



Greenhouse Gas Assessment Report

Garden Street Extension

City of Gosnells

6 July 2022

→ The Power of Commitment



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Executive Summary

The City of Gosnells ('the City') commissioned GHD to undertake a Greenhouse Gas (GHG) Assessment to support a referral to the Environmental Protection Authority (EPA) under section 38 (s38) of the *Environmental Protection Act 1986* (EP Act) for the proposed Garden Street Extension (GSE) project in Huntingdale.

The purpose of this report is to provide an estimate of scope 1, scope 2, and scope 3 GHG emissions resulting from the construction and operation (including maintenance) of the GSE project. An understanding of associated operational GHG emission which typically results from lighting, vehicles using the road (asset users), and road maintenance activities is also critical in enabling the City to assess its operational climate related impacts and direct progress towards reducing the City's carbon footprint. The estimated GHG emissions can also be used to assess the requirement for the development of a GHG management plan (GHGMP), as per the GHG Factor Guideline (EPA 2020). The emissions threshold for the requirement to prepare a GHGMP is currently set at 100,000 tonnes of operational carbon dioxide equivalent (tCO₂-e) emissions per annum under the EP Act.

The GHG emissions assessment includes estimates for scope 1, scope 2 and scope 3 emissions attributed to the construction and operation of the GSE, using the Transport Authorities Greenhouse Gas Group (TAGG) Carbon Gauge Tool (CGT) and custom energy models respectively. GHG emissions estimates relating to the decommissioning of the GSE were not within the scope of the GHG emissions assessment, as this rarely occurs for roads.

The GSE construction is expected to last 18 months, with total emission of 1,242 tCO₂-e while annual operational (including maintenance) GHG emission was estimated to be 2,647 tCO₂-e.

Scope	Activity	Emissions [tCO ₂ -e]
Construction		
Scope 1	Diesel – Transport/stationary & lost carbon sink	951
Scope 2	Purchased Electricity	-
Scope 3	Fuel and Energy Related Activities & materials	291
Total		1,242
Operation (annual GHG emissions)		
Scope 1	Diesel – Transport/Stationary	6
Scope 2	Purchased Electricity	28
Scope 3	Fuel and Energy Related Activities and Material Use	2,613
Total		2,647

These GHG emissions estimates place the GSE project significantly below the 100,000 tCO₂-e per year threshold in terms of estimated total GHG emissions.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.4 and the assumptions and qualifications contained throughout the Report.

Acronyms

Acronym	Definition
ABS	Australian Bureau of Statistics
ATAP	Australian Transport Assessment and Planning
AR5	IPCC Fifth Assessment Report
CGT	Carbon Gauge Tool
the City	The City of Gosnells
CO ₂	Carbon Dioxide
CH ₄	Methane
DISER	Department of Industry, Science, Energy and Resources
DIRD	Department of Infrastructure and Regional Development
e.g.,	Example
EPA	Environmental Protection Authority
EP Act	<i>Environment Protection Act 1986</i>
GHG	Greenhouse Gas(es)
GHGMP	Greenhouse Gas Management Plan
GSE	Garden Street Extension
GWP	Global Warming Potential
ha	Hectare
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
ITS	intelligent Transport Systems
kL	kilolitre
km	kilometre
LED	Light Emitting Diode
LV	Light Vehicle
MRS	Metropolitan Region Scheme
kWh	kilowatt per hour
NGA Factors	Australian National Greenhouse Accounts Factors 2021
N ₂ O	Nitrogen Dioxide
PFCs	Perfluorocarbons
SF ₆	Sulphur Hexafluoride
TAGG	Transport Authorities Greenhouse Group
tCO ₂ -e	tonne of Carbon Dioxide equivalent
TPS	Town Planning Scheme
ULP	Unleaded Petrol
WA	Western Australia
%	Percentage

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1. Introduction

1.1 Background

The City commissioned GHD to undertake a GHG emissions assessment to support a referral to the EPA under section 38 (s38) of the EP Act for the proposed GSE project in Huntingdale.

The development envelope that will form part of the s38 EPA referral includes part of the road reserve between Harpenden Street and Holmes Street in Huntingdale (Figure 1). The development envelope is reserved as 'Other Regional Roads' under the Metropolitan Region Scheme (MRS) and Town Planning Scheme No. 6 (TPS) and is under the management of the City.

The development envelope, which covers the full extent of proposed works, including earthworks, batters, laydown areas is 2.65 ha and the development footprint, which covers the physical elements of the proposal is 1.95 ha. Part of the development envelope contains cleared areas; however, majority (2.03 ha) consists of intact native vegetation.



Figure 1 Proposed Garden Street Extension Development Envelope and Footprint

Under section 15 of the EP Act, the EPA has the objective to use its best endeavours to protect the environment and to prevent, control and abate pollution and environmental harm. If the EPA assesses a proposal, section 44(1) of the EP Act requires the EPA to prepare a report on the outcome of its assessment of the proposal and give that report to the Minister for the Environment. Section 44(2) establishes that the report must set out what the EPA considers to be the key environmental factors identified during the assessment. The EPA has fourteen (14) environmental factors, organised into five themes: Sea, Land, Water, Air and People.

The EPA has identified an environmental objective for each environmental factor and has regard to these objectives when determining whether the environmental impact of a proposal or scheme may be significant. The environmental objectives are aimed towards ensuring the objects and principles of the EP Act are achieved.

1.1.1 Project Elements

A list of the identified elements of the GSE project and the phases in which they occur are provided in Table 1.

Table 1 Identified project elements and phases

Project Element	Project Phase
Vegetation clearing	Construction
Vehicles and equipment (including stationary)	Construction & Maintenance
Drainage	Construction
Pavement	Construction & Maintenance
Road furniture	Construction
Earthworks (cut to fill, imported fill)	Construction
Lighting	Operation
Asset/Road Users	Operation

1.2 Purpose of this report

The purpose of this report is to provide an estimate of scope 1, scope 2, and scope 3 GHG emissions resulting from the construction and operation (including maintenance) of the GSE project.

The estimated GHG emissions can be used to assess the requirement for the development of a GHGMP, as per the Environmental Factor Guideline Greenhouse Gas Emissions (GHG Factor Guideline). The emissions threshold for the requirement to prepare a GHGMP is currently set at 100,000 tCO₂-e per annum under the EP Act.

An understanding of associated operational GHG emissions is also critical in enabling the City to assess its operational climate related impacts and direct progress toward reducing the City's carbon footprint.

1.3 Scope of this report

The GHG emissions assessment includes estimates for scope 1, scope 2 and scope 3 emissions attributed to the construction and operation (including maintenance) of the GSE. For the operation elements, scope 2 and 3 emissions have been modelled showing annual predicted emissions.

The estimates include GHG emissions related to both direct (scope 1) and indirect (scope 2 and scope 3) emissions as defined in Table 2.

Table 2 GHG emissions scope definitions

Principle	Description
Scope 1	Direct emissions from owned or controlled sources resulting from the combustion/consumption of fuels (e.g., combustion of diesel in engines)
Scope 2	Indirect emissions from the generation of purchased energy (e.g., purchased electricity)
Scope 3	All indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions (e.g., purchase of goods and services)

Activities and potential emissions sources which have not been included in the emissions assessment have been detailed in section 3.1.1.

1.4 Limitations

This report has been prepared by GHD for the City and may only be used and relied on by the City for the purpose agreed between GHD and the City set out in section 1.2 and section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than the City arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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2. Carbon Accounting and Reporting

Carbon accounting is the process of identifying and measuring the amount of GHG, measured in tCO₂-e, emitted by an entity or project. Carbon reporting is the process of reporting on that accounting.

2.1.1 GHG emissions

The carbon account is inclusive of the following GHG emissions covered by the United Nations Framework Convention on Climate Change (UNFCCC) Reporting Guidelines and in line with the GHG Factor Guideline:

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous dioxide (N₂O)
- Sulphur hexafluoride (SF₆)
- Perfluorocarbons (PFCs)
- Hydrofluorocarbons (HFCs)

While all the above-mentioned GHG's have been considered, GHG's relating to infrastructure developments are primarily limited to CO₂, CH₄ and N₂O.

2.1.2 Scopes of GHG emissions

The GHG Protocol defines three (3) scopes of emissions to ensure that single emission sources are not counted twice within the supply chain. Scope 1 and 2 emissions are required to be included in recognised GHG inventory reporting schemes and these emissions therefore should be included within any GHG assessment.

Scope 3 emissions are typically considered optional in most compliance reporting schemes. However, it is recognised that the inclusion of scope 3 emissions provides a more holistic view of a project's environmental impact. They also provide an opportunity to be innovative in GHG emissions management.

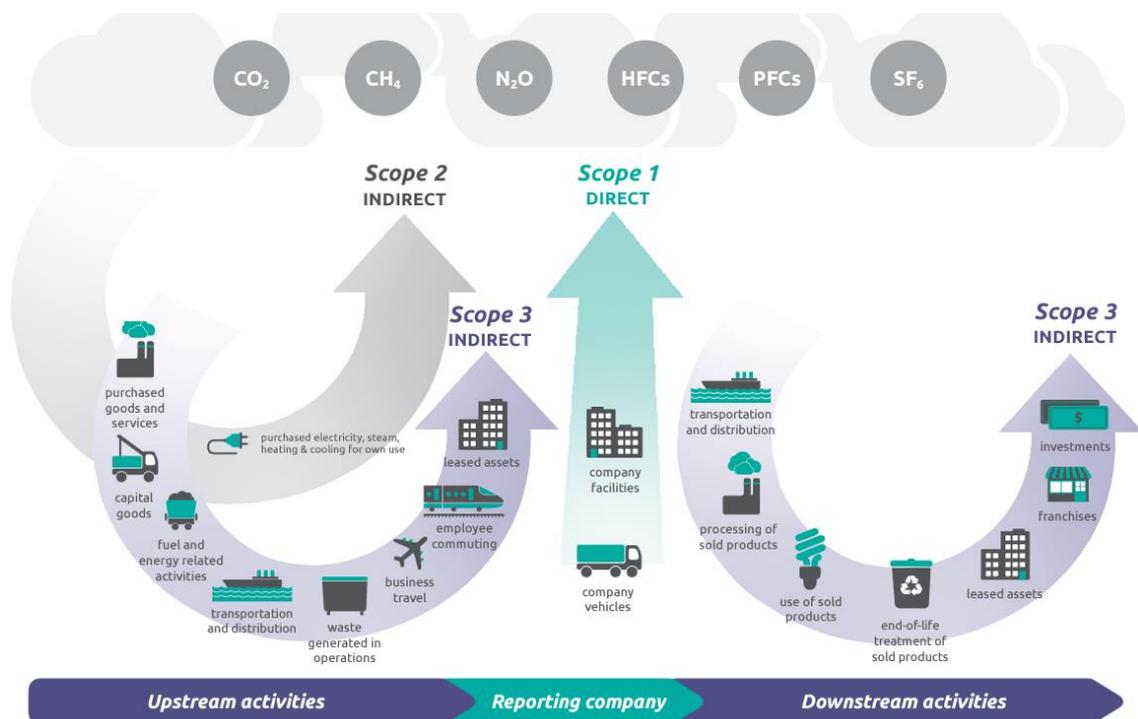


Figure 2 Overview of scopes and emissions across a value chain¹

¹ Source: <https://ghgprotocol.org/standards/scope-3-standard>

Figure 2 provides an overview of the relationship between the scopes and the activities that generate direct and indirect emissions along an entity's and/or projects value chain.

2.1.3 GHG Assessment Boundaries

In estimating GHG emissions for the GSE project, the assessment boundary has been considered to include all the emission sources that were deemed to potentially be impacted by decisions made by designers, constructors, managers, operators and/or end users of the road.

Figure 3, 4 and Figure 5 illustrate the complete construction, operation (including maintenance) GHG assessment boundaries for road projects using the Transport Authorities Greenhouse Gas Group (TAGG) Carbon Gauge Tool (CGT), prior to the materiality assessments. Using a process flow diagram shows the individual processes and their inter-relationships and defines:

- Where the process begins, in terms of the receipt/extraction of raw materials or intermediate products
- The nature of the transformations and operations that occur as part of the process, and
- Where the process ends, the destination of the intermediate or final products.

The diagrams show the emission sources that are both included and excluded from the GHG assessment boundary for road projects (TAGG 2013).

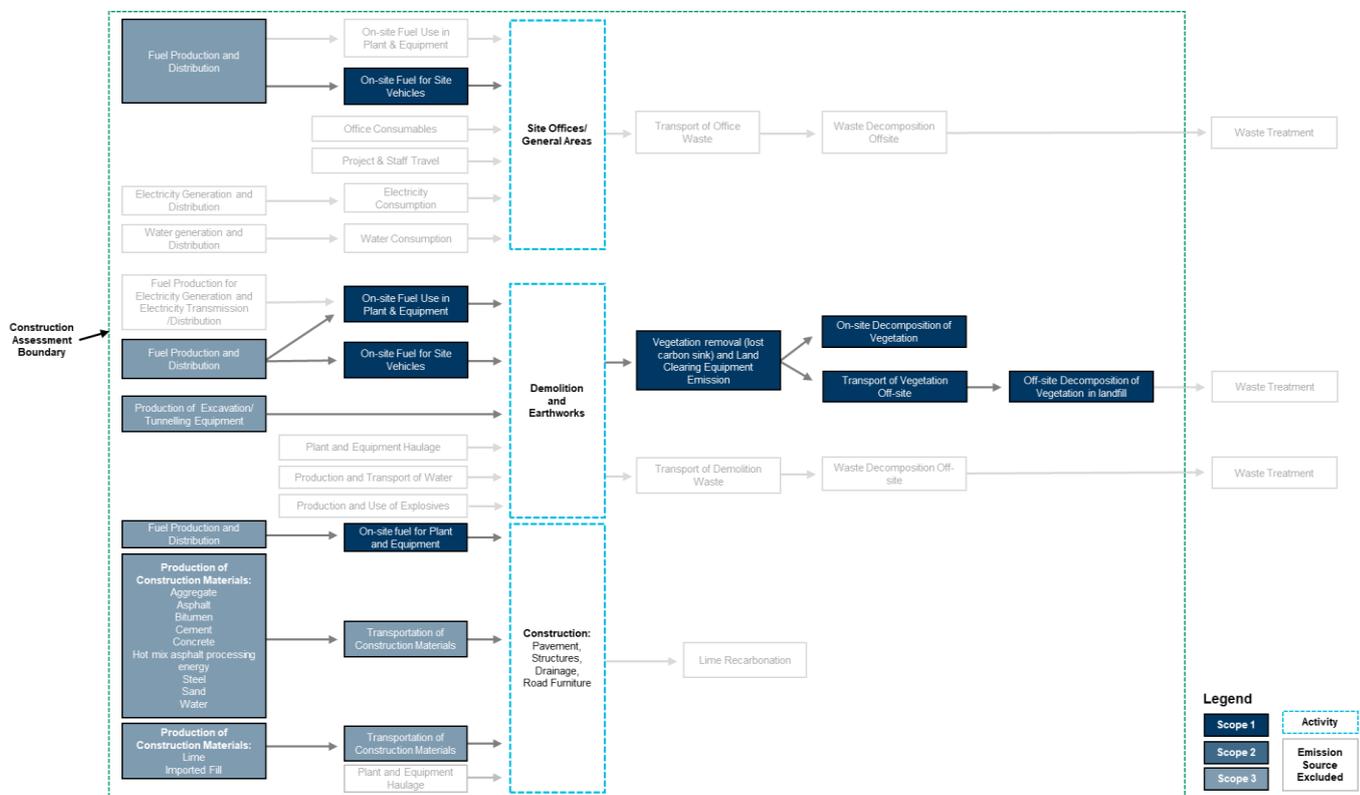


Figure 3 Complete GSE Project (Construction) GHG Assessment Boundary²

² Based on the TAGG Supporting Document for Greenhouse Gas Assessment Workbook for Road Projects (2013) Figure 3.1

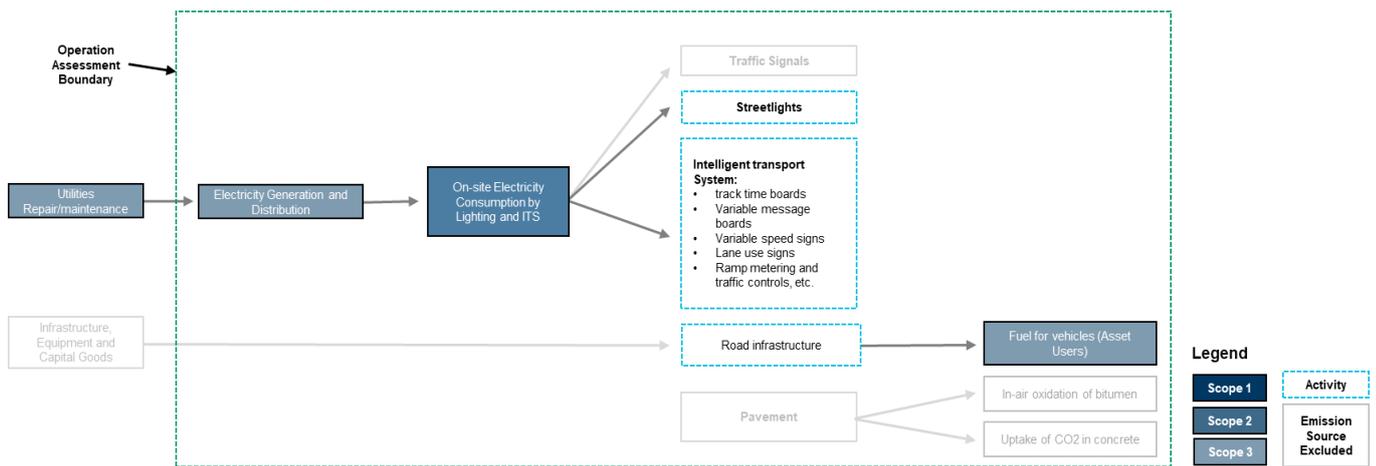


Figure 4 Complete GSE Project (Operation) GHG Assessment Boundary³

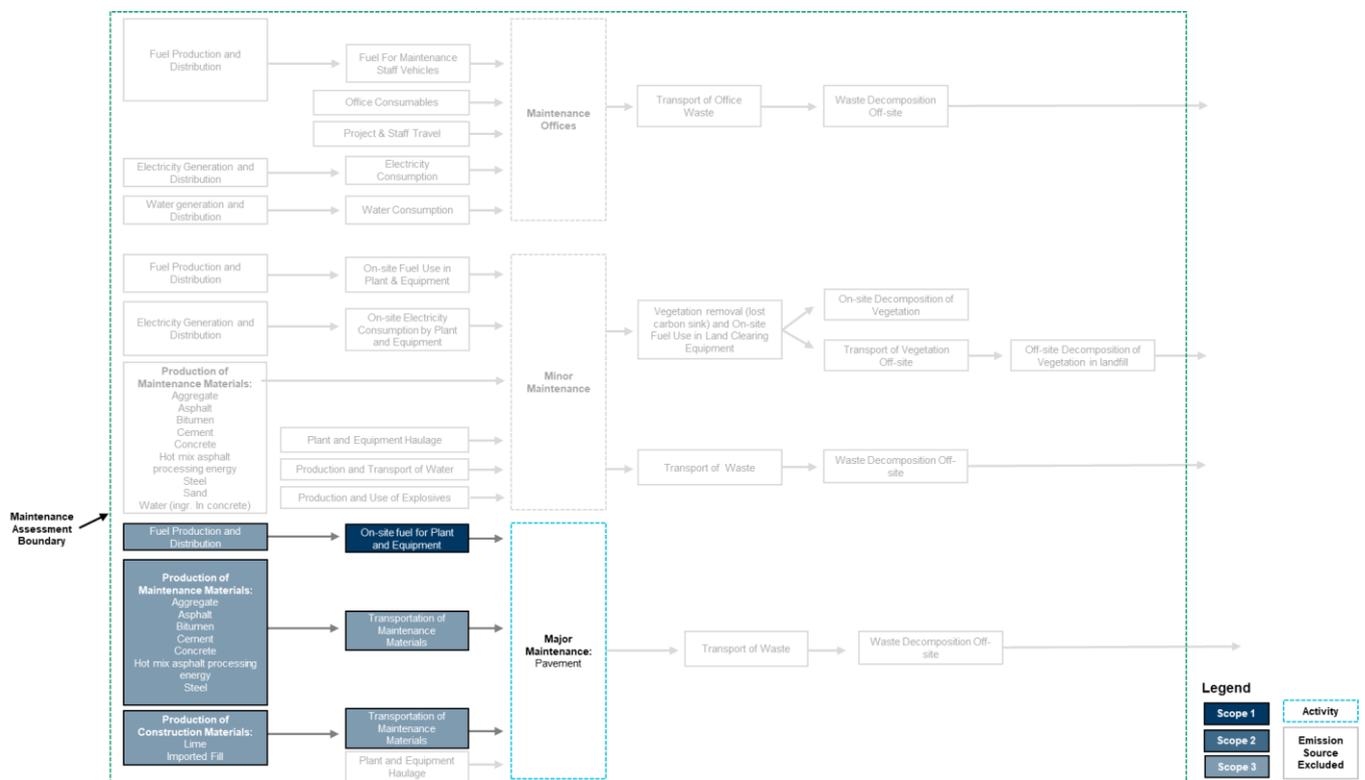


Figure 5 Complete GSE Project (Maintenance) GHG Assessment Boundary⁴

2.1.4 Materiality

Materiality is a measure of the perceived effect that the inclusion or exclusion of an emission source or activity may have on the accuracy or validity of a GHG emission assessment. Different standards stipulate different definitions and thresholds for materiality. An organisation can determine materiality themselves, but if reporting under a specific scheme, then materiality is determined by the scheme's requirements and standards.

The materiality threshold applied during the GHG assessment is outlined in section 3.1.1.

³ Based on the TAGG Supporting Document for Greenhouse Gas Assessment Workbook for Road Projects (2013) Figure 3.2

⁴ Based on the TAGG Supporting Document for Greenhouse Gas Assessment Workbook for Road Projects (2013) Figure 3.3

2.2 Policy and Reference Documents

The following documents have been used for the purposes of defining appropriate methods for quantification of emissions from individual sources:

- TAGG Greenhouse Gas Assessment Workbook for Road Projects (2013)
- TAGG Supporting Document for Greenhouse Gas Assessment Workbook for Road Projects (2013)
- Australian National Greenhouse Accounts (NGA) Factors 2021
- Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (GHG Protocol)
- Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard

3. Methodology

The calculation methodologies used to estimate the GHG emissions attributable to the construction, operation, and maintenance of the GSE project are in alignment with GHG Protocol Corporate Accounting and Reporting Standard (GHG Protocol) and have been based on the principles outlined in Table 3.

Full details on the methodologies applied are in section 0 and 3.2.

Table 3 GHG accounting and reporting principles

Principle	Description
Relevance	Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of internal and external stakeholders
Completeness	Account for and report on all GHG emission sources and activities within the chosen inventory boundary, disclosing and justifying any specific exclusions from the emissions assessment
Consistency	Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors
Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used
Accuracy	Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information

Emissions estimated are represented in CO₂-e using current global warming potential (GWP). The GWPs from the IPCC Fifth Assessment Report (AR5) have been used in this assessment and are listed in Table 4.

Table 4 Greenhouse gases and 100-year global warming potentials

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	28
Nitrous Oxide (N ₂ O)	265

The scope 1, scope 2, and scope 3 emission factors used in the estimation of GHG emissions have been taken from the National Greenhouse Accounts (NGA) Factors 2021.

3.1 Carbon Gauge Tool

The CGT provides the means for estimating GHG emissions for all activities and sources that are found to contribute significantly to the overall emissions arising from a road project. The process requires a materiality checklist to be complete to determine the required data inputs. Default assumptions are built into the CGT tool,

which have been checked against the information provided by the City to ensure they are relevant and representative.

The TAGG CGT has been used to determine scope 1, 2 and 3 emissions associated with construction and maintenance aspects including:

- Vegetation clearing
- Fuel use for vehicles, plant, and equipment
- Construction aspects including pavements, drainage, road furniture and earthworks

3.1.1 Materiality Checklist

As per the requirements of the CGT, a materiality assessment has been conducted to determine the inclusions and exclusions within the GHG assessment. The materiality test and relevant inclusion and exclusions are listed in Table 5.

Table 5 TAGG CGT materiality checklist, inclusions, and exclusions

Option	Selection	Details
Will a diesel generator be used to provide power to the project site office for more than 12 months?	No	Fuel combusted in powering site offices excluded
Will more than 120 buildings be required to be demolished per 1km of road?	No	Fuel combusted in demolishing buildings excluded
Will more than 0.5 ha of vegetation be removed?	Yes	Vegetation removal included
Will the project involve tunnelling?	No	Electricity consumption and explosives excluded
Is the project located more than 200km from the nearest material suppliers/quarry/city?	No	The emissions associated with the transport of materials to site excluded
Will the project utilise onsite batching plants or other continuously operating stationary plant and equipment for more than 6 months?	No	Fuel combusted in stationary engines excluded
Will the project include safety barriers along more than 50% of the road length if barriers are used on both sides of a dual carriageway or 100% of the road length if used on both sides of a single carriageway?	Yes	The emissions from the construction and installation of road safety barriers included
Will the project include noise walls along more than 75% of the road length?	No	The emissions from the construction and installation of noise walls excluded

3.2 Custom Energy Tool

A custom energy tool has been developed to calculate operational emissions in relation to lighting and asset users. This methodology was selected to provide as accurate as possible estimates, taking into consideration the limitations of the CGT with regards to these aspects. The methodology used to calculate scope 2 and 3 emissions associated with operation of the asset is detailed below.

3.2.1 Lighting

Scope 2 and 3 emissions for operational lighting have been estimated using a basic calculation considering the number of luminaires, type and wattage of the luminaires and expected usage (hours/day and days/year in use), providing us with an annual consumption (kWh). The consumption timeframe adopted for an annual estimate is based on the 2022 consumption, using the NGA Factors, to provide the most conservative estimate possible.

Estimates have also been calculated for subsequent years, however in using the Department of Industry, Science, Energy and Resources (DISER) projected emission factors for Australia’s electricity grid contained in the Australian Emissions Projections Report (2021), the consumption and subsequently GHG emissions trends downwards, providing a reduced footprint over the life of the asset.

3.2.2 Asset Users

Operational emissions associated with asset users have been calculated using a custom energy tool, which uses available traffic modelling estimates to calculate annual average fuel use. Details relating to each component of the calculation are provided below:

Number of vehicles

To determine emissions from asset users, the daily traffic volumes over various timeframes including 2021, 2026, 2031, 2036 and 2051, were sourced from the Stantec Southern River Traffic Impact Study Garden Street Extension Modelling Report ('Stantec Report'). The Stantec Report was specifically prepared to assess how an extension to Garden Street may alleviate traffic growth from existing local roads. The daily traffic volumes have been used to predict numbers for daily and annual vehicles, and the subsequent fuel use.

Consumption

The data set provides vehicle volumes for the proposed road extension, which represents a stop-start consumption model. The consumption model was based on the Australian Transport Assessment and Planning (ATAP) Guidelines, and assumptions are detailed in Table 9. From vehicle numbers, the distance travelled for both light and heavy vehicles have been calculated using the road length links for Garden Street. Finally, using assumptions for light and heavy vehicle split, fuel has been calculated using a consumption estimate (L/100km) for the stop-start route.

Proportion LV/HV

The proportion split between light and heavy vehicles was identified in consultation with the City to be 90% and 10% for light and heavy vehicles, respectively.

Proportion fuel type

To determine the split of fuel types between the various vehicle classifications, data from the Australian Bureau of Statistics (ABS) has been used, looking at total fuel consumption by type of vehicle and fuel type. The usage for each fuel type has been calculated as a percentage of the total fuel usage for that vehicle class.

EV uptake

The uptake of electric vehicles has not been considered in the assessment and is therefore expected to contribute to an overestimation of scope 3 asset user emissions.

3.3 Assumptions

The assumptions used in the GHG emissions assessment are presented in Table 6. These assumptions have been developed from information provided by the City, default Carbon Gauge Tool assumptions and previous project experience.

Table 6 Assumptions used in the estimation of GHG emissions

Activity	Assumption
Vegetation clearing	<ul style="list-style-type: none"> - Vegetation removal will be conducted using conventional plant (i.e., graders and dozers) - Class 2 equivalent to 50-100 t dry matter/ha - Class D vegetation type - described as diverse group of vegetation communities including Banksia woodland, based on the ecological survey undertaken by Biologic
Earthworks (cut to fill, imported fill)	<ul style="list-style-type: none"> - Earthworks will be conducted using conventional plant (i.e., graders and dozers) - Cut to fill includes scraper, excavator/truck operation within 1km. also includes fuel used for compaction - Import and place filling assumes bulk operation in metro location. Does not include fuel used to 'extract' import fill (i.e., offsite emissions)
Pavement	<ul style="list-style-type: none"> - Surface – 40mm Open Grade Asphalt - Binder – 10mm Primerseal - Base – 200mm Road base - Subbase – 200mm Crushed limestone
Drainage	<ul style="list-style-type: none"> - Mountable kerbing, unreinforced - 450mm Reinforced Concrete Pipe (RCP), assumes trench width is approximately 600mm wider than pipe diameter, cover equal to 1m and includes all imported bedding, surround, and backfill materials, steel is 1.8% of the total weight - Open, unlined table drain, assumed to be cut with a grader
Road Furniture	<ul style="list-style-type: none"> - W-beam barrier assumed to be 5m panels of 2.7mm base metal thickness, steel posts 150mm x 110mm x 4.3mm at 2m spacing
Vehicle (transport and Stationary)	<ul style="list-style-type: none"> - Stationary and off-road energy requirements for generators, plant and equipment is comprised of 100% petroleum diesel or unleaded gasoline. - Fuel type for site vehicles assumed to be split for diesel (70%) and unleaded petrol (30%). - Transport energy requirements for light and heavy vehicles for onsite and offsite use comprised of 100% petroleum diesel or unleaded gasoline. - No electric vehicles or plant used during construction. - No biofuels used during construction
Lighting	<ul style="list-style-type: none"> - LED street lighting within the median island - 70m spacing totalling 50 luminaires based on GHD Electrical Engineer advice due to incomplete lighting design - On average, lights are on between 6pm-6am all year round (12 hours a day). - LED wattage 188W - Factors for electricity consumption based on National Greenhouse Accounts Factors 2021
Asset Users	<ul style="list-style-type: none"> - Annualisation factor of 338 days has been applied to calculate the annual fuel consumption based on number of vehicles and distance travelled. This is applied to account for weekends, public holidays, and school holidays, including typical non- weekday traffic conditions. - Asset user figures have been based on an average of the AM and PM peak hourly volume sourced from the Stantec Report, assuming the peak hourly average represents 10% of total daily vehicle numbers. Asset user information is contained in Table 10. - Consumption model based on the ATAP Guidelines, using the Start-Stop model - Model co-efficient values have been taken from the ATAP Guidelines (Table 36, Transport, and Infrastructure Council, 2016), which covers 20 vehicle types, then aligned with the 12 AustRoads Vehicle Classifications using calculated average parameter values - Vehicle type based on classification assumes split between light vehicles (90%) and heavy vehicles (10%) based on information provided by City of Gosnells - Proportion of fuel consumption by vehicle type has been based on the Australia Bureau of Statistics data for WA (ABS, 2020 [Table 5]). - Length of link is 0.85 km - Average link speed is 70 km/h

4. Greenhouse Gas Emissions Inventory

The GHG emission inventory included construction and operation activities, including maintenance works, to provide an overview of the impact of the GSE project during its full life cycle. While majority of emissions are concentrated to the construction phase, the footprint of asset users, namely cars driving on this section of the network, is insurmountable in comparison.

4.1 Construction

Emissions associated with construction have been broken down by various construction activities. The estimates have been based on 18 months of construction activities.

Table 7 Construction emissions breakdown by activity

Activity	Scope 1	Scope 2	Scope 3	Total [tCO ₂ -e]
Site office/general areas	47	-	4	51
Demolition, clearing & earthworks	771	-	17	788
Construction – pavements	55	-	150	205
Construction – drainage	77	-	84	161
Construction – road furniture	1	-	36	37
Total	951	-	291	1,242

Total GHG emission from construction for the GSE project have been estimated to be **1,242 tCO₂-e**, with over 63% of total emissions being attributed to the demolition and earthworks activities, which includes lost carbon sink from vegetation clearing.

Table 7 and Figure 6 contain the construction emissions sources broken down by activity and emissions scope.

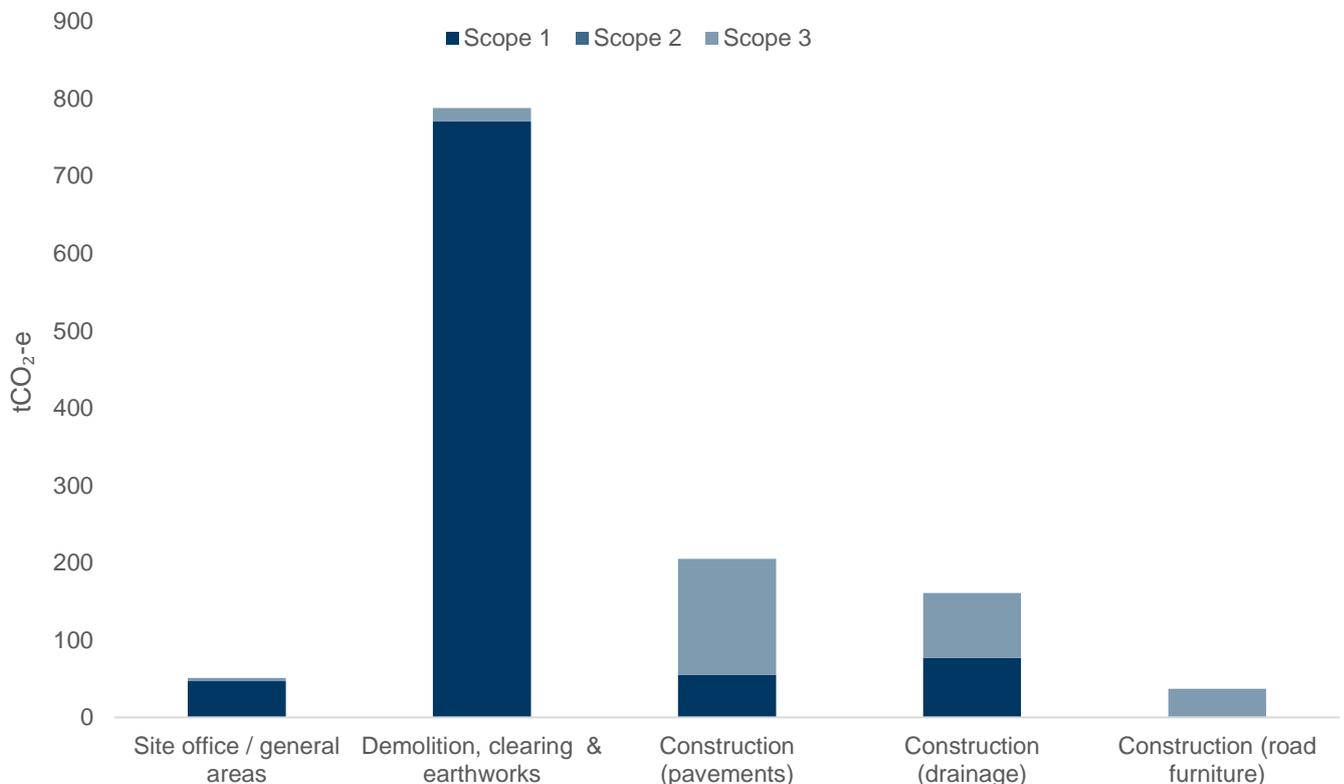


Figure 6 Construction emissions breakdown by activity

The overall construction emissions by emissions source are displayed in Table 8 and Figure 7.

Table 8 Construction emissions breakdown by emission source

Source	Scope 1	Scope 2	Scope 3	Total [tCO ₂ -e]
Fuel combustion – site vehicles	47	-	4	51
Fuel combustion – plant & equipment	133	-	10	143
Fuel combustion – demolition & earthworks	210	-	16	226
Fuel combustion – vegetation removal	7	-	1	8
Vegetation removal – lost carbon sink	554	-	-	554
Material usage – aggregate	-	-	112	112
Material usage – concrete	-	-	56	56
Material usage – steel	-	-	41	41
Material usage - bitumen	-	-	51	51
Total	951		291	1,242

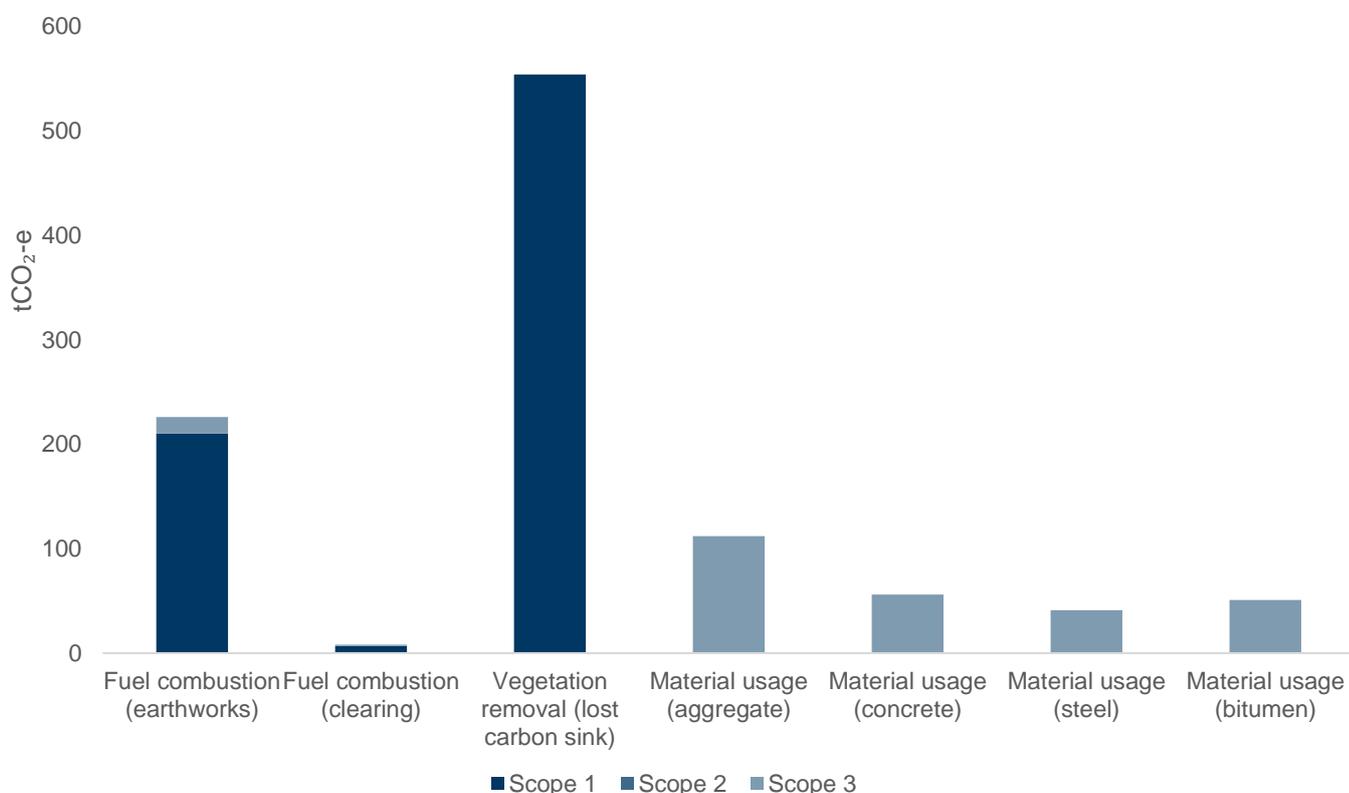


Figure 7 Construction emissions breakdown by emissions source

4.2 Operation

Annual emissions associated with operation, including maintenance, have been summarised by source and the annual totals presented in Table 9. Pavement maintenance has been calculated over a 50-year period, and the figures provided below based on an annual estimate. For operational lighting and asset user emissions, a similar timeframe has been adopted to provide worst case scenario for electricity consumption (lighting use) and average fuel consumption for asset users in the modelled year 2026.

Consideration was given to the transition of the electricity grid to net zero carbon and the introduction of electric vehicles over the next few decades; however, these aspects were not included as part of the final assessment in order to provide a worst-case estimate of operational emissions.

Table 9 Annual operation emissions breakdown by source

Source	Scope 1	Scope 2	Scope 3	Total tCO ₂ -e
Fuel combustion – pavement maintenance	6	-	-	6
Material usage – pavement maintenance	-	-	8	8
Electricity consumption – lighting	-	28	1	29
Fuel combustion – asset users	-	-	2,604	2,604
Total	6	28	2,613	2,647

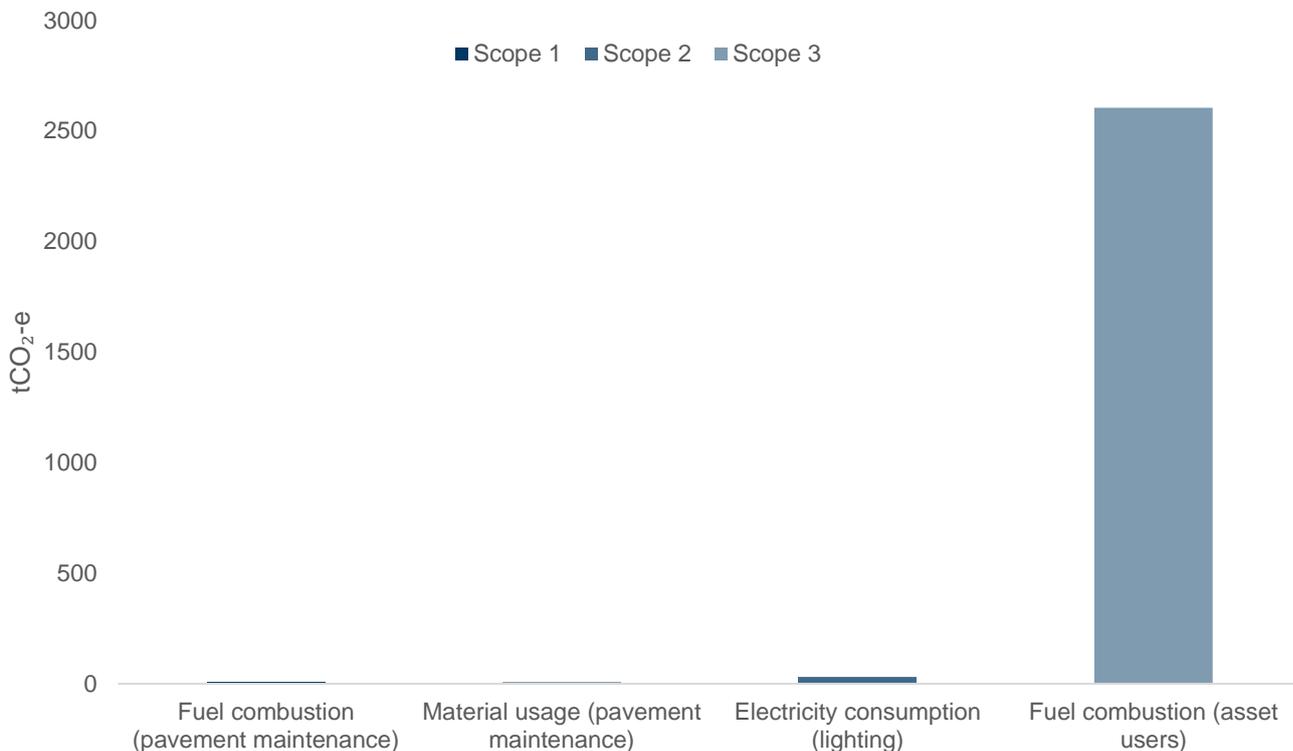


Figure 8 Annual operation emissions breakdown by source

Total worst-case annual GHG emission from operational activities relating to the GSE project have been estimated to be **5,178 tCO₂-e**, with over 99% of total operational emissions being attributed to asset users.

Annual emissions associated with asset users have been assessed based on the traffic modelling undertaken by Stantec and presented in the Stantec Report. The daily number of vehicles has been based on the average of the predicted AM and PM peak vehicle volumes using the assumptions outlines in Table 6. The modelled timeframes each present varying resultant GHG emissions, due to the increases in daily traffic volumes over time. Therefore, the following table presents the outcomes of the assessment against each of these timeframes for consideration by the City.

Table 10 *Estimated asset user emissions from 2021 to 2051*

Scope	Timeframe	Daily Number of Vehicles (#)	Annual consumption (kL)	Annual Emissions (tCO ₂ -e)
Scope 3	2021	15,500	403	2,242
	2026	18,000	468	2,604
	2031	22,500	585	3,255
	2036	28,500	741	4,123
	2051	35,500	923	5,135

The timeframe detailed in Table 10 (2026) has been selected to provide a degree of consistency between the operational lighting, from which GHG emissions are expected to be highest in the first years of operation (i.e., 2023/24).

The absolute worst-case scenario for asset users, not considering the uptake of electric vehicles or decarbonisation of the electricity grid, would be the 2051 timeframe. The estimated asset user emissions are presented in Table 10 and Figure 9.

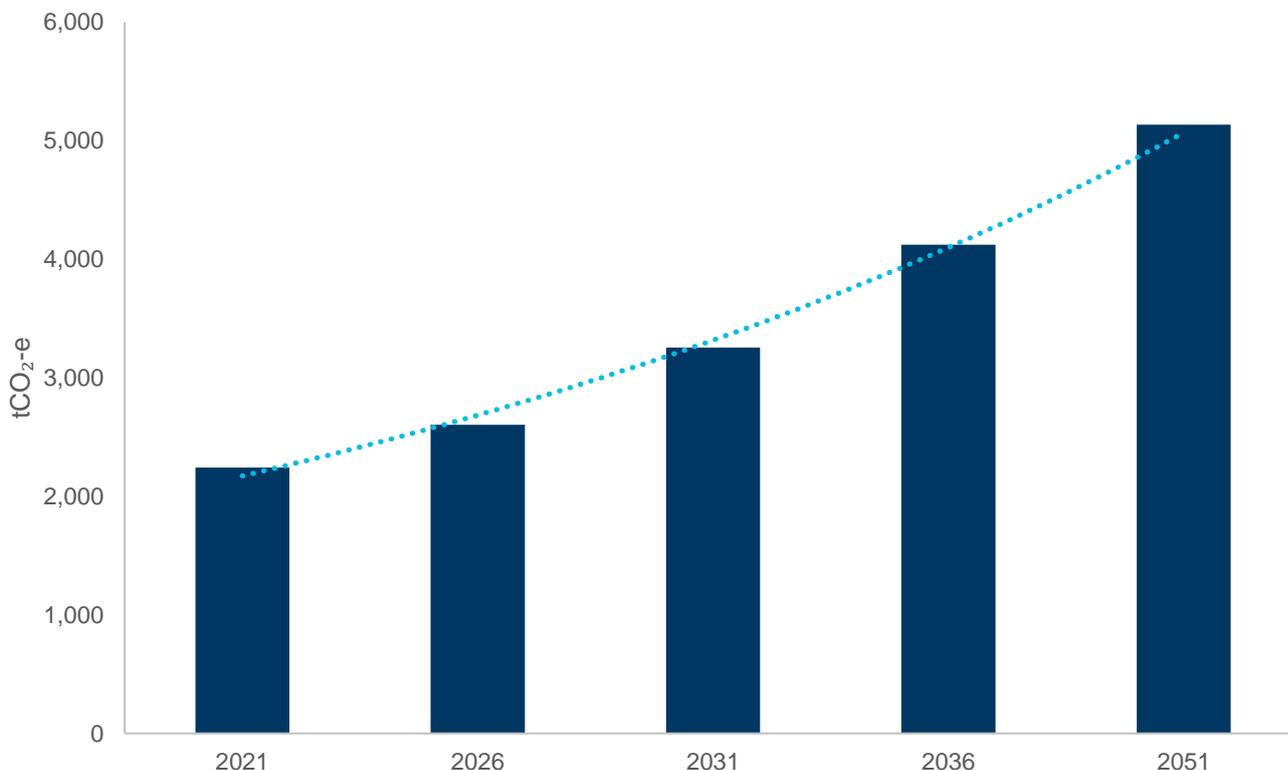


Figure 9 *Estimated asset user emissions from 2021 to 2051*

5. Discussion and Conclusion

The City's proposal for the GSE project requires a GHG emissions assessment to support a referral to the Environmental Protection Authority (EPA) under section 38 (s38) of the EP Act. The GHG emissions assessment has been undertaken using the TAGG CGT and custom energy tools to assess emissions associated with construction and operation, including maintenance aspects.

The GSE construction is expected to last 18 months with total emissions of 1,242 tCO₂-e while annual operational (including maintenance) GHG emissions have been estimated to be 2,647 tCO₂-e. Demolition and earthworks, including lost carbon sink, was the biggest emission source during construction phase with 788 tCO₂-e (63%) of total emissions, while 99% of total annual operational emissions was associated with asset users with 2,604 tCO₂-e.

Scope 1 and scope 2 emissions were attributed to 77% of total construction emissions while scope 3 contributed the remainder. Operational scope 1 and 2 emissions consisted of just over 1% of total emissions, whereas scope 3 accounted for the remaining 99% of operational emissions.

Alternative timeframes for asset user emissions have also been considered in this report, as summarised in Table 10, however it is anticipated the submission to the EPA will utilise the operational emissions summary as detailed in Table 9.

Regardless of the asset user timeframe adopted, the estimated GHG emissions place the GSE project significantly below the 100,000 tCO₂-e per year threshold. Therefore, it is not anticipated that a GHGMP will be required under the EPA referral conditions.

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