Specialist Environmental Services Ltd

Technical Review of Assessment of Effects of Discharges to Air

Alliance Mataura Meat Processing Plant - Boiler and Odour Discharges

Report Prepared for: Environment Southland

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Status: Final

Date: 20th November 2020

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1. Introduction

Alliance Group Limited (**Alliance**) is seeking consent to continue to discharge contaminants to air from the Mataura meat processing plant. The existing consent to discharge to air from the site was granted in 2015 for a five-year term, expiring on 15 December 2020. The consent requires monitoring that includes emission testing of fine particulate matter (**PM_{10}**) discharged from the main boiler stack and ambient monitoring of PM_{10} in the area neighbouring the site.

The plant now processes only beef at a rate of up to 1120 animals per day. Rendering ceased at the site in 2012. Renderable material (by-product) is stored in a $50m^3$ bin before removal from the site. The peak processing time at the plant is between March and June.

An assessment of effects (**AEE**) of the discharges from the Mataura plant has been prepared by Golder Associates (**Golder**). The assessment has been undertaken in three separate reports addressing:

- The effects of discharges from the existing coal-fired boilers at the site;
- The effects of discharges following proposed changes to the boiler plant; and
- The effects of odour discharged from the meat processing plant.

The AEE for the existing boiler plant discharges indicates potential for adverse effects that are more than minor. As a consequence, Alliance is proposing changes to the main boiler that would involve either:

(a) Fitting a bag filter to the main 9.4MW coal fired boiler (**CFB**) to reduce PM_{10} emission concentrations to less than $50mg/Nm^3$ (adjusted to standard conditions); or

(b) Installing a new 8MW biomass fired boiler (**BFB**) achieving PM_{10} emission concentrations of less than $50mg/Nm^3$.

It is proposed that one of these changes to the boiler plant would be implemented within three years of commencement of consent.

The odour AEE concludes that odour is causing adverse effects at residential properties in Mataura and recommends mitigation measures to reduce those effects to an acceptable degree. The mitigation measures proposed include:

- Extraction of emissions from the Dissolved Air Flotation (**DAF**) solids decanter centrate drain and treatment in a small biofilter;
- Using smaller bins for “compost solids” loadout and removal of solids from the site daily; and
- Ventilation of head space air from the $50m^3$ by-products bin to a biofilter.

It is proposed that the effectiveness of these odour mitigation measures would be reviewed within two years after commissioning.

Environment Southland has engaged Specialist Environmental Services Limited (**SES**) to undertake a technical review of the AEE in relation to boiler and odour discharges from the Mataura plant. The review has been carried out by John Iseli, a Senior Air Quality

Consultant with over 25 years of experience in the assessment of effects of discharges to air from industrial processes. The review will examine the assumptions and methodologies used in the Golder assessments and make recommendations regarding appropriate mitigation, monitoring and consent conditions.

A site visit was undertaken on 3rd November 2020. The boiler plant, the wastewater treatment plant, the by-products bin and other potential odour generating sources were examined during the site visit. The locations of potentially affected neighbouring residential properties in Mataura were also identified.

2. Contaminant Emissions

2.1 Boiler Discharges

The boilers at the plant, existing and proposed, are summarised in Table 1. The AEE states that the backup boiler and the small office boiler are now rarely used, but discharge from these boilers is authorised by the existing consent. The Hide Plant Boiler (**CFB3**) is located at the northern end of the site, approximately 2km from the main boiler. The BFB, if installed, would burn wood chips or a blend of DAF solids and wood chips. The BFB discharge has been assessed based on combustion of 75% wood chips and 25% DAF solids.

Description	Output (MW)	Maximum % MCR[1]	Fuel	Stack Height (m)	Efflux Velocity (m/s)
Main Boiler (CFB2)	9.4	64	lignite	30	2.8[3]
Backup Boiler (CFB1)[2]	3.8	n/a		30	n/a
Hide Plant Boiler (CFB3)	0.923	40		20	2.3[3]
Office Boiler[2]	0.16	n/a		6.5	n/a
Main Boiler - Proposed	9.4	68		30	2.9[3]
Biomass Fired Boiler (BFB) - Proposed	8	100	Wood/ DAF solids	29	15

[1] MCR = Maximum continuous rating
[2] The backup boiler and office boiler are rarely used; the backup boiler being last used in 2013. The main and backup boilers share a common 30m stack.
[3] Emission velocities are very low because of the large diameter of the existing concrete stack.

Table 1. Specifications for boilers at the Alliance Mataura site.

Golder has determined that the primary contaminants discharged from the boilers that require assessment are PM_{10}, **$PM_{2.5}$** (inhalable particles less than 2.5 microns in diameter), sulphur dioxide (**SO_2**) and nitrogen dioxide (**NO_2**). I agree that these are the key contaminants discharged from CFBs and BFBs with potential to cause adverse effects, based on experience assessing numerous boiler plant discharges. Any adverse effects associated with contaminants discharged in trace amounts, including metals, carbon monoxide and volatile organic compounds, are expected to be less than minor in this case.

The AEE assumes the contaminant emission rates for the boilers that are listed in Table 2.

Contaminant	Emission Rate (g/s)			
	Main Boiler Existing (CFB2)	CFB2 with Bag Filtration	Hide Plant Boiler (CFB3)	New BFB (75% wood/25% DAF)
	64% MCR	68% MCR	40% MCR	100% MCR
SO_2	5.5	5.9	0.47	1.31
NO_x[1]	1.9	2.0	0.16	13.6
PM_{10}	2.5	0.21	0.21	0.23
$PM_{2.5}$[2]	2.0	0.21	0.17	0.23

[1] NO_x is composed of NO and NO_2. NO_2 is the critical contaminant in terms of potential effects on human health. Approximately 5-10% of NO_x is NO_2 at the point of discharge.
[2] The AEE assumes that 80% of PM_{10} is $PM_{2.5}$ for the existing CFBs, but that all PM_{10} is $PM_{2.5}$ for the proposed bag filtered discharges at 50mg/Nm^3.

Table 2. Contaminant emission rates assumed for the dispersion modelling assessment of boiler discharges.

In terms of potential adverse effects, the key contaminants discharged are PM_{10} and $PM_{2.5}$. The aged spreader stoker boilers CFB1, CFB2 and CFB3 have high PM emission rates and low thermal efficiencies, relative to other common boiler types. Calculated PM_{10} emissions are based on 640mg/Nm^3 from emission testing results. I agree that the PM emission rates calculated by Golder are reasonable, based on emission factors and the test results. However, although the resultant PM emission rates are very high for coal fired boilers, the ambient PM_{10} and $PM_{2.5}$ monitoring results discussed by Golder indicate that the calculated emission rates for the existing main boiler may not be conservative under all operating conditions.

The proposed emission rates for the bag filtered CFB and the BFB indicate a more than 90% reduction in PM_{10} emissions from the main boiler. It is noted that the application does not specifically propose to install a bag filter for the BFB option. However, it is expected that such mitigation will be required to achieve the 50mg/Nm^3 PM_{10} emission concentration required.

The SO_2 emission rates calculated by Golder, and used for dispersion modelling, are based on a maximum sulphur content in coal burned in the boilers of 0.45% by weight, assuming 5% retention in the ash. The Newvale lignite currently burned has an average sulphur content of 0.4%, indicating that a 0.45% sulphur content limit could be readily met. However, I note that a 0.6% sulphur content limit is imposed by condition of the current consent for the plant. Based on the results of the dispersion modelling discussed later, that limit is no longer considered to be appropriate.

I consider that the NO_x emission rates calculated by Golder for the various boiler fuel options are appropriate. The NO_x emission rate of 13.6g/s for the BFB burning a DAF solids/wood chips blend is based on all the organic nitrogen in the 25% DAF solids being converted to NO_x. This is expected to result in a conservative estimate of peak NO_x emissions from the boiler plant.

2.2 Odour Discharges

The main sources of odour at the meat processing plant are identified in the application as:

- Storage and loadout of "compost solids" from wastewater screening;
- Wastewater treatment, including the DAF tanks and sludge management;
- The DAF solids decanter (installed in 2017);
- Storage and loadout of rendering by-products;
- The cattle yards; and
- Blood storage and processing.

I agree with Golder that the cattle yards and blood processing are not expected to be sources of significant odour experienced off-site, provided standard cleaning procedures and mitigation measures in place are employed. Preservation of hides occurs at the Hide Plant, approximately 2km north of the main site, before further processing off-site. The hide plant has not been identified as a significant source of odour. Based on my observations during the site visit and my experience of similar processes, I consider that the DAF solids decanter, DAF sludge management, handling of compost solids and the by-products bin are likely to be the primary sources of odour identified by complainants and odour diarists.

3. Review of Assessment of Effects

3.1 Boiler Discharges

3.1.1 Dispersion Modelling Methodology

Golder has undertaken dispersion modelling of the boiler discharges using the CALPUFF model. This model is commonly used for assessment of large-scale discharges in New Zealand, particularly in circumstances where dispersion is affected by complex terrain or coastal effects. Given the complex terrain in the Mataura River Valley, I consider that the CALPUFF model is an appropriate choice for assessment of the boiler discharges in this case.

I have examined the model inputs and assumptions listed by Golder and consider these to be appropriate. Building downwash effects and terrain effects have been taken into account. The modelling assumes constant discharge at peak output (from steam records) of 64% Maximum Continuous Rating (**MCR**) for the existing main CFB, 68% MCR for the proposed CFB with bag filtration, 100% MCR for the proposed BFB and 40% MCR for the Hide Plant boiler. This approach is expected to result in reasonable predictions for peak 1-hour average concentrations. However, it is likely to result in a slight over-prediction of 24-hour average concentrations and a substantial over-prediction of annual average concentrations. Nevertheless, the assumption is appropriately conservative given the inherent uncertainty associated with model predictions.

Meteorological data for modelling was developed using the prognostic model TAPM to generate upper air profiles for input into the CALMET model. CALMET's meteorological fields were based on a combination of local surface data and outputs from TAPM. Meteorological modelling was carried out for a full year (August 2003 – August 2004), coinciding with the availability of monitoring data from Edendale.

The wind rose generated from CALMET shows that the site wind patterns are significantly influenced by the raised terrain running along the eastern side of the Mataura River. Southerly and northerly wind conditions generally align with a north-northeast to south-southwest bearing and cold air drainage flows are expected to flow from the plant to the south-southwest towards Mataura township.

3.1.2 Air Quality Criteria and Background Concentrations

Golder have compared the modelled peak ground level concentrations (GLCs) of contaminants plus estimated background concentrations with relevant air quality standards and guidelines. Assessment criteria for primary contaminants have been selected from the National Environmental Standards for Air Quality (**NESAQ**) and New Zealand Ambient Air Quality Guidelines (**AAQGs**). In the case of $PM_{2.5}$, the Ministry for the Environment has proposed NESAQ values that are equivalent to the World Health Organisation (**WHO**) 24-hour and annual average guidelines of 25µg/m^3 and 10µg/m^3 respectively. The selected assessment criteria are appropriate and are listed in Tables 3 to 5 below.

As required by the current discharge permit, ambient air quality monitoring has been undertaken in Mataura in March to early July 2018. The monitoring results are described by Golder in the assessment documents. The monitoring occurred on elevated terrain east of the main boiler stack (Hillcrest Avenue) and at the southern boundary of the site. The monitoring did not cover a full winter period, but provided sufficient data to indicate that concentrations of PM_{10} and $PM_{2.5}$ in Mataura township are unlikely to consistently comply with the NESAQ and the WHO guidelines. Residential home heating has been identified as the primary source of PM emissions during the autumn and winter periods.

Background contaminant concentrations have been estimated by Golder to enable prediction of cumulative GLCs. In the case of PM_{10} and $PM_{2.5}$, the ambient monitoring data for Mataura has been used to estimate mean and upper confidence level background concentrations during specific weather conditions. This approach has enabled Golder to estimate background concentrations expected to occur during conditions when the peak GLCs are predicted for the boiler discharges. I consider that this approach is reasonable and the mean to 99^{th} upper confidence level background values are shown in Tables 3 to 5.

SO_2 background concentrations have been estimated from monitoring data in Edendale and Timaru where historical burning of coal has occurred. Given that SO_2

monitoring has not been undertaken in Mataura, that approach is appropriate. The background concentrations shown in Tables 3-5 are expected to be generally conservative.

NO_2 background concentrations for Mataura have been estimated from New Zealand Transport Agency (**NZTA**) data. This is standard practice where local monitoring data are not available and will result in appropriately conservative estimates of NO_2 background levels for assessment purposes.

3.1.3 Summary of Modelling Results

The dispersion modelling predicts the peak GLCs listed in Tables 3 to 5 for the three boiler scenarios:

- Existing CFB discharges;
- Proposed bag filtered main CFB discharge plus Hide Plant CFB; and
- Proposed BFB plus Hide Plant CFB.

Contaminant	Maximum off-site GLC (μg/m³)		Maximum at most affected dwelling (μg/m³)		Estimated Background (μg/m³)	Guideline or Standard (μg/m³)
	Modelled	Cumulative	Modelled	Cumulative		
24-hr PM_{10}	30	44	28 (3)[1]	39-42	11-14[2]	50
Annual PM_{10}	3	15	2	14	12	20
24-hr $PM_{2.5}$	24	**30-32**	23 (2)[1]	**29-31**	6-8[2]	25
Annual $PM_{2.5}$	2	9	1.5	9	7	10
1-hr SO_2	174	294	141	261	120	350/570[3]
24-hr SO_2	65	95	62	92	30	120
Annual SO_2	6	11	4	9	5	30
1-hr NO_2	20	80	7	67	60	200
24-hr NO_2	4	44	3	43	40	100

[1] Peak modelled GLCs occur during wind speeds greater than 3m/s when background concentrations are relatively small. Bracketed values are predicted GLCs when background concentrations (due to domestic fires) are highest.
[2] Estimated mean, 75th and 99th confidence level background values.
[3] The NESAQ specifies a value of 350μg/m³ with allowance for 9 exceedances annually up to an upper limit of 570 μg/m³.

Table 3. Predicted peak GLCs and cumulative concentrations for key contaminants discharged from the existing CFBs.

Contaminant	Maximum off-site GLC (μg/m³)		Maximum at most affected dwelling (μg/m³)		Estimated Background (μg/m³)	Guideline or Standard (μg/m³)
	Modelled	Cumulative	Modelled	Cumulative		
24-hr PM_{10}	18 (CFB3)	32	2.3 (1.3)[1]	13-16	11-14[2]	50
Annual PM_{10}	1	13	0.2	12	12	20
24-hr $PM_{2.5}$	12 (CFB3)	20	2.3 (1.1)[1]	8-10	6-8[2]	25
Annual $PM_{2.5}$	1	8	0.2	7	7	10
1-hr SO_2	180	300	146	266	120	350/570[3]
24-hr SO_2	67	97	65	95	30	120
Annual SO_2	6	11	5	10	5	30
1-hr NO_2	20	80	7	67	60	200
24-hr NO_2	4	44	3	43	40	100

[1] Peak modelled GLCs occur during wind speeds greater than 3m/s when background concentrations are relatively small. Bracketed values are predicted GLCs when background concentrations (due to domestic fires) are highest. The bracketed values are predicted at House 4 identified in the Golder report due to the Hide Plant boiler discharge.
[2] Estimated mean, 75th and 99th confidence level background values.
[3] The NESAQ specifies a value of 350μg/m³ with allowance for 9 exceedances annually up to an upper limit of 570 μg/m³.

Table 4. Predicted peak GLCs and cumulative concentrations for key contaminants discharged from the proposed CFBs with bag filtration of the main boiler.

Contaminant	Maximum off-site GLC (μg/m³)		Maximum at most affected dwelling (μg/m³)		Estimated Background (μg/m³)	Guideline or Standard (μg/m³)
	Modelled	Cumulative	Modelled	Cumulative		
24-hr PM_{10}	18 (CFB3)	32	2.6 (1.3)[1]	14-17	11-14[2]	50
Annual PM_{10}	1	13	0.2	12	12	20
24-hr $PM_{2.5}$	12 (CFB3)	20	2.6 (1.1)[1]	9-11	6-8[2]	25
Annual $PM_{2.5}$	1	8	0.2	7	7	10
1-hr SO_2	174 (CFB3)	294	35	155	120	350/570[3]
24-hr SO_2	40 (CFB3)	70	14	44	30	120
Annual SO_2	3 (CFB3)	8	1	6	5	30
1-hr NO_2	58	118	50	110	60	200
24-hr NO_2	20	60	20	60	40	100

[1] Peak modelled GLCs occur during wind speeds greater than 3m/s when background concentrations are relatively small. Bracketed values are predicted GLCs when background concentrations (due to domestic fires) are highest. The bracketed values are predicted at House 4 identified in the Golder report due to the Hide Plant boiler discharge.
[2] Estimated mean, 75th and 99th confidence level background values.
[3] The NESAQ specifies a value of 350μg/m³ with allowance for 9 exceedances annually up to an upper limit of 570 μg/m³.

Table 5. Predicted peak GLCs and cumulative concentrations for key contaminants discharged from the proposed BFB and Hide Plant boiler.

3.1.4 Effects of Particulate Matter

Both the dispersion modelling and the ambient air quality monitoring indicate that the existing CFB discharges are likely to cause PM_{10} and $PM_{2.5}$ GLCs that make a significant contribution to background concentrations in Mataura. This finding is not surprising given the high PM emission rates measured for the spreader stoker boilers.

The maximum 24-hour average GLCs at the most affected dwelling caused by the boiler discharges alone are predicted to be 28μg/m^3 PM_{10} and 23μg/m^3 $PM_{2.5}$. Taking into account background concentrations occurring under coincident meteorological conditions (wind speeds greater than 3m/s), cumulative PM_{10} concentrations are predicted to approach the NESAQ and cumulative $PM_{2.5}$ concentrations are predicted to exceed the WHO guideline of 25μg/m^3 (24-hour average) that is proposed as a NESAQ. Ambient PM monitoring has indicated that there is potential for $PM_{2.5}$ emissions from the main boiler to, at times, exceed the emission rate used for dispersion modelling. It is therefore appropriate that mitigation (bag filtration or installing a BFB) has been proposed to reduce the effects of PM_{10} and $PM_{2.5}$ to an acceptable level.

It is noted that a period of three years has been requested to install a bag filter or a new BFB. Given that effects of $PM_{2.5}$ are predicted to be significant and that exceedance of the proposed NESAQ and the WHO guideline is predicted, a shorter time period to implement mitigation may be appropriate.

The proposed bag filter and BFB options are expected to result in a more than 85% reduction in $PM_{2.5}$ emissions and a more than 90% reduction in PM_{10} emissions from the main boiler. The predicted modelling results presented in Tables 4 and 5 are consistent with this degree of emission reduction. The maximum predicted PM_{10} and $PM_{2.5}$ GLC caused by the proposed discharge options is 2.6μg/m^3 (24-hour average) at the most affected dwelling and cumulative concentrations are predicted to be well within the relevant NESAQ and WHO guidelines. Predicted GLCs caused by the main boiler discharge are significantly smaller during meteorological conditions when background PM concentrations are high in Mataura due to domestic fires.

The maximum of-site PM_{10} and $PM_{2.5}$ GLCs are predicted to be caused by the smaller Hide Plant boiler (CFB3). However, these GLCs occur on uninhabited rural land and the Hide Plant boiler is predicted to cause a maximum $PM_{2.5}$ GLC at the most affected dwelling (House 4 in the Golder AEE) of 1.1μg/m^3 (24-hour average) at times when background concentrations are highest. The Hide Plant boiler is located approximately 2km north of the main boiler and is not predicted to contribute significantly to the peak concentrations in Mataura township caused by the main boiler discharge.

The dispersion modelling of the proposed main boiler bag filtration or BFB options indicates that adverse effects of these PM discharges will be acceptable. A significant reduction in peak PM_{10} and $PM_{2.5}$ GLCs at the most affected dwellings is achieved, relative to the existing discharge. Ambient concentrations in Mataura may continue to exceed the NESAQ and WHO guidelines at times due to domestic fire emissions, but the contributions from Alliance boiler emissions to such exceedances is expected to be small.

3.1.5 Effects of Sulphur Dioxide

The dispersion modelling, based on 0.45% coal sulphur content, predicts maximum 1-hour average SO_2 GLCs caused by the CFBs of 180μg/m^3 off-site and cumulative concentrations up to 300μg/m^3. Peak GLCs predicted at the most affected dwelling for the three scenarios are 146μg/m^3 and 266μg/m^3 (1-hour averages). While there is uncertainty associated with the estimated background concentration of 120μg/m^3, due to lack of monitoring data for Mataura, this value is likely to be conservative. I therefore consider that compliance with the NESAQ of 350μg/m^3 (1-hour average) is likely to be achieved, allowing for 9 exceedances annually.

The maximum predicted 24-hour average SO_2 GLC at the most affected dwelling is 65μg/m^3 and cumulative concentrations off-site are predicted to be up to 97μg/m^3. This value is 81% of the AAQG of 120μg/m^3 (24-hour average). The cumulative concentrations predicted are acceptable. However, bearing in mind the uncertainties associated with model predictions and estimating background concentrations, I consider that burning of coal with sulphur content of 0.6% (as authorised by the current consent) is not appropriate. Provided the coal sulphur content does not exceed 0.5% by weight (resulting in peak predicted 24-hour average cumulative GLCs of 108μg/m^3), I am satisfied that any adverse effects of SO_2 discharged from the Alliance boilers is likely to be less than minor.

3.1.6 Effects of Nitrogen Dioxide

Combustion of solid fuels in boilers located in areas with relatively low population density, as occurs in this case, does not typically give rise to cumulative NO_2 GLCs that are likely to cause exceedance of the NESAQ. This observation is confirmed by the dispersion modelling results, particularly in relation to the coal fired boiler discharges.

Golder have used the Janssen equation to calculate the conversion of nitrogen oxides to NO_2. The Good Practice Guide for Assessing Discharges to Air from Industry[1] notes that this equation may be appropriate in certain circumstances for assessment of large combustion plant discharges in rural areas. However, the Guide cautions that the Janssen equation has not been validated or assessed for relevance in the New Zealand context and therefore is not a specifically recommended method. Nevertheless, given the magnitude of GLCs predicted and the use of conservative background NO_2 concentrations, I consider that use of the Janssen equation in this instance is acceptable.

Burning of a 25% DAF solids/75% wood chips blend in the BFB results in a relatively high NO_x emission rate, based on the assumption that all the organic nitrogen in the DAF solids is converted to NO_x. For that scenario, cumulative NO_2 GLCs are predicted

[1] Ministry for the Environment. 2016. Good Practice Guide for Assessing Discharges to Air from Industry. Wellington: Ministry for the Environment.

to be up to 60% of the NESAQ. Provided the percentage of DAF solids in the blend burned in the BFB does not exceed the 25% proposed, I am satisfied that any adverse effects of NO_2 are likely to be less than minor.

3.1.7 Conclusion Regarding Effects of the Boiler Discharges

Both the dispersion modelling and the limited ambient air quality monitoring indicate that the existing Alliance CFB discharges of PM_{10} and $PM_{2.5}$ make a significant contribution to background concentrations in Mataura. This finding is not surprising given the high PM emission rates measured for the spreader stoker boilers.

The dispersion modelling of the proposed options, main boiler bag filtration or installing a BFB, indicates that adverse effects of these PM discharges will be acceptable. A significant reduction in peak PM_{10} and $PM_{2.5}$ GLCs at the most affected dwellings is achieved, relative to the existing discharges. Ambient concentrations in Mataura may continue to exceed the NESAQ and WHO guidelines at times due primarily to domestic fire emissions, but the future contribution from Alliance boiler emissions to such exceedances is expected to be small.

A period of three years has been requested to install a bag filter or a new BFB. Given that effects of $PM_{2.5}$ are predicted to be significant and may result in exceedance of the proposed NESAQ and the WHO guideline, a shorter time period to implement mitigation may be appropriate.

The dispersion modelling assessment indicates that any adverse effects of SO_2 and NO_2 discharged from the boiler plant are likely to be less than minor. This conclusion is contingent on two conditions:

- the percentage of DAF solids in the DAF/wood chip blend burned in the BFB does not exceed 25% (as proposed); and
- the sulphur content of coal burned in the boilers does not exceed 0.5% by weight.

3.2 Odour Discharges

3.2.1 The Receiving Environment and Assessment Approach

The Alliance meat processing plant is located near the centre of Mataura township and is surrounded by predominantly residential dwellings in all directions, except for directly due north of the plant. The Golder AEE identifies the nearest residential dwellings as 110 m to the west, 200 m to the south and 300 m north east of the main coal-fired boiler. Houses are also located on elevated terrain approximately 210 m east of the main boiler. Because of the close proximity of dwellings to the site, the local receiving environment is sensitive to odour discharges from the processing plant.

Golder have assessed the effects of odour by examining odour diary records kept by nearby residents, analysing odour complaint records, and conducting a site visit with recommendations regarding appropriate mitigation. I agree with Golder that an odour annoyance survey is not likely to be practical in this case because of the low population density in the affected area. I consider that the assessment approach taken is generally in accordance with advice in the Good Practice Guide for Assessing and Managing Odour[2]. However, I note that the odour diary programme included a small number of participants and occurred for only three months (15th November 2019 to 22nd February 2020) that do not coincide with peak operation at the plant.

3.2.2 Odour Diary Results

The odour diarists were located as follows:

- Diarist A, Culling Terrace, 360m to the southeast of the DAF tanks;
- Diarist B, Carlyle Street, 500m to the southwest;
- Diarist C, Oakland St, 500m to the southwest;
- The Watch House at the Alliance site boundary, 140m to the southwest.

The selected diarist locations are generally appropriate, being in close proximity to the plant. Drainage flows (typically associated with wort-case odour dispersion) move down valley from the plant to the south-southwest, towards the township. Wind data from the Daikin site, 4.5km from the plant, were used to determine potential sources of odour in relation to wind direction, allowing for a 60-degree directional range.

Golder concluded from the diary records that routine odour discharges, such as the DAF solids decanter, are the most likely cause of off-site odour experienced. However, the timing of observations (odour was most frequently recorded 8pm to 10pm) indicated that "dropping" of solids in the DAF tanks may also be causing effects. Golder postulate that this may be due to dewatering of the resultant sludge.

Odour exposure times for Diarist A and the Watch House have been calculated by Golder, based on the diary record. Estimated exposure times of 1.7% and 0.8% were calculated for Diarist A and the Watch House respectively. Insufficient observations were recorded to enable exposure times to be calculated for Diarists B and C. For residential diarists, odour exposure times of more than 1% indicate that long term exposure may be causing effects that are more than minor. I agree with Golder that the limited diary record indicates that additional mitigation of odour from the plant is appropriate.

3.2.3 Complaints Record

The odour complaints record for a five-year period (1 October 2015 to 10 August 2020) was analysed by Golder. A total of 53 complaints were received during this period, with a peak in December 2017 (6 complaints) and January 2018 (9 complaints) following installation of the DAF solids decanter at the site. Golder observe that works undertaken in July 2018 to extract odour emissions from the decanter to the boiler resulted in an apparent reduction in complaints.

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[2] Ministry for the Environment. 2016. Good Practice Guide for Assessing and Managing Odour. Wellington: Ministry for the Environment.

The majority of odour complaints occurred during light wind speeds of less than 4m/s. This is consistent with the results of the odour diary programme where odour observations were typically associated with light wind conditions. I agree with Golder that the odour emission sources causing complaints are likely to be the same sources that resulted in odour diary observations.

Odour complaints at a rate of up to three per month have continued to occur during the past two years, following venting of the DAF solids decanter emissions to the boiler in mid-2018. The complaints record, in combination with the odour diary results, indicates that additional odour mitigation is appropriate.

3.2.4 Golder Site Assessment

A site visit and assessment of odour sources was undertaken by Golder on 15th July 2020. The assessment was carried out by Roger Cudmore who has substantial experience in the design of odour mitigation, including biofiltration, for the meat processing industry. Mr Cudmore observed that the discharge of centrate from the DAF solids decanter to the wastewater drain results in a sharp "DAF solids" odour which could be recognised at the southern plant boundary. He recommended enclosing the head space of the centrate discharge tank and extracting odorous air to a small biofilter containing approximately 2-3m^3 of soil/bark media.

The site assessment also observed that wastewater screened solids ("compost solids") are currently stored in a large 20m^3 bin. Because of the bin size, compost solids are stored for periods of up to a week or more before auguring out for removal from the site. This has potential to generate strong odour emissions on warm days. I agree that holding such material for more than 24 hours prior to disposal is not good practice. The suggested solution of requiring smaller pick-up bins to ensure daily load-out of compost solids is appropriate.

The large 50m^3 by-products bin was also identified by Golder as a potential odour source. Mr Cudmore has recommended ventilation of the head space air from this bin to a biofilter having a surface area of approximately 25m^2. I agree that this mitigation is appropriate and consider that by-products load-out should occur at least daily.

The conclusions of the Golder site assessment are generally consistent with my observations during the site visit on 3rd November 2020. However, I note that a substantial discharge via the centrate drain was not occurring at the time of my visit so I could not assess the odour potential of this source.

The mitigation measures suggested are reasonable and are expected to result in a reduction in odour emissions from the site. Golder consider that the proposed changes will result in adverse odour effects that are minor or less. Until the mitigation measures have been implemented and further community feedback is obtained, I am not sufficiently confident to conclude that effects will be less than minor. However, I consider that the proposed mitigation combined with careful site management via the management plan is likely to result in odour effects that are acceptable.

3.2.5 Conclusion Regarding Odour Effects

Analysis of the odour complaints record and odour diary results indicates that odour is causing adverse effects at residential properties in Mataura. Based on expert site assessment, Golder has recommended mitigation measures to reduce those effects to an acceptable degree. The mitigation measures proposed include:

- Extraction of emissions from the DAF solids decanter centrate drain and treatment in a small biofilter;
- Using smaller bins for “compost solids” loadout and removal of solids from the site daily; and
- Ventilation of head space air from the 50m^3 by-products bin to a biofilter.

The conclusions of the Golder site assessment are generally consistent with my observations on site. The primary odour emission sources from the site have been identified and appropriate mitigation is proposed.

The mitigation measures suggested are reasonable and are expected to result in a reduction in odour emissions from the site. Until the mitigation measures have been implemented and further community feedback is obtained, I am not sufficiently confident to conclude that odour effects will be less than minor. However, I consider that the proposed measures combined with appropriate site management via the management plan is likely to result in odour effects that are acceptable.

The AEE concludes that adverse odour effects of the existing discharges are likely to be more than minor. Given that conclusion, the proposed three-year time frame to implement odour mitigation is considered to be too long. The proposed works are relatively minor and I consider they should be implemented within 12 months of commencement of consent. It would be appropriate to undertake a further odour diary programme within a year thereafter, to confirm the effectiveness of the mitigation measures.

4. Mitigation Measures and Monitoring

The mitigation measures proposed by Alliance for the boiler plant and odour discharges are considered to be appropriate and should be implemented as soon as practicable. In addition, the review has identified specific mitigation that should be included in conditions of consent, to ensure that activity is consistent with the assessment. Recommended mitigation measures are as follows:

- Require either bag filtration of the main 9.4MW CFB discharge or installation of a new 8MW BFB to reduce PM_{10} emission concentrations from the main boiler plant to less than 50mg/Nm^3 (adjusted to standard conditions);
- Restrict the main CFB output to not more than 68% MCR and the Hide Plant CFB to not more than 40% MCR;
- Limit the percentage of DAF solids in the DAF/wood chip blend burned in the

BFB to not more than 25%;
- Limit the sulphur content of coal burned in the boilers to not more than 0.5% by weight;
- Set minimum stack heights of 30m for the main CFB, 29m for the BFB and 20m for the Hide Plant boiler;
- Require a minimum efflux velocity from the BFB at MCR of 15m/s;
- Limit the opacity of boiler discharges;
- Require annual servicing of boilers;
- Within 1 year, require extraction of emissions from the DAF solids decanter centrate drain and treatment in an appropriately designed biofilter;
- Within 1 year, use smaller bins for "compost solids" loadout to facilitate the removal of solids from the site daily;
- Within 1 year, require ventilation of the head space air from the 50m^3 by-products bin to an appropriately designed biofilter;
- Require removal of compost solids and by-products daily from the site;
- Specify that non-condensable gases from the blood dryer must be extracted to the boiler plant for combustion;
- Require an updated air discharge management plan for the site containing mitigation, monitoring, contingency and complaint procedures, to be reviewed annually.

The following monitoring is recommended:
- A further odour diary programme to be completed within two years of commencement of consent;
- Review of the effectiveness of the odour mitigation by an independent, suitably qualified person within three months after completion of the odour diary programme;
- Emission testing of PM_{10} from the main boiler at least annually and at least every three years for the Hide Plant boiler;
- Analysis of the coal blend burned for sulphur content at least 6-monthly;
- Recording of any complaints received and the response to those complaints.

5. Appropriate Consent Conditions

The application does not include a set of proposed consent conditions. It is anticipated that appropriate recommended conditions will be formulated in the Environment Southland planning report, based on the existing consent conditions with amendments and additions to include the matters listed in Section 4 above. Technical input will be provided to the formulation of those conditions, as requested.