#### **BEFORE THE WAIMAKARIRI DISTRICT PLAN REVIEW HEARINGS PANEL**

IN THE MATTER OF the Resource Management Act 1991

AND

- **IN THE MATTER OF** the hearing of submissions and further submissions on the Proposed Waimakariri District Plan
- AND hearing of submissions and further submissions on Variations 1 and 2 to the Proposed Waimakariri District Plan

Hearing Stream 12E: Rezoning Requests

#### FIRST STATEMENT OF EVIDENCE OF CATHERINE ELIZABETH NIEUWENHUIJSEN (ODOUR) FOR RICHARD AND GEOFF SPARK (PDP SUBMITTER 183 / VARIATION 1 SUBMITTER 61)

Dated 4 March 2024

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### QUALIFICATIONS AND EXPERIENCE

- 1. My full name is Catherine (Cathy) Elizabeth Nieuwenhuijsen.
- I am a Principal Air Quality consultant at WSP New Zealand Limited. I have a degree in Chemical and Process Engineering and I am a Certified Air Quality Professional. I have over 20 years' experience in wide range of Air Quality Assessments.
- 3. With regards to odour assessments I have:
  - (a) Been a project manager and a technical lead in preparing assessments for various chicken farms, including Brinks Poultry (Canterbury and Waikato) and Cobb Vantross poultry farm (Waikato).
  - (b) Been an internal technical reviewer for a number of other assessments, including Lamond Poultry (a free-range layer farm) in Christchurch, and working for potentially affected neighbours in undertaking a review of two meat chicken farms in Canterbury.
  - (c) Been the technical lead and Project Manager of assessments on Rendering sites, including Taranaki By-Products, Hawkes Bay Proteins and Tuakau Proteins.
  - (d) Worked as Environment Canterbury's expert for the review of a composting operation, including attending Environment Court Mediation.
  - (e) Assisted with assessment of odour and contaminants from Ravensdown's three fertiliser factories and several Alliance meat processing operations, including rendering/fellmongering and wastewater treatment plants.
  - (f) Reviewer and author of odour assessments for both industrial and municipal wastewater treatment plant operations at various locations in New Zealand.
  - (g) Significant atmospheric dispersion modelling experience and have been technical lead on numerous air quality assessments involving complex dispersion models. These include assessment of energy plant, milk powder driers, pyrolysis plants, generators, and refinery emissions.
- 4. I confirm that I have prepared this evidence in accordance with the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. The issues addressed in this statement of evidence are within my area of expertise except where I state that I am relying on the evidence or advice of another person. The data, information, facts and assumptions I have considered in forming my opinions are set out

in the part of the evidence in which I express my opinions. I have not omitted to consider material facts known to me that might alter or detract from the opinions I have expressed.

5. I have been engaged by the Submitter to provide air quality advice in relation to the proposed rezoning, specifically on reverse sensitivity odour risks associated with residential development in the vicinity of the Rangiora wastewater treatment plant (the WWTP).

# SCOPE OF EVIDENCE

- 6. The scope of my evidence is an assessment of reverse sensitivity effects of odour discharged from the Rangiora WWTP on residential, business, and commercial activities within the proposed rezoning, specifically the need or otherwise for housing to be setback from the Rangiora WWTP.
- 7. In preparing my evidence, I have reviewed the following documents:
  - (a) Submission on Proposed Waimakariri District Plan and Submission on Proposed Waimakariri District Plan Variation 1;
  - (b) Waimakariri District Council (WDC) report
     Activity Management Plan 2021 –

    Rangiora Wastewater Scheme. July 2021;
  - MWH report Application for Resource Consents for Rangiora Wastewater Treatment Plant Upgrade Aeration Basin. Report dated December 2016;
  - (d) Odour complaint records provided by WDC; and
  - (e) Published New Zealand and Australia odour buffer guidelines.
- 8. My evidence is based on a review of the current operation and potential future uses of the Rangiora WWTP, a review of odour complaint records, an assessment of published odour buffer guidelines and prevalent wind patterns and terrain effects.

#### SUMMARY

- 9. I reviewed the consented and existing activity in the vicinity of the proposed rezoning land. The activity includes the Rangiora WWTP, which has the potential to impact the proposed rezoning. I have reviewed the Rangiora WWTP operation, local topography and meteorology, odour complaint records and published separation distance criteria.
- 10. Based on my desk-top based review, I consider the Rangiora WWTP appears to operate within its consent conditions and has included appropriated measures to minimise odour

emissions. The Rangiora WWTP has not resulted in odour complaints since the upgrade of DO probe control was completed.

- 11. My wind pattern analysis indicates the existing residential dwellings at the vicinity of the WWTP could have moderate to high frequencies of being downwind of the treatment ponds during low wind speed conditions. Two sections of the proposed rezoning land (more than 250 m from the WWTP) are expected to be downwind of the WWTP for a moderate percentage, which is similar to the existing medium density houses to the northwest of the WWTP.
- 12. I have also reviewed the separation distance criterion and considered an appropriate buffer between new residential dwellings on the proposed rezoning land and the WWTP is 500 m. I considered residential activities and other activities that are sensitive to odours from the WWTP are unlikely to be adversely affected by odours from the WWTP beyond this distance, therefore new residential dwellings would not increase the sensitivity of the environment, and therefore result in a reverse sensitively effects on the WWTP.
- 13. I consider industrial operation could operate at Area 1 (as shown in Figure 2) in circumstances where these operations are likely to have a low sensitivity to wastewater odour. Note Area 1 is referred to as Block C in Mr Thomson's evidence
- 14. Considering the existing environment already has a number of houses within 250 m to 500 m from the WWTP and there is high sensitivity to odour effects (due to the residential nature of activity), I expect establishment of residential dwellings at Area 2 (250 m to 500 m from the WWTP) would not change the sensitivity of the existing environment. Note Area 2 is a part of Block B in Mr Thomson's evidence
- 15. If Area 3 (also part of Block B in Mr Thomson's evidence) which is more than 500 m from the WWTP, was rezoned to General Residential or Medium Density Residential, I consider that there is low potential for odour impact from the WWTP on the new dwellings or for those new dwellings to result in reverse sensitivity effects that would impact the WWTP operation.

# EVIDENCE

# Proposed Changes to the Proposed Waimakariri District Plan

- 16. The submission on the Proposed Waimakariri District Plan seeks:
  - (a) Rezoning of the land to the south of Boys Road from Rural Lifestyle Zone to Medium Density residential, or alternatively, rezone this land to Medium Density

residential, Business Industrial and Large Format Retail/Mix Use Zone or a mix of them.

- (b) Rezoning of the land to the north of Boys Road from Rural Lifestyle Zone to General Residential.
- 17. I undertook a site visit on 19th January 2023 to review the site layout relative to the Rangiora WWTP.

# Current and future operation of the Rangiora WWTP

- 18. Based on my review of the most recent consent application document and WDC report, I understand the current WWTP consists of inlet screens, a primary aeration basin, two secondary facultative ponds with mechanical aeration<sup>1</sup>, and two maturation ponds with machinal aeration to treat raw wastewater prior to being discharged to the Kaiapoi WWTP wetlands<sup>2</sup>. A sludge disposal area has been established immediately to the north of the maturation pond.
- 19. The WWTP was upgraded in 2018/19 to include the primary aeration basin so as to reduce the Biological Oxygen Demand (BOD) load to the pond system and to eliminate odour effects associated with BOD overload. A second aeration basin is scheduled to be built in 2025/26 to meet an increase demand due to population growth.
- According to the WDC report, the WWTP currently serves a population of approximately 18,000 population, which is expected to increase by 31% by year ten of the 2021-31 long term plan (a population of approximately 24,000 in 2031).
- 21. Odour discharges from the WWTP are authorised under the current air discharge consent for the WWTP (CRC173124, granted in 2017) that will expire in 2038. The consent application document has concluded that the odour from the WWTP would not give rise to adverse environmental effects beyond the WWTP site boundary.
- 22. I consider the dominant odour sources from the WWTP are the aeration basin and treatment ponds. Short periods of odour effects can occur during abnormal operation (e.g., outage of aeration and ponds become anaerobic) and at the time of sludge removal operations. I understand sludge removal from the ponds is scheduled to be undertaken in 2028. The abnormal operation and sludge remove are likely to occur infrequently.

<sup>&</sup>lt;sup>1</sup> According to the WDC engineer, one of the facultative ponds is aerated currently. The other pond can be aerated if required.

<sup>&</sup>lt;sup>2</sup> The spray of wastewater is no longer operated at the WWTP.

- 23. According to the WDC website, the wastewater is predominantly gravity fed to the WWTP. I consider the use of gravity mains minimises the time the sewage stays in the sewer network and therefore the opportunity for the sewage to turn septic and odorous.
- 24. I have reviewed the Dissolved Oxygen (DO) concentrations recorded in 2022 provided by WDC engineer<sup>3</sup>. The DO concentrations were measured at a depth of 100 mm below the pond surface and two samples were taken from each pond between 11 am and 2 pm every seven days. The recorded DO concentrations indicate that the facultative and maturation ponds meet the Consent Condition 2, which requires maintaining DO concentrations at levels of no less 2 g/m<sup>3</sup>, based on the 10<sup>th</sup> percentile of annual results.
- 25. However, the DO concentrations measured at one location in the aeration basin were less than 2 g/m<sup>3</sup> for approximately 30 % of the time in 2022, with a 10<sup>th</sup> percentile value of 1.3 g/m<sup>3</sup>. According to the WDC engineer<sup>4</sup>, the aeration basin was designed to treat wastewater with DO concentrations from approximately 0.6 to 2 g/m<sup>3</sup> and they expected DO concentrations lower than 2 g/m<sup>3</sup> would not cause any issues to the operation of aeration basin. They have noticed this DO probe has been measuring relatively low DO concentrations over the past year and are seeking a variation to allow lower DO concentrations measured from the aeration basin.
- 26. I have also reviewed the testing results of Total Biochemical Oxygen Demond (TBOD) at the inlet of the WWTP provided by the WDC engineer<sup>5</sup>. Three samples were taken from the inlet in 2020 and the average TBOD was 169 g/m<sup>3</sup>, which is equivalent to approximately 130 g/m<sup>3</sup> of 5-day Biochemical Oxygen Demond (BOD<sub>5</sub>). This is expected to be a relatively low strength domestic wastewater stream based on the expected range of 110 to 400 g/m<sup>3</sup> (Metcalfe 1991)<sup>6</sup>. Based on an average daily flow of 6,763 m<sup>3</sup>/day (5-year average), a BOD loading is calculated to be 1,142 kg/day.
- 27. Based on the above, I consider the Rangiora WWTP is generally operating within the consent conditions, except for DO concentrations in the aeration basin. This assessment is based on the WWTP achieving its consent condition requirements.

#### **Topography and Site Wind Pattern**

28. The terrain of Rangiora township is relatively flat. Substantive mountain ranges (over 1,000 m) are more than 24 km to the northwest. I have accessed the meteorological data

<sup>&</sup>lt;sup>3</sup> Email from R Frizzell dated 22 February 2023.

<sup>&</sup>lt;sup>4</sup> Email from R Frizzell dated 1 March 2023.

<sup>&</sup>lt;sup>5</sup> Email from R Frizzell dated 23 February 2023.

<sup>&</sup>lt;sup>6</sup> Metcalfe 1991. Wastewater Engineering – Treatment, Disposal and Reuse, Third Edition. Metcalfe and Eddy Incorporated. Revised by Tchobanoglous G and Burton F L. McGraw-Hill Incorporated, Singapore, 1991.

measured at Rangiora EWS, which is located at the Rangiora WWTP. Wind data from January 2021 to December 2022 was collected from this weather station to develop a local wind rose and to assess the frequency in which the existing dwellings would be downwind of the WWTP treatment ponds. A wind rose plot is shown in Figure 1.

29. Light winds are often associated with worst odour effects, as there is little atmospheric mixing which minimise the ability for odour to disperse and dilute as it moves away from the source. I consider wind speeds that are less than 3 m/s have the greatest potential to cause odour nuisance. Figure 1 shows a high portion of light winds (wind speed less than 3 m/s) from the west, northeast, and south-west. The proposed rezoning lands would not be downwind of the WWTP during these wind conditions.



Figure 1: Wind rose plot for 2021 and 2022.

30. Cold air drainage flow conditions create a greater potential for nuisance odour due to low dispersion. I expect the local katabatic drainage flows would flow from the northwest and down the Ashley River / Rakahuri, towards the coast. These katabatic drainage flows are likely to be associated with light westerly and north-westerly winds observed at night-time at the EWS. The proposed rezoning lands would not be downwind of the WWTP during these cold air drainage flow conditions.

#### **Existing receiving environment**

31. Between 150 m to 500 m from the Rangiora WWTP treatment ponds, there are four and nine isolated dwellings to the south and north of the WWTP respectively. The west of the

WWTP is dominated by industrial and commercial premises, with a number of medium density housing (MDH) to the northwest. Figure 2 shows the location of these dwellings and proposed subdivision in relation to the Rangiora WWTP.



Figure 2: Location of the existing dwellings and proposed subdivision in relation to the Rangiora WWTP.

# **Downwind Frequency Analysis**

32. To understand the potential odour effects on the existing dwellings, the percentage of time that light winds (wind speed ≤ 3 m/s) blowing from the WWTP to the existing dwellings (labelled 1 to 15 in Figure 2) is established in Table 1.

Receptor No.	Distance to the	Directions when	Frequency of
	nearest treatment	downwind of	downwind of WWTP
	ponds (m)	WWTP	(WS ≤ 3 m/s)
1	360	260 °N to 316 °N	17 %
2	300	261 °N to 330 °N	18 %
3	175	282 °N to 8 °N	14 %
4	450	332 °N to 31 °N	7 %
5	250	85 °N to 161 °N	10 %
6	153	162 °N to 251 °N	13 %
7	265	118 °N to 198 °N	7 %
8	325	112 °N to 186 °N	7 %
9	350	107 °N to 174 °N	6 %
10	376	105 °N to 168 °N	6 %
11	418	103 °N to 162 °N	6 %
12	415	124 °N to 183 °N	5 %
13	500	120 °N to 173 °N	5 %
14 (MDHs within 500m	400 – 500	91 °N to 156 °N	8 %
from WWTP)			
15 (MDHs beyond 500m from WWTP)	500 - 700	93 °N to 158 °N	7 %

Table 1: Frequency of receptors downwind of the Rangiora WWTP during light winds (wind speed less than 3 m/s).

- 33. Table 1 indicates the existing dwellings to the immediate south, southeast and northeast of the WWTP (R1 to R3, R5 and R6) have high frequencies of being downwind of the treatment ponds during low wind speed conditions, while the isolated dwellings further away from the WWTP (more than 250 m) will be downwind for a lower percentage of time (less than 7 % of the time). The MDHs within 700 m from the WWTP are expected to experience light winds blowing from the WWTP for approximately 7 to 8 % of the time.
- 34. I have also considered the downwind frequency for the proposed rezoning land to the south of Boys Road. This land is divided into three sections in my analysis in Table 2. The section that is closest to the WWTP (Area 1) is expected to experience highest frequency of light winds blowing from the WWTP, whereas other sections (Areas 2 and 3) have a lower frequency, similar to those MDHs to the northwest of the WWTP and isolated houses that are more than 250 m from the WWTP.
- 35. The proposed subdivision to the north of Boys Road is more than 900 m away from the WWTP ponds. Based on my experience, this distance is sufficient to ensure less than minor odour effects and therefore this land is not considered in this analysis.

Table 2: Frequency of pr	oposed subdivision	n downwind o	of the Rangiora	a WWTP du	ring light v	vinds (less
than 3 m/s).	-		-			-

Proposed subdivision	Distance	to	the	Directions	when	Frequency		of
	nearest	treat	ment	downwind	of	downwind	of	WWTP
	ponds (m	)		WWTP		(WS ≤ 3 m/	/s)	
Area 1 (Block C)	135 - 370			85 °N to 210	0 °N	15 %		
Area 2 (Part of Block B)	250 - 500			126 °N to 2	14 °N	8 %		
Area 3 (Part of Block B)	500 - 900			119 °N to 2 <sup>-</sup>	11 °N	8 %		

### Community feedback – odour complaints

- 36. At the time when the aeration basin and new inlets work were being commissioned in late 2018 and early 2019, the WWTP had received three complaints<sup>7</sup> in relation to odour generated from the WWTP. I was not able to identify the location of the complainants as this information has been redacted.
- 37. I understand these complaints related to an event when the DO probes in the aeration basin read inaccurately and as a result, the aerators were not operating correctly. WDC has solved this issue by upgrading the control of DO probes and there have been no complaints since then.

### Separation Distance Guideline Assessment

- 38. The consent application document for the Rangiora WWTP has not considered the separation distance in the assessment. In my view, separation distance provides a typical albeit usually conservative distance beyond which odour effects are likely to be acceptable given good practice operational. Therefore, this is considered and discussed in my assessment below.
- 39. Separation distance guidelines for WWTPs are usually based on Population Equivalent (PE), which is a measure used to quantify the design load of a wastewater treatment from a variety sources, including domestic and non-domestic (i.e., commercial and industrial). The current operating capacity of the WWTP, as a PE, was not stated in the recent consent applications. For simplicity, my assessment has used the population estimates from the WDC report as a PE, given the domestic population is the dominant user of the Rangiora WWTP.
- 40. I have reviewed and considered the following New Zealand and Australian separation distance guidelines for my assessment:

<sup>&</sup>lt;sup>7</sup> A Letter from WDC on 19 February 2023, responding to the complaint records request from I Xu on 19 January 2023.

- (a) Wickham, L (2012). Separation Distances for Industry. A decision document prepared for Auckland Council (2012). Prepared by Emission Impossible Ltd.
- (b) ACT Australia (2018). Separation Distance Guidelines for Air Emissions, Australian Capital Territory, Canberra, 2018. November 2018.
- (c) South Australia (2019). Evaluation distances for effective air quality and noise management. Issued in August 2016, updated in March 2019.
- (d) Victoria EPA (2013). Recommended separation distances for industrial residual air emissions. Published by EPA Victoria, 2013.
- 41. With the exception of Vic EPA, there is no buffer guidance available for a treatment capacity PE greater than 15,000 from the above sources.
- 42. Table 3 shows separation distance guidelines for two pond systems from the Vic EPA.A PE of 18,000 has been used to identify relevant buffer distance recommendation with respect to the current WWTP operation and a PE of 24,000 used for the future operation.

System	Recommended buffer	Recommended	Notes
	distance – current	buffer distance –	
	operation 18,000 PE	future operation	
		24,000 PE	
Aerobic pondage	671 m	775 m	5 x PE <sup>1/2</sup>
systems			
Facultative ponds	1342 m	1550 m	10 x PE <sup>1/2</sup>

Table 3: Summary of separation distance criteria for relevant wastewater treatment systems (Vic EPA).

- 43. I consider that the Rangiora WWTP is best defined as an aerobic pondage system. This is because of a presence of one aeration basin and four mechanical aerated treatment ponds at the plant. Dissolved Oxygen (DO) concentrations in all the basin and treatments ponds are required to be maintained at levels of no less than 2 g/m<sup>3</sup> as part of the current consent condition (CRC173124). Therefore, the buffer distances that are most relevant for the proposed subdivision are the ones associated with aerated pond systems.
- 44. However, in my view, the buffer distance criteria need to be considered in conjunction with site specific conditions and experience to determine an appropriate distance between the WWTP and residential areas. Site specific conditions I have considered include the WWTP design/operation, wind patterns, community feedback and as I have discussed above.

- 45. The design and operation of the WWTP includes BOD<sub>5</sub> loading and appropriate measures to minimise odour emissions, including the use of aeration basin, the requirement of positive DO and gravity fed wastewater.
- 46. A number of houses have been built at the vicinity of the WWTP, along Marsh Road. These existing houses are expected to be downwind of the WWTP frequently during light wind conditions. House further away (approximately 350m from the WWTP) would experience less frequent winds blowing from the WWTP.
- 47. Based on the above and my experience with similar WWTPs, I consider requiring a separation distance of 670 m to 775 m is likely to be excessive given the site specific conditions discussed above. I expect a distance between residential housing and WWTP of 500 m is likely to be sufficient to minimise the likelihood of adverse odour effects that are minor or more.

### **Recommended Setbacks**

- 48. Given the wind pattern analysis and an appropriate buffer between potentially sensitive receptors, including residential dwellings, on the proposed rezoning land and Rangiora WWTP is 500 m, due to the potential for odour, I do not recommend that residential dwellings are established within Area 1 (Block C).
- 49. I consider light industrial activities are likely to be tolerant of odours from the WWTP and unlikely to experience adverse odour effects if established within Area 1 (Block C). Industrial activities, e.g., storage yards, or other low sensitivity activities are likely to be appropriate in Area 1. Commercial activities, such as supermarkets, cafés and retail, are usually considered to have a similar sensitivity to odours as residential area and therefore I recommend these are established beyond Aera 1.
- 50. The existing environment already has a number of houses within 250 m to 500 m from the WWTP and these are expected to high sensitivity to odour effects (due to the residential nature of activity). Considering Area 2 are expected to be downwind of the WWTP for similar percentage of the time as the existing MDHs, and given the site specific condition and absence of odour complaints post upgrade of DO probe control, I expect rezoning the Area 2 (part of Block B) to Medium Density Residential is unlikely to change the sensitivity of the existing environment from that which is currently established or can be established under the current plan zoning.
- 51. For Area 3 (part of Block B), as outlined above, a separation distance of more than 500 m is considered sufficient to avoid offsite odour effects for the proposed current and future operation of the WWTP given good practice with regard to management.

Therefore, I would not expect rezoning this area to Medium Density Residential, would result in either odour impact on the potential new dwellings or reverse sensitivity effects that would impact the WWTP operation.

# Cathy Nieuwenhuijsen

4 March 2024