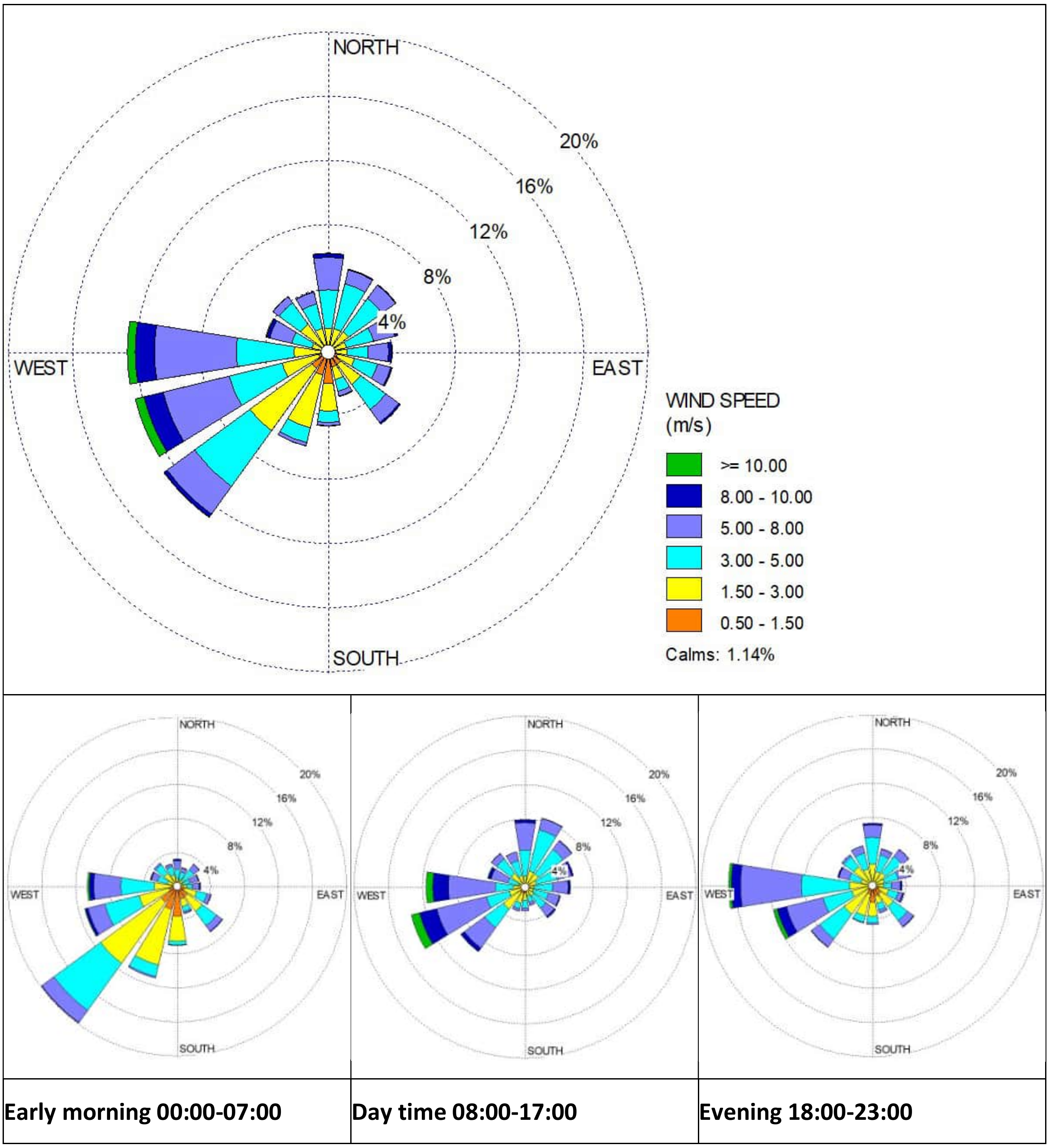


Figure 2.4: Wind rose at the Metservice Tauranga Aero Aws monitoring station 2008 – 2012

The atmospheric dispersion modelling study uses a meteorological dataset for three modelling years (2014, 2015 and 2016) prepared by Atmospheric Science Global Limited[5] for the BoPRC using the CALMET model. A wind rose for the Allied site, from the CALMET file for this three-year period, is presented in **Figure 2.5**. Overall, the windrose for the Site shows good agreement with the measured wind pattern at the airport

[5] Atmospheric Science Global Limited. August 2018. Continuous Emission Modelling and SO2 removals. Results for 10-minute, 1-hour and 24-hour SO2 for 2014, 2015 and 2016 from Industry, Airport, White Island, Shipping and Road Traffic.

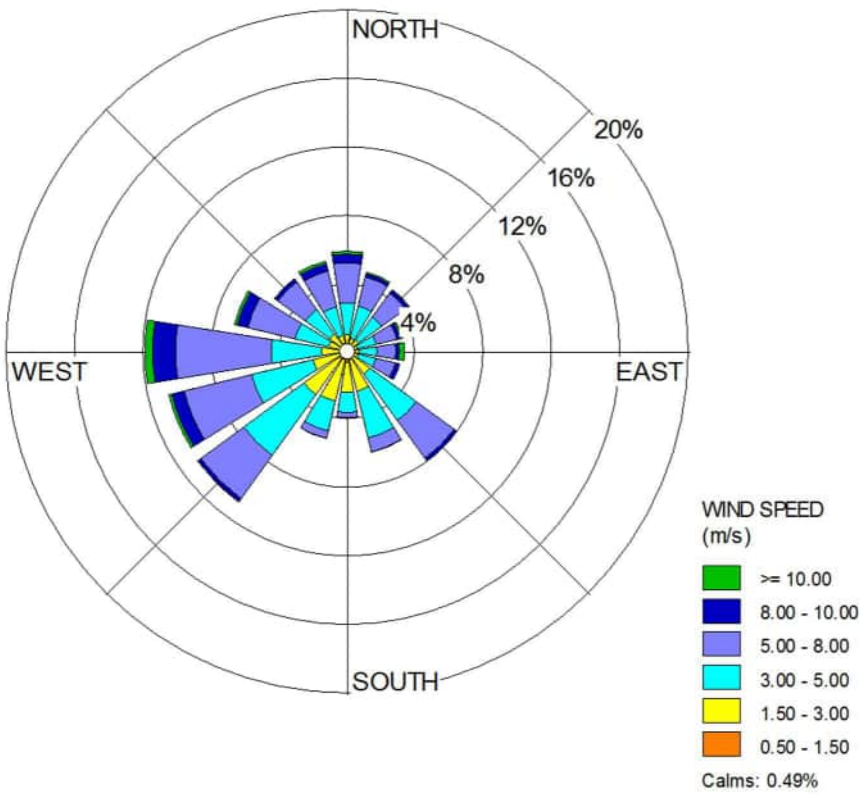


Figure 2.5: CALMET generated wind rose at the Allied site, 2014 to 2016

Future climate change projections (at 2040 and at 2090)[6] broadly predict minimal changes in western wind speed over the winter period in the North Island[7], and no change to the prevailing wind direction across New Zealand (west-southwest). Overall, current dispersion patterns of emissions from stack sources at the Allied site are expected to remain broadly similar in the foreseeable future.

Fugitive[8] dust emissions associated with aggregate storage or entrainment of dust from sealed surfaces are likely to be more prevalent during dry, windy conditions and are conversely suppressed under wet conditions. Dust pick-up by wind is usually only significant at wind speeds above 5 m/s and increases with increasing wind speed. Winds greater than 5 m/s are predicted to occur 40% of the time at the site in the CALMET dataset.[9]

Daily rainfall data has been sourced from the Tauranga AWS monitoring station via the US National Oceanic and Atmospheric Administration Integrated Surface Database[10]. The average of monthly rainfall measured at the Tauranga AWS monitoring station between January 2010 and December 2021 is presented in **Figure 2.6**. The driest months of the year are generally October to March (with the exception of December, which tends to have higher mean rainfall) and particular attention to dust management is required during those months.

[6] Climate change effects and impacts assessment: A guidance manual for local government in New Zealand, Publication number ME 870, May 2008 (https://www.mfe.govt.nz/publications/climate-change/climate-change-effects-and-impacts-assessment-guidance-manual-local-52)
[7] Projected changes in the north-south wind component are less clear. There is a tendency for more northerly flow in future, but the changes are not large enough to alter the prevailing wind direction from the west-southwest.
[8] Fugitive discharges are diffuse, non-point source emissions. This term is used to differentiate from point source emissions (such as stacks).
[9] This is a higher prevalence than measured at the Tauranga Airport AWS (28% of the time)
[10] https://www1.ncdc.noaa.gov/pub/data/noaa/isd-history.txt. Retrieved 15 June 2022.

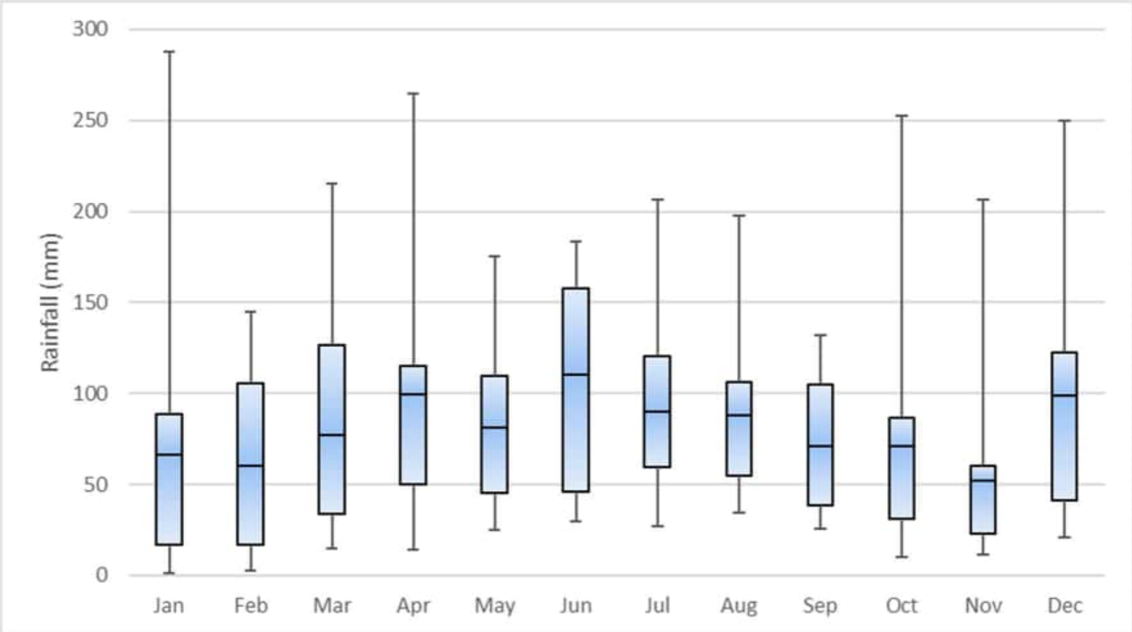


Figure 2.6: Box and whisker plot for monthly rainfall recorded from 2010 to 2021 at the Tauranga AWS

2.4 Existing air quality

2.4.1 Locations where air quality is monitored in the Mt Maunganui airshed

The BoPRC operates seven air quality monitoring stations within the Mt Maunganui Airshed (as illustrated in **Figure 2.7**). The contaminants monitored at these locations and the commencement dates for monitoring are summarised in **Table 2.2**. This section presents a summary of the air quality monitoring undertaken by BoPRC since 2016 for the key pollutants relevant to the discharges to air from the Site (SO_2, PM_{10} and $PM_{2.5}$).

Figure 2.7: Location of BoPRC air quality monitoring stations in the Mt Maunganui Airshed. Aerial Imagery via Esri, Maxar, Earthstar Geographics, and the GIS User Community

Table 2.2: Summary of BoPRC monitoring stations in the Mt Maunganui airshed

Monitoring Station	Distance from Site (direction)	Commencement of monitoring			Comment
		SO_2	PM_{10}	$PM_{2.5}$	
Whareroa Marae	1,500 m (west)	September 2015	August 2018	NM	This location is heavily influenced by the large industrial sources to the north, in particular the Agri-Nutrients fertiliser manufacturing plant. It is not expected to be representative of background levels at the Allied Site.
Tauranga Bridge Marina	1,900 m (west)	April 2016	August 2018	NM	This location is upwind of the main industrial sources of PM_{10} and SO_2 under the prevailing SW wind direction. It can be considered a background site with little industrial influence, that is likely to be mainly influenced by motor vehicle emissions and shipping.
Totara Street	1,300 m (northwest)	March 2007	August 2018	December 2018	This location is somewhat influenced by particulate emissions from activities at the Port to the west, and SO_2 emissions from the Ballance fertiliser works to the south. however, can be considered broadly representative of background industrial air quality.
Rail Yard South	1,900 m (north northwest)	October 2018	October 2018	NM	This site is located in close proximity to the port and is heavily influenced by port activities.
Sulphur Point	2,800 m (northwest)	August 2018	August 2018	NM	This monitor is located at the northern end of the Sulphur Point wharves on the western side of the Port. It can be considered a background site with little industrial influence. It is likely to be mainly influenced by shipping emissions and marine aerosols.
De Havilland Way	400 m (south-southeast)	NM	October 2018	NM	This location is highly influenced by nearby dust sources, specifically the animal feed handling at the stores north of the monitor.
Rata Street	2,900 m (north northwest)	December 2018	December 2018	NM	This location is somewhat influenced by activities at the Port to the southwest, however, can be considered broadly representative of background industrial air quality. However, it is located a significant distance from the Site.

NM = Not monitored

The closest monitoring locations to the Site are at De Havilland Way and Totara Street:

- The De Havilland Way monitoring site is impacted by animal feed unloading and storage activities located in close proximity to the monitor. The peak particulate levels measured at this site are therefore not considered representative of air quality at the Site.
- The Totara Street monitoring site is located on the western side of the Mt Maunganui airshed. It is likely to broadly representative of air quality in the area, though it is more heavily influenced by port activities than would be expected at the eastern end of the airshed where the Site is located.

Given their distance from the Site, most of the BoPRC monitoring stations are in locations that would not be affected by discharges to air from the Allied asphalt plant. The exception is the PM_{10} monitor at De Havilland Way that may include a very small contribution of emissions from the Site. However, days with elevated PM_{10} concentrations at De Havilland Way are likely to be dominated by the influence of local sources.

2.4.2 Representative background air concentrations

BoPRC has recommended background concentrations of PM_{10} and $PM_{2.5}$ to be adopted for the purpose of assessing the effects of the proposed asphalt plant. We understand these values are based on the 98th percentile of monitoring data from BoPRC air quality monitoring stations at De Havilland Way, Whareroa Marae, Sulphur Point and Bridge Marina (the time period over which the data has been analysed is not known).

For SO_2, the representative 1-hour and 24-hour background values have been selected based on the highest 98th percentile concentration measured in 2020 and 2021 at the BoPRC air quality monitoring station at Totara Street as a broadly representative industrial location (see **Appendix A**). The 98th percentile value was used (in preference to a higher percentile or worst case) to avoid capturing high concentrations associated with local sources in the vicinity of the Totara Street monitor (particularly the impacts of emissions from the Ballance fertiliser works).

Representative background concentrations estimated for each contaminant and averaging period are summarised in **Table 2.3**. Where local monitoring data is not available, recommended values from the Waka Kotahi background air quality tool and the Good Practice Guide for Assessing Discharges to Air from Industry (Ministry for the Environment, 2016) have been adopted.

Table 2.3: Estimated background concentrations of air quality contaminants

Contaminant	Averaging period	Estimated background concentration (µg/m^3)	Basis for concentration estimate
PM_{10}	24-hour	30.2	BoPRC recommendation
	Annual	14.6	BoPRC recommendation
$PM_{2.5}$	24-hour	14.0	BoPRC recommendation
	Annual	7.5	BoPRC recommendation
SO_2	1-hour	23.4	98th percentile of Totara Street data, 2020
	24-hour	13.8	98th percentile of Totara Street data, 2020
NO_2	1-hour	65	Waka Kotahi background air quality tool – Tauranga Main Urban Area
	24-hour	43	Waka Kotahi background air quality tool – Tauranga Main Urban Area

Contaminant	Averaging period	Estimated background concentration (µg/m^3)	Basis for concentration estimate
CO	1-hour	5,000	MfE GPG Industry default value – Main urban area
	8-hour	3,000	MfE GPG Industry default value – Main urban area
Benzene	Annual	1.0	MfE GPG Industry default value – Main urban area

3 Description of proposed activity

3.1 Overview

Allied proposes to construct and commission a new asphalt manufacturing plant at the Site. The existing asphalt plant will be decommissioned once the new plant is operational. The transition between the existing and new plants will be managed so that both plants will not be operated at the same time, i.e. the discharges to air from both plants will not occur simultaneously. Therefore, the cumulative effects of emissions from both plants have not been considered in this assessment.

The new plant will be a Marini Top Tower 2500 batch-mix plant, pictured in **Figure 3.1** and **Figure 3.2** (image shows a slightly larger capacity plant).

The existing asphalt plant is a parallel flow single drum hot mix asphalt plant. The full process description from the 2020 consent application is appended as **Appendix C** for reference. The design of the proposed plant has several significant benefits in terms of discharges to air of odour and particulate compared to the existing plant. The following paragraphs describe the proposed plant, and highlight the key differences compared with the existing plant.

In the existing plant, the aggregate is transferred into the hot mix drum at the burner end to dry the aggregate. Hot bitumen is pumped from the storage tanks into the hot mix drum at a point two-thirds along the length of the drum for combination with the aggregate mix. Air from the drum is extracted via an induced draught fan to a venturi water scrubbing section and centrifugal water/dust separator.

In the proposed plant design, the aggregate is dried in a counter-current drying drum before being size-separated and stored in heated silos. The separated drying drum design ensures the bitumen is not exposed to high temperatures in the flame zone. Exhaust gas from the drying drum is extracted and passed through a cyclone and baghouse. The hot aggregate is weighed and discharged into a separate mixing unit where bitumen and other materials are added as required. The mixing unit and storage bins are enclosed, and air from these and from the load out operations are extracted to a bluesmoke aerosol treatment system before being reintroduced to the baghouse stack.

Odour emissions from asphalt plants are mainly related to the volatilisation of Volatile Organic Compounds (VOCs) from the bitumen. In the proposed plant design, the temperature of the bitumen is minimised by introducing it to the pre-heated aggregate in a separate mixing unit. There is no potential for bitumen to be exposed to flame. In addition, the proposed plant will have the ability to manufacture low energy/low emissions asphalt (in addition to standard hot mix asphalt). The low energy asphalt has a reduced mixing temperature of 120°C (compared to 160 – 170°C for standard hot mix). Given the additional controls on odour described above, odour emissions from the proposed plant are expected to be significantly lower than from the existing plant, which has been verified in stack testing of the existing plant and a similar model of Marini vertical batching plant in Australia (see Section **4.2.4** for details).

Particulate emissions from the asphalt plant are mainly related to the processing of aggregate through the drying drum. The air pollution control equipment will comprise a primary dust collector (cyclone) to remove the coarse fraction and return it to the heated aggregates and a secondary dust collector (reverse-air baghouse). The proposed consent limit for total suspended particulate (TSP) emissions from the baghouse is 30 mg/Nm^3 (equivalent to 1.25 kg/hour), compared to the consent limit for the discharges from the current asphalt plant of 250 mg/Nm^3 and 4.2 kg/hour.

The proposed plant will have a larger production capacity than the existing plant (80 tonnes/hour). The maximum production capacity will be 200 tonnes/hour, although the normal production rate is likely to be approximately 120 tonnes/hour.

The proposed plant has a larger burner (13.4 MW) than the existing plant (7 MW) and will therefore burn fuel at a higher rate than the existing plant. However, as it is a batch plant (compared to the current continuous plant) there are expected to be longer periods of time when the plant is not operating (and no emissions are occurring).

Given uncertainties about security of supply and cost, Allied needs to retain the ability to use a range of possible fuels (natural gas, diesel, biodiesel or used oil). Therefore the proposed plant burner has multi fuel capacity (as does the current plant).

Another key difference between the plants is that the proposed plant will have a taller stack (27.6 m) compared to the existing plant (18 m). The taller stack will result in improved dispersion and dilution of emissions compared to the existing plant.

Figure 3.1: Marini 2500 batch mix plant

Figure 3.2: Marini Top Tower 3000 as installed in Sydney, Australia.

3.2 Asphalt production

3.2.1 Raw material storage and handling

All materials with an appreciable fine content (fine grade aggregates, sand and recycled asphalt pavement (RAP)) will be stored in covered storage bays. The covered bays will provide protection from wind to reduce windblown dust as well as reduce the moisture content of the materials for production. Recycled water dust suppression systems (sprinkler system) will be used to reduce entrained dust around aggregate storage and handling areas.

Coarse grade aggregate and slag that are unlikely to generate dust will be stored in uncovered bays.

All areas of the Site, including yard areas and aggregate storage bays will be paved. There is the potential for vehicles and equipment moving across paved areas to resuspend deposited dust. The key controls at the Site to minimise this will include scheduled mechanical sweeping of yard surfaces, restricting vehicle speed (site speed limit of 15 km/hour[11]), regular removal of materials spilled on sealed surfaces and operation of fixed water sprinklers for dust suppression should visible emissions arise under dry conditions.

The proposed plant will have storage silos for recovered fines and for lime storage and dispensing. A bag filtration system will be installed on each of the silos to minimise the discharge of dust or lime during filling.

[11] Consistent with the recommendations of Section 5.2.4 of the Good Practice Guide for Managing and Assessing Dust, MfE 2016

Six 11 m^3 cold feed hoppers will be used to feed virgin aggregate, two 8 m^3 hoppers will be used to feed RAP and one 3 m^3 fibre hopper will be used to feed paper fibre for use in certain types of asphalt mixes.

Three operational bitumen tanks are proposed. These will store straight-run bitumen and bitumen used for asphalt manufacture and chip sealing. The tanks will include two 60,000 L vertical tanks and one 40,000 L horizontal asphalt plant bitumen supply tank.

Emissions to air from bitumen tanks are will typically only occur during the delivery of bitumen, as air is displaced from the tanks. Discharges to air from bitumen tanks will be passed through a water bath system to remove condensables associated odour.

Bitumen tanks will be electrically heated, with failsafe thermostats to prevent the overheating of bitumen. Bitumen will be stored at 160°C with a failsafe temperature of 170°C and polymer bitumen will be stored at 180 °C with a failsafe temperature of 190°C.

One 50,000 L fuel storage tank will be located on Site for fuelling the burner. Kerosene, diesel and other solvents will not be used as asphalt release agents on truck beds prior to loading of asphalt.

A waste asphalt stockpile will be established on site for the storage of production and paving waste, prior to being removed from site for processing into RAP.

3.2.2 Description of proposed asphalt plant

The proposed production process is described below:

- Unheated aggregate will be transferred to feed hoppers via front end loaders. Aggregate will then be conveyed via covered charging conveyors to the aggregate drying drum for drying.
- Aggregate is dried in the counter-flow drying drum by a direct-fired 13.4 MW burner which is fired using natural gas, diesel, biodiesel or used oil. The drying drum will operate at around 170°C for standard asphalt mixes. This plant will also have the ability to manufacture low energy asphalt mixes, requiring a reduced drum temperature of around 120°C.
- Exhaust gases from the drying drum are extracted and treated to remove particulate matter prior to discharge via a 27.6 m stack. Coarse particulate matter is first removed by a cyclone (primary dust collector) and returned to the heated aggregates. Secondary dust collection is provided by a reverse air bag house, removing fine particulate and collecting it for disposal or reuse. The secondary baghouse is rated to a maximum discharge concentration of 20 mg/m^3 (corrected to 20°C and 1 atmosphere pressure).
- Dried, hot aggregate will be transferred to the top of the tower unit via enclosed bucket elevator.
- Dried, hot aggregate will be passed through a multi-layered screening unit located at the top of the tower unit, separated and stored in different bins based on the aggregate size. Air from the screening unit is extracted and discharged to air via the baghouse.
- Aggregates required for each batch are then weighed and discharged by gravity into a mixing unit. Reclaimed fines are also added by weight as required for mixing.
- If RAP is used in the batch recipe, this is fed from a cold hopper and is conveyed via conveyor belt and bucket elevator to the weighing platform, then transferred into the mixing unit. The plant will be able to utilise up to 40% RAP in asphalt manufacture.
- Lime flour and paper fibres may be added as required for certain mix types. In each case, lime flour and paper fibres will be transferred from silos, conveyed pneumatically to the weighing platforms and discharged into the mixing unit.
- Bitumen will be conveyed by pipeline from one of the three storage tanks and pumped via a heated weigh kettle. It is weighed then discharged into the mixing unit.

- The combined aggregates, filler, fibres and bitumen will then be mixed for a fixed duration (mixing duration is dependent on recipe). The mix will then discharge via gravity into a hot asphalt storage silo. No external conveyance of hot mix will be required between the mixer and silo.
- Fumes from the mixing unit, hot mix storage bins at the base of the tower will be extracted to a bluesmoke aerosol filter for removal of oils and semi-volatile organics (and associated odours) prior to discharge to the tall plant stack.
- Trucks will be positioned below the hot asphalt storage silo and loaded by gravity with the hot asphalt for dispatch. The hot asphalt loading area is not proposed to be enclosed. Allied estimates that on average, up to 100 loadouts per day will occur at the Site.
- An automated process control system is used to control the manufacturing process with operator oversight.

3.2.3 Hours of operation

The hours of operation of the proposed asphalt plant will be driven by customer needs and therefore Allied rely on a flexible operating window. Typical operating hours are weekdays, 6 am to 5 pm. However, particularly for works on large State Highway projects, asphalt may be required to be generated at night-time and, rarely, on weekends. Therefore, asphalt manufacturing may occur all hours of the day, 7 days per week.

Allied expects the market demand for asphalt to increase somewhat in the foreseeable future to facilitate development in Tauranga. The higher production rate associated with the new plant means that more asphalt is able to be produced in a shorter period of time. As the plant is a batch mix plant, this means there are likely to be longer periods where the plant is not operating compared to the existing plant.

Given the need for operational flexibility, this assessment has assumed that the stack emissions occur continuously to represent the maximum envelope of effects that would be authorised by the consent. We note that for contaminants with assessment criteria for longer term averaging periods (three month and annual), this is likely to substantially overstate Allied's contribution to ground level concentrations.

3.2.4 Plant location

The location of the proposed new asphalt plant is near the southern boundary of the Site, south of the existing asphalt plant. The proposed locations of the asphalt plant and other new structures (coloured orange) is presented in **Figure 3.3** below.

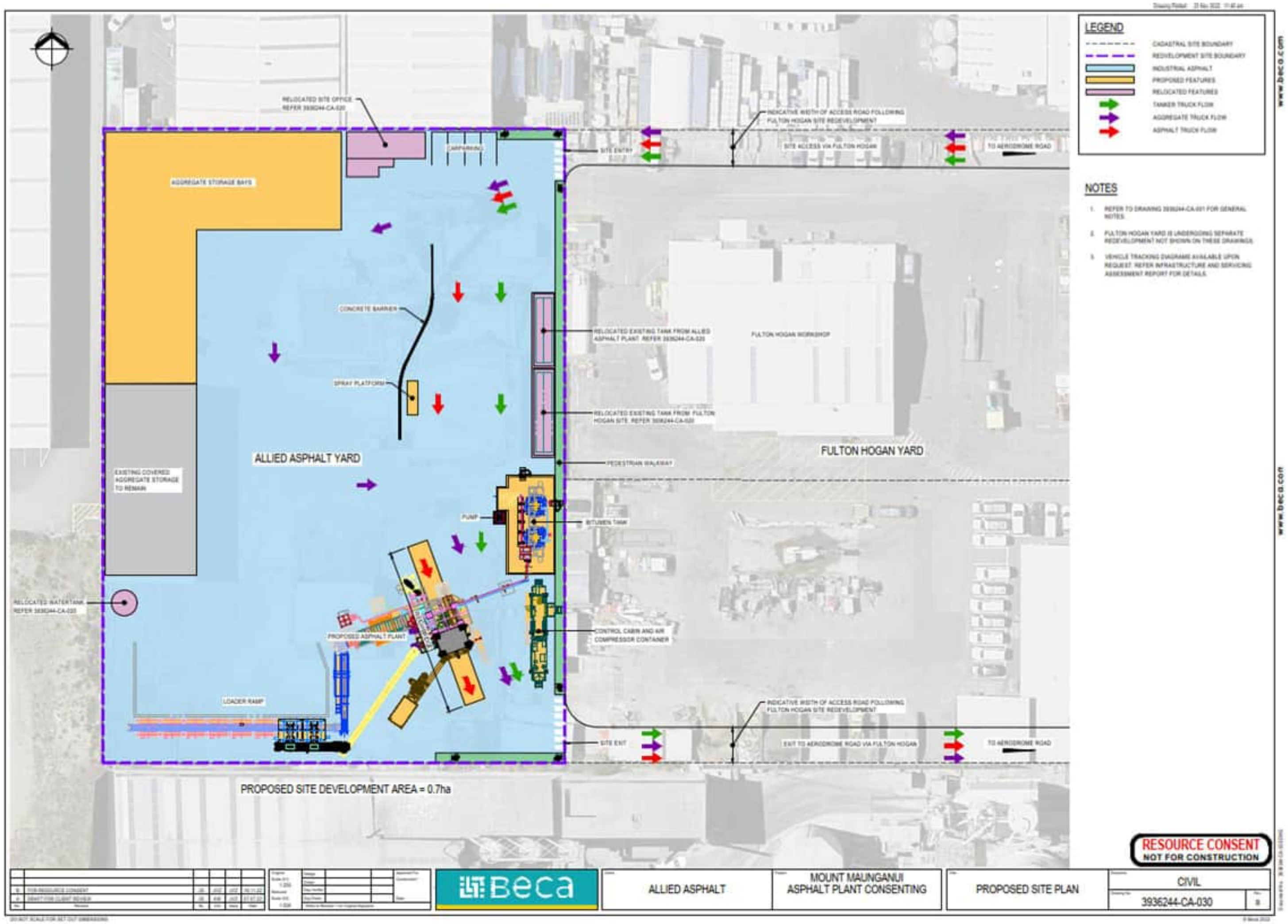


Figure 3.3: Proposed site layout. Draft note: minor revisions to ancillary facilities are expected. *Source: BECA*

3.3 Construction and decommissioning associated with the site redevelopment

3.3.1 Overview

Demolition and construction works are required for the proposed new asphalt plant and associated facilities. This work, will include, but is not limited to:

- The demolition of existing buildings and structures, including the existing asphalt plant.
- Relocation of material stockpiles, including RAP and aggregate stockpiles.
- Excavation and re-paving of the southern extent of the Site for installation of the new plant.
- Construction of new structures associated with the plant.

The principal discharge to air associated with construction and demolition works for the proposed Site redevelopment is dust. The main sources of dust from the proposed works are:

- Demolition works, including concrete cutting and breaking works.
- Earthworks, including the handling of material and loading into trucks.
- Vehicles and machinery movements on sealed and unsealed surfaces.
- Wind erosion from exposed areas and product stockpiles.

The estimated duration of construction activities, including required earthworks, is a maximum of 6 months. Commissioning of the new plant is expected to take up to a month. Once the new plant is operational, decommissioning of the existing plant will commence and is estimated to take 10 weeks.

3.3.2 Decommissioning works

Breaking and cutting works and spoil removal are the key dust generating activities associated with demolition works.

Measures to reduce dust during decommissioning of the existing plant include minimising the work area and ensuring water is available as a dust suppressant should visible emissions arise. Limiting works during strong winds would provide further control of dust emissions.

3.3.3 Earthworks activities

Earthworks activities may include excavating, re-levelling, contouring and placement of fill. The application of new asphalt seal to the new plant area and removal of undersealed parts of the Site may also be required.

The key dust generating activities will be the disturbance and handling of materials and the loading/unloading of trucks. There is a greater potential for dust emissions if the material contains a high proportion of fines, and during dry, windy conditions.

The main practical measure to reduce dust emissions from spoil is to promptly remove the spoil and excavated materials from site. During loading, the drop height onto the truck should be minimised and all trucks containing loads of dusty materials should be covered. The use of water sprays to dampen spoil on dry days would further control dust.

4 Nature of discharges to air

4.1 Contaminants of interest

The key contaminants of interest in the discharges to air from asphalt production are:

- Discharges from the plant stack including:
  - Fine particulate matter (PM_{10} and $PM_{2.5}$).
  - Sulphur dioxide (SO_2).
  - Oxides of nitrogen (NO_X).
  - Carbon monoxide (CO).
  - Volatile organic compounds (VOCs) and poly-cyclic aromatic hydrocarbons (PAHs).
  - Trace contaminants from the combustion of used oil (trace metals).
- Odour.
- Dust during the Site operation.
- Dust from demolition and construction of the new plant.

PM_{10} and $PM_{2.5}$ are generated from the combustion of fuels, from the drying, tumbling and screening of aggregates and from the condensation of organic contaminants volatilised during the manufacture of asphalt. The combustion of natural gas, diesel, biodiesel or used oil will also generate a range of by-products including SO_2, NO_X and CO. Trace metals may also be volatilised and discharged to air in the combustion of used oil. The heating of bitumen can also cause the release of VOCs. Exposure to airborne hazardous air pollutants can cause adverse effects on human health, particularly on respiratory function.

Odour, comprised primarily of organic contaminants, can be generated from the mixing of bitumen with heated aggregate, from the warm storage of bitumen and from the storage and handling of hot-mix asphalt. Odours from asphalt production can impact on the perceived amenity in the local area.

Coarse particulate matter such as dust emitted from vehicle movements, the handling of materials, pick-up from wind and construction and demolition activities can impact on the perceived amenity in the local area and cause soiling of property if deposited in sufficient quantities on surfaces.

The following sub-section describes the method used to characterise contaminant emissions. Further details on contaminant emission rates and other parameters used in dispersion modelling are discussed in **Appendix D**.

4.2 Characterisation of contaminant emissions

4.2.1 Fine particulate matter

The Mt Maunganui Airshed is classified as a polluted airshed and therefore Regulation 17 of the NESAQ applies as detailed in Section **7.1** of this AQA. Consent for discharges to air from the proposed plant can only be granted if the amount and rate of PM_{10} discharge to be expressly allowed by the proposed consent are the same as or less than under the existing consent (regulation 17(2)(b)). Particulate emissions from the proposed plant have been estimated based on the manufacturer's specification for a maximum TSP emission concentration of 20 mg/Nm^3. Conservatively, a higher concentration of 30 mg/Nm^3 has been modelled for the proposed plant. Maximum emission rates for the existing Allied and Higgins plants, which are controlled by wet scrubbers, have been modelled based on the respective consent limits for TSP.

For the proposed plant, we have assumed that PM_{10} and $PM_{2.5}$ comprises 80% and 40% of TSP, respectively based on stack emission test results for Fulton Hogan's established double barrel drum mix asphalt plant at Reliable Way Mt Wellington, and one test from Fulton Hogan's drum mix asphalt plant in Silverdale. The Jacobs Air Quality Assessment for the existing plant assumed 83% PM_{10} and did not cover $PM_{2.5}$ emissions due to the absence of NZ air quality standards at the time of the assessment. As no size fraction analysis data for the existing parallel flow drum plants at these sites are available, we have assumed that performance of 80% PM_{10} and 40% $PM_{2.5}$ also applies.

4.2.2 Products of combustion

The application seeks to authorise the proposed asphalt plant to be fired with natural gas, diesel, biodiesel or used oil. The combustion of these different fuels will result in different emission characteristics.

Combustion of used oil can emit greater quantities of contaminants, such as particulate and sulphur oxides as well as trace organic and metal contaminants than cleaner burning fuels such as diesel or natural gas. The combustion of used oil is likely to represent the worst-case of emissions associated with these fuels. We have modelled SO_2, NO_X and trace metal species associated with the combustion of used oil for both the existing and proposed plants at the Site. Emission rates (and consequent ground level concentrations) from use of natural gas as a fuel are lower for all contaminants. The Higgins plant is fuelled by diesel, a low sulphur fuel.

The US EPA AP-42 emission factors for the combustion of waste oil in drum mix plants and batch mix asphalt plants have been used to estimate emissions from the existing and proposed plants, respectively. These emission factors are used for estimation of emission rates of NO_X, CO, VOCs, PAHs and trace metal species[12]. The AP-42 NO_X emission factors for drum mix and batch mix asphalt plants are similar for use of natural gas as a fuel, however they are significantly higher for batch mix plants using used oil as a fuel. NO_X emissions largely arise from combustion and therefore there is no obvious reason for this difference, and review of the background data shows that the batch mix plant emission factor was based on only two tests (compared to 11 for the drum mix factor). On this basis, we have used the same NO_X emission factor for each type of plant based on fuel type (see **Appendix D** Section **D2.3.3**).

The used oil will meet the specifications for reprocessed oil detailed in the Environmental Protection Authority Code of Practice for Management and Handling of Used Oil (HSNOCOP 63)[13] which places maximum allowable levels on arsenic, cadmium, chromium and lead. These levels are also specified as composition maximums on the used oil safety data sheet, which additionally includes a limit for copper. These levels are set out in **Table 4.1** below**.** The resource consent for the existing plant limits the maximum sulphur content of used oil to 20,000 ppm (2% w/w). However, the current supply contracts specify no more than 5,000 ppm (0.5% w/w) sulphur, which is proposed to be adopted as a new consent limit.

To account for potential variability in contaminant concentrations of used oil we have assessed the potential effects of sulphur dioxide, arsenic, cadmium, chromium and lead assuming sulphur and other contaminants are present at the maximum allowable levels provided for in HSNOCOP 63, the used oil SDS and supply agreements, as set out in **Table 4.1**. In the calculation of emission rates of these contaminants, we have assumed a maximum used oil consumption rate for each plant as set out in **Appendix D** Section **D2.3.**

[12] Because the AP-42 emission factors for drum mix plants are based on fabric filtration, the emission factors for metals and PAHs used for the existing plant have been multiplied by four to reflect the comparative performance of the venturi scrubber control equipment on the existing plant.
[13] Environmental Protection Authority. November 2013. Management and Handling of Used Oil HSNOCOP 63.

Table 4.1: Maximum allowable levels of contaminants in used oil

Contaminant	Maximum allowable level
Sulphur content	5,000 ppm (0.5 % w/w)
Arsenic	5 ppm
Cadmium	2 ppm
Chromium	10 ppm
Copper	100 ppm
Lead	100 ppm

PAHs are compounds naturally occurring in petroleum products. They are primarily released as products of incomplete combustion, in the presence of chlorine, and therefore are expected to be produced at the burner and in the asphalt plant.

Emission rates for PAHs have been developed based on the AP-42 emission rates for drum mix and batch mix asphalt plants. Mixtures of PAHs have been expressed as the Benzo[a]pyrene (BaP) equivalence concentration based on Potency Equivalence Factors for different PAHs (i.e. concentration expressed as BaP_{eq}) as set out in the MfE Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (revised 2011).

4.2.3 Volatile organic compounds

As there is a range of VOCs of varying toxicity, certain VOCs were identified for assessment on the basis of the scale of their emissions in relation to the relevant assessment criteria. As such, the assessment of VOCs has focussed on benzene, acetaldehyde and formaldehyde. Emission rates for these VOCs were developed using the US EPA emission factors for batch mix and drum mix plants as appropriate.

4.2.4 Odour

In the existing single-drum parallel-flow asphalt plant, bitumen is introduced part way along the drum length. This design exposes bitumen to high temperatures and increases the release of odorous compounds compared to alternative designs where the drying of aggregate and mixing with bitumen are kept separate. These odorous compounds are not effectively treated in the wet scrubbing treatment system (which is mainly designed to remove particulate matter and soluble gaseous contaminants).

For the proposed plant, as there is no odour emission data available for comparable asphalt plants in New Zealand, Allied commissioned stack testing at a vertical batching plant in Laverton, Australia. The Laverton plant is a Marini 2500 similar to that proposed at the Mt Maunganui site. However, there are some configuration differences. Vapours from the mixing unit at the Laverton plant are returned to the aggregate drying drum to be combusted and emitted to the stack. In the proposed configuration at Mt Maunganui, vapours and aerosols from the mixing unit will be treated via a proprietary blue smoke aerosol filter to remove oils and semi-volatile organic compounds (and associated odours) prior to discharge to the tall plant stack.

We understand that this option has been selected as it will provide greater control of odour in the highly sensitive context of the Mt Maunganui location, compared to returning the vapours to the drying drum. As such, the odour predictions using the emission rate developed from the Laverton plant are likely to overstate the potential odour impacts of the proposed plant.

The proposed asphalt plant design, odour treatment system and a significantly higher stack are expected to result in substantially reduced odour impacts in the surrounding area compared to the existing plant.

Emission testing for odour was also undertaken from the existing asphalt plant stack in September 2022. As expected, the odour emission rates were higher than from the Laverton plant. This stack testing has been used as the basis for estimating maximum and typical odour emissions rates from the existing Allied plant and for the Higgins asphalt plant, which is also a single-drum parallel flow plant with a wet scrubber.

For the purposes of dispersion modelling, maximum and typical odour emission rates have been estimated by scaling to the equivalent production rate at each plant based on the production rate at the time of the sampling. These values are presented in **Table 4.3**. Further information on how these odour emission rates have been developed is set out in **Appendix D** (Section **D2.4**).

4.3 Summary of modelled emission rates

The emission rates of contaminants that have been used in the dispersion modelling assessment are set out in **Table 4.2**. Emission rates for the Higgins plant, which have been included in the modelling for the purpose of assessing cumulative effects, are set out in **Appendix D**.

Table 4.2: Contaminant emissions rates for the existing and proposed asphalt plants

Contaminant	Emission rate from the existing asphalt plant @ 80 t/hour (kg/hour)		Emission rate from the proposed asphalt plant @ 200 t/hour (kg/hour)	
	Natural gas-fired	Used oil-fired	Natural gas-fired	Used oil-fired
TSP	4.2		1.25	
PM_{10}	3.36 [A]		1.0 [B]	
$PM_{2.5}$	1.68 [A]		0.50 [B]	
SO_2	0.03	2.79 [C]	0.06	5.35
NO_X	2.00	4.64	5.00	11.60
CO	5.20	5.20	40	40
Arsenic	8.96×10^{-5}	2.79×10^{-3}	4.6×10^{-5}	5.35×10^{-3}
Beryllium	-		1.50×10^{-5}	
Cadmium	6.72×10^{-4}	1.12×10^{-3}	6.1×10^{-5}	2.14×10^{-3}
Chromium	8.80×10^{-4}	2.79×10^{-3}	5.7×10^{-5}	1.24×10^{-2}
Chromium VI	7.20×10^{-5}		4.80×10^{-6}	
Copper	4.96×10^{-4}	2.79×10^{-2}	2.80×10^{-4}	5.35×10^{-2}
Lead	9.92×10^{-5}	2.79×10^{-2}	8.90×10^{-5}	1.24×10^{-1}
Manganese	1.23×10^{-3}		6.90×10^{-4}	
Mercury	3.84×10^{-5}	4.16×10^{-4}	4.10×10^{-5}	
Nickel	1.01×10^{-2}		3.00×10^{-4}	
Selenium	5.60×10^{-5}		4.90×10^{-5}	
Benzene	1.56×10^{-2}		2.80×10^{-2}	

Contaminant	Emission rate from the existing asphalt plant @ 80 t/hour (kg/hour)		Emission rate from the proposed asphalt plant @ 200 t/hour (kg/hour)	
	Natural gas-fired	Used oil-fired	Natural gas-fired	Used oil-fired
Acetaldehyde	-	5.20×10^{-2}	3.20×10^{-2}	
Formaldehyde	1.24×10^{-1}		7.40×10^{-2}	
BaP_{eq}	7.58×10^{-6}		3.17×10^{-7}	

Table Notes:

A = Based on the existing total suspended particulate consent limit of 4.2 kg/hour (Clause 5.5).

B = Based on proposed total suspended particulate consent limit of 30 mg/Nm^3 and max volumetric flowrate of 41,805 Nm^3/hour at 20°C, 1 atmosphere, dry gas basis.

C = Assuming a maximum sulphur limit of 0.5%w/w, rather than the 2.0%w/w authorised by the current consent.

As discussed in Section **3.2.3**, asphalt plants do not operate continuously. The odour modelling assessment criteria differ for continuous odour sources compared to intermittent odour sources (see Section **5.3**). Therefore, for the purposes of providing a more realistic assessment of the potential effects of odour emissions, and for comparison with assessment criteria for intermittent odour sources, a “typical” operating scenario has also been considered for the existing asphalt plants. This assumes operation at a typical production rate for reduced hours in the day starting at 7am and finishing at 12 pm. A similar assessment of a “typical” scenario was not undertaken for the proposed plant as the modelled odour concentrations are well below the odour modelling assessment criteria using the conservative assumption of continuous operation and will therefore also readily meet the criteria for intermittent odour sources.

The modelled odour emission rates and operating hours are presented in **Table 4.3**.

Table 4.3: Odour emission rates and operating hours for the existing and proposed asphalt plants

Plant description	Production rate (tonnes/hr)	Operating hours	Stack odour emission rate (OU/s)
	Maximum scenario		
Proposed Allied plant	200	00:00 – 24:00	39,000
Existing Allied plant	80	00:00 – 24:00	280,000
Existing Higgins Asphalt plant	60	00:00 – 24:00	210,000
	Typical scenario		
Existing Allied plant	50	07:00 – 12:00	180,000
Existing Higgins Asphalt plant	40	07:00 – 12:00	140,000

5 Approach to assessment

5.1 Dispersion modelling

The effects of discharges to air from the asphalt plant stack, which include fine particulate (PM_{10} and $PM_{2.5}$), products of combustion (SO_2 and NO_2) and odour, as well as minor emissions of PAHs, metals and VOCs have been assessed using dispersion modelling. The worst-case emissions of products of combustion and trace metals are associated with the use of used oil as the burner fuel. We have modelled both natural gas and used oil fuel use scenarios. The detailed methodology for the dispersion modelling assessment is set out in **Appendix D**.

Fugitive emissions of VOCs from loadout of hot mix asphalt and from bitumen storage have not been assessed in dispersion modelling as the scale of these discharges are likely to be substantially lower than stack emissions. There will also be a hood extraction system that activates during loadout and is ducted to a blue smoke aerosol filter. The treated gases are then ducted to the main stack.

The dispersion modelling assessment has been used to predict maximum ground level concentrations (MGLC) of contaminants at locations where people may be exposed for the averaging periods of the relevant air quality criteria shown in **Table 5.1**. Where the air quality assessment criteria are expressed as a 1-hour average, the relevant locations are anywhere beyond the site boundary. By convention, the 99.9^{th} percentile 1-hour average model output has been reported as representing the MGLC.

Where the air quality assessment criteria are expressed as longer averaging periods, such as 24-hour or annual average, the relevant locations are sensitive receptors where people may be present continuously over this time period, such as dwellings. For completeness, other sensitive receptors, such as pre-schools, have also been evaluated, although people are generally only present for periods of time during the day. The modelled discrete receptors are shown in **Appendix D Figure 2.**

For completeness, it is noted that, in some cases, the MGLC for the existing plant differ from those presented in the air quality assessment submitted with the application for replacement consent (RM20-0301). There are a number of reasons for these differences, including:

- the use of the CALPUFF model for this assessment compared to the steady state dispersion model (AERMOD) in the 2020 assessment.
- differences in the assumed background concentrations and the location of the reported results, which were not limited to places where people are likely to be exposed for the relevant period; and
- minor differences in the selection of representative stack exit parameters, such as exit velocity.

For particulates and odour, emissions from the Higgins asphalt plant stack, located approximately 300 m northeast of the Site, have also been modelled and added to the background concentration to characterise potential cumulative effects. The emissions of particulate, SO_2 and odour from the Higgins plant have been modelled separately and added contemporaneously to the Allied model output to illustrate the cumulative effect of the two sites on the sensitive receptors.

For the assessment of impacts on ambient NO_2 concentrations, the 'Proxy Method' described in Appendix 3 of the Good Practice Guide for Assessing Discharges to Air from Industry (MfE, 2016) has been used to account for the atmospheric oxidation of emitted NO to NO_2 and background NO_2 concentrations for 1-hour and 24-hour average predictions (discussed further in **Appendix D**. Section **D3.2.4**). It should be noted that the methods used to represent atmospheric oxidation of NO to NO_2 are likely to substantially overestimate cumulative NO_2 concentrations that would occur in practice.

5.2 Air quality assessment criteria

Predicted ambient contaminant concentrations have been compared with health-based air quality assessment criteria to assess the potential for adverse effects on human health.

The MfE GPG Industry recommends that the following criteria for assessing the effects of air quality should be selected, in the following order of priority:

- National Environmental Standards for Air Quality (NESAQ).
- National Ambient Air Quality Guidelines (AAQG).
- Regional objectives (unless more stringent than the above criteria). The Bay of Plenty Regional Air Plan refers to the NESAQ and AAQG- rather than set unique limits.
- World Health Organisation Air Quality Guidelines (WHO 2005).
- California Office of Environment Health Hazard Assessment (OEHHA) reference exposure levels (REL) (acute and chronic) where available.

In February 2020, the Ministry for the Environment released proposed amendments to the NESAQ for public consultation. The amendments included addition of new standards for ambient $PM_{2.5}$ concentrations (as 24-hour and annual averages) equating to the corresponding WHO 2005 Air Quality Guideline values. Although none of the proposed amendments have been adopted to date, the prospective standards for $PM_{2.5}$ have been considered in this assessment.

The ambient air quality criteria apply in the open air beyond the site boundary, anywhere where people may be exposed for the relevant averaging period. In practical terms for the assessment, this means:

- 1-hour average criteria apply anywhere beyond the site boundary.
- 8-hour average criteria apply at workplaces and residential dwellings.
- 24-hour, 3-month and annual average criteria apply anywhere where residential activity may occur (including dwellings, marae and temporary accommodation).

Air quality criteria for the contaminants of interest have been adopted from these sources as shown in **Table 5.1**.

Table 5.1: Air quality assessment criteria

Contaminant	Time average	Concentration (µg/m³)	Allowable annual exceedances	Source
Fine particulates (PM_{10})	24-hour	50	1	NESAQ
	Annual	20	N/A	AAQG
Fine particulates ($PM_{2.5}$)	24-hour	25	3	Proposed NESAQ
	Annual	10	N/A	Proposed NESAQ
Sulphur dioxide	1-hour	350	9	NESAQ
	1-hour	570	0	NESAQ
	24-hour	120	N/A	AAQG
Nitrogen dioxide	1-hour	200	9	NESAQ
	24-hour	100	N/A	AAQG
Carbon monoxide	1-hour	30,000	N/A	AAQG
	8-hour	10,000	1	NESAQ

Contaminant	Time average	Concentration (µg/m^3)	Allowable annual exceedances	Source
Arsenic	Annual	0.0055	N/A	AAQG
Beryllium	Annual	0.007	N/A	OEHHA
Cadmium	Annual	0.02	N/A	OEHHA
Trivalent and elemental chromium	Annual	0.11	N/A	AAQG
Hexavalent chromium	Annual	0.0011	N/A	AAQG
Copper	1-hour	100	N/A	OEHHA
Lead	3-month rolling average	0.2	N/A	AAQG
Manganese	Annual	0.09	N/A	OEHHA
Mercury	Annual	0.33	N/A	AAQG
Nickel	Annual	0.014	N/A	OEHHA
Selenium	Annual	20	N/A	OEHHA
Benzene	Annual	3.6	N/A	AAQG
Acetaldehyde	Annual	30	N/A	AAQG
Formaldehyde	30-minute average	100	N/A	AAQG
BAPeq	Annual	0.0003	N/A	AAQG

5.3 Assessment of odour emissions

In addition to odour dispersion modelling, the effects of odour emitted from the Site have been qualitatively assessed based on the following assessment methods:

- An evaluation of odour generating activities and the measures proposed to manage odour emissions and mitigate the potential for odour nuisance effects.
- A consideration of the receiving environment in terms of sensitivity (as well as odour dispersion) and the geographical separation between potential odour sources and local sensitive activities (Section **2.2**).
- Evaluation of odour dispersion modelling results at sensitive locations against odour modelling assessment criteria.
- Analysis of the results of a programme of odour monitoring surveys conducted by T+T staff at an asphalt plant using similar technology, and commentary from Auckland Council on the results of its own odour investigation for the same plant.
- An overall assessment of the potential for odour nuisance considering the FIDOL factors (frequency, intensity, duration, offensiveness/character and location).

Odour concentrations predicted using dispersion modelling can be compared with relevant criteria to assess the potential for nuisance odour effects. The Ministry for the Environment's Good Practice Guide for Assessing and Managing Odour recommends guideline values for the assessment of odour modelling concentration predictions as outlined in **Table 5.2**.

The odour modelling guideline values are presented as 99.9th or 99.5th percentile values. The 99.9th percentile values are intended to be used for intermittent sources. Where this assessment has modelled the stack emissions as a continuous source (which is conservative), the 99.5th percentile model result is the relevant percentile for evaluating predicted concentrations. For the existing Allied and Higgins plants, a "typical" operation scenario, with the plant operating from 7 am – 12 pm at the average production rate was also modelled, and the results evaluated using the 99.9th percentile model prediction. A similar assessment was not undertaken for the proposed plant as the modelled odour concentrations are well below the odour modelling assessment criteria using the conservative assumption of continuous operation and will therefore also readily meet the criteria for intermittent odour sources

The odour modelling guidelines take into account the frequency, intensity, duration and location of the FIDOL factors[14]. However, they do not take into account the "offensiveness" of the odour.

The model predictions in the adjacent industrial area have been assessed against the criteria for low sensitivity receiving environments (5 OU/m³). For high sensitivity receptors (i.e., residential dwellings and other receptors identified in **Table 2.1**), we have compared against the criteria for high sensitivity receiving environments where the worst-case impacts are likely to occur during neutral to stable conditions (applicable to discharges from a tall stack) (2 OU/m³).

Table 5.2: MfE recommended odour-modelling guideline values

Sensitivity of the receptor location	Odour concentration	Percentiles
High (worst-case impacts during unstable to semi-unstable conditions)	1 OU/m³	0.1% and 0.5%
High (worst-case impacts during neutral to stable conditions)	2 OU/m³	0.1% and 0.5%
Moderate (all conditions)	5 OU/m³	0.1% and 0.5%
Low (all conditions)	5 – 10 OU/m³	0.5%

5.4 Assessment of dust emissions

A qualitative approach to assessing nuisance dust impacts from the construction and operational emissions from the proposal has been adopted. The qualitative assessment includes:

- Identification of dust generating activities, factors which influence dust generation and the estimation of the relative scale of dust emissions.
- Evaluation of the receiving environment in terms of sensitivity and separation distances between dust sources and local sensitive activities (Section **2.2**).
- Identification of local prevailing winds and meteorological conditions conducive to dust propagation (Section **2.3**).
- Consideration of complaints relating to historical dust emissions from the existing site operations
- Consideration of the measures employed and proposed to manage dust emissions and mitigate potential nuisance dust effects.
- An overall evaluation of the potential for dust nuisance effects considering the FIDOL factors.

[14] Frequency, Intensity, Duration, Character/Offensiveness and Location.

6 Assessment of air quality effects

6.1 Effects of emissions of fine particulate matter, products of combustion and trace contaminants

6.1.1 Effects of emissions of fine particulate matter and products of combustion

The MGLCs of particulate matter (PM_{10} and $PM_{2.5}$) and products of combustion (CO, NO_2 and SO_2) are summarised in **Table 6.1**. We note that the MGLCs presented in this table are associated with used oil as burner fuel, due to higher emission factors for this fuel compared to natural gas.

For 24-hour average concentrations, the highest modelled concentrations at any sensitive receptor are predicted to occur at the worker accommodation units on De Havilland Way. For annual average concentrations, the highest concentrations at any sensitive receptor are predicted at to occur at 1 MacDonald Street. The modelled incremental contributions of the Site's emissions to the annual average PM_{10} and $PM_{2.5}$ levels are all very small (between 0.8% and 3.6%) compared to the assessment criteria.

The peak modelled 1-hour average concentrations of CO, NO_2 and SO_2 for the proposed plant, the peak concentrations are predicted to occur southeast of the site boundary at the HR Cement site. The modelled concentrations are, at most, less than 10% of the relevant assessment criteria.

Modelled concentrations at more distant receptors than those discussed above, including in the residential area east of Maunganui Road, will be even lower.

The modelled effects of the emissions of particulate and combustion gases from the proposed plant are significantly lower than for the existing plant for all pollutants except 24-hour average NO_2 and SO_2 and 8-hour average CO. For these contaminants, the modelled concentrations from the proposed plant are slightly higher than from the existing plant. This reflects the higher modelled emission rates of these contaminants associated with higher rate of combustion of used oil compared to the existing plant (due to its greater production capacity). These increased emissions are not fully offset by the increased stack height. The NO_2, SO_2 and CO model predictions for both the existing and proposed plant are low with respect to the assessment criteria. It is also important to note that these modelled concentrations are conservatively high because of the assumption of continuous operation burning used oil. In practice, the proposed plant is likely to operate for fewer hours in the day compared to the existing smaller asphalt plant. Consequently, 24-hour average concentrations of contaminants may, in practice, be lower than from the existing plant.

The cumulative MGLC predictions combine the predicted Allied plant contribution and estimated background concentrations. Cumulative concentrations of all contaminants comply with the assessment criteria for all averaging periods.

Contour plots illustrating the spatial distribution of peak concentrations associated with the proposed plant emissions are included as **Appendix D**.

The potential for cumulative effects of PM_{10} emissions including contributions from the Higgins plant has also been considered in the dispersion modelling. At the worst-impacted sensitive receptor for the existing Allied plant, the modelled concentration (excluding background) increases from 4.2 $\mu g/m^3$ (24-hour average) to 5.8 $\mu g/m^3$ (24-hour average) when emissions from Higgins plant are also included. For the proposed plant, the modelled concentration at the sensitive receptor most impacted by emissions from the proposed plant increases from 0.98 $\mu g/m^3$ (24-hour average) to 1.8 $\mu g/m^3$ (24-hour average). We consider that adding these cumulative model predictions to the background concentration is inappropriate as, if the background has been determined correctly, it should account for the effects of existing industrial activities in the area, including the Higgins plant. Therefore, adding the modelled cumulative concentrations would double-count the effects of the

Higgins plant. There is already a conservative element of double-counting in the assessment as, for the same reason, the background concentration should already account for the existing emissions from the Allied plant.

Table 6.1: Predicted concentrations of fine particulate matter and products of combustion

Contaminant	Averaging period	Assessment criterion (from Table 5.1) (µg/m^3)	Background concentration (from Table 2.3) (µg/m^3)	MGLC (Allied plant contribution only, µg/m^3)		Cumulative MGLC (including background, µg/m^3)^A		Location of MGLC	
				Proposed plant	Existing plant	Proposed plant	Existing plant	Proposed plant	Existing plant
PM_{10}	24-hour^B	50	30.2	0.98	4.5	31.2	34.7	3 De Havilland Way	1 De Havilland Way
	Annual^B	20	14.6	0.16	0.72	14.8	15.3	1 MacDonald Street	1 MacDonald Street
$PM_{2.5}$	24-hour^B	25	14.0	0.49	2.2	14.5	16.0	3 De Havilland Way	1 De Havilland Way
	Annual^B	10	7.5	0.08	0.36	7.6	7.9	1 MacDonald Street	1 MacDonald Street
SO_2	1-hour	350	23.4	31.3	136.1	54.7	159.5	HR Cement site, over SE boundary	Tyreworks site, over N boundary
	24-hour^B	120	13.8	5.3	3.6	19.1	17.4	3 De Havilland Way	1 De Havilland Way
NO_2	1-hour	200	65	6.8	22.6	119.8^C	135.6^C	HR Cement site, over SE boundary	Tyreworks site, over N boundary
	24-hour^B	100	43	1.1	0.6	76.1^C	75.6^C	3 De Havilland Way	1 De Havilland Way
CO	1-hour	30,000	5,000	234	254	5234	5254	HR Cement site, over SE boundary	Tyreworks site, over N boundary
	8-hour^B	10,000	3,000	185	152	3185	3152	HR Cement site, over SE boundary	Tyreworks site, over N boundary

Table Notes:

A: Cumulative MGLC predictions include predicted plant contributions and estimated background concentrations

B: Highest concentration predicted at a sensitive receptor

C: Cumulative MGLC predictions are calculated from the direct NO_2 emission using the proxy method to account for atmospheric conversion and background concentrations (MfE, 2016).

6.1.1.1 2021 WHO guidelines

On 22 September 2021, the World Health Organisation (WHO) released its updated global air quality guidelines[15]. This update includes revision of WHO's guidelines for fine particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide, nitrogen dioxide and carbon monoxide.

The WHO 2021 guidelines are based on current evidence on health effects however are not intended to address specific recommendations on policies and interventions because these are largely context specific and may not work in all environmental settings. For example, we note that the guideline concentrations for $PM_{2.5}$ are similar to concentrations experienced at background monitoring sites in New Zealand. We would expect that many coastal locations would exceed these concentrations due to the influence of marine aerosols.

The WHO guidelines are not statutory guidelines in New Zealand; however, it is good practice to consider international guidelines, such as those from the WHO, in absence of New Zealand statutory standards or guidelines. Only the WHO 2021 24-hour average carbon monoxide guideline does not have an equivalent New Zealand statutory standard or guideline.

A comparison of the WHO 2021 guidelines and the equivalent New Zealand statutory standard or guideline is set out in **Table 6.1**.

Table 6.2: WHO 2021 global air quality guidelines and New Zealand statutory standards or guidelines

Contaminant	Averaging period	WHO 2021 global air quality guideline (µg/m³)	New Zealand statutory standard or guideline (µg/m³)
PM_{10}	24-hour	45[A]	50 (NESAQ)[B]
	Annual	15	20 (AAQG)
$PM_{2.5}$	24-hour	15[A]	25 (proposed NESAQ)
	Annual	5	10 (proposed NESAQ)
NO_2	1-hour	200	200 (NESAQ)[C]
	24-hour	25[A]	100 (AAQG)
	Annual	10	None
SO_2	24-hour	40[A]	120 (AAQG)
CO	1-hour	35,000	30,000 (AAQG)
	8-hour	10,000	10,000 (NESAQ)[B]
	24-hour	4,000[A]	None

Table Notes:

A = 99th percentile (i.e., 3-4 exceedances allowed in a 12-month period)

B = 1 exceedance allowed in a 12-month period

C = 9 exceedances allowed in a 12-month period

NESAQ = Resource Management (National Environmental Standards for Air Quality) Regulations 2004

AAQG = New Zealand Ambient Air Quality Guidelines

The predicted peak concentration at locations where a person may reasonably be exposed for 24-hours or longer (i.e., dwellings) are compared to the WHO 2021 guideline values in **Table 6.2**. Background concentrations for all contaminants are derived in Section **2.4.2** of this report, and

[15] World Health Organisation. WHO global air quality guidelines. Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. 22 September 2021.

annual average NO_2 background concentration is recommended by Waka Kotahi. There is no monitoring of CO undertaken in the area. Background concentrations for CO have been estimated as the average of the worst-case 24-hour average CO concentrations measured between 2010 and 2014 at the Takapuna air quality monitoring station (1,900 µg/m^3) in Auckland, as a comparable urban monitoring location.

The maximum fourth highest (99th percentile) 24-hour average concentration and the highest annual average concentration for the proposed plant are predicted to occur at 1 Macdonald Street approximately 440 m northeast of the site boundary.[16].

Table 6.3: Predicted peak concentrations and comparison with the 2021 WHO guidelines

Contaminant	Averaging period	2021 WHO criterion (µg/m^3)	Background	Proposed plant		Proposed plant and background	
				Worst case MGLC (µg/m^3)	% of assessment criterion	Worst case MGLC (µg/m^3)	% of assessment criterion
PM_{10}	24-hour	45^A	30.2	0.76	1.7%	31.0	69%
	Annual	15	14.6	0.16	1.1%	14.8	98%
$PM_{2.5}$	24-hour	15^A	14	0.38	2.5%	14.4	96%
	Annual	5	7.5	0.08	1.6%	7.6	152%
SO_2	24-hour	40^A	13.8	4.1	10.2%	17.9	45%
NO_2	24-hour	25^A	43	0.88^B	3.5%	75.9^C	304%
	Annual	10	16	1.9^D	19.0%	17.9	179%
CO	24-hour	4,000^A	1,900	30.4	0.8%	1,930	48%

Table Notes:

A = 99th percentile (i.e., 3-4 exceedances allowed in a 12-month period)

B = Primary emitted NO_2 only.

C = Assumes a proxy NO_2 concentration of 75 µg/m^3.

D = Assumes all NO is converted to NO_2.

The predicted peak 24-hour average CO ground level concentration is well below the WHO 2021 guideline.

The contribution of primary NO_2 from the proposed asphalt plant is very low compared to the WHO 2021 guidelines. However, it is also necessary to account for a portion of the emitted NO being converted to NO_2. The recommended 'Proxy method' (MfE, 2016) requires addition of a proxy NO_2 concentration of 75 µg/m^3 which, on its own, exceeds the WHO 2021 guideline. Therefore, it is not possible to demonstrate compliance with the WHO 2021 guideline using the recommended method.

MfE (2016) also sets out a very conservative alternative screening method that assumes all emitted NO_X is converted to NO_2. This approach has been used to estimate the worst-case annual average concentration. If applied to the 24-hour average (4th highest) prediction, the worst-case contribution from the Site would be 8.8 µg/m^3 of NO_X (as NO_2) (35% of the WHO 2021 guideline). This value is very conservative as the plant will not operate continuously for a 24-hour period and not all of the

[16] The highest 24-hour average concentration at any sensitive receptor in any of the three modelled years is predicted to occur at de Havilland Way. However, when considering the fourth highest value, the maximum occurs at 1 Macdonald Street.

emitted NO will be converted to NO_2. The recommended default background concentration for the Tauranga Main Urban Area is 43 µg/m^3, which exceeds the WHO 2021 guideline.

The predicted peak 24-hour average SO_2 ground level concentration is low when compared to the WHO 2021 guideline, and cumulative with the background concentration remains well below the guideline.

The predicted site contributions to ground level concentrations of particulate at the most impacted sensitive location are less than 5% of the guideline values in all cases. The adopted background concentration for annual average $PM_{2.5}$ exceeds the WHO 2021 criteria, which is expected to be the case in many urban areas in New Zealand. The annual average PM_{10} concentration background level is marginally lower than the WHO 2021 criteria, and the increment predicted from the continuous operation of the proposed plant does not cause the cumulative concentration to exceed the guideline.

In all cases apart from SO_2, the cumulative concentrations are dominated by the assumed background concentrations. We note that the modelled site contributions are conservative when considering the long-term averaging periods, because the asphalt plant is not expected to operate for 24 hours a day or continuously over a year.

6.1.2 Effects of emissions of trace contaminants

The MGLC of trace metals, PAH (as BaP_{eq}) and VOCs predicted as a result of the combustion of used oil in the proposed plant are presented in **Appendix D** Section **D3.2.6**.

The effects of all trace metals, PAHs and VOCs are predicted to be well below the assessment criterion at locations where people are likely to be present for the relevant averaging periods.

For all metals and trace contaminants based on emission factors (except benzene), the MGLCs decrease. For metals based on the waste oil specification (arsenic, lead, copper, chromium) and benzene, the predicted MGLCs are slightly higher for the proposed plant scenario due to the conservative modelling inputs and the annual average criteria.

6.1.3 Methods to minimise air pollutant emissions

The principal source of fine particulate and other hazardous air pollutant emissions is the drying drum (in general, metal and heavy organic contaminants will be present in particulate emissions). In this case, air extracted from the drum and aggregate screens is proposed to be treated using fabric filtration (reverse air baghouse) to remove particulate matter before it is discharged via the main stack.

The baghouse specified for the proposed plant is a reverse air baghouse, in which a fan rotates over the bags blowing reverse air into them to remove dust. This type of baghouse generates a lower pressure than the compressed air pulses of a pulse-jet baghouse. This minimises wear and tear on the bags.

Baghouses represent the current best practice for the control of particulate matter from asphalt plants and, provided that the bag house is appropriately sized for the volume of air and the loading of particulate and is well operated and maintained, the use of this technology will be highly effective at controlling particulate. The manufacturer's specifications for the baghouse are for a maximum total suspended particulate discharge of 20 mg/m^3 (at 20°C, 1 atmosphere pressure, dry gas basis)[17]. This represents a significant improvement over the measured performance of the existing plant

[17] The dispersion modelling assessment has added a 50% safety margin of 50% as to the manufacture specification and particulate emissions from the proposed plant have been modelled based on an emission concentration of 30 mg/m^3 (at 20°C, 1 atmosphere pressure, dry gas basis)

which utilises a venturi scrubber and cyclone for particulate control. Annual particulate emission testing from the existing plant from 2019 to 2022 shows that the existing plant has an average total suspended particulate discharge concentration of 124 mg/m^3 (at 0°C, 1 atmosphere pressure, dry gas basis). The individual test results ranged from 70 – 180 mg/m^3 (at 0°C, 1 atmosphere pressure, dry gas basis).

The baghouse will use 450 oval filter bags made from Nomex meta-aramid fabric 400 g/m^2 with a filtering surface area of 663 m^2. Auckland Regional Council Technical Publication TP 152 (Draft)[18] includes guidance for design and operating criteria for baghouses. This guidance document recommends a maximum air to cloth ratio of 1.0 m/min for reverse air baghouses.

Using the maximum rated volumetric flow rate of 41,805 Nm^3/hour (697 Nm^3/min) and filter surface area of 663 m^2 the cloth to air ratio of the proposed baghouse is 1.1 m/min which is generally consistent with the recommended guideline of a maximum of 1.0 m/min for reverse air baghouses. This would indicate that the baghouse is appropriately sized.

Emissions from the proposed asphalt plant will be discharged vertically from the 27.6 m high stack to aid dispersion and reduce ambient ground level contaminant concentrations. The stack is taller than the 18 m high stack of the existing plant.

A suitably sized stack is the most practicable method of dispersion for emissions from a hot mix asphalt plant. The results of dispersion modelling from the new main stack indicate that the height is appropriate for emissions from the proposed plant.

Overall, with the inclusion of a reverse air baghouse and a taller stack, particulate emissions from the proposed asphalt plant will be improved. As a result, the proposed control regime for particulate is considered to represent the best practicable option for this purpose.

6.2 Effects of odour emissions

6.2.1 Odour dispersion modelling assessment

6.2.1.1 Effects of existing and proposed Allied plants

The odour dispersion modelling assessment is set out in **Appendix D**. The peak odour concentrations predicted off-site and at sensitive receptor locations are presented in **Table 6.4** and compared with the relevant MfE odour modelling guidelines values. Contour plots for the 99.5th percentile odour concentrations are shown in **Figure 6.1**.

These predictions are based on the conservative assumption of continuous operation at maximum capacity and will therefore overstate odour effects likely to occur in practice. Assessment of a more realistic scenario is presented later in this section, for comparison.

The odour dispersion modelling demonstrates a significant reduction in modelled odour concentrations from the proposed plant compared to the existing plant. This is due to the combined effect of much lower odour emissions (due to the plant design and odour controls) and a taller stack that improves dispersion.

Because of the taller stack on the proposed plant, the worst-case odour impacts occur at different locations compared to the existing plant. The peak off-site odour concentrations associated with the proposed plant emissions (which are not at levels that would cause an odour nuisance) are predicted to occur on HR Cement Ltd's site approximately 90 m southeast of the proposed plant. The peak off-

[18] Auckland Regional Council. Technical Publication TP 152 Assessing Discharge of Contaminants into Air (Draft). April 2002.

site odour concentrations for the existing plant are predicted to occur on the northern boundary of the Site over the Tyre Works Mega building.

Table 6.4: Odour dispersion modelling predictions (assuming continuous operation)

Location	Sensitivity of location	MfE recommended guideline (OU/m^3)	99.5th percentile odour concentration (OU/m^3)	
			Existing plant	Proposed plant
Peak off-site	Low	5-10	32.5	0.67
Peak sensitive receptor	High (neutral to stable conditions)	2	2.8	0.27

The assessment approach will overstate the frequency at which odours from the existing (and proposed) Allied plant are likely to occur in the surrounding area, due to the assumption of continuous operation. However, the modelling suggests that asphalt odours in the industrial area around the existing plant have the potential to cause a nuisance effect. It also shows that there is currently the potential for odour effects associated with the existing plant in the residential area northeast of the site.

The odour modelling results for the proposed plant are well within the odour modelling criteria at all locations and therefore it is unlikely that the proposed plant would cause odours that might be considered offensive or objectionable either in the neighbouring industrial area or the more distant residential area.

6.2.1.2 Cumulative effects of Higgins and Allied asphalt plants

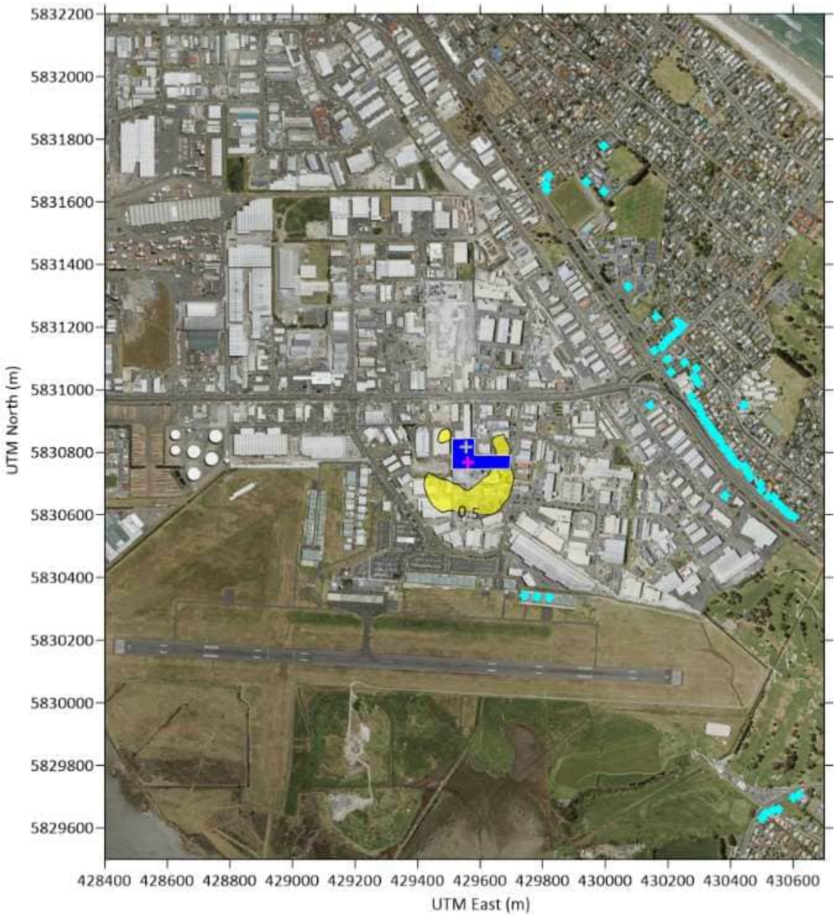
For a given receptor location, the stack emissions from the Higgins and Allied plants will generally not impact at the same time. This is particularly the case for the residential area east of Maunganui Rd. As such, the maximum modelled odour concentrations may not be significantly higher for the combined scenario compared to the higher of the two individual scenarios. However, the effect of two asphalt plants, that generate the same odour, is to potentially increase the overall frequency at which asphalt odours occur at a given location.

To avoid being excessively conservative, and to provide a more realistic assessment of likely cumulative effects, typical operating scenarios (production rates and operating hours) have been considered. As this modelling is for intermittent odour sources, the results are presented as the 99.9th percentile odour concentration in **Appendix D Table 23**.

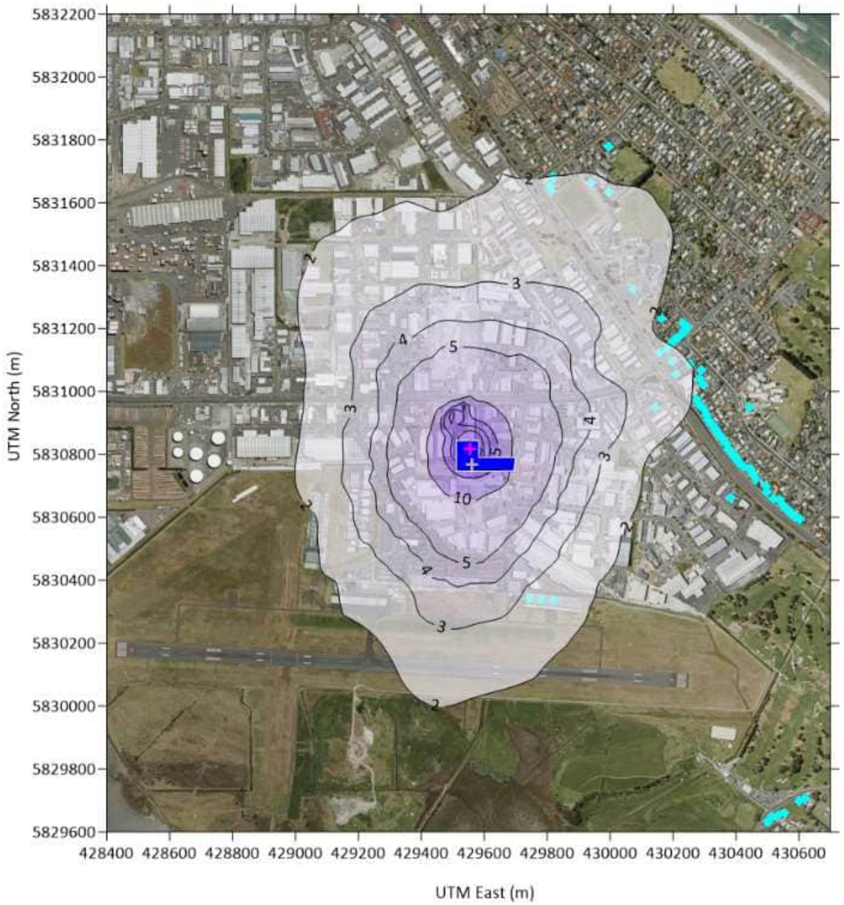
The cumulative effects of the two existing plants are only marginally greater than the individual effects. However, as the individual effects are close to the odour modelling guideline, the small cumulative effect is enough to increase the 99.9th percentile value to be just at the assessment criterion at the most-impacted sensitive receptors.

There is no material cumulative effect in the industrial area, in comparison with the relevant odour modelling guideline. However, both existing plants have the potential to create nuisance odours in the immediate vicinity.

It is not necessary to present a detailed assessment of cumulative effects of the proposed plant with the Higgins plant, as the contribution from the proposed asphalt plant is so small that it does not contribute to exceedances of the odour modelling guidelines.



99.5th percentile 1-hour average odour concentration contour plot for the proposed Allied plant



99.5th percentile 1-hour average odour concentration contour plot for the existing Allied plant

Figure 6.1: 99.5th percentile 1-hour average odour concentration contour plots for the proposed (left) and existing (right) Allied asphalt plants. The blue polygon indicates Allied's site, pink cross indicates the active stack in each scenario.
Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited.

6.2.2 Odour monitoring surveys

A programme of odour monitoring surveys was undertaken by T+T staff in 2021 at the recently constructed Higgins Contactors Limited (Higgins) asphalt plant at 43 Peters Way, Silverdale (Higgins Silverdale). The Higgins Silverdale plant was chosen as its design is similar to that proposed at the Allied Site (i.e., a vertical batchwise plant with aggregate pre-heating so the bitumen is not exposed to a direct flame).

The main difference between the Higgins Silverdale plant and the proposed asphalt plant relates to production capacity. Higgins Silverdale has a maximum capacity of 240 tonnes/hour and the proposed plant will have a maximum capacity of 200 tonnes/hour. Given the higher production capacity of the Higgins Silverdale plant in comparison to the proposed plant, it is generally expected that the scale of odour generated from the proposed Allied plant would be less than that of the Higgins Silverdale Plant.

The methodology for the odour monitoring was developed based on EN16841-2:2016[19] and AS/NZS 4323.3:2001[20]. The monitoring targeted publicly accessible locations (e.g., footpaths and roadways) downwind of the Higgins Silverdale plant. Monitoring locations were spaced at 100 m intervals (where possible) and up to 900 m from the Higgins Silverdale property boundary. The monitoring targeted times which were likely to coincide with peak production and/or weather conditions which are conducive to the transport of odour (i.e., calm and light wind speed conditions). At each location, monitoring was conducted over 10 minutes, with the observer recording the intensity and character of odour observed every 10 seconds for a total of 60 odour observations. One ten-minute odour measurement constitutes a 'survey'.

The purpose of the survey was to identify the frequency, intensity and distance from the site in which recognisable odours attributed to the Higgins asphalt plant might occur. In accordance with the method recommended in EN 16841-1:2016, each survey was evaluated to determine whether it constitutes an 'odour hour' for odours with an asphalt odour. A survey counts as an odour hour when the percentage odour time (for that odour) reaches or exceeds 10%, i.e., a recognisable odour is observed at least 6 out of 60 observations, made at ten-second intervals within a ten-minute measurement duration. The odour hour calculation does not take into account the intensity of odours (i.e. a 'positive' odour is recorded as soon as an odour is clearly recognisable). In a New Zealand context, quantification of odours hours can be useful to confirm the absence/presence of recognisable odour and to inform the frequency aspects of a FIDOL assessment.

The full methodology and results of the odour monitoring survey programme are included in **Appendix F**. The key conclusions of the programme are as follows:

- A total of 31 odour surveys were carried out at a variety of downwind locations up to 900 m from the Higgins Silverdale asphalt plant.
- There were 4 out of 31 surveys where asphalt odour was recognised at a targeted downwind monitoring site. The maximum distance from the Higgins Silverdale asphalt plant at which recognisable odours with an asphalt character was recorded was 300 m.
- Of 31 odour surveys carried out at a variety of downwind locations, there were no surveys where recognisable odours with an asphalt character were recorded for more than 10% of observations and therefore no surveys which constituted an 'odour hour'.

In March and April of 2022, Auckland Council also carried out odour observations to investigate a series of odour complaints. This investigation comprised of 19 inspections and encompassed 74

[19] European Standard EN16841-2: Ambient Air – Determination of odour in ambient air by using field inspection – Part 2: Plume method. European Committee for Standardisation (CEN). November 2016.
[20] AS/NZS 4323.3:2001 Stationary source emissions – Determination of odour concentration by dynamic olfactometry. Standards Australia and Standards New Zealand, September 2001.

individual locations. Odour was identified at 11 of the 74 locations, nine of which were classified 'very weak' and two were classified 'weak'. These two weak observations occurred as asphalt trucks were passing.

Auckland Council concluded that the odour complaints were likely a combination of factors, including that the facility was new and in a highly visible location on an exposed ridge on the edge of the Heavy Industry Zone, bordering the rural residential area to the south in Stillwater. Additionally, the Higgins facility had been contracted to produce large volumes of high-temperature asphalt immediately on commissioning the plant, and found it challenging to balance the new process while producing a high temperature mix. Finally, the highly visible nature of the fugitive releases from loadout activities contributed to the spate of complaints. Given that only 'very weak' intensity odours were detected by Auckland Council, and in light of the remedial actions undertaken by Higgins in the months leading up to the inspections, no further action was determined to be necessary.

6.2.3 Complaints record

While odour complaints (or a lack thereof) are not conclusive indicators of odour nuisance effects or an absence of those effects, the record of odour complaints and confirmed incidences of offensive or objectionable odour can provide a broad indication of odour nuisance experienced in the vicinity of the existing operations.

BoPRC compliance records indicate that it confirmed an offensive and objectionable odour from the plant in August 2019. Allied implemented the following corrective measures:

- Additional lifters added to improve material curtain in drum;
- Servicing of the fuel oil heater and burner;
- Full service of the scrubber system;
- Introduction of a more inclusive stack monitoring system;
- Complete check of all temperature monitoring equipment;
- Temperature cross check recorded more consistently;
- Reduction in mixing temperatures for all mixes, (these are being continually monitored to ensure that any new materials are thoroughly compliant);
- Additional monitoring and training of staff to reinforce awareness of responsibilities; and
- Instigate a process for the immediate cessation of operation if any repetition of these issues arises in the future.

The record of complaints received by the BoPRC in relation to existing activities at the Site between June 2019 and September 2022 indicate that:

- After the corrective actions taken to address the infringement notice, there were no further complaints in 2019 regarding odour made to BoPRC.
- Four complaints were received regarding odour nuisance in 2020.
- 40 complaints were received for odour in 2021.
- Four complaints in 2021 also related to visual effects of steam/smoke from the stack.
- Nine complaints have been received for odour in 2022.
- There were no recorded complaints relating to dust over this period.

At the end of 2021, an electrical fault was identified that was caused by water infiltration from a partial blockage of air extraction ducting from the drying drum. Maintenance was undertaken to the system to remove the blockage, replace damaged equipment and clear the switching mechanisms, which the complainant confirmed had resolved the odour issue at that time.

BoPRC's records do not specify the exact location of the odour incidents in order to protect the identity of each complainant, however many complaints are noted to occur during westerly or west-south westerly wind conditions around Omanu Preschool and the residential community northwest of the site.

Most of the complaints were investigated by BoPRC. In most cases they were unable to confirm the presence of odour or the source, however this may be due, at least in part, to the inevitable time delay between the complaint and the council officer arriving at the affected location. In a few cases, it was determined that Allied was not the source of the odour (as the plant was not operating) but in others, the source of the odour was inconclusive. Two complaints at the end of 2021 (discussed above) were confirmed to be related to abnormal process conditions at the Allied plant.

In summary, a number of complaints have been received in relation to odour from the existing plant and offensive and objectionable odour has been confirmed on one occasion. However, the improvements to the odour controls proposed as part of the upgrade are predicted to reduce odour impacts and should alleviate the potential for offensive or objectionable odour to occur in future.

6.2.4 Review of plant odour sources and proposed management measures

The following aspects of the asphalt manufacturing process have the potential to generate odour:

- Mixing of aggregate and bitumen – The temperatures to which bitumen is exposed during asphalt mixing are an important influence on the scale of emissions of organic contaminants (and the odour with which they are associated). Exposure of bitumen to higher temperatures generally results in higher emissions. In the existing asphalt plants, aggregate is simultaneously dried and mixed with bitumen in a single parallel flow drum. By comparison, in the proposed plant design, aggregate is dried in a dedicated drum, and bitumen is later added and mixed in a separate unit. As a result, there is no potential for bitumen to come into contact with the burner flame and the temperatures to which bitumen are exposed is lower. The volatilisation of volatile organic components of bitumen will be lower, leading to a lesser generation of odour. The proposed plant will also be able to manufacture low energy asphalt at a reduced mixing temperature of 120°C (compared to 170°C for 'standard' hot mix).
- Addition and mixing of RAP – When re-heated, RAP has the potential to generate odour through volatilisation of organic contaminants in bitumen. In the proposed plant, RAP is added and mixed in a separate unit to the drying drum at a lower temperature than the existing plant, meaning the potential for odour generation is lower.
- Hot storage of product – Odour can occur from conveyance and storage of hot product. In the proposed plant, hot product drops directly from the mixing unit into the insulated storage unit.
- Load-out of product – During load-out of hot-mix product there is a potential for the release of odour. Odour from the load-out of asphalt is proposed to be minimised through the use of standard operating procedures, which require the task to be performed quickly and equipping the truck trailers with automatic tarps to cover the material once load out is complete. These operational measures limit the exposure of asphalt product to air and minimise the release of odour during load out.
- Bluesmoke aerosol filter - Fumes from the mixing unit and hot mix storage bins at the base of the tower are extracted to a bluesmoke aerosol filter for removal of oils and semi-volatile organics (and associated odours) prior to discharge to the tall plant stack.
- Storage of bitumen – Bitumen is stored in insulated and temperature-controlled tanks. The storage of bitumen at temperature is likely to generate low levels of odour. Odour emissions

from bitumen tanks will be greatest during the loading of new bitumen into tanks when air is displaced from the tanks. In the proposed plant, bitumen tanks will be vented via a water bath system to remove semi-volatile organics (and associated odour).

The proposed plant design, which separates aggregate drying from the mixing of bitumen and RAP, and control measures, which include the bluesmoke aerosol filter system to reduce odour emissions from the mixing unit and hotmix storage bins, are considered to represent the best practicable option for managing odour emissions and mitigating odour impacts.

6.2.5 FIDOL assessment

Whether an odour has an offensive or objectionable effect typically requires an overall judgement that considers the "FIDOL" factors. These FIDOL factors are described in the MfE "Good Practice Guide for Assessing and Managing Odour"[21] (MfE, 2016a) and are as follows:

Frequency	How often an individual is exposed to the odour.
Intensity	The strength of the odour.
Duration	The length of exposure.
Offensiveness / character	The character relates to the "hedonic tone" of the odour, which may be pleasant, neutral, or unpleasant.
Location	The type of land use and the nature of human activities in the vicinity of the odour source.

These factors are considered in relation to the potential for odour nuisance at the nearest receptors in **Table 2.1**. The following FIDOL assessment also highlights the measures that the applicant proposes in order to avoid, remedy or mitigate any potential adverse effects on the environment.

Table 6.5: FIDOL assessment of proposed plant

Factor	Consideration
Frequency / duration	The frequency and duration of odour experienced at off-site locations will be dictated by the frequency of emissions from the plant and by wind conditions. The plant may operate at all hours of the day and all days of the year. However, operation is subject to project demands so it is unlikely that the plant will continuously operate over this time. Dispersion of odour will be poorest (resulting in higher odour concentrations is areas surrounding the site) in calm or light wind conditions (wind speeds of less than 3 m/s). Measured winds at the Tauranga AWS indicate 38% of all winds will be less than 3 m/s. Winds less than 3 m/s occur 16% of the time towards the closest sensitive receptors to the northeast of Site.
Intensity	The intensity of odour experienced at off-site locations will be a function of the intensity of emissions from the plant and the degree of dispersion that occurs prior the emissions reaching receptor locations. The degree of odour dispersion will be influenced by the weather conditions (Section **2.3**) and the geographical separation distances of receptors to the emission source (Section **2.2**). Odours discharged from the asphalt plant will decrease in concentration, and therefore, intensity with increased distance from the source. The design controls to reduce the intensity of odour emitted from the proposed plant include:

[21] Ministry for the Environment. 2016. Good Practice Guide for Assessing and Managing Odour. Wellington: Ministry for the Environment (MfE 2016a).

Factor	Consideration
	• Mixing of aggregate, RAP and bitumen outside of the drying drum, and not impinging bitumen in the combustion zone. • Mixing at a reduced temperature so the potential release of VOCs (and their associated odour) from bitumen is lower. • Extraction of air from the dryer drum, aggregate screens, mixing unit and hot mix storage bins, and discharge to air through the baghouse stack to improve dispersion. • Passing of air vented from bitumen storage tanks through a water bath system to remove odour. With these measures in place, the intensity of odour emitted from the plant is likely to be lower than emissions from most plants in New Zealand that do not feature all of these measures. Off-site odour concentrations predicted through dispersion modelling discussed in Section **6.2.1** indicate that odour from the stack is likely to be on a very low intensity, at most, in the surrounding. To assess the potential off-site intensity of odours we have undertaken odour dispersion modelling and carried out odour monitoring surveys that uses similar technology. The results of the odour monitoring around a similar plant in Silverdale, Auckland indicate that odours of a recognisable may be detected at locations up to 300 m of the proposed asphalt plant. Given that local sensitive receptor activities, such as residential dwellings, are located at least 400 m from the proposed plant, odour model predictions and observations indicate that the intensity of odour from the plant is likely to be negligible at these locations.
Character	Odours derived from asphalt manufacturing and bitumen storage are generally considered to have a moderately unpleasant hedonic tone.
Location	The asphalt plant is proposed to be located on the existing industrial site, surrounded by similar industrial activities with low sensitivity to odour. The nearest high sensitivity activities include the worker accommodation to the southeast of the site on De Havilland Way and the childcare centres, dwellings and schools located to the northeast in the suburb of Omanu. Overall, the asphalt plant is located in an area with low sensitivity to odour and the separation to sensitive activities will facilitate dilution and dispersal of any odours produced at the site.

6.2.6 Summary of odour effects

In summary of the odour assessment:

- Odours of a moderately unpleasant hedonic tone may be generated from asphalt manufacture.
- The site is appropriately sited in an industrial zone where the sensitivity to odour is low and will be well separated from with the nearest sensitive receptors (residential dwellings) the nearest of which are the worker accommodations on De Havilland Way around 400 m from the Site boundary.
- A number of complaints have been received by Allied or BoPRC relating to odour from the existing plant in recent years and BoPRC confirmed an incidence of offensive or objectionable odour from the existing plant in 2019. This is consistent with the odour dispersion modelling, which suggests the potential for odour effects in the residential area northeast of the site. This area may also be impacted by odour emissions from the Higgins asphalt plant. Dispersion

modelling demonstrates that the effects of the proposed plant are significantly lower than the current plant and well below odour modelling assessment criteria.

- The plant may operate at any time of day; however, production will be dependent on project demands and the plant is unlikely to operate continuously (i.e., across a full year). Low wind speed conditions (i.e., less than 3 m/s) will blow most frequently towards the northeast (towards adjoining industrial properties) and sensitive receptors located further afield, such as Little Einsteins Montessori (440 m away), Mount Maunganui College (600 m), Omanu School (860 m) and residential dwellings (at least 540 m away).
- A number of design controls will be implemented to reduce the intensity of odour emitted from the proposed plant. These controls are expected to greatly reduce the potential for odour to be generated and augment the dispersion of emissions.
- The results of odour monitoring in the vicinity of another asphalt plant operating similar technology in New Zealand indicates that, although odours may be detected at locations within 300 m of the proposed asphalt plant at times, the frequency and intensity of odours are unlikely to result in offensive or objectionable effects. The nearest sensitive receptors are all over 500 m from the Allied site, with the exception of the worker accommodation on De Havilland Way, which is approximately 400 m southeast of the site boundary and the Montessori preschool at 1 MacDonald Street, approximately 440 m northeast of the Site boundary.

Overall, the assessment indicates that the proposed plant will reduce odour effects in the local environment and is unlikely to cause offensive or objectionable effects beyond the boundary of the site.

6.3 Effects of dust emissions

6.3.1 Effects of dust during operation

6.3.1.1 Dust generating activities and management of dust

Dust has the potential to be generated from a number of sources on site during operation of the asphalt manufacturing plant. The potential sources of dust on site, and the methods to control dust generation on site include:

- Storage of bulk aggregate - Fine aggregate will be stored in covered bays to reduce exposure of the aggregate stockpiles to wind. Coarse aggregate will be stored outdoors in three-sided bins.
- Handling of bulk aggregate – Distances between aggregate storage bins and cold-feed hoppers are minimised to reduce the size of transfer areas on site. Cold feed hoppers will be covered to reduce exposure of materials to wind. Water carts for wet suppression of dust will be used as required in aggregate handling and transfer areas.
- Storage of lime and reclaimed dust – Static bag filters will be installed at lime and reclaimed dust silos to prevent the release of materials during filling.
- Conveyance of materials – Product conveyors will be enclosed to prevent wind pick-up and transport of dust.
- Drying/tumbling of aggregate in the drying drum – Air from the drying drum will be extracted to a baghouse to remove coarse and fine dust.
- Screening of aggregate – Air from aggregate screens will be extracted to a baghouse to remove suspended dust generated during screening.

- Vehicle and machinery movements across site – Areas used by heavy vehicles will be sealed, with sealed areas around the aggregate handling areas regularly swept. Water carts will be available on site for wetting of surfaces as required during dry, windy weather.

Those measures, if well implemented and maintained should provide effective control and management of dust emissions from the site.

6.3.1.2 FIDOL assessment of dust from operation

A FIDOL assessment to of the potential for dust nuisance from operation of the proposed plant at the nearest receptors in **Table 6.7**.

Dust has the potential to be generated from a range of activities on site. The design of the plant and proposed management measures are likely to control the generation of dust and the intensity of dust from operations is likely to be low. The majority of dust particles which are generated are expected to deposit and settle within 100 m of the source, except for under high wind conditions (greater than 5 m/s), which are likely to occur around 15% of the time towards the direction of the nearest residential receptors on Maunganui Road in Omanu.

There have been no recorded complaints relating to dust nuisance from the Site.

Overall, provided dust management measures are implemented as proposed, the risk of nuisance dust effect from the operation of the proposed plant at the nearest sensitive receptors is low.

Similar to odour, the primary concern of dust emissions is whether it has an offensive or objectionable effect on the off-site environment. The FIDOL factors may also be used to evaluate the potential for dust nuisance. The following FIDOL assessment (**Table 6.6**) also highlights the measures that the applicant proposes in order to avoid, remedy or mitigate any potential effects on the environment.

Table 6.6: FIDOL factors for assessing dust nuisance

Factor	Consideration
Frequency / duration	The frequency and duration of dust experienced at off-site locations will be dictated by the frequency of dust emissions from the plant and by the frequency of winds blowing towards the location. Dust emissions from the plant will vary through the day. Dust emissions from mechanical disturbance activities (e.g., aggregate handling) will typically be associated with plant production but dust from wind erosion and pick-up of material can occur at any time depending on wind conditions. Dust pick-up by wind is usually occurs in wind speeds above 5 m/s and increases with increasing wind speed above this level. Based on winds measured at the Tauranga AWS monitoring station between 2008 and 2012, winds of speeds greater than 5 m/s are likely to occur around 28% of the time (in all directions) and up to 15% of the time in the direction of the nearest sensitive residential receptors to the west of the site. Overall, the frequency of winds conducive to transporting dust to the nearest sensitive properties is low.

Factor	Consideration
Intensity	The intensity of dust exposure at off-site locations will depend on the scale of emissions from dust sources and the distances separating the dust sources and the location. In relation to the latter, the intensity of dust is likely to decrease with distance from the source and most dust particles will deposit out of the air within about 100 m of the source (except under very high wind speed conditions). In relation to the scale of dust emissions, the proposed plant incorporates a number of design features to minimise dust emissions from the manufacturing process itself. The largest potential for dust is likely to be during the handling and transfer of aggregate materials and the pick-up of dust through vehicle movements. Management measures such as the regular sweeping of trafficable areas and use of wet suppression systems during summer is likely to minimise the dust generated from these activities. Overall, the intensity of dust from the operation experienced off-site is likely to be low, provided dust management measures are well implemented.
Character	Offensiveness relates to the colour of the dust which may increase its potential for adverse effects. Dust generated from the proposed works will be soil and dust from aggregate handling, neither of which have particularly offensive characteristics.
Location	Industrial neighbours in the surrounds of the site are likely to have a low sensitivity to dust effects. Residential dwellings and schools (described in Section 2.2) are likely to have a high sensitivity to dust effects, and all residences are located over 500 m from the site boundary, with the exception of the workers accommodations at De Havilland Way located over 400 m southeast of the site boundary in the industrial zone.

The FIDOL assessment above indicates that the scale of dust emission from the site is likely to be low. Provided dust generating activities are well managed when they occur, the FIDOL consideration indicates that dust nuisance effects beyond the site boundary are unlikely.

6.3.2 Effects of dust from construction/deconstruction activities

6.3.2.1 Dust generating activities and management of dust

The potential dust generating activities from construction and demolition activities are described in Section **3.3**. A summary of these activities and the proposed dust management measures to minimise the generation of dust is provided in **Table 6.7**.

Table 6.7: Dust control measures

Activity	Control measure
Demolition of structures	• Remove spoil as soon as practicable following demolition. • Limit potentially dusty demolition activities during high wind speed conditions. • Use of water as a dust suppressant should visible emissions arise.
Earthworks and paving activities	• Limit the area of soil exposed. • Stabilise exposed surfaces as soon as practicable, through compaction and sealing. • Minimise drop heights to control the fall of materials when loading or stockpiling materials.

Activity	Control measure
Truck and machinery movements	• Speed limits over unsealed surfaces. • Clean-up of spilled materials on sealed surfaces. • Loads of dusty materials (such as fine aggregate) should be covered. • Use of water as a dust suppressant should visible emissions arise. • Use of site vehicle wash to prevent tracking of dust off-site.
Wind erosion of stockpiles and unsealed land	• Limit the area of soil exposed. • Stockpiles with dry, fine materials to be maintained adequately damp or covered. • Limiting heights of stockpiles. • Use of water as a dust suppressant should visible emissions arise.

6.3.2.2 FIDOL assessment of dust from construction activities

A FIDOL assessment of the potential for dust nuisance from construction and demolition activities at the nearest receptors is included in **Table 6.8**.

Dust has the potential to be generated from demolition and construction in the development of the site for the new asphalt plant. The effects of dust from construction activities are generally localised and the majority of particulate is expected to deposit out of the air within about 100 m of the source, with the exception of under high wind speed conditions (> 5 m/s) which are likely to occur around 15% of the time from the southwest quadrant towards the closest residential receptors on Maunganui Road. There are no sensitive receptors within 100 m of works associated with the development of a new site entry/exit on Aerodrome Road, and provided construction activities are well managed to minimise the generation of dust under dry, high wind conditions, the intensity of dust is likely to be low.

Overall, provided dust management measures are implemented as proposed, the risk of nuisance dust effects from the construction and demolition activities at the nearest sensitive receptors is low.

Table 6.8: FIDOL assessment of dust effects from construction activities

Descriptor	Assessment
Frequency/Duration	The proposed construction activities that have the greatest potential for dust emissions include: • Demolition works. • Earthworks. • Vehicle and machinery movements. • Wind erosion from exposed areas and product stockpiles. The duration dust may be generated will be broadly related to the overall duration of construction and demolition works. The frequency of dust emissions can vary over the day with most emissions occurring during construction hours. Dust effects could potentially occur when construction activities coincide with winds blowing towards sensitive receptors (principally dwellings). Dust pick-up by wind is usually only occurs at wind speeds above 5 m/s and increases with increasing wind speed. Based on winds measured at the Tauranga monitoring station between 2008 and 2012, winds of speeds greater than 5 m/s are likely to

Descriptor	Assessment
	occur around 28% of the time (in all directions) and up to 15% of the time in the direction of the nearest residential receptors to the east of the Site.
Intensity	The intensity of dust emissions will be mitigated by the dust management measures proposed in Section **6.3.2.1**. Exposure to the dust off-site is likely to decrease with distance from the source and most dust particles will deposit out of the air within about 100 m of the source (except under very high wind speed conditions). Provided the construction activities are well managed and given the 440 m separation distance to the nearest sensitive receptor locations, the intensity of dust at these locations is likely to be low.
Character/Offensiveness	Offensiveness relates to the colour of the dust which may increase its potential for adverse effects. Dust generated from the proposed works will be soil and dust from aggregate handling, neither of which have particularly offensive characteristics.
Location	The Site is within an industrial area with over 500 m separation to the nearest residential area in Omanu. The workers accommodation in the industrial zone on De Havilland Way is the closest highly sensitive receptors, located approximately 400 m from the Site boundary. A childcare facility in the commercial zone has 440 m separation from the Site boundary. Dust from construction activities is unlikely to carry over these separation distances.

7 National Environmental Standards for Air Quality

7.1 Regulation 17

The Site is located in the Mt Maunganui Airshed, which was gazetted in accordance with the NESAQ in November 2019. The airshed is classified as 'polluted' with respect to PM_{10} concentrations under Regulation 17 of the NESAQ.

Regulation 17 of the NESAQ states that:

> *(1) A consent authority must decline an application for a resource consent (the proposed consent) to discharge PM_{10} if the discharge to be expressly allowed by the consent would be likely, at any time, to increase the concentration of PM_{10} (calculated as a 24-hour mean under Schedule 1) by more than 2.5 micrograms per cubic metre in any part of a polluted airshed other than the site on which the consent would be exercised.*
>
> *(2) However, subclause (1) does not apply if---*
>
> *(a) the proposed consent is for the same activity on the same site as another resource consent (the existing consent) held by the applicant when the application was made; and*
>
> *(b) the amount and rate of PM_{10} discharge to be expressly allowed by the proposed consent are the same as or less than under the existing consent; and*
>
> *(c) discharges would occur under the proposed consent only when discharges no longer occur under the existing consent.*
>
> *(3) Subclause (1) also does not apply if—*
>
> > *(a) the consent authority is satisfied that the applicant can reduce the PM_{10} discharged from another source or sources into each polluted airshed to which subclause (1) applies by the same or a greater amount than the amount likely to be discharged into the relevant airshed by the discharge to be expressly allowed by the proposed consent; and*
> >
> > *(b) the consent authority, if it intends to grant the proposed consent, includes conditions in the consent that require the reduction or reductions to take effect within 12 months after the consent is granted and to then be effective for the remaining duration of the consent.*

The discharges from the proposed asphalt plant are predicted to increase 24-hour average PM_{10} concentrations within the polluted Mount Maunganui Airshed by up to 2.8 $\mu g/m^3$ (i.e. by more than 2.5 $\mu g/m^3$) although this does not occur at a location where a person could be exposed over a 24-hour period.

The discharges of PM_{10} from the new asphalt plant are not subject to an existing resource consent (resource consent 62740 authorises discharges to air from the existing plant only) and therefore subclause (2) is not applicable.

However, under the proposed consent conditions Allied will cease operating the existing asphalt plant once the proposed plant is commissioned. Therefore, the discharges of PM_{10} from the existing asphalt plant, which are greater than those from the proposed plant, will be removed from the airshed. In other words, the removal of the PM_{10} contribution from the existing plant will more than offset the new emissions from the proposed plant.

The rate of PM_{10} emissions from the new asphalt plant that is proposed to be authorised by this application is compared with the rate of PM_{10} emissions permitted by the existing consent 62740 in **Table 7.1** below. This assessment is based on the maximum rate of PM_{10} emissions authorised by the current and proposed resource consents, i.e. the consented emission rates and assuming continuous operation. These maximum emission rates, particularly on an annual basis, are significantly higher than will occur in practice, as the plants will generally operate well below the consented limit and do not operate continuously.

The emission rate for the existing asphalt plant is based on the consented maximum total suspended particulate emission rate of 4.2 kg/hr and assuming 80% of the TSP comprises PM_{10}. The emission rate for the proposed asphalt plant is based on a stack concentration of 30 mg/m^3 (at 20°C, 1 atmosphere pressure, dry gas basis) from the proposed plant stack, again assuming 80% of the TSP comprises PM_{10}.

This demonstrates that the emissions from the proposed asphalt plant will be more than offset by the cessation of production from the existing plant and the result will be a net reduction in PM_{10} emissions into the airshed. Therefore, under clause 3, there is no impediment to the granting of this consent under Regulation 17 of the NESAQ.

Table 7.1: PM_{10} emission offset calculation

Scenario	PM_{10} emission rate (kg/hr)	24 hour mass emission (kg/day	Annual mass emission (tonnes/year)
Existing plant	3.36	81	29
Proposed plant	1.00	24	9
Net reduction in PM_{10} emitted into the airshed	2.36	57	20

7.2 Regulation 20

Regulation 20 of the NESAQ states that:

(1) A consent authority must decline an application for a resource consent to discharge carbon monoxide into air if the discharge to be expressly allowed by the resource consent—

(a) is likely, at any time, to cause the concentration of that gas in the airshed to breach its ambient air quality standard; and

(b) is likely to be a principal source of that gas in the airshed.

(2) A consent authority must decline an application for a resource consent to discharge oxides of nitrogen or volatile organic compounds into air if the discharge to be expressly allowed by the resource consent—

(a) is likely, at any time, to cause the concentration of nitrogen dioxide or ozone in the airshed to breach its ambient air quality standard; and

(b) is likely to be a principal source of oxides of nitrogen or volatile organic compounds in the airshed.

As detailed in section **6.1.1**, all ambient air quality standards for CO and NO_2 are predicted to be complied with for both the existing and proposed plant. As a result, the restrictions on granting consent for the discharge under Regulation 21 are not applicable.

7.3 Regulation 21

Regulation 21 of the NESAQ states that:

A consent authority must decline an application for a resource consent to discharge sulphur dioxide into air if the discharge to be expressly allowed by the resource consent is likely, at any time, to cause the concentration of sulphur dioxide in the airshed to breach its ambient air quality standard.

Section **6.1.1** details the predicted ground level concentrations from the operation of the proposed plant, which in the maximum case complies with the ambient air quality standard. As a result, the restrictions on granting consent for the discharge under Regulation 21 are not applicable.

8 Conclusions

8.1 Proposed plant

This technical air quality assessment report sets out a comprehensive assessment of the potential effects of emissions to air from the construction and operation of the proposed asphalt manufacturing plant.

The assessment draws the following conclusions:

- A range of contaminants are discharged to air from operation of the proposed asphalt plant including:
  - Fine particulate matter (PM_{10} and $PM_{2.5}$).
  - Sulphur dioxide (SO_2).
  - Oxides of nitrogen (NO_X).
  - Carbon monoxide (CO).
  - Volatile organic compounds (VOCs)
  - Trace contaminants from the combustion of used oil (trace metals).
  - Odour.
  - Dust.
- The proposed plant will be operated at Allied's existing asphalt manufacturing site, which is located within an established industrial area. The Site is surrounded primarily by low sensitivity industrial activities and is well separated from high sensitivity activities located mainly in the residential area to the east. The nearest residential dwellings are located over 500 m from the Site. The closest sensitive receptors include worker accommodation 400 m southeast of the Site in aircraft hangers on De Havilland Way and a preschool located approximately 440 m northeast of the Site boundary.
- Dispersion modelling predictions, using conservative assumptions, indicate that the cumulative effects of emissions of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, VOCs and trace metals from the proposed plant are well below relevant air quality assessment criteria. For most contaminants, the air quality effects of the proposed asphalt plant are lower than the effects of the existing plant due to improved air pollution control and a taller stack, which will increase dispersion and dilution of emissions.
- The Mt Maunganui Airshed is a polluted airshed for PM_{10}. However, the incremental effect of the emissions from the proposed asphalt plant are small and are significantly lower than the existing asphalt plant. The decommissioning of the existing plant will more than offset the consented PM_{10} emissions to the airshed and will result in a net reduction in consented PM_{10} mass emissions.
- There is no impediment to the granting of this consent under Regulation 17, 20 or 21 of the NESAQ.
- Provided dust management measures are implemented as proposed, the effects of dust from the construction and operation of the proposed asphalt plant are likely to be less than minor.
- The assessment of odour effects indicates that, with the improvements to odour control, the frequency, intensity and duration of odour likely to be experienced beyond the boundary of the site is such that that offensive or objectionable odour is unlikely.
- The proposed plant will implement a number of controls that constitute the best practicable option (BPO), including use of a reverse-air baghouse for removal of particulate from emissions from the aggregate drying unit, and a bluesmoke aerosol treatment system for

capture of oils and semi-volatile organic compounds (and associated odours) from the mixing of bitumen.

8.2 Existing plant

This report also sets out an assessment of the effects of emissions to air from the existing asphalt manufacturing plant. The proposed consent conditions will include a timeframe for decommissioning of the existing asphalt plant and there will be no overlap between the operation of the two asphalt plants.

The assessment draws the following conclusions:

- The existing plant has also been evaluated in the dispersion modelling assessment. The cumulative effects of emissions of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, VOCs and trace metals from the existing plant are well below relevant air quality assessment criteria for the continuous operation at the maximum production rate.
- The operation of the existing plant has been the subject of odour complaints from the community located to the northeast of the site. Modelling of the maximum production rate on a 24 hour basis does suggest that 99.5^{th} percentile 1-hour average odour concentrations higher than the MfE guideline could occur at the nearest receptors to the northeast of the site.
- Modelling for the typical production rate for typical operating hours of 7 am – 12 pm shows that the MfE guideline is met for the 99.9^{th} percentile 1-hour average odour concentrations at all receptors, although is just at the assessment criterion if cumulative effects with the Higgins plant are included.
- Replacement of the existing plant with the proposed vertical batching plant is expected to significantly reduce the propensity for odour to be generated during production through separation of the drying and bitumen mixing operations and installation of specialised odour emissions treatment for bluesmoke aerosols.

9 Applicability

This report has been prepared for the exclusive use of our client Allied Asphalt Limited, with respect to the particular brief given to us and 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.

We understand and agree that our client will submit this report as part of an application for resource consent and that Bay of Plenty Regional Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

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Rose Turnwald

Environmental Engineer

Authorised for Tonkin & Taylor Ltd by:

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Jenny Simpson

Project Director

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Appendix A Background SO_2 air quality data

The proposed background concentrations for SO_2 have been developed by considering the recommended values and the recent measurements at Totara Street. Where available, the equivalent data for Tauranga Bridge Marina is provided for context.

The 98th percentile of 1-hour average values at each location has dropped since 2019, which is likely to be attributable to changes in regulation of the sulphur content of marine fuels under MARPOL. Improvements at Totara Street have been more significant than those at Tauranga Bridge Marina.

Appendix A Table 1: 1-hour average SO_2 background

Site	Parameter	2019	2020	2021	GPG recommended value
Totara Street	98th percentile	59.4	23.4	21.0	20[A]
Tauranga Bridge Marina	98th percentile	48.1	26.5	28.7	

A. Good Practice Guide for Industry (MfE, 2016), Table 8, default value for 1-hour SO2 in a Main Urban Area

Likewise, the 98th percentile of the 24-hour average dataset for SO_2 (**Appendix A Table 2**) shows that the air quality has improved since 2019, though is still higher than the default recommended value.

Appendix A Table 2: 24-hour average SO_2 background

Site	Parameter	2019	2020	2021	Waka Kotahi recommended value
Totara Street	98th percentile	36.2	13.8	13.0	8[A]
Tauranga Bridge Marina	98th percentile	29.7	17.8	20.3	

A. Good Practice Guide for Industry (MfE, 2016), Table 8, default value for 24-hour SO_2 in a Main Urban Area

The adopted background concentrations are summarised in Section 2.4.2 of the AQA report.

Appendix B Higgins asphalt plant

Higgins Contractors Limited (Higgins) holds resource consent 63317 authorising the discharges to air from an asphalt plant at 92 Hewletts Road. This consent was due to expire on 30 September 2020, and an application[22] for a new discharge permit was lodged 26 March 2020 and is being processed by BoPRC as application RM20-0190.

The Higgins plant is located approximately 300 m northeast of Allied's site, as indicated on **Figure Appendix B.1** below.

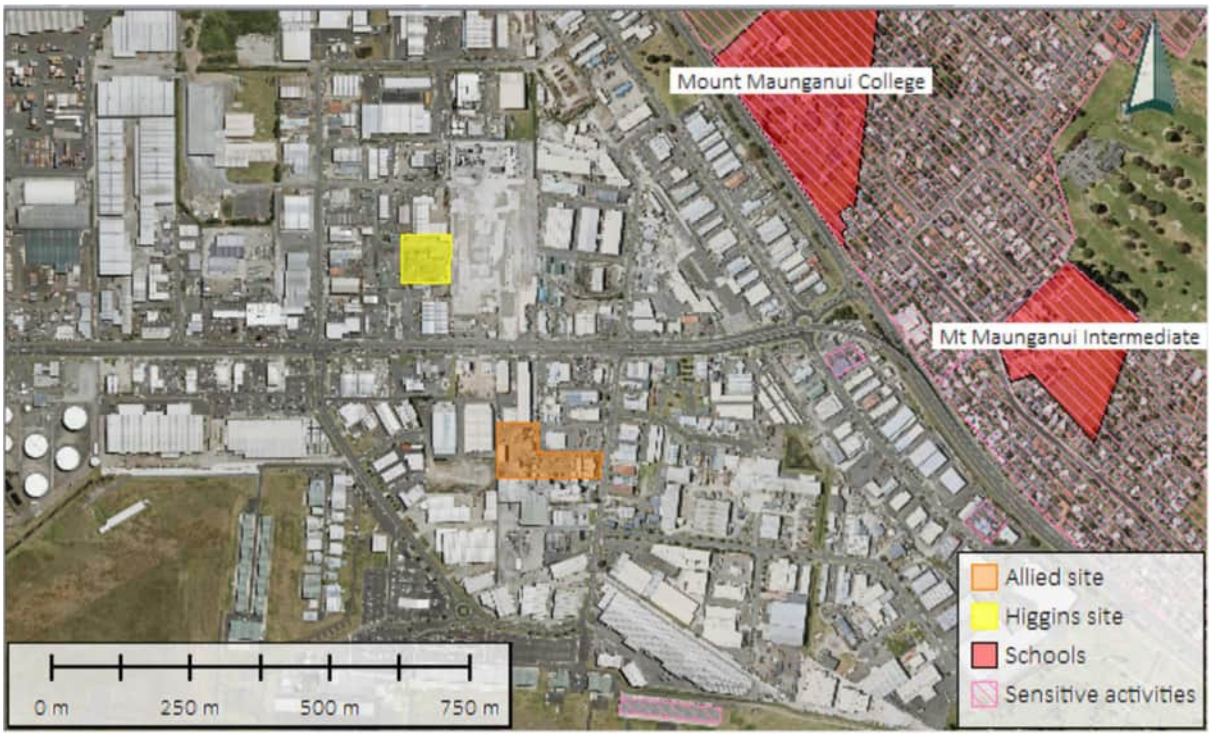

Figure Appendix B.1: Location of the Higgins and Allied site's relative to the nearest local sensitive receptors
Source: Aerial image from ESRI World Imagery used under the Creative Commons Licence

The existing Higgins plant is a continuous parallel-flow single drum mix plant, like the existing Allied plant. However, the Higgins plant has a lower peak production rate of 60 tonnes/hour. The burner has a rating of 4.5 MW and is authorised to use diesel fuel only.

The Higgins plant discharge rates and parameters are set out in **Appendix D Section D2** and modelling results are evaluated cumulatively with those for Allied's existing and proposed plants in **Appendix D** Section **D3**.

[22] Pattle Delamour Partners Limited. Assessment of Environmental Effects – Replacement Air Discharge Permit. Prepared for Higgins Contractors Limited. 26 March 2020

Appendix C Existing plant description

4. Description and Operation of Plant & Associated Processes

4.1 Hot Mix Plant

Allied's asphalt plant is a parallel-flow drum mix plant, a common type of asphalt plant in New Zealand. This type of plant operates on a continuous basis with the drum used to both dry and heat aggregate and to mix liquid bitumen with hot aggregate to produce hot mix asphalt.

The plant has a maximum production capacity of 80 tonnes per hour (Tph) of product. Figure 4.1 presents a generic diagram of a drum mix asphalt plant to illustrate the operation of this process. The particulate emission control system is a venturi water scrubber. The hot mix asphalt storage is in elevated bins rather than being loaded out directly into the truck as shown. The plant consists of the following sections:

- Aggregate storage facilities, lime storage in a 46 tonne silo and fibre filler;
- Five cold feed bins and associated conveyor to the dryer drum;
- Three thermally insulated electric heated bitumen storage tanks fitted with atmospheric breathers for pressure equalisation, with a total capacity of around $50 m^3$.
- Diesel storage (about 1000 litres);
- Drum mix asphalt plant (consisting of the rotary drying drum; a duel fuel burner and integral combustion air fan; bitumen drum injection system; and an expansion box);
- A venturi water scrubbing section in the duct from the expansion box to the centrifugal water/dust separator;
- An exhaust fan;
- A cyclonic separator and a discharge chimney 18 m high;
- Scrubber settling pond;
- Three hot mix storage bins supplied from an enclosed slat conveyor from the mixer; and
- A control room.

A burner for an 80 Tph parallel flow plant at maximum rate of heat release has a required thermal capacity of about 7 MW gross. The calculated fuel consumption for this rate of heat release is up to 630 m^3 of natural gas/hour (calorific value of 40 MJ/m^3) or about 575 kg for used lubricating oil (calorific value of around 44 MJ/kg).

The emission control facilities consist of a venturi water scrubber. This is designed to substantially remove particulate matter. The scrubber water is collected in the scrubber pond, settled, and then reused in the scrubber.

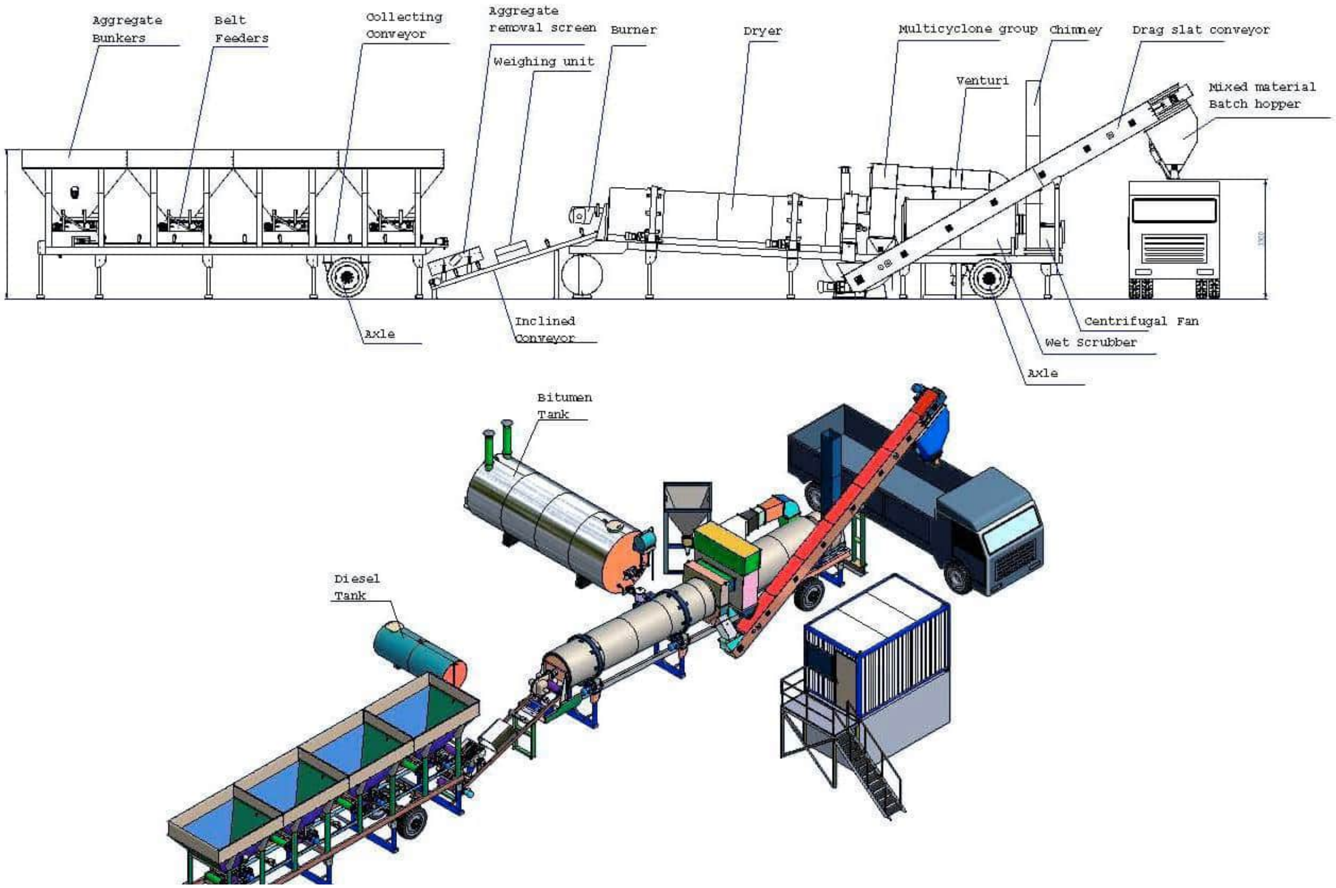

Figure 4.1: Parallel Drum Mix Flow Asphalt Plant

4.2 Raw Materials

Raw materials consist of gravel chip, sand, and crusher dust (collectively aggregates). About 6% bitumen by weight is incorporated into the aggregate during processing. Fuel is ULO, but the burner is dual fuel enabling the use of natural gas subject to commercial considerations. At this stage, the burner is ignited using gas and is then switched to used lubricating oil.

4.2.1 Aggregates

Aggregates for asphalt manufacture are a blend of fine aggregate and course aggregates. Different asphalt mix types have different percentages of course and fine aggregates. Allied Asphalt uses predominantly aggregates from greywacke quarries. Fine aggregates stockpiles are stored in covered sheds to prevent windblown dust, and water sprinklers minimise any emissions during delivery truck unloading, and frontend loader operations during asphalt manufacturing. Course aggregates are large particles of crushed rock that have too much mass to be mobilised by wind, and may be covered or uncovered in stockpile.

4.2.2 Bitumen

Bitumen is a solid to semi-solid residue resulting from the distillation of heavy crude oils. Bitumen consists of a complex mixture of high boiling point paraffinic, aromatic hydrocarbons, and heterocyclic compounds containing sulphur, nitrogen, and oxygen. Although bitumen contains a variety of aromatic compounds, it is substantially different to coal tar and pitches, which are derived by high temperature carbonisation (destructive distillation) of bituminous coal. According to the World Health Organisation[6] coal tars are composed of highly condensed-ring aromatic and heterocyclic hydrocarbons, while bitumen contains a much lower proportion of these compounds.

Bitumen is stored hot (135°C to 165°C) using electric heating via thermal oil heat exchangers to keep contents sufficiently fluid to pump to the hot mix drum and inject into the aggregate mix. Bitumen tank temperature is controlled by thermostat set in fail-safe mode. The storage tank is fitted with a short breather vent to permit pressure equalisation.

4.2.3 Patching Mixes

Asphalt may occasionally be manufactured for patching mixes.

4.2.4 Release Agent

Truck and trailer trays are swabbed with a proprietary release agent solution to prevent asphalt sticking to the tray using an ecologically friendly detergent. This is normal practice in the asphalt industry.

4.2.5 Fuel

Fuel for current plant is either natural gas or ULO. ULO has a maximum sulphur content of 1.0% by weight. The generic specification of ULO supplied by ExOil is presented in Table 4.1. The full Safety Data Sheet for ULO is provided in Appendix B.

[6] World Health Organization. Selected Petroleum Products. Environmental Health Criteria 20; WHO, Geneva, 1982.

Table 4 1: Properties of ULO

Element	Target	Typical
Ash (% w/w)	<1.0	<1.0
Water (% w/w)	<1.0	<1.0
Arsenic (ppmw)	<5.0	<1.0
Cadmium (ppmw)	<2.0	<1.0
Total Chromium (ppmw)	<5.0	1-3
Copper (ppmw)	<50	<30
Lead (ppmw)	<50	<30
Sulphur (% w/w)	<1.0	0.5-0.7
Polychlorinated biphenyls (ppmv)	Nil	Not detectable
Halogen (chlorine) (ppmv)	<1000	<500

4.3 Operation of Plant

4.3.1 Drying and Mixing

Parallel-flow drum mix plants operate on a continuous basis with the drum used to both dry and heat aggregate and to mix hot aggregate with bitumen. Aggregate is conveyed into the drum at the burner end and then travels down the slightly inclined rotating drum (which is fitted with flights) where products of combustion from the burner and excess air dries and heats the aggregate. The lifting motion of the flights achieves good contact between aggregate and drying gases. Hot liquid bitumen is injected into the drum about half way down and the mixing action of the rotating drum ensures a good and even coating of bitumen on aggregate particles. A steam barrier generated by the drying aggregate, and burner design, prevents the burner flame impinging on the bitumen. Hot mix temperatures range from about 135 to 170°C depending on the blend (about 150°C for the standard blends) and contains about 5% moisture. Product is discharged from the drum at the opposite end to the burner onto a slat conveyor for transfer to thermally insulated hot storage bins and then load-out.

Combustion gases, dust, bitumen volatile matter and pyrolysis products are drawn by an induced draught (ID) fan through the particulate water scrubber before gases are discharged into air through the stack.

Spraying the bitumen into the aggregate and the steam generated by drying aggregate removes a substantial portion of the entrained dust (i.e. acts as a primary dust collector) which lowers the loading on the down-stream emission control equipment.

Parallel flow plants are energy efficient. Although the drying drum acts as the mixer, the potential for dryer drum fires with modern plant is low. As well as the plant being equipped with normal process sensors and control systems to maximise product quality, the cold bin to drum conveyor is fitted with a fail-safe load sensor, which shuts down the burner if aggregate flow ceases for about 15 seconds or more.

4.3.2 Plant Emissions Control

The drying of aggregate generates dust and steam within the drier drum. Negative pressure is maintained within the drum by the main fan situated down-stream of the injection section of the water scrubber. Dust not captured in the drying/mixing drum is drawn into the expansion box at the end of the drying drum where large particles settle out and drop into the aggregate/bitumen mix.

Air and remaining entrained dust is scrubbed in an adjustable throat high efficiency venturi wet scrubber. Dust-containing water droplets entrained in the gas flow downstream of the venturi scrubber are centrifugally removed in the scrubber drum to discharge into the scrubber settling pond. This type of venturi scrubber, when appropriately set-up and operated, can consistently achieve dust emission concentrations of less than 250 mg/Nm^3 dry gas basis. The actual concentration of particulate depends on the rate of drying, the percentage of fines in the aggregate, the pressure drop across the venturi scrubber and its water flow, and the degree of settling achieved in the scrubber pond prior to recycle of water to the scrubber.

Not all of the particulate discharged from the scrubber is PM_{10}. USEPA emission factors do not speciate particulate emitted from venturi scrubbers but the ratio of PM_{10} to TSP will be lower than the ratio specified by the USEPA for fabric filters (70% of the TSP from fabric filters is PM_{10}).

Given that water injection nozzles are maintained in good condition increasing the venturi water flow increases particulate removal efficiency, but excessive water injection may overload downstream droplet removal causing excessive droplet carryover into the stack and problems with emission testing (and sometimes the ejection of droplets from the stack). Such droplets are often ‘muddy’ due to carryover of dirty scrubber water and washing of particulate from inside ducting and stack surfaces.

The height of the plant chimney is 18 m with an exit diameter of 0.75 m. Temperature of chimney gases is usually between 50 - 80°C with 70-75°C being a typical value at high rates of production. During normal operation, the discharge from the stack an opaque white steam plume is obvious. Design volumetric flow of an 80 tph plant is about 4.65 Nm^3/s wet gas basis at 25% moisture or about 3.7 Nm^3/s dry gas basis, which equates to an actual rate of discharge of around 5.8 Am^3/s at 65°C. Actual volumetric flow (and its temperature) from the stack varies depending on how the drier is set up, the rate of drying, and on scrubber operating factors.

Recent discharge testing of the Company’s plant performed by CRL in March 2019 indicates that at high rates of production volumetric flows of ~4.7 Nm^3/s dry basis, which equates to a rate of discharge of ~6.2 Nm^3/s wet basis or 7.8 Am^3/s saturated at 70°C. A copy of the discharge testing report is provided in Appendix C. The discharge testing measured an average particulate concentration as total suspended particulate over three sample runs of 113 mg/m^3 0°C, dry gas basis.

4.4 Nature and Composition of Discharges to Air – Normal Operation

4.4.1 Asphalt Plant Stack

Table 4.2 summarises the plant’s discharges to air under normal operations at maximum operating capacity. Further explanatory comments on the emission rates are provided below

Table 4 2: Plant Chimney Discharges Parallel Drum Plant (80 Tph or 7 MW gross)

Parameter	Value
Heat release - at 575 kg/hour ULO or recycled oil	Around 7 MW gross
Discharge gas volume (design)	~3.7 Nm^3/s dry basis (~4.65N m^3/s wet basis)
Typical operating conditions at high rates of production	~4.7 Nm^3/s dry basis (~6.2 Nm^3/s wet basis) or 7.8 Am^3/s saturated at 70ºC
Carbon dioxide - natural gas Carbon dioxide – ULO	About 1,350 kg/hour About 1,750 kg/hour
Carbon monoxide natural gas and oil fuels (USEPA 2004)[7]	5 kg/hour

[7] USEPA Emission factors, AP-42. March, 2004.

Appendix D Dispersion modelling assessment

D1 Modelling methodology

D1.1 Overview

Atmospheric dispersion modelling has been used to separately predict the potential ground level concentrations of contaminants as a result of discharges to air from the existing and proposed asphalt manufacturing plants.

A three-dimensional meteorological dataset for three modelling years (2014, 2015 and 2016) has been prepared using CALMET (version 6.5.0) software, with upper air and surface inputs derived from the Weather Forecasting Model (WRF) and local surface weather monitoring stations. The CALMET model domain consists of a 10 x 10 km grid centred on the site with a grid resolution of 100 m.

Dispersion modelling of contaminant emissions has been conducted using the CALPUFF (version 7.2.1) software. Predictions have been made over a 4 x 4 km grid of receptors. Nested grids of 10, 20, 30, 40, 50, 100 and 200 m spacing have been centred on the Allied site at the midpoint between the existing and proposed asphalt plant stacks, extending 0.1, 0.2, 0.3, 0.4, 0.5, 1 and 2 km respectively from the site.

In addition to the gridded receptors, discrete receptor points have also been placed at the nearest sensitive receptors (residences, schools and childcare centres) to the site (see Section B3.1 for details).

D1.2 Selection of model

The pollutant dispersion modelling has been carried out using the CALMET/CAPUFF non-steady state puff dispersion modelling software suite. For this application, the advantages of CALPUFF over alternative Gaussian dispersion models (such as AERMOD) include:

- Calm and low wind speeds will be treated more realistically as the model can simulate diffusion as well as dispersion.
- The previous hour's emissions are included so if the wind direction changes, the model will show the plume "meandering".
- The effects of causality are simulated (i.e., the model takes into account the time it takes for a pollutant to travel.

D1.3 Meteorological inputs

T+T have obtained a meteorological dataset for three modelling years (2014, 2015 and 2016) prepared by Atmospheric Science Global Limited[23] for the BoPRC using the CALMET model. The CALMET meteorological domain covers Allied's site and the surrounding areas, consisting of a 42.66 x 35.64 km grid, with a 180 m resolution. Upper-air information was derived from WRF and recent local terrain and land cover data were used in this dataset.

A wind rose has been generated at the site location from the CALMET dataset for the modelled period as shown in . In general, the CALMET generated wind roses for the Site show similar wind directions to monitoring at the Tauranga AWS monitoring station (discussed in Section 2.3). Wind

[23] Atmospheric Science Global Limited. August 2018. Continuous Emission Modelling and SO2 removals. Results for 10-minute, 1-hour and 24-hour SO2 for 2014, 2015 and 2016 from Industry, Airport, White Island, Shipping and Road Traffic.

speeds in the predicted site wind rose have a lower proportion of lower speed wind conditions (<3 ms^{-1}) than those at the AWS.

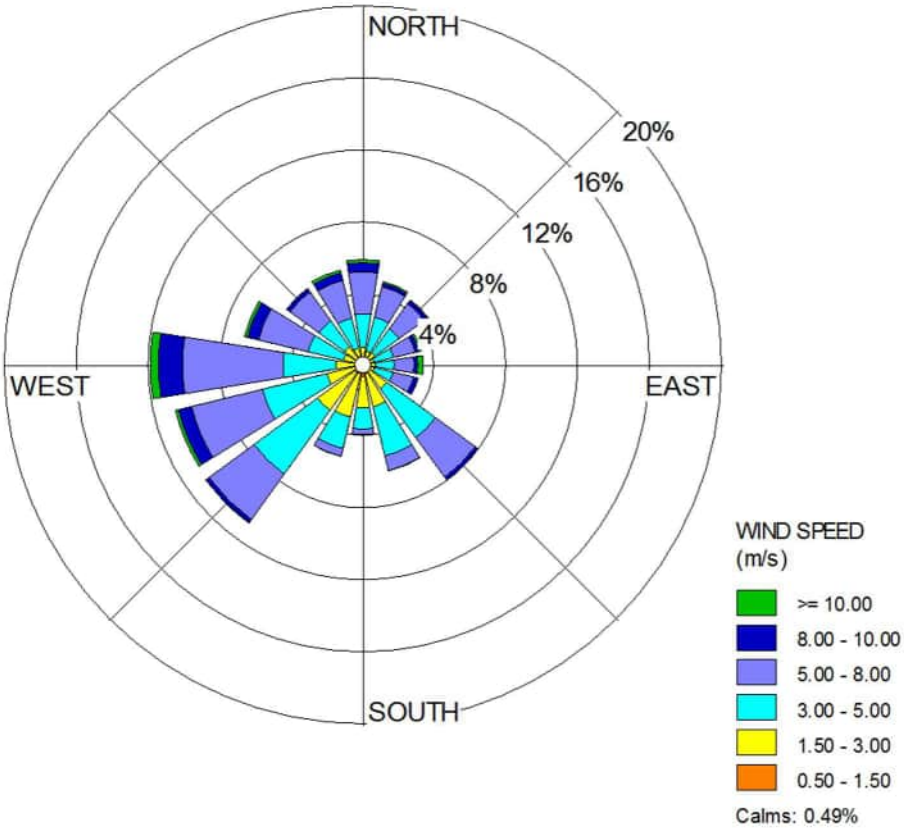

Figure Appendix D.1: Wind speed and direction frequency roses, generated at the Allied site location from the CALMET dataset for the period 1 January 2014 to 31 December 2016.

D1.4 Dispersion modelling parameters

CALPUFF dispersion modelling parameters selected for the assessment are listed below:

- Transitional plume rise modelled.
- Stack tip downwash modelled.
- Partial plume penetration of mixed layers for point sources.
- Dispersion coefficients calculated internally from micrometeorological variables.
- Probability Density Function method used for calculating sigma-z in the convective boundary layer.
- Partial plume path terrain adjustment scheme applied to nested and discrete receptors.

D1.5 Building downwash

Airflow around buildings can create zones of strong turbulence and downwind mixing on the lee side of a building. This effect is known as building downwash. In such cases, the entrainment of exhaust gases released by short stacks or in the wake of a building can result in much higher ground level concentrations close to the source than the model would otherwise predict. A well-designed stack can minimise building downwash effects.

For this assessment, the Plume Model Enhancements (PRIME) algorithm has been used to simulate building downwash effects. This is the method recommended in the MfE Good Practice Guide for Atmospheric Dispersion Modelling (MfE, 2004).

The building downwash effects of buildings and structures at the Allied site, Higgins site and neighbouring properties have been considered in the modelling assessment. Building elevations for existing buildings and structures have been derived from the Bay of Plenty Northwest digital surface model (DSM) and digital elevation model (DEM) LIDAR data, captured in 2020-2021[24]. Heights for proposed future buildings and structures have been provided by Allied Asphalt.

D1.6 Atmospheric oxidation of NO to NO_2

Emissions of nitrogen oxides (NO_X) from combustion processes are mainly in the form of NO, with only about 5 to 10 % typically comprising of NO_2. NO_2 (rather than NO) is the contaminant of interest with respect to potential health effects. NO released from the stack can react with ozone in the air to form NO_2. The amount of NO that can be converted to NO_2 is limited by the amount of ozone in the atmosphere.

To account for the atmospheric conversion of NO to NO_2, the proxy method has been used, as recommended in the Good Practice Guide for Assessing Discharges to Air from Industry (2016). This method assumes that that all of the emitted NO is converted to NO_2, but that this process is limited by the availability of ozone. The dispersion model results are added to a 'Proxy NO_2' concentration that represents the combined background concentration of NO_2 and ozone (as a NO_2 equivalent).

The recommended proxy NO_2 concentrations are 113 µg/m^3 (1-hour average)[25] and 75 µg/m^3 (24-hour average). We have assumed that 10 % of stack NO_X is present in the form of NO_2.

It should be noted that the methods used to represent atmospheric oxidation of NO to NO_2 are likely to lead to a substantial overestimation of cumulative NO_2 concentrations that are likely to occur in practice. The proxy and screening methods are therefore intended to provide a high level of conservatism.

D2 Emission parameters

D2.1 Overview

The existing and proposed Allied plants are able to utilise natural gas, diesel, biodiesel or used oil as a fuel source. Higgins plant utilises only diesel as a fuel.

The emission rates of contaminants were estimated based on the following sources:

- Plant and stack parameters used in the March 2020 air quality assessment for the Higgins asphalt plant[26].
- Plant and stack parameters used in the May 2020 Air Discharge Assessment of Effects for the existing Allied asphalt plant[27].
- Manufacturer specifications for the proposed asphalt plant provided by Allied.

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[24] BOPLASS Limited, Toitū Te Whenua Land Information New Zealand (LINZ) (2021). Bay of Plenty Northwest, New Zealand 2020-2021. Collected by Aerial Surveys, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G9W66J0Z. Accessed: 2022-07-13

[25] This proxy NO_2 concentration applies to locations within 300 m of a motorway or 150 m of an arterial road.

[26] Beca Infrastructure Limited. 19 September 2011. "Fulton Hogan Limited Hamilton Asphalt Plant: Assessment of Air Discharges. Addendum to the Assessment of Environmental Effects Report".

[27] Jacobs New Zealand Limited. Air Discharge Assessment of Effects – Application for air discharge consent. May 2020.

- Modelling of emissions of PM_{10}, $PM_{2.5}$, SO_2 and odour from Higgins' asphalt plant has been included in the assessment to account for any cumulative impacts with Allied existing or proposed plants, as requested by BoPRC.
- US EPA emission factors (AP-42) for NO_X, CO, VOCs and metals from used oil combustion and natural gas combustion in drum mix and batch asphalt plants[28]. It should be noted that the US EPA emission factors for drum plants and batch plants differ slightly, with emission factors for batch plants being higher in comparison to drum mix plants. In practice, it is expected that the emissions of contaminants from combustion would be similar between drum mix and batch mix plants and therefore, for these contaminants, the difference in emission factors between the existing plant and the proposed plant are likely to be overstated.
- For all plants, we have assumed that PM_{10} and $PM_{2.5}$ comprises 80% and 40% of TSP, respectively based on stack test results for the existing double barrel drum mix asphalt plant established in Mt Wellington.
- For all plants, the sulphur dioxide emission rate is based on the maximum sulphur content of the applicable fuel type and the fuel consumption rate is based on the MW rating of the burner in each plant and the calorific value of the fuel type. The sulphur content of diesel is 10 ppm[29], natural gas has a maximum sulphur content of 50 mg/m[30] and the used oil is subject to supply agreements that limit the sulphur content to 5,000 ppm.
- For the existing and proposed Allied asphalt plants, the emission rates for arsenic, cadmium, chromium, copper and lead have been based on the maximum levels specified in the used oil data sheet. The use of the maximum levels of these contaminants will account for the potential variability of these contaminants in used oil. The allowable levels of arsenic, cadmium, chromium and lead are also consistent with those set in HSNOCOP 63 *Management and Handling of Used Oil*. Test data for recent batches of used oil show that actual levels of these metals are lower than the specification, so emission rates developed from the specification will provide conservative maximum off site concentrations (see Section D3.2.6 for representative oil samples in comparison with the specification).
- For the metals that are not specified in the used oil data and for PAHs, because the AP-42 emission factors for drum mix plants are based on fabric filtration, the emission factors used for the existing plant have been multiplied by four to reflect the comparative performance of the venturi scrubber control equipment on the existing plant[31].

In the calculation of contaminant emission rates, we have assumed that the operation of each plant is at its maximum asphalt production rate. Modelling has been undertaken on the basis that these emissions are continuous, despite batching of asphalt occurring for shorter discontinuous periods of the day. This will provide a conservative assessment for the 24-hour and annual averaging periods.

D2.2 Stack parameters

Appendix D Table 1 presents the emission parameters input into the atmospheric dispersion model for the existing and proposed asphalt plants.

[28] US EPA. 2006. "AP-42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1, Chapter 11.1 Hot Mix Asphalt Plants".
[29] Schedule 2, Engine Fuel Specifications Regulations 2011
[30] New Zealand Standard (NZS 5442: 2008) specification for reticulated natural gas
[31] The existing plant has an average TSP emission rate of 124 mg/m^3 (at 0°C, 1 atmosphere pressure, dry gas basis) based on the annual stack tests collected 2019 – 2022. The proposed TSP consent limit for the new batch plant is 30 mg/m^3 (at 20°C, 1 atmosphere pressure, dry gas basis) based on the fabric filter baghouse specification.

Appendix D Table 1: Modelled asphalt plant stack parameters

Parameter	Higgins asphalt plant	Existing Allied asphalt plant	Proposed Allied asphalt plant
Stack height (m)	13	18	27.6
Stack diameter (m)	0.65	0.75	0.95
Stack temperature (°C)	100	70	100
Stack velocity (m/s)	15.0	15.1	22.4

D2.3 Contaminant emissions

D2.3.1 Overview

Appendix D Table 2 presents the emission rates of contaminants from Allied's existing and proposed asphalt plants. Emission rates for select contaminants from Higgins' plant are included in **Appendix D Table** 3**.**

Appendix D Table 2: Contaminant emissions rates for the existing and proposed asphalt plants (kg/hour)

Contaminant	Existing asphalt plant (80 t/hour)		Proposed asphalt plant (200 t/hour)	
	Natural gas	Used oil	Natural gas	Used oil
TSP	4.2		1.25	
PM_{10}	3.36 [A]		1.0 [B]	
$PM_{2.5}$	1.68 [A]		0.50 [B]	
SO_2	0.03	2.79	0.06	5.35
NO_X	1.04	4.64	2.60	11.60
CO	5.20	5.20	40	40
Arsenic	8.96×10^{-5}	2.79×10^{-3}	4.6×10^{-5}	5.35×10^{-3}
Beryllium	-		1.50×10^{-5}	
Cadmium	6.72×10^{-4}	1.12×10^{-3}	6.1×10^{-5}	2.14×10^{-3}
Chromium	8.80×10^{-4}	2.79×10^{-3}	5.7×10^{-5}	1.24×10^{-2}
Chromium VI	7.20×10^{-5}		4.80×10^{-6}	
Copper	4.96×10^{-4}	2.79×10^{-2}	2.80×10^{-4}	5.35×10^{-2}
Lead	9.92×10^{-5}	2.79×10^{-2}	8.90×10^{-5}	1.24×10^{-1}
Manganese	1.23×10^{-3}		6.90×10^{-4}	
Mercury	3.84×10^{-5}	4.16×10^{-4}	4.10×10^{-5}	
Nickel	1.01×10^{-2}		3.00×10^{-4}	
Selenium	5.60×10^{-5}		4.90×10^{-5}	
Benzene	1.56×10^{-2}		2.80×10^{-2}	
Acetaldehyde	-	5.20×10^{-2}	3.20×10^{-2}	

Contaminant	Existing asphalt plant (80 t/hour)		Proposed asphalt plant (200 t/hour)	
	Natural gas	Used oil	Natural gas	Used oil
Formaldehyde	1.24×10^{-1}		7.40×10^{-2}	
BaP_{eq}	7.58×10^{-6}		3.17×10^{-7}	

A = Based on the existing total suspended particulate consent limit of 4.2 kg/hour (Clause 5.5).

B = Based on proposed total suspended particulate consent limit of 30 mg/Nm^3 and max volumetric flowrate of 41,805 m^3/hour at 20°C, 1 atmosphere, dry gas basis.

Appendix D Table 3: Contaminant emissions rates for the cumulative assessment of emissions from the Higgins asphalt plant (kg/hour)

Contaminant	Higgins asphalt plant (60 t/hour)
	Diesel
PM_{10}	2.0[A]
$PM_{2.5}$	1.0[A]
SO_2	0.0033

A = Based on existing total suspended particulate consent limit of 2.5 kg/hr.

D2.3.2 Derivation of SO_2 emission rates

Greater detail on the derivation of SO_2 emission rates are provided in **Appendix D Table 4** and **Appendix D Table 5**. The fuel calorific value is used to find the maximum fuel consumption rate to the burner based on the MW rating, and the sulphur content of the fuel is then used to find the maximum emission rate of SO_2. AP-42 Section 11.1 Hot Mix Asphalt Plants Table 11.7 also advises that based on test data for drum plants, 50 percent of the fuel-bound sulphur (up to a maximum of 0.05 kg (as SO_2)/tonne of product) is expected to be retained in the asphalt product, with the remainder emitted as SO_2. The background document to AP-42 Section 11.1[32] notes that emission of 50% for fuel bound sulphur is the highest percentage of fuel-bound sulphur emitted as SO_2 (rounded to the nearest 10 percent), as data suggest between 3% and 53% for the fuel sulphur is emitted (38% released on average). Therefore, the SO_2 emission rate for each scenario has been calculated on the basis that 50% of fuel-input sulphur is retained and 50% released to the stack.

Appendix D Table 4: Fuel parameters for calculation of SO_2 emission rates

Parameter	Fuel type		
	Diesel	Natural gas	Used oil
Sulphur content (mg/kg)	10	50	5,000
Calorific value	45.8 MJ/kg[A]	40.3 MJ/m^3[B]	45.1 MJ/kg[C]

A. Oil statistics | Data tables for oil. (2022). Retrieved May 2022, from https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/oil-statistics/

B. Gas statistics | Data tables for gas. (2022). Retrieved May 2022, from https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/gas-statistics/

C. Certificate of analysis, February 2022

Appendix D Table 5: Derivation of SO_2 emissions rate by fuel type

Parameter	Burner rating (MW)	Maximum fuel consumption rate			SO_2 emission rate (kg/hour)		
		Diesel (kg/hour)	Natural gas (m^3/hour)	Used oil (kg/hour)	Diesel	Natural gas	Used oil
Existing plant	7	NA	559	625	NA	0.03	2.79
Proposed plant	13.4	1,054	1,196	1,070	0.01	0.06	5.35

[32] USA EPA, Emission Factor Documentation for AP-42 Section 11.1, Hot Mix Asphalt Plants Final Report, 2004

D2.3.3 Derivation of NO_2 emission rates

The USEPA Compilation of Air Pollutant Emissions Factors (AP-42) Volume 11.1 for Hot Mix Asphalt Plants recommends very similar emission factors for batch plants (0.013 kg/Mg) and drum mix plants (0.013 kg/Mg) when using natural gas as a fuel. However, it specifies a much higher NO_X emission factor for use of liquid fuels in batch plants (0.058 kg/Mg) compared to drum mix plants (0.028 kg/Mg). NO_X emissions from asphalt plants are solely related to combustion. There is on logical reason why NOx emissions from batch mix plants should be higher than from drum mix plants (consistent with the AP42 emission factors for use of natural gas as a fuel).

The liquid fuels NOx emission factor for batch plants was only based on two tests (A and B rating) and has an overall confidence rating of E, while the drum mix plant factor was based on 11 tests (10 x A and 1 x B rating) and has an overall confidence rating of C. Therefore, the emission factor for drum mix plants is more reliable than that for batch plants and has been adopted as representative of both the existing (drum mix) plant and proposed (batch) plants, as shown in **Appendix D Table 6**.

Appendix D Table 6: NO_X Emission Factors

Fuel	NO_X emission factor (kg/Mg)	NO_X emission rate (kg/hour)	
		Existing asphalt plant (80 t/hour)	Proposed asphalt plant (200 t/hour)
Natural gas	0.013	1.0	2.6
Liquid (diesel or waste oil)	0.058	4.6	11.6

D2.4 Odour emissions

To enable development of representative emission rates for odour stack testing was undertaken at the existing plant and at a comparable vertical batching plant model in Australia (testing attached as **Appendix G**).

The odour emission rate measurements are summarised in **Appendix D Table 7**.

For odour measurements where production rate was recorded, the odour emission rate has been scaled based on the proposed maximum production rate of 200 tonnes/hour. The geometric mean of these odour emission rates has been used in odour dispersion modelling for the proposed plant.

As the design and mitigation measures proposed for the new plant are likely to control odour to a greater extent than the Reliable Way plant (by tonne of hot mix produced), the modelled odour predictions are likely to conservatively overstate the potential odour impacts of the new plant.

Appendix D Table 7: Odour emissions rates measurements, Australian plant, 30 September 2022

Date	Odour concentration (OU)	Average odour emission rate measured (OU/s) [1]	Production rate during testing (t/hour)	Odour emission rate scaled to 200 t/hour (OU/s)[1]
Test 1	3,200	23,000	130	36,000
Test 2	3,800	28,000	130	44,000
Average	3,500	25,000	130	39,000

1 Rounded to nearest 2 significant figures

Appendix D Table 8: Odour emissions rates measurements, existing Mt Maunganui plant, 29 September 2022

Date	Odour concentration (OU)	Average odour emission rate measured (OU/s) [1]	Production rate during testing (t/hour)	Odour emission rate scaled to 80 t/hour (OU/s) [1]
Test 1	24,709	120,000	40	240,000
Test 2	33,822	170,000	50	270,000
Test 3	35,535	200,000	50	310,000
Average	31,355	160,000	47	280,000

1 Rounded to nearest 2 significant figures.

Appendix D Table 9 presents the odour emission rates used in modelling of the existing and proposed asphalt plants, scaled based on the applicable maximum and typical production rates.

Appendix D Table 9: Odour emissions rates for the existing and proposed plants (OU/s)

Plant description	Production rate (tonnes/hr)	Operating hours	Stack odour emission rate (OU/s)
	Maximum scenario		
Proposed Allied plant	200	00:00 – 24:00	39,000
Existing Allied plant	80	00:00 – 24:00	280,000
Existing Higgins Asphalt plant	60	00:00 – 24:00	210,000
	Typical scenario		
Proposed Allied plant	See note 1	See note 1	See note 1
Existing Allied plant	50	07:00 – 12:00	180,000
Existing Higgins Asphalt plant	40	07:00 – 12:00	140,000

2 The maximum production rate and continuous operation scenario for the proposed plant complied with all criteria at ground level, therefore modelling of the typical scenario was not undertaken.

D3 Dispersion modelling results

D3.1 Assessment locations

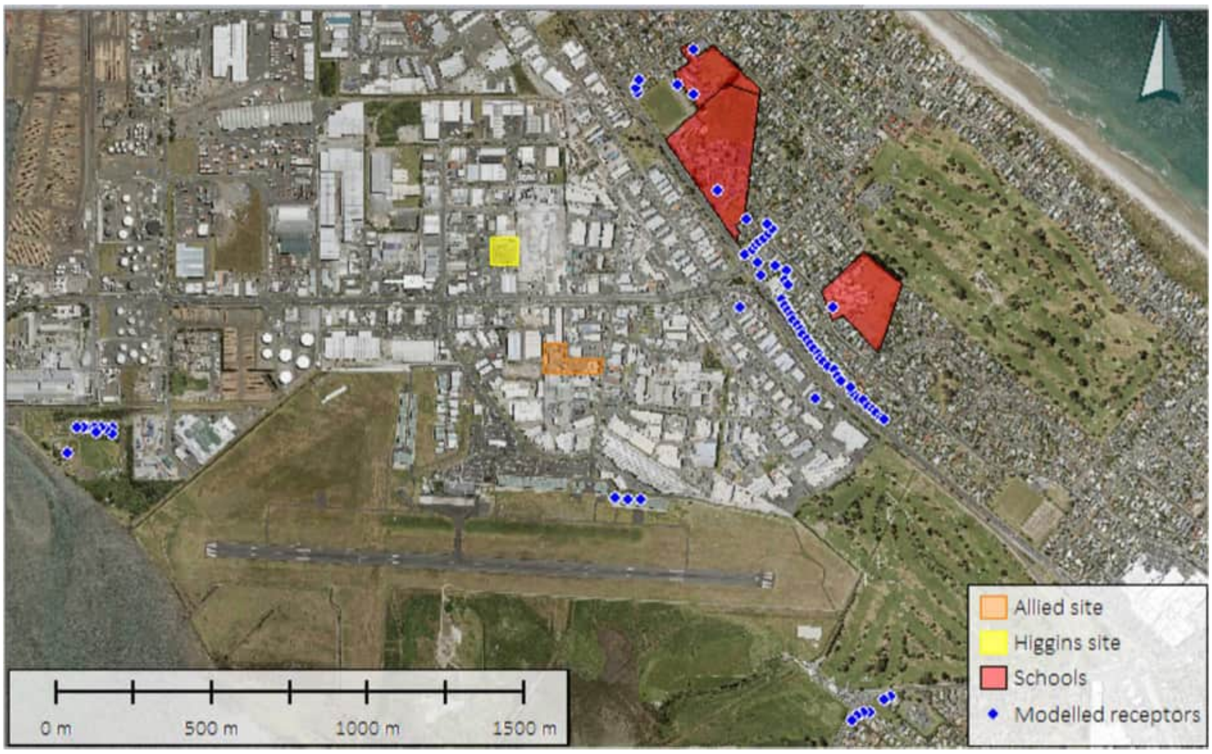
A selection of nearest sensitive receptors at the fringe of the nearby residential areas were included in the modelling to determine the peak prediction for the longer-term averaging periods (24-hour, annual average). For short term averaging periods (1-hour and 8-hour rolling), any location beyond the site boundary is considered in the assessment. The list of local residences in **Appendix D Table 10** below is not intended to be exhaustive, but it to provide representative locations for the assessment of effects.

Appendix D Table 10: Discrete receptor locations

Reference	Address	Type
R_1	Whareroa Marae	Marae
R_2	3 Taiaho Pl	Residence
R_3	3b Taiaho Pl	Residence
R_4	5 Taiaho Pl	Residence
R_5	7 Taiaho Pl	Residence
R_6	9a Taiaho Pl	Residence
R_7	9b Taiaho Pl	Residence
R_8	11 Taiaho Pl	Residence
R_9	13 Taiaho Pl	Residence
R_10	14 Taiaho Pl	Residence
R_11	566 Maunganui Road	Residence
R_12	2E Golf Road	Residence
R_13	569 Maunganui Road	Residence
R_14	Mt Maunganui College	Residence
R_15	7 Waitui Grove	Residence
R_16	573 Maunganui Road	Residence
R_17	3 Golf Road	Residence
R_18	5 Golf Road	Residence
R_19	7B Golf Road	Residence
R_20	8A Links Avenue	Residence
R_21	10B Links Avenue	Residence
R_22	4C Links Avenue	Residence
R_23	12B Links Avenue	Residence
R_24	Mt Maunganui Intermediate	School
R_25	574 Maunganui Road	Residence
R_26	575 Maunganui Road	Residence
R_27	576B Maunganui Road	Residence
R_28	577A Maunganui Road	Residence
R_29	578 Maunganui Road	Residence
R_30	579A Maunganui Road	Residence
R_31	580 Maunganui Road	Residence
R_32	581A Maunganui Road	Residence

Reference	Address	Type
R_33	582 Maunganui Road	Residence
R_34	583 Maunganui Road	Residence
R_35	584 Maunganui Road	Residence
R_36	585A Maunganui Road	Residence
R_37	586A Maunganui Road	Residence
R_38	587A Maunganui Road	Residence
R_39	588 Maunganui Road	Residence
R_40	589B Maunganui Road	Residence
R_41	590A Maunganui Road	Residence
R_42	Gateway Motor Inn	Residence
R_43	592 Maunganui Road	Residence
R_44	594 Maunganui Road	Residence
R_45	Gwen Rogers Kindergarten, 22 Tui Street	Pre-school
R_46	Omanu School, 22 Tui Street	School
R_47	Omanu Preschool, 20 Tui Street	Pre-school
R_48	9B Golf Road	Residence
R_49	11 Golf Road	Residence
R_50	1A Waitui Grove	Residence
R_51	1 Waitui Grove	Residence
R_52	595 Maunganui Road	Residence
R_53	596 Maunganui Road	Residence
R_54	597 Maunganui Road	Residence
R_55	598 Maunganui Road	Residence
R_56	599 Maunganui Road	Residence
R_57	600 Maunganui Road	Residence
R_58	564 Maunganui Road	Residence
R_59	563 Maunganui Road	Residence
R_60	2B Tui Street	Residence
R_61	67 Matapihi Road	Residence
R_62	69 Matapihi Road	Residence
R_63	7 Palm Court	Residence
R_64	5 Palm Court	Residence
R_65	6 Palm Court	Residence

Reference	Address	Type
R_66	93 Matapihi Road	Residence
R_67	Little Einsteins Montessori, 1 MacDonald Street	Pre-school
R_68	BestStart Macdonald Street, 39 MacDonald Street	Pre-school
R_69	1 De Havilland Way	Residence
R_70	3 De Havilland Way	Residence
R71	5 De Havilland Way	Residence



Appendix D Figure 2: Modelled receptor locations

Aerial imagery source: Bay of Plenty 0.1m Urban Aerial Photos (2020), imagery captured for BOPLASS Ltd by AAM NZ Limited,

D3.2 Contaminant modelling

D3.2.1 Overview

A summary of the predicted peak ground level concentrations of contaminants at locations where a person could reasonably be exposed for the relevant averaging period is presented in **Appendix D Table 11** below.

The peak predictions for short term averages (1-hour and 8-hour) are 99.9th percentiles and reported for any off site location in accordance with the MfE GPG[33]. The peak predictions for 24-hour and annual averaging periods are the maximum values reports at a sensitive receptor as identified in section D3.1.

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Appendix D Table 11: Peak predicted ground level concentrations from the existing and proposed asphalt plants (µg/m³) at locations where a person could reasonably be exposed for the relevant averaging period

Contaminant	Averaging period	Existing asphalt plant		Proposed asphalt plant	
		Natural gas	Used oil	Natural gas	Used oil
PM_{10}	24-hour	4.5 A		1.0 B	
	Annual	0.72 A		0.16 B	
$PM_{2.5}$	24-hour	2.2 A		0.5 B	
	Annual	0.36 A		0.08 B	
SO_2	1-hour	1.5	136	0.4	31.3
	24-hour	0.04	3.6	0.06	5.3
NO_2	1-hour	5.1 C	22.6 C	1.9 C	6.8 C
	24-hour	0.1 C	0.6 C	0.3 C	1.1 C
CO	1-hour	254		234	
	8-hour	152		185	
Arsenic	Annual	1.92×10^{-5}	5.99×10^{-4}	7.33×10^{-6}	8.52×10^{-4}
Beryllium	Annual	No emission		2.39×10^{-6}	
Cadmium	Annual	1.44×10^{-4}	2.39×10^{-4}	9.72×10^{-6}	3.41×10^{-4}
Chromium	Annual	1.89×10^{-4}	5.99×10^{-4}	9.08×10^{-6}	8.52×10^{-4}
Chromium VI	Annual	1.54×10^{-5}		7.65×10^{-7}	
Copper	1-hour	2.42×10^{-2}	1.36	1.64×10^{-3}	3.13×10^{-1}
Lead	3-month rolling	3.20×10^{-5}	9.00×10^{-3}	2.14×10^{-5}	1.29×10^{-2}
Manganese	Annual	2.64×10^{-4}		1.10×10^{-4}	
Mercury	Annual	8.23×10^{-6}	8.91×10^{-5}	6.53×10^{-6}	
Nickel	Annual	2.16×10^{-3}		4.78×10^{-5}	
Selenium	Annual	1.20×10^{-5}		7.81×10^{-6}	
Benzene	Annual	3.34×10^{-3}		4.46×10^{-3}	
Acetaldehyde	Annual	-	1.11×10^{-2}	5.10×10^{-3}	
Formaldehyde	30-minute	6.6		0.5	
BaP_{eq}	Annual	1.62×10^{-6}		5.06×10^{-8}	

A = Based on existing total suspended particulate consent limit of 4.2 kg/hour

B = Based on proposed total suspended particulate consent limit of 30 mg/m³.

C = Direct emission of 10% NO_2

Discussion of these results with consideration of the relevant assessment criteria and background concentrations is included in the following subsections.

D3.2.2 Fine particulate matter (PM_{10} and $PM_{2.5}$)

The maximum ground level concentrations (MGLC) of PM_{10} and $PM_{2.5}$ predicted as a result of the highest allowable TSP emission concentration of 30 mg/m³ (at 0°C, 1 atmosphere pressure, dry gas basis) from the proposed plant stack are shown in **Appendix D Table 12**. The MGLC for the 24-hour period is predicted at 3 De Havilland Way approximately 400 m southeast of the boundary and for the annual averaging period is predicted at the preschool (Little Einsteins Montessori) at 1 MacDonald Street. While the preschool location is not likely to be occupied by any one person on an annual basis, the result is compared with the assessment criteria as a conservative worst case exposure concentration. All exposures at locations in the further afield Omanu residential area where a person could reasonably be exposed for the relevant averaging periods at any one time will be lower than that predicted for the preschool.

The predicted contributions of the proposed plant emissions to ambient PM_{10} and $PM_{2.5}$ concentrations are well below the relevant assessment criteria at the most impacted sensitive locations (the De Havilland Way residences for the 24-hour average period and Little Einsteins Montessori for the annual average period). The 24-hour average contour plot for PM_{10} is included as **Figure Appendix E.1**.

Appendix D Table 12: Predicted MGLC of PM_{10} and $PM_{2.5}$ from the proposed asphalt plant

Contaminant	Averaging period	Assessment criterion (µg/m³)	Plant contribution only		Plant contribution + estimated background concentration	
			MGLC (µg/m³)	% of assessment criterion	Cumulative MGLC (µg/m³)	% of assessment criterion
PM_{10}	24-hour	50 (NESAQ)	1.0	2.0%	31.2	62.4%
	Annual	20 (AAQG)	0.16	0.8%	14.8	73.8%
$PM_{2.5}$	24-hour	25 (WHO 2005)	0.5	2.0%	14.5	58.0%
	Annual	10 (WHO 2005)	0.08	0.8%	7.6	75.8%

The MGCL for PM_{10} and $PM_{2.5}$ from the existing plant at the Site also occur at a residence on De Havilland Way (Unit 1 instead of Unit 3) for the 24-hour averaging period and at the preschool for the annual averaging period. The predictions are higher than for the proposed site, as shown in **Appendix D Table 13,** due to the higher consented emission rate.

Appendix D Table 13: Predicted MGLC of PM_{10} and $PM_{2.5}$ from the existing asphalt plant

Contaminant	Averaging period	Assessment criterion (µg/m³)	Plant contribution only		Plant contribution + estimated background concentration	
			Worst case MGLC (µg/m³)	% of assessment criterion	Cumulative worst-case MGLC (µg/m³)	% of assessment criterion
PM_{10}	24-hour	50 (NESAQ)	4.5	8.9%	34.7	69.3%
	Annual	20 (AAQG)	0.72	3.6%	15.3	76.6%
$PM_{2.5}$	24-hour	25 (WHO 2005)	2.2	8.9%	16.2	64.9%
	Annual	10 (WHO 2005)	0.36	3.6%	7.9	78.6%

Modelling of the maximum consented emissions from the Higgins site was also undertaken and the contemporaneous predictions added to understand the cumulative impact of the operation of the two plants simultaneously. For the existing plant, the most impacted modelled receptor for the cumulative scenario was very similar as for the existing plant only (at 5 De Havilland Way as opposed to 1 De Havilland Way). At this receptor, the predicted 24-hour MGCL was 4.2 µg/m^3 for the existing plant alone, and 5.8 µg/m^3 when emissions from Higgins plant were also included.

For the proposed plant, the most impacted modelled receptor for the cumulative scenario was predicted at 564 Maunganui Road, northeast of the Allied site. At this receptor, the predicted 24-hour average MGCL was 0.3 µg/m^3 for the proposed plant alone, and 3.8 µg/m^3 when emissions from Higgins plant were also included. At the receptor that is most impacted by the proposed plant (3 De Havilland Way) the 24-hour average MGLC was 0.98 µg/m^3 for the proposed plant alone, and 1.8 µg/m^3 with the contemporaneous addition of the Higgins model predictions results.

D3.2.3 Sulphur dioxide

The MGLC of sulphur dioxide predicted as a result of the combustion of used oil in the proposed plant are presented in **Appendix D Table 14**. Results from the use of diesel or natural gas will be significantly lower due to the lower maximum sulphur content of these fuel types.

The predicted SO_2 concentrations from the proposed plant are well below the relevant assessment criteria. The 1-hour peak for the proposed plant is predicted to occur approximately 90 m southeast of the proposed stack at HR Cement's yard. The peak 24-hour average MGLC from the proposed plant are predicted to occur at 3 De Havilland Way. While the modelling was undertaken to account for emission of SO_2 from the neighbouring Higgins plant, its contribution to the maximum impacted locations was indiscernible, due to the fuel source being diesel, which contains a fifth of the maximum sulphur content of natural gas and 1/500th the maximum sulphur content of the waste oil proposed to be used for fuel at Allied's site.

The contour plots for the 1-hour and 24-hour averaging periods from the proposed plant are included as **Figure Appendix E.2** and **Figure Appendix E.3**. The outer contour represents 5% of the applicable assessment criterion.

Appendix D Table 14: Predicted MGLC of SO_2 from the proposed asphalt plant

Averaging period	Assessment criterion (µg/m^3)	Plant contribution only		Plant contribution + estimated background concentration	
		Worst case MGLC (µg/m^3)	% of assessment criterion	Cumulative worst-case MGLC (µg/m^3)	% of assessment criterion
1-hour^A	350 (NESAQ)	31.3	8.9%	54.7	16%
24-hour	120 (AAQG)	5.3	4.4%	19.1	16%

A = 99.9th percentile concentration

For comparison, the predicted MGLCs for the existing plant when using used oil for fuel is included in **Appendix D Table 15**. Due to the shorter stack, the 1-hour predication is higher and the peak is located over the northwestern boundary of the Site over Tyre Works Mega's building. Predicted 24-hour average levels at the nearest sensitive receptor (1 De Havilland Way) are slightly higher for the proposed plant and in both cases well below the assessment criteria.

Appendix D Table 15: Predicted MGLC of SO_2 from the existing asphalt plant

Averaging period	Assessment criterion (µg/m³)	Plant contribution only		Plant contribution + estimated background concentration	
		Worst case MGLC (µg/m³)	% of assessment criterion	Cumulative worst-case MGLC (µg/m³)	% of assessment criterion
1-hour[A]	350 (NESAQ)	136.1	38.9%	159.5	46%
24-hour	120 (AAQG)	3.6	3.0%	17.4	14%

A = 99.9th percentile concentration

D3.2.4 Nitrogen dioxide

The MCLC of nitrogen dioxide (NO_2) predicted as a result of the combustion of used oil in the proposed plant are presented in **Appendix D Table 16**.

The predicted effects of direct NO_2 concentrations from the proposed site's stack emissions are small compared to the 1-hour NESAQ and 24-hour AAQG. The worst-case NO_2 concentration predicted using the proxy method is 60% of the 1-hour NESAQ and 76% of the 24-hour AAQG, though as noted in Section 5.2, cumulative NO_2 concentrations are likely to be much lower in practice. Like with SO_2, the peak 1-hour average NO_2 concentrations for the proposed plant are predicted at approximately 90 m southeast of the stack over the HR Cement site for the proposed plant, and peak 24-hour concentration is predicted to occur at 3 De Havilland Way, southeast of the site.

Appendix D Table 16: Predicted MGLC of NO_2 from the proposed asphalt plant

Averaging period	Assessment criterion (µg/m³)	Plant contribution only – Direct NO_2		Plant contribution + estimated background concentration	
		Worst case MGLC (µg/m³)[A]	% of assessment criterion	Cumulative worst-case MGLC (µg/m³)	% of assessment criterion
1-hour[B]	200 (NESAQ)	6.8	3.4%	119.8[C]	60%
24-hour	100 (AAQG)	1.1	1.1%	76.1[D]	76%

A = Primary emitted NO_2 only.

B= 99.9th percentile concentration.

C = Assumes a proxy concentration of 95 µg/m³.

D = Assumes a proxy NO_2 concentration of 75 µg/m³.

E = Assumes all NO is converted to NO_2.

The dispersion modelling results for the existing plant are presented in **Appendix D Table 17**. The peak 1-hour average NO_2 concentrations are predicted over the Tyre Works Mega's building on the northwestern boundary of the Site, and peak 24-hour concentration is predicted to occur at 3 De Havilland Way, southeast of the Site.

For both plants (existing and proposed), the levels of NO_2 at off site locations are predicted to comply with all relevant assessment criteria.

Appendix D Table 17: Predicted MGLC of NO_2 from the existing asphalt plant

Averaging period	Assessment criterion (µg/m³)	Plant contribution only – Direct NO_2		Plant contribution + estimated background concentration	
		Worst case MGLC (µg/m³)[A]	% of assessment criterion	Cumulative worst-case MGLC (µg/m³)	% of assessment criterion
1-hour[B]	200 (NESAQ)	22.6	11.3%	135.6[C]	68%
24-hour	100 (AAQG)	0.6	0.6%	75.6[D]	76%

A = Primary emitted NO_2 only.

B= 99.9th percentile concentration.

C = Assumes a proxy concentration of 95 µg/m³.

D = Assumes a proxy NO_2 concentration of 75 µg/m³.

D3.2.5 Carbon monoxide

The MCLC of carbon monoxide predicted as a result of the combustion of used oil in the proposed plant are presented in **Appendix D Table 18**.

The predicted effects of the proposed plant's CO emissions are negligible compared to the 1-hour NESAQ (0.8%) and small compared to the 8-hour NESAQ (1.9%). They are very similar to the MGLC predictions for the existing plant shown in **Appendix D Table 19**.

Appendix D Table 18: Predicted MGLC of CO from the proposed asphalt plant

Averaging period	Assessment criterion (µg/m³)	Plant contribution only		Plant contribution + estimated background concentration	
		Worst case MGLC (µg/m³)	% of assessment criterion	Cumulative worst-case MGLC (µg/m³)	% of assessment criterion
1-hour[A]	30,000 (AAQG)	234	0.8%	5,234	17%
8-hour	10,000 (NESAQ)	185	1.9%	3,185	32%

A = 99.9th percentile concentration

Appendix D Table 19: Predicted MGLC of CO from the existing asphalt plant

Averaging period	Assessment criterion (µg/m³)	Plant contribution only		Plant contribution + estimated background concentration	
		Worst case MGLC (µg/m³)	% of assessment criterion	Cumulative worst-case MGLC (µg/m³)	% of assessment criterion
1-hour[A]	30,000 (AAQG)	254	0.8%	5,254	18%
8-hour	10,000 (NESAQ)	152	1.5%	3,152	32%

A = 99.9th percentile concentration

D3.2.6 Trace contaminants

The MGLC of trace metals and VOCs from the combustion of used oil in the proposed plant are presented in **Appendix D Table 20**. In all cases, the emission rates for trace contaminants in used oil are equal to or higher than the emission rates for natural gas.

All trace contaminants MGLCs for the proposed plant are less than 1% of the corresponding assessment criteria, with the exception of arsenic (15.5%), lead (6.4%) and cadmium (1.7%). The emission rates for these metals are based on specified limits in waste oil. These estimates are considered conservative maxima, as the measured content in the waste oil is typically lower (see **Appendix D Table 21**). The assessment is also conservative as the MGLCs assume continuous operation of the asphalt plant burning used oil with the metal content at the specified limit for the entire year. Even at the maximum specified concentrations in the used oil and assuming continuous operation of the plant at peak production rate, the predicted ambient levels of these trace contaminants are below the assessment criteria.

The effects of other trace metals, PAH (as BaP_{eq}) and VOCs are predicted to be well below the assessment criterion at locations where people are likely to be present for the relevant averaging periods.

Appendix D Table 20: Predicted MGLC of trace contaminants from the proposed asphalt plant

Contaminant	Averaging period	Assessment criterion (µg/m³)	Existing plant		Proposed plant	
			Worst case MGLC (µg/m³)	% of assessment criterion	Worst case MGLC (µg/m³)	% of assessment criterion
Arsenic	Annual	0.0055	5.99×10^{-4}	10.9%	8.52×10^{-4}	15.5%
Beryllium	Annual	0.007	-	-	2.39×10^{-6}	0.03%
Cadmium	Annual	0.02	2.39×10^{-4}	1.2%	3.41×10^{-4}	1.7%
Chromium	Annual	0.11	5.99×10^{-4}	0.5%	8.52×10^{-4}	0.8%
Hexavalent chromium	Annual	0.0011	1.54×10^{-5}	1.4%	7.65×10^{-7}	0.07%
Copper	1-hour[A]	100	1.36	1.4%	3.13×10^{-1}	0.3%
Lead	3-month	0.2	9.00×10^{-3}	4.5%	1.29×10^{-2}	6.4%
Manganese	Annual	0.09	2.64×10^{-4}	0.3%	1.10×10^{-4}	0.12%
Mercury	Annual	0.33	8.91×10^{-5}	0.03%	6.53×10^{-6}	0.002%
Nickel	Annual	0.014	2.16×10^{-3}	15.4	4.78×10^{-5}	0.3%
Selenium	Annual	20	1.20×10^{-5}	0.0001%	7.81×10^{-6}	0.00004%
Benzene	Annual	3.6	3.34×10^{-3}	0.09%	4.46×10^{-3}	0.12%
Acetaldehyde	Annual	30	1.11×10^{-2}	0.04%	5.10×10^{-3}	0.02%
Formaldehyde	30 minute[B]	100	6.6	6.6%	0.5	0.5%
BaP_{eq}	Annual	0.0003	1.62×10^{-6}	0.54%	5.06×10^{-8}	0.017%

A = 99.9th percentile concentration
B = Converted from the 1 hour model predictions using the 30 minute correction factor of 1.15 as provided in Table 4.3 of the Good Practice Guide for Atmospheric Dispersion Modelling, MfE 2004.

The recommended background concentration for benzene is 1.0 µg/m^3, which is 28% of the assessment criteria. The addition of the predicted MGLCs from the proposed or existing plants is less than 1% of the criteria.

Appendix D Table 21: Used oil analysis results

Contaminant	Proposed maximum level assessed (ppm)	Measured contaminant concentration (ppm)		
		Sample 1 – 26/01/2022	Sample 2 – 01/02/2022	Sample 3 – 28/06/2022
Sulphur	5,000	3,396.3	3,300	1,979
Arsenic	5	0.5	< 1	< 1
Cadmium	2	1.5	< 1	< 1
Chromium	10	0.0	2	< 1
Lead	100	8.1	9	< 1
Copper	100	18.3	Not tested	< 1

D3.3 Odour modelling

D3.3.1 Odour effects of existing and proposed Allied plants

The predicted worst-case 99.5th percentile peak odour concentrations associated with continuous operation of the existing and proposed Allied asphalt plants at maximum capacity are presented in **Appendix D Table 22**.

Contour plots for the 99.5th percentile odour concentrations are attached as **Figure Appendix E.4** for the proposed plant and **Figure Appendix E.5** for the existing plant

The modelling clearly demonstrates the significant reduction in odour effects from the proposed plant compared to the existing plant.

Appendix D Table 22: Odour dispersion modelling predictions (assuming continuous operation)

Location	Sensitivity of location	MfE recommended guideline (OU/m^3)	99.5th percentile odour concentration (OU/m^3)	
			Existing plant	Proposed plant
Peak off-site	Low	5-10	32.5	0.67
Peak sensitive receptor	High (neutral to stable conditions)	2	2.8	0.27

The assessment approach will overstate the frequency at which odours from the existing Allied plant are likely to occur in the surrounding area, due to the assumption of continuous operation. However, the modelling suggests that asphalt odours in the industrial area around the site have the potential to cause a nuisance effect. It also shows that there is currently the potential for odour effects in the residential area northeast of the site.

The odour modelling results for the proposed plant are well within the odour modelling criteria at all locations and therefore it is unlikely that the proposed plant would cause odours that might be considered offensive or objectionable either in the neighbouring industrial area or the more distant residential area.

D3.3.2 Cumulative odour effects with Higgins asphalt plant

For a given receptor location, the stack emissions from the Higgins and Allied plants will generally not impact at the same time. This is particularly the case for the residential area east of Maunganui Rd. As such, the maximum modelled odour concentrations may not be significantly higher for the combined scenario compared to the higher of the two individual scenarios. However, the effect of two asphalt plants, that generate the same odour, is to potentially increase the overall frequency at which asphalt odours occur at a given location.

Cumulative effects of odour from the existing Allied and Higgins asphalt plants have been modelled. It is not necessary to present a detailed assessment of cumulative effects of the proposed plant with the Higgins plant, as the contribution from the proposed asphalt plant is so small that it does not contribute to exceedances of the odour modelling guidelines.

To avoid being excessively conservative, and to provide a more realistic assessment of likely cumulative effects, typical operating scenarios (production rates and operating hours) have been considered. As this modelling is for intermittent odour sources, the results are presented as the 99.9th percentile odour concentration in **Appendix D Table 23**.

Appendix D Table 23: Average operating modelling scenario at sensitive receptors

Location	**Sensitivity of location**	**Odour modelling guideline (OU/m^3)**	**Worst case 99.9th percentile odour concentration (OU/m^3)**		
			Existing Allied plant only	**Existing Higgins plant only**	**Combined**
564 Maunganui Road	High (neutral to stable conditions)	2	1.4	1.8	2.0
Mt Maunganui College	High (neutral to stable conditions)	2	1.9	0.9	2.0

It is important to note that the location of the worst-case 99.9th percentile concentrations can be in different locations for all three model runs (existing Allied plant, existing Higgins plant and combined), i.e. the worst-case combined odour concentration is not the sum of the individual worst-case concentrations, as they occur in different locations. This is best illustrated in the contour plots.

Figure Appendix E.6 and **Figure Appendix E.7** show the contour plots for the individual plant emissions, and **Figure Appendix E.8** shows the combined contours. A close-up of the combined contours is shown in **Figure Appendix E.9** for comparison with the odour modelling guideline for low sensitivity receiving environments.

In summary, this assessment shows that the cumulative effects of the two plants are small in comparison with the odour modelling guideline, i.e. the cumulative effects are only marginally greater than the individual effects. However, as the individual effects are close to the odour modelling guideline, the small cumulative is enough to increase the 99.9th percentile value to be just at the assessment criterion at the most-impacted sensitive receptors.

There is no material cumulative effect in the industrial area, in comparison with the relevant odour modelling guideline. However, both plants have the potential to create nuisance odours in the immediate vicinity.

Appendix E Contour plots

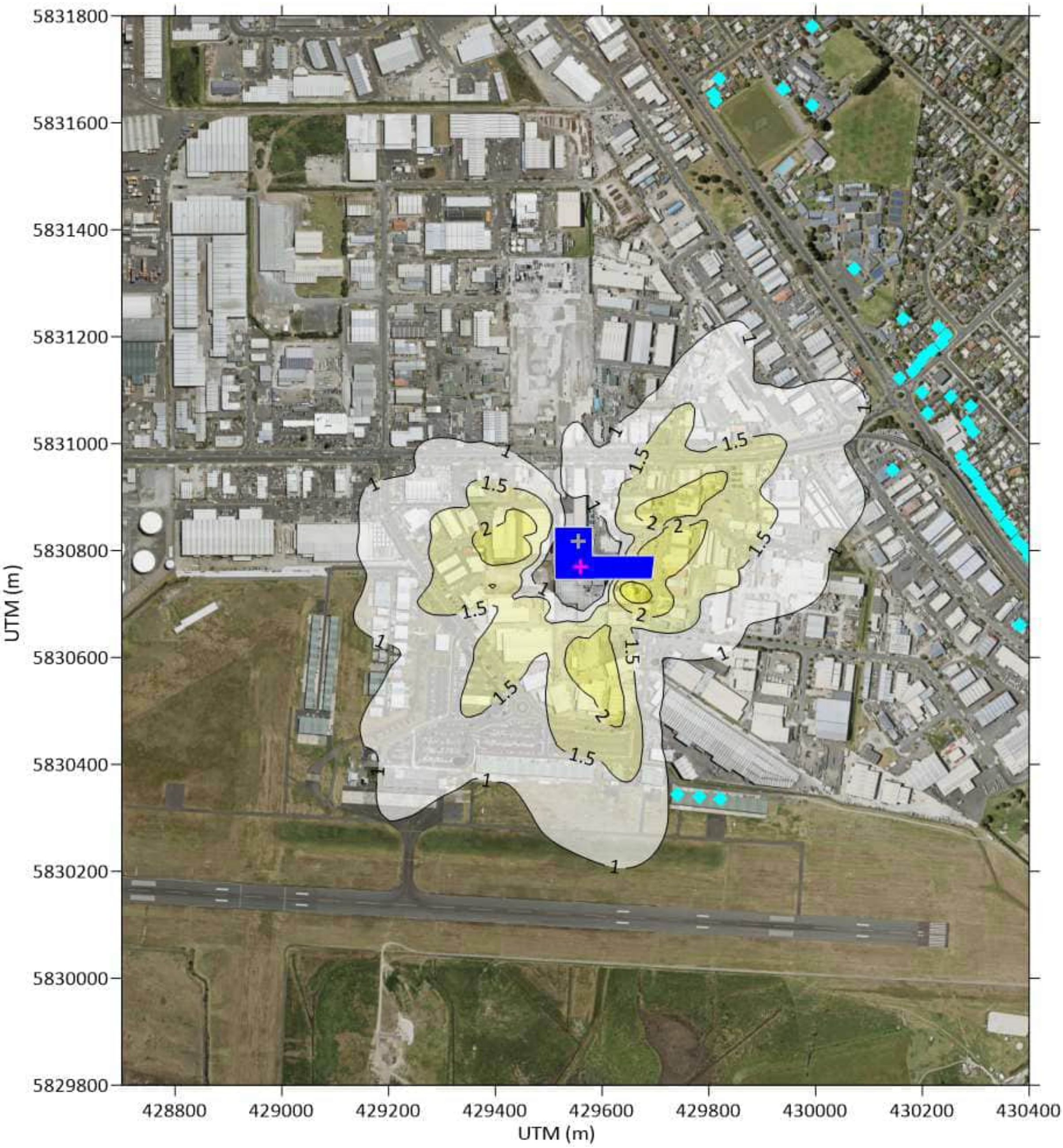

Figure Appendix E.1: Maximum 24-hour average PM10 concentration contour plot for the proposed plant (pink cross indicates the proposed stack)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

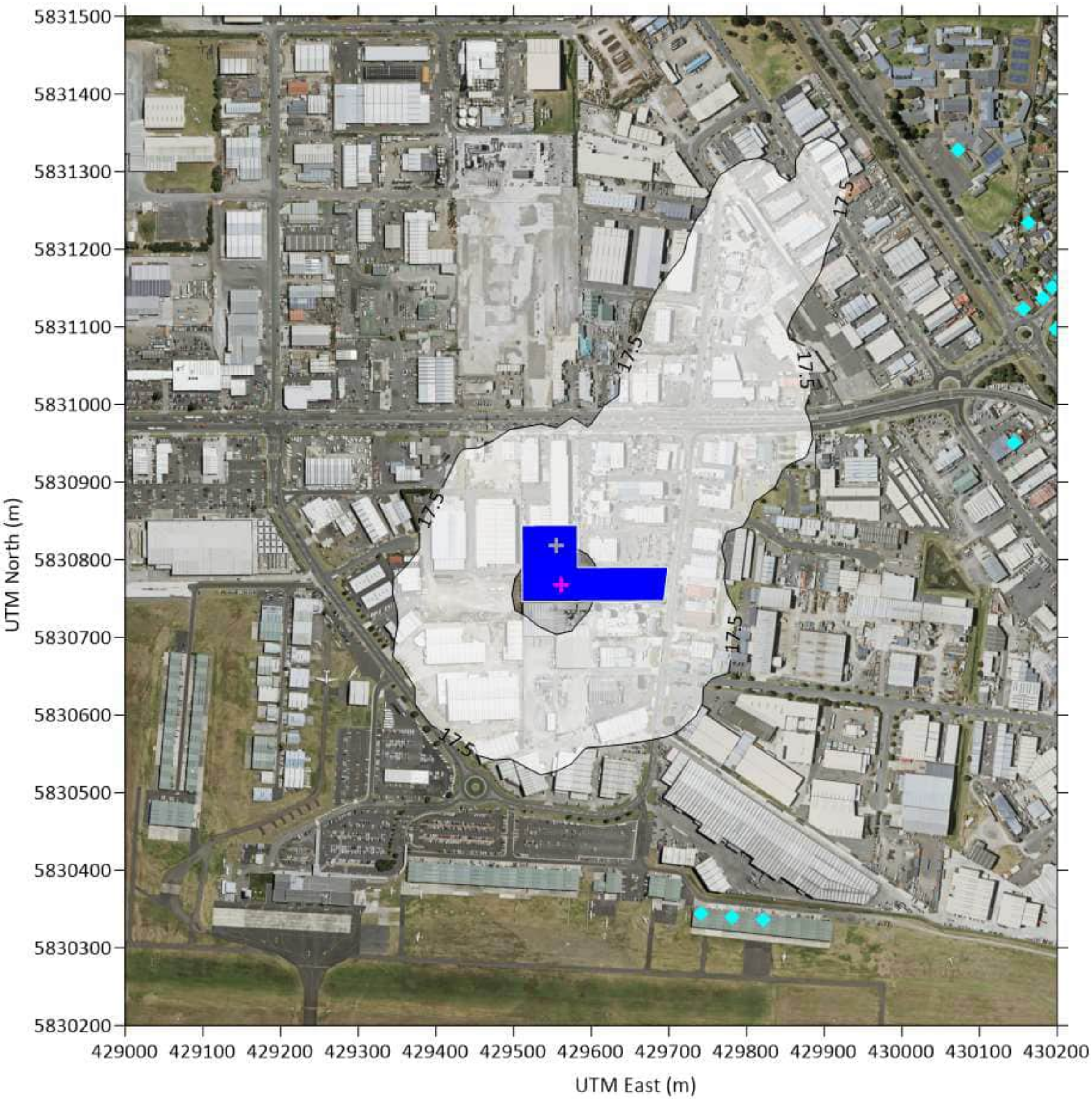

Figure Appendix E.2: 99.9th percentile 1-hour average SO_2 concentration contour plot for the proposed plant (pink cross indicates the proposed stack)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

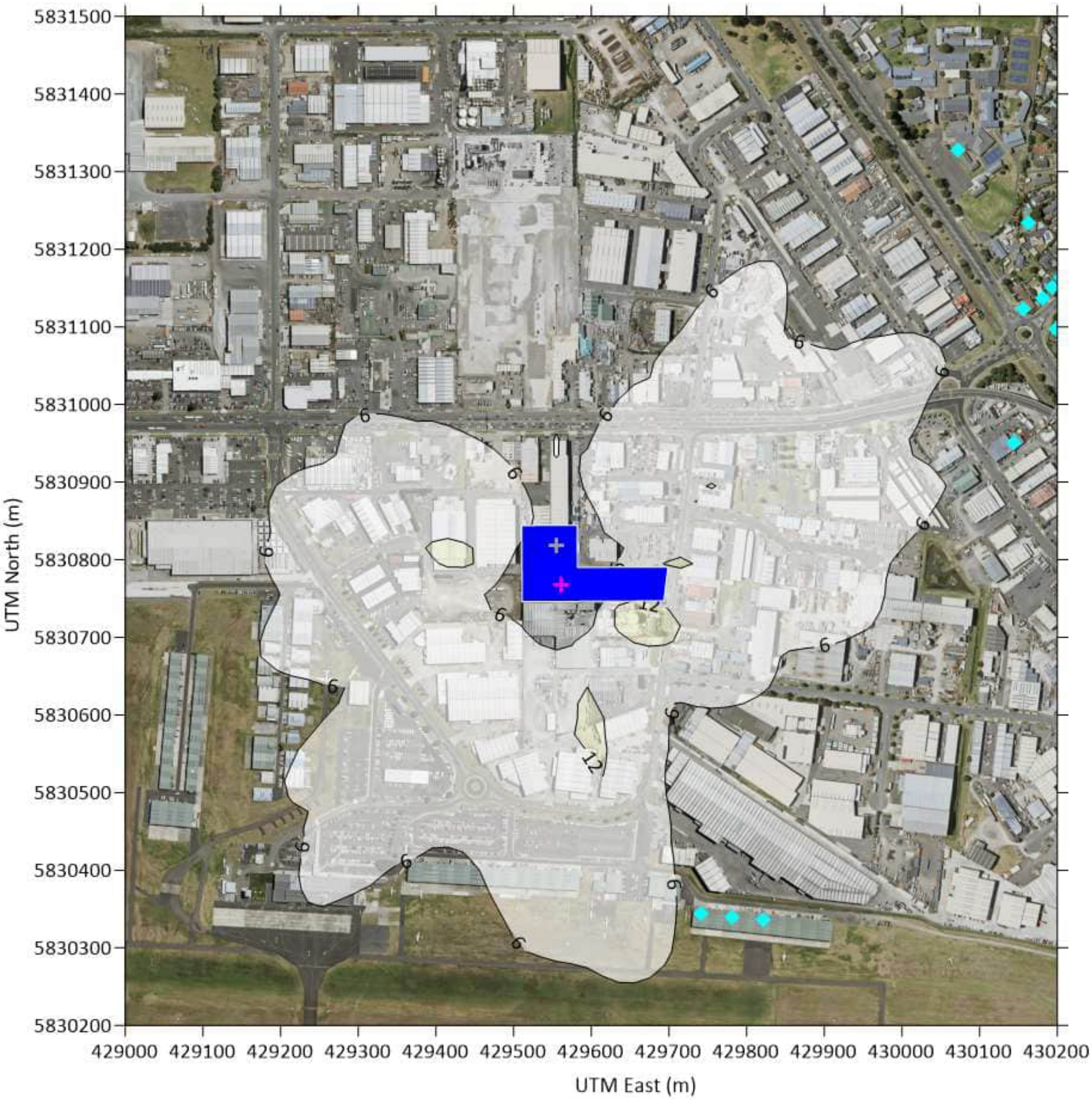

Figure Appendix E.3: Maximum 24-hour average SO_2 concentration contour plot for the proposed plant (pink cross indicates the proposed stack)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

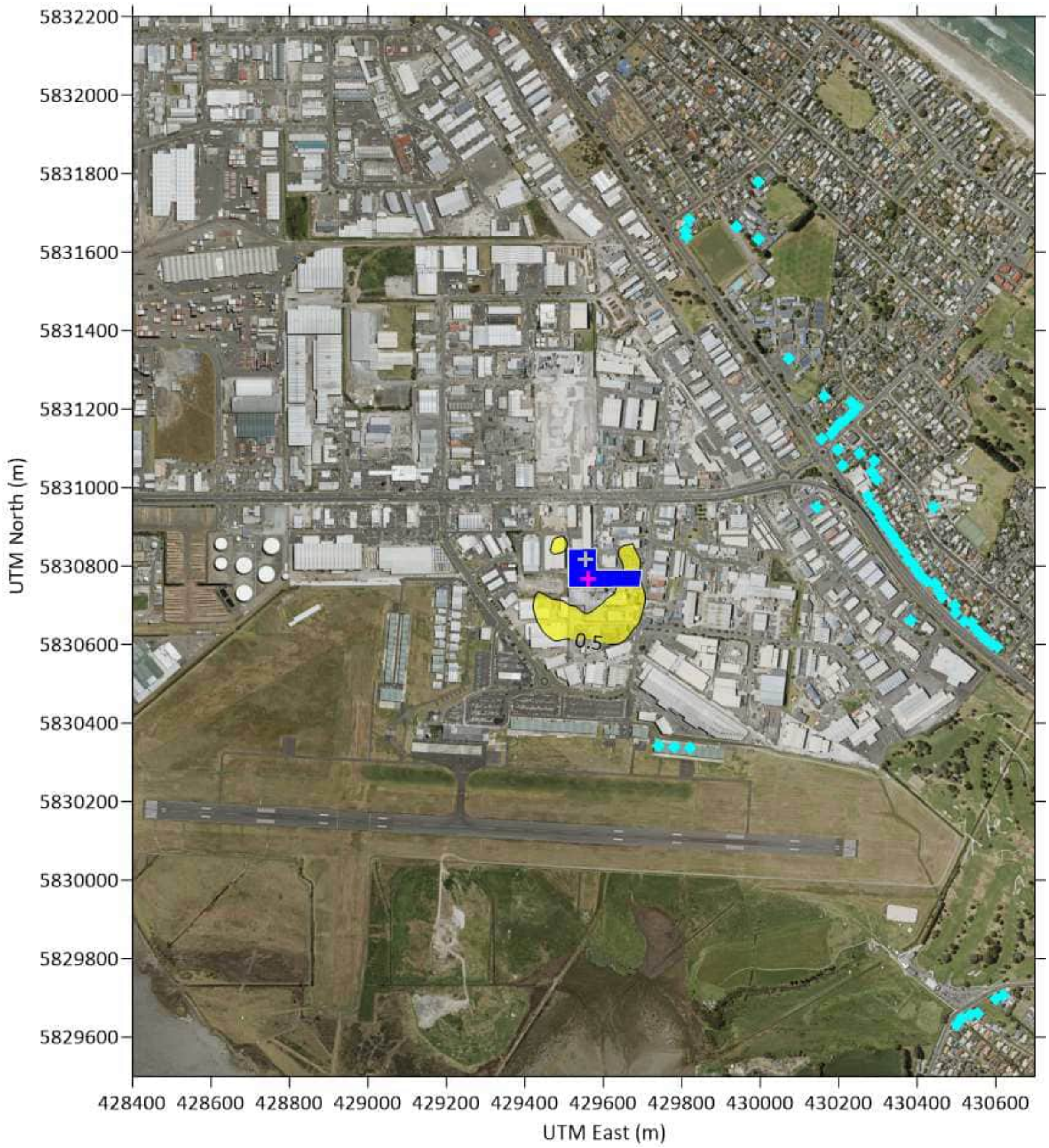

Figure Appendix E.4: 99.5th percentile 1-hour average odour concentration contour plot for the proposed plant (pink cross indicates the proposed stack)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

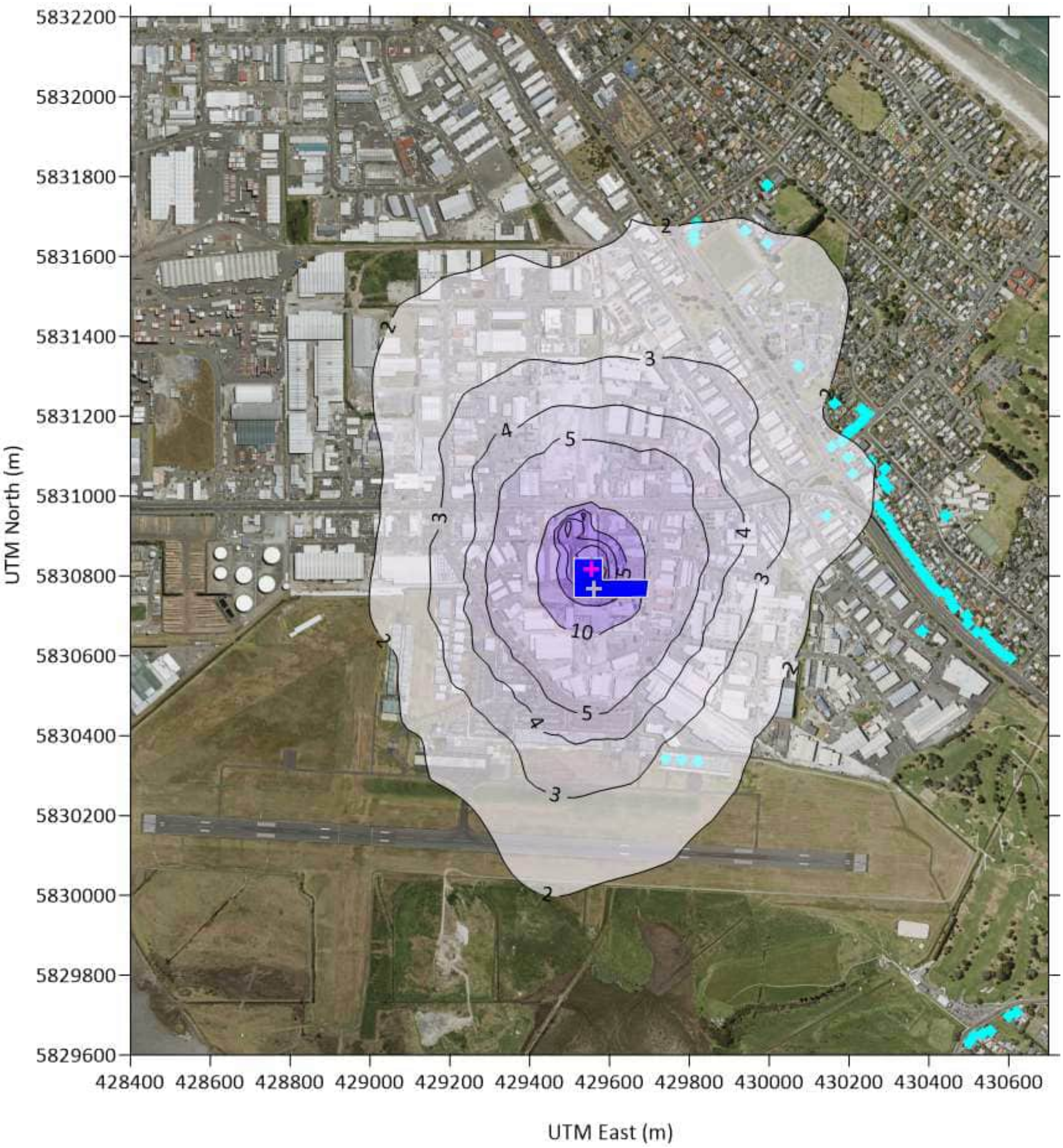

Figure Appendix E.5: 99.5th percentile 1-hour average odour concentration contour plot for the existing Allied plant (pink cross indicates the proposed stack)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

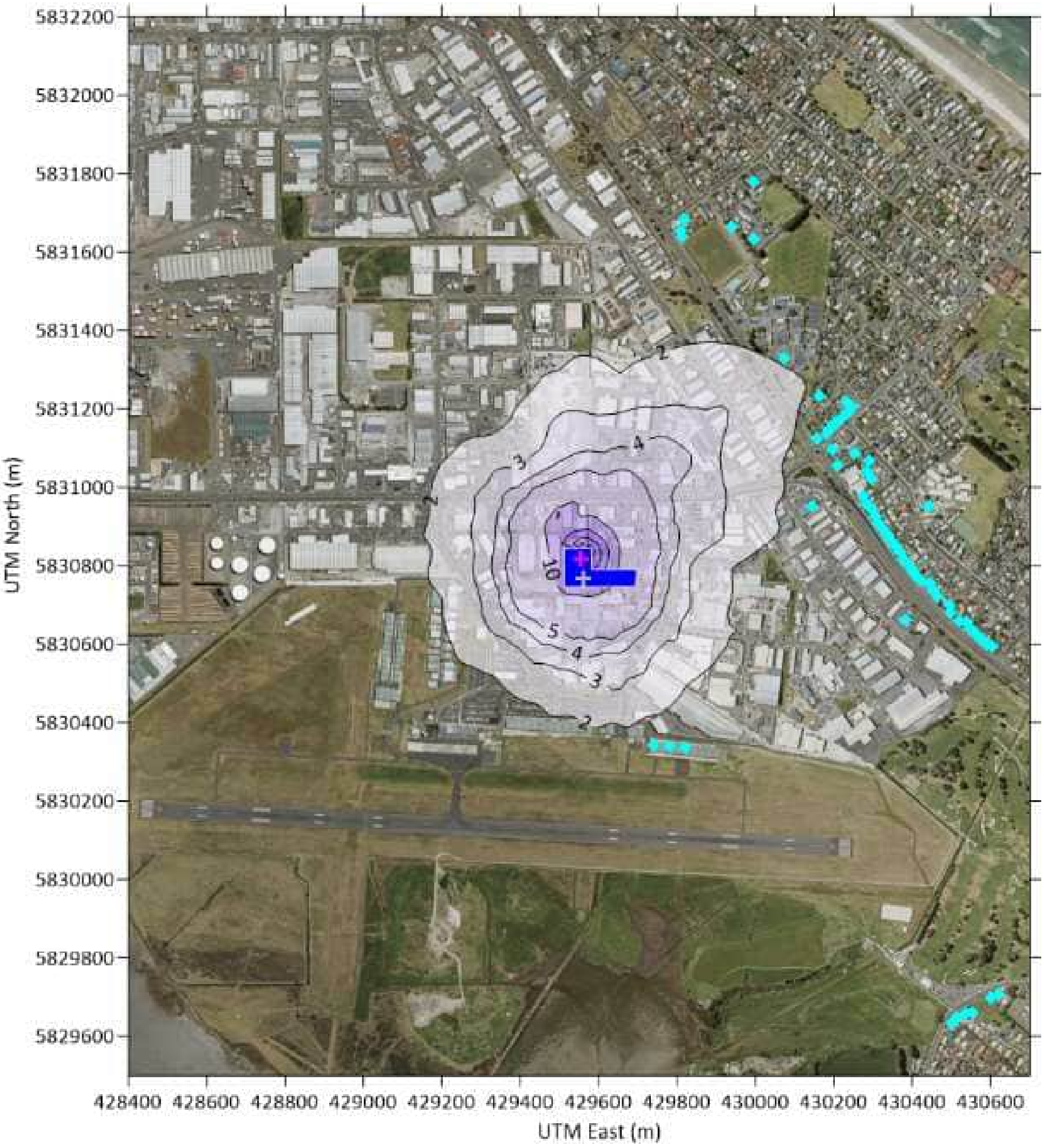

Figure Appendix E.6: 99.9th percentile 1-hour average odour concentration contour plot for the existing plant, operating at the average production rate over 7am -12pm, (pink crosses indicate the active stacks)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

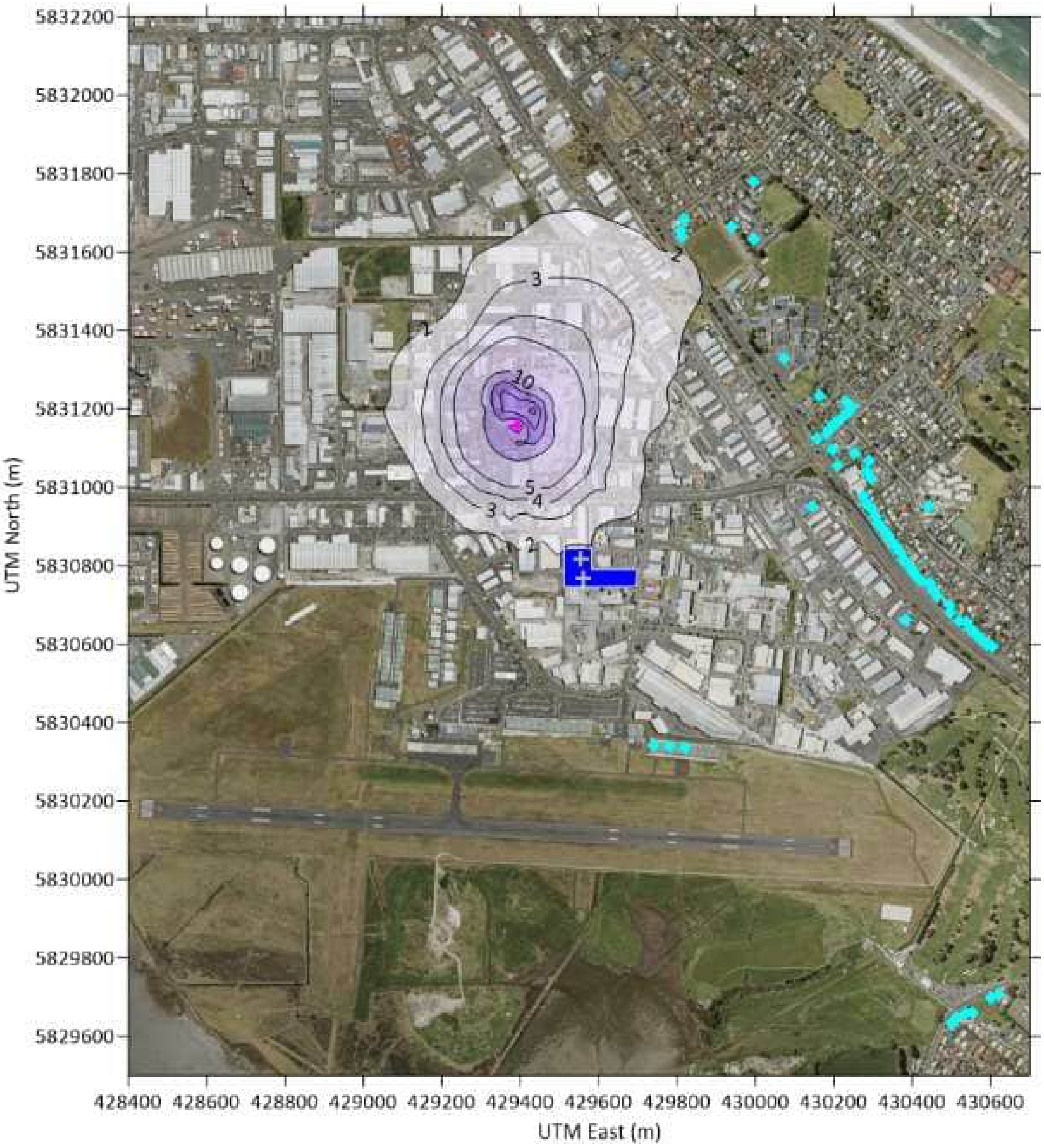

Figure Appendix E.7: 99.9th percentile 1-hour average odour concentration contour plot for the Higgins plant, operating at the average production rate over 7am -12pm (pink crosses indicate the active stacks)

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

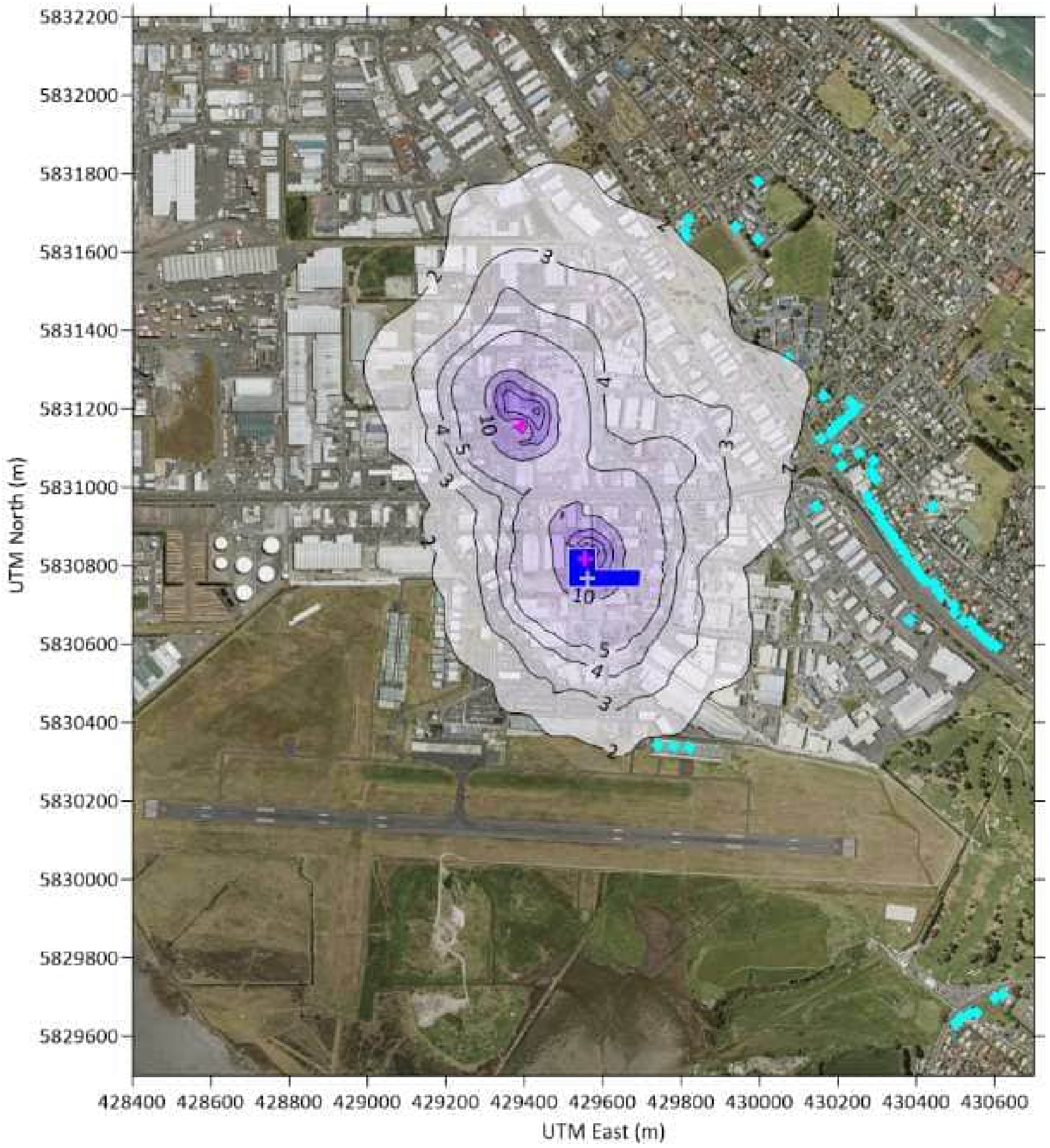

Figure Appendix E.8: 99.9th percentile 1-hour average odour concentration contour plot for the combined model results for the existing Allied plant and the Higgins plant, both operating at the average production rate over 7am -12pm (pink crosses indicate the active stacks)

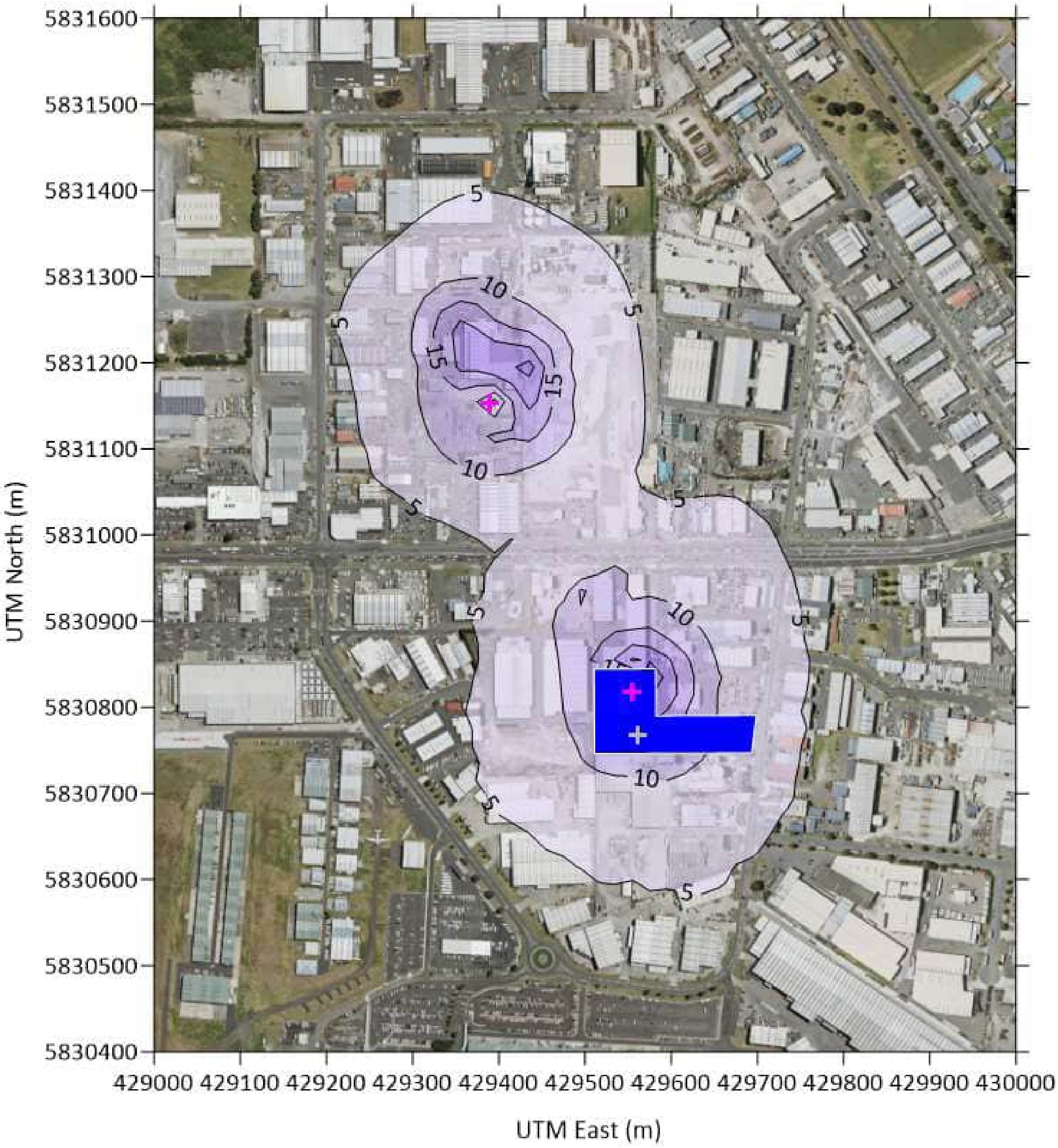

Figure Appendix E.9: 99.9th percentile 1-hour average odour concentration contour plot for the combined model results for the existing Allied plant and the Higgins plant, operating at the average production rate over 7am - 12pm (pink crosses indicate the active stacks) – close up of industrial area.

Aerial imagery: Imagery was captured for BOPLASS Ltd by AAM NZ Limited

Appendix F Field odour survey report

REPORT

Field Odour Survey Report

Prepared for
Fulton Hogan Limited
Prepared by
Tonkin & Taylor Ltd
Date
July 2021
Job Number
1016830.v1

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www.tonkintaylor.co.nz

Document Control

Title: Field Odour Survey Report					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
02/07/2021	1	Draft odour survey report	R. Turnwald	D. Vernall	J. Simpson

Distribution:

Fulton Hogan Limited	1 electronic copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

Table of contents

1 Introduction

Tonkin & Taylor Limited (T+T) has been engaged by Fulton Hogan Limited (Fulton Hogan) to undertake an odour monitoring survey in the surrounds of the Higgins Contractors Ltd asphalt manufacturing plant at 43 Peters Way, Silverdale (Higgins Silverdale). The Higgins Silverdale plant is similar in design to the proposed asphalt plant at Fulton Hogan's site at Higgins Road, Frankton, Hamilton.

A total of 12 odour monitoring events were completed between 10th June 2021 and 23rd June 2021. During 3 of the 12 odour monitoring events, the plant did not appear to be in operation. The results of the observations when the plant was not operating are not presented and have not been included in the analysis presented in this report. This report presents a summary of the findings from the odour monitoring events.

2 Objectives

The objective of the odour survey programme was to characterise odours from the Higgins Silverdale plant, which is a similar facility to that proposed for Fulton Hogan's Hamilton location.

The results of the odour surveys in the area surrounding the Higgins Peters Way asphalt manufacturing facility will be used to inform the assessment of odour effects for the Fulton Hogan Hamilton site. This will include the characterisation of the frequency, intensity, duration, offensiveness/character and location of odours from the Higgins Silverdale plant.

3 Odour monitoring method

The methodology for the odour survey programme is detailed in the Odour Survey Monitoring Plan (OSMP) (see **Appendix A**).

A summary of the methodology is provided below:

- A site visit was undertaken by field staff prior to conducting the monitoring to familiarise staff with the types of odours from the site.
- Monitoring was undertaken in downwind locations of the Higgins Silverdale plant at publicly accessible locations (i.e., public roads and walkways). Field monitoring routes were determined based on road and walkway locations and spaced at approximately 100 m intervals (where possible) from the site boundary up to a distance of 900 m).
- Monitoring was generally spread throughout the day (early morning (~ 6 am), morning (~9 am), midday/afternoon (~12 pm), and evening (~ 5 pm) to coincide with periods of peak production and/or weather conditions which are conducive to the transport of odour (calm and light wind conditions).
- At each location, monitoring was conducted over 10 minutes, with the field member sniffing the air and recording the findings every 10 seconds for a total of 60 odour samples (or observations). One ten-minute odour measurement constitutes a 'survey'.
- Odour strength and odour descriptions were recorded at each survey location.

The key odour descriptor used for asphalt manufacturing-related odours was the "tar-like, asphalt" odour (descriptor #29).

4 Monitoring locations

The monitoring locations are shown in Figure 4.1. Targeted monitoring followed a route that incorporated the following locations, depending on wind direction:

- Northerly winds (Route 1): targeting monitoring locations to the south of the site (T1, T2, T3 and T4).
- North easterly winds (Route 2): targeting monitoring locations to the southwest of the site (T5, T6 and T15).
- Easterly winds (Route 3): targeting monitoring locations to the west of the site (T10, T11, T12, T13, T14 and T15)
- South easterly winds (Route 4): targeting monitoring locations to the northeast of the site (T16, T17, T18, T19, T20 and T21).
- Southerly winds (Route 5): targeting monitoring locations to the north of the site (T22, T23, T24, T25 and T26).
- South westerly winds (Route 6): targeting monitoring locations to the northeast of the site (T27, T28, T29, T25 and T30).
- Westerly winds (Route 7): targeting monitoring locations to the east of the site (T8).
- North westerly winds (Route 8): targeting monitoring locations to the southwest of the site (T9).

Field staff started the surveys at the farthest locations on each route, moving sequentially closer to the Higgins Silverdale site to minimise the risk of desensitising the nose by exposure to the most intense odours first.

If odours were detected during the targeted monitoring at specific locations, then the odour survey would switch to the Plume method to evaluate the width and extent of the odour plume.

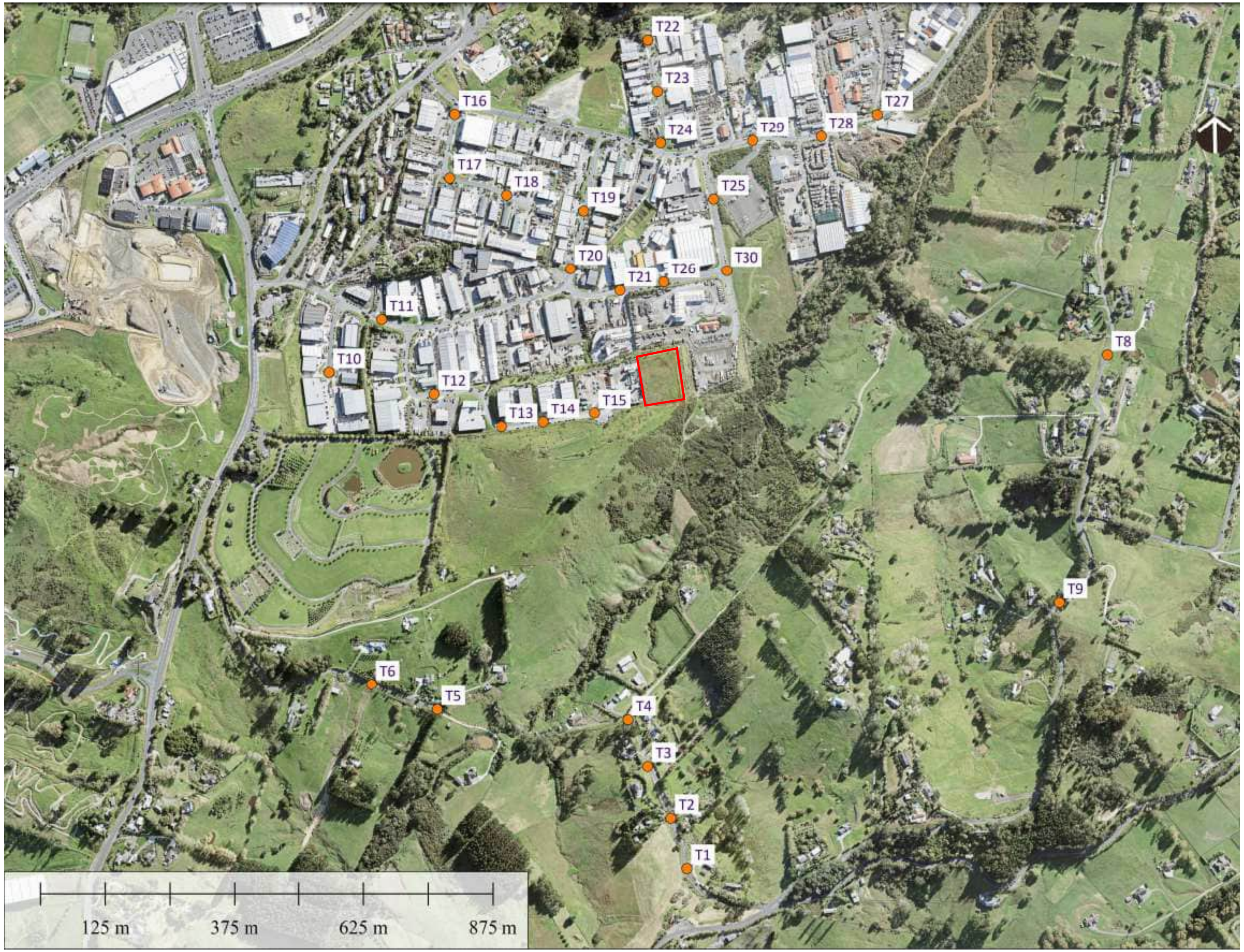

Figure 4.1: Targeted off site monitoring locations (T#). Higgins Silverdale site boundary indicated in red.

5 Monitoring results

5.1 Introduction

This section of the report is structured as follows:

- Section 5.2 evaluates the frequency of positive odour observations at each monitoring location.
- Section 5.3 evaluates the intensity of odours during hours where there was a positive odour observation.

All monitoring was conducted using the targeted monitoring method. The few occasions where an asphalt odour was identified, the odour was intermittent and had not been identified at the previously surveyed location (more distant from the site), so plume monitoring was not undertaken.

5.2 Frequency of odour hours

In accordance with the method recommended in EN 16841-1:2016[1], each ten-minute measurement (survey) has been evaluated to determine whether it constitutes an 'odour hour' for each odour type. A single measurement counts as an odour hour when the percentage odour time (for that odour) reaches or exceeds 10 %, i.e., a recognizable odour is observed in at least 6 out of 60 observations, made at ten-second intervals within a ten-minute measurement duration.

The odour hour frequency for each odour type at a particular location is the number of "positive" odour hours divided by the total number of surveys undertaken at that location.

Table 5.1 documents the incidence of odour hours at the targeted off-site monitoring locations. The targeted locations have been grouped by the distance of the monitoring location from the site boundary.

It is important to note that this analysis does not consider the intensity of odours that were detected. The intensity of odours is discussed in the following section.

The key findings in relation to the frequency of odours hours (of any intensity) are that:

- There were 4 occasions out of 31 surveys where asphalt odour was present at a targeted downwind monitoring site.
- The maximum distance from the site at which a survey recorded odours with an asphalt character that met the odour hour threshold was 300 m.

[1] EN 16841-1:2016 Ambient air – Determination of odour in ambient air by using field inspection – Part 1: Grid method.

Table 5.1: Odour hour frequency

Distance (m)	100	150	200	300	400	500	600	700	800	900
Locations	**T15**	**T21, T26**	**T14, T20, T30**	**T13, T19, T25**	**T24, T29**	**T11, T17, T23, T28**	**T4, T10, T16, T22, T27**	**T3**	**T2, T6, T8, T9**	**T1**
No. of monitoring events[1]	1	2	4	3	3	3	6	2	6	1
Odour hours - Tar-like, asphalt (#29)	1 (100%)	1 (50%)	1 (25%)	1 (33%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

1. Does not include monitoring events when the Higgins Silverdale plant was observed to be inactive.

5.3 Odour intensity

EN 16841-1:2016 does not cover the measurement of the intensity of ambient odours, therefore a modified form of the guidance in the German standard VDI 3940 Part 3[2] has been used.

VDI 3940 Part 3 sets out a method whereby the odour intensity is characterised in the field by two values that are assigned at the end of the 10-minute period:

a The maximum odour impression over the 10-minute period (on a scale of 1 to 6); and

b The average odour impression over the 10-minute period recorded as a whole-number value, representing the overall impression of odour.

For this survey, the observers were asked to record the odour intensity separately for each 10-second observation period. In order to evaluate this data in a manner broadly consistently with the recommended method, two values have been recorded for each 'odour hour' – the highest recorded intensity in any 10-second period and the average of the intensity values, ignoring the intervals with no recognisable odour, rounded to the nearest whole number.

Bar graphs of the intensity of odours recorded for asphalt production odour hours at the targeted downwind monitoring locations are shown in the following figures (Figure 5.1 and Figure 5.2).

The average intensity of odours identified as having an 'asphalt' character was 'Weak' (2 on the VDI 3940 Part 3 odour intensity scale). The maximum observation intensity of 'Strong' (4) was recorded at 200 m and 300 m from the plant boundary.

[2] VDI 3940 Part 3: Measurement of odour impact by field inspection - Determination of odour intensity and hedonic odour tone.

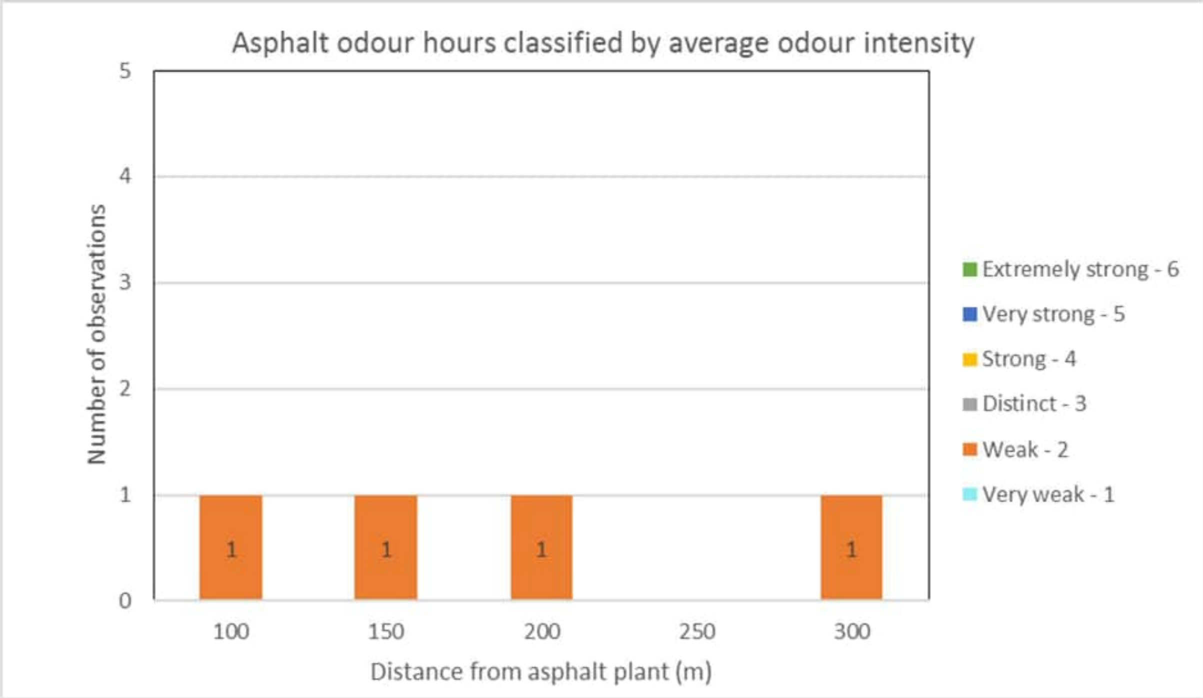

Figure 5.1: Asphalt production odour hours classified by average intensity

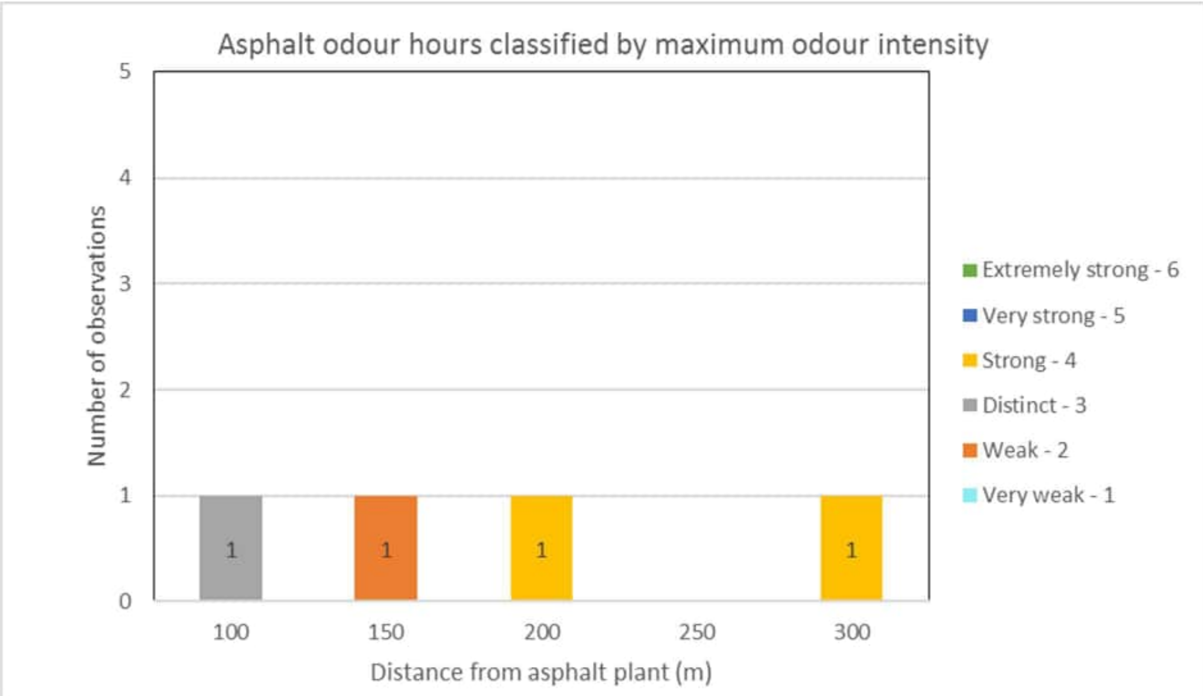

Figure 5.2: Asphalt production odour hours classified by maximum intensity

6 Conclusions

- Out of 31 odour surveys carried out at a variety of downwind locations, only 4 surveys were identified as 'odour hours' with the presence of asphalt odour.
- Odour hours were detected up to 300 m from the boundary of the Higgins Silverdale site.
- The average intensity of observations with an asphalt character during odour hours was 'Weak' (2).
- The maximum intensity of observations with an asphalt character during odour hours was 'Strong' (4).

7 Applicability

This report has been prepared for the exclusive use of our client Fulton Hogan Limited, with respect to the particular brief given to us and 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.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Rose Turnwald	Jenny Simpson
Environmental Engineer	Project Director

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Appendix A: Odour Survey Monitoring Plan

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REPORT

Tonkin+Taylor

Odour Survey Monitoring Plan

Peters Way, Silverdale

Prepared for
Fulton Hogan Limited
Prepared by
Tonkin & Taylor Ltd
Date
June 2021
Job Number
1016830.1000

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Document Control

Title: Odour Survey Monitoring Plan					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
10/06/2021	1	Odour Survey Monitoring Plan	R Turnwald	D Vernall	J Simpson

Distribution:

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1 Introduction

1.1 Overview

Tonkin & Taylor Limited (T+T) has been engaged by Fulton Hogan Limited (Fulton Hogan) to undertake field odour monitoring surveys in the surrounding area of Higgins Contractors Limited (Higgins) asphalt plant at 47 Peters Way, Silverdale as part of the investigations into the odour effects for Fulton Hogan's Hamilton site redevelopment.

This Odour Survey Monitoring Plan (OSMP) has been developed to document the monitoring methodology which will be adopted by all field members undertaking the odour survey.

1.2 Objectives

The objective of the odour survey is to determine the extent in which odours are observed from the Higgins Peters Way asphalt manufacturing facility, which is a similar facility as that proposed for Fulton Hogan's Hamilton location. The results of the odour survey in the area surrounding the Higgins Peters Way asphalt manufacturing facility will be used to inform the assessment of odour effects for the Fulton Hogan Hamilton site.

This will include the characterisation of the frequency, intensity, duration, offensiveness/character and location of odours from 47 Peters Way.

1.3 Guidance documents

The monitoring programme described in this OSMP has been developed based on:

- *European Standard EN16841-2: Ambient Air – Determination of odour in ambient air by using field inspection – Part 2: Plume method*. European Committee for Standardisation (CEN). November 2016.
- *AS/NZS 4323.3:2001 Stationary source emissions – Determination of odour concentration by dynamic olfactometry.* Standards Australia and Standards New Zealand, September 2001.

The measurement approach is based on the stationary plume method set out in EN 16841-2:2016, however has been modified for reasons of practicality. The main deviation from the standard is that only one field member will be generally used for each survey round. Therefore, plume transect measurements will not be undertaken simultaneously. This approach has been adopted as the required density of odour measurements, the practicality of multiple field staff attending site and the cost associated with this could not be justified.

Additionally, as the observations will be undertaken in an established industrial area, monitoring of transects to determine the width of plumes may not be possible.

1.4 Project members

The project team structure is summarised in Table 1.1.

At any one time, one field member will be undertaking the odour survey. The Project Director, Project Manager and Technical Reviewer will be available to assist remotely, if needed by the field member.

Table 1.1: Project team

Role	Project member	Contact details
Project Director	Jenny Simpson (T+T)	027 704 7842
Project Manager	Dylan Vernall (T+T)	021 585 765
Technical Reviewer	Jason Pene (T+T)	021 061 2142
Field Members	Rose Turnwald (T+T)	021 0252 4455
	Kayla Fairbairn (T+T)	021 048 7335
	Robyn Butler (T+T)	022 025 8427
Client Contact	Mason Jackson (Mitchell Daysh)	027 230 8567

2 Site information

2.1 Location and operating hours

The site is located at 47 Peters Way, Silverdale, Auckland.

Asphalt manufacturing operations occur between on a 24-hour basis, seven days per week. Trucks may arrive on-site for deliveries at any time (day or night shift).

2.2 Odour sources on-site

The Higgins site operates a natural gas fired batch mix asphalt plant with the capacity to process 240 tonnes per hour (tph). The asphalt batch plant mixes aggregate, lime and bitumen in controlled proportions to produce asphalt for road surfacing.

The sources on-site which have the potential to generate odours include (but may not be limited to):

- Hot-mix asphalt manufacturing. Odours may be vented from the baghouse stack and during loadout into trucks.
- Venting of volatile organic compounds from hot bitumen storage tank breathers.
- Kerosene and diesel dispensing.
- Storage of recycled asphalt product (RAP).

Of those sources the batching plant is likely to be the predominant odour source, and odour generated from the batching plant is influenced the temperature of the mix and the percentage of RAP used in the mix.

2.3 Surrounding land use

The Higgins asphalt plant is located in a Heavy Industry zone and is bordered by Light Industry zoned sites to the south, and Rural – Countryside Living zoned land to the southeast.

A number of other odour sources may be present within the wider Silverdale industrial area, notably:

- Manufacturing and construction activities.
- Food production and breweries.
- Compost, greenwaste handling and garden supply centres.
- A refuse transfer and waste handling facility.
- Automotive engineers and panel-beaters.

Generally, odours from these activities are unlikely to be cumulative with those from the Higgins Asphalt plant.

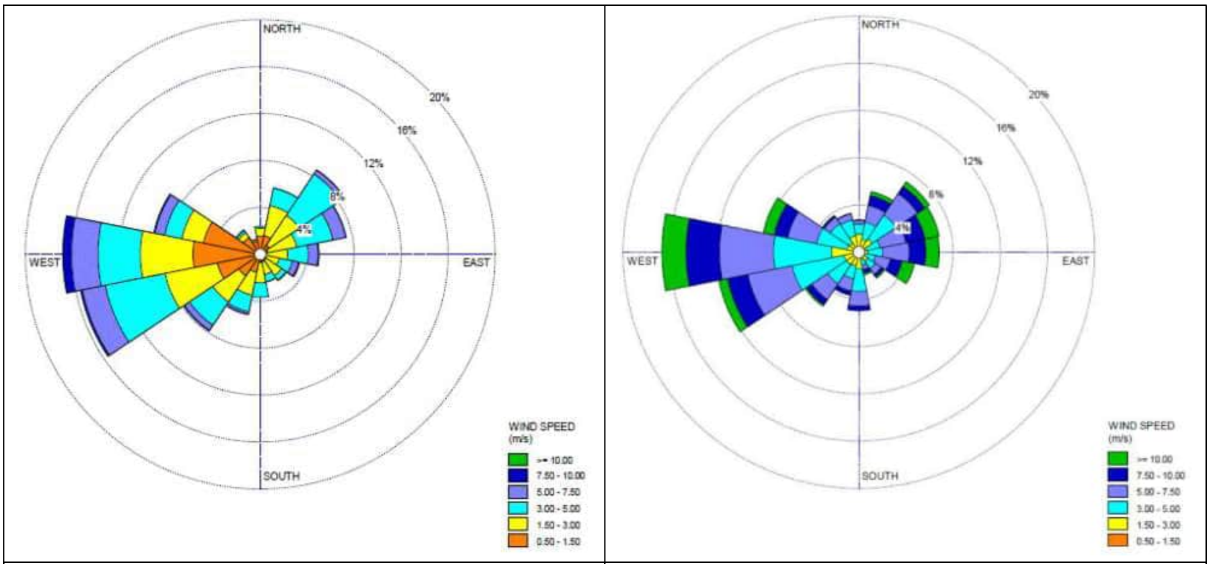
The nearest asphalt plant to the Higgins Asphalt Plant is the Fulton Hogan North Shore asphalt plant (40 Flexman Place), located around 930 m north of the Higgins Asphalt Plant. It is unlikely that at this distance cumulative impacts will occur. However, if odours are present, validation of the odour source by checking wind direction should be completed.

The large lots of privately owned rural land to the south and east of the site make access to suitable monitoring locations difficult.

2.4 Meteorology

There is no publicly available meteorological monitoring data for the Silverdale area. Wind directions measured at the Whangaparaoa and Albany weather stations are likely to be broadly representative of regional wind flows. Winds measured at these locations indicate the predominant wind directions are from the western quadrant, with a secondary prevalence of winds from the northeast quadrant. Wind speeds are likely to be similar to those at Albany.

The Higgins Peters Way site is located within an area of complex terrain, and local valleys may influence the direction of winds in the surrounding area. For this reason, observations of wind speed and direction will be taken at the start and end of each survey.



Albany weather station	Whangaparaoa weather station

Figure 2.1: Wind roses for the Albany and Whangaparaoa weather station, 2007, 1-hour average data. Derived from 'AECOM New Zealand Limited. "Assessment of Air Quality Effects for Higgins Silverdale Asphalt Plant". 11 March 2019.'

3 Odour monitoring methodology

3.1 Field member requirements

Field members undertaking field monitoring work will require the following equipment:

- Field sheets and map showing the monitoring locations.
- Job safety analysis (JSA), high vis and steel cap boots.
- Global positioning system (GPS) to record monitoring locations.

Prior to undertaking a monitoring event, all field members will observe the following:

- No smoking or vaping for a minimum of 1 hour before starting odour measurements.
- No eating or drinking (except for unflavoured water) for a minimum of 1 hour before starting odour measurements.
- Will not be exposed to strong odours or work in an odorous environment for at least one day prior to monitoring.
- Will not wear odorous cosmetics, perfumes, deodorants, insect repellent etc on the day of monitoring.

Any member who cannot meet the above criteria, or has a cold, blocked nose or other ailment that would affect the odour measurement, will not take part in monitoring until they are well enough to proceed.

3.2 Monitoring type

The monitoring undertaken as part of this OSMP will be targeted monitoring. This is stationary monitoring to monitor odour at targeted locations based on wind direction and 'informal' dynamic monitoring to identify the rough extent of any odour plume.

3.3 Targeted monitoring

3.3.1 Proposed monitoring locations

Table 3.1 shows the proposed locations for boundary and targeted monitoring and their corresponding coordinates. **Appendix B** provides the overview map showing all the proposed locations.

Table 3.1 Coordinates of proposed monitoring locations

Survey point[1]	Distance from Higgins Asphalt plant (m)	Latitude	Longitude	Downwind of Higgins Plant during wind direction:
T1	900	-36.6351	174.6817	N
T2	800	-36.6342	174.6814	N
T3	700	-36.6333	174.6809	N
T4	600	-36.6325	174.6805	N
T5	700	-36.6323	174.6764	NE
T6	750	-36.6318	174.675	NE
T8	800	-36.6264	174.6911	W
T9	800	-36.6307	174.6899	NW
T10	600	-36.6263	174.6743	E
T11	500	-36.6254	174.6754	E
T12	400	-36.6268	174.6765	E
T13	300	-36.6274	174.678	E
T14	200	-36.6273	174.6789	E
T15	100	-36.6272	174.68	E and NE
T16	600	-36.6219	174.6771	SE

Survey point[1]	Distance from Higgins Asphalt plant (m)	Latitude	Longitude	Downwind of Higgins Plant during wind direction:
T17	500	-36.623	174.677	SE
T18	400	-36.6233	174.6782	SE
T19	300	-36.6236	174.6799	SE
T20	200	-36.6246	174.6795	SE
T21	150	-36.625	174.6806	SE
T22	600	-36.6207	174.6813	S
T23	500	-36.6216	174.6815	S
T24	400	-36.6225	174.6815	S
T25	300	-36.6235	174.6827	S and SW
T26	150	-36.6249	174.6815	S
T27	600	-36.6221	174.6862	SW
T28	500	-36.6224	174.685	SW
T29	420	-36.6225	174.6835	SW
T30	200	-36.6247	174.6829	SW

1 T7 has been removed as it was determined to be inaccessible.

These proposed locations take into account:

- Accessible locations for field members to carry out surveys. These locations will be on public roadways, or on private properties where access is agreed.
- Safety for the field member to stand unobstructed and away from traffic and other interferences during the survey.

The distance of the furthest proposed locations is up to 900 m from the asphalt plant boundary. It is anticipated that odours associated with the plant are unlikely to be detected at distances greater than 1 km.

The proposed locations will be inspected in an initial odour survey for safety and suitability. If there are any changes to the proposed locations, the coordinates of the new monitoring location will be determined using GPS and recorded on the measurement field sheet.

3.3.2 Checking wind conditions

Prior to commencing odour monitoring, the field member will check the Metservice website for the latest observations at Whangaparaoa weather station, accessed at the following website:

- https://www.metservice.com/weather-station-location/93103/whangaparaoa-peninsula

At each monitoring location, the field member will record observations of wind speed and direction using the Beaufort Scale as shown in Table 3.2 below. Monitoring will not occur in conditions that exceed the Beaufort number 5.

Table 3.2: Beaufort scale for meteorological condition classification on location

Beaufort number	Description	Speed (km/h)	Visual Clues and Damage Effects
0	Calm	Calm	Calm wind. Smoke rises vertically with little if any drift.
1	Light Air	1 - 5	Direction of wind shown by smoke drift, not by wind vanes. Little if any movement with flags. Wind barely moves tree leaves.
2	Light Breeze	6 - 10	Wind felt on face. Leaves rustle and small twigs move. Ordinary wind vanes move.
3	Gentle Breeze	11 - 20	Leaves and small twigs in constant motion. Wind blows up dry leaves from the ground. Flags are extended out.
4	Moderate Breeze	21 - 30	Wind moves small branches. Wind raises dust and loose paper from the ground and drives them along.
5	Fresh Breeze	31 - 40	Large branches and small trees in leaf begin to sway. Crested wavelets form on inland lakes and large rivers.
6	Strong Breeze	41 - 50	Large branches in continuous motion. Whistling sounds heard in overhead or nearby power and telephone lines. Umbrellas used with difficulty.
7	Near Gale	51 - 60	Whole trees in motion. Inconvenience felt when walking against the wind.
8	Gale	61 - 75	Wind breaks twigs and small branches. Wind generally impedes walking.

3.3.3 Targeted monitoring

Targeted monitoring will be undertaken to identify the absence/presence of an odour plume and, secondly, the rough extent of any plume. The reconnaissance will take into account the wind directions from at the nearest station and on-site observations during the boundary monitoring.

The monitoring will follow a route that incorporates 10-minute odour observations at the following targeted locations, depending on wind direction:

- Northerly winds (Route 1): targeting monitoring locations to the south of the site (T1, T2, T3 and T4)
- North easterly winds (Route 2): targeting monitoring locations to the southwest of the site (T6, T5 and T15).
- Easterly winds (Route 3): targeting monitoring locations to the west of the site (T10, T11, T12, T13, T14 and T15).
- South-easterly winds (Route 4): targeting monitoring locations to the northwest of the site (T16, T17, T18, T19, T20 and T21)
- Southerly winds (Route 5): targeting monitoring locations to the north of the site (T22, T23, T24, T25 and T26).
- South-westerly winds (Route 6): targeting monitoring locations to the northeast of the site (T27, T28, T29, T25 and T30)
- Westerly winds (Route 7): targeting monitoring locations to the east of the site (T8)
- North-westerly winds (Route 8): targeting monitoring locations to the southeast of the site (T9)

Observations should occur in the order listed in the bullets above, so that the first observation is at approximately 600 m from the plant, with each observation moving closer to the source. If odour is detected at the first location (furthest from the source), plume monitoring will be undertaken using the method set out in the following sub-section.

If an odour plume is not identified in the targeted monitoring reconnaissance, the field survey is complete.

3.4 Odour plume extent

It is anticipated that the distance of the furthest targeted locations is likely to encompass the reach of any odour plume originating at the site. However, if odour is detected at the furthest survey locations, the field team will add further downwind locations as appropriate until odour is no longer detected.

For this study, monitoring of the extent of the plume may be constrained by safe access, particularly at locations to the southeast of the site. It is therefore unlikely that the recommended minimum of 20 odour measurement points and 6 transition points (absence/presence) in *EN16841-2:2016* will be achievable for a full transect plume investigation.

When monitoring occurs at a location not included on the targeted monitoring plan, the GPS coordinates of where the observation was undertaken will be recorded.

3.5 Monitoring frequency

There will be at least 12 monitoring events, with a monitoring event scheduled every day for approximately 2 weeks, starting on Monday 06 June 2021 and ending Friday 18 June 2021.

Each monitoring event can be carried out within any of the three time slots of the day, to provide a spread throughout the day corresponding to activity patterns of sensitive receptors and diurnal changes in weather conditions.

Accordingly, each monitoring event will be timed to occur starting at approximately:

Table 3.3: Overview of proposed monitoring schedule

Start time	Category	Activity	Target number of monitoring events
6:00 am	Early morning	To coincide with asphalt production in typically calm and light wind conditions.	3
9:00 am	Morning	To coincide with the loading of asphalt mix to trucks for transport to infrastructure projects and delivery of bitumen to site.	3
12:00 pm	Midday/afternoon	To coincide with asphalt production and product transfers during typically moderate wind conditions.	3
5:00 pm	Evening	To coincide with site activities during typically reduced windspeed conditions.	3

The intention of the overall monitoring frequency is to have three sessions in each category with a spread of prevailing wind directions across the 12 monitoring events, where possible.

4 Methodology

4.1.1 Odour field observations

The following procedure is based on adaptation of *EN 16841-2:2016* to the site/local circumstances, and will be followed when conducting the odour monitoring at each location:

- Upon arriving at the location, field member will turn the car off, exit the vehicle and move up wind of the car to determine whether an odour is present at the location. Monitoring at each location will be carried out for 10 minutes.
  - Field member will sniff the air every 10 seconds, and if odour is present, record the identified odour descriptor (**Section 4.1.3**) on the field sheet (**Appendix A**).
  - It is noted that at each 10-second interval, the field member assesses only the individual breath of air and not the odour impression gained during the preceding 10 seconds.
  - In the event of disturbances during individual odour assessments within the 10 minutes, samples can be added immediately afterwards at 10 second intervals.
  - At the end of each 10-minute single measurement duration, the field member would have assessed 60 odour samples.
- If an odour is present:
  - The strength of the odour will be assessed, in accordance with **Section 4.1.2**.
  - The characteristics of the odour will be assessed, in accordance with **Section 4.1.3**.
  - A note of the time, weather conditions and any other observations that would be useful to identify the odour source.
  - Once all relevant details have been recorded, the field member will return to the vehicle and proceed to the next monitoring point, following the same procedure as described above.
- If the odour is assessed as recognisable and considered to be from the site, the distance to which the site odour has travelled will be assessed.

During each monitoring event, field member will record the ambient air temperature, wind speed and wind direction at each survey location.

Any significant changes in weather conditions will be recorded (i.e., significant changes in wind speed and/or wind direction) along with the approximate time of the change.

At the completion of the field works, field member will provide all records to the Project Manager.

4.1.2 Assessing odour strength

The strength of an odour will be assessed in accordance with **Table 4.1**.

Table 4.1 Odour strength categorisation

Scale	Description	Criteria
6	Extremely Strong	The odour is likely to be offensive, and an instinctive reaction would be to mitigate against further exposure.
5	Very Strong	Odour at this level is likely to be undesirable.
4	Strong	The odour character is easily recognisable.
3	Distinct	The odour character is barely recognisable.
2	Weak	The odour is present but cannot be described using precise words or terms.
1	Very weak	There is probably some doubt as to whether an odour is present.
0	Not Perceptible	No odour or odour below the recognition threshold.

4.1.3 Odour descriptors

Where identifiable, the characteristics of the odour will be described by using one or more of the following descriptors, as listed in **Table 4.2**.

Table 4.2 Odour descriptors

No.	Descriptor	No.	Descriptor
01	Fragrant	22	Rubbish
02	Perfume	23	Compost
03	Sweet	24	Silage
04	Fruity	25	Sickening
05	Bakery (fresh bread)	26	Musty, earthy, mouldy
06	Coffee-like	27	Sharp, pungent, acid
07	Spicy	28	Metallic
08	Meaty (cooked)	29	Tar-like, asphalt
09	Sea/marine	30	Oil, fatty
10	Herbal, green, cut grass	31	Petrol, diesel, kerosene, solvents
11	Bark-like	32	Fishy
12	Woody, resinous	33	Putrid, foul, decayed
13	Medicinal	34	Paint-like
14	Burnt, smoky	35	Rancid
15	Soapy	36	Sulphur-like, rotten egg
16	Garlic, onion	37	Dead animal
17	Cooked vegetables	38	Manure
18	Chemical	39	Sewer
19	Ether-like, anaesthetic	40	Dust
20	Sour, acrid, vinegar	41	Concrete or cement
21	Raw meat, blood-like	42	Other (describe)

5 Applicability

This report has been prepared for the exclusive use of our client Fulton Hogan Limited, with respect to the particular brief given to us and 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.

Tonkin & Taylor Ltd

Report prepared by:

....

Rose Turnwald

Environmental Engineer

Authorised for Tonkin & Taylor Ltd by:

....

Jenny Simpson

Project Director

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p:\1016830\issueddocuments\field odour survey report\210609 odour survey monitoring programme.docx

Appendix A: Field Sheet templates

Odour Monitoring Field Record - Reconnaisance & Targeted Monitoring (Page 1)

Project: Fulton Hogan Odour Observations
Job No: 1016830

Field Member: ____________________
Monitoring Date: ____________________

Prevailing Wind Conditions

Time: ____________________
Wind Speed (beaufort scale): ____________________
Wind Direction: ____________________ **(indicate on map)**
Nominated Route (based on wind): ____________________

Legend:

Northerly winds (Route 1): T1, T2, T3, T4

North easterly winds (Route 2): T6, T5, T15

Easterly winds (Route 3): T10, T11, T12, T13, T14 and T15

South-easterly winds (Route 4): T16, T17, T18, T19, T20 and T21

Southerly winds (Route 5): T22, T23, T24, T25 and T26

South-westerly winds (Route 6): T27, T28, T29, T25 and T30

Westerly winds (Route 7): T8

North-westerly winds (Route 8): T9

Remarks:

Tonkin+Taylor

Odour Monitoring Field Record - Reconnaisance & Targeted Monitoring (Page 2)

Project: Fulton Hogan Odour Observations

Job No: 1016830

Field Member: ______________________

Weather: ______________________

Monitoring Route #: ______________________

Monitoring Date: ______________________

#	Location ID	Time Start	Time End	Latitude (S)	Longitude (E)	Other Comments/Observations	Weather Observations				
							Wind Speed Beaufort	Wind Direction	Temp (°C)	Atmos. Pressure* (hPa @ MSL)	Comments
1											
2											
3											
4											
5											
6											

* Taken from Whangaparaoa Weather Station

#1 Observations - Absence/ Presence of Odour

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

#2 Observations - Absence/ Presence of Odour

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

Odour strength (OS)

- 0 - No odour
- 1 - Very weak
- 2 - Weak
- 3 - Distict
- 4 - Strong
- 5 - Very Strong
- 6 - Extremely strong

Odour descriptors (OD)

See Table 3.3 for descriptor #

#3 Observations - Absence/ Presence of Odour

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

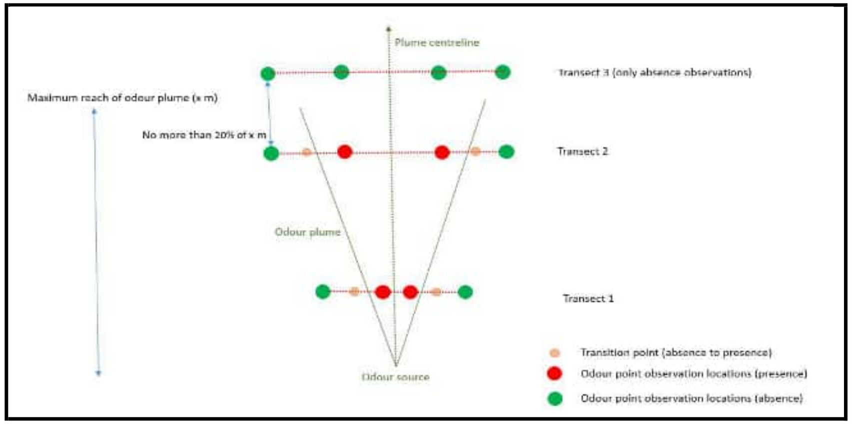
#4 Observations - Absence/ Presence of Odour

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

Odour Monitoring Field Record - Stationary Plume Monitoring (Page 1)

Project: 1016830
Job No: Fulton Hogan Odour Observations

Field Member:
Monitoring Date:
Monitoring Route #:



#	Transect #	Location #	Time Start	Time End	Latitude (S)	Longitude (E)	Other Comments/Observations	Weather Observations				
								Wind Speed m/s	Wind Direction	Temp (°C)	Atmos. Pressure* (hPa @ MSL)	Comments
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

* Taken from Whangaparaoa Weather Station

Remarks:

Odour Monitoring Field Record - Stationary Plume Monitoring (Page 2)

Tonkin+Taylor

Project: Fulton Hogan Odour Observations
Job No: 1016830
Field Member: ______________________
Weather: ______________________

Monitoring Route #: ______________________
Monitoring Date: ______________________

#1 Observations

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

#2 Observations

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

Odour strength (OS)

0 - No odour
1 - Very weak
2 - Weak
3 - Distict
4 - Strong
5 - Very Strong
6 - Extremely strong

Odour descriptors (OD)

See Table 3.3
for descriptor #

#3 Observations

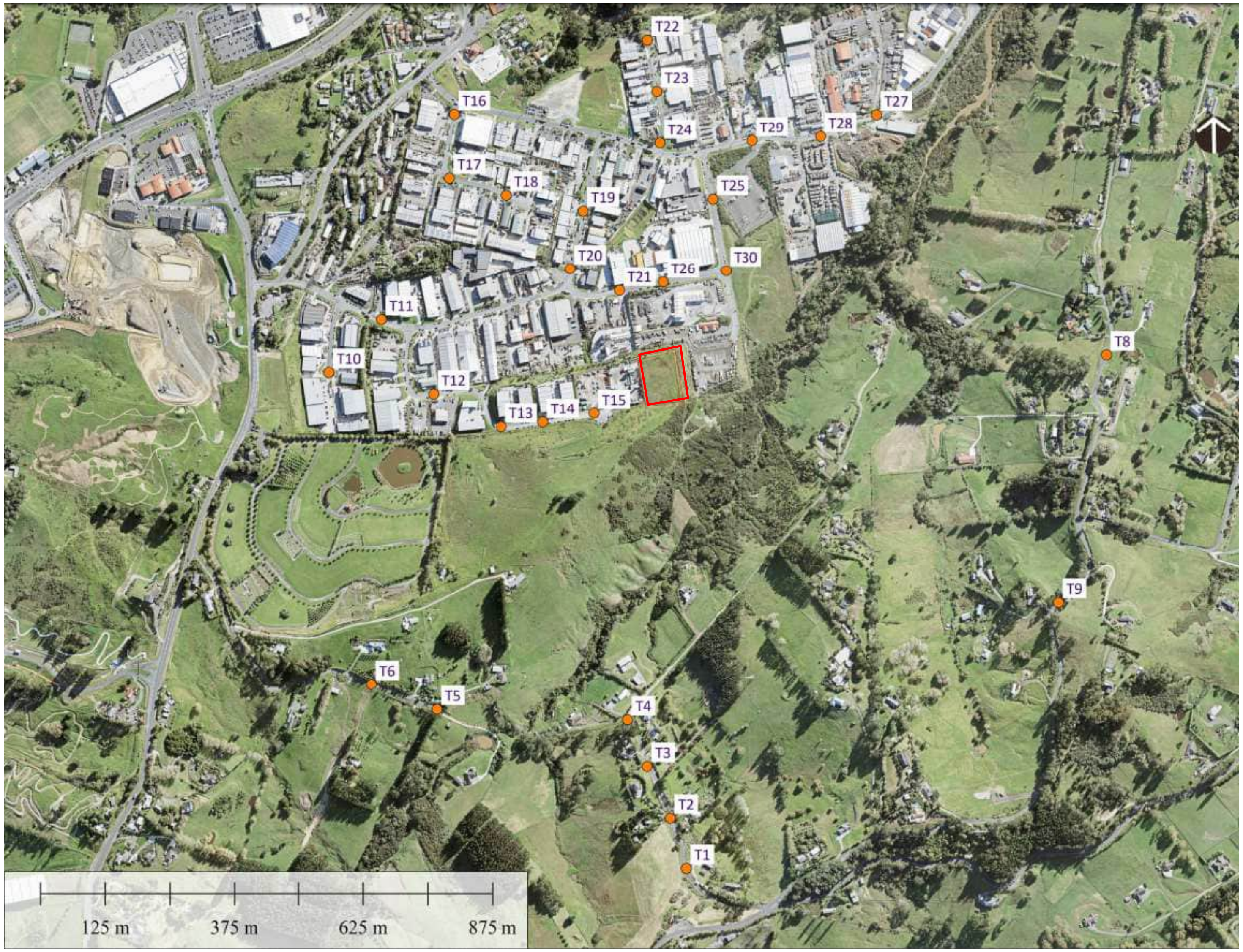
Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

#4 Observations

Minute							
Minute 1	OS						
	OD						
Minute 2	OS						
	OD						
Minute 3	OS						
	OD						
Minute 4	OS						
	OD						
Minute 5	OS						
	OD						
Minute 6	OS						
	OD						
Minute 7	OS						
	OD						
Minute 8	OS						
	OD						
Minute 9	OS						
	OD						
Minute 10	OS						
	OD						

Remarks:

Appendix B: Monitoring Locations



Appendix B Figure 1: Targeted off site monitoring locations (T#). Higgins Silverdale site boundary indicated in red.

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Appendix B: Monitoring event summaries

D
R
A
F
T

Appendix B Table 1: Summaries of monitoring events [1] [2]

Event no.	Date	General wind direction/ wind speed [3]	Targeted locations monitored	Odour similar to asphalt plant sources [4]	Other comments
1	10/06/21 12:53 pm – 1:37 pm	NE/E Moderate	• T10, T13, T15	• Asphalt odour (#29) detected at T13 (19 out of 60 observations) and T15 (14 out of 60 observations)	• Smoke (#14), grass (#10) and chemical smell associated with glass manufacture (#18) were detected at T10 • Smoke (#14) and a metallic (#28) odour associated with nearby metal works • Sewer (#39) odour associated with construction • Dust detected (#40) • Truck exhaust (#31) detected at T13
2	11/06/21 4:41 pm – 5:37 pm	NE/E Light winds	• T6, T5 T14, T15	• No odours associated with the asphalt plant were detected.	• No activity observed at Higgins Silverdale plant, presumed closed. • Grass (#10), bark (#11) and earth (#26) detected at T6 • Wood resin (#12) and smoke (#14) detected at T5 • Truck exhaust (#31) and smoke (#14) detected at T14 and T15
3	12/06/21 6:25 am – 7:26 am	E Light winds	• T10, T12, T13, T14, T15	• No odours associated with the asphalt plant were detected.	• Higgins Silverdale plant gates shut – likely inactive. • Metallic (#28) odour detected at T10 • Rubbish (#22) odour detected at T12 • Metallic (#28) and smoke (#14) odours detected at T13, T14, T15 • Vehicle exhaust (#31) detected at T15
4	14/06/21 9:20 am – 9:59 am	N/NE Light	• T2, T3, T4	• No odours associated with the asphalt plant were detected.	• Grass/pine (#10) detected at T2, T3 and T4 • Smoke (#14) from domestic heating detected at T3
5	15/06/21 9:35 am – 10:25 am	N Light-moderate	• T1, T2, T3, T4	• No odours associated with the asphalt plant were detected.	• Grass/pine (#10) and smoke (#14) detected at T2, T3 and T4 • Earthy (#26) odour detected at T4
6	15/06/21 5:01 pm – 5:35 pm	W Moderate	• T8, T30	• No odours associated with the asphalt plant were detected.	• Sweet chemical odour (#3 and #18) like liquorice and exhaust fume (#31) at T30
7	16/06/21 6:12 am – 6:38 am	W Light	• T8 and T9	• No odours associated with the asphalt plant were detected.	• Grass (#10) and bark (#11) odours detected at both T8 and T9
8	17/06/21 9:40 am – 10:15am	W Light winds	• T8, T30	• Asphalt odour (#29) detected at T8 (5 weak readings)	• Grass/pine (#10) and smoke (#14) detected at T8 • Smoke (#14 and #42) and Grass/pine (#10) detected at T30

Event no.	Date	General wind direction/ wind speed [3]	Targeted locations monitored	Odour similar to asphalt plant sources [4]	Other comments
9	21/06/21 9:05 am – 10:11 am	S Light-moderate	• T22, T23, T24, T25, T26	• Asphalt (#29) detected at T24 (3 weak observations out of 60)	• Paint (#34), garlic (#16) and smoke (#14) detected at T22 • Rubbish (#22), smoke (#14) and exhaust (#31) detected at T23 and T24 • Grass (#10) and concrete (#41) detected at T25 • Coffee (#06), grass (#10) pies (#08) and exhaust fume (#31) detected at T26
10	21/06/21 11:56 am – 12:59 pm	SW Light-moderate	• T27, T28, T29, T25, T30	• Asphalt (#29) detected at T30 (12 out of 60 observations)	• Bark (#11) and wood resin (#12) detected at T27 and T28 • Rubbish (#22) and compost (#23) also detected at T27 • Smoke (#14) and grass (#10) detected at T29, T25 and T30, with dust (#40) also at T25
11	22/06/21 12:15 pm – 1:19 pm	SW Moderate	• T27, T28, T29, T25, T30	• No odours associated with the asphalt plant were detected.	• Plant does not appear to be operating • Bark (#11) and wood resin (#12) odours detected at T27 • Rubbish (#22), exhaust fume (#31) and dust (#40) detected at T28 • Exhaust fume (#31) odour detected at T29 • Paint (#34) and recreational smoke (#42) detected at T25 • Grass (#10) odour detected at T29, T25 and T30
12	23/06/2021 5:05 pm – 6:11 pm	SE Light	• T16, T17, T18, T20, T21	• Asphalt (#29) detected at T30 (16 weak observations out of 60) • One weak asphalt (#29) observation out of 60 at T18	• Wood resin (#12) odour detected at T16 • Diesel (#31) odour from boat workshop and grass (#10) odour at T17 • Smoke (#14) and bread (#05) detected at T20 • Anaesthetic (#19) odour briefly at T21, along with vehicle exhaust (#31) and smoke (#14)

Table Notes:

1 Wind speed observed by field member using the Beaufort Scale, and wind direction recorded from the Whangaparaoa Metservice station

2 Reference to an observation means one inhalation after 10 seconds.

3 Wind directions – northerly (N), north easterly (NE), east north easterly (ENE), easterly (E), south easterly (SE), southerly (S), south westerly (SW), westerly (W), north westerly (NW).

4 Odour strength and odour characterisation (denoted by #no.) from Table 4.1 and Table 4.2 of the OSMP, respectively.

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Appendix G Stack odour tests

Existing plant Mt Maunganui

Laverton site

Author(s): **A.Englefield**

Verum Group Ref : **J000316**

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GREYMOUTH OFFICE
43 Arney Street
PO Box 290
Greymouth 7840
New Zealand
TEL +64 3 768 0586

Title : **Determination of Odour and Volumetric Flow Rates at Allied Asphalt Tauranga – 29th Sept 2022**

Client Name : **Allied Asphalt**

Date of Issue : **21 October 2022**

Signature : ______________________

Name & Designation : **Andy Englefield, Air Quality Analyst**

Reviewed by : ______________________

Name & Designation : **William Porter, Air Quality Analyst**

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

ACCREDITED IANZ TESTING LABORATORY

This report must be quoted in full except with permission from Verum Group.

Determination of Odour and Volumetric Flow Rates at Allied Asphalt Tauranga – 29th Sept 2022

Introduction

Verum Group has been engaged by monitor air flow from Allied Asphalt Tauranga. On 29th September 2022, Verum Group staff undertook measurements of velocities from the asphalt plant on site. The velocities were used to determine volumetric flow rates from the stack. Odour samples were collected from the same sampling points.

Methodology

Velocities were recorded using a S type pitot tube and measurements were made at intervals across traverses of the fan or exhausts. Theses intervals were calculated using methods modified from USEPA methods 1-5 and 201A where the sampling plane is divided into equal areas and a traverse point is located at the center of each area. Volumetric flow rates were calculated using flow rates and the area of the sampling plane.

Odour samples were collected using a negative pressure barrel into Nalophan bags. Bags were partially filled to 'condition' the bag with odour, then emptied and re-filled. Odour bag samples were then sent away for analysis by Watercare. The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry' AS/NZS4323.3:2001. Odour samples were collected from the following sources:

1. Asphalt Plant Stack: Collected on 29th September 2022.

Results

Site	Load	Bag Number	Lab	Date	Time Measured	Fan/Duct Diameter (m)	Average Velocity (m/s)	Volumetric Flow Rate (m3/hr)	Volumetric Flow Rate (m3/s)	Stack Temp (oC)	O2 (%)	CO (ppm)	Atmospheric Pressure (hPa)
Allied Asphalt Tauranga	40 t/hr	220809-02 and 220809-07	WC	29/9/22	8:50-9:30	0.750	13.5	14998	4.17	59	15.9	253	101.3
Allied Asphalt Tauranga	40 t/hr	220809-06 and 220617-04	WC	29/9/22	9:30-10:00	0.750	13.9	15399	4.28	59	16.0	260	101.3
Allied Asphalt Tauranga	50 t/hr	220714-15 and 220405-8	WC	29/9/22	11:00-11:40	0.750	15.1	16803	4.67	58	15.8	249	101.3

Watercare
Laboratory Services

Sensory Evaluation Unit

Olfactometry Results (Forced Choice)

Client:	**Verum Group**
Contact:	**William Porter**
Address:	**97 Nazareth Avenue, Middleton, Christchurch 8024**
Date Received:	**30/9/2022**
Report Date:	**17/10/2022**
Report Number:	**rp 22037s**

- Odour concentration analysed in accordance with AS/NZS 4323.3:2001: "Determination of odour concentration by dynamic olfactometry" using Olfasense – TO-Evolution. Calibration set by Watercare in July 2022.

- Odour character analysed in accordance with Watercare Services Ltd: Method EM02.159 Section 4.6.

Panel Threshold for measurement (AS/NZS 4323.3:2001)[1]:

Panellist	Average Threshold (ppb)	Standard Deviation	Acceptable Range	Qualified
Panellist 1	49.5	1.89	Threshold range: 20-80ppb Standard Deviation: ≤ 2.3	Yes
Panellist 2	41.2	1.48		Yes
Panellist 3	45.8	1.72		Yes
Panellist 4	33.5	1.51		Yes
Panellist 5	35.9	1.57		Yes

[1]Average taken from 20 individual threshold estimates (ITEs) for reference gas (n-butanol 60ppm, ID: 030000062057/1).

Environmental Conditions for measurement (AS/NZS 4323.3:2001 Section 9.6)[2]:

Temperature Range	Ventilation	Environment odourless and pleasant	Noise or light Interference
21.6 °C – 22.2 °C	50.80 – 68.99 m^3/hr/person	Yes	No

[2]Section 9.6 (AS/NZS 4323.3:2001) states temperature fluctuations during the measuring process shall be less than Minimum ventilation rate of 4.4m^3/ hour per person.

Actual Sampling Conditions:

Lab Reference	Description[3]	Temperature (°C)[3]
220930-01	Air Sample 1	58.8
220930-02	Air Sample 2	59.1
220930-03	Air Sample 3	57.4

[3]Data supplied by customer

Odour Concentration (AS/NZS 4323.3:2001)[4]:

Sample Date & Time[5]		Analysis Date & Time		Description	Results (OU)	Lab. Reference	Sampling Method
29/09/2022	9:02	30/09/2022	9:15	Air Sample 1	24709	220930-01	Point Source
29/09/2022	9:48	30/09/2022	9:37	Air Sample 2	33822	220930-02	Point Source
29/09/2022	11:18	30/09/2022	9:56	Air Sample 3	35535	220930-03	Point Source

[4] < LOD is < 19 OU, the lowest detectable odour concentration that can be determined with 95% statistical confidence.
[5] Data supplied by customer

Odour Character (Watercare Services Ltd method EM02.159, section 4.6):

Laboratory Reference	Description of Odour
220930-01	Strong Chemical/Diesel
220930-02	Strong Chemical/Diesel
220930-03	Strong Chemical/Diesel

Comments:

1. A minimum of four panellists were presented with three runs.
2. All samples retrospectively screened.
3. For Description of Odour, the original sample was presented to the panellists.
4. Pre-dilution was not required prior to analysis.
5. All samples were collected by Verum Group.
6. Each sample was transferred to a separate bag for analysis due to condensation in original sample bag.

Trevor Everett
Author

Dimuthu Dorake Vithanage
Peer Reviewer

Ektimo

Fulton Hogan Vic, Laverton

Citywide Asphalt Plant Odour Emission Monitoring

Report Number R013644

Document Information

Template Version 190722

Client Name:	Fulton Hogan Vic
Report Number:	R013644
Date of Issue:	30 September 2022
Attention:	Patrick Boyce
Address:	132 Dohertys Rd Laverton North, Victoria
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Iman Mafakher **Client Manager**	NATA Accredited Laboratory No. 14601	**Terry Burkitt** **Ektimo Signatory**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

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Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation as described in the Test Methods table. This does not include calculations that use data supplied by third-parties, comments, conclusions, or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by Fulton Hogan to perform odour emission testing from the baghouse exhaust stack, serving the tower batch mix asphalt plant, located at their Laverton North asphalt plant. Testing was performed during typical production conditions, while producing the SMI product at a rate of 130 t/hr. During testing, no process interruptions were noted.

1.2 Project Objective & Overview

The objective of the project is:

- Determine the odour emission rate from the baghouse exhaust stack when the tower batch mix asphalt plant is operating under typical production conditions as shown below:

Location	Test Date	Test Parameters*
Baghouse Stack	26 September 2022	Odour concentration and emission rate Character and hedonic tone

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP. Plant operating conditions have been noted in the report.

2 Results

2.1 Baghouse

Date	26/09/2022	**Client**	Fulton Hogan
Report	R013644	**Stack ID**	Baghouse Exhaust
Licence No.	-	**Location**	Laverton
Ektimo Staff	Iman Mafakher, Nick Heatley	**State**	VIC
Process Conditions	Product type - SMI - Product rate - 135 t/hr		220818

Sampling Plane Details	
Sampling plane dimensions	1200 mm
Sampling plane area	1.13 m²
Sampling port size, number & depth	4" BSP (x2), 60 mm
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 8 D
Upstream disturbance	Centrifugal fan 8 D
No. traverses & points sampled	2 12
Sample plane conformance to AS 4323.1	Ideal sampling plane

Comments
The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.03	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1200	
Temperature, °C	70	
Velocity at sampling plane, m/s	8.1	
Volumetric flow rate, actual, m³/min	550	
Volumetric flow rate (wet STP), m³/min	440	

Odour	Average		Test 1		Test 2	
Sampling time			3105 - 1212		1215 - 1217	
	Concentration ou	Odourant Flow Rate oum³/min	Concentration ou	Odourant Flow Rate oum³/min	Concentration ou	Odourant Flow Rate oum³/min
Results	3500	1500000	3200	1400000	3800	1700000
Lower uncertainty limit	2700		2200		2600	
Upper uncertainty limit	4600		4700		5600	
Hedonic tone			mildly unpleasant		mildly unpleasant	
Odour character			combustion, burnt		combustion, burnt	
Analysis date & time			26/09/22, 1400-		26/09/22, 1400-	
Holding time			2 hours		2 hours	
Dilution factor			6.6		6	
Bag material			Teflon™		Teflon™	
Butanol threshold (ppb)	67					
Laboratory temp (℃)	22					
Last calibration date	September 2022					

3 Plant Operating Conditions

The process conditions at the time of testing were:

- Product: SMI
- Production rate: 130 t/hr

These process conditions were supplied by Fulton Hogan personnel and stated to be typical.

See Fulton Hogan Vic records for complete process conditions.

4 Test Methods

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling method	Analysis method	Uncertainty*	NATA accredited Sampling	NATA accredited Analysis
Sampling points - Selection	AS 4323.1	NA	NA	✓	NA
Flow rate & velocity	AS 4323.1	AS 4323.1	8%, 7%	✓	✓
Odour	AS 4323.3	AS 4323.3	refer to results	✓	✓¥
Odour characterisation	NA	direct observation	NA	NA	×

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* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

¥ Odour analysis conducted at the Mitcham, VIC laboratory by forced choice olfactometry, NATA accreditation number 14601. Results were reported on 26 September 2022 in Report OV-00672.

5 Quality Assurance/Quality Control Information

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

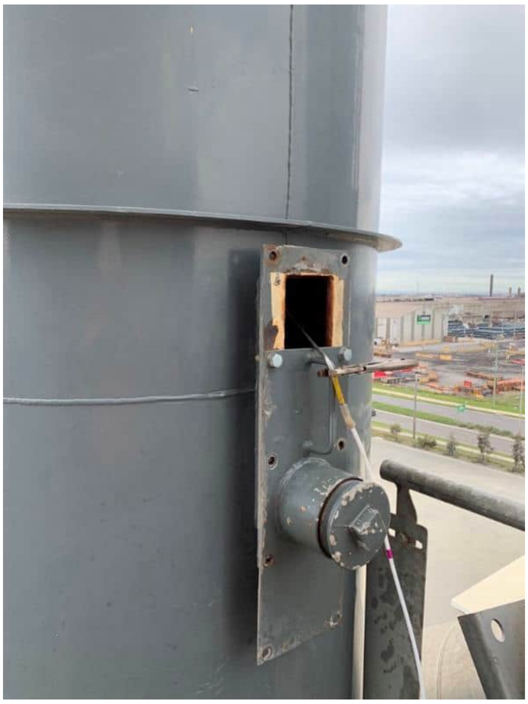
NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

6 Definitions

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM/CEMS	Continuous emission monitoring/Continuous emission monitoring system
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone is defined as the particle diameter at which the cyclone achieves a 50% collection efficiency i.e. half of the particles are retained by the cyclone and half pass through it. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier transform infra-red
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PM_{10}	Particulate matter having an equivalent aerodynamic diameter less than or equal to 10 microns (µm).
$PM_{2.5}$	Particulate matter having an equivalent aerodynamic diameter less than or equal to 2.5 microns (µm).
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
RATA	Relative accuracy test audit
Semi-quantified VOCs	Unknown VOCs (those for which an analytical standard is not available), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration is determined by matching the area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0 °C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa.
TM	Test method
TOC	Total organic carbon. This is the sum of all compounds of carbon which contain at least one carbon-to-carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity difference	The percentage difference between the average of initial flows and after flows.
Vic EPA	Victorian Environment Protection Authority
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

7 Appendix 1: Site Photos



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