REPORT

Tonkin+Taylor

Greenhouse Gas Community Inventory

2019 Update for the Queenstown Lakes District

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Queenstown Lakes District Council
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Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
BOD	Biochemical Oxygen Demand
CO_2	Carbon Dioxide
CH_4	Methane
GHG	Greenhouse Gas
GPC	Global Protocol
HFCs	Hydrofluorocarbons
IPPU	Industrial Processes and Product Use
$kgCO_2e$	Kilogrammes of carbon dioxide equivalent
kWh	Kilowatt hour
LPG	Liquid Petroleum Gas
LULUCF	Land Use, Land Use Changes and Forestry
MAI	Mean Annual Increment
MfE	Ministry for the Environment
MPI	Ministry of Primary Industries
NF_3	Nitrogen triflouride
NO_2	Nitrogen dioxide
N_2O	Nitrous oxide
PFCs	Perfluorocarbons
QAC	Queenstown Airport Cooperation
QLDC	Queenstown Lakes District Council
SF_6	Sulphur hexafluoride
tCO_2e	Tonnes of carbon dioxide equivalent
T&D	Transmission and Distribution
VKT	Vehicle Kilometres Travelled
WERF	Water Environment Research Foundation
WRI	World Resource Institute

1 Introduction

The Queenstown Lakes District Council (QLDC) has commissioned Tonkin & Taylor Ltd (T+T) to assist in the development of a *high-level* Greenhouse Gas (GHG) Emission Inventory for the QLDC area. Access to good quality emissions data is key to the district's ability to take action on mitigating climate change, and monitoring progress for national and global GHG Emission targets. An initial inventory was carried out for the 2017 calendar year, with this being an update for the 2019 calendar year.

The QLDC GHG inventory follows the guidance outlined in the *Global Protocol (GPC) for Community-Scale Greenhouse Gas Emissions Inventories*[1] and includes the following sectors: Stationary Energy, Transport, Waste, and Agriculture, Forestry and Other Land Use (AFOLU) (Table 1.1). Not all the GPC sectors and sub-categories were included within the QLDC inventory and Appendix A includes explanations as to why each sector and sub-category was or was not included.

This report summarises the total QLDC GHG emissions by relevant sectors, based on the data collected and calculations prepared. It is noted that this is a high-level assessment, limited by the availability and quality of data for the district.

Table 1.1: Included Sectors and Sub-sectors of city GHG emissions, adapted from (WRI, 2015) (see Appendix A for full list of sectors)

Sectors and Sub-sectors	
STATIONARY ENERGY	**TRANSPORTATION**
Electricity consumption	Road transportation
LPG Use	Aviation
WASTE	**AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU)**
Landfill solid waste disposal	Agriculture
Septic tanks	Land use, land use change, forestry (LULUCF)
Wastewater treatment and discharge	

1.1 Methodology

Under the GPC, a city must define their inventory/reporting boundary, which in the case of QLDC, is their administrative boundary. The GPC is designed to account for GHG emissions over a single year and includes the seven gases covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen triflouride (NF_3) (WRI, 2015). However, due to the nature of emissions and the activities that occur within the QLDC boundary, this report focuses on CO_2, CH_4 and N_2O only. The GPC requires a city to create a GHG inventory using one of two complementary approaches; the ***scopes*** approach or the ***city-induced frameworks*** approach (WRI, 2015).

The **city-induced framework** was selected at a *BASIC+* level (as per WRI, 2015), as the appropriate reporting method for QLDC. This was because data was available across three related scopes of sub-categories within the QLDC area. This approach allows for an activity within the QLDC area that creates GHG emissions, however does not necessarily release the gas within the reporting boundary (such as air travel where some emissions will be released within the boundary and the rest along the route of the journey). These emissions are included within the city-induced framework and this

[1] (2015) Developed by the World Resources Institute, C40 Cities Climate Leadership Group and ICLEI – Local Governments for Sustainability (ICLEI).

means the inventory covers GHG emissions at a *BASIC+* level. Figure 1.1 (WRI, 2015) below provides a representation of the types of emissions that can occur within and outside of the reporting boundary and their equivalent scope.

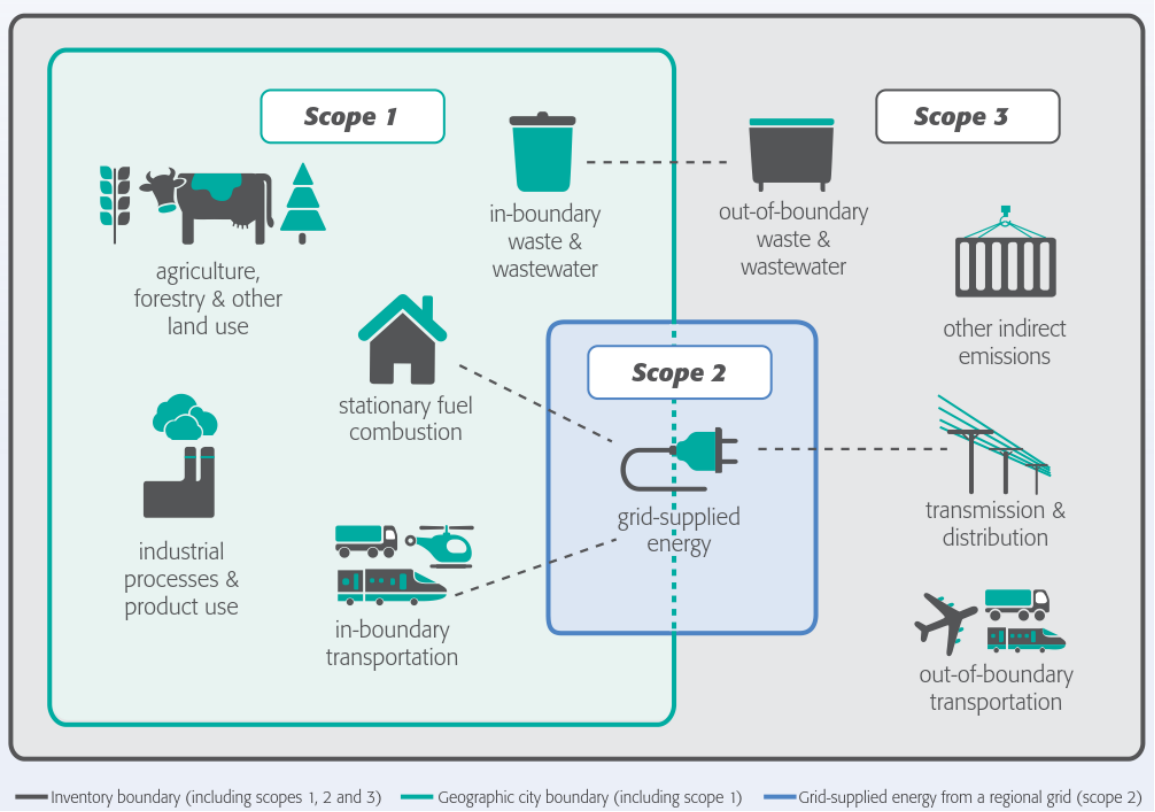


Figure 1.1: Sources and boundaries of city GHG emissions (WRI, 2015)

- *Scope 1* includes emissions that physically occur within the reporting boundary.
- *Scope 2* includes those that occur from the use of electricity, steam, and/or heating/cooling supplied by grids, which may or may not cross-reporting boundaries.
- *Scope 3* includes emissions that occur outside the city but are driven by activities taking place within the reporting boundary.

The emissions for each sector and sub sector have been calculated using a range of data sources and emissions factors which are detailed within the sections below.

1.2 Updates since 2017

Since the 2017 inventory, the Ministry for the Environment (MfE) has developed a detailed guide for measuring GHG emissions (MfE, 2019b). The guide provides updated emissions factors as well as methods for calculating overall GHG emissions. Additionally, some of the baseline activity data sources haves been improved, and as a result the 2017 inventory has been updated in places to reflect these changes. Changes are discussed within Section 7.

2 Total emissions

2.1 Gross emissions

The QLDC area produced gross emissions[2] of approximately **659,274 tCO_2e** in 2019 through the stationary energy, transport, waste and AFOLU sectors. Figures 2.1 and 2.2 below provide an overview of the distribution of the GHG emissions from each sector, as well as a breakdown of the emissions by sub-sector.

Transport[3] remains the largest contribution of GHG emissions in 2019 with 307,844 tCO_2e (47%). This includes on road transport, domestic aviation and on-stand emissions. This is then followed by AFOLU with 180,537 tCO_2e (27%), waste with 94,871 tCO_2e (14%), and finally stationary energy with 76,022 tCO_2e (12%).

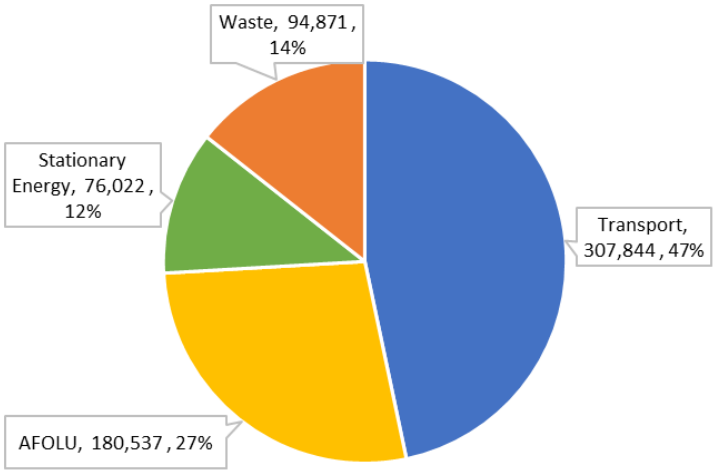


Figure 2.1: Gross GHG emissions for the QLDC area by sector (tCO_2e)

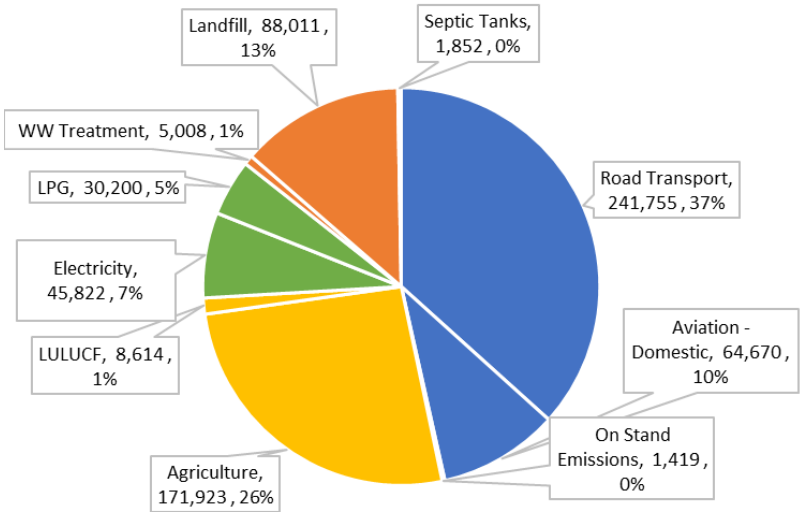


Figure 2.2: Gross GHG emissions for the QLDC area by sub-sector (tCO_2e)

[2] Gross emissions exclude forestry related offsets, whilst net emissions also consider the effects of forestry.
[3] Note: QLDC totals do not include international flight emissions. Please see section 4.2 for further detail.

Table 2.1 provides a summary of the gross GHG emissions for 2019. Any assumptions made or changes to methodologies in calculating the emissions between 2017 and 2019 resulting in changes to the emissions, are discussed in Section 7.

Table 2.1: 2019 Gross GHG Emissions for the QLDC area (tCO_2e)

Sector	Total Emissions 2019
Transport	**307,844**
Road Transport	241,755
Aviation - Domestic transboundary	64,670
Queenstown Airport On-Stand	1,419
AFOLU	**180,537**
Agriculture	171,923
LULUCF	8,614
Stationary Energy	**76,022**
Electricity	45,822
LPG	30,200
Waste	**94,871**
WW Treatment	5,008
Landfill	88,011
Septic Tanks	1,852
Total (tCO2e)	**659,274**

2.2 Net emissions (including sequestration removals from forestry)

The level of understanding and accuracy around carbon sequestration from native and exotic forestry is subject to ongoing research. Also, the ability to include legitimate removals from existing forestry, afforested areas, or deforested areas within a community emissions inventory will depend on a wide range of factors. These include the age of the forest, the type of trees, and its permanence.

Given that much of this detailed information was unavailable, a number of assumptions have been made in estimating sequestration (refer Section 6).

Sequestration removals were estimated as **-140,699 tCO_2e,** resulting in a NET estimate of carbon emissions for the QLDC area in 2019 of **518,575 tCO_2e**.

3 Stationary emissions

Stationary emissions for the QLDC area include GHG emissions produced through electricity consumption and LPG use. Stationary emissions contributed approximately **76,022 tCO_2e** in 2019.

3.1 Electricity consumption

Electricity consumption within QLDC area produced **45,822 tCO_2e** throughout 2019. The emissions factor used to calculate the total GHG emissions for 2019 was 0.0977 $kgCO_2e$/kWh (kilowatt-hour). This emissions factor was taken from MfE (2019b).

Emissions from electricity consumption were calculated using the total electricity consumed at grid exit points within the QLDC area (provided by local electricity lines companies PowerNet and Aurora). The exit points included Frankton, Upper Clutha and Kingston (Table 3.1).

Table 3.1: Total consumption of electricity and carbon emissions across exit points

2019 Electricity Emissions		
Exit Point	KWh	Emissions (tCO_2e)
Frankton	336,149,305	32,842
Upper Clutha	131,312,052	12,829
Kingston	1,544,604	151
Total	**469,005,961**	**45,822**

3.2 LPG

LPG use contributes on average **30,200 tCO_2e** per year. This is based on an annual estimate of 10,000 tonnes of LPG usage in the QLDC area provided by RockGas Ltd.[4]. The emissions factor used to calculate this was 3.02 $kgCO_2e$/kg of LPG from MfE (2019b). LPG is distributed throughout the QLDC by four main providers Contact (Rockgas), Genesis (Nova), Ongas and Elgas. The annual LPG use is made up of bottled gas, bulk storage in industry, vehicles, BBQs, and reticulated supplies (Wanaka, Arrowtown, Queenstown, Arthurs Point).

[4] Personal communication with Aaron Nash, Rock Gas, July 2020. Note detailed LPG usage data was not available.

4 Transport

The total transport-related emissions produced in the QLDC area has been estimated as **307,844 tCO_2e** in 2019. The transport emissions include those produced by both road and domestic aviation transport.

4.1 Road transportation

Road transportation contributed approximately **241,755 tCO_2e** in 2019 and was calculated based on the volume of fuel sold within the QLDC area. The volume sold was estimated from the Otago Regional Council Fuel Tax Summary[5] from 2019 for both diesel and petrol. This data was an aggregate total for QLDC, Central Otago District Council (CODC) and Clutha District Council. Resident and guest night (MBIE, 2019) estimates were used as a basis for developing proportions for each Council.

An emissions factor of 2.45 $kgCO_2e/L$ was used to calculate the emissions from the volume of petrol sold, and 2.69 $kgCO_2e/L$ for diesel. Both emissions factors were sourced from MfE (2019b).

Table 4.1: Road transport summary (based on proportion of fuel sales)

2019 Road Transport Emissions		
Item	**Value**	**Units**
Regional Resident total (Statistics NZ, 2018)	77,601	
Regional Guest Nights Total (MBIE, 2019)	13,822	
Regional total	91,423	
QLDC Proportion of regional total	57%	
Total Regional Petrol Sales	67,073,299	L
Total Regional Diesel Sales	97,503,554	L
Total Regional Petrol Emissions	164,330	tCO_2e
Total Regional Diesel Emissions	262,285	tCO_2e
Queenstown Petrol Emissions	93,123	tCO_2e
Queenstown Diesel Emissions	148,632	tCO_2e
Total	**241,755**	**tCO_2e**

4.2 Aviation – Transboundary

Queenstown Airport Limited are currently developing their reporting systems for emissions both as a result of transboundary aviation, local aviation and on-stand emissions. Unfortunately, at the time of writing this report, this data was not able to be provided. As such a number of assumptions were made, as outlined below.

[5] Obtained from Central Otago District Council

Domestic emissions
Domestic aviation contributed approximately **64,670 tCO_2e** to the total 2019 emissions. Domestic emissions were calculated by determining the proportion of the national domestic emissions (from MfE (2020)), produced by the Queenstown Airport - based on the proportion of domestic passengers through the airport in 2019 (both inbound and outbound)[6].

International emissions
International aviation emissions have not been included within the QLDC total, as they are also not included within the national emissions inventory (MfE, 2019b).

4.3 Aviation – Local

Total on-stand emissions (emissions contributed by aircrafts on the ground as well as airport vehicles) from the Queenstown Airport were based on 2017 totals, and estimated as **1,419 tCO_2e**[7].

No data was available for local (in boundary) air travel (helicopters, small planes etc), however it is assumed that this is captured within the QAC's proportion of domestic emissions (calculated based on Jet Kerosene volumes sold) – refer Section 4.2.

5 Waste

Total solid waste emissions produced in the QLDC area was estimated as **94,871 tCO_2e** in 2019. The sub-sectors that produce significant emissions within the reporting boundary include solid waste (landfills), wastewater and septic tanks.

5.1 Solid waste

Municipal solid waste within the QLDC area is disposed of at the Victoria Flats Landfill (VFL). The VFL generated **88,011 tCO_2e** throughout 2019 which is based on the volume of waste received at the landfill, multiplied by emissions factors (from MfE, 2019b).

The emissions factors used are based on the 2020 waste survey (SWAP data), provided by Deta Consulting (2020). The VFL receives waste from the Cromwell, Frankton, Wanaka and Alexandra transfer stations, as well as Council domestic collection, general waste and special waste from Queenstown as well as Central Otago waste. The annual volumes of solid waste categories received by the VFL are detailed in Table 5.1 along with the resulting emissions that these generate.

Table 5.1: Solid waste emissions summary

2019 Solid Waste Emissions			
Landfill	Volume (t/year)	Emissions factor (tCO2e/t)	Emissions (tCO2e)
Paper	6,278	3.000	18,834
Plastics	6,818	-	-
Organic	14,513	1.315	19,085
Ferrous metals	1,418	-	-
Nonferrous metals	405	-	-
Glass	1,013	-	-

[6] Sourced from Annual Reports from each airport.
[7] This has been taken from the 2017 emissions provided by the Queenstown Airport Corporation due do information not being readily available for the 2019 calendar year.

Textiles	2,903	1.800	5,225
Sanitary paper	2,160	2.400	5,184
Rubble	6,548	-	-
Timber	12,286	3.230	39,683
Rubber	540	-	-
Potentially hazardous	810	-	-
Total	55,691		**88,011**

5.2 Wastewater treatment

The total emissions produced from wastewater treatment across the QLDC area is estimated to be **5,008 tCO_2e** per year. The QLDC operates five wastewater treatment plants (WWTP) in the QLDC area, Wakitipu, Wanaka, Cardrona, Hawea and Luggate. WWTP volumes were provided by QLDC for the 2019 year.

Work carried out by Deta Consulting (2020) consisted of a detailed assessment of the Wastewater emissions for the Wakatipu WWTP, as well as an estimate of emission from biosolids for Wakatipu and Wanaka plants. Work carried out by Bloomberg, Lovett & Rissmann (2018) was used to estimate emissions for the plants/ponds at the Cardrona, Hawea and Luggate plants.

Refer to Appendix B for further detail.

Table 5.2: Total wastewater emissions summary

2019 Wastewater emissions						
WWTP	**Processes**	**2019 Volume (m3)**	**Plant emissions (tCO2/yr)**	**Pond emissions (tCO2/yr)**	**Biosolids emissions (tCO2/yr)**	**Total emissions (tCO2e)**
Wakatipu WWTP	MLE Plant and Pond	4,040,830	-	-	815	4,120
Wanaka WWTP	SBR Plant	1,308,263	297	-	515	812
Cardrona WWTP	Plant	3,434	1	-	-	1
Hawea WWTP	Pond	127,110	-	72	-	72
Luggate WWTP	Plant	14,930	3	-	-	3
					Total	**5,008**

5.3 Septic tanks

The total emissions produced by septic tanks in the QLDC area was estimated to be **1,852 tCO_2e** in 2019. There are approximately 3,526 septic tanks within the QLDC area[8] with an average of 2.6 persons per household (Statistics NZ, 2013). The emissions factor used was at 202 $kgCO_2e$ per capita year and was sourced from MfE (2019b).

[8] Email correspondence with Mark Baker of QLDC

6 Agriculture, forestry and other land use (AFOLU)

The following sections outline emissions produced/removed by agriculture and LULUCF (forestry) within the QLDC area. AFOLU contributed a total of **180,537 tCO_2e** in 2019 is made up of livestock and deforestation emissions.

6.1 Agriculture

Livestock including sheep, dairy, beef and deer contributed approximately **171,923 tCO_2e** in 2019 (Table 6.1 below). Livestock emissions were calculated by from data provided by Beef + Lamb NZ (sourced from Stats NZ). Emissions factors were obtained from MfE (2019b).

Table 6.1: Agriculture Calculations

2019 Agriculture Emissions						
Stock type	QLDC Animal Estimate 2019	EF Enteric Fermentation ($kgCO_2e$/unit)	EF Manure Management ($kgCO_2e$ /unit)	EF Ag soils ($kgCO_2e$ /unit)	Total emissions	Unit
Dairy	3,913	2,060	150	514	10,659	tCO_2e
Beef	21,184	1,500	20	321	39,000	tCO_2e
Sheep	262,397	300	3.15	72	98,307	tCO_2e
Deer	34,490	560	6.6	128	23,957	tCO_2e
				Total	**171,923**	**tCO_2e**

6.2 Land Use, Land Use Change, and Forestry (LULUCF)

LULUCF (forestry) emissions were divided into exotic and native forest carbon emissions and sequestration removals. The total emissions from deforestation were calculated as **8,614 tCO_2e.** The total sequestration removals from exotic and natural forestry was estimated as **-140,699 tCO_2e.**

Exotic Forests sequestration removals

The total carbon removals from *exotic* forest sequestration was calculated as **-24,642 tCO_2e** (Table 6.2). The amount is documented as a negative as it refers to the amount of CO_2e taken out of the atmosphere by the trees.

The area and average age of exotic trees in the QLDC area was sourced from the *National Exotic Forest Description (NEFD)* (MPI, 2019) with the area of deforestation obtained from Otago Regional Council and was subtracted from the total exotic forest area. This was because the Arthurs Point plantation was harvested in late 2019 and therefore assumed to have not been picked up in the 2019 NEFD. The Planted Forests emissions factor used was -33,807 $kgCO_2e$/ha/year and was sourced from the MfE (2019b).

Table 6.2: Exotic forest sequestration removals

2019 Exotic forest sequestration removals calculations			
Type	Area (ha)	Total Sequestration	Unit
Radiata Pine	230.9	-7,806	tCO_2e
Douglas-fir	451	-15,247	tCO_2e
Cypress Species	0	-	tCO_2e

Softwoods	44	-1,488	tCO_2e
Eucalypt Species	0	-	tCO_2e
Hardwoods	3	-101	tCO_2e
Total	**728.9**	**-24,642**	**tCO_2e**

Natural Forests sequestration removals

The total carbon removals from *native / natural* forest sequestration was estimated to be **116,057 tCO_2e** in 2019 (Table 6.3). The area of native forest in the QLDC area was obtained from the Land Cover Database (LCDB) and estimated to be 142,311 ha. Based on MfE (2019b) it was assumed that 16% (national average percentage) of the native forest area is regenerating natural forest[9] which sequestered the total 116,057 tCO_2e. This was calculated using an emissions factor of -5,097 $kgCO_2e$/ha/year from MfE (2019b). The remaining 84% of the native area was assumed to be tall natural forest[10] which is assumed to no longer sequester carbon from the atmosphere.

Table 6.3: Natural forest sequestration removals

2019 Natural forest sequestration removal calculations			
Type	**Area (ha)**	**Total Sequestration**	**Unit**
QLDC native / natural total	142,311		
Regenerating (16%)*	22,770	-116,057	tCO_2e
Tall Forest (84%)*	119,541	-	
	Total	**-116,057**	**tCO_2e**

*Based on national averages (MfE, 2019b).

Emissions from exotic deforestation

The total carbon emitted from exotic deforestation was estimated to be **8,614 tCO_2e** due to the harvesting of 9.1 ha at the Arthurs Point plantation[11] (Table 6.4). This was calculated using an emissions factor of 946,605 $kgCO_2e$/ha for harvested and deforested planted forests (MfE,2019b).

Table 6.4: Emissions from deforestation

2019 Deforestation emissions calculations			
Plantation	**Area (ha)**	**Total Emissions**	**Unit**
Arthurs Point	9.1	8,614	tCO2e
	Total	**8,614**	**tCO2e**

[9] **Regenerating natural forest:** comprises indigenous and naturally occurring vegetation, including broadleaved hardwood shrubland, mānuka–kānuka and other woody shrubland, with potential to reach forest under its current management (MfE, 2019b).

[10] **Tall natural forest:** comprises mature indigenous forest, and may contain self-sown exotic trees, such as wilding pines (MfE, 2019b).

[11] Area obtained from Mark Byrnes, Otago Regional Council.

7 QLDC emission comparisons

7.1 Comparison of 2019 and 2017 emissions

This section provides a comparison of 2017 and 2019 emissions. It is noted that 2017 emissions have been updated to reflect new baseline activity data and changes in methodologies/emissions factors.

Overall, QLDC's gross emissions have increased by around 3% since 2017. This is detailed further in Table 7.1 below.

Sequestration removals for 2019 have increased slightly when compared with 2017.

Table 7.1: Gross GHG Emissions for the QLDC area for 2017 and 2019 (tCO_2e)

Sector	Total Emissions 2017 (tCO_2e)	Total Emissions 2019 (tCO2e)	Commentary / Reasons for change
Transport	**301,016**	**307,844**	
Road Transport	241,213	241,755	Overall slight increase in regional fuel use.
Aviation – Domestic*	58,383	64,670	Overall domestic emissions have increased as a result of total domestic passenger numbers increasing by approximately 23%, an increase in total national emissions, and an increase in QLDCs proportion of the national total.
On Stand Emissions	1,419	1,419	No changes.
AFOLU	**188,252**	**180,537**	
Agriculture	188,252	171,923	Slight decrease in animal numbers.
LULUCF	0	8,614	Deforestation reported by ORC.
Stationary Energy	**71,005**	**76,022**	
Electricity	43,825	45,822	Increase in total kWh.
LPG	27,180	30,200	Increase in total LPG usage.
Waste	**83,506**	**94,871**	
WW Treatment	4,183	5,008	Increase due to additional data provided by QLDC for Hawea, Cardrona and Luggate WWTP. Overall increase in volume for Wanaka and Wakatipu WWTPs.
Landfill	77,471	88,011	Increase in landfill volumes.
Septic Tanks	1,852	1,852	No changes
Total Gross Emissions	**643,778**	**659,274**	

Forestry Sequestration	-134,880	-140,699	
Forestry - Exotic	-24,950	-24,642	Minor decrease.
Forestry – Native	-109,930	-116,057	Minor increase in native forestry, based on new data.
Total Net Emissions	**508,898***	**518,574**	

*Note: International aviation emissions are not included as these are not accounted for within New Zealand's National Inventory at present (MfE, 2019b).

Figure 7.1 and Figure 7.2 below provide an overview of the emissions for 2017 and 2019 by sector and sub-sector respectively. Road transport makes up the primary emissions source in both years, followed by agriculture.

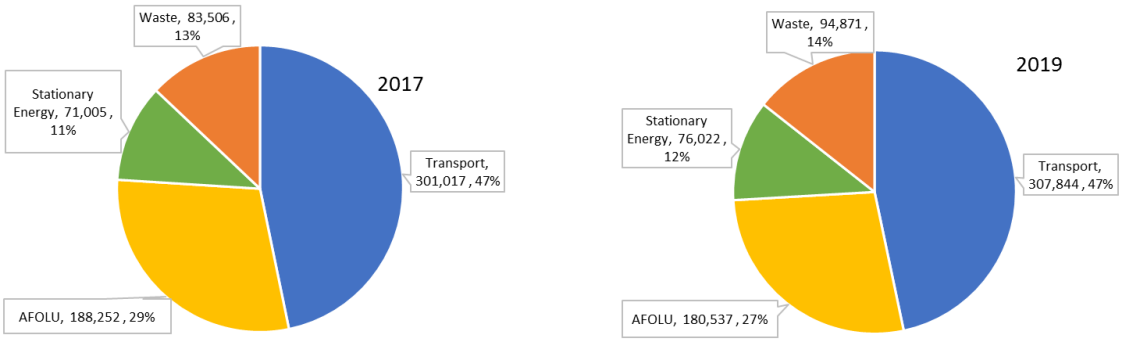


Figure 7.1: Gross GHG emissions for the QLDC area by sector for 2017 and 2019 (tCO_2e)

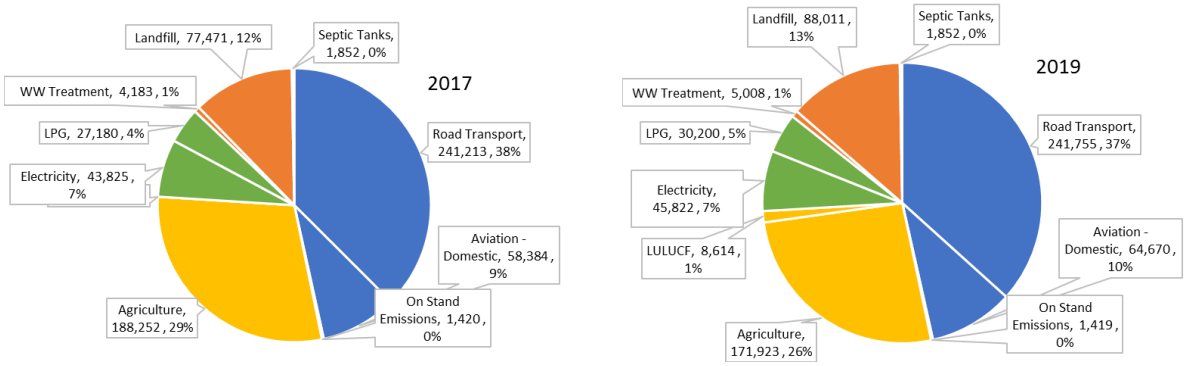


Figure 7.2: Gross GHG emissions for the QLDC area by sub-sector for 2017 and 2019 (tCO_2e)

7.2 Comparison of 2019 per capita emissions

In this section, the gross emissions from QLDC are compared with a range of selected NZ cities on a per capita basis. It is noted that comparisons are inherently difficult due to the assumptions, boundaries, methodologies and data sources used within the various assessments.

Figure 7.1 shows that if the resident population (39,153 – Statistics NZ) is used, QLDC's total emissions (at **17tCO$_2$e/capita/**year), are in line with the national average, significantly higher than Tauranga's, and lower the Gisborne and Rotorua. When AFOLU emissions are removed from consideration, however, it is evident that QLDC's emissions from the remaining sources are higher, per capita, than other centres.

Given the high number of visitors to the District, a combined resident + guest population estimate (51,808) (MBIE, 2019) was also used to generate per capita figures. This resulted in per capita emissions of **13 tCO$_2$e/capita/year** for the total gross emissions.

In terms of road transport emissions, QLDC per capita emissions are relatively high when compared to other NZ cities – at around **8 tCO$_2$e/capita/year** based on resident only population and **6 tCO$_2$e/capita/year** based on a combined resident + guest population equivalent.

Stationary energy per capita emissions are in a similar order to that of other areas, waste emissions are slightly higher than others, and AFOLU emissions are higher than Tauranga, similar to Dunedin, and significantly lower than Rotorua and Gisborne.

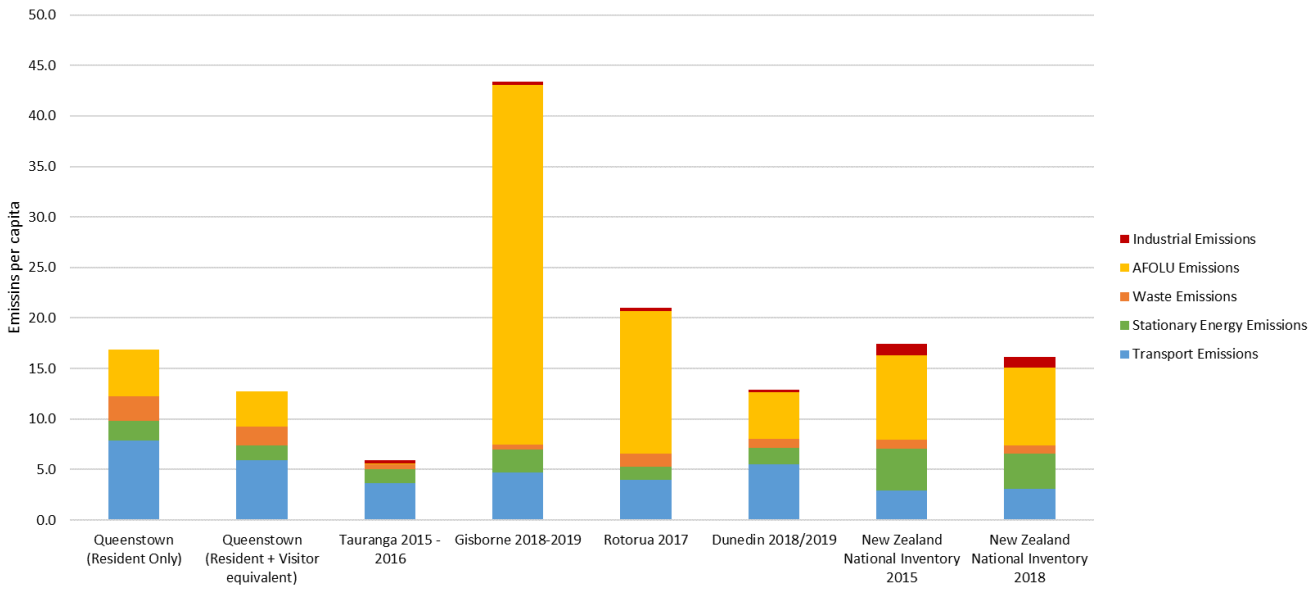


Figure 7.3: Comparison of gross emissions by sector across selected cities and nationally (tCO$_2$e/capita/year)[12]

[12] Tauranga data obtained from the Tauranga City Council Community Carbon Footprint (AECOM, 2017). Gisborne data obtained from Tairawhiti Regional Greenhouse Gas Emissions Inventory (Gisborne District Council, 2020). Dunedin data obtained from Dunedin's Community Carbon Footprint (AECOM 2020). Rotorua data obtained from Bay of Plenty Community Carbon Footprint (AECOM, 2017). National Data obtained from the 2015 and 2018 National GHG Inventories (MfE, 2017; MfE, 2020).

8 Summary and next steps

This report presents an estimate of carbon emissions for QLDC. The analysis has shown that the total 2019 gross emissions are **659,274 tCO_2e** - which is derived from the stationary energy, transport, waste and AFOLU sectors.

Forestry offsets were estimated as **-140,699 tCO_2e,** resulting in a NET estimate of carbon emissions of **518,574 tCO_2e**.

Comparatively, QLDC's total per capita emissions are generally in line with other NZ centres. Emissions from transport and waste sources are comparatively higher per capita than other centres.

The various sectors presented have different levels of confidence associated with the data sources. Improvements in this data will, over time, allow further refinement and accuracy of the inventory in future years. The suggested improvements are as follows:

- LPG: Actual sales volumes were not provided by gas companies. QLDC will need to continue discussions with these companies to obtain data.
- Aviation: QAC are in the process of developing their internal processes for capturing and reporting on emissions, and flight data. This should be available within the next year.
- Wastewater: Further refinement could be made to wastewater emissions, however this is a minor proportion of the total
- Forestry (sequestration): Data on afforestation and deforestation was estimated from national datasets. Further accuracy in these estimates could be achieved by developing a local assessment.

National guidance and support in data acquisition would be beneficial, and may eventuate as a result of the establishment of the Climate Commission. The Commission will also likely provide direction around where responsibilities for emissions reductions best reside, and what local Councils should consider when developing their own plans.

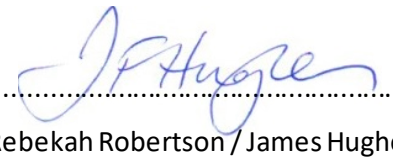
This emissions inventory establishes a baseline, allowing QLDC to understand the relative contributions to their emissions profile and to then develop plans and strategies to manage/reduce these emissions over time.

9 Applicability

This report has been prepared for the exclusive use of our client Queenstown Lakes District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:



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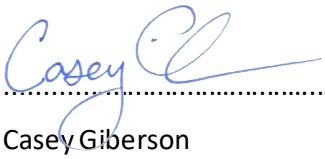

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Project Director

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Appendix A: Assumptions, limitations and data sources

The table below summarises all the sectors and sub-sectors as per WRI (2015) and indicates which were included within the QLDC assessment. The table also lists relevant assumptions, limitations and data sources.

Sector/Subsector	Assumptions, Limitations and Data Source
STATIONARY ENERGY	
Electricity consumption (grid)	**Included** – Grid exit point data was provided by local lines companies Aurora Energy and PowerNet.
LPG	**Included** – An estimate of total district annual LPG sales was provided by RockGas (verbally from Aaron Nash, RockGas).
Residential, commercial and institutional buildings and facilities	Excluded – this sub sector relates to coal burning at residential, commercial and institutional buildings and facilities. It is assumed no significant site level coal burning. Electricity and gas use are covered in categories below.
Electricity generation	Excluded – there is no electricity generation within the reporting boundary.
Electricity T&D loss	Excluded – as minor.
Natural gas consumption	Excluded – no significant reticulated natural gas consumption within the reporting boundary.
Coal	Excluded – no significant coal burning within the reporting boundary.
Biofuel use	Excluded – no expected biofuel use within the reporting boundary.
Fugitive Emissions	Excluded – no expected production of oil and gas within the reporting boundary.
TRANSPORT	
On-road transportation	**Included** – Fuel sales tax data was used. Data provided was a total for QLDC, Clutha and Central Otago districts, so a proportion of the sales was calculated based on resident and visitor population equivalents.
Aviation – domestic transboundary	**Included** – Domestic air travel emissions taken as a proportion of the national aviation emissions based on the numbers of passengers. National emissions data was obtained from the National GHG Emissions Inventory (MfE, 2020).
Aviation – Local (on stand emissions, skydive, helicopter, sightseeing)	**Included** – No data was provided by the Queenstown Airport Corporation for this category. On stand emissions were assumed to be the same as the 2017 inventory. This is due to up to date information not being readily available. No data was available for local air travel (helicopters, small planes etc), however it is assumed that this in captured within the QACs proportion of national emissions (calculated based on Jet Kerosene volumes sold).
Aviation – international transboundary	**Excluded from QLDC total –** as not captured within NZ national inventory.
Water transport	Included – Implicitly within the road transportation data as cannot distinguish the difference between fuels bought for road transport vs water transport.

Off-road transportation	Included – Implicitly within the road transportation data as cannot distinguish the difference between fuels bought for on road vs off road.
Railways	Excluded – no rail transport within the reporting boundary.
WASTE	
Solid waste disposal	**Included** – Solid waste disposal was calculated using volumes of waste delivered to the Victoria landfill. Data was provided by QLDC.
Wastewater treatment	**Included** – Wastewater treatment emissions were calculated based on data provided by Deta Consulting, as well as pro-rata emissions factors taken from the detailed Wakatipu and Wanaka wastewater treatment plant GHG emissions report (Bloomberg, Lovett, & Rissmann, 2018). Wastewater treatment plant volumes were provided by QLDC. Refer Appendix B.
Septic tank	**Included** – Assumptions on the number of septic tanks based on the rates data indicating that QLDC has 993 more WW connections than water supply, and 20,676 rating units (SUIP) with a water rate and a district total of 25,195 general rating units. So (25,195-20,676)-993 = 3526 septic tanks, as a rough number (based on conversation and correspondence with Mark Baker). The average number of people per household for the QLDC area was 2.6 - sourced from Statistics New Zealand.
Biological treatment	Excluded – Minor and therefore assumed do not contribute to net emissions (e.g. composting or burning firewood).
Incineration	Excluded – no expected burning of waste within the reporting boundary.
IPPU	
Industrial processes	Excluded – assumed minor or nil within the reporting boundary.
Product use HFC, PCFs and SF_6	Excluded – assumed minor or nil within the reporting boundary.
AFOLU	
Agriculture	**Included** – Livestock numbers for QLDC were sourced from Beef + Lamb NZ (sourced from Stats NZ). Emissions factors were obtained from MfE (2019b).
LULUCF	**Included** – Native forest data was obtained from LINZ and exotic forest data was obtained from the National Exotic Forest Description report. Harvested areas were provided by Otago Regional Council based on the information that is reported to them. We have assumed the national average breakdown for natural forests which assumes that 16% of natural forests are regenerating natural forest and therefore sequestering carbon, refer MfE 2019 Detailed Guidance. The remaining 84% are assumed to be tall natural forest which are assumed to no longer sequester carbon from the atmosphere.

Appendix B: Wastewater emissions data

Table B1 summarises the Wakatipu emissions, calculated by Beca, and provided by Deta Consulting.

Table B1: 2019 Wakatipu Wastewater emissions (Beca, 2020)	
Volume (m^3/yr)	4,040,830
Average emissions factor pre-upgrade ($tCO2e/m^3$)	0.00102
Total Wakatipu 2019 emissions (tCO2e)	4,120

Note: Wakatipu emissions figures provided by Beca (2020). Emissions from Wakatipu are composed of 26% ponds emissions, and 74% plant emissions which includes biosolids with landfill gas capture.

Table B2 summarises biosolids volumes and emissions, as provided by Deta Consulting.

Table B2: 2019 Wastewater biosolids emissions (Deta Consulting, 2020)				
	2019		2017	
	Wakatipu	Wanaka	Wakatipu	Wanaka
Biosolids mass (t solids)	2,525	1,596	2,355	1,497
Emissions factor (tCO2e/t)	0.32	0.32	0.32	0.32
Biosolids emissions tCO2e)	815	515	754	479

Note: Biosolids mass and emissions factors provided by Deta Consulting.

Table B3 summarises the plant and pond emissions factors (from 2017 data) used to calculate 2019 emissions for Wanaka, Cardrona, Hawea and Luggate treatment plants.

Table B3: 2017 Wastewater plant and pond emissions based on Bloomberg, et. al., (June 2018)				
WW volume (m3)	Plant emissions (tCO2/yr)	Pond emissions (tCO2/yr)	Plant emissions factor (tCO2/m3)	Pond emissions factor (tCO2/m3)
3,729,789	562	2120	0.000151	0.00057
1,182,418	268	N/A	0.000227	

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