



Ōhoka Greenhouse Gas Emission Review

Prepared for Waimakariri District Council
Prepared by Beca Limited

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Executive Summary

This report reviews the evidence related to Greenhouse Gas (GHG) emissions provided by the proponent for the development proposed at Ōhoka in the District Plan Review hearing (Hearing Stream 12D – Ōhoka).

The proposed development seeks to rezone the site from Rural Lifestyle Zone into a combination of Settlement Zone, Large Lot Residential Zone, Local Commercial Zone and Natural Open Space Zone with overlays providing for a polo field, associated facilities and educational facilities.

This analysis has focused on traffic and GHG impacts of the activity proposed by the submitter, but has not considered any planning consideration of the specific zoning requested.

The submitter's GHG assessment suggests that the proposal would align with the Objective in the National Policy Statement on Urban Development (NPS-UD), that planning decisions support a reduction in GHG emissions.

In reaching this conclusion the submitter's assessment implies comparison of the proposal against three potential baseline scenarios, namely:

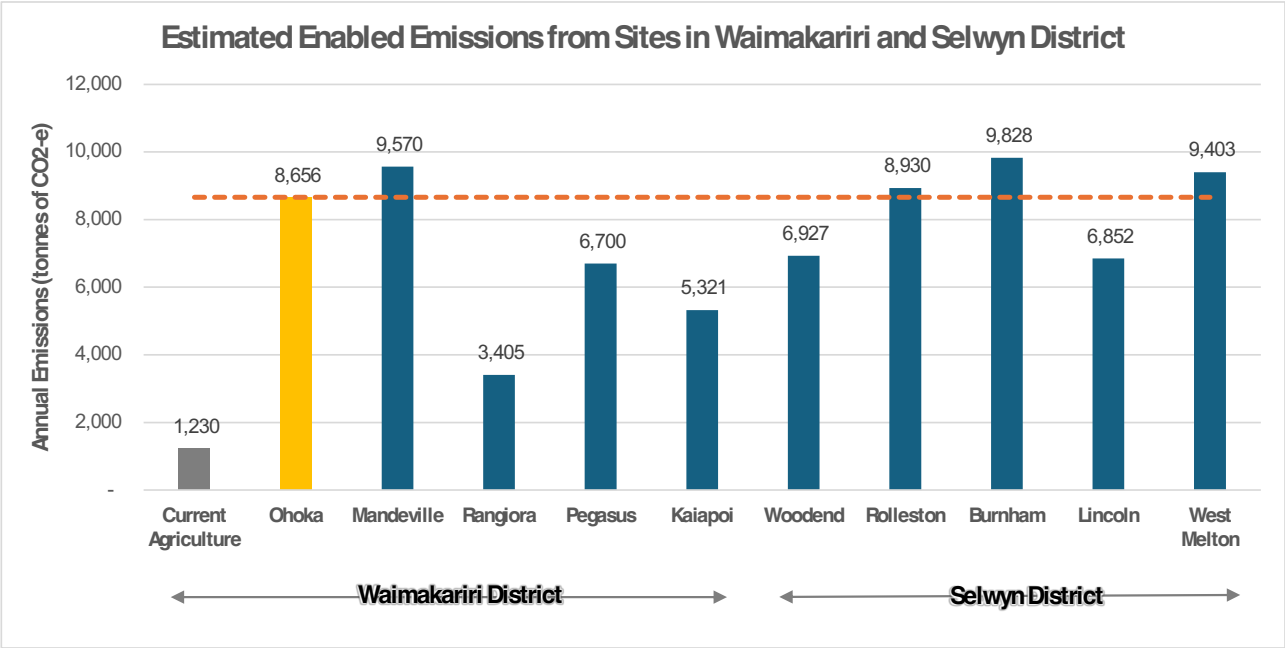
- Baseline 1: continuation of the current agriculture use
- Baseline 2: The same type and scale of development but without proposed design features that would support the reduction of GHG emissions (e.g. provision of cycling facilities, tree planting and banning of gas appliances);
- Baseline 3: The same type and scale of development at alternative sites elsewhere in Waimakariri or Selwyn Districts.

The assumptions required for Baseline 1 to be valid are considered highly unlikely and Baseline 2 is not considered suitable for the purposes of land use planning decisions of the development itself. Baseline 3 is considered a relevant baseline scenario.

The comparative assessment of embodied emissions for the development is highly sensitive to the urban form the site is compared to. Any such comparison is considered best done on a per unit rather than the per m² basis suggested in the submitters evidence. The available research indicates that on a per unit basis, low density, detached housing such as proposed for this site has higher embodied carbon than apartment or medium density units.

In terms of Baseline 1, the emissions from the existing agricultural use is estimated to be some 1,230 tonnes CO₂-e per year while enabled vehicle emissions associated with the development are estimated to be significantly higher at some 8,656 tonnes per annum.

Baseline 3 comparisons of enabled vehicle emissions for the same scale of development in other locations were estimated as per the following figure.



This comparison suggests that the vehicle emissions for this site would be higher than locations closer to existing centres such as Kaiapoi, Rangiora, Woodend or Pegasus, but could be lower than locations even further from the main Christchurch urban areas such as Mandeville, West Melton or Burnham.

Given these high-level findings, it is considered that there is insufficient evidence to support the submitters claim that the proposed development at the Ōhoka rezoning site “*supports a reduction in GHG emissions*” (as per NPS-UD Policy 1(e)). In fact, this review indicates that the GHG emissions associated with this proposal would be higher than either the existing agricultural land use or similar scale development in planned growth areas in existing centres such as Kaiapoi, Rangiora, Woodend or Pegasus. Only if compared against similar development in areas even more remote from the main Christchurch urban areas would this site be likely to have lower GHG emissions.

1 Introduction

Beca Limited (Beca) has been commissioned by Waimakariri District Council to provide a review of the Greenhouse Gas (GHG) emissions assessment related to the development proposed at Ōhoka as proposed by a submitter to the District Plan Review hearing ([Hearing Stream 12D – Ōhoka](#)).

The submission provides evidence associated with a proposed urban development at Ōhoka that was subject to a separate private plan change (PC31).

The scope of this report is a review of the evidence related to GHG emissions provided by the proponent of the development. This has included a review of the following assessments in the evidence of Mr Paul Farrelly for the submitter:

- The assessment of agriculture emissions of the existing use of the site;
- The assessment of embodied emissions related to the physical materials and resources involved in the creation of the proposed land use;
- The assessment of emissions enabled by the land use change, specifically as relates to vehicle emissions associated with the land use;
- Various baseline (or ‘counter-factual’) scenarios against which the development was assessed; and
- Assessment against the policies and objectives of the National Policy Statement on Urban Development (NPS-UD), as relates to planning decisions supporting reductions in greenhouse gas emissions.

These assessments are focused on traffic and GHG impacts of the activity proposed by the submitter, but has not considered any planning consideration of the specific zoning requested. This review has also relied on details of the proposal (e.g. assumptions of development size) provided in the submitter evidence of the following experts:

- Evidence of Mr Paul Farrelly (for GHG);
- Evidence of Nicholas Peter Fuller (for transport);
- Evidence of Tim Walsh (for planning);
- Evidence of Jeremy Phillips (for planning).

Although the focus of the review is the proposal put forward by the submitter, this review has also considered the response provided by the council through the previous PC31 process, namely:

- Memo from Mr Shane Binder (for transport)
- Memo from Mr Mark Buckley (for GHG)

The report presents its findings in the following sections:

- Summary of submitter evidence;
- Discussion of baseline for comparison (i.e. counter-factual scenarios);
- Review of carbon effects for agricultural, embodied and enabled emissions;
- Review of the proposal against NPS-UD requirements, to support reductions in greenhouse gas emissions; and
- Conclusion.

2 Summary of Submitter Evidence

This section summarises the submitter evidence around the following points:

- The proposed development details,
- Emissions from the existing agricultural land use activity,

- Embodied and operational emissions associated with the development and operation of the urban environment,
- Emissions enabled from the development, namely vehicle emissions from the residents and visitors to the site. This included comparison with similar development at other locations,
- NPS-UD – Consideration of the NPS-UD for land use planning decisions to support reductions in greenhouse gas emissions.

The relevant source of information is included in footnote.

2.1 The Proposal

The proposal seeks to rezone the area at 535 Mill Road inside Ōhoka. Ōhoka is a small rural settlement in the Waimakariri District Council area, north of the Christchurch City Council area. The proposed development for the site, as depicted in Figure 1¹, seeks to rezone the site from Rural Lifestyle Zone (‘RLZ’) into a combination of Settlement Zone (‘SETZ’), Large Lot Residential Zone (‘LLRZ’), Local Commercial Zone (‘LCZ’) and Natural Open Space Zone (‘NOSZ’) with overlays providing for a polo field, associated facilities and educational facilities².



Figure 1 – Outline Development Plan for Ōhoka

For the respective zones, the sizes of the proposed development are summarised in the table below.

¹ Appendix 1 of evidence of Nick Fuller.
² Paragraph 40 of evidence of Tim Walsh.

Table 1 – Development Size Proposed by Zone

Zone	Development Size
SETZ	<ul style="list-style-type: none"> Approximately 704 residential allotments, minimum allotment size being 600m² (of which, 55 standard residential units may be replaced by 220 units of retirement units) 250-pupil primary school or 42 additional residential units³
LLRZ	<ul style="list-style-type: none"> Approximately 146 residential allotments, with allotment size ranging from 2,500m² to 3,300m²
LCZ	<ul style="list-style-type: none"> A cap of 2,700m² gross floor area (GFA) of retail activities
NOSZ	<ul style="list-style-type: none"> Ecological restoration and protection, and for recreation and connectivity

The earliest establishment of dwellings at the site is estimated to occur in 2028.⁴

2.2 Agricultural Emissions

In Mr Farrelly's evidence on agricultural, emissions from the farming operation on the existing site were calculated using guidance provided by the Ministry for the Environment (MfE). In Mr Farrelly's evidence, as a comparator to the agricultural emissions estimated, the equivalent number of vehicle kilometres travelled were stated, and the equivalent emissions from average annual electricity usage of households in Canterbury were also stated.

In Mr Buckley's GHG memorandum the agricultural emissions estimation by Mr Fuller were reviewed, resulting in a minor difference in the overall agricultural emissions estimation. Mr Buckley's GHG memorandum Appendix 1 provided an estimation of the embodied emissions of proposed development and used this as a comparator.

These estimates are discussed further in the following sections.

2.3 Embodied and Operational Emissions

Mr Farrelly's statement provides lifetime emissions for multi-storey apartment (AP), (medium density (MDH) and detached housing (DH) typologies from a 2020 industry study, noting that *'On a per m² basis, across a 90-year period, the lifetime emissions are highest for multi-story apartments (21 kg CO₂-e/m²/yr) when compared to lifetime emissions for detached housing and medium density housing (13 kg CO₂-e/m²/yr).'*

Mr Buckley's GHG memorandum notes that *'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'*.

These estimates are discussed further in the following sections.

2.4 Emissions from Transportation

2.4.1 Vehicle Generation

With the potential of a primary school and retirement village, three development options for the land have been assessed for transport impact, they were⁵:

- **Option 1:** Up to 850 dwellings plus a commercial zone and a 250-pupil primary school;
- **Option 2:** Up to 892 dwellings plus a commercial zone; and
- **Option 3:** As per Options 1 and 2, although with an allowance to replace one dwelling with four retirement villas.

³ Paragraph 50 of evidence of Tim Walsh.

⁴ Paragraph 77 of evidence of Nick Fuller

⁵ Paragraph 15 of evidence of Nick Fuller

In Mr Fuller's evidence for the submitter, a residential traffic generation rate of 8.2 vehicles per day was assumed and agreed with WDC⁶. The evidence also stated that these options would be likely to generate similar amount of traffic from the rezoning site to the wider area. The evidence assumed that the commercial area would not draw traffic to the site from the wider area and no dedicated traffic generation has been assumed. The total traffic generation from the rezoning site in Mr Fuller's evidence was estimated to be 7,480 vehicles per day⁷.

While we question some of these assumptions (such as the commercial area not generating any vehicle trips of its own), the overall vehicle trip generation rate seems reasonable for the purposes of this GHG assessment, particular in the context of the comparative analysis against other locations discussed later in this report.

2.4.2 Avoided Vehicle Emissions through use of Walking and Cycling

The evidence for the submitter by Mr Fuller also outlines proposed walking and cycling facilities proposed within and adjacent to the site, along with a discussion about future cycle facilities to be provided by WDC connecting the site to existing locations such as Kaiapoi. He notes that this internal and (assumed future) strategic cycle network would "...place the Site within an approximately 10km cycle from the centre of Rangiora and 9km from the centre of Kaiapoi. These distances would take approximately 30 minutes to cycle, so they are achievable (particularly with the take up of ebikes), although I accept that it is unlikely that many residents would choose to cycle for purposes other than recreation."

The proposed internal and adjacent cycle networks would be useful in terms of recreational use and general accessibility for the site, but are unlikely to make a material difference to vehicle use of its residents. Although not explicitly stated, it is assumed this was considered when a net vehicle trip generation rate was agreed with WDC.

We consider that the agreed vehicle trip rate is suitable for the use in estimating comparative GHG transport emissions, with no further reductions needed to reflect the proposed cycle facilities.

2.4.3 Avoided Vehicle Emissions through use of Public Transport

The evidence of Mr Simon Milner outlines the proposal by the submitter to provide bus services between the site and Kaiapoi, allowing onward connections via existing services between Kaiapoi and other locations. He concludes that, in regard to the NPS-UD policies and objectives, "...the proposed rezoning of the Site will be 'well-serviced by existing or planned public transport' and will achieve 'good accessibility for all people by way public transport'".

In terms of enabled transport emissions, the attractiveness (and hence use), of such public transport services is relevant in regard any impact on the likely use of private vehicles. The proposal suggests these would be electric buses so the emissions from the bus services themselves is less relevant. The evidence has not presented forecast patronage on the new services. The proposed services, with 30-minute peak frequencies and need to transfer to onward services from Kaiapoi would mean they are unlikely to be an attractive alternative for those with ready access to cars, and therefore only likely to be used by a small proportion of residents.

The proposed services, while useful in terms of accessibility, are therefore unlikely to make a material difference to vehicle use from the site. Although not explicitly stated, we assume this was considered when a vehicle trip generation rate was agreed with WDC.

⁶ Paragraph 65 of evidence of Nick Fuller

⁷ Paragraph 70 & 71 of evidence of Nick Fuller

We consider that the agreed vehicle trip rate is suitable for the use in estimating GHG transport emissions, with no further reductions needed to reflect the proposed bus services.

2.4.4 Consideration of Greenhouse Gases

Mr Farrelly mentioned that due to difficulty in accurately calculating future GHG emissions⁸, the likely enabled emissions raising from the traffic generated was estimated. However, he made the following points in relation to the potential reduction of enabled emission in the future:

- The total emissions resulting from current activity on the farm per annum (1,230 tonnes) is equivalent to 4.9 million vehicle kilometres travelled in a typical New Zealand vehicle (using the MFE's default private car emission factor (2023) per km of 0.252kg)⁹.
- A number of measures (enforceable via a binding legal instrument) are proposed for the rezoning site, to support the reduction of GHG emissions¹⁰.
- Emissions from transportation related to the rezoning request are a function of the mode of transport, distance travelled and frequency of travel.¹¹ The distance travelled varies by trip purpose and are assessed at a high level in three categories of commercial/recreation, work and education.¹²
- With cycling and public transport improvements in the area, vehicular journey to work trips are likely to drop due to mode shift to public transport, carpooling, cycling and working from home. With expected raise in electric vehicle (EV) uptake, the average emission rate of vehicular trips is also likely to drop¹³.
- For alternative location considerations, the type of buyers if they were unable to purchase a section in Ōhoka, would look elsewhere in the Waimakariri or Selwyn District.

2.5 NPS-UD Considerations

The NPS-UD requires planning decisions to contribute to well-functioning urban environments, which are environments that “support reductions in greenhouse gas emissions” (Policy 1(e))¹⁴. In his evidence, Mr Farrelly considered that Policy 1(e) is not intended to mean that an absolute reduction in greenhouse gas emission is required¹⁵, and provides assessment of the proposal against the existing land use activity and provides discussion of the likely transport emissions of a similar development located elsewhere in the region. He concludes that:

“...the rezoning request development contributes to a well-functioning urban environment that ‘supports a reduction in GHG emissions’ (as per NPS-UD Policy 1(e)) due to both the removal of dairying activity from the land, and the practical steps being undertaken by the submitters to support a reduction in emissions arising from the development”.

This conclusion regarding a reduction in GHG is therefore based on, and sensitive to, the baseline against which the proposal is assessed. This is discussed in the following section.

3 Discussion of Baseline

The NPS-UD policy relates to planning decisions so requires an assessment of the proposal against a relevant baseline, in order to assess if there is likely to be a reduction in greenhouse gas emissions.

⁸ Paragraph 23 of evidence of Paul Farrelly

⁹ Paragraph 43.1 of evidence of Paul Farrelly

¹⁰ Paragraph 32 of evidence of Paul Farrelly

¹¹ Paragraph 69 of evidence of Paul Farrelly

¹² Paragraph 73 of evidence of Paul Farrelly

¹³ Paragraph 81, 83, 84 & 88 of evidence of Paul Farrelly

¹⁴ Paragraph 17 of evidence of Paul Farrelly

¹⁵ Paragraph 20 of evidence of Paul Farrelly

The baseline requires particular attention when considering housing development for a future, growing population. Given the cumulative, global impact of GHG emissions and the context of these planning decisions impacting the future environment, the most valid baseline is considered to be a future scenario with similar global population. That is, the proposal with future, new residents should not be compared against the current-day population. Mr Farrelly appears to agree with this where he notes that any greenfield development would not meet NPS-UD requirements, if Policy 1(e) were to mean that an absolute reduction in GHG emissions is required and this was a net increase in development rather than replacement for similar development elsewhere.

Mr Farrelly appears to have assessed the proposal against three different baseline scenarios:

1. Business as usual (**BAU**) – continuation of the current agriculture use and the development does not happen anywhere;
2. The same type and scale of development but without proposed design features that would support the reduction of GHG emissions (e.g. provision of cycling facilities, tree planting and banning of gas appliances);
3. The same type and scale of development at alternative sites (**AS**) elsewhere in Waimakariri or Selwyn Districts.

Baseline 1 is only considered valid if the development and the associated demand for housing of this type would not appear elsewhere, and the displaced agricultural use would not be possible elsewhere. This baseline implies a net reduction in dairy activity and a net increase in urban development and population (i.e. swapping population for dairy cows). This relies on an assumption that there is no other capacity available for either equivalent dairy use or urban development elsewhere, which is not considered plausible. As such this is not considered a relevant baseline for this planning decision, except in the unlikely event that this assumption can be proven. Notwithstanding this concern, this review has considered the relative GHG emissions of the existing and proposed activities.

Baseline 2 assumes that the same proposed activity would take place, but without suitable mitigating design features. This is not considered a valid baseline for the purposes of planning decisions on whether to allow for the development in the first place.

Baseline 3 is considered the most relevant and intuitive scenario for the assessment of NPS-UD requirements.

4 Review of Carbon Effects

Taking account of the submitted evidence and the considerations for suitable baseline to assess NPS-UD Policy 1(e) against, this section summarises the review of carbon effects for the agriculture, embodied and enabled emissions. It covers the following emissions categories:

Agricultural emissions – Farm-related GHG emissions emitted (for example from animals, manure management, and nitrogen fertiliser) or absorbed (sequestered in forests or vegetation).

Embodied and operational emissions – Embodied (or embedded) emissions are the GHG emissions resulting from manufactured products and materials used in construction of the built environment. Operational emissions are the GHG emissions resulting from the energy use of a building during its operation. Combined, the sum of embodied emissions plus the sum of the operational emissions constitutes 'total emissions in the built environment'.

Enabled emissions – Emissions resulting from the public use of infrastructure (for example tailpipe emissions as a result of vehicle kilometres travelled (VKT)).

4.1 Agricultural Emissions

A comprehensive and detailed analysis of the agricultural emissions estimations provided by Mr Farrelly has not been undertaken, however the methodology used by the Mr Farrelly to calculate agricultural emissions is in alignment with standard industry practice.

We are broadly in agreement with Mr Buckley's response approach and statements relating to agricultural emissions. A detailed review of the embodied GHG emissions calculations in Appendix 1 of Mr Buckley's memorandum has not been completed, however we note that if the operational emissions of the development were to be added to the embodied emissions estimation already provided, this would further increase the development related GHG emissions over the 10-year period.

As noted above, baseline 1 is not considered a likely or valid comparison. Even if this were valid, given the existing use of any alternative sites is not known, if there was agricultural use at these sites then emissions could be higher, lower or similar.

4.2 Embodied and Operational Emissions

When considering the proposed development site against counterfactual sites in other locations, the main factor that would have an impact on the embodied and operational emissions would be:

- housing typologies and density within the development.

Other considerations that may affect the overall embodied emissions for a development include:

- land typology and topography,
- any infrastructure provision required around the site to support the development.

In the absence of detail relating to these factors for alternative sites, it is not possible to determine whether the embodied and operational emissions would be higher or lower than the proposed development, as this would be highly dependent on the above-mentioned factors. Studies relating to estimations of embodied and operational emissions for different housing typologies (for example low, medium, high density) are limited for the New Zealand context. As such, the industry study referenced in Mr Farrelly's statement can be considered as a useful industry reference point.

Mr Farrelly's statement provides lifetime emissions on a per m² basis. A per unit measure would be a more appropriate comparison and using this alternative metric, the industry study referenced indicates that on a per unit basis, both an apartment unit and a medium density housing unit have lower embodied and operational emissions than a detached house.

4.3 Enabled Emissions from Transportation

Mr Farrelly did not estimate total emissions from transport, but seems to imply these would be similar to the current agriculture emissions. However, simple calculations using the submitter's data can be used to back-calculate the implied vehicle trip length for this to be true:

Table 2 – Transport Emissions Calculation – Daily and Annual Rate

Transport Emissions ¹⁶	Calculation	Value
Daily per km	7,480 trips per day × 0.252kg CO ₂ -e per km	1,885kg CO ₂ -e per day
Annual per km	Daily × 300 days ¹⁷	565 tonnes per year

This indicates that, if the total emissions were to be no worse than the BAU baseline scenario (1,230 tonnes per annum), the average trip length of all traffic associated with the development would need to be less than 2.2km. This is approximately the distance from Mill Road (at Bradleys Road) to the existing residential development in Ōhoka (at Modena Place). This is considered extremely short and extremely unlikely.

Even if the emission rate for the residents’ vehicles dropped by as much as 20%¹⁸ from current averages to take account of the increase in EV uptake and change in fleet composition in the future, this still implies that the average trip length must be less than 2.8km. This is also considered implausible short given the distance of the development from a wide range of social, educational and economic services and opportunities.

To estimate the likely trip length and enabled emissions, the strategic transport model (Christchurch Transportation Model V21a) is used. That model estimates future travel patterns in response to land use and transport inputs. This is understood to be the same model used in the evidence of Mr Fuller to estimate the distribution of development traffic to the surrounding road network.

The following map shows the daily average trip length from light vehicles, estimated by the model for 2028, from sites located in the vicinity of Ōhoka or locations with similar a rural-settlement context.

¹⁶ From proposed land use, based on assumptions used in the existing evidence
¹⁷ As the daily number usually represent a normal week day, which generally had more trips than the weekend or public holidays, a annualisation factor less than 365 (days in a year) and higher than 250 (working days in a year) is applied to convert from daily to annual.
¹⁸ Based on VEPM 6.3, the emission factors for light vehicles are expected to drop between 11% to 18% from 2018 to 2031.

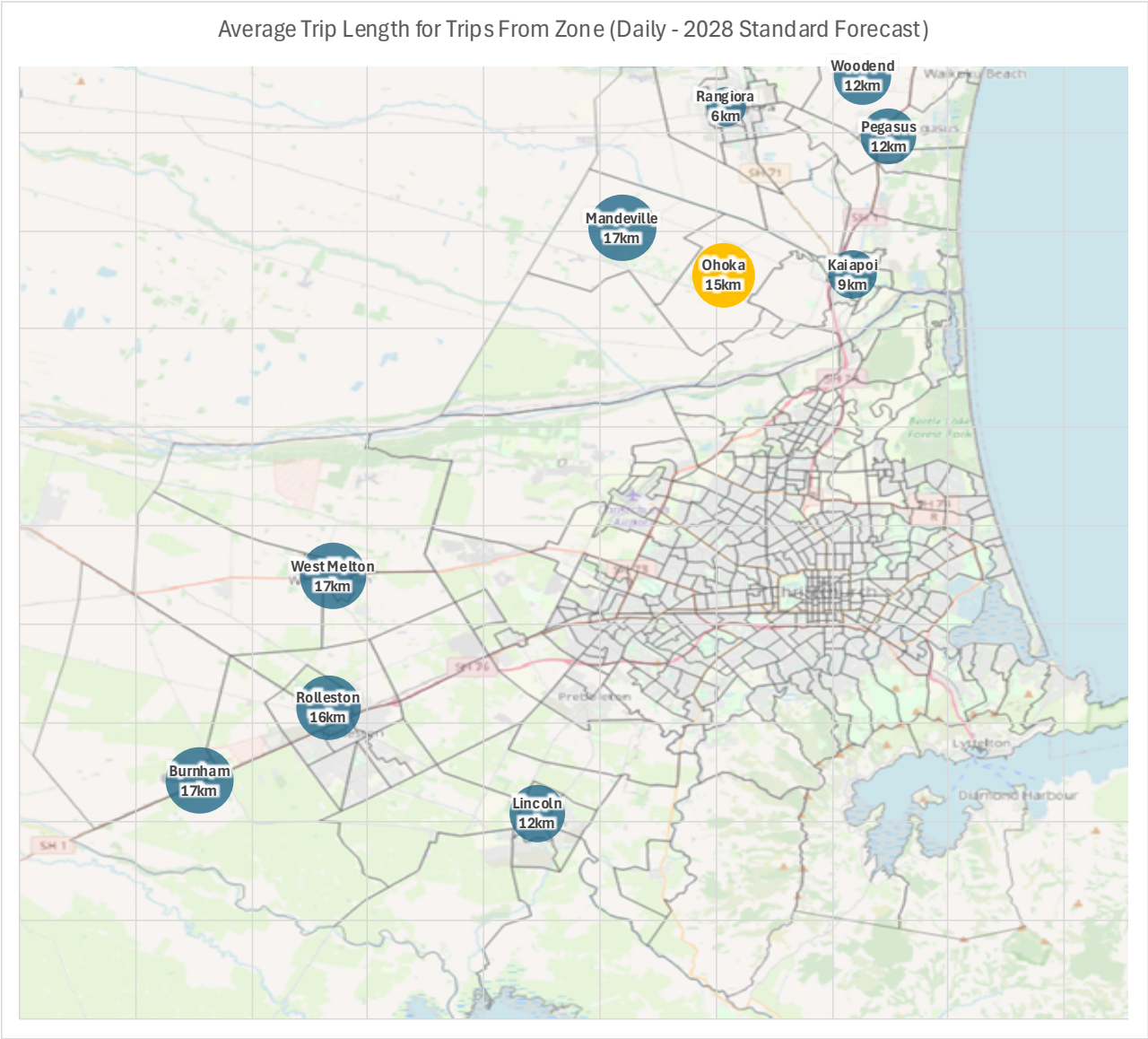


Figure 2 – Daily Average Trip Length from Zone around Greater Christchurch Region (based on 2028 modelled results)

As indicated by the map, even for well-established townships like Rangiora and Kaiapoi, the average trip length from these locations is between 6km to 9km respectively. The neighbouring settlement of Mandeville is estimated to have a daily average trip length of 17km. All of which were higher than the derived trip length of under 3km from the data referenced in the submitter’s evidence.

Using the trip length data and the transport emission rate for the proposed development (i.e. 565 tonnes per year per km in **Table 2**), the following graphs depict the expected annual enabled emissions for a number of sites in Waimakariri and Selwyn District.

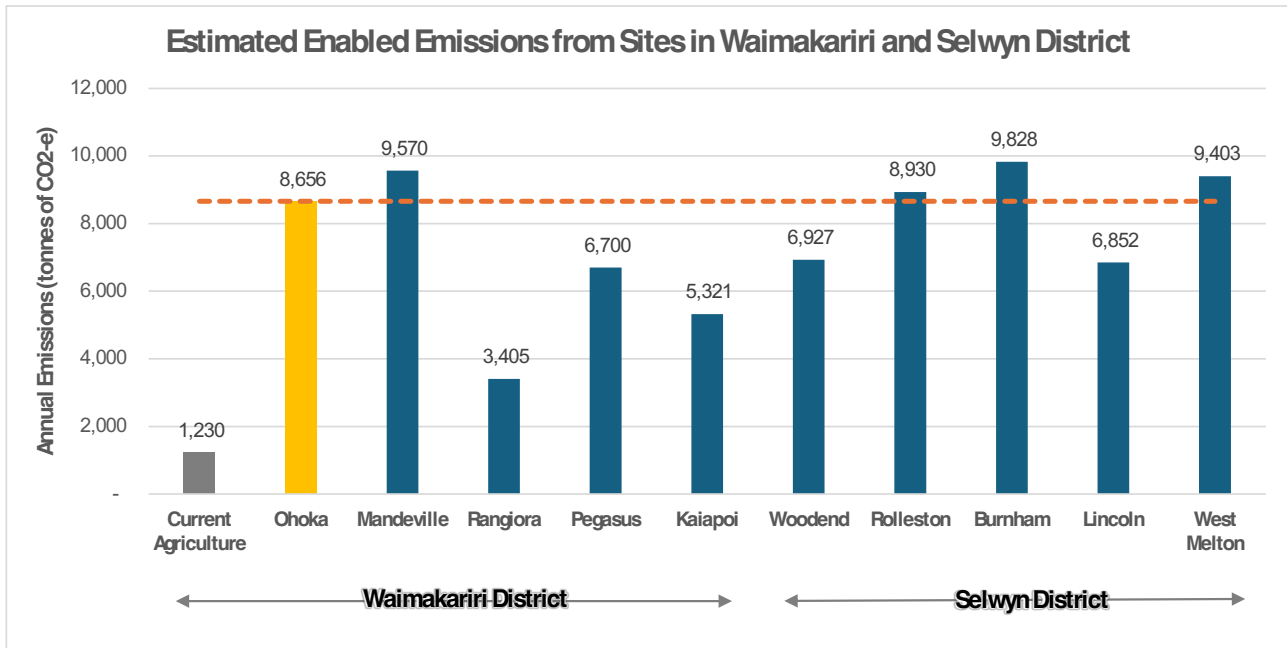


Figure 3 – Estimated emissions from transport based on 2028 modelled daily average trip length – ordered by distance to the Christchurch CBD

As shown in the figures, emissions from current agriculture activity (as per the submitter's evidence, and highlighted in grey in the graphs) is significantly lower than emissions estimated for Ōhoka and all other alternative sites. The estimated emissions for the proposed development at Ōhoka is higher, compared to alternative sites in Rangiora, Pegasus, Kaiapoi, Lincoln and Woodend, while slightly lower than sites in Mandeville, Rolleston, West Melton and Burnham.

5 Conclusion

The specific conclusions of this analysis are as follows:

- The submitters GHG assessment implies comparison of the proposal against three potential baseline scenarios, namely:
 - Baseline 1: continuation of the current agriculture use
 - Baseline 2: The same type and scale of development but without proposed design features that would support the reduction of GHG emissions (e.g. provision of cycling facilities, tree planting and banning of gas appliances);
 - Baseline 3: The same type and scale of development at alternative sites elsewhere in Waimakariri or Selwyn Districts.
- The assumptions required for Baseline 1 to be valid are considered highly unlikely and Baseline 2 is not considered suitable for the purposes of land use planning decisions of the development itself. Baseline 3 is considered a relevant baseline scenario;
- The emissions from the existing agricultural use of some 1,230 tonnes CO₂-e per year is considered appropriate;
- The comparative assessment of embodied and operational emissions for the development is highly sensitive to the urban form the site is compared to. Any such comparison is considered best done on a per unit rather than the per m² basis suggested in the submitter's evidence. The available research indicates that on a per unit basis, low density, detached housing such as proposed for this site has higher combined embodied and operational carbon than apartment or medium density units;

- The submitters proposal for cycle facilities and public transport services are considered useful in terms of recreational use, amenity use and general accessibility for the site, but are unlikely to attract sufficient regular usage to make a material difference to vehicle use of its residents;
- The submitters adopted net vehicle trip rate is considered suitable for use in estimating comparative GHG transport emissions, with no further reductions needed to reflect the proposed cycle facilities or bus services;
- The enabled vehicle emissions associated with the development are estimated to be in the order of 8,656 tonnes per annum;
- Comparisons with the same scale of development in other locations suggest the vehicle emissions for this location would be higher than locations closer to existing centres such as Kaiapoi, Rangiora, Woodend or Pegasus, but could be lower than locations even further from the main Christchurch urban areas such as Mandeville, West Melton or Burnham;
- The development is therefore likely to have significantly higher GHG emissions than the existing land use and higher than equivalent developments in planned growth areas closer to existing centres such as Kaiapoi, Woodend or Rangiora;

Given these high-level findings, it is considered that there is insufficient evidence to support the submitters claim that the proposed development at the Ōhoka rezoning site “*supports a reduction in GHG emissions*” (as per NPS-UD Policy 1(e)). This review indicates that the GHG emissions associated with this proposal would be higher than either the existing agricultural land use or similar scale development in planned growth areas in existing centres such as Kaiapoi, Rangiora, Woodend or Pegasus. Only if compared against similar development in areas even more remote from the main Christchurch urban areas would this site be likely to have lower GHG emissions.