WAIMAKARIRI DISTRICT COUNCIL

MEMO

FILE NO AND TRIM NO:	DDS-06-05-01-31-4
DATE:	31 July 2023
MEMO TO:	Andrew Willis
FROM:	Mark Buckley
SUBJECT:	Assessment of Green House Gas Emissions from the proposed Ohoka subdivision.

Introduction

I have prepared this memorandum on behalf of the Waimakariri District Council (**District Council**) in respect of technical related matters arising from the applicant's technical expert on greenhouse gas emission for the Private Plan Change RCP031 (**RCP031**).

In preparing this memorandum I have reviewed the following:

1.1 The evidence of Mr Paul Farrelly;

1.2 The evidence of Mr Tim Walsh;

1.3 NPS-UD; and

1.4 Various scientific publications that are referenced within this evidence.

The memorandum addresses the following matters:

1.5 Assessment of potential greenhouse gas emission associated with the proposed land use change;

1.6 Comments on alternative development locations and housing typology; and

1.7 Assessment against national policy instruments and guidance.

Qualifications and Experience

I hold the qualifications of Bachelor of Science and a Master of Science in Earth Science from Waikato University. I have 30 years' experience working as a Planner in local and central government, and as an Environmental Scientist.

I have worked for past three and a half years I have been employed at Waimakariri District Council as a Principal Policy Planner in the Development Planning Unit and have been involved with the Proposed District Plan.

I have previously been employed as an Environmental Scientist by Wimpey Environmental (UK) and Works Consultancy Services (subsequently Opus). As part of my job I undertook landfill gas investigations, hazard assessments and design mitigation measures from historic and active landfills within London, Edinburgh, Wellington and Porirura City. I also produced a landfill gas report as part of the Sustainable Management Fund project for the Ministry for the Environment. From this research I am well versed in the process of greenhouse gas generation, and movement through soils and cover material.

Land Use Change

Greenhouse gas emissions assessment associated with land use change should be considered across both a short term and long-term basis. In the case of the proposed plan change, the existing rural land use comprises a dairy farm, under which there are existing agricultural greenhouse gas emissions comprising methane, carbon dioxide and nitrous oxide.

Mr Farrelly has calculated the long term GHG emissions associated with the continued operation of the land as a dairy farm and breeding stock. I agree with his approach to the calculation of GHG emissions from the dairy farm, but the information contained within his evidence only gives a value of 1,221 tonnes of CO_2-eq per annum rather than the 1,359 tonnes CO_2-eq per annum in the evidence. It is not clear in his evidence where the extra 138 tonnes CO_2-eq comes from in his calculation, as he has provided a list of exclusions in paragraphs 59 and 60.

Dairy cattle	2,970kg CO2 eq x 270 cows	= 801.9 tonnes CO_2-eq per annum,
Non-dairy cattle	1,828.4kg CO_2-eq x123 cows	=224.89 tonnes CO_2-eq per annum,
Fertiliser	36 tonnes x 5.4 CO_2-eq	=194.4 tonnes CO_2-eq per annum
Total		**=1,221 tonnes CO_2-eq per annum**

I note that in his calculations he has used the fertiliser values comprising non-urea-based nitrogen fertiliser without any urease inhibitors. Urease inhibitors block the activity of enzyme urease, reducing ammonia volatilization and denitrification, and nitrogen loss as ammonia. Although not contributing directly to nitrous oxide, ammonia can act as a secondary source of nitrous oxide[1].

[1] Saggar S. et al, 2013. Quantification of reductions in ammonia emissions from fertiliser urea and animal urine in grazed pastures with urease inhibitors for agriculture inventory: New Zealand as a case study. Science of the Environment 465, pp. 136-146.

It can be reasonably assumed that urease inhibitors will become more common within nitrogen-based fertilisers, forming one of many actions that can occur on the farm to reduce GHG emissions[2].

Mr Farrelly in paragraph 61 has compared GHG from the farming operation against vehicle kilometres travelled and emissions from electricity usage for houses. He states that 1,359 tons of CO2-e is equivalent to 5.1 million vehicle trips. However, while this sounds significant on closer inspection I consider that 5.1 million vehicle kilometres is equivalent to 98,077 return trips to Christchurch CBD, and that this only equates to 117 days of commuting from Ohoka to Christchurch for one car per dwelling across the entire 850 dwellings. This calculation assumes a return trip distance of 51km and one trip per day from each of the 850 households, which I consider is conservative. I note that there are still CO_2 emissions for the remaining 248 days of the year not accounted for in this comparison. Mr Binder has also calculated the likely GHG emissions in his response to the Applicants evidence. While we calculate it slightly differently (as we use different assumptions), our conclusions are similar in that the likely GHG emissions from transport are greater than Mr Farrelly anticipates.

In order to get a more accurate reflection of the impacts in change of land use, the calculations should be averaged over a 10-year period, which could be considered a reasonable period of time for near complete subdivision development (development time of Silverstream and Sovereign Palms). A rough order comparison (See Table 1 in Appendix 1) shows that GHG emissions from the proposed development of a subdivision are approximately 47,152 tonnes CO_2-eq (earthworks, construction of houses, roads and footpaths).

In comparison, at 1,221 tonnes CO_2-eq per annum for the existing farming operation over 10 years is 12,210 tonnes CO_2-eq or 26% of the subdivision land use GHG emissions.

Using Mr Farrelly's calculations the farming production equates to only 29% of the subdivision land use GHG emissions.

Long Term GHG Emissions

Mr Farrelly in paragraph 48 refers to agriculture being the largest contributor of GHG emissions within the Canterbury region. This should not be a surprise given that there are also seven other regions in New Zealand where agricultural GHG emissions are also the major contributor. The agricultural emissions should be weighed up against the fact that Canterbury also produces 80% of the country's wheat, 69% barley, 60% oats and has just under 20% of the country's dairy herd.

[2] Leahy S.C. et al. 2019. Mitigating greenhouse gas emissions from New Zealand pasture-based livestock farm systems. Journal of New Zealand Grasslands, Vol 81, pp. 101-110.

Agricultural emissions from the existing dairy operation assuming no change in management or reduction in methane emissions from use of methane inhibitors, will be 1,221 tonnes CO_2 eq as calculated above.

For a new subdivision most of the long term GHG emissions are associated with vehicle emissions, energy consumption, human sources and reduction in soil sequestration.

Using Mr Farrelly's electricity figures from paragraph 61.2 in his foot note 5, the total GHG emissions from electricity usage would be 872 tonnes per year.

Using Mr Farrelly's vehicle emissions figures from paragraph 61.1 and assuming a 50% uptake of EV vehicles (which I consider is an optimistic assumption), the annual CO_2 eq emissions could be 1,991 tonnes CO_2 eq per year.

The approximate long-term annual GHG emissions from the subdivision will be 2,863 tonnes CO_2 eq per year. Meaning that GHG emissions from the farming operation equates to only 43% of the emissions associated with the proposed subdivision per annum. As such, the change in land use will not result in a reduction in GHG emissions.

Alternative Locations

I note the argument that 'people have to live somewhere' has been used to justify a change in land use. While this may have merit, would not the same argument be equally as relevant for GHG emissions from agricultural production – the livestock has to go somewhere. Moving an agricultural operation onto marginal land, assuming that all easily developable land has been used, may actually result in an increase in GHG emissions. These could come from increased fertiliser usage to bring the land up to a production level similar to the present operation, increased travel time for products to processing centres and market. I note that there is no guarantee that the proposed reduction in farming output on the site will not be provided somewhere else in the district, New Zealand, or overseas at some point in the future as there remains demand for the product.

Mr Farrelly in his evidence [para 76] referred to a paper that showed the lifetime emissions per square metre for a multistorey apartment are higher than a detached and medium density dwelling. The study used a limited sample of one apartment building and one medium density building upon which to base its conclusions on. While the study concluded that on a square metre basis apartment unit would result in a higher lifetime emission, on a per unit basis the opposite was true, in that each apartment unit contributed only 16 tonnes CO_2eq compared to 35 tonnes CO_2eq for a detached dwelling at the 1.5°C climate target. I note that the stated comparison, while interesting, is not necessarily relevant for the likely situation in Ohoka. A more accurate comparison would be comparing a standalone single-family dwelling in Ohoka with a more dense / medium density development in Rangiora, Kaiapoi or Christchurch. Based on recent residential development within the District, multi storey apartment buildings are unlikely to be built in the District in any great numbers any time soon. In paragraph 76 of Mr Farrelly's evidence, he seems to suggest that the lifetime emissions for detached housing and medium density housing is actually the same (13 kg CO2-e/m^2/yr). As such, it appears that there is no actual difference in the lifetime emissions for the types of buildings most likely to occur within the District for the foreseeable future.

While it is recognised that new developments are required to address the housing shortfall, the location of new housing developments can influence the amount of GHG emissions being generated. The location of any new housing development should form part of any decision-making process when looking at a well-functioning urban environment and consideration under Policy 1(e) of the NPSUD.

GHG emissions from new housing development in Ohoka will not be the same as if that housing has been provided in Rangiora, Kaiapoi or Christchurch. Key differences between the location are around residential density, the utilisation of existing infrastructure, vehicle distances travelled (access to services, public transportation), and effects on the wider environment (reverse sensitivity effects on neighbouring agricultural production).

High density development near the centre of Christchurch City will result in lower GHG emissions in the following areas compared to a development over 20km from Christchurch:

- Earthworks;
- Materials transportation;
- Infrastructure development (roads, footpaths etc);
- Long term vehicle emissions;
- Loss of soil carbon storage; and
- Loss of productive land.

Intensification within Rangiora or Kaiapoi would also provide similar benefits to that of Christchurch, except transportation emissions are likely to be higher due to Rangiora being 3km further away from Christchurch, while Kaiapoi is 5km closer to Christchurch. Both Rangiora and Kaiapoi have existing public transport systems that connect to Christchurch.

Higher levels of residential density contribute towards lower GHG emissions[3][4]. Normal et al (2006) found that high density development was 2 to 2.5 times more energy efficient and lower in GHG emissions than low residential density. In this study higher density development was apartment blocks, as against the medium density residential development proposed by the RM Amendment Act. Although a study by Birchmore (2018) [5] found energy costs for medium density housing was less than that of low-density housing.

Conclusion

Mr Farrelly in paragraph 141 of his evidence states: "*that the conversion of the proposed land from rural to residential development, enabled by PC31, will lead to a reduction in emissions…*" As presented above, the change in land use from agriculture to residential will not reduce GHG emissions but will in fact increase emissions during development and on an ongoing basis.

Lower GHG emissions are associated with housing intensification, use of public transport and better utilisation of existing infrastructure. While the 'houses have to go somewhere', the proposed location will result in more GHG emissions than other more centrally or better transport connected locations that support higher density-built outcomes.

The GHG emissions from the existing land use is only 29% of those generated by the proposed development and equivalent to 43% of the ongoing annual emissions.

There is no guarantee that the loss of agriculture on the site will not be undertaken elsewhere, and therefore the anticipated reduction in GHG emissions cannot be confirmed.

The proposed development fails to meet Policy 1(e) by being a well-functioning urban environment and supporting the reduction in greenhouse gas emissions.

[3] Sun C., *et al*. 2022. The impacts of urban form on carbon emissions: A comprehensive Review. *Land*, 11, 1430. https://www.mdpi.com/2073-445X/11/9/1430 accessed 10 January 2023.

[4] Norman J. et al. 2006. Comparing high and low residential density: Life-cycle analysis of energy and greenhouse gas emissions. *Journal of Urban Planning and Development*, Vol 132, No 1, pp. 10-21.

[5] Birchmore, R. (2018). Medium-density dwellings in Auckland and the building regulations. Unitec ePress Occasional and Discussion Paper Series (2018:2). Retrieved from http://www.unitec.ac.nz/ epress.

Appendix 1: Table 1. GHG Emission calculations.

GHG Components		**Existing Farming Operation**	**GHG Components**		**Proposed Subdivision**
270 Dairy cattle	2,970kg CO_2 eq per cow	801.9 tonnes CO_2 eq per year	Earthworks (34ha dwelling + 8ha roads)	8kg CO_2 eq per m^2	3,360 tonnes CO_2 eq
123 Non-dairy cattle	1,828kg CO_2 eq per cow	224.8 tonnes CO_2 eq per year	Houses (850) construction	145kg CO_2 eq per m^2	24,403 tonnes CO_2 eq
Fertiliser use 36 tons/year	5.4kg CO_2 eq per kg fert	195 tonnes CO_2 eq per year	Road and footpath construction	1,699 tonnes CO_2 eq/km road 19.4 kg CO_2/km footpath	19,389 tonnes CO_2 eq
Annual farming Total		**1,221.7 tonnes CO_2 eq per year**	**Development total**		**47,152 tonnes CO_2 eq**