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Dear **Ben Baird**

Subject: Technical Air Quality Response to Request for Further Information – PC190061

Introduction

In a letter dated 6/9/19, Selwyn District Council (**SDC**) has requested further information to support the application for plan change PC190061.

NZ Air Limited (**NZ Air**) has been engaged to supply a response to the following air quality questions raised in the letter:

As per our peer review of the air quality report. Can you please respond to the following questions:

1. ***Please consider revising the contaminant emission rates using the process specific emission factors, advise how they compare to the emission rates used in the modelling supplied, and assess how the differences would affect the modelling results.***
   Some emissions weren't included in the assessment. The assessment covered fuel combustion from the kilns but no other potential emissions from the brick material itself. Contaminant emission rates have been calculated based on fuel consumption rates, using emission factors for coal and oil. Emissions of metals have also been estimated based on the assumed concentrations of metals in the recycled oil. We note that there are emission factors specific to brick drying (see Australian Government NPI Emissions Estimations Technique Manual for Bricks, Ceramics and Clay Product Manufacture and USEPA AP-42, Section 11.3 – Bricks and Clay Related Processes). The emission factors include emissions from the drying of brick material itself as well as the products of fuel combustion used to provide heat to the kilns. These contaminants include metals, fluoride, and VOCs not emitted from fuel combustion itself, so are additional.
2. ***Please assess the potential effects of fugitive dust from material storage piles, crushing, grinding and screening operations, and any existing and proposed mitigation measures.***
   No assessment of dust caused from manufacturing and where it my drift. We note that there are a number of potential sources of dust from the manufacture of bricks, which are not discussed in the air quality report.
3. ***Please provide a discussion of likely background concentrations and an assessment of cumulative results with the kiln discharges.***

Modelling did not include any general background contaminants. Background concentrations of air contaminants have not been included in the assessment for determining cumulative effects of the kiln discharges with background concentrations. Section 5 of the air quality report states that there is no publicly available ambient air quality monitoring data for the Darfield area. The MfE Good Practice Guide for Assessing Discharges to Air from Industry (2016) provides guidance on deriving background contaminant concentrations in the absence of monitoring data.

4. ***Please provide a discussion of any potential odour effects from the operation of the kilns and combustion appliances at the site.***
   There is no discussion of odour effects from the brick manufacture.

Question 1 Response - Contaminant Emission Rates

NZ Air produced an assessment of potential ambient air quality effects that may occur within the proposed plan change area in a report titled "Air Quality Assessment – Canterbury Clay Bricks Furnace Operation" in July 2018 (hereafter referred to as the NZ Air report). Within this report emission factors for both coal burning and re-refined oil burning were used to estimate discharge parameters for the furnace emissions. These were presented in Tables 5 and 6 in the NZ Air report (reproduced below)

TABLE 1 COAL BURNING MODELLING INPUTS

Kiln	Fuel burn rate (kg/hr)	Stack height (m)	exit diameter (m)	exit velocity (m/s)	exit temp (deg C)	NO_2 (g/s)	CO (g/s)	PM_{10} (g/s)	SO_2 (g/s)
Batch Kiln	27.4	21.3	0.6	1.22	503	0.042	0.019	0.050	0.260
Tunnel Kiln	122.6	15.5	0.5	7.84	503	0.187	0.085	0.225	1.165

TABLE 2 RE-REFINED OIL BURNING MODELLING INPUTS

Kiln	Fuel burn rate (l/hr)	Stack height (m)	exit diameter (m)	exit velocity (m/s)	exit temp (deg C)	Arsenic (g/s)	Cadmium (g/s)	Chromium (g/s)	Lead (g/s)
Batch Kiln	22	21.3	0.6	0.6	300	0.000031	0.000012	0.000061	0.00061
Tunnel Kiln	99	15.5	0.5	15.3	300	0.000137	0.000055	0.000275	0.00275

These emission factors were calculated based on fuel burn rates and emission factors associated with the fuel combustion only.

In the further information request SDC has requested that emissions from the brick drying itself be assessed utilising emission factors from alternate sources such as; Australian Government NPI Emissions Estimations Technique Manual for Bricks, Ceramics and Clay Product Manufacture and USEPA AP-42, Section 11.3 – Bricks and Clay Related Processes. The Australian NPI manual contains factors which are based on those published in the US EPA AP42 chapter. Therefore, there is only one source of emission factors represented between the two documents.

All of the emission factors are based on brick production rates. Unfortunately, NZ Air does not have access to the Canterbury Clay Bricks site and therefore even a rough estimate of plant production rates is not possible. NZ Air has been informed that the plant production rates are commercially sensitive and therefore this information is not available.

However, if we are to back calculate the amount of bricks that would need to be produced based on the PM_{10} mass emission of particulates modelled and associated results in the NZ Air report; the CCB factory would be producing approximately 1.4 tonnes of bricks an hour (33.6 tonnes per day, 235.2 tonnes per week). CCB would need to have production rates higher than this for the modelled off-site PM_{10} results presented in the report to under represent the potential off-site effects.

Furthermore, the brick production rates would need to be more than double that quoted above (i.e. more than 2.8 tonnes per hour, 67.2 tonnes per day, 470.4 tonnes per week) for the PM_{10} 24 hour average ambient air quality criteria to be exceeded within the PC61 development area.

In the SDC further information, the emission of pollutants which are not related to the fuel combustion was raised. SDC consider that there are emissions from brick kiln drying that are in addition to that of the fuel combustion (i.e. from the bricks themselves). In the NPI and EPA documents there is no Total Fluorides or HCL emission data for brick manufacture using the kiln type which is installed at CCB (note that there is no consented sawdust or natural gas fired plant at the CCB factory). Therefore, off-site peak concentrations of these pollutants would not be able to be estimated.

There are volatile organic compound (VOC) emission rates for coal fired kilns. However, these are also based on product production rates (which are unknown) and therefore it is not possible for NZ Air to accurately assess the potential effects associated with these potential pollutants.

However, once again, if we were to back calculate the brick production rates which would need to occur for the New Zealand Ambient Air Quality Guideline for benzene (3.6 $\mu g/m^3$) to be exceeded in the PC61 development, the CCB factory would need to be producing over 16,000 tonnes of bricks per hour. It is extremely unlikely that the CCB production rates are this high.

In summary, it is not possible for NZ Air to provide accurate predictions of peak off-site concentrations of air pollutants using the USEPA AP42 Chapter Section 11.3 emission factors as the brick production rates are not available. However, based on back calculations of the required emission rates/brick production rates it is unlikely that using these emission factors would result in substantially higher off-site effects than that presented in the NZ Air report. Therefore, the overall conclusions of the NZ Air report still stand. NZ Air considers that the emissions of pollutants from kiln drying of bricks are dominated by the fuel combustion rather than the bricks themselves. Thus, the emission estimation technique used in the original NZ Air report is still representative of actual peak off-site concentrations (especially given the conservatism in the modelling approach).

Notwithstanding the above, modelled peak off-site concentrations of the current operation were higher at an existing dwelling than that within the PC61 development area. Therefore if the effects of the factory's emissions were to result in unacceptable levels within the PC61 Development area, the effects would be even worse at this existing dwelling and it is unlikely that the CCB factory would be able to continue to operate (as it would be breaching National Environmental Standards for air quality).

Question 2 Response – Fugitive dust

As NZ Air has been unable to access the site, it is difficult to provide an in depth assessment of potential fugitive dust emissions and their potential effect on the proposed PC61 development. However, CCB has a video tour of the manufacturing process on their website (https://clay-bricks.co.nz/about-us/) which has provided an indication of the activities which occur on-site. Based on this limited information NZ Air has the following comment on the potential for level nuisance dust effects within the PC61 development area.

Much of the final product preparation, extrusion, drying and baking activities occur within a large enclosed building. The product is damp/wet during most of these processes (until dried where the product is consolidated and has a minimal potential for dust emission). Therefore, emissions of nuisance dust from these processes are negligible.

Based on this video and aerial imagery of the site, it appears that nuisance dust emissions could occur primarily from the following sources:

- Vehicle movements on internal unsealed roads.
- Loading and unloading of raw products (i.e. clay and sand).
- Raw material stockpiles (located outdoors on the north western end of the factory).
- Product screening, mixing and grinding (which occurs within a large open-ended building).

The primary fugitive dust emission points are likely to be from the vehicle movements along outside unsealed roads and raw material handling activities (either outdoors or in the open-ended building).

The clay stockpiles are likely to be damp below the surface of the stockpile. It is likely that only the surface of the stockpile will be dry. Given that the bulk of this material is likely to be damp this material will have a lower potential for dust emissions during handling activities (this is apparent in the video).

Activities (primarily screening and mixing) which occur within the large (77 m) open ended building are likely to have a lower dust emission potential due to the fact that the surface wind speed across these dust disturbance activities will be reduced and deposition of the particulates is likely to occur primarily within the building. Emissions are only likely to occur from the ends of this building.

There is a row of established trees adjacent to the southern boundary of the CCB site and a large pine hedge the runs the length of the proposed PC61 development land. These established trees will reduce windspeeds across the surface of the site and help to capture some of the fugitive dust emissions entrained in the airflow.

Overall it is considered that there is a relatively low potential for nuisance dust to be produced from the site, due to the fact that most of the material is likely to be damp, a large portion of material handling activities occur undercover and the dust producing activities occur at a relatively small scale.

The separation distance between nuisance dust emissions and the proposed residential portion of the PC61 development is greater than 200 m. Generally, nuisance dust effects do not occur greater than 100 - 200 m of a significant dust emission source[1] (i.e. quarries, bulk material handling, unsealed roads, etc).

[1] Cowherd C., Grelinger M.A., Gebhart D.L., "Development of an Emission Reduction Term for Near-Source Depletion" prepared by Midwest Research Institute for US Army Construction Engineering Research Laboratory, 2006

It appears from the video that some of the mixers have spray bars on them which will limit the emissions from this source during material loading and disturbance. Other than this; the partial containment of dust sources, and separation distances, there does not appear to be any other dust mitigation measures in place. It is likely that there are site specific speed limits for on-site vehicles, but NZ Air is unable to confirm or deny this.

Figure 1 presents wind roses from two local weather stations in the vicinity of the site. There are variable wind patterns observed at these stations. However, in both datasets, strong winds (above 10 m/s, annotated as the light blue bar in the wind roses) occur from the north – northwest. During these stronger windspeeds it is more likely that nuisance dust emissions will occur from the site. These wind directions will blow any dust directly towards the proposed PC61 development. The other dominant wind direction is north easterly winds (which occur between 6 – 17% of the time). These winds will blow any dust emissions (with are likely to occur primarily from the western end of the site) across the western end of the PC61 development.

Overall, despite the fact that the dominant wind patterns in the area will blow any dust emissions towards the PC61 development, it is NZ Air's opinion that the separation distances, small scale of the operation, and the fact that a large portion of the process is enclosed will result in a low potential for nuisance dust effects as a result of dust discharges from CCB within the PC61 development.

Figure 1. Local Wind Patterns

Question 3 Response – Background concentrations

NZ Air did not include ambient air quality background concentrations in the NZ Air report.

To estimate the potential background concentrations of air pollutants in the PC61 development, NZ Air has reviewed data in the NZTA background air quality estimator[2].

This tool estimates that the particulate matter less than 10 µm in diameter (**PM_{10}**) 24 hour average background concentration is 18.75 µg/m^3.

The background concentrations for nitrogen dioxide (**NO_2**) in the NZTA estimator are:

- 1 hour average: 37 µg/m^3.
- 24 hour average: 23 µg/m^3.

In the absence of any other available data, NZ Air consider that these estimated background concentrations for PM_{10} and NO_2 are appropriate.

NZ Air is not aware of any available measured background data for carbon monoxide (**CO**) and sulfur dioxide (**SO_2**) surrounding the site, therefore the default background concentrations in the MfE GPG for Industry[3] have been used.

The background ambient air pollutant concentrations used in this assessment are presented in **Table 1**.

Table 1. Background Concentrations (µg/m^3)

Contaminant	Background Concentration µg/m^3
NO_2 (1-hr)	37
NO_2 (24-hr)	23
CO (1-hr)	5,000
CO (8-hr)	2,000
PM_{10} (24-hr)	18.75
PM_{10} (annual average)	15*
SO_2 (1-hr)	20**
SO_2 (24-hr)	8**

*There is no NZTA annual average for PM_{10}, a value of 23 µg/m^3 is considered conservative for this environment.

**Note that there is no SO_2 background for rural environments in the MfE GPG Industry, so the urban values have conservatively been used.

Table 2 presents the modelled peak off-site air pollutant concentrations with the above background ambient air quality concentrations added.

[2] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/air-quality-climate/planning-and-assessment/background-air-quality/

[3] Ministry for the Environment Good Practice Guide for Assessing Discharges to Air from Industry, 2016

Table 2. Modelling Results with Background Values Included (µg/m³)

	PM_{10} µg/m³		SO_2 µg/m³		NO_2 µg/m³		CO µg/m³	
Averaging period	**24 hour**	**Annual**	**1 hour 99.9%ile**	**24 hour**	**1 hour 99.9%ile**	**24 hour**	**1 hour 99.9%ile**	**8 hour**
Max off-site	29.3	4.5	279.9	151.6	45.0	24.4	20.46	15.5
Max in PC61	14.4	1.5	182.2	73.3	29.3	11.8	13.32	9.46
R1	19.7	3.0	164.3	102.3	26.4	16.5	12.01	10.66
R2	9.6	1.0	158.8	49.7	25.5	8.0	11.61	6.2
R3	7.7	0.3	86.6	39.8	13.9	6.4	6.33	4.38
Background	18.75	15	20	8	37	23	5000	2000
Max in PC61 plus background	33.2	16.5	202	81	66	35	5013	2009
Guideline	50	20	350	120	200	100	30000	10000

With the assumed background values included, there is little difference in the overall report conclusions. The peak cumulative ground level concentrations predicted within the PC61 land are all comfortably below the relevant ambient air quality criteria.

Question 4 Response – Odour

There will be minimal odour discharged from the brick manufacturing process. The only potential odour source on-site would be minor odours associated with combustion of fuel in the kilns.

Given the high temperatures that the kilns operate at it is unlikely that there will be any residual odorous compounds emitted from the kiln stacks. When poor grade coal is burnt inefficiently there can be a sulphurous smell. However modern burners are very efficient and this sulphurous odour is less apparent when complete combustion occurs. The current air discharge consent (CRC921703.1) for the CCB site stipulates that the sulfur content in the coal to be burnt is to be no greater than 1.8%.

It is noted that the health based ambient air quality criteria presented in the NZ Air report are all below relevant nuisance odour based criteria for these pollutants. Should any residual odorous compounds be discharged from the combustion of fuels in the kilns, the air dispersion modelling demonstrates that there is substantial dispersion of the emissions from the stack. Ground level concentrations are approximately 3 orders of magnitude lower than that at the emission point.

Therefore, NZ Air consider that any odour discharged from the kiln stacks will be so dilute within the PC61 development that it will be undetectable. Even if very low concentrations of odour were detectable it is unlikely that they would be considered offensive or objectionable.

Closure

If you have any questions about this work, please contact Donovan Van Kekem on 021329970.

Yours Sincerely,

Donovan Van Kekem

Managing Director

NZAIR