Sunfield Masterplanned Community

Enabled Transport Emissions Assessment

Stantec

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Executive Summary

Winton Land Limited intend to submit a substantive application to the New Zealand Government for the proposed Sunfield development as a listed project under the Fast-track Approvals Act. Sunfield's innovative and inherently sustainable design promotes a car-less living model, supported by a 15-minute neighbourhood framework, an autonomous solar powered electric shuttle fleet (Sunbus), and well-integrated cycling and pedestrian infrastructure. These features are expected to significantly contribute to reduced private vehicle ownership and reliance, and associated fuel consumption for residents, contributing to a reduced emissions footprint compared to a conventional community development.

This document presents a high-level comparative Greenhouse Gas (GHG) emissions assessment, specifically considering enabled (user) transport emissions associated with private vehicle use by Sunfield residents. The intent of the comparative analysis is to assess Sunfields' enabled emissions reduction potential, based on the strategic car-less design, and limited proportion of residential lots within the development that have the ability for car ownership (just 10% of the 3,204 residential lots), compared to a Base Case scenario. The Base Case development has been established utilising the same number of lots within Sunfield and applying a business-as-usual assumption of private vehicle ownership, based on the conventional proportion of Auckland households that have access to one or more private vehicles.

The proportion of residential lots that have the ability for car ownership (i.e. the ability to park a car onsite) is the key differentiating factor in estimating Sunfield's enabled emissions reduction potential against the Base Case. Assumptions used to inform the assessment including the number of residential lots, Vehicle Kilometer Travelled (VKT) per day per household, and proportional number of cars per dwelling (where allowable), are consistently applied to both Sunfield and the Base Case to enable a direct comparison for future years 2038 and 2048.

The findings of this assessment indicate that enabled emissions associated with private transport fuel are estimated to be approximately 90% lower than those of the Base Case scenario, as illustrated in Figure 1 below.

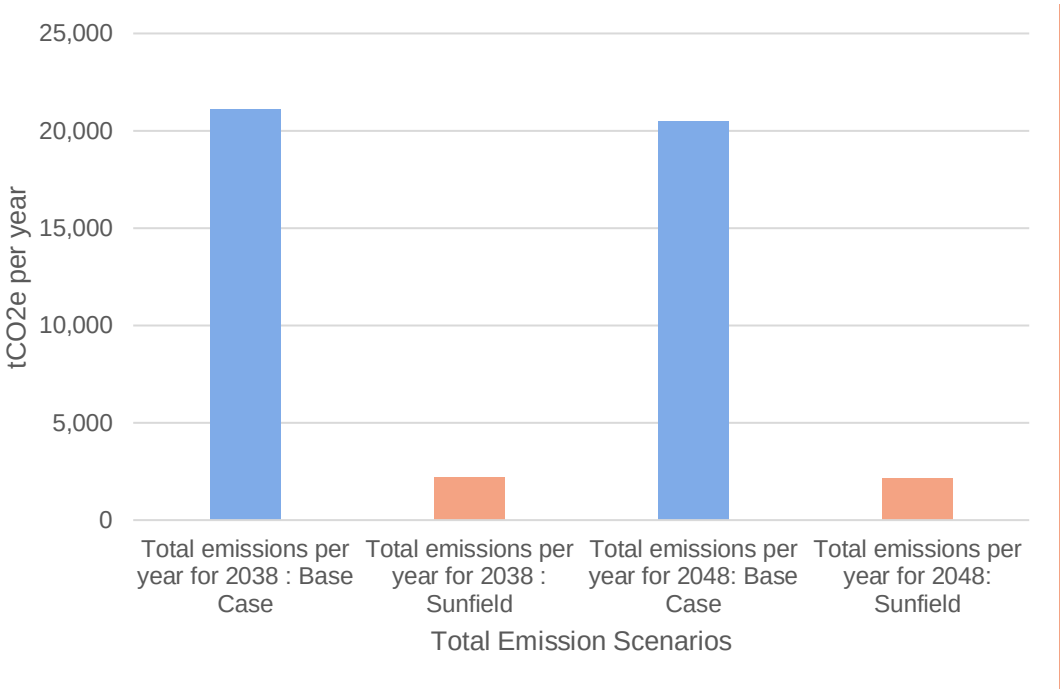

Figure 1 Sunfield and Base Case enabled transport emissions scenarios for 2038 and 2048

This substantial reduction is driven by the development's low car ownership model, which contrasts with the prevailing car dependency in Auckland, where 93% of households have access to at least one vehicle, and 60% have access to two or more. The analysis highlights the significant sustainability benefits of Sunfield's design and transport strategy, aligning with broader national and global decarbonisation objectives. By minimising reliance on private vehicles, Sunfield demonstrates a scalable and impactful approach to reducing transport-related emissions, setting a precedent for sustainable urban development in New Zealand.

Acronyms / Abbreviations

Acronym / Abbreviation	Full Name
CO_2e	Carbon Dioxide Equivalent
EECA	Energy Efficiency and Conservation Authority
EV	Electric Vehicle
GHG	Greenhouse Gas
MSM	Macro Regional Model
Stats NZ	Statistics New Zealand
VKT	Vehicle Kilometers Travelled

1 Introduction

This high-level Sunfield Enabled Transport Emissions Assessment has been prepared for Winton Land Limited to support their substantive application to the New Zealand Government for the proposed Sunfield development as a listed project under the Fast-track Approvals Act. The proposed Sunfield community comprises 244.5-hectares of land, underpinned by several inherent sustainable design principles, including the objective to be a 15-minute neighbourhood, provision of significant green space including 27 hectares of land that will be dedicated to open space, recreation areas, stormwater mitigation and ecological restoration areas, and the innovative car-less design, facilitating a modal shift away from private vehicle reliance in alignment with global and national GHG emissions reductions targets.

The focus on enabled (user) emissions from private vehicles within this report compliments Stantec's *Sustainability and GHG Emissions Assessment Report*, where a high-level GHG emissions assessment has been completed including consideration of key identified capital and operational emissions sources.

1.1 Scope and Objective

The aim of this report is to provide a high-level comparative assessment, specifically exploring *enabled*[1] emissions associated with Sunfield transport fuel emissions, and the potential emissions reductions based on the ability for private car ownership for dwellings (i.e. the ability to park a car onsite at a residential lot), against a Base Case scenario. These two scenarios are further defined below:

- Scenario A: The proposed Sunfield development, where 10% of the 3,204 residential lots have the ability for car ownership.
- Scenario B: A conventional development of the same scale as Sunfield (3,204 lots), applying 'business as usual' assumptions in relation to car ownership (adopting the *2023 Census* findings that 93% of Auckland households have access to at least one motor vehicle and over 60% have access to two or more).

It is acknowledged that GHG emissions associated with vehicles encompass various lifecycle stages including materials manufacture and transport (upfront GHG emissions), the use stage (enabled emissions) and recycling and disposal (end of life emissions), however, the scope of this assessment solely considers the enabled emissions associated with the use stage for future years 2038 and 2048, applying a consistent set of assumptions (where applicable) to each scenario outlined above.

[1] Infrastructure Australia defines enabled emissions as *emissions generated from third parties using infrastructure*.

For both scenarios, transport fuel emissions due to private vehicles has been informed by average daily travel demand forecasts generated by Auckland Forecasting Centre's (AFC) Macro Strategic Model (MSM), based on an analysis of average Vehicle Kilometer Travelled (VKT) per household.

Further detail in relation to the assumptions and data utilised to inform this assessment is outlined within Sections 2.1 and 2.2.

1.2 Project Description

Winton Land Limited is proposing to deliver Sunfield, a unique, forward thinking master planned community development located in Takanini. The proposed community comprises 244.5-hectares of land, with the objective to be a 15-minute sustainable neighbourhood, enabling car-less living. The development includes approximately 3,400 individual homes, 3 retirement villages, employment, retail, healthcare and education precinct, a 7.6 town centre, a school, retail hubs throughout the community, and 27.7 hectares of open spaces, green links, recreation parks and reserves and ecological offsets, including extensive restoration and native planting of the core stream and wetland network. Figure 2 below provides an illustration of the Sunfield master plan.

Figure 2 Sunfield Development Indicative Master Plan

Sunfield's eight core design principles encompass: Enable Car-less living, Kaitiakitanga, Live Local, Just Transition, Diverse Lifestyle Choices, Connected with the Natural Environment, Low Impact and Sustainable and Work Local.

This assessment report focuses on the car-less design aspect of the Sunfield development, which is a cornerstone of its innovative, sustainable design. The 15-minute neighbourhood design and inclusion

of all local amenities within close distance of households, enables this core principle to take effect. In addition, a comprehensive network of walking, cycling and public transport links including the Sunbus EV fleet will further support the developments car-less dwelling design. With only 10% of households expected to own a private vehicle, Sunfield's masterplan is purposefully designed to significantly reduce reliance on private cars. The reduction in private vehicle reliance is anticipated to have a positive impact on the development's overall GHG emissions, aligning with its commitment to low-impact, sustainable living. This report specifically examines how this unique feature of Sunfield contributes to measurable GHG emission reductions compared to a more traditional suburban development model.

1.3 New Zealand Transport GHG Context

According to Ministry of Transport (2024), transport emissions are the fastest growing source of GHG emissions in New Zealand, with light vehicles making up 11.6% of the overarching 40% GHG footprint contribution from energy-related emissions. At a household scale, transport is the largest contributor to consumption-based emissions, with a contribution of 31% to the overall household GHG emissions footprint (Stats NZ, 2023). The scale of the impact associated with private vehicle use can be linked to the findings that approximately 93% of Auckland households have access to at least one motor vehicle and over 60% have access to two or more (Property Economics, 2024).

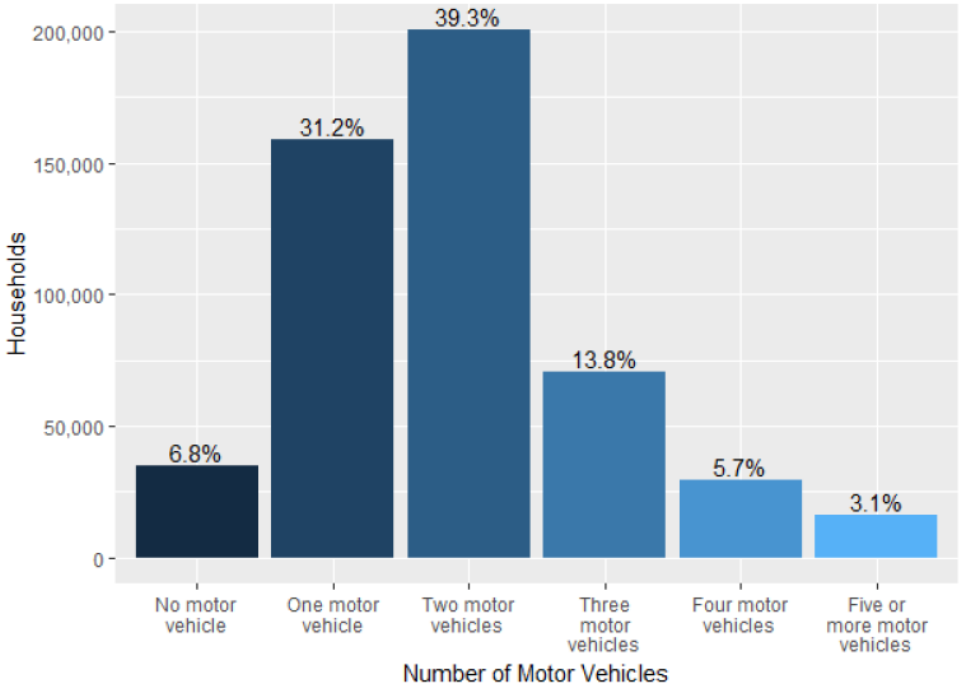

Figure 3 Number of motor vehicles per household Auckland, Stats NZ Property Economics 2024

A further breakdown of the transport GHG emissions footprint per Auckland household is illustrated in Figure 4 below, demonstrating that petrol and diesel usage contribute most significantly to the overall

transport footprint per household.

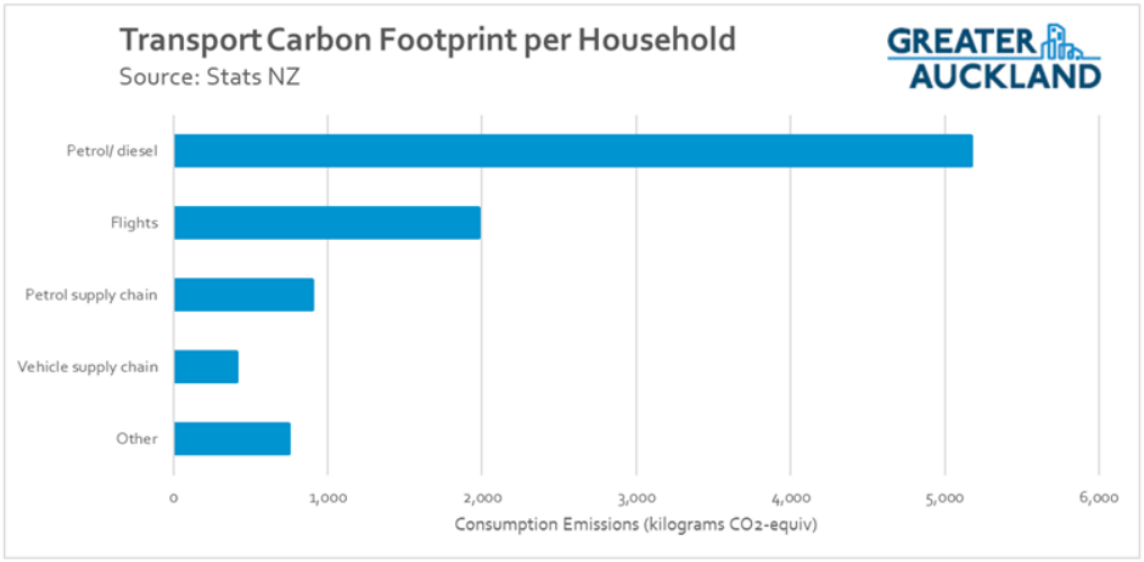

Figure 4 Transport carbon footprint per household New Zealand, (Greater Auckland, 2020)

1.3.1 Electric Vehicle (EV) Uptake

In 2022, New Zealand had 4.6 million vehicles, up from 2.8 million in 2001. Fossil fuel-powered vehicles still dominate, though EV and hybrid adoption has risen since 2016. Despite growth, EVs made up less than 2% of the light fleet, while petrol hybrids accounted for 3.8%. To reach the government's target of 30% zero-emission vehicles by 2035, uptake must increase significantly. As of 2022, Auckland had approximately 19.4 EVs per 1,000 people, the highest rate in New Zealand.

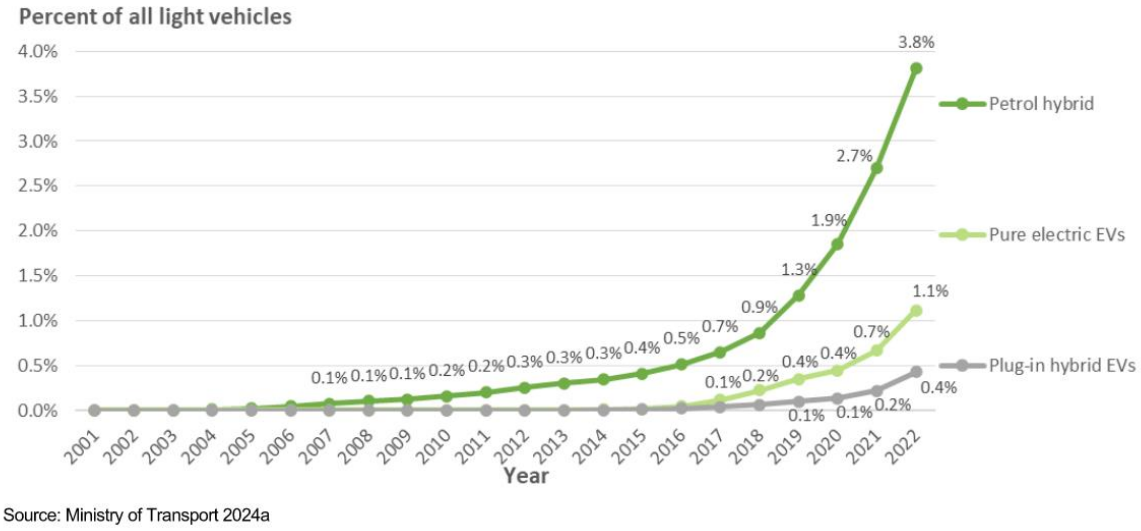

Figure 5 Electric and petrol Hybrid vehicles as percentage of the light fleet, 2001-2022 (Ehinz Surveillance, Environmental Health Intelligence New Zealand, 2022)

2 GHG Emissions Assessment

2.1 Methodology

Stantec have prepared a GHG emissions assessment in order to evaluate the estimated *enabled* GHG emissions associated with transport fuel emissions from private vehicles for the proposed Sunfield development, compared to a conventional development of the same scale. The methodology used to undertake the assessment has been adapted from the *'Measuring emissions: A guide for organisation: 2024 Detailed Guide'*, Ministry of Environment (May 2024), aligning with the following key and widely recognised standards:

- GHG Protocol Corporate Accounting and Reporting Standard
- ISO 14064-1:2018

The estimated transport fuel emissions for both scenarios have been calculated based on the following equation, (sourced from *Measuring emissions: A guide for organisation: 2024 Detailed Guide'*, Ministry of Environment (May 2024)), with data sources utilised to inform the variable inputs further detailed below:

Transport fuel emissions (kg CO_2e per year) = Quantity of fuel used (litre) x Emissions factor (kg CO_2e per litre) [Equation 1]

Data Input: Quantity of Fuel

The quantity of fuel used has been calculated based on an analysis of average VKT per day per 'residential' household (a product of the average distance travelled and average number of vehicles per household), informed by travel demand forecasts generated by Auckland Forecasting Centre's (AFC) Macro Strategic Model (MSM). In order to ensure the data was representative of a residential development within Auckland, 'residential zones' were defined as 80% residential and 20% employment zone. Projections for VKT per residential household present the average daily VKT for previous projects which met the defined 'residential' zone criteria. The forecasts generated by AFC provide consistent assumptions about future land use, economic conditions, transport policies and infrastructure investments. It is important to note that this data is based on an average from previous projects; therefore, while representative of a residential community, the nuances and efficiencies embedded within the design of Sunfield (such as accessibility to employment and retail precincts), have not been specifically modelled. Further, internal trips within residential zones are excluded from the model outputs. Therefore, the inputs used to inform *quantity of fuel used* does not consider various trips purposes where the origin and destination are in the same zone (i.e. residential community).

The table below provides the VKT for each future year adopted for the purposes of this assessment, noting the VKT in 2048 is projected to be lower than 2038, likely due to worsening congestion.

Table 1 Average daily VKT per household

Year	Average Daily VKT/Household
2038	71
2048	69

The *quantity of fuel used* variable within Equation 1 has been informed by the results from Equation 2 and 3, described below. Distance per day (km) (Equation 2) is based on the VKT outputs in Table 1.

Litres per day = Distance per day (km) x Fuel efficiency (l/100km)/100 [equation 2]

Litres per year = Litres per day x 365 [equation 3]

Data Input: Emission Factors

The emission factor (kg CO_2e per litre) has been sourced from Table 4 within *Measuring emissions: A guide for organisation: 2024 Detailed Guide'*, Ministry of Environment (May 2024), as detailed within Table 2 below.

For simplicity, the emissions factor for *regular petrol* has been selected and applied to the total *quantity of fuel used* figure. Therefore, for the purposes of this assessment, 100% of cars are assumed to use regular petrol under both the Sunfield and Base Case scenario (though diesel has been included below for reference).

Table 2 Transport fuels emissions factors (adapted from Ministry of Environment (May 2024))

Fuel Type	Unit	kg CO_2-e/unit	Uncertainties
Transport Fuels			
Regular petrol	Litre	2.37	± 1.6%
Diesel	Litre	2.68	± 0.7%

It is noted that emissions factors will vary for future years 2038 and 2048, however, this assessment has relied on information available at the time of undertaking.

2.2 Inputs & Assumptions

Table 3 below provides a breakdown of the data inputs and assumptions adopted for the Sunfield development (Scenario A) and the Base Case (Scenario B). The Base Case scenario is assumed to represent a typical New Zealand development with higher vehicle ownership, in line with data from Auckland, where a significant percentage of households own one or more cars. A consistent set of assumptions has been adopted where applicable to enable a direct comparison, including the number of residential lots, the quantity of fuel used (litres of fuel per vehicle per year) and the proportional number of cars per household between the Sunfield development and the Base Case scenario.

Table 3 Data used for GHG emissions assessment for Sunfield and Base Case

Data Type	Data	Notes
Scenario A: Sunfield Development		
Number of lots within Sunfield Development	3,204 lots	Based on the latest available Indicative Master Plan issued 12/12/2024
Percentage of lots that have the ability to have car ownership	10%	Based on the latest available Indicative Master Plan issued 12/12/2024
Number of lots that have the ability to have car ownership	320	Based on the above data
Total neighbourhood area (ha)	81.23	Based on the latest available Indicative Master Plan issued 12/12/2024
Housing typology split: Number (and percentage of total)	2B: 618 (19%) 3B: 1695 (53%) 4B: 177 (6%) 4B+: 714 (22%)	Based on the latest available Indicative Master Plan issued 12/12/2024
Total number of cars	512	Based on the 320 lots total owning a car (of which 60% have 2 or more and the remaining own 1 car, based on current Auckland averages).
Scenario B: Base Case		
Number of lots	3,204 lots	Consistent with Sunfield
Percentage of lots that have the ability to have car ownership (1 car)	93%	Number of households in Auckland that have access to 1 car (*2023 Census* as outlined within Property Economics *Embracing a Car-free future*).
Percentage of lots that have the ability to have car ownership (2 cars)	60%	Number of households in Auckland that have access to 2 car (*2023 Census* as outlined within Property Economics *Embracing a Car-free future*).
Number of lots with 2 or more cars	1922	Based on the 60% Auckland statistic owning 2 or more cars.
Number of lots that own 1 car	1057	Based on the remainder of 60%, totalling the 95% of Auckland owning at least 1 car.
Total number of cars	4,902	Based on 3204 lots of which 2980 lots have 2 or more cars.

Table 4 below provides the data for the fuel consumption used for both scenarios analysis.

Table 4 GHG Assessment Analysis - Data Input

Data Type	Data	Notes
Average fuel consumption	7 litres/100km	(Morley, 2024) (Based on small city hatchback)
Daily fuel consumption 2038	4.97	Litres used per household per day
Daily fuel consumption 2048	4.83	Litres used per household per day
Yearly fuel consumption 2038	1814	Litres used per household per year
Yearly fuel consumption 2048	1763	Litres used per household per year

3 Greenhouse Gas Assessment Results

3.1 Comparative Analysis Outcomes

The results of the assessment for Sunfield and the Base Case scenario in 2038 and 2048 are outlined in Table 5 below. As outlined, and further illustrated in Figure 6 (overage), Sunfield's enabled emissions are estimated to be approximately 90% lower than a conventional (Base Case scenario) development, when solely considering the proportion (10%) of residential lots that have the ability for car ownership (i.e. the ability to park a car onsite at a dwelling) within Sunfield, compared to the current car ownership statistics in Auckland.

Table 5 Total emissions for Base Case and Sunfield for 2038 and 2048

Total emissions per year	Sunfield (Scenario A)	Base Case (Scenario B)
Total emissions per year 2038 (tCO_2e/year)	2,201	21,076
Total emissions per year 2048 (tCO_2e/year)	2,139	20,482

As previously noted, for simplicity, the emissions factor for *regular petrol* has been selected and applied to the total *quantity of fuel used* figure, therefore, the figures above assume 100% of cars use regular petrol. This assumption has been applied to both the Sunfield and Base Case scenario for consistency, however, realistically a proportion of vehicles rely on other higher emission fuel types such as diesel. The intent of this assessment is to consider the proportional difference between Sunfield and the Base Case, therefore, these figures should not be relied on definitively.

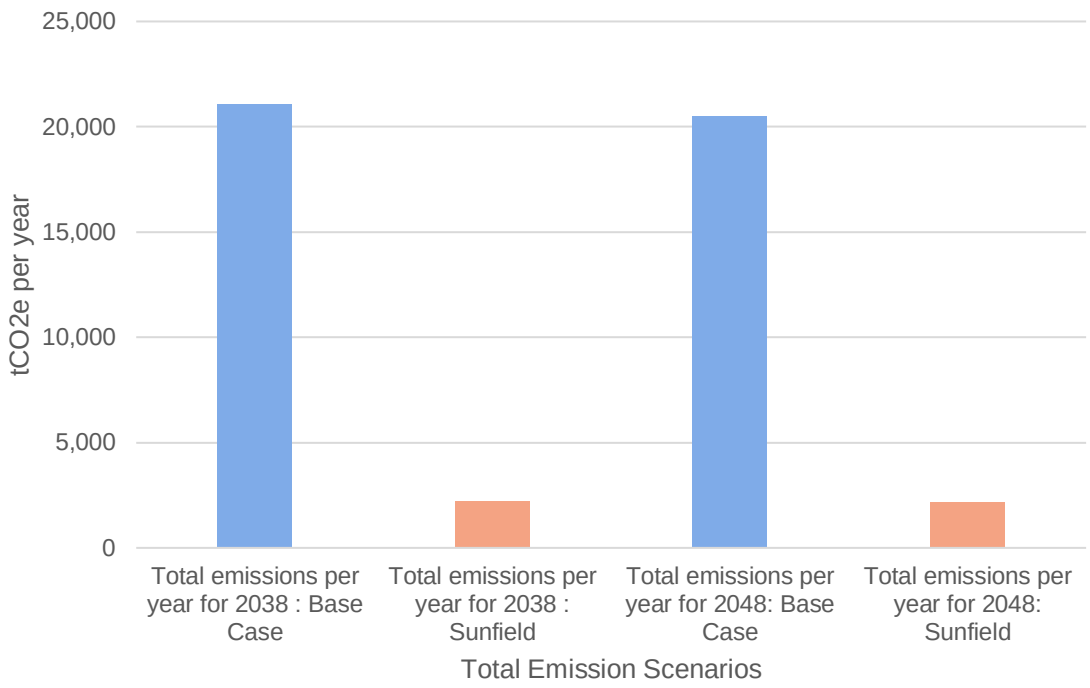

Figure 6 Total Emissions for Base Case and Sunfield 2038 and 2048

It is important to note that this assessment has been carried out solely considering the proportion of residential lots that have the ability for car ownership against a Base Case scenario, and other factors may vary the results discussed within this report (refer to the Limitations discussed within Section 5).

3.2 Sensitivity Analysis

It is important to understand that GHG emissions estimates have a large degree of uncertainty due to various factors including the availability of data, geographic representation of data, assumptions, limitations associated with the scope of the assessment. Various studies have discussed the uncertainty associated with GHG assessments, including a recent study (Stephan et al., 2022) which states that an uncertainty of ±20% should be used for operational GHG emissions results. Figure 7 highlights the sensitivity and uncertainty associated with the results.

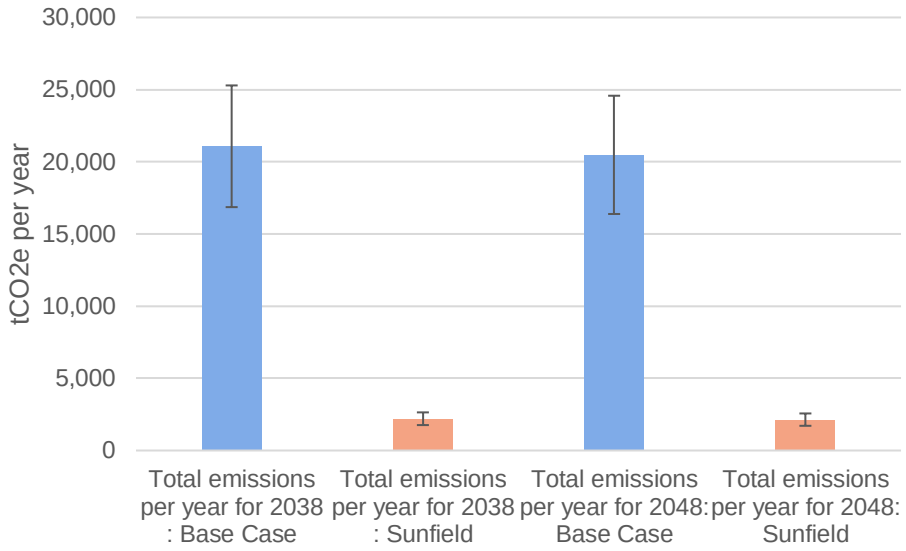

Figure 7 Uncertainty range of results

3.3 Future Considerations

Future considerations and additional factors that may influence enabled emissions both for Sunfield and in a Base Case scenario which have not been considered in this assessment are discussed below. For example, by 2038, it is possible that a significant portion of Auckland's vehicle fleet could be electric, and increase in uptake of EV's would likely further decrease the estimated enabled emissions, both for Sunfield and in the Base Case scenario.

Table 6 Future scenarios affecting enabled emissions

Scenario	Details	Impact on Results	Increase or Decrease in GHG Emissions
High EV Adoption	A greater proportion of residents adopt electric vehicles (EVs), reducing emissions per km compared to internal combustion engine vehicles (ICEs).	Reduced emissions from transport	Decrease
Increased Public Transport Usage	Development of effective and accessible public transport reduces reliance on private vehicles, cutting transport-related emissions.	Reduced car dependency	Decrease
Slow EV Charging Infrastructure Rollout	Lack of sufficient EV charging infrastructure discourages EV adoption, maintaining reliance on ICE vehicles.	Continued high emissions	Increase

Scenario	Details	Impact on Results	Increase or Decrease in GHG Emissions
Delayed Decarbonisation of Grid	A slower transition to renewable energy for electricity generation increases the lifecycle emissions of EVs compared to their potential.	Higher emissions from EV charging	Increase
Policy Interventions	Government policies promoting active transport, EV subsidies, or fossil fuel taxes reduce transport-related GHG emissions.	Reduced reliance on private cars	Decrease
Behavioural Change in Residents	Education and incentives encourage residents to adopt greener transport habits, such as carpooling, cycling, or remote working.	Reduced car dependency	Decrease
Population Growth	Increased population leads to more households, potentially more vehicles, and more traffic. However, if the growth is in higher-density areas with good public transport, this can reduce car reliance.	Higher demand for private vehicles; potential increase in emissions	Increase or Decrease (depends on density and public transport development)
Increase in One-Person Households	A rise in one-person households may increase the number of cars per household, as individuals may prefer to own a car for convenience. Smaller households might also be less likely to adopt shared transport solutions.	Increased car ownership per capita, leading to higher emissions per person	Increase
Decrease in Diesel Car Uptake	A reduction in the uptake of diesel cars, particularly for private vehicles, would lower emissions, as diesel engines typically emit more GHGs than petrol or electric alternatives.	Lower emissions from private vehicles, particularly in the long term.	Decrease

4 Conclusion

Stantec has undertaken a high-level assessment of Sunfields' enabled transport emissions reduction potential, based on the strategic car-less design, and limited proportion of residential lots within the

development that have the ability for car ownership (just 10% of the 3,204 residential lots), compared to a Base Case scenario. The proportion of residential lots that have the ability to park a car onsite is the key differentiating factor in estimating Sunfield's enabled emissions reduction potential against the Base Case, and while other factors which have not been considered may influence the outcomes presented in this report, the intent of this assessment is to consider the proportional improvement in enabled emissions that Sunfield aims to achieve through strategic design.

The findings of this assessment indicate that enabled emissions associated with private transport fuel are estimated to be approximately 90% lower than those of the Base Case scenario. Though not quantified as part of this assessment, it is anticipated that consideration of Sunfield's comprehensive sustainable design measures and transport solutions including the autonomous solar powered electric shuttle fleet (Sunbus) and well-integrated cycling and pedestrian infrastructure would likely further contribute to a reduced GHG emissions footprint.

Sunfield represents a pioneering example of sustainable urban planning. The anticipated 90% reduction in private transport fuel emissions compared to a traditional residential development illustrates the significant impact of strategic land-use planning and integrated transport solutions in contributing to global and national emission reduction targets.

5 Limitations

The list below provides an overview of the limitations associated with this report:

- The assessment is limited to *enabled* emissions solely related to private vehicle petrol use for small to medium size cars only and does not include any other potential GHG emissions source, type or reduction potential (such as other transportation modes, fuel types or vehicle lifecycle emissions, (e.g., production and disposal))[2].
- Scenario A (Sunfield) applies the assumption that 10% of dwellings (340 in total) within the development use a private vehicle. The assumption does not take into consideration use of vehicles beyond this 10% for other dwelling or communal areas. It is acknowledged that a further 10% (additional 340 carparks) will be provided in the hubs, however, vehicle use and associated GHG emissions facilitated through use of the additional 340 carparks within the hubs is excluded from this assessment.
- It is important to note that the scope of the assessment for Sunfield and the Base Case is limited to the reliability and availability AFC's MSM data outputs for previous projects, where the definition of 'residential zone' in sourcing past project data considers 80% residential land use, 20% employment zone; therefore, while representative of a residential community, the nuances and efficiencies embedded within the design of Sunfield (such as accessibility to

[2] Other GHG emissions sources are considered within Stantec's *Sustainability and GHG Emissions Assessment Report.*

employment and retail precincts), have not been specifically modelled. Further, internal trips within residential zones are excluded from the model outputs and the inputs used to inform *quantity of fuel used* does not consider various trips purposes where the origin and destination are in the same zone (i.e. residential community).

- The proportion of residential lots that have the ability to park a car onsite is the key differentiating factor in estimating Sunfield's enabled emissions reduction potential against the Base Case, and while other factors which have not been considered may influence the outcomes presented in this report, the intent of this assessment is to consider the proportional improvement in enabled emissions that Sunfield aims to achieve through strategic car-less design.
- Assumptions regarding car ownership and fuel usage are based on current data and trends, which may change with future developments in transport technology or policy shifts.
- For simplicity, the emissions factor for *regular petrol* has been selected and applied to the total *quantity of fuel used* figure, therefore, the figures above assume 100% of cars use regular petrol, based on current emissions factors available at the time of undertaking. This assumption has been applied to both the Sunfield and Base Case scenario for consistency, however, realistically a proportion of vehicles rely on other higher emission fuel types such as diesel. The intent of this assessment is to consider the proportional difference between Sunfield and the Base Case, therefore, these figures should not be relied on definitively.
- The VKT is based on a typical workday and is subject to variations and nuances (weekend, public holiday and school holiday travel).
- All data used for the analysis (e.g., number of lots, percentages of households with access to cars) is sourced from the most up-to-date and reliable information available at the time of the report, including master plans, census data, and direct correspondence with Winton Land Limited.

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