MAY 21

RUAMĀHANGA STRATEGY

VOLUME 1: CLIMATE CHANGE STRATEGY

TE KAUNIHERA-Ā-ROHE O TARATAHI
CARTERTON
DISTRICT COUNCIL

SOUTH WAIRARAPA
DISTRICT COUNCIL
Kia Reretahi Tātau

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1 Glossary

Definitions

Anthropogenic greenhouse gases: Greenhouse gases that are emitted from human activities

Biogenic Methane: Methane produced from biological (plant and animal) sources.

Carbon reservoirs: they are features that stores carbon (such as a tree).

Carbon sequestration: it is the process of removing carbon from the atmosphere and storing it. Trees are a great way to sequestered carbon.

CO_2e: Carbon Dioxide Equivalent – all greenhouse gases have a different GWP (Global Warming Potential). Therefore, all the greenhouse gases emitted can be summarised by using CO_2e. For example, methane has a GWP of 25, meaning that 1 tonne of methane will cause the same amount of warming as 25 tonnes of carbon dioxide: 1t CH4 = 25 tCO_2e.

Evapotranspiration: This is the sum of the plants' transpiration and the ground's evaporation.

Greenhouse effect: It is a process that occurs when gases (greenhouse gases) in Earth's atmosphere trap the Sun's heat, and increase radiative forcing. This process makes Earth much warmer than it would be without an atmosphere. The greenhouse effect is one of the things that makes Earth a comfortable place to live.

Greenhouse gases: they are the gases that increase the greenhouse effect. More than forty gases are greenhouse gases, but the most important ones are Water vapour (H_2O) Carbon Dioxide (CO_2), Methane (CH_4), Ozon (O_3), Nitrous Oxide (N_2O) and fluorinated gases (HFC, PFC, SF_6).

Radiative forcing: It is the difference between the solar energy received by the planet and the energy reflected back to space. A positive radiative forcing means that Earth receives more energy than what is reflected. Therefore, the planet warms. The higher the radiative forcing is, the warmer the planet becomes. A negative radiative forcing means that Earth reflects more energy than what is received. Therefore, the planet cools down.

Sustainability: It is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (environmental protection, social and economic development) - Brundtland Report, 1987

Acronyms

CDC: Carterton District Council

CD: Carton District

CO_2: Carbon dioxide

EV: Electric Vehicles

GDP: Gross Domestic Product

GHG: greenhouse Gas

GPC: Global Protocol for Community Scale Greenhouse Gas Emissions Inventory

GWP: Global Warming Potential

GWRC: Greater Wellington Regional Council

ICE: Internal Combustion Engine

IPCC: Intergovernmental Panel on Climate Change

IPPU: Industrial Processes and Product Use

NIWA: National Institute of Water and Atmospheric research

RCP: Representative Concentration Pathways

UNFCCC: United Nation Framework Convention on Climate Change

SWDC: South Wairarapa District Council

SWD: South Wairarapa District

TA: Territorials Authorities

WIP: Work In Progress

WRCCF: Wellington Region Climate Change Forum

WRCCWG: Wellington Region Climate Change Working Group

WREVWP: Wellington Region Electric Vehicle Working Party

Te Reo

Hawaiki: Ancient homeland - the places from which Māori migrated to Aotearoa/New Zealand.

Iwi: Extended kinship group, tribe, nation, people, nationality, race - often refers to a large group of people descended from a common ancestor and associated with a distinct territory. Ngāti Kahungunu ki Wairarapa and Rangitāne o Wairarapa are the two iwis in Wairarapa.

Kai moana: Seafood

Kaitiaki: Guardians and protectors of places

Kaitiakitanga: the responsibility to care for the physical, ecological and spiritual well-being of a place or resource to ensure harmony within the environment and protection against elements that cause permanent imbalances.

Kokopu: Whitebait

Ngā atua: Deity

Pākehā: Person from another country

Piharau: Lamprey

Tangata whenua: Local people, hosts, indigenous people

Taniwha: Guardians and protectors of places. Rākai Uru is the taniwha who is the caretaker of the lake Wairarapa. He takes the form of a large tōtara log.

Taonga: Treasure

Tapu: Sacred

Tuna: Eels

Whaitua: Designated space or catchment

2 Introduction

Climate Change is the biggest environmental challenge we are facing.

As Wairarapa is already experiencing the effect of Climate Change, especially temperature increase, droughts, sea level rise and erosion, Carterton District Council (CDC) and South Wairarapa District Council (SWDC) are committed to doing their part in mitigating Climate Change (reducing the greenhouse gas emissions).

In 2015, the Mayors signed the New Zealand Local Government Leaders' Climate Change Declaration and committed to:

- Develop and implement ambitious action plans that reduce greenhouse gas emissions and support resilience within our own councils and for our local communities. These plans will:
    - promote walking, cycling, public transport and other low carbon transport options;
    - work to improve the resource efficiency and health of homes, businesses and infrastructure in our district;
    - support the use of renewable energy and uptake of electric vehicles;
- Work with our communities to understand, prepare for and respond to the physical impacts of climate change;
- Work with central government to deliver on national emission reduction targets and support resilience in our communities.

The Ruamāhanga Strategy has been developed to reduce the carbon footprint of Carterton District Council and South Wairarapa District Council. This strategy was adopted in February 2020 for CDC and March 2020 for SWDC.

This strategy has two volumes. The first volume:

- presents the districts (socio-economic, environmental and cultural contexts);
- explains what Climate Change is and what may be the impact for Wairarapa;
- presents the greenhouse gas inventory for the Wellington Region (lead by Greater Wellington);
- presents the inventories of greenhouse gas emissions from Wairarapa and from council's activities for each Councils;
- sets up targets.

The second volume presents:

- our achievements since the strategy was adopted in 2020;
- An updated action plan for the coming years (2020-2023 and 2023-2033).

Adoption	CDC: February 2020 SWDC: March 2020
1st review	March 2021
Next review due	2024

3 Executive summary

Climate Change is the biggest environmental challenge we are facing.

As Wairarapa is already experiencing the effect of Climate Change, especially sea level rise and erosion, Carterton District Council (CDC) and South Wairarapa District Council (SWDC) are committed to doing their part in mitigating Climate Change (reducing the greenhouse gas emissions).

The Ruamāhanga Strategy has been developed to reduce the carbon footprint of Carterton District Council and South Wairarapa District Council.

Socio-economic context

With a population of 19,773 in 2018, South Wairarapa and Carterton Districts are attractive, and the population had a +23.6% growth between 2006 and 2018 (around +1.8% per year). South Wairarapa and Carterton Districts are rural districts with a density of 5.4 pers/km^2.

In 2018, 37.1% of the households in the districts own one or less motor vehicles. 18.1% of the households in the district own 3 or more motor vehicles.

In 2018, the main fuel type for the district's households was wood (74.7%), followed by electricity (59.9%). Bottled gas and coal respectively had a 43.6% and 73.2% decrease between 2013 and 2018.

In 2018, unemployment in South Wairarapa and Carterton Districts was lower than in New Zealand (3.0% compared to 4.0%). The main industries are 'agriculture, forestry and fishing' (15.6% of the workforce) followed by 'professional, scientific and technical services' (9.2% of the workforce).

In 2018, 75.3% of the residents from South Wairarapa and Carterton Districts worked within the districts. 61.7% of the residents drove a car, truck or van to travel to work. Public transport (trains and buses) are used by 9.2% of the residents to go to work and 5.3% of the residents walked, jogged or biked.

Over 96% of the residents of South Wairarapa and Carterton Districts live and work within the districts.

Environmental context

Carterton and South Wairarapa Districts have dry and warm summers and wet and mild winters.

The main features in the landscape are the Tararua range in the North-West, the Aorangi range in the South, the Ruamāhanga plains and the rugged East coast.

The districts are mainly covered by farmlands (55.7%, including 6.7% of planted forests), closely followed by natural areas (43.8%, including 35.7% of natural forests). The farmlands and the four settlements of Featherston, Greytown, Martinborough and Carterton are mainly located in the Wairarapa plains and the Eastern Wairarapa. The Tararua Range and the Aorangi Range are the main natural areas of the districts.

Carterton and South Wairarapa Districts have a 142-kilometre shoreline. The coast has the settlements of Ngawi, Tora and Flat Point, but is mainly composed of rural and natural areas.

Historical and cultural context

The Wairarapa has a strong mana whenua history with many important Māori heritage sites. The cultural landscape includes those places associated with ngā atua (deities), taniwha and kaitiaki (guardians and protectors of places), as well as places discovered, visited and or named by ancestors and explorers.

What is Climate Change and its impact for Wairarapa

According to the UNFCCC (United Nation Framework Convention on Climate Change), Climate Change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

The IPCC (Intergovernmental Panel on Climate Change) set up different scenarios depending on the greenhouse gas emissions. RCP2.6 is a low emissions scenario, RCP4.5 is a low to moderate emissions scenario, RCP6.0 is a moderate emission scenario and RCP8.5 is a high emissions scenario.

Globally, surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent. The ocean will continue to warm and acidify, and global mean sea level to rise.

Greater Wellington Regional Council provides climate change assumptions based on the RCP4.5 and RCP8.5. These assumptions were used to understand the likely impacts of climate change in Wairarapa.

The expected direct impacts of climate change (such as increased temperature, increased flood intensity and sea level rise) impact the communities living in Carterton and South Wairarapa District. The key impacts on the communities are:

- Impact on the environmental well-being (biodiversity losses, increased pests and rodents, increased coastal inundation…);
- Impact on the social well-being (increased risk on the human health and human life, increased pressure on drinking water quality and availability…);
- Impact on the economic well-being (reduced productivity, increased damage to properties, increased pressure on insurances and mortgages…);
- Impact on the cultural well-being (loss of cultural identity, loss of important cultural activities, loss of taonga species…).

Wairarapa Combined District greenhouse gas inventory

In 2018/19 reporting year, the Wairarapa Combined District emitted gross 1,734,320 tCO_2e and net 353,460 tCO_2e.

The biggest sector is agriculture (77.8%), followed by transport (15.7%). Stationary energy (3.4%), Waste (2.3%) and Industry (0.8%) are minor sources of emissions in the Wairarapa.

Total gross emissions fell by 7%, from 1,871,095 tCO_2e in 2001 to 1,734,320 tCO_2e in 2019. Reductions in emissions from stationary energy, waste and agriculture are responsible for the fall in total gross emissions. As the area's population has risen (by 22%, from 39,090 to 47,590), per capita gross emissions have reduced by 24% from 47.9 tCO_2e in 2001 to 36.4 tCO_2e in 2019.

Net forestry sequestration reduced by 30% between 2001 and 2019 causing net emissions to increase from net-negative total emissions (-91,460 tCO_2e in 2001) to net-positive emissions (353,460 tCO_2e in 2019).

Carterton District Council greenhouse gas inventories

Carterton District Council had a gross emission of 372.91 tCO_2e in 2018 (base year) and 275.99 tCO_2e in 2020 (-26%). The biggest source is transport (50%) followed by electricity (21%, wastewater treatment (19%) and water supply (9%). Waste and refrigerant are minor sources of greenhouse gas.

Carterton District Council had a net emission of -6,864.48 tCO_2e in 2018 (base year) and -6,961.40 tCO_2e in 2020 (+1.41%).

Biogenic methane emissions increased by 2.73% between 2018 and 2020.

South Wairarapa District Council greenhouse gas inventories

South Wairarapa District Council had a gross emission of 247.54 tCO_2e in 2018 (base year) and 243.17 tCO_2e in 2020 (-2%). The biggest source is the electricity (38%) followed by water supply (21%), transport (21%) and wastewater treatment (19%). Waste and refrigerant are minor sources of greenhouse gas.

South Wairarapa District Council had a net emission of 2,687.02 tCO_2e in 2018 (base year) and 665.70 tCO_2e in 2020 (-79%).

Biogenic methane emissions decreased by 2% between 2018 and 2020.

Targets

Carbon targets have been set up. They are ambitious but also, achievable and realistic. Being small councils, we must be aware of our limits.

During the period 2020 – 2030, Carterton and South Wairarapa District Councils aim to:

- Reduce their gross greenhouse gas emissions;
- Increase the reservoirs, therefore the amount of greenhouse gas sequestered every year;
- Reduce biogenic methane by 10% below 2017 levels.

4 Socioeconomic context

With a population of 19,773 in 2018, South Wairarapa and Carterton Districts are attractive, and the population had a +23.6% growth between 2006 and 2018 (around +1.8% per year). South Wairarapa and Carterton Districts are rural districts with a density of 5.4 pers/km^2.

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In 2018, unemployment in South Wairarapa and Carterton Districts was lower than in New Zealand (3.0% compared to 4.0%). The main industries are 'agriculture, forestry and fishing' (15.6% of the workforce) followed by 'professional, scientific and technical services' (9.2% of the workforce).

In 2018, 75.3% of the residents from South Wairarapa and Carterton Districts worked within the districts. 61.7% of the residents drove a car, truck or van to travel to work. Public transport (trains and buses) are used by 9.2% of the residents to go to work and 5.3% of the residents walked, jogged or biked.

Over 96% of the residents of South Wairarapa and Carterton Districts live and work within the districts.

4.1 Carterton District (CD)

4.1.1 Population

	2006	2013	2018	Change between 2006 - 2018	2050 (forecast)	Change between 2018 - 2050
Population	7,101	8,235	9,198	+29.5%	13,068	+42.1%

Source: Infometrics, 2021

Table 1: CD's population

	Population 2018	Land area	Density (pers/km^2)
Population	9,198	1,180 km^2	7.79

Source: Infometrics, 2021

Table 2: CD's population density in 2018

Between 2006 and 2018 Carterton District's population increased quickly (average: 2.2% per year) and passed from 7,101 in 2006 to 9,198 in 2018. The forecast shows that the population will keep increasing even though it is slower (average: 1.1% per year). The population in 2050 is estimated to be 13,068.

CD's density is low (7.79 persons per km^2).

4.1.2 Dwellings

4.1.2.1 Dwellings

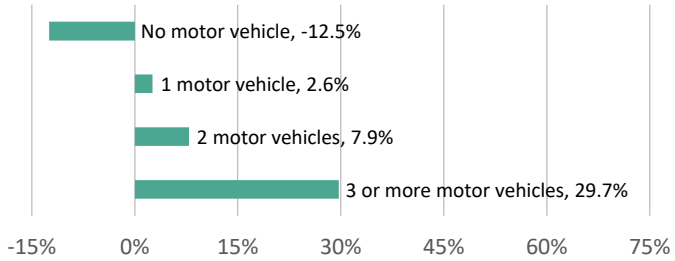
	2006	2013	2018	Change between 2013 – 2018
Dwellings	2,784	3,321	3,657	+10.1%

Source: Infometrics, 2021

Table 3: CD's dwellings

CD had a 10.1% increase in dwellings between 2013 and 2018.

4.1.2.2 Car ownership

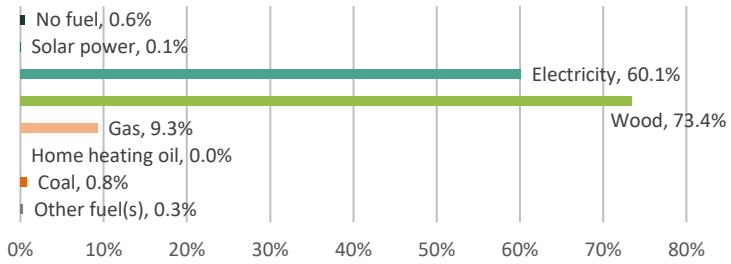


Source: Infometrics, 2021

Figure 1: CD's households car ownership change between 2013 and 2018

Households without motor vehicles decreased by 12.5% between 2013 and 2018 while households with at least one motor vehicle increased. The biggest increase is for the households with 3 or more vehicle (+29.7%). Because CD is a rural district and due to limited public transport, people rely on their own vehicles.

4.1.2.3 Household fuel type



Source: Infometrics, 2021

Figure 2: CD's households fuel type in 2018

Wood (73.4% of the households) and electricity (60.1% of the households) are the two main fuels for the households in CD in 2018.

4.1.3 Employment

4.1.3.1 Employment status

	2006		2013		2018		Change between 2013 – 2018
	Number	%	Number	%	Number	%	
Employed full-time	2,733	48.8%	3,015	74.2%	3,492	46.8%	+15.8%
Employed part-time	885	15.8%	1,047	25.8%	1,242	16.7%	+18.6%
Unemployed	129	2.3%	243	6.0%	240	3.2%	-1.2%
Not in labour force	1,731	30.9%	2,070	51.0%	2,484	33.3%	+20.0%
Unidentified	129	2.3%	222	5.5%	0	0.0%	-100.0%
	5,604		**4,062**		**7,458**		

Source: Infometrics, 2021

Table 4: CD's residents employment status

The unemployment rate in 2018 for CD was below the national rate of 4.0%.

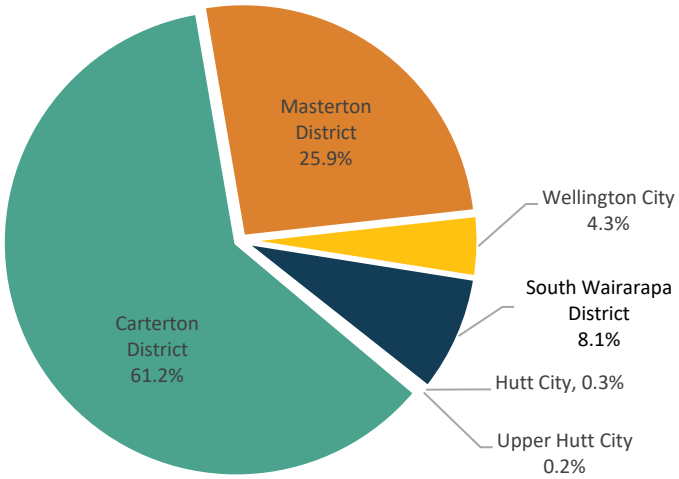
4.1.3.2 Workforce profiles

Source: NZ Stat, 2021

Figure 3: CD's workforce industry sector of employment in 2018

Agriculture, forestry and fishing is the biggest sector and represents almost 14% of the workforce profile. Manufacturing is the second biggest sector with over 10% of the workforce.

4.1.3.3 Carterton's residents place of work

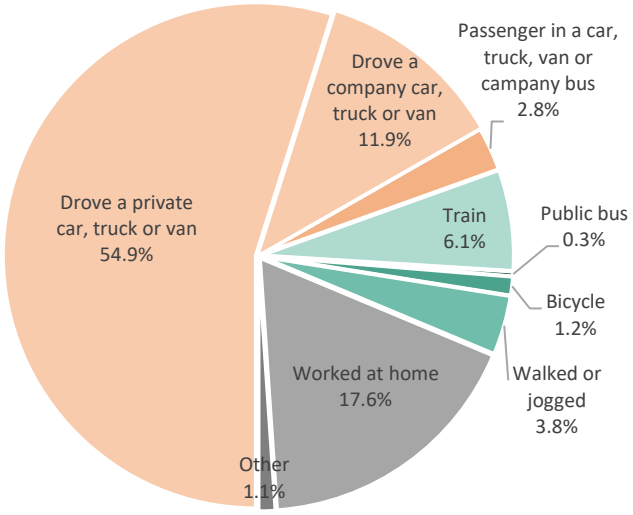


Source: Commuter Waka App, 2021

Figure 4: CD's residents place of work in 2018

Over 95% of the CD's residents works in Wairarapa (61.2% in CD, 25.9% in Masterton District and 8.1% in South Wairarapa District). 4.3% of the CD residents work in Wellington City. A small number of residents works in Hutt City and Upper Hutt City.

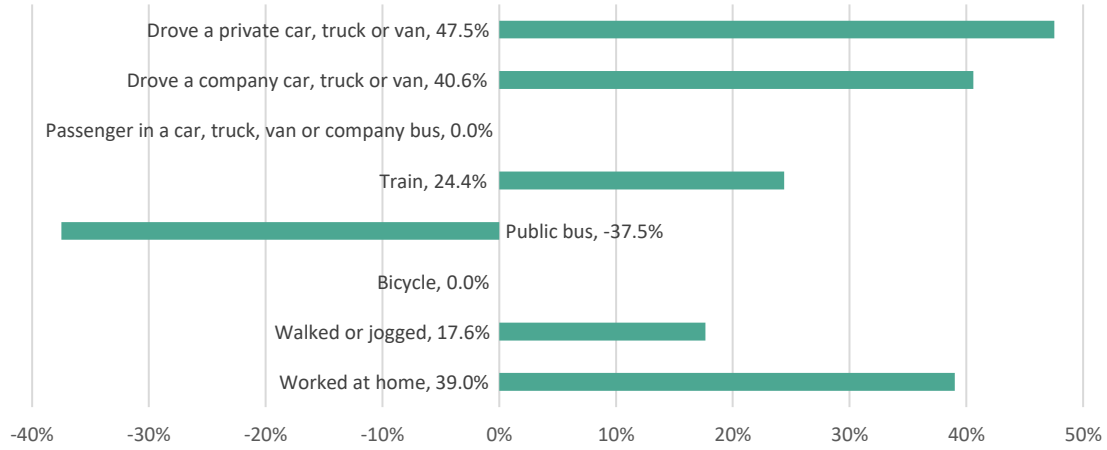
4.1.3.4 Method of travel to work



Source: Infometrics, 2021

Figure 5: CD's residents' method of travel to work in 2018

Almost 70% of the CD's residents use a high carbon emission way of transport to work (drive a car, truck or van or be a passenger). 11.8% of residents use a low carbon way of transport to go to work (train, walk or jogged, bicycle, public bus).

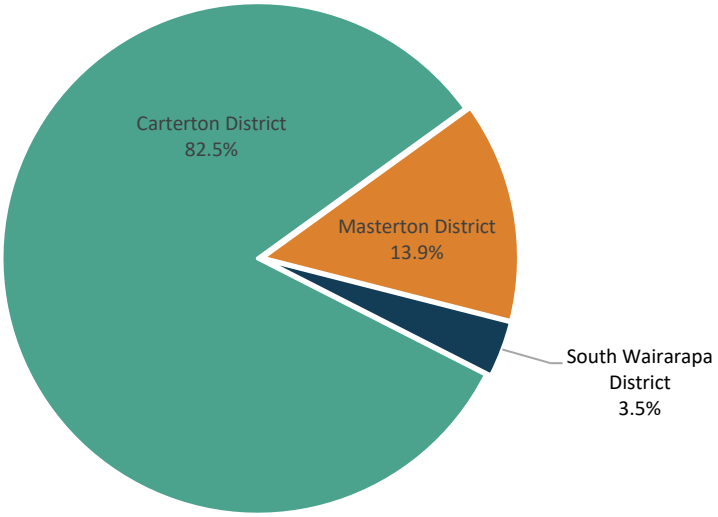


Source: Infometrics, 2021

Figure 6: CD's residents' method of travel to work change between 2013 and 2018

The low carbon way of travel (train (+24.4%) and walked or jogged (+17.6%)) increased between 2013 and 2018. However, the bicycle users stayed stable and the public bus users decreased (-37.5%). Moreover, the high carbon emission way of travel increased (+47.5% for the private car, truck or van users and +40.6% for the company car, truck or van users).

4.1.3.5 Carterton's workers place of residence



Source: Commuter Waka App, 2021

Figure 7: CD's workers place of residence in 2018

Carterton's workers live for almost 83% in Carterton District, almost 14% in Masterton District and 3.5% in South Wairarapa District.

4.2 South Wairarapa District (SWD)

4.2.1 Population

	2006	2013	2018	Change between 2006 - 2018	2050 (forecast)	Change between 2018 - 2050
Population	8,892	9,528	10,575	+18.9%	14,098	+33.3%
Featherston	*2,343*	*2,250*	*2,487*	*+6.1%*	*3,469*	*+39.5%*
Greytown	*2,103*	*2,238*	*2,466*	*+17.3%*	*3,642*	*+47.7%*
Martinborough	*1,329*	*1,473*	*1,767*	*+33.0%*	*2,493*	*+41.1%*
Rural areas	*3,114*	*3,570*	*3,852*	*+23.7%*	*4.494*	*+16.7%*

Source: Infometrics, 2021

Table 5: SWD's population

	Population 2018	Land area	Density (pers/km^2)
Population	10,575	2,457 km^2	4.3

Source: Infometrics, 2021

Table 6: SWD's population density in 2018

Between 2006 and 2018 South Wairarapa District's population increased quickly (average: 1.5% per year) and went from 8,892 in 2006 to 10,575 in 2018. The forecast shows that the population will keep increasing even though it is slower (average: 1% per year). The population in 2050 is estimated to be 14,098.

SWD's density is very low (4.3 persons per km^2).

4.2.2 Dwellings

4.2.2.1 Dwellings

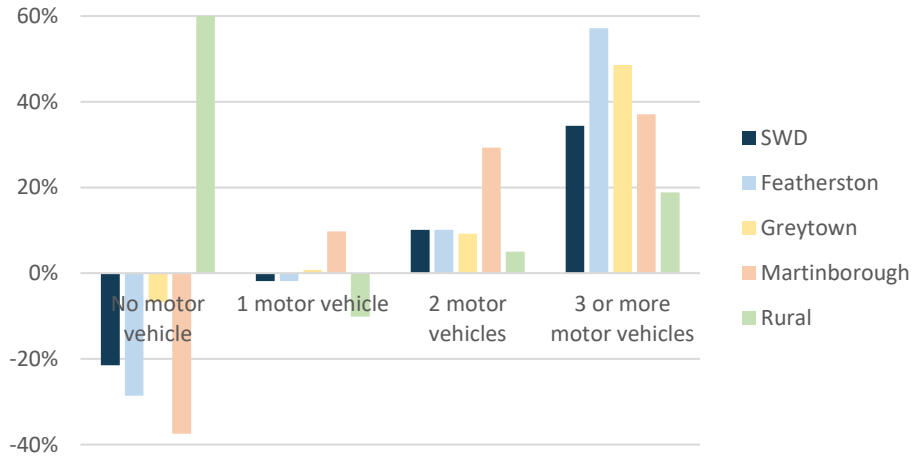
	2006	2013	2018	Change between 2013 – 2018
SWD	3,678	3,984	4,395	+10.3%
Featherston	969	996	1,035	+3.9%
Greytown	879	942	1,059	+12.4%
Martinborough	585	639	759	+18.8%
Rural areas	1,242	1,407	1,545	+9.8%

Source: Infometrics, 2021

Table 7: SWD's dwellings

SWD had an 10.3% increase in dwellings between 2013 and 2018. The biggest increase happened in Martinborough (+18.8%), followed by Greytown (+12.4%).

4.2.2.2 Car ownership

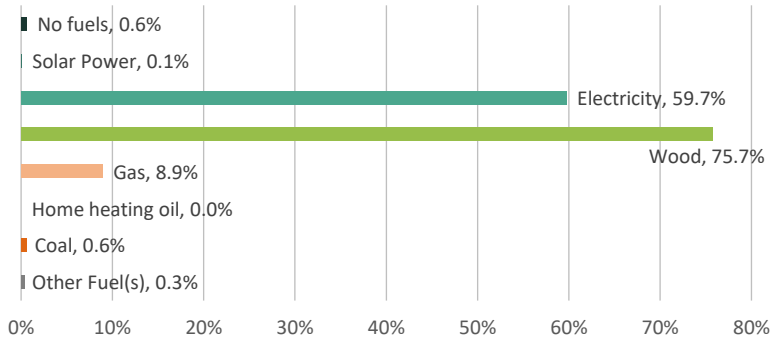


Source: NZ Stat, 2021

Figure 8: Car ownership change between 2013 and 2018

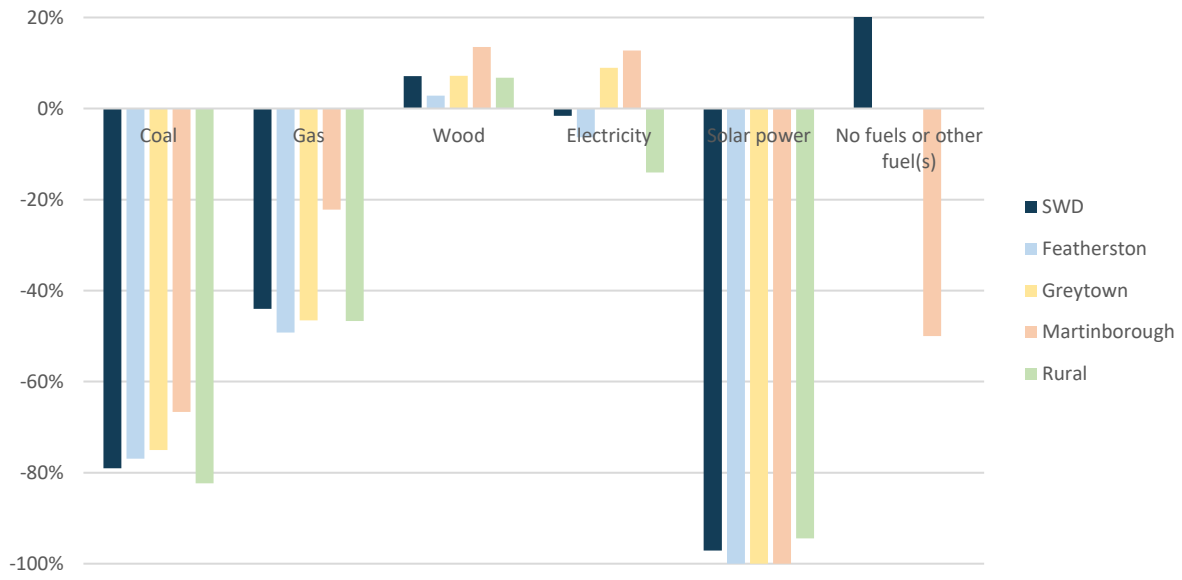
The percentage of households with 3 or more motor vehicles increased by 34.4% between 2013 and 2018 and the number of households without a motor vehicle decreased by 21.5%. This increase of households with 3 or more motor vehicles can be explained by the fact that SWD is a rural district and people living there rely on their vehicles.

4.2.2.3 *Household fuel type*



Source: Infometrics, 2021

Figure 9: SWD's households fuel type in 2018



Source: Infometrics, 2021

Figure 10: Households fuel type change between 2013 and 2018

The fuel type which are high greenhouse gas emitters such as coal and gas are decreasing. The use of wood increased everywhere in the district.

4.2.3 Employment

4.2.3.1 Employment status

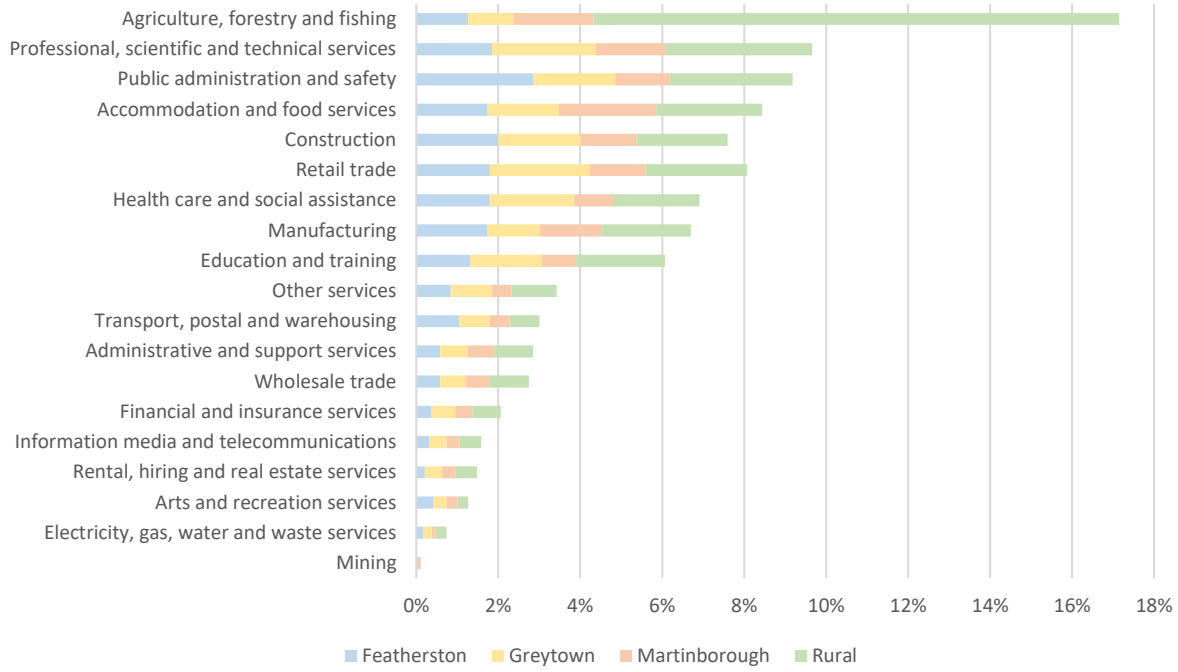
	2006		2013		2018		Change between 2013 – 2018
	Number	%	Number	%	Number	%	
SWD							
Employed full-time	3,483	49.5%	3,225	42.0%	4,239	49.0%	+31.4%
Employed part-time	1,062	15.1%	1,260	16.4%	1,446	16.7%	+14.8%
Unemployed	141	2.0%	261	3.4%	237	2.7%	-9.2%
Not in labour force	2,109	30.0%	2,343	30.5%	2,736	31.6%	+16.8%
Unidentified	246	3.5%	285	3.7%	0	0.0%	-100.0%
	7,041		7,674		8,658		
Featherston							
Employed full-time	813	45.0%	765	41.9%	924	45.8%	+20.8%
Employed part-time	225	12.5%	237	13.0%	267	13.2%	+12.7%
Unemployed	63	3.5%	117	6.4%	108	5.3%	-7.7%
Not in labour force	624	34.6%	651	35.6%	720	35.7%	+10.6%
Unidentified	75	4.2%	60	3.3%	0	0.0%	-100.0%
	1,806		1,827		2,019		
Greytown							
Employed full-time	747	43.7%	741	40.6%	921	45.0%	+24.3%
Employed part-time	279	16.3%	303	16.6%	330	16.1%	+8.9%
Unemployed	30	1.8%	54	3.0%	42	2.1%	-22.2%
Not in labour force	630	36.8%	684	37.5%	747	36.5%	+9.2%
Unidentified	27	1.6%	51	2.8%	0	0.0%	-100.0%
	1,710		1,824		2,046		
Martinborough							
Employed full-time	525	47.7%	555	45.8%	723	49.0%	+30.3%
Employed part-time	153	13.9%	204	16.8%	246	16.7%	+20.6%
Unemployed	18	1.6%	33	2.7%	30	2.0%	-9.1%
Not in labour force	354	32.2%	381	31.4%	480	32.5%	+26.0%
Unidentified	45	4.1%	39	3.2%	0	0.0%	-100.0%
	1,101		1,212		1,476		
Rural areas							
Employed full-time	1,401	57.6%	1,470	52.4%	1,671	53.6%	+13.7%
Employed part-time	402	16.5%	516	18.4%	603	19.3%	+16.9%
Unemployed	27	1.1%	57	2.0%	57	1.8%	0.0%
Not in labour force	495	20.3%	627	22.4%	789	25.3%	+25.8%
Unidentified	99	4.1%	135	4.8%	0	0.0%	-100.0%
	2,433		2,805		3,120		

Source: Infometrics, 2021

Table 8: SWD's resident employment status

The unemployment rate in SWD is below the national rate (4.0% in 2018). However, Featherston is above the national rate (5.3% unemployment) but this rate has decreased since 2013. The district's employment increased a lot since 2013 (+31.4% for full-time employment and +14.8% for part-time employment), especially in Martinborough.

4.2.3.2 Workforce profiles

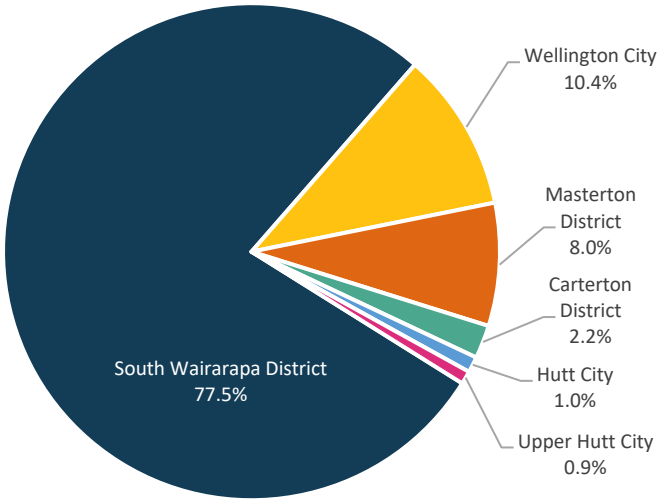


Source: NZ Stat, 2021

Figure 11: SWD's workforce industry sector of employment in 2018

Agriculture, forestry and fishing is the biggest sector and represents 17.2% of the workforce profile.

4.2.3.3 South Wairarapa's residents place of work

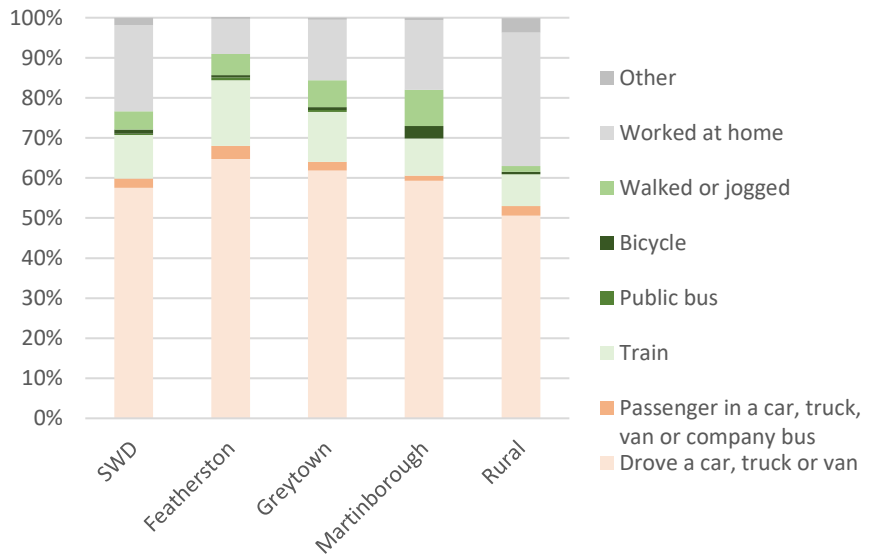


Source: Commuter Waka App, 2021

Figure 12: SWD's residents place of work in 2018

Almost 90% of the SWD's residents works in Wairarapa (77.5% in SWD, 8% in Masterton District and 2.2% in Carterton District). 10.4% of the residents works in Wellington City. A small number of residents works in Hutt City and Upper Hutt City.

4.2.3.4 Method of travel to work

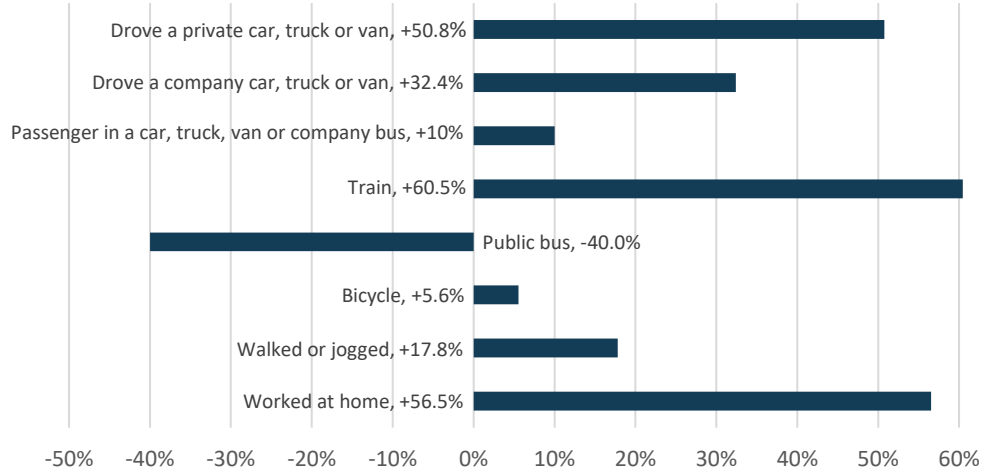


Source: Infometrics, 2021

Figure 13: Residents' method of travel to work in 2018

Almost 60% of the SWD's residents use a high carbon emission way of transport to work (drive a car, truck or van or be a passenger). 16.7% of the residents use a low carbon way of transport to go to work (train, walk or jogged, bicycle, public bus).

These trends are about the same for the three towns. However, we note a higher use of the train in Featherston (due to the proximity of the train station) and of the bicycle in Martinborough. The rural areas' residents mainly use motor vehicles to go to work or work from home.

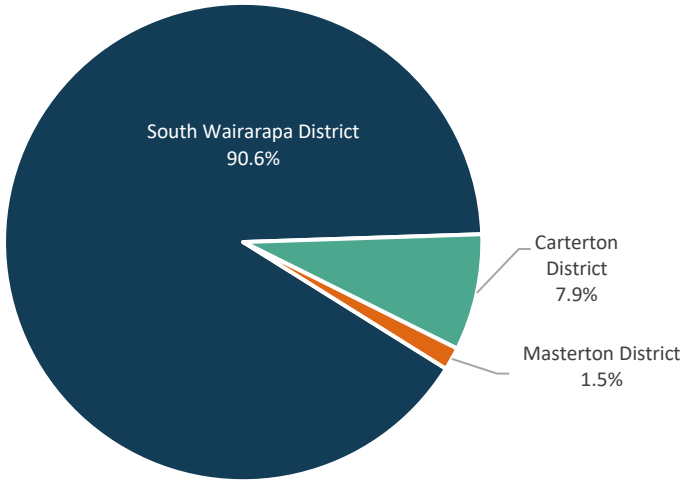


Source: Infometrics, 2021

Figure 14: SWD's residents' method of travel to work evolution between 2013 and 2018

The train users (+60.5%) increased quicker than the car, truck or van users (+50.8% for private vehicles and +32.4 for company vehicles) between 2013 and 2018 and the walkers/joggers increased by 17.8%. However, the public bus users decreased by 40.0%.

4.2.3.5 South Wairarapa's workers place of residence



Source: Infometrics, 2021

Figure 15: SWD's workers place of residence in 2019

Over 90% of the SWD's workers live in the SWD, 8% in Carterton District and 1.5% in Masterton District.

5 Environmental context

5.1 Climate

Carterton and South Wairarapa Districts have dry and warm summers and wet and mild winters.

The following data is provided by the NIWA[1]. They have been recorded between 1981 and 2010 in Masterton.

Temperature

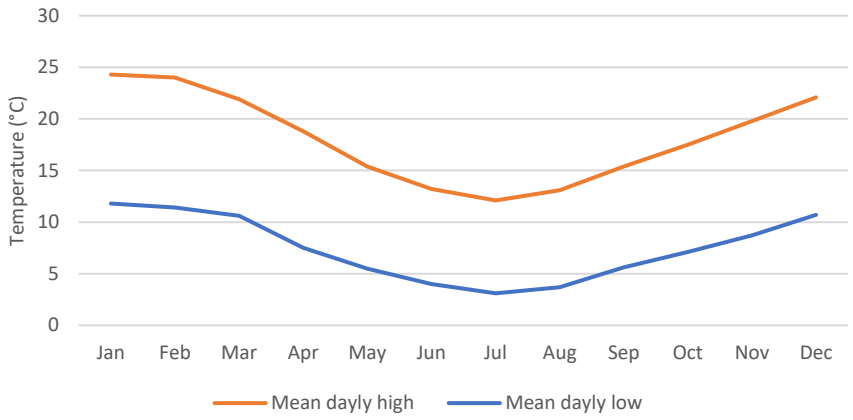
See Figure 21, page 28.

Wairarapa enjoys warm summers and mild winters even though frost may happen.

In summer maximum air temperatures range from 20°C to 28°C, but temperatures above 30°C have been recorded. High temperature may be accompanied by a strong dry foehn wind from the northwest.

Winter is mild in the north of the region and cooler in the south. Typical winter daytime maximum air temperatures range from 10°C to 16°C.

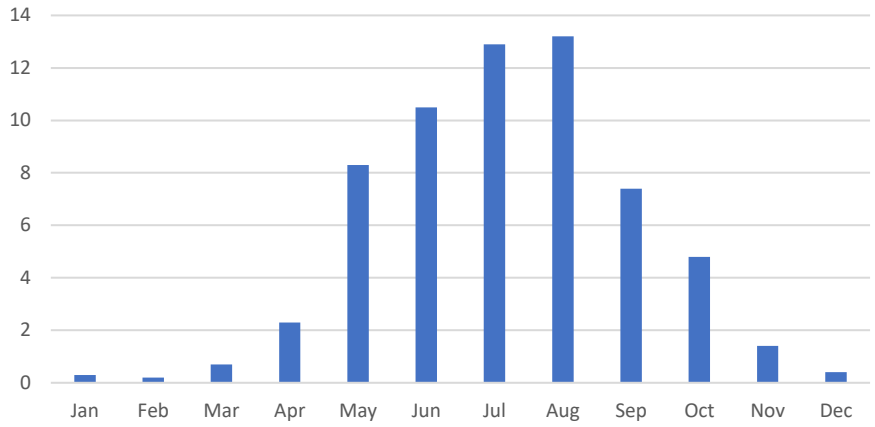
Frost occurs mainly in winter even though frosts can happen occasionally all year around. July and August are the months with the most frosts recorded (12.9 and 13.2 days respectively).



Source: NIWA 2012

Figure 16: Mean temperature in Masterton for 1981 – 2010

[1] National Institute of Water and Atmospheric Research



Source: NIWA 2012

Figure 17: Mean monthly value in Masterton for 1981 – 2010, Numbers of days of ground frost

Pluviometry

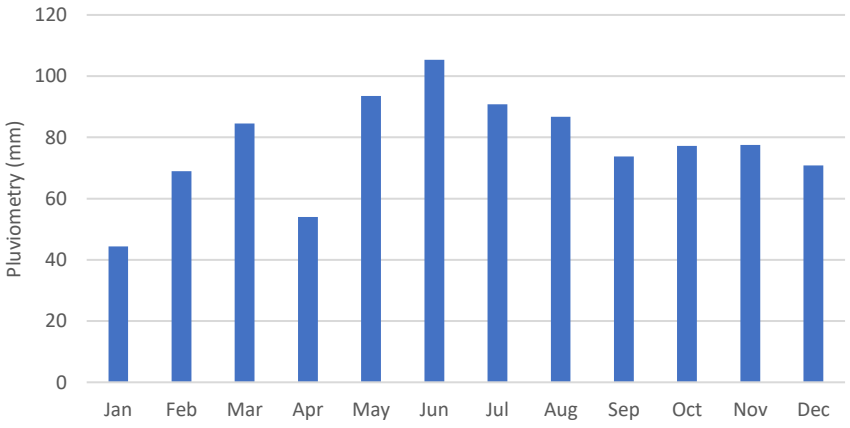
See Figure 22, page 29.

Rainfall is influenced to a large extend by the Tararua Range that lie across the west to east movement of the weather systems.

The ranges are wetter than the plains. Eastern Wairarapa is also slightly wetter than the plains:

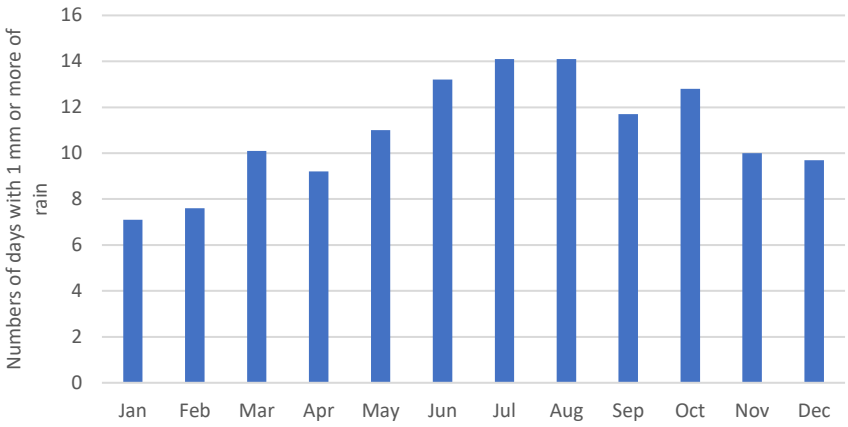
- over 2,000 mm for the Tararua range and 1,800 mm of the Aorangi range;
- under 800 mm for Martinborough and the plains around;
- between 1,000 and 1,400 mm for the Eastern Wairarapa.

Masterton receives 927.6 mm of rain every year. January (44.4 mm and 7.1 wet days) and April (54 mm and 9.2 wet days) are the driest months. May (93.6 mm and 11 wet days), June (105.3 mm and 13.2 wet days) and July (90.9 mm and 14.1 wet days) are the wettest.



Source: NIWA 2012

Figure 18: Mean monthly pluviometry in Masterton for 1981 – 2010



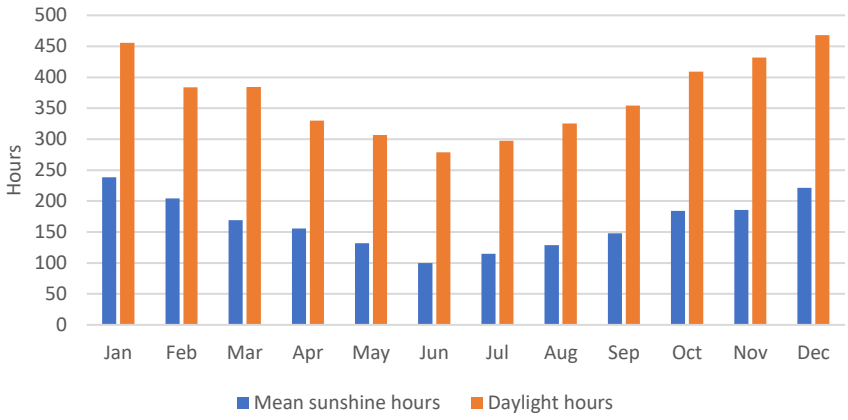
Source: NIWA 2012

Figure 19: Mean monthly value in Masterton for 1981 – 2010, Numbers of days with 1 mm or more of rain

Sunshine

See Figure 23, page 30.

Summer is the sunniest time of the year (238.6 hours of sunshine in January and 221.3 hours of sunshine in December) when winter is the least sunny time of the year (99.9 hours of sunshine in June, 114.9 hours of sunshine in July).



Source: NIWA 2012

Figure 20: Mean monthly hours of sunshine in Masterton for 1981 – 2010

Masterton receives 1,982.1 hours of sunshine every year. The Tararua range is the least sunny part of the region (under 1,750 hours of sunshine yearly) and the coast is the sunniest part of the region (2,100 hours of sunshine every year).

Wind

See Figure 24, page 31.

The strongest winds happen at the summit of the ranges (mean annual average between 8 and 9 m/s[2]). The wind in the Wairarapa plains range between 2 and 3 m/s. The wind gets stronger and stronger as we move east and ranges from 5 m/s (west of Eastern Wairarapa) to 7 m/s (east of Eastern Wairarapa).

In summer the winds are mainly dry north-westerlies and in winter, they are moist south and south-easterlies.

[2] Metre per second

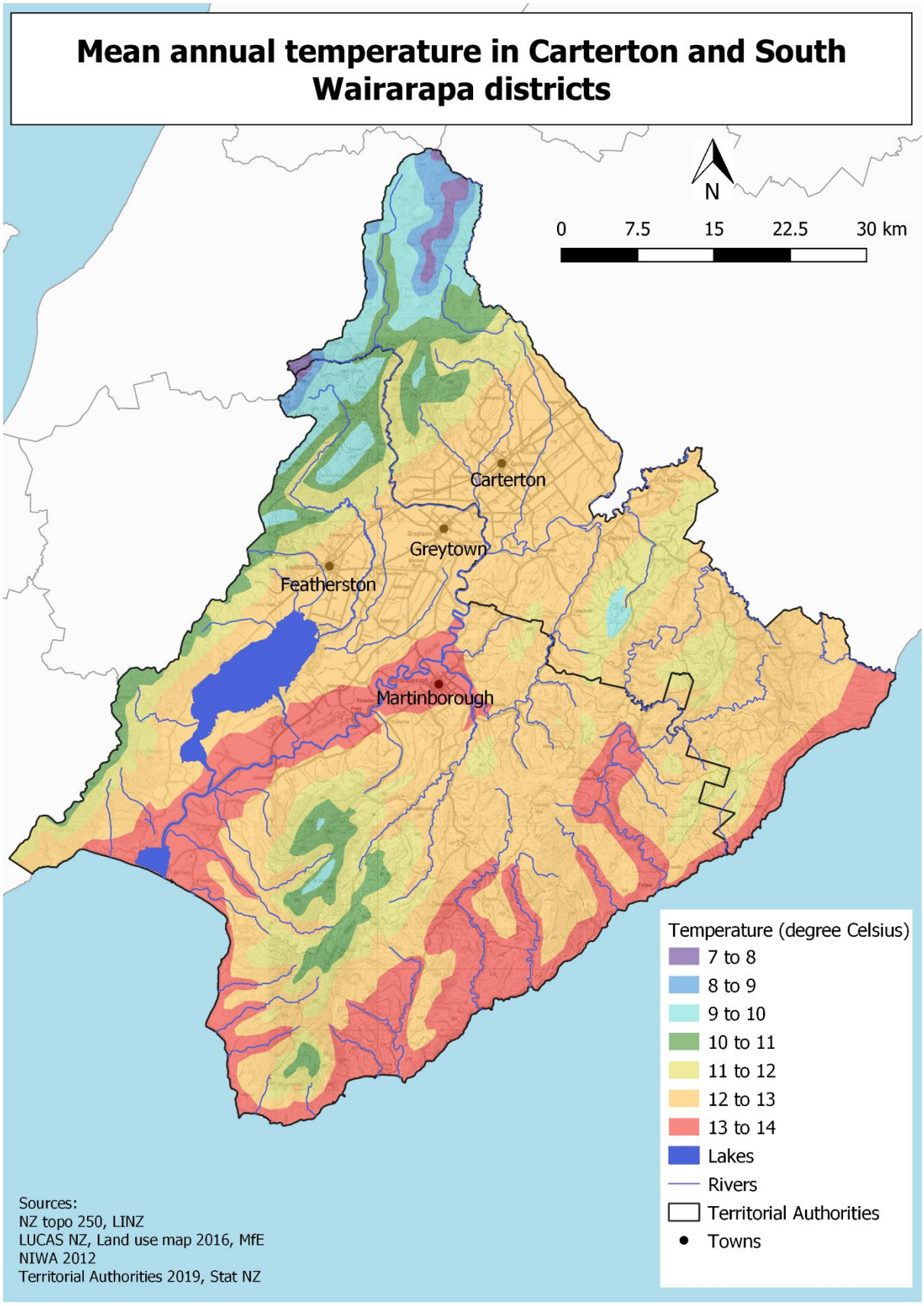


Figure 21: Mean annual average temperature for CD and SWD

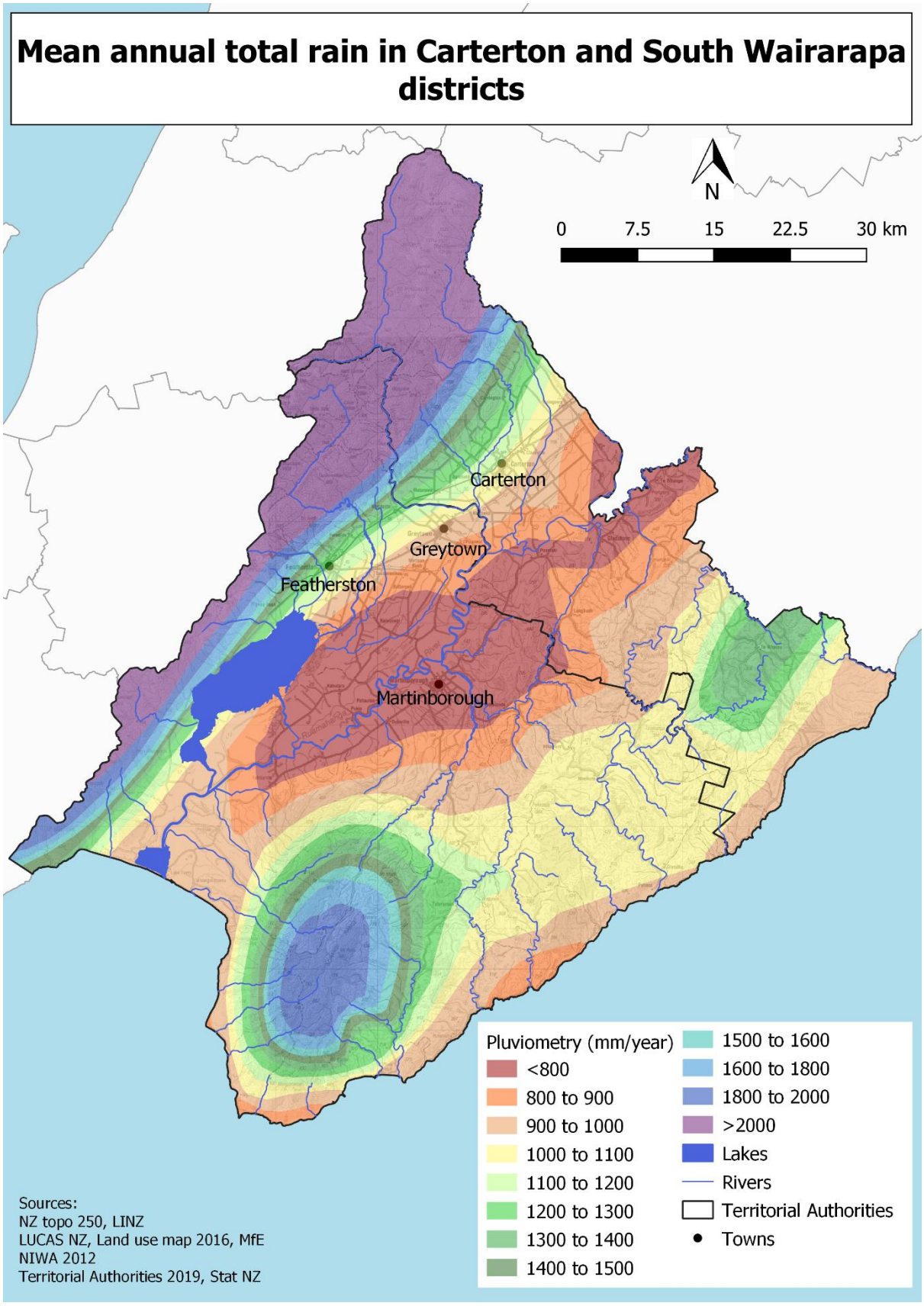


Figure 22: Mean annual total rainfall for CD and SWD

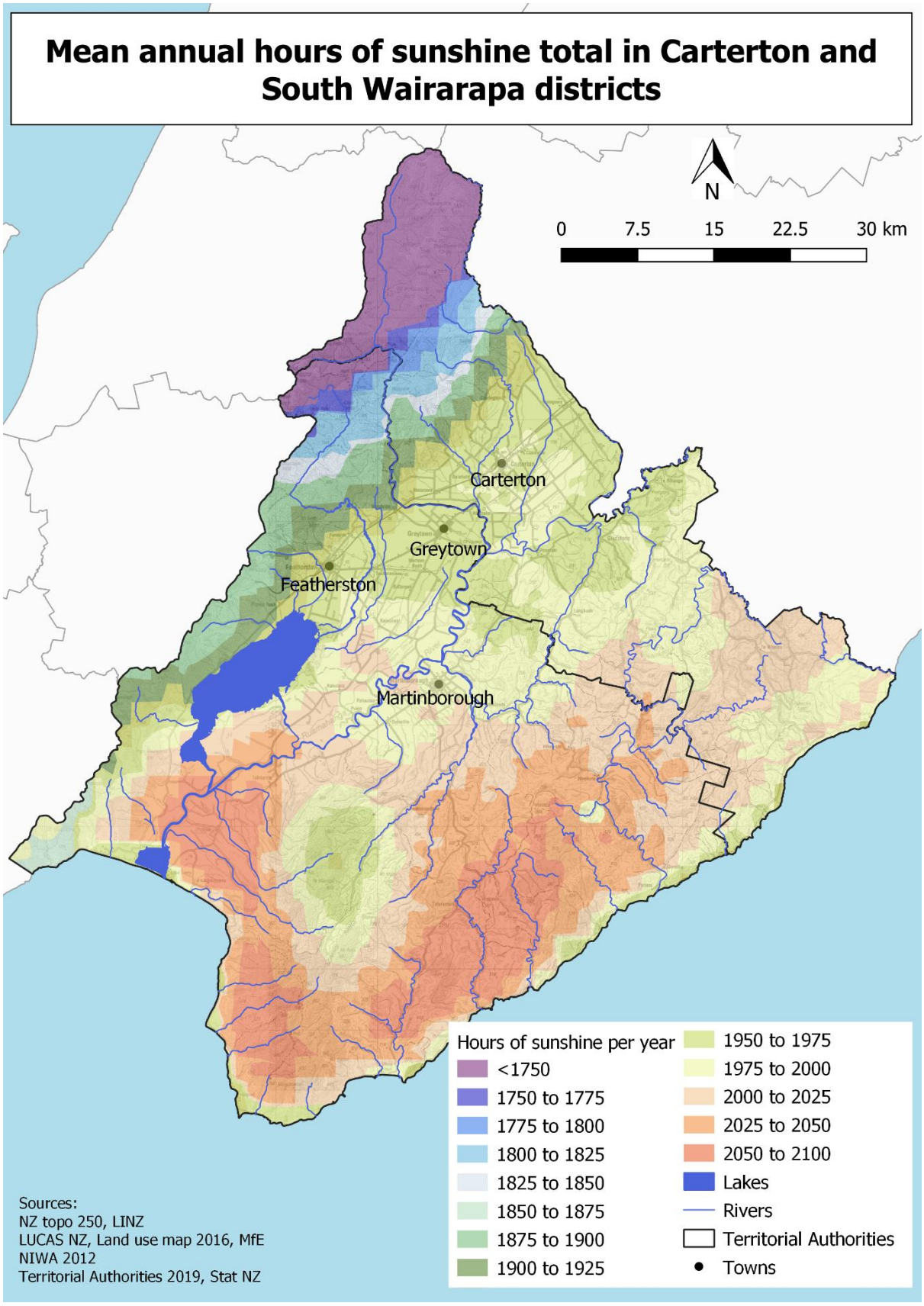


Figure 23: Mean annual sunshine hours total for CD and SWD

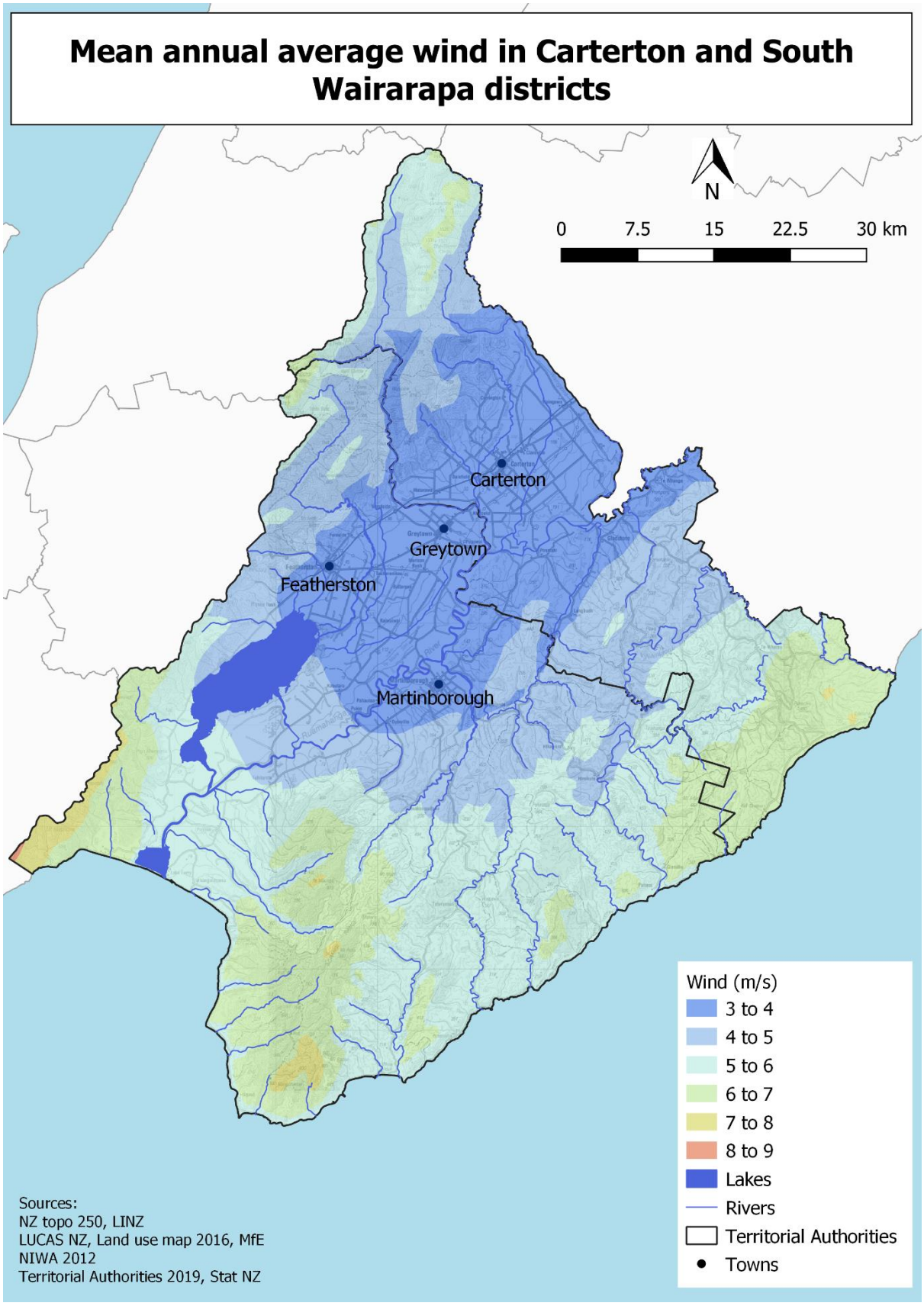


Figure 24: Mean annual average wind for CD and SWD

5.2 Landscape features

The main features in the landscape are the Tararua range in the North-West, the Aorangi range in the South, the Ruamāhanga plains and the rugged East coast.

Carterton and South Wairarapa Districts are mainly rural districts. The main features in the landscape are:

- The Tararua range in the North-West: mainly native forest;
- The Aorangi range in the South of SWD: mainly native forest;
- The plains between the ranges (around the Ruamāhanga river): mainly high producing exotic grassland but also wetlands around Lake Wairarapa and Lake Onoke;
- East of Wairarapa: this part is more rugged. The lowest part are mainly low producing grassland and the highest part are mainly forest (planted and native).

As shown in the Figure 25, page 35 and Figure 26, page 36, the landscape and the landcover depends very much on the ground elevation.

5.3 Landcover

The districts are mainly covered by farmlands (55.7%, including 6.7% of planted forests), closely followed by natural areas (43.8%, including 35.7% of natural forests). The farmlands and the four settlements of Featherston, Greytown, Martinborough and Carterton are mainly located in the Wairarapa plains and the Eastern Wairarapa. The Tararua Range and the Aorangi Range are the main natural areas of the districts.

Carterton and South Wairarapa Districts have a 142-kilometre shoreline. The coast has the settlements of Ngawi, Tora and Flat Point, but is mainly composed of rural and natural areas.

	Surface (km^2)	Percentage (%)
Agriculture and Forestry	2025	55.7%
Grassland - High producing	*1137*	*31.3%*
Grassland - Low producing	*595*	*16.4%*
Planted forest	*243*	*6.7%*
Cropland	*51*	*1.4%*
Natural areas	1594	43.8%
Forest - Natural	*1299*	*35.7%*
Grassland - With woody biomass	*176*	*4.8%*
Wetland	*120*	*3.3%*
Settlements	12	0.3%
Other	5	0.1%
TOTAL	**3636**	**100%**

Table 9: Landcover in 2016 for CD and SWD

5.3.1 Rural areas

The majority of Wairarapa's environment has a rural character, in which the environmental quality is largely determined by prevailing natural elements, whether the land is used for primary productive purposes or for conservation purposes.

Rural land is a significant resource due to the economic value of primary production activities to Wairarapa, and the associated processing and service industries. The use of this resource is constantly changing, in response to economic demands and conditions. The continued prosperity of Wairarapa as a whole is largely dependent on the use of rural resources adapting to changing economic opportunities.

The rural environment is typically characterised by the following elements:

- Open space, natural landscapes, and vegetation predominate over the built environment;
- Working productive landscape, with a wide range of agricultural, horticultural and forestry purposes;
- Large areas of exotic and indigenous vegetation, including pasture, crops, forest and scrublands;
- Place where people live and work, with low population density;

Significant areas of the Rural Zone are held in public ownership and managed for conservation purposes, with the key assets being the Tararua and Aorangi Forest Parks and Lake Wairarapa. Aside from their intrinsic ecological values, Wairarapa's conservation management areas also have important cultural, economic and recreational values. These areas are perceived to be part of Wairarapa's rural environment, although they differ from the primary production areas in their land use, environmental character and amenity values.

5.3.1.1 Agriculture and forestry

See Figure 27, page 37.

In South Wairarapa and Carterton Districts, agriculture, forestry and fishing represents 20.4% of the workforce industry sector of employment (2018). The land used for agriculture and forestry represents 55.7% of Carterton and South Wairarapa districts combined.

Most of the high producing grassland is located in the Wairarapa Plain and the low producing grassland is located in the East of Wairarapa. The planted forests are mainly in the East of Carterton district. Areas of planted forest can be found around the Aorangi and the Tararua ranges.

5.3.1.2 Natural areas

See Figure 28, page 38.

The natural forest covers 35.7% of South Wairarapa and Carterton Districts. It is mainly located in the Tararua and the Aorangi Ranges and in the Eastern Wairarapa.

South Wairarapa District presents 120 km^2 of wetlands, mainly located around Lake Wairarapa and lake Onoke. These wetlands are very important for the biodiversity.

5.3.2 Human infrastructure

See Figure 29, page 39.

Both districts contain a variety of residential areas, including those within the main urban communities of Carterton, Featherston, Martinborough and Greytown, as well as smaller coastal and rural settlements.

Most of the infrastructure is located in the Wairarapa plain.

Featherston, Greytown and Carterton are connected by the State Highway 2 (SH2) and Martinborough is connected to Featherston with the State Highway 53 (SH53). Bidwills Cutting road is the link between Martinborough and Greytown and Ponatahi road is the link between Martinborough and Carterton.

Featherton, Greytown and Carterton are linked with the railway (Featherston station, Woodside station, Matarawa station and Carterton station).

The settlements cover only 0.3% of the land of both districts.

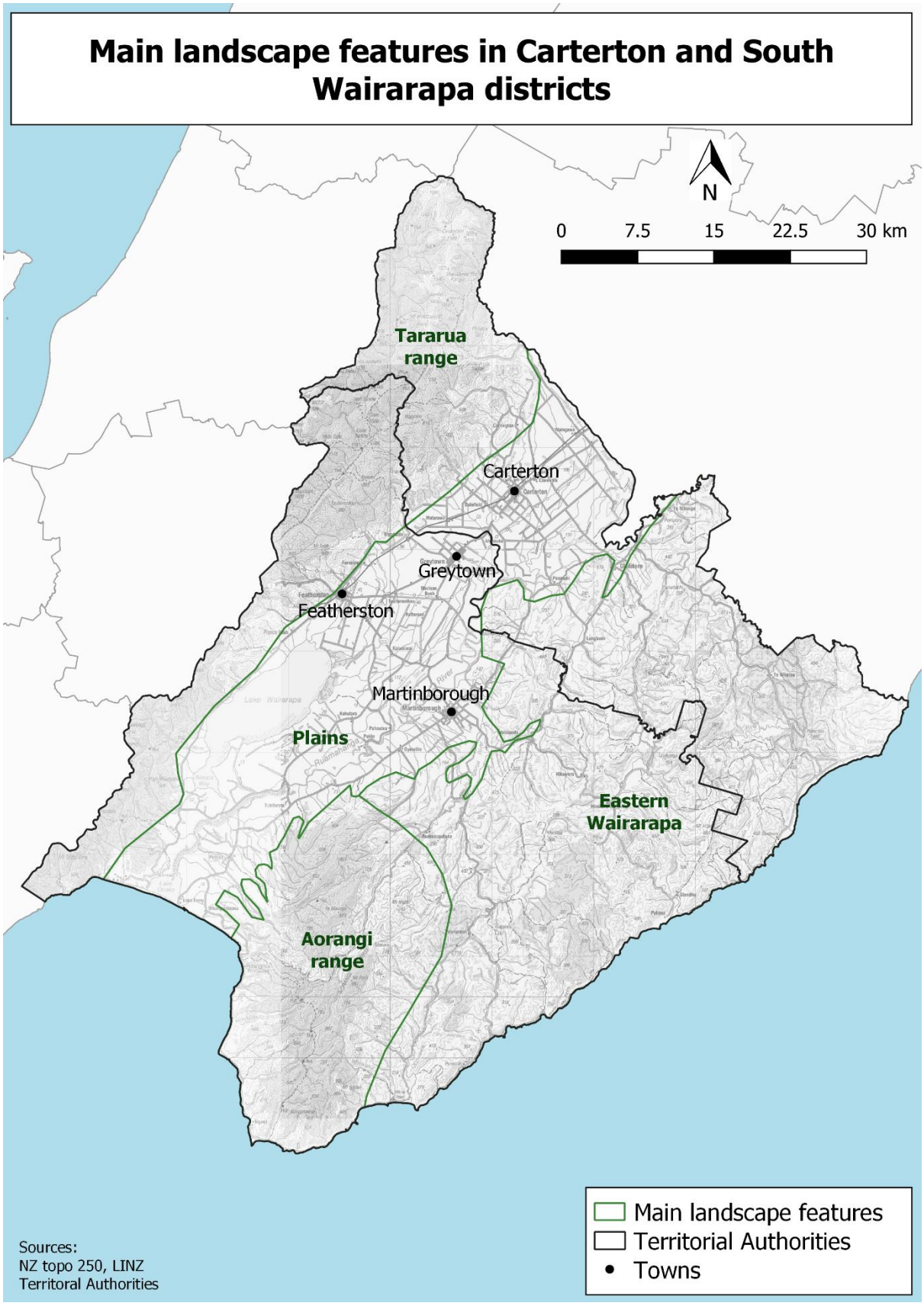


Figure 25: Main landscape features for CD and SWD

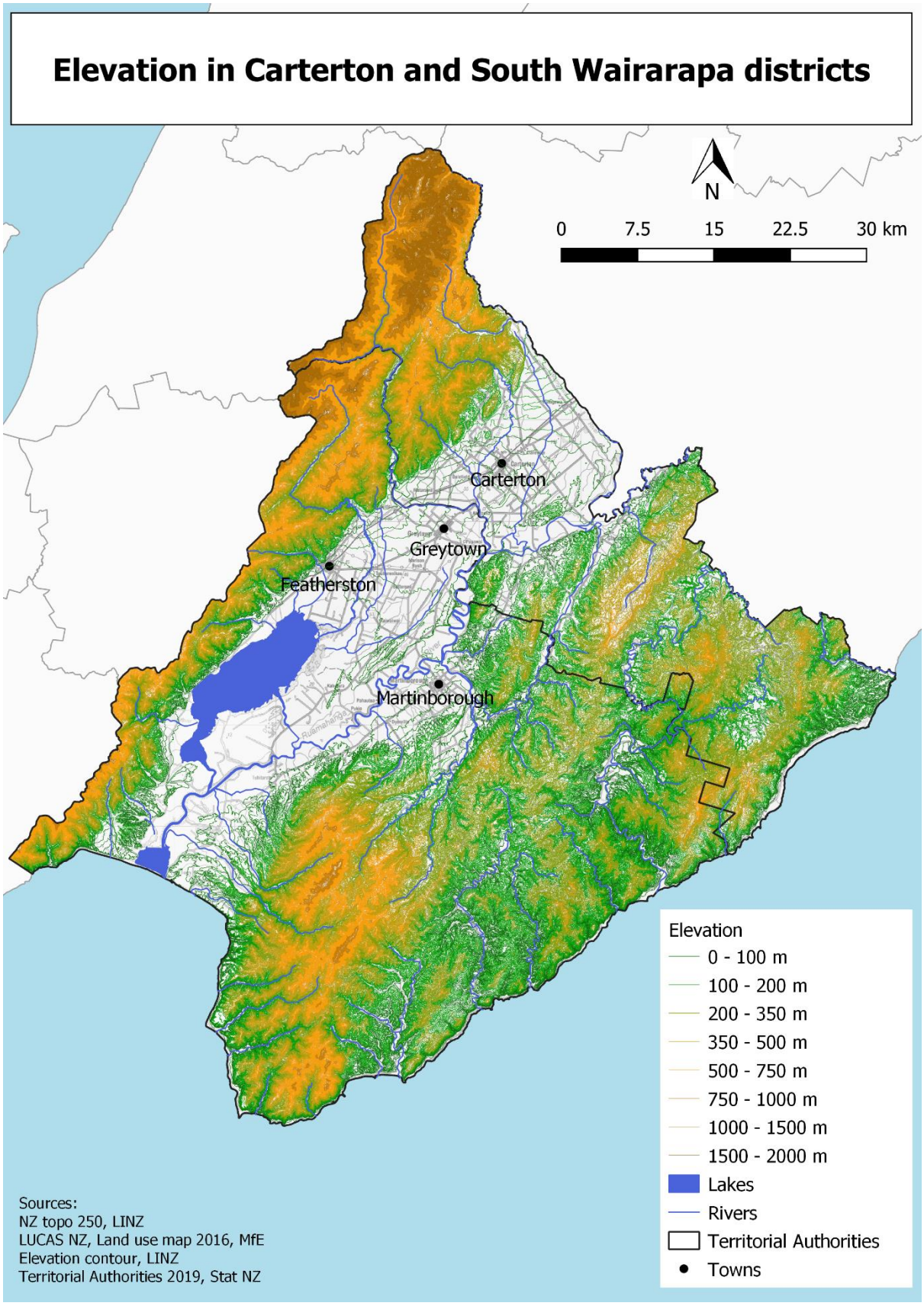


Figure 26: Elevation for CD and SWD

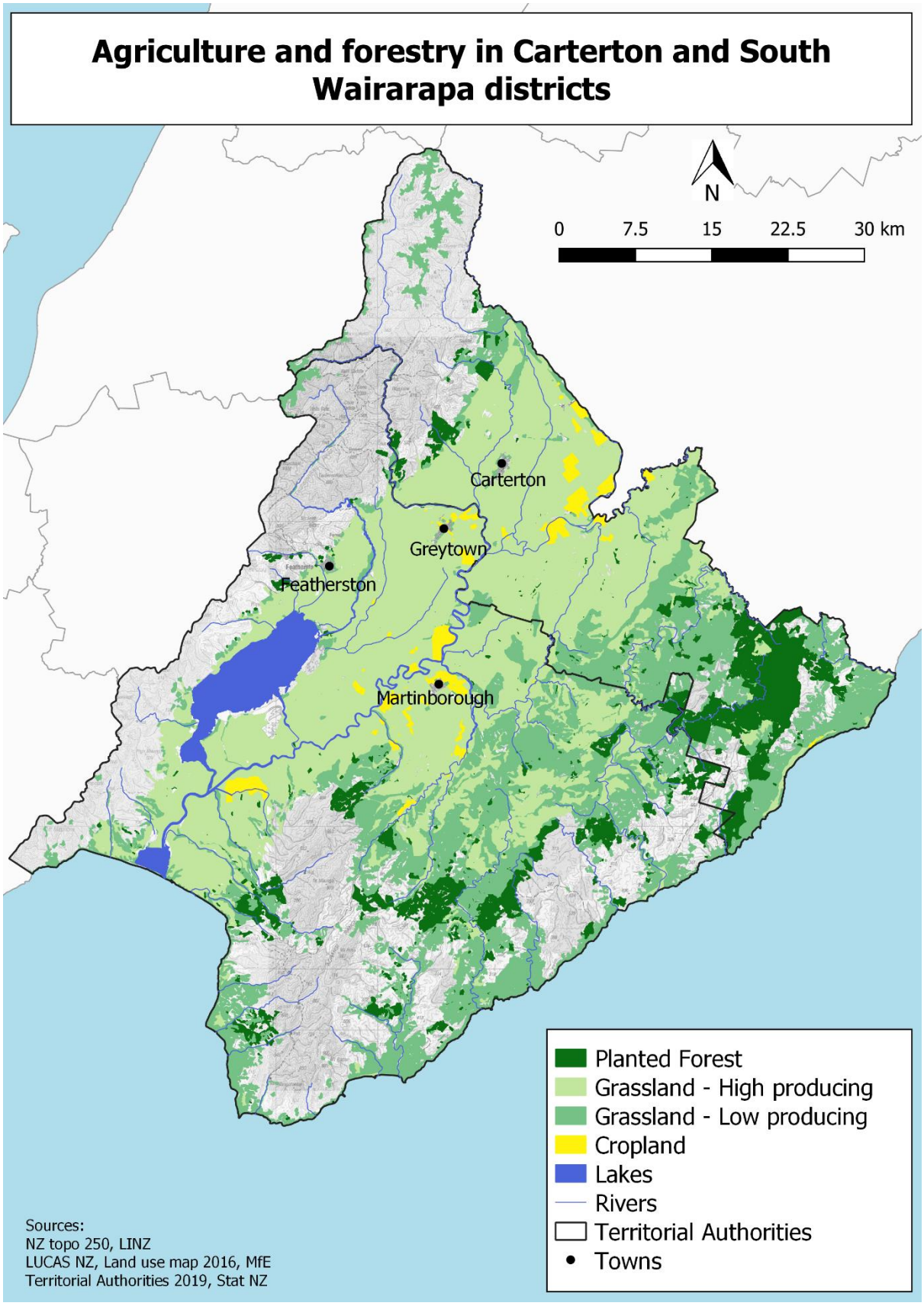


Figure 27: Agriculture in CD and SWD

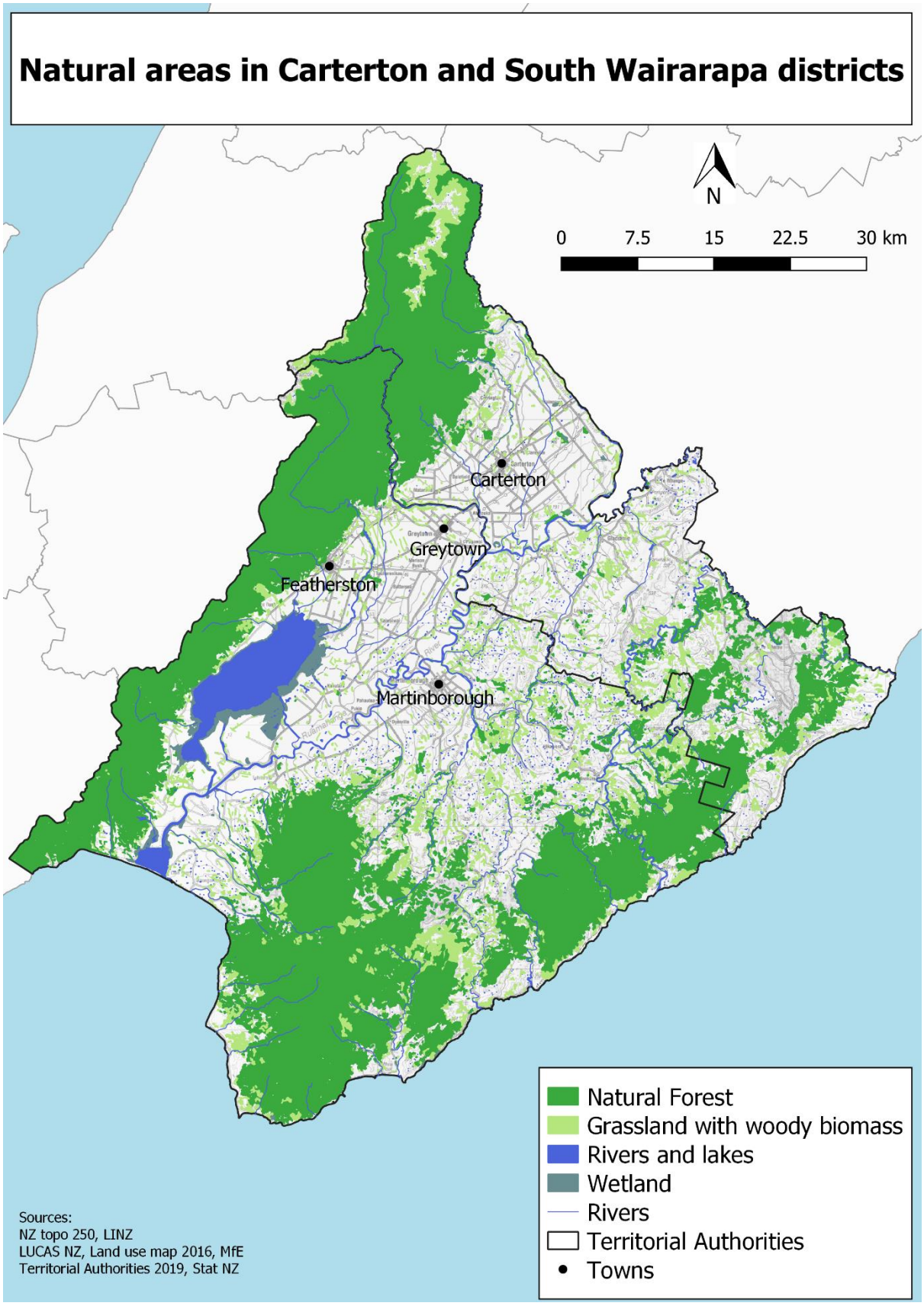


Figure 28: Natural areas in CD and SWD

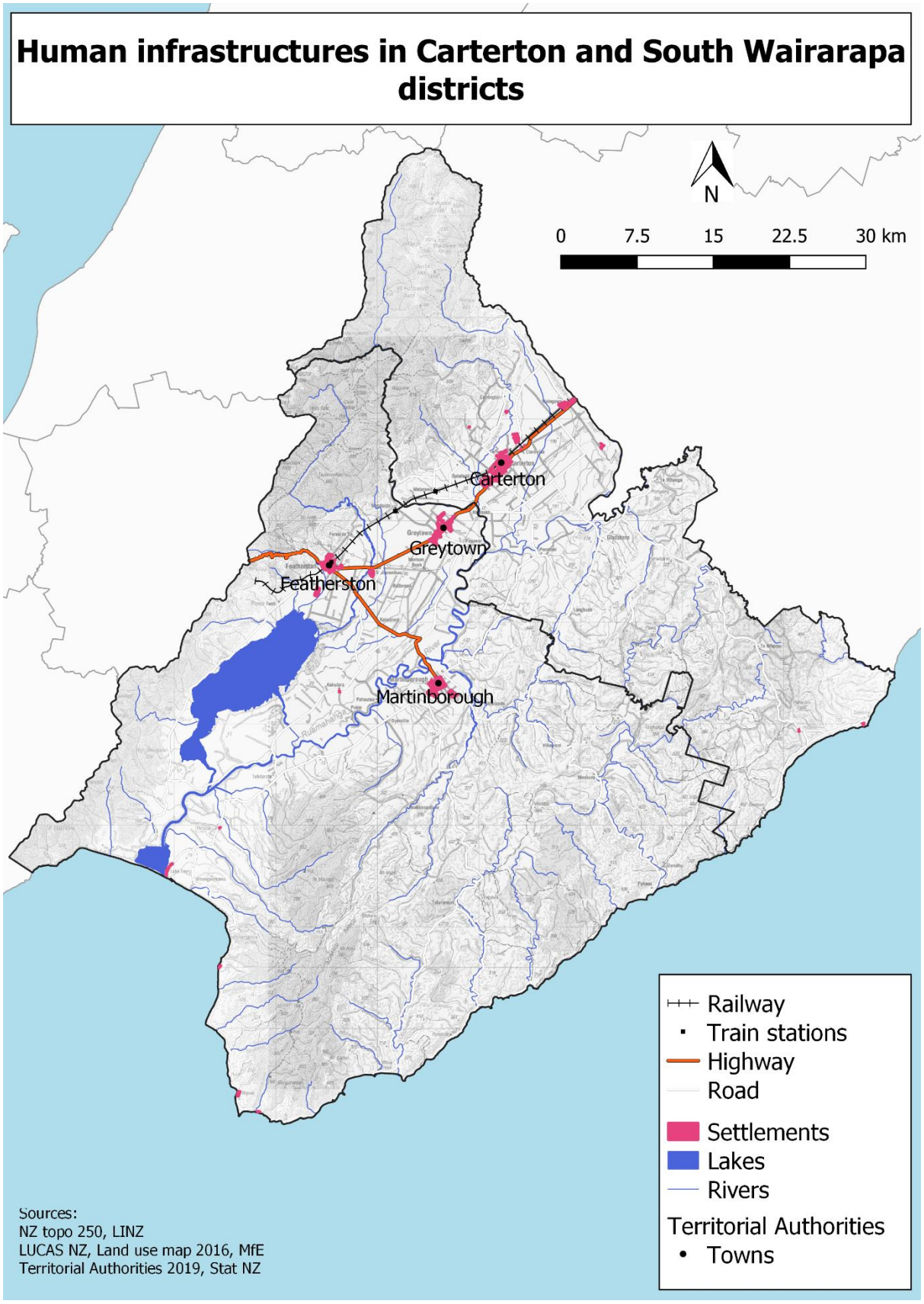


Figure 29: Human infrastructures in CD and SWD

6 Historical and cultural context

The Wairarapa has a strong mana whenua history with many important Māori heritage sites. The cultural landscape includes those places associated with ngā atua (deities), taniwha and kaitiaki (guardians and protectors of places), as well as places discovered, visited and or named by ancestors and explorers.

6.1 History

6.1.1 Pre-European era

Well established Māori communities lived in the southern Wairarapa since the 14th century. They were descended from a place of origin in the Pacific known to them as Hawaiki.

They were communities of people who:

- hunted and gathered food from the rocky shoreline, the coastal environment and the lakes, primarily harvesting tuna (eels) but also other native species including kokopu (whitebait) and piharau (lamprey);
- ventured into the interior to hunt for forest birds and gather other wild produce from the inland valleys, wetlands and hills;
- developed areas of land for the cultivation of kumara and probably also taro and gourd.

For centuries the natural environment has provided both material and spiritual sustenance for Māori communities. Lake Wairarapa and the South Wairarapa coastline are of immense cultural, spiritual and historic significance to Māori.

Wairarapa Māori regarded the lakes and their surrounding lands as an important source of physical and spiritual well-being, seeing it as a taonga, handed to them by their ancestors to be cherished. The land, the waters and all their inhabitants, human and non-human alike, were part of a wider world governed by gods and were tapu or sacred.

6.1.2 European colonisation

European settlers arrived on the margins of Wairarapa Moana in the early 1840s, bringing with them a completely different set of cultural values and a truly foreign way of looking at and assessing land.

For the early settlers, the land was a great opportunity to develop farming: *"The land is for the most part covered with fern and coarse grass, easily cleared and affording ample pasturage for cattle in its present state"* wrote the New Zealand Company's surveyor Robert Stokes in 1841. In 1844, the surveyor Henry Tiffen wrote that the soil is very fertile and up to six feet deep in places. He also said that the land around the bottom lake was prone to be flooded but if the lake could be kept at a lower level, 4,000 acres of rich watered meadow land would be available for graziers.

In 1844, the first stations were established around the shore of the lake. The Wharekākā farm was the first extensive sheep station in New Zealand. Then started the disagreement between Māori and Pākehā over the control of the lake Onoke outlet. Māori wanted a high-water level for tuna (eel) fishing when Pākehā wanted a low-water level for grazing.

In the 1850s, the Māori started to sell their land to the Pākehā after leasing was made illegal by the Crown. Māori made it clear the sale did not include the bed of the lakes and that they were selling to the tahakupu, the highwater mark. The failure to properly survey the land, and the disagreement over exactly what had been sold and what had been retained by Māori was to lead to tension over ownership of the land uplifted in the 1855 earthquake, and the ability to control the outlet to the sea.

This disagreement ended in 1896 when tangata whenua gifted the lakes to the Government. The settlers were then free to:

- Stop bank the Ruamāhanga river, the Lake Wairarapa Lake and the Lake Onoke;
- Drain the rich swamp pasture;
- Control the Lake Onoke outlet.

What has been gifted was the Native Land Court title the Crown had forced on Māori, and with it control of the outlet at Onoke. What had not been gifted, were the waters and fisheries of Wairarapa Moana. Premier Richard Seddon, who can take much of the credit for the gifting of the lakes said, *"The waters are still yours and so are the fish*". However, after a few years, these words were forgotten.

The last major wetland destruction around the lake happened in 1974 when the Te Hōpai Lagoon has been drained and turned into pasture.

6.2 Cultural context

Kaitiakitanga

Kaitiakitanga encompasses guardianship, preservation, conservation and protection. In its simplest form kaitiakitanga is the responsibility to care for the physical, ecological and spiritual well-being of a place or resource to ensure harmony within the environment and protection against elements that cause permanent imbalances.

The primary kaitiaki or guardian were the Atua; Tāne is the kaitiaki of the forest and Tangaroa is the kaitiaki of the sea. A kaitiaki can be spiritual (such as a taniwha) or physical such as the tōtara log of Wairarapa Moana.

Lake Wairarapa

Lake Wairarapa is of immense cultural and spiritual significance to Māori.

Traditional fishing (such as tuna/eel fishing) was a major activity on the lake. "*Throughout the ages, the mouth of Wairarapa Moana has paid homage to its eel migration by obligingly closing its mouth at the end of February or the beginning of March. Legend records that Rākai Uru, the taniwha who is the caretaker of the lake, is responsible for this seasonal closing. Rākai Uru takes the form of a large tōtara log. When the migration is about to take place he makes a journey out to sea, and the mouth of the lake closes behind him*"[3]. Māori exported as many as ten tons of tuna/eels annually as far away as the Bay of Plenty.

With the changes to the Lake Wairarapa wetlands over the past 150 years many traditional fishing sites and sources of plant materials such as flax, ti (cabbage tree) and pingao have been lost or greatly reduced. With appropriate management and plantings, some of these sites could be restored specifically for the sustainable harvest of cultural materials, which would have the additional benefit of increasing habitat diversity for wildlife.

Guidelines for the management of the Lake Wairarapa wetlands have been produced and adopted by interested parties.

[3] T.V. Saunders 'The eels of Lake Wairarapa', Te Ao Hou, June 1965.

Nowadays, projects are being led in order to restore wetlands (therefore the important role to local iwi for gathering kai moana) around Lake Wairarapa. For instance, the Pou Aruhe Saltmarsh Freshwater Initiative near Lake Onoke is an ambitious project with Greater Wellington Regional Council, mana whenua and local conservation groups. Ra Smith[4] said Māori bring important values to these projects which could connect the whole region.

Ruamāhanga river and other rivers

Ra Smith says, "*We [Māori] think of rivers as a character, and the character of the river holds the mauri[5], often called the life force*".

"*On the opposite side from where the two rivers meet is the whare kōhanga, a place like a maternity ward. When babies were born they would take the whenua [placenta] and be buried in the ground, and they would take the baby down into the river and make up a lullaby. It was no rockabye baby, it was eight verses of very intense lullaby about the blessing of the baby and its life expectancy.*"

Ra Smith says the most important confluence was where the Ruamāhanga met Lake Wairarapa, a point that no longer exists.

[4] Ra Smith is part of the Ngāti Kahungunu ki Wairarapa iwi.

[5] According to the Māori Dictionary, Mauri is "life principle, life force, vital essence, special nature, a material symbol of a life principle, source of emotions - the essential quality and vitality of a being or entity. Also used for a physical object, individual, ecosystem or social group in which this essence is located".

7 Climate Change and impacts for Carterton and South Wairarapa Districts

7.1 What is Climate Change

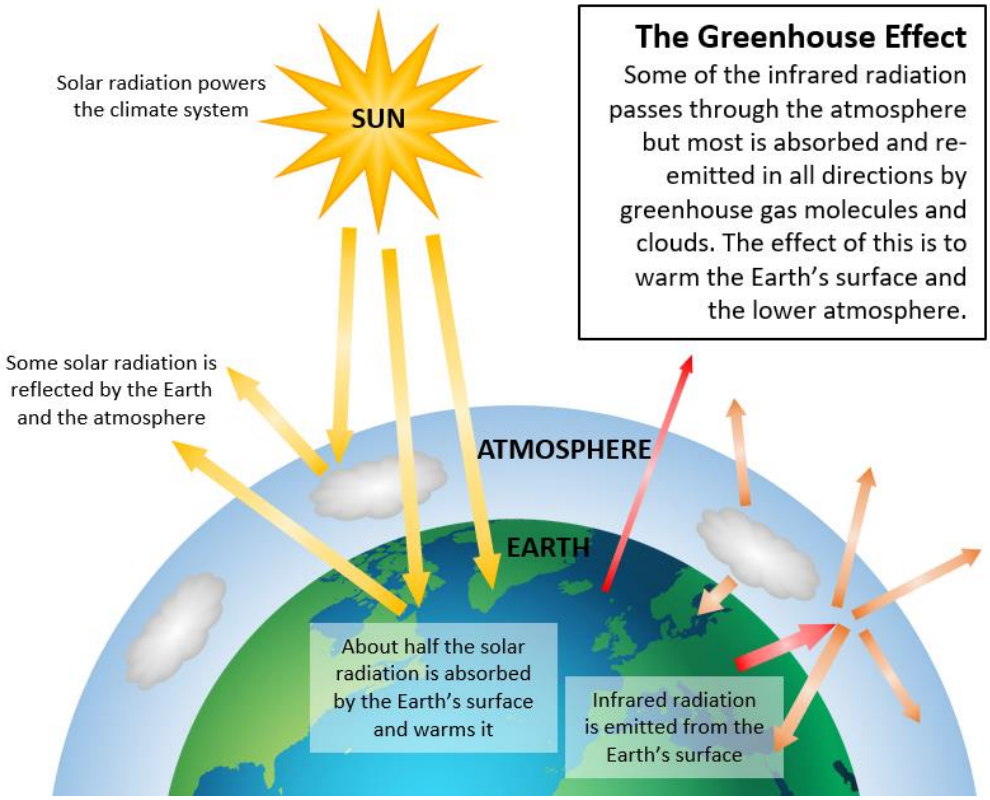
According to the UNFCCC (United Nation Framework Convention on Climate Change), Climate Change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

7.1.1 Atmosphere composition

Earth's atmosphere is made up of nitrogen (78%), oxygen (21%), and a small percentage of greenhouse gases, such as carbon dioxide and methane.

7.1.2 Greenhouse effect

Greenhouse gases trap warmth from the sun and make life on Earth possible. Without the influence of the greenhouse effect on our planet, the average surface temperature would be -18°C (average temperature on Earth with the greenhouse effect is 15°C).

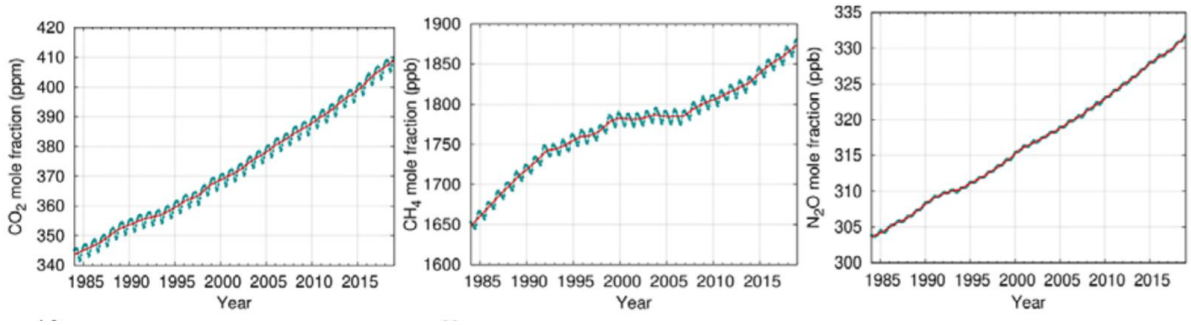


Source: NIWA, https://www.niwa.co.nz/our-science/climate/information-and-resources/clivar/greenhouse

Figure 30: The greenhouse effect

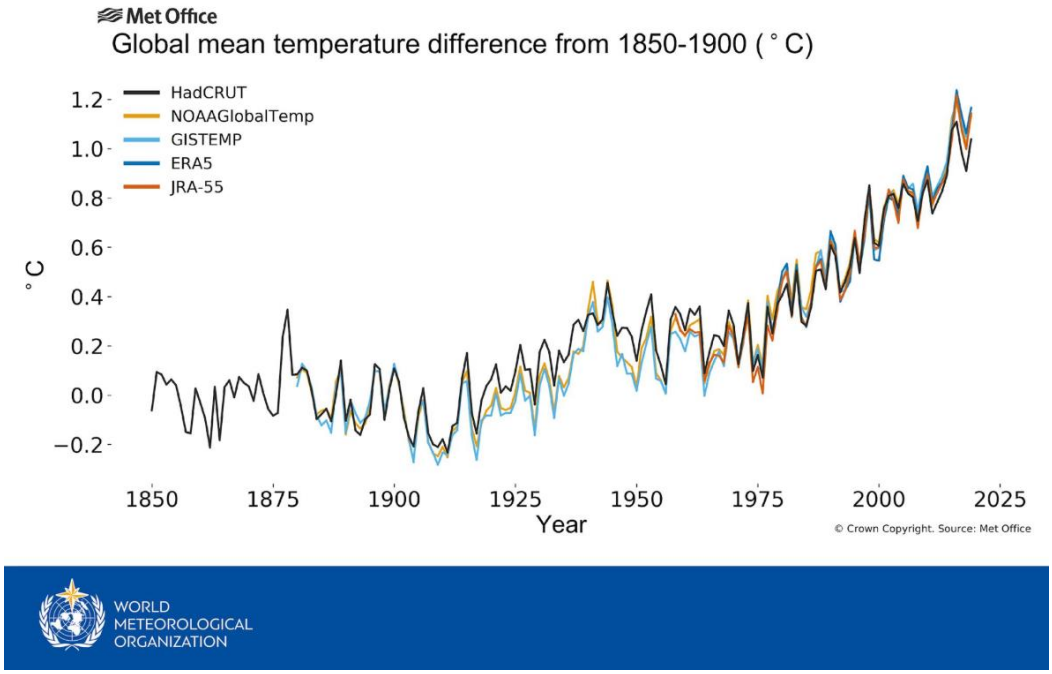
7.1.3 What causes Climate Change?

The greenhouse gas (CO_2, CH_4 and N_2O) concentration in the atmosphere has been raising quickly since the last 150 years (since the industrial revolution) because of fossil fuels burning, deforestation, etc. The temperature is correlated to the greenhouse gas concentration as shown in the graphs below.



Source: WMO Provisional Statement on the State of the Global Climate in 2019, World Meteorological Organization, 2019

Figure 31: Concentration (ppm) in Carbon dioxide, Methane and Nitrous oxide from 1984 to 2018.



Source: WMO Provisional Statement on the State of the Global Climate in 2019, World Meteorological Organization, 2019

Figure 32: Global annual mean temperature difference pre-industrial conditions (1850-1900, °C)

Not only are temperatures rising but the whole climate is changing (increase in the extreme weather events (e.g. storm, drought), melt of the ice pack, sea level rise, ocean acidification, etc).

The next section will expose the climate change projections and the likely impacts on Wairarapa.

7.2 Climate change projections and likely impacts

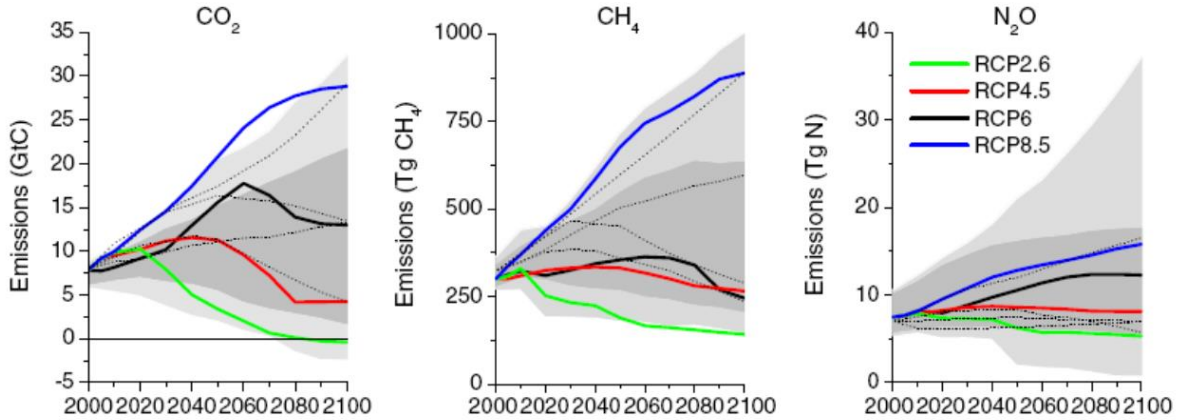
7.2.1 IPCC emissions scenarios

The IPCC (Intergovernmental Panel on Climate Change) set up different scenarios depending on the greenhouse gas emissions. RCP2.6 is a low emissions scenario, RCP4.5 is a low to moderate emissions scenario, RCP6.0 is a moderate emission scenario and RCP8.5 is a high emissions scenario.

Anthropogenic GHG emissions are mainly driven by population size, economic activity, lifestyle, energy use, land use patterns, technology and climate policy. The Representative Concentration Pathways (RCPs), which are used for making projections based on these factors, describe four different 21st century pathways of GHG emissions and atmospheric concentrations, air pollutant emissions and land use. The RCPs include:

- A stringent mitigation scenario (RCP2.6): aims to keep global warming likely below 2°C above pre-industrial temperatures. CO_2 emissions peak in 2020 and start to decline to reach net zero in 2050 and zero in 2100. Radiative forcing reaches 2.6 W m-2 at year 2100, relative to pre-industrial conditions;
- A low/intermediate scenario (RCP4.5): CO_2 emissions peak in 2040 and start to decline to reach net zero in 2080. Radiative forcing reaches 4.5 W m-2 at year 2100, relative to pre-industrial conditions;
- An intermediate scenario (RCP6.0): CO_2 emissions peak around 2060 and start to decline. Radiative forcing reaches 6.5 W m-2 at year 2100, relative to pre-industrial conditions;
- A scenario with very high GHG emissions (RCP8.5): no measures are taken to reduce the greenhouse gas emissions. Radiative forcing reaches 8.5 W m-2 at year 2100, relative to pre-industrial conditions.

Scenarios without additional efforts to constrain emissions ('baseline scenarios') lead to pathways ranging between RCP6.0 and RCP8.5.



Grey area indicates the 98th and 90th percentiles (light/dark grey) of the literature. The dotted lines indicate four of the SRES marker scenarios. Note that the literature values are not harmonized

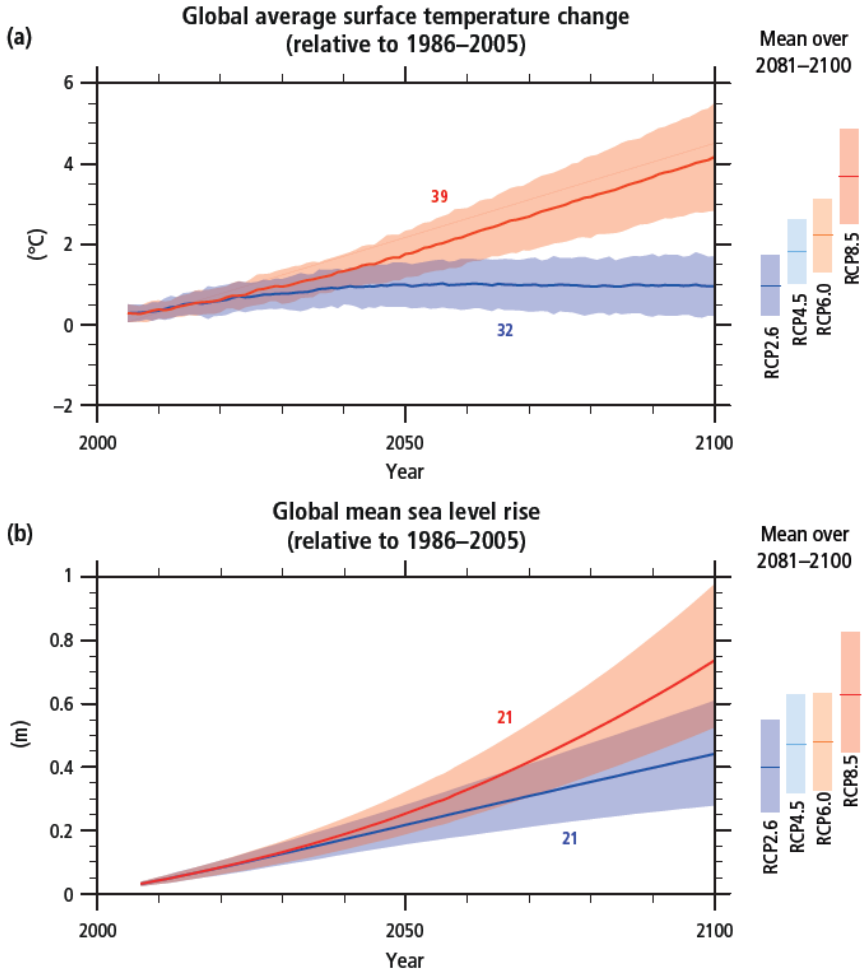
Source: The representative concentration pathways: an overview, Van Vuuren et al., 2011 - https://link.springer.com/article/10.1007/s10584-011-0148-z

Figure 33: emissions of the main greenhouse gases across the RCPs

7.2.2 Likely global impacts

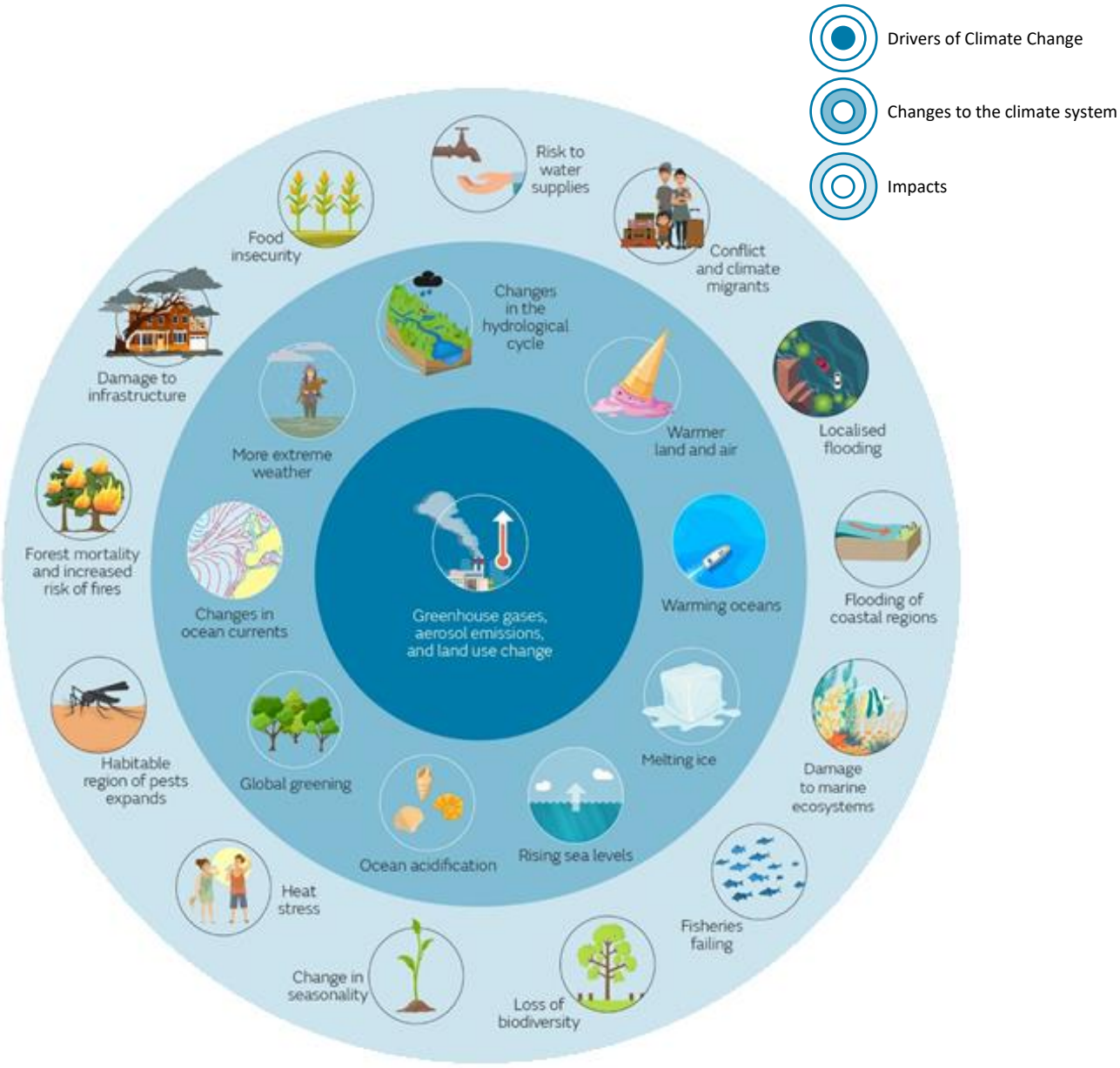
Globally, surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent. The ocean will continue to warm and acidify, and global mean sea level to rise.

Globally, surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent. The ocean will continue to warm and acidify, and global mean sea level to rise.



Source: Climate change 2014 – Synthesis report – Summary for policy makers, AR5, IPCC, 2014

Figure 34: Global average surface temperature change and global mean sea-level rise relative to 1986-2005



Source: Metoffice, https://www.metoffice.gov.uk/weather/learn-about/climate-and-climate-change/climate-change/effects-of-climate-change

Figure 35: Illustration of some of the drivers of Climate Change and impacts they could have on the climate system

7.2.3 Climate Change projections for Wairarapa

Greater Wellington Regional Council provides climate change assumptions based on the RCP4.5 and RCP8.5. These assumptions were used to understand the likely impacts of climate change in Wairarapa.

GWRC provides climate change parameters for each Whaitua catchment (super catchments) in the Wellington region. These parameters are based on the following reports:

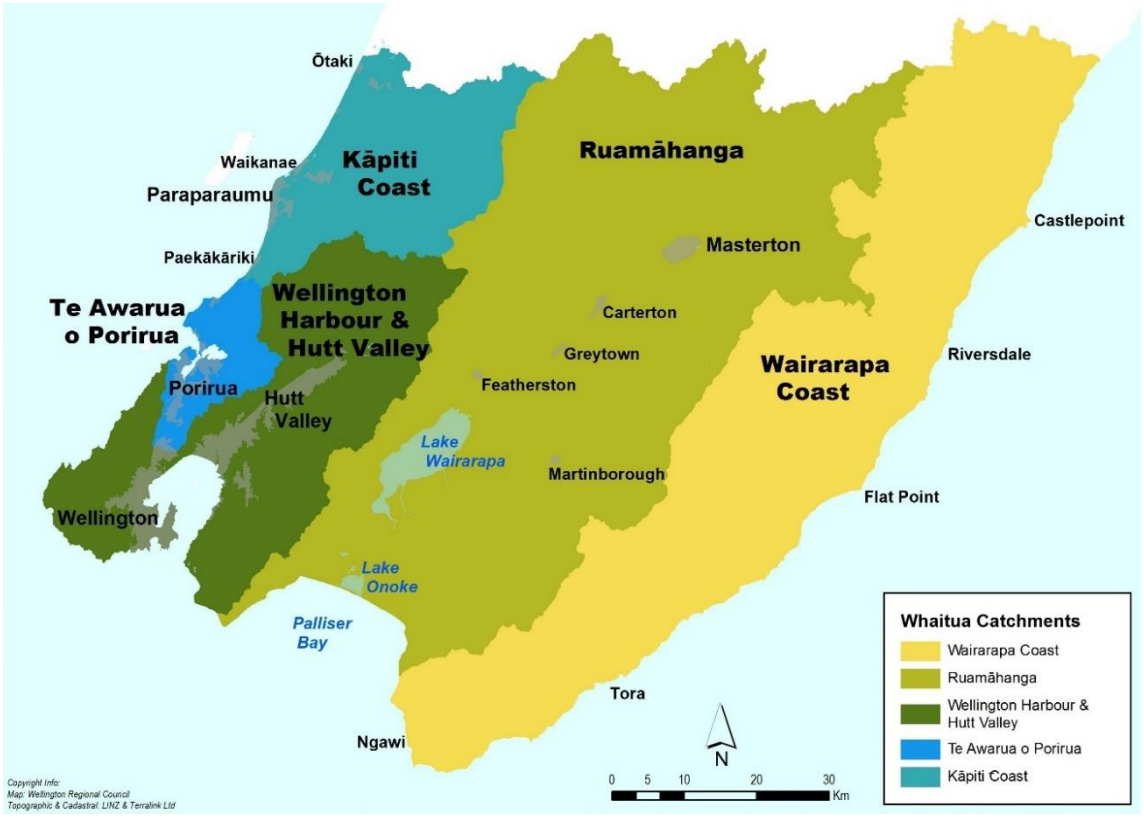
- Climate Change and variability – Wellington Region, report prepared by NIWA for GWRC, June 2017;
- Wellington Region climate change extremes and implications, report prepared by NIWA for GWRC, December 2019.

These reports and parameters are based on the following IPCC scenarios:

- RCP4.5: Intermediate/low emissions scenario;
- RCP8.5: High emissions scenario.

The following Table 10 summarise the projected impacts of climate change for the Wairarapa (Ruamāhanga Whaitua and Wairarapa Coast Whaitua, see Figure 37).

The uncertainties regarding the climate models are low: physics is well known and well modelised. However, there are uncertainties regarding the greenhouse gas emissions projections (how much anthropogenic greenhouse gas will be released in the atmosphere in the future).



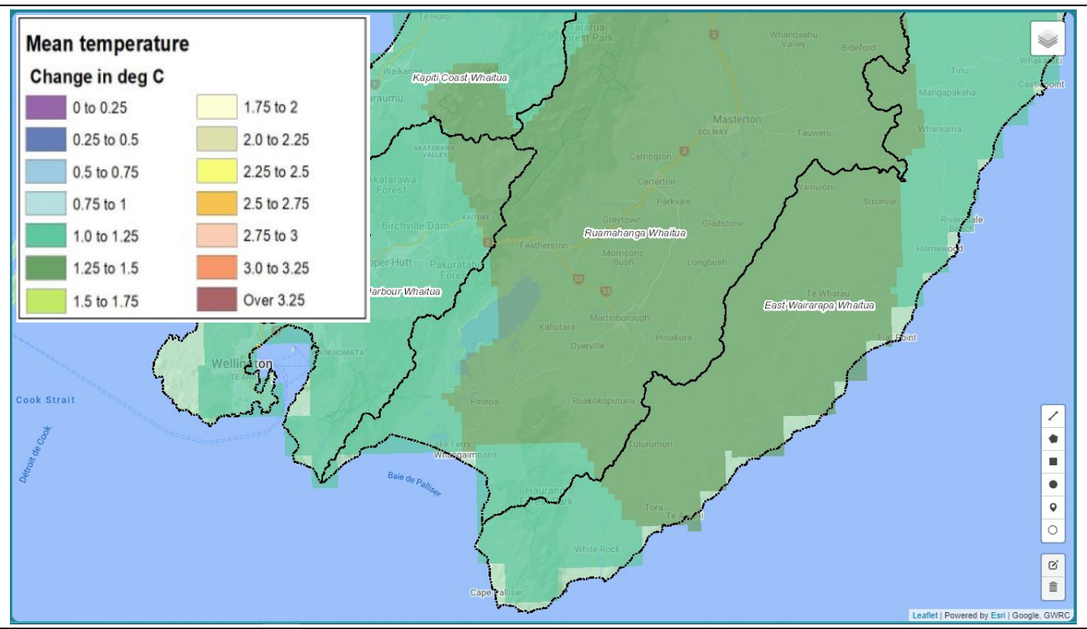
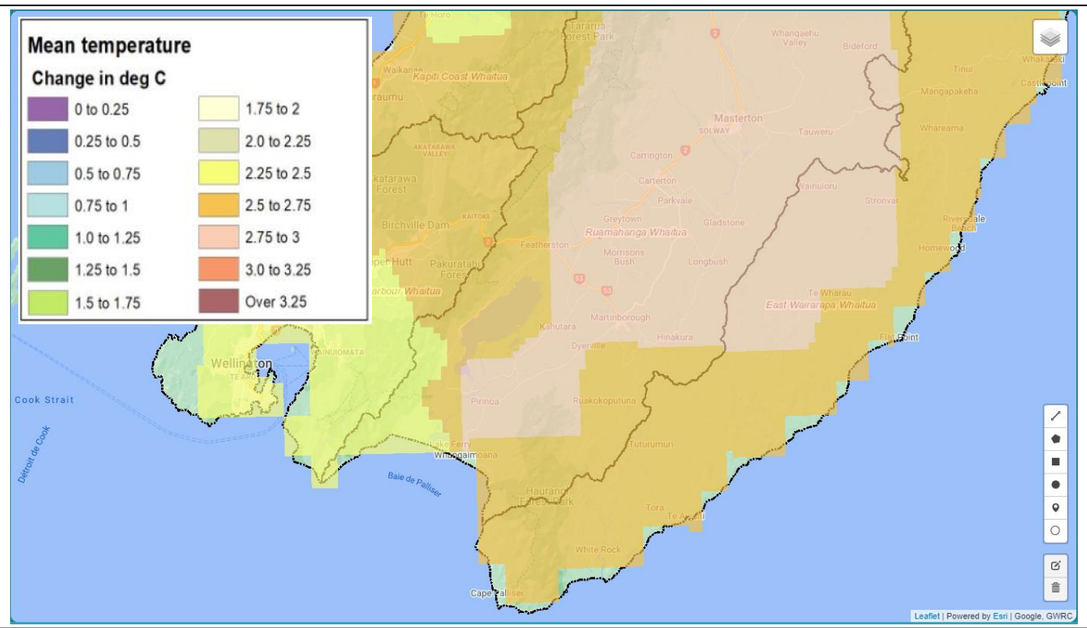
Source: GWRC, http://www.gw.govt.nz/assets/Whaitua-Te-Whanganui-a-Tara/whaitua-map.jpg

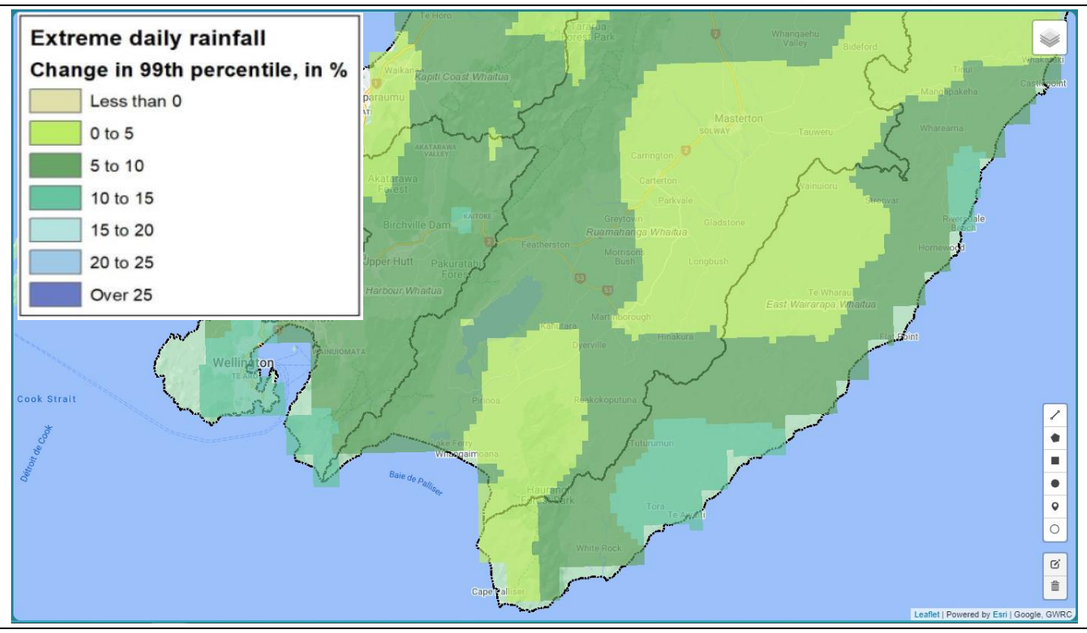
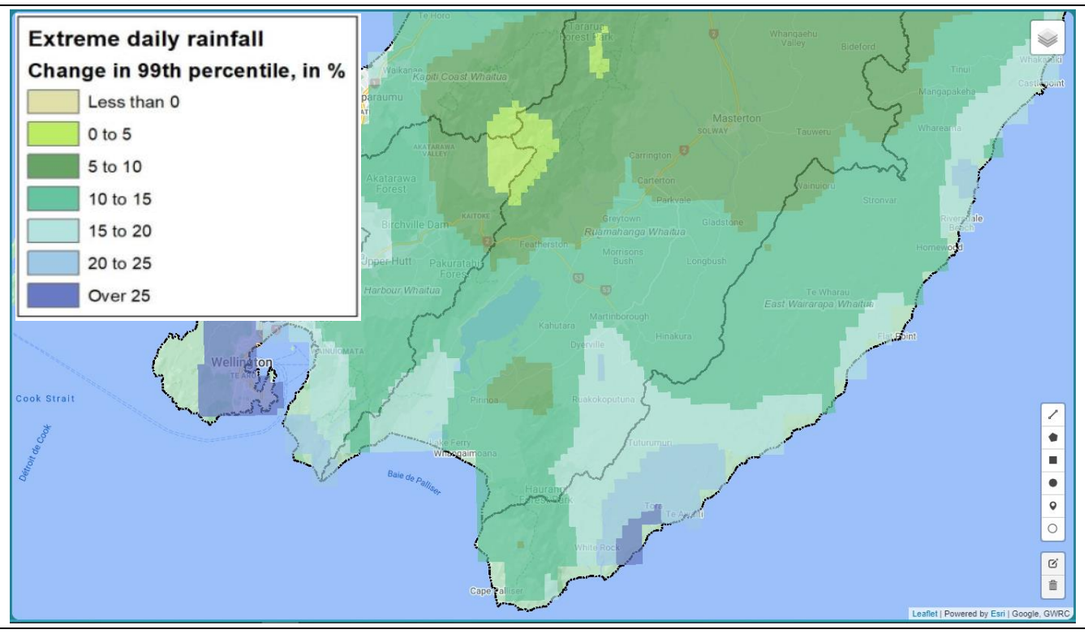
Figure 36: Whaitua Catchments in the Wellington Region

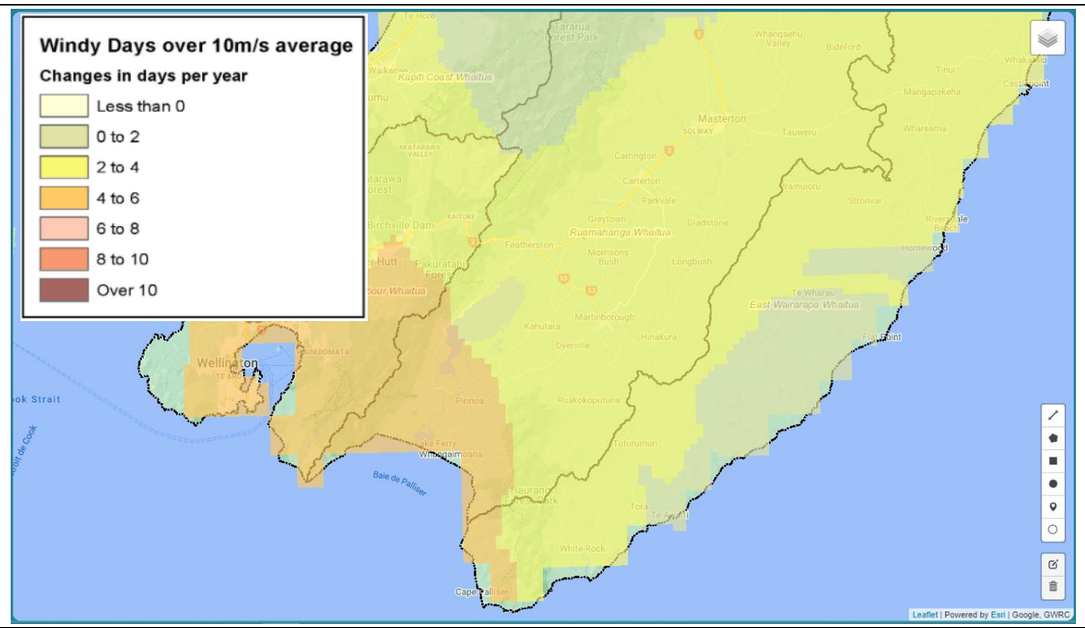
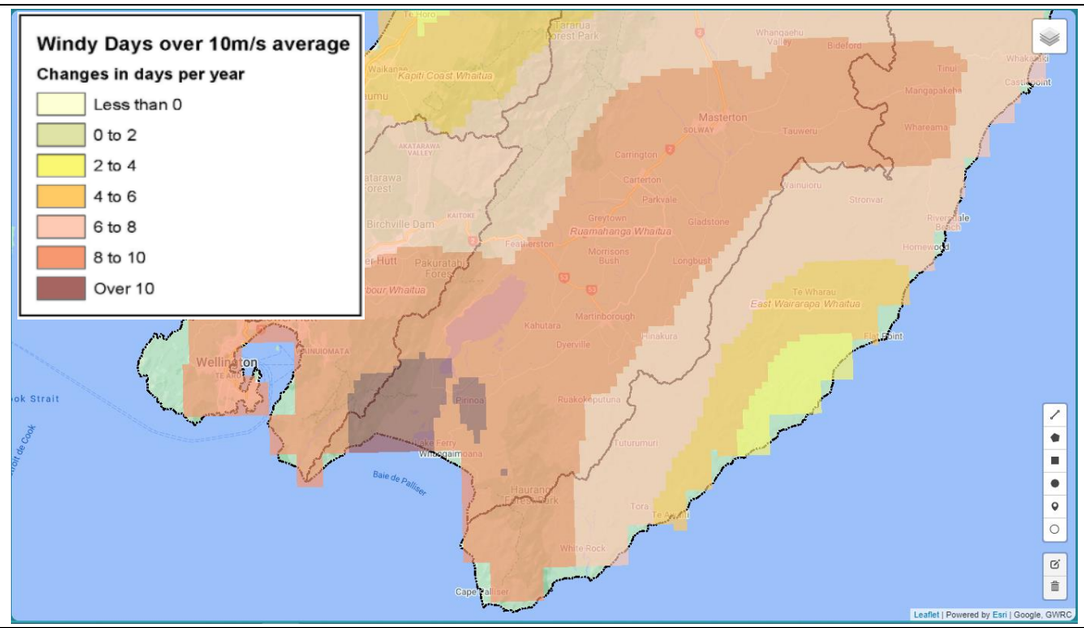
		2040	2090	Seasonal changes	Climate extremes predictions	Uncertainties
Temperature and seasonality	Average annual T°C	Ruamāhanga Whaitua: +0.7 to +1°C above present Wairarapa Coast Whaitua: +0.5 to +1°C above present	Ruamāhanga Whaitua: +1.2 to +3°C above present Wairarapa Coast Whaitua: +1 to +3°C above present	Ruamāhanga Whaitua: Maximum warming in autumn and summer, least in winter Wairarapa Coast Whaitua: Maximum warming in autumn and summer, least in spring	Warm nights (>15°C) could triple in Masterton by the end of the century, while cold days (<10°C) may entirely disappear Heat wave days (i.e. at least three consecutive hot days) could increase by fivefold Unprecedented weather: very long duration heat waves (more than 10 or 15 consecutive hot days) will start to occur in the future Long dry spells (10 or more consecutive days without rain) are expected to increase by up to 50% (additional 20 days per year)	Ruamāhanga Whaitua: lower range for significant emissions reduction (Paris Agreement targets met), and upper range for high emissions. Wairarapa Coast Whaitua: Lower range for RCP4.5 and upper range for RCP8.5
	Hot days (above 25°C)	Ruamāhanga Whaitua: Between 0 and 30 days increase Wairarapa Coast Whaitua: Between 5 and 30 days increase	Ruamāhanga Whaitua: Between 0 and 80 days increase Wairarapa Coast Whaitua: Between 15 and 60 days increase			
	Frost nights	Ruamāhanga Whaitua: Between 0 and 15 days reduction Wairarapa Coast Whaitua: Between 0 and 5 days reduction	Ruamāhanga Whaitua: Between 0 and 40 days reduction Wairarapa Coast Whaitua: Between 0 and 15 days reduction			
	Annual Growing Degree Days (GDD) base 10°C $GDD = (T°C_{max} + T°C_{min})/2) - T°C_{base}$ Measures potential for crop and pasture growth	Increase of 0 to 300 GDD units	Ruamāhanga Whaitua: Increase of 200 to 1000 GDD units Wairarapa Coast Whaitua: Increase of 200 to 900 GDD units			
	Annual potential evapotranspiration deficit (mm) Measures drought intensity	Ruamāhanga Whaitua: +20 to +120 mm Wairarapa Coast Whaitua: +40 to +120 mm	Ruamāhanga Whaitua: +0 to +180 mm Wairarapa Coast Whaitua: +40 to +160 mm			
Rainfall patterns and intensity	Average annual rainfall	5% decrease to 5% increase	Ruamāhanga Whaitua: 0% to 10% decrease Wairarapa Coast Whaitua: 10% decrease to 5% increase	Greater likelihood of positive changes in autumn, winter and spring.	High impact, short duration extreme rainfall events (expected to occur once every 100 years or longer) are predicted to occur more frequently, and also produce up to 13% more rain per degree of warming	There is a large uncertainty in the range of changes due to model differences, emissions scenarios. Changes against emission scenarios are not necessarily linear.
	Amount of rain falling during heavy rainfall days (>99th percentile of daily rainfall)	Ruamāhanga Whaitua: 0% to 10% increase Wairarapa Coast Whaitua: 0% to 15% increase	Ruamāhanga Whaitua: 0% to 20% increase Wairarapa Coast Whaitua: 0% to 30% increase			Although the uncertainty in average rainfall range is high, extreme rainfall increases are more certain due to the increased amount of water vapour that the atmosphere can hold as it gets warmer (about 8% increase in saturation vapour per degree of warming)
	River mean annual low flow discharge (MAL) Measure water shortage in the catchments	Up to 60% decrease	Up to 80% decrease			
	River mean annual flood discharge (MAF) Measures flood potential in the catchments	Ruamāhanga Whaitua: 20% decrease to 40% increase depending on catchment Wairarapa Coast Whaitua: 20% decrease to 20% increase depending on catchment	20% decrease to 60% increase depending on catchment			

	Days of very high and extreme forest fire danger	100% to 150% increase	100% to 150% increase			These figures are given by IPCC model averages. Individual models can show much higher increases of up to 700%.
Wind	Annual number of windy days	Ruamāhanga Whaitua: 0 to 4 days increase Wairarapa Coast Whaitua: 0 to 6 days increase	Ruamāhanga Whaitua: 0 to 12 days increase Wairarapa Coast Whaitua: 0 to 10 days increase			
	Intensity of wind during windy days (>99th percentile of daily mean)	0% to 3% increase	1% to 4% increase			
Sea level and coastal hazards	Permanent sea level rise	+0.12 m to +0.24 m above present	+0.68 m to +1.75 m above present	More regular storm events in the fragile coastal environment may also mean faster and more significant coastal retreat.		The projected sea level rise for 2090 is based on IPCC AR5 plus an estimated additional contribution from Antarctica, based on papers published in Nature in 2018. There is very high confidence in sea level rise projections, probably more so than any other variable.
Oceanic changes	Acidification of the ocean					
	General temperature rise of sea water					
	Marine heatwaves					

Table 10: Projected impacts of climate change for the Wairarapa

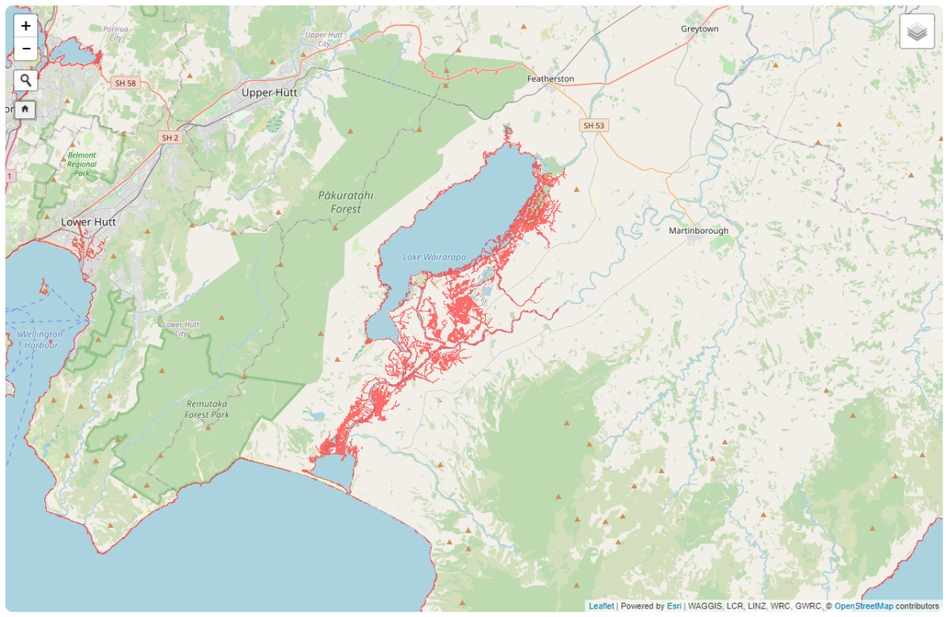
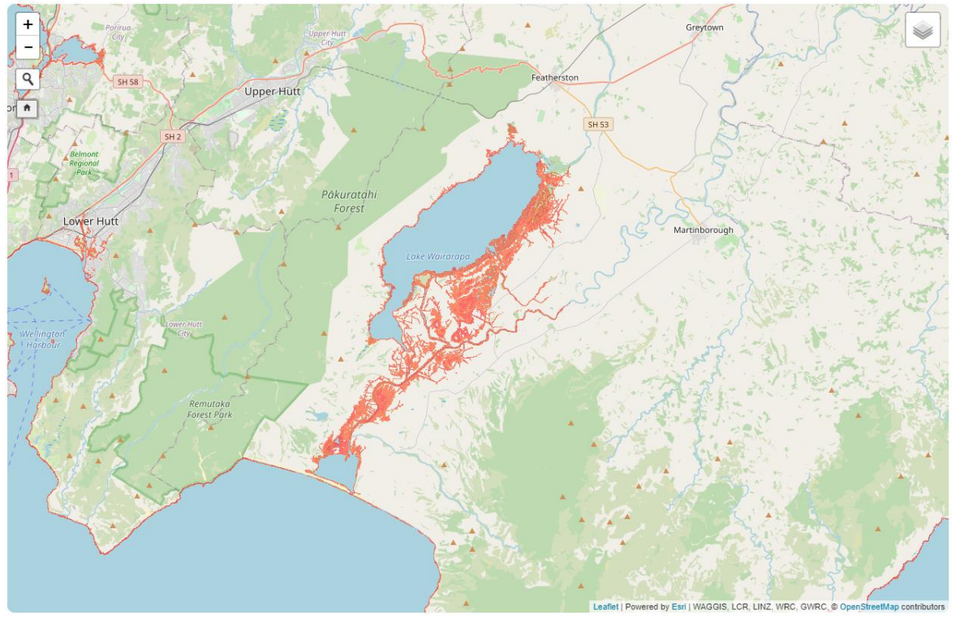
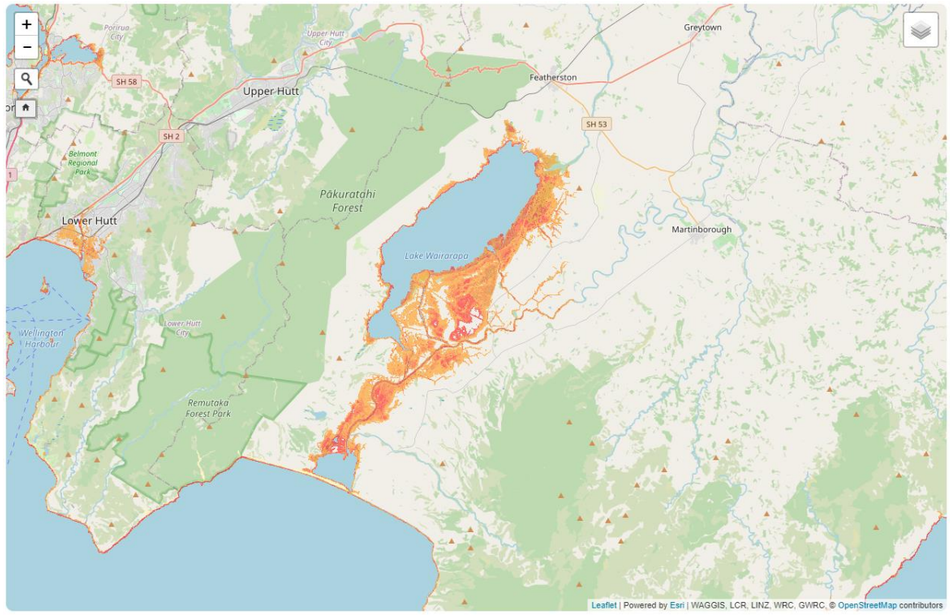
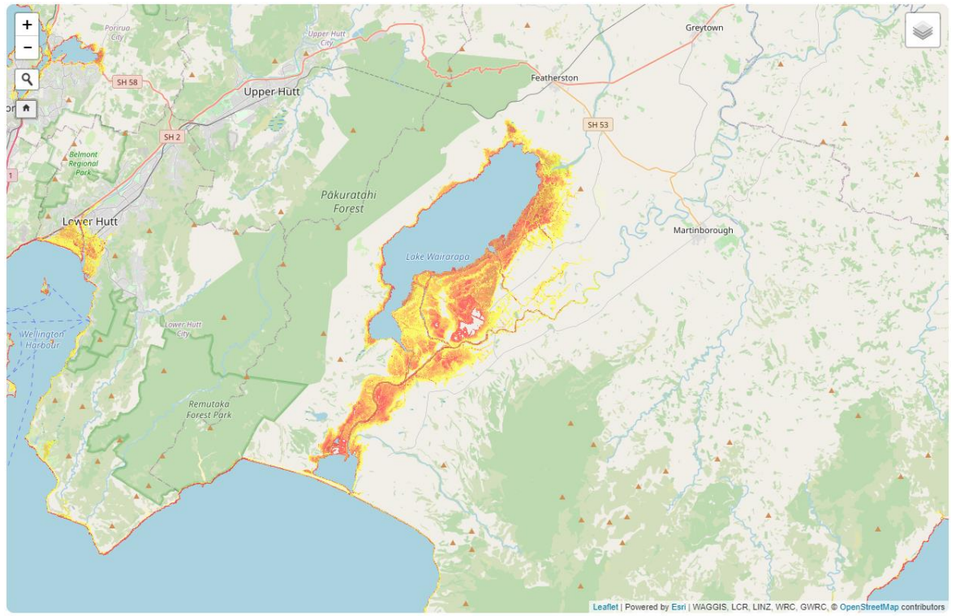
RCP4.5	RCP8.5
Mean temperature change in 2090 (2081-2100) compare to 1995 (1981-2010)	
	

RCP4.5	RCP8.5
Total rainfall change in 2090 (2081-2100) compare to 1995 (1981-2010)	
	
Extreme daily rainfall change in 99th percentile in 2090 (2081-2100) compare to 1995 (1981-2010)	
	

RCP4.5	RCP8.5
Days of windy days (over 10m/s average) change in 2090 (2081-2100) compare to 1995 (1981-2010)	
	

Source: GWRC, https://mapping1.gw.govt.nz/gw/ClimateChange/

Figure 37: Climate change predictions

Sea level rise in 2040 (2031-2050) compare to today	Sea level rise in 2090 (2081-2100) compare to today
+0.2m (predictions: +0.12 to +0.24m)	+0.6m (predictions: +0.68 to +1.75m) – best-case scenario
	
Sea level rise in 2090 (2081-2100) compare to today	**Sea level rise in 2090 (2081-2100) compare to today**
+1.2m (predictions: +0.68 to +1.75m) – Mid-range scenario	+1.8m (predictions: +0.68 to +1.75m) – Worst scenario
	

Source: GWRC, https://mapping1.gw.govt.nz/gw/slr/

Figure 38: Sea level rise predictions around Lake Wairarapa and Lake Onoke

7.2.4 Likely impacts of Climate Change for Wairarapa

The expected direct impacts of climate change (such as increased temperature, increased flood intensity and sea level rise) impact the communities living in Carterton and South Wairarapa District. The key impacts on the communities are:

- Impact on the environmental well-being (biodiversity losses, increased pests and rodents, increased coastal inundation…);
- Impact on the social well-being (increased risk on the human health and human life, increased pressure on drinking water quality and availability…);
- Impact on the economic well-being (reduced productivity, increased damage to properties, increased pressure on insurances and mortgages…);
- Impact on the cultural well-being (loss of cultural identity, loss of important cultural activities, loss of taonga species…).

Expected direct impacts of climate change	**Impacts on communities from expected effects of climate change**			
	Environmental well-being	**Social well-being**	**Economic well-being**	**Cultural well-being**
- **Increased temperatures, drought frequency and intensity***	- **Biodiversity losses*** - Extinction of some species - Higher stress on indigenous ecosystems, plants and animals - Range and habitat of native plants and animals will change (including marine species) - Timing of seasonal activities such as flowering, breeding and migration will change - **Increased pests such as wasps and rodents*** - **Reduced soil fertility*** - **High potential for fruit fly establishment*** - Increased air pollution	- **Increased seasonal allergies (e.g. pollen)*** - Increased human stress (climate anxiety) - Increased human heat stress and mental issues, rurally and in urban centres - Increased diseases (e.g. due to new pests, air pollution, etc) - Increased heat islands due to human activities, large areas of concrete, buildings and vehicles	- Reduced workplace productivity - Higher temperatures may allow for different crops to be grown - Impacts on rural productivity and forestry - Opportunity for tourism due to warmer temperatures	- Loss of cultural identity - Loss on taonga species
- **Increased flood intensity***	- Impacts on plants, animals and natural habitats	- Increased human stress (climate anxiety) - Impact on human life (injuries and/or deaths)	- Increased damage to property and infrastructure - Difficulty in obtaining insurance (reduce or remove insurances from certain areas, significant price increase, mitigation measure required by insurers) - Impacts on rural productivity and forestry	- Loss of identity - Loss of important cultural activities (e.g. mahinga kai)
- **Increased erosion (e.g. due to runoff or sea level rise)***	- Impacts on plants, animals and natural habitats	- Increased human stress (climate anxiety) - Impact on human life (injuries and/or deaths)	- Increased damage to property and infrastructure - Difficulty in obtaining insurance (reduce or remove insurances from certain areas, significant price increase, mitigation measure required by insurers) - Impacts on rural productivity and forestry	- Loss of identity - Loss of important cultural activities (e.g. mahinga kai)
- **Water quality and availability pressures***	- Increased level of toxic algae - Biodiversity losses	- **Increased pressure on water storage*** (higher demand for drinking water at times when water is likely to be scarcer) - Increased human stress (climate anxiety) - Health affected by poor water quality - Increased pressure to reduce water consumption - Impacts on recreational activities	- Impacts on rural productivity and forestry (water shortages) - Increased pressure on the community to become more resilient and self-sufficient (water tanks)	- Loss of identity - Impact Ko wai, mo wai, no wai (waterways connect communities) – cultural value
- **Saltwater intrusion*** on groundwater		- **Groundwater quality and availability pressures*** - Increased human stress (climate anxiety)		- Loss of identity - Impact Ko wai, mo wai, no wai (waterways connect communities) – cultural value
- **Increased wildfire***	- Impacts on plants, animals and natural habitats - Biodiversity losses	- Increased human stress (climate anxiety) - Impact on human life (injuries and/or deaths)	- Impacts on rural productivity and forestry	- Loss of identity
- Sea level rise	- **Increased coastal inundation (some areas to become permanently inundated)*** - Saltwater incursion into freshwater habitats - Biodiversity losses	- Increased human stress (climate anxiety) - Population displacement	- Increased damage to property and infrastructure - Difficulty in obtaining insurance (reduce or remove insurances from certain areas, significant price increase, mitigation measure required by insurers)	- Loss of identity - Loss of important cultural activities (e.g. mahinga kai) - Loss in archaeological sites
- **Ocean acidification***	- **Decline in fish population*** - Altered marine ecosystems, particularly affecting hard shelled species - Biodiversity losses	- Increased human stress (climate anxiety) - Impacts on recreational activities	- Impacts on aquaculture and fishing industries	- Loss of identity

Expected direct impacts of climate change	Impacts on communities from expected effects of climate change			
	Environmental well-being	**Social well-being**	**Economic well-being**	**Cultural well-being**
- Increased winds	- More frequent damages to trees	- Increased human stress (climate anxiety) - Impacts on recreational activities	- Impacts on forestry productivity	- Loss of identity

*** Key environmental impacts for the Ruamāhanga Whaitua and the Wairarapa Coast Whaitua**

Table 11: Impact on the communities from expected direct impacts of climate change

8 Greenhouse gas inventory

8.1 Wairarapa Combined District

In 2018/19 reporting year, the Wairarapa Combined District emitted gross 1,734,320 tCO2e and net 353,460 tCO2e. The biggest sector is agriculture (77.8%), followed by transport (15.7%). Stationary energy (3.4%), Waste (2.3%) and Industry (0.8%) are minor sources of emissions in the Wairarapa.

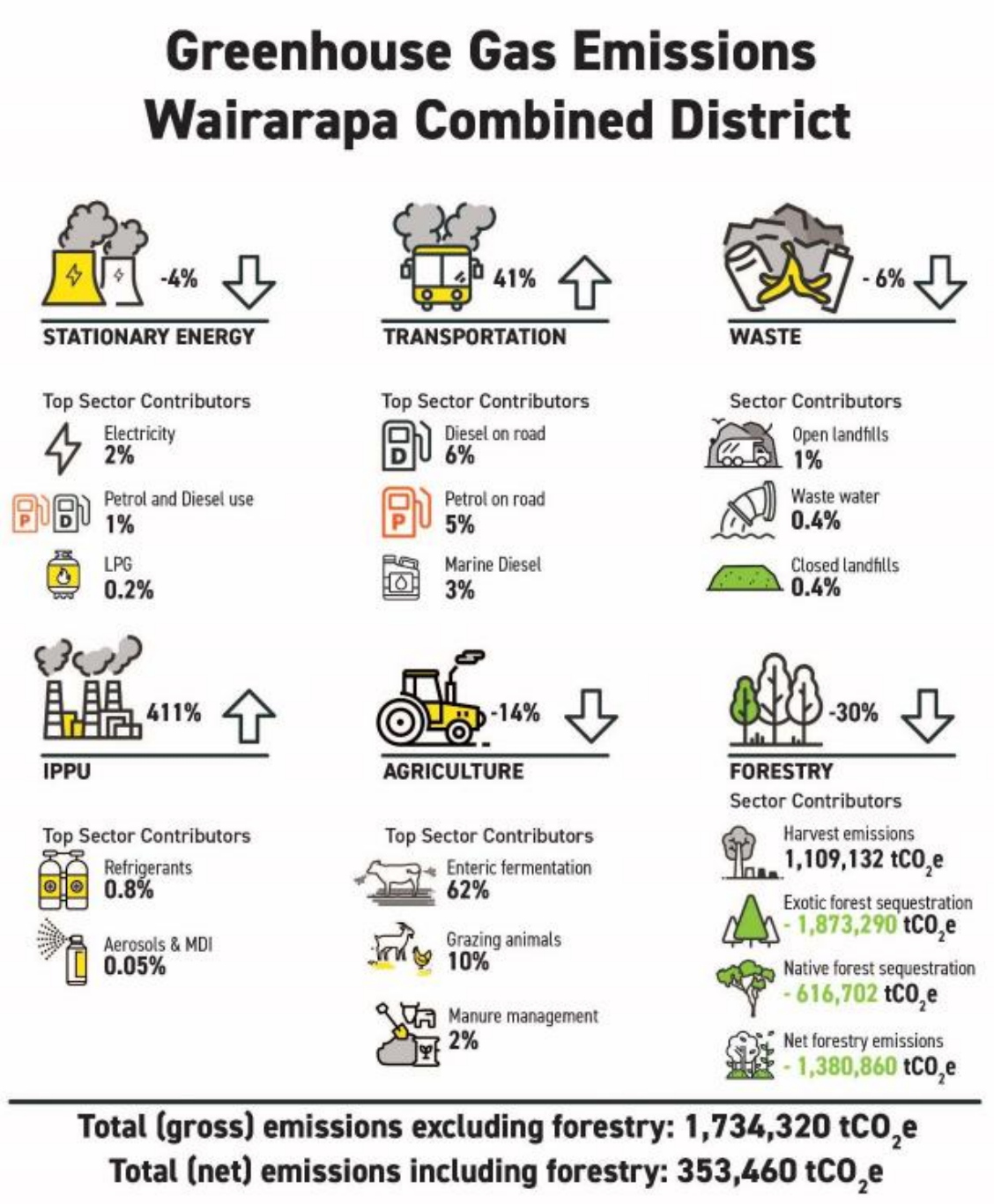
Total gross emissions fell by 7%, from 1,871,095 tCO2e in 2001 to 1,734,320 tCO2e in 2019. Reductions in emissions from stationary energy, waste and agriculture are responsible for the fall in total gross emissions. As the area's population has risen (by 22%, from 39,090 to 47,590), per capita gross emissions have reduced by 24% from 47.9 tCO2e in 2001 to 36.4 tCO2e in 2019.

Net forestry sequestration reduced by 30% between 2001 and 2019 causing net emissions to increase from net-negative total emissions (-91,460 tCO2e in 2001) to net-positive emissions (353,460 tCO2e in 2019).

Carbon emissions for the Wairarapa Combined districts have been measured using the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC). The method includes emissions from stationary energy, transportation, waste, industry (IPPU), agriculture and forestry sectors. This work has been done by AECOM, commissioned by Greater Wellington Regional Council.

8.1.1 Summary

Figure 39 summarises the rate of change in emissions and top contributors to emissions for different sectors.



Source: Wairarapa Combined District Greenhouse Gas Inventory, AECOM, 2020

Figure 39: Summary of change in emissions from 2001 to 2019 including top contributors to total gross emissions from each sector in 2019

8.1.2 2018/19 Wairarapa Combined District inventory

Sector	tCO_2e	% Gross	% Sector
Stationary Energy			
Electricity Consumption	31,928	1.8%	53.8%
Electricity T&D Loss	2,622	0.2%	4.4%
Natural Gas	-	0.0%	0.0%
Natural Gas T&D Loss	-	0.0%	0.0%
LPG	3,130	0.2%	5.3%
Stationary Petrol & Diesel Use	20,159	1.2%	34.0%
Coal	718	0.0%	1.2%
Biofuel / Wood	737	0.0%	1.2%
Total:	59,293	3.4%	100%
Transportation			
Petrol	91,514	5.3%	33.7%
Diesel	105,330	6.1%	38.8%
Rail Emissions	696	0.0%	0.3%
Bus (Electric)	9	0.0%	0.0%
Jet Kerosene	23,367	1.3%	8.6%
Av Gas	51	0.0%	0.0%
Marine Diesel	47,294	2.7%	17.4%
Light Fuel Oil	3,018	0.2%	1.1%
LPG	232	0.0%	0.1%
Total:	271,511	15.7%	100%
Waste			
Solid Waste Disposal	32,665	1.9%	81.8%
Wastewater	7,285	0.4%	18.2%
Total	39,950	2.3%	100%
IPPU			
Industrial Emissions	14,219	0.8%	100.0%
Total	14,219	0.8%	100%
Agriculture			
Agriculture	1,349,348	77.8%	100%
Total	1,349,348	77.8%	100%
Forestry			
Exotic Forest Sequestration	-1,873,290	N/A	N/A
Native Forest Sequestration	-616,702	N/A	N/A
Harvest Emissions	1,109,132	N/A	N/A
Total	-1,380,860	N/A	100%

Total Emissions	tCO_2e
Total (net) incl. forestry	353,460
Total (gross) excl. forestry	1,734,320

Source: Wairarapa Combined District Greenhouse Gas Inventory, AECOM, 2020

Table 12: Summary of Wairarapa Combined District's gross emissions split by sector and associated sub-categories

In 2018/19 reporting year, the Wairarapa Combined District emitted gross 1,734,320 tCO_2e and net 353,460 tCO_2e.

The biggest sector is agriculture (77.8%), followed by transport (15.7%). Stationary energy (3.4%), Waste (2.3%) and Industry (0.8%) are minor sources of emissions in Wairarapa.

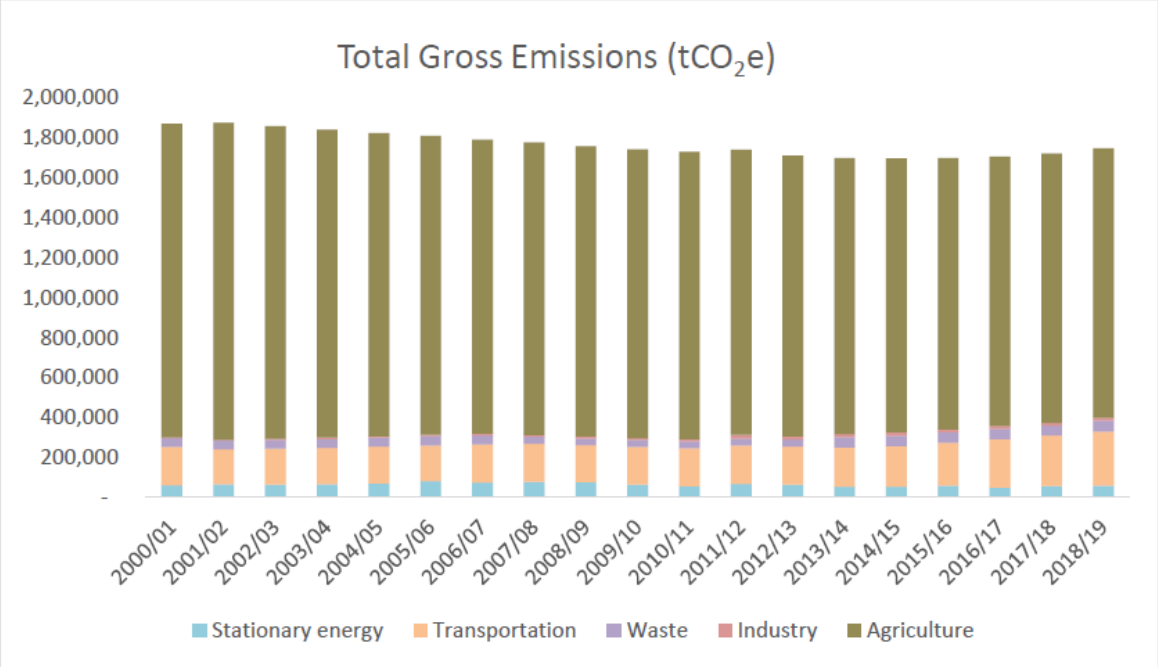
Biogenic Methane (Included in gross emissions)		
Biofuel	19	t CH_4
Biodiesel	-	t CH_4
Landfill Gas	961	t CH_4
Wastewater Treatment	187	t CH_4
Enteric fermentation	31,813	t CH_4
Manure Management	992	t CH_4
Total biogenic CH_4	**33,972**	**t CH_4**

Source: Wairarapa Combined District Greenhouse Gas Inventory, AECOM, 2020

Table 13: Biogenic Methane emitted in 2018/19

Table 13 state the biogenic methane emissions. The Wairarapa Combined District emitted 33,972 tons of Biogenic Methane in 2018/19. The importance of Biogenic Methane is highlighted in NZ's Climate Change Response (Zero Carbon) Amendment Act. The Act includes targets to reduce Biogenic CH_4 between 24 percent and 47 percent below 2017 levels by 2050, and 10 percent reduction below 2017 levels by 2030.

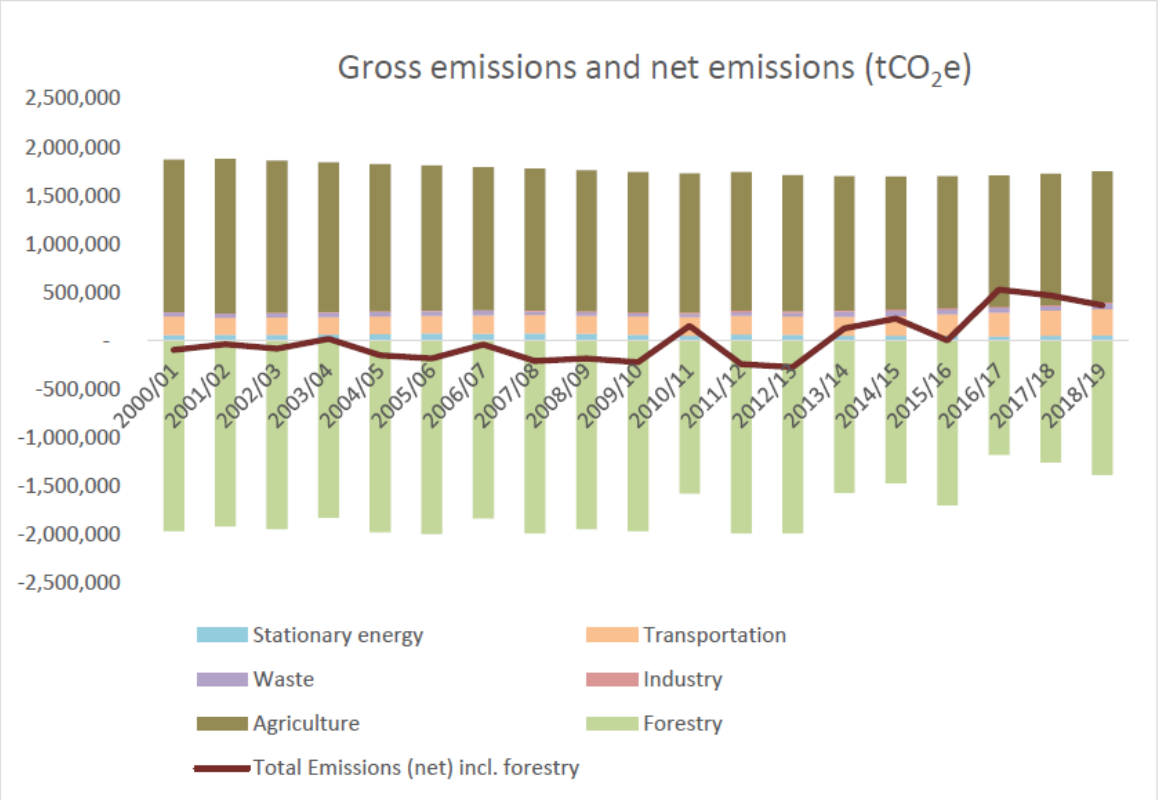
8.1.3 Changes in emissions inventory, 2001 to 2019



Source: Wairarapa Combined District Greenhouse Gas Inventory, AECOM, 2020

Figure 40: Gross emissions per year (excluding forestry) from 2001 to 2019

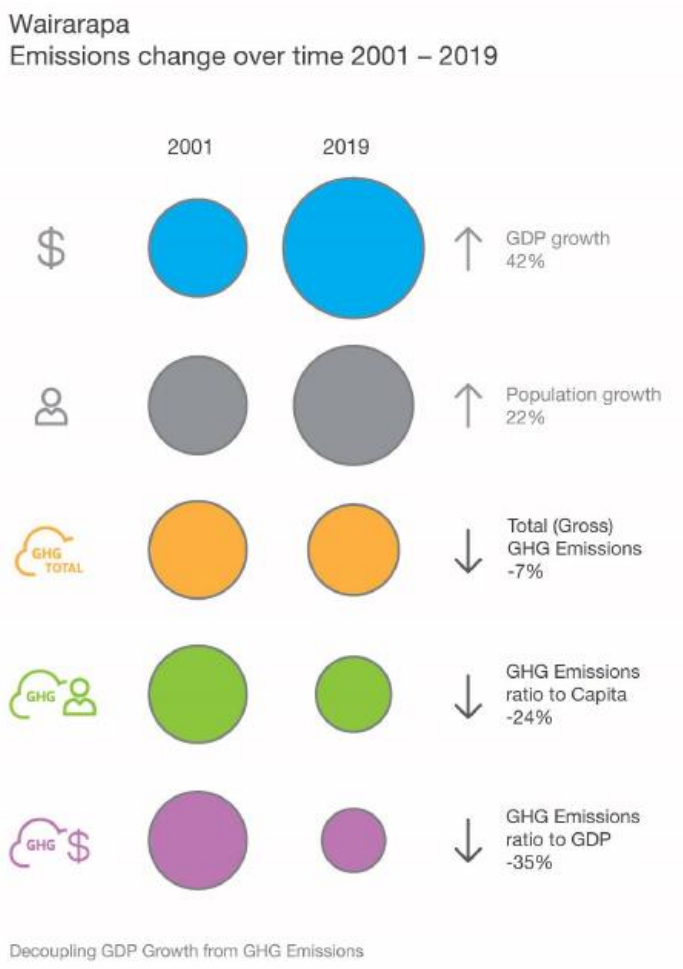
Total gross emissions fell by 7%, from 1,871,095 tCO_2e in 2001 to 1,734,320 tCO_2e in 2019. Reductions in emissions from stationary energy, waste and agriculture are responsible for the fall in total gross emissions. As the area's population has risen (by 22%, from 39,090 to 47,590) and per capita gross emissions have reduced by 24% from 47.9 tCO_2e in 2001 to 36.4 tCO_2e in 2019.



Source: Wairarapa Combined District Greenhouse Gas Inventory, AECOM, 2020

Figure 41: Annual emissions showing gross and net emissions (including forestry) from 2001 to 2019

Figure 41 shows the impact of sequestration in the forestry sector on reducing net emissions. Net forestry sequestration reduced by 30% between 2001 and 2019 causing net emissions to increase from net-negative total emissions (-91,460 tCO_2e in 2001) to net-positive emissions (353,460 tCO_2e in 2019).



Source: Wairarapa Combined District Greenhouse Gas Inventory, AECOM, 2020

Figure 42: Change in total gross emissions compared to other metrics of interest

Figure 42 shows the change in gross emissions when compared to changes in other metrics of interest between 2001 and 2019. Total gross emissions have reduced by 7%, against the backdrop of a 22% growth in population within the Wairarapa. Per capita emissions have fallen roughly in line with the rise in population observed (by 24%).

When emissions grow less rapidly than Gross Domestic Product (GDP) as a measure of income then this process is known as decoupling. The term decoupling is an expression of the desire to mitigate emissions without harming economic wellbeing. The changes in emissions and GDP illustrated in Figure 42 suggest at a high-level decoupling has occurred in the last two decades. GDP was 42% higher in 2019 than in 2001 while emissions per unit of GDP declined by 35%.

The exact drivers for the decoupling of emissions from GDP are difficult to pinpoint. New policies, for restructuring the way to meet demand for energy, food, transport and housing will all contribute. In this case, both direct local actions including reducing the emissions from landfill gas and indirect national trends e.g. reduction of emissions from electricity generation will have contributed to the trends noted.

8.2 Carterton District Council

Carterton District Council had a gross emission of 372.91 tCO_2e in 2018 (base year) and 275.99 tCO_2e in 2020 (-26%). The biggest source is transport (50%) followed by electricity (21%, wastewater treatment (19%) and water supply (9%). Waste and refrigerant are minor sources of greenhouse gas.

Carterton District Council had a net emission of -6,864.48 tCO_2e in 2018 (base year) and -6,961.40 tCO_2e in 2020 (+1.41%).

Biogenic methane emissions increased by 2.73% between 2018 and 2020.

The Table 14, Table 15, Table 16, Table 18, Table 17 and Table 20 are the summary on the greenhouse gas inventory made for CDC since 2018. For further information, refer to the greenhouse gas inventory reports.

The methodology used for these greenhouse gas inventories is the methodology provided by MfE 'Measuring Emissions: A Guide for Organisations'. The emission factors were updated in 2020. Also, due to Covid-19, a lockdown (level 3 and 4) happened between the 23rd of March 2020 and 14th May 2020.

	Scope	t Co_2e - 2018	t Co_2e - 2019	t Co_2e - 2020	Evolution 2018 - 2020
CORPORATE SERVICES		**13.77**	**14.11**	**15.17**	**+10.16%**
Electricity – Other	Scope 2	*3.10*	*2.92*	*3.07*	
Transport and distribution losses	Scope 3	*0.27*	*0.25*	*0.26*	
Transport – Diesel	Scope 1	*0*	*0*	*0*	
Transport – Petrol	Scope 1	*7.50*	*7.89*	*8.06*	
Transport – Flights	Scope 3	*0.60*	*0.75*	*0.83*	
Waste	Scope 3	*2.30*	*2.30*	*2.95*	
Refrigerant	Scope 1	*0*	*0*	*0*	
COMMUNITY SERVICES		**63.70**	**57.99**	**23.14**	**-63.68%**
Electricity – Other	Scope 2	*58.67*	*53.41*	*21.31*	
Transport and distribution losses	Scope 3	*5.03*	*4.58*	*1.83*	
OPERATIONS		**112.73**	**127.31**	**79.43**	**-29.54%**
Electricity – Other	Scope 2	*3.04*	*3.18*	*1.57*	
Electricity – Street lights	Scope 2	*64.89*	*49.70*	*20.38*	
Transport and distribution losses	Scope 3	*5.82*	*4.35*	*1.88*	

	Scope	t Co_2e - 2018	t Co_2e - 2019	t Co_2e - 2020	Evolution 2018 - 2020
Transport – Diesel	Scope 1	*30.82*	*55.71*	*48.98*	
Transport – Petrol	Scope 1	*8.16*	*14.19*	*6.62*	
WATER		**106.68**	**106.56**	**118.33**	**+10.92%**
Transport – Diesel	Scope 1	*47.82*	*43.42*	*41.30*	
Transport – Petrol	Scope 1	*0*	*0*	*0*	
Water supply	Scope 3	*21.64*	*24.97*	*25.55*	
Wastewater treatment	Scope 3	*47.82*	*38.16*	*51.48*	
PARKS AND RESERVES		**64.04**	**42.32**	**28.89**	**-54.89%**
Electricity – Other	Scope 2	*12.63*	*7.95*	*6.57*	
Transport and distribution losses	Scope 3	*1.08*	*0.68*	*0.56*	
Transport – Diesel	Scope 1	*42.09*	*25.42*	*20.11*	
Transport – Petrol	Scope 1	*0.74*	*0.77*	*0.78*	
Green waste	Scope 3	*7.50*	*7.50*	*0.86*	
REGULATORY		**12.00**	**10.35**	**11.04**	**-8.04%**
Transport – Diesel	Scope 1	*6.52*	*5.93*	*2.63*	
Transport – Petrol	Scope 1	*5.48*	*4.42*	*8.40*	
GROSS EMISSIONS		**372.91**	**358.67**	**275.99**	**-25.99%**

Table 14: Emissions by business units

	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
Scope 1	149.12	157.74	136.89	-8.20%
Scope 2	142.33	117.16	52.91	-62.83%
Scope 3	81.46	83.73	86.20	+5.82%
GROSS EMISSIONS	**372.91**	**358.67**	**275.99**	**-25.99%**

Table 15: Emissions by scopes[6]

[6] Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions not included in scope 2

	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
ELECTRICITY	**154.53**	**127.21**	**57.44**	**-62.83%**
Streetlights	*64.89*	*49.70*	*20.38*	
Other	*77.44*	*67.46*	*32.53*	
Transport and distribution losses	*12.20*	*10.05*	*4.54*	
TRANSPORT	**149.72**	**158.49**	**137.71**	**-8.02%**
Petrol	*21.87*	*27.27*	*23.86*	
Diesel	*127.25*	*130.47*	*113.02*	
Flights	*0.60*	*0.75*	*0.83*	
WASTEWATER	**37.21**	**38.16**	**51.48**	**+38.33%**
WATER SUPPLY	**21.64**	**24.97**	**25.55**	**+18.07%**
WASTE	**9.80**	**9.80**	**3.81**	**-61.16%**
REFRIGERANT	**0.00**	**0.00**	**0.00**	**0%**
GROSS EMISSIONS	**372.91**	**358.67**	**275.99**	**-25.99%**

Table 16: Emissions by sources

	t Co_2e - 2018	t Co_2e - 2019	t Co_2e - 2020	Evolution 2018 - 2020
GROSS EMISSIONS	**372.91**	**358.67**	**275.99**	**-25.99%**
Sequestration (forests)	*-7,237.39*	*-7,237.39*	*-7,237.39*	*0%*
Harvest emissions	*0*	*0*	*0*	*0%*
TOTAL	-7,237.39	-7,237.39	-7,237.39	0%
NET EMISSIONS	**-6,864.48**	**-6,878.76**	**-6,961.40**	**+1.41%**

Table 17: Forestry

	2018	2019	2020	Evolution 2018 - 2020
Gross emissions per FTE (t CO_2e) 2018: 59.8 FTE 2019: 61.2 FTE 2020: 66.3 FTE	6.24	5.86	4.16	-33.25%
Gross emissions per capita (kg CO_2e) 2018: 9,440 2019: 9,690 2020: 9,888	39.50	37.01	27.91	-29.43%

Table 18: Emissions per FTE and per head of population

	tCH_4 – 2018	tCH_4 – 2019	tCH_4 – 2020	Evolution 2018 - 2020
Waste	2.30	2.30	2.95	+28.00%
	7.50	7.50	0.50	-93.33%
Wastewater	18.61	19.08	25.74	+38.33%
Total	28.41	28.88	29.19	+2.73%

Table 19: Biogenic methane emissions

8.3 South Wairarapa District Council

South Wairarapa District Council had a gross emission of 247.54 tCO_2e in 2018 (base year) and 243.17 tCO_2e in 2020 (-2%). The biggest source is the electricity (38%) followed by water supply (21%), transport (21%) and wastewater treatment (19%). Waste and refrigerant are minor sources of greenhouse gas.

South Wairarapa District Council had a net emission of 2,687.02 tCO_2e in 2018 (base year) and 665.70 tCO_2e in 2020 (-79%).

Biogenic methane emissions decreased by 2% between 2018 and 2020.

The Table 20, Table 21, Table 22, Table 24, Table 23 and Table 25 are the summary on the greenhouse gas inventory made for SWDC since 2018. For further information, refer to the greenhouse gas inventory reports.

The methodology used for these greenhouse gas inventories is the methodology provided by MfE 'Measuring Emissions: A Guide for Organisations'. The emission factors were updated in 2020. Also, due to Covid-19, a lockdown (level 3 and 4) happened between the 23rd of March 2020 and 14th May 2020.

	Scope	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
CORPORATE SERVICES		**33.89**	**42.54**	**30.85**	**-8.97%**
Electricity – Other	Scope 2	5.52	4.75	*5.48*	
Transport and distribution losses	Scope 3	0.47	0.41	*0.47*	
Transport – Diesel	Scope 1	7.35	12.87	*9.82*	
Transport – Petrol	Scope 1	16.55	18.66	*13.02*	
Transport – Flights	Scope 3	1.93	3.78	*0*	
Waste	Scope 3	2.07	2.07	*2.07*	
Refrigerant	Scope 1	0.00	0.00	*0*	
COMMUNITY SERVICES		**20.98**	**25.60**	**25.79**	**+22.90%**
Electricity – Other	Scope 2	19.33	23.58	*23.75*	
Transport and distribution losses	Scope 3	1.66	2.02	*2.04*	
OPERATIONS		**55.19**	**44.99**	**35.82**	**-35.10%**
Electricity – Other	Scope 2	0.33	0.33	*2.04*	
Electricity – Street lights	Scope 2	30.71	23.27	*22.77*	
Transport and distribution losses	Scope 3	2.66	2.02	*2.13*	
Transport – Diesel	Scope 1	7.64	6.23	*1.48*	

	Scope	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
Transport – Petrol	Scope 1	13.85	13.14	*7.40*	
WATER		**93.16**	**81.43**	**97.99**	**+5.18%**
Water supply	Scope 3	46.04	46.05	*52.04*	
Wastewater treatment	Scope 3	47.12	35.39	*45.95*	
PARKS AND RESERVES		**31.40**	**30.85**	**39.15**	**+24.68%**
Electricity – Other	Scope 2	26.46	25.22	*31.11*	
Transport and distribution losses	Scope 3	2.27	2.16	*2.67*	
Transport – Diesel	Scope 1	0.00	0.00	*0*	
Transport – Petrol	Scope 1	2.67	3.46	*5.37*	
REGULATORY		**12.91**	**12.72**	**13.56**	**+5.04%**
Transport – Diesel	Scope 1	11.48	11.58	*11.71*	
Transport – Petrol	Scope 1	1.43	1.15	*1.86*	
GROSS EMISSIONS		**247.54**	**238.14**	**243.17**	**-1.77%**

Table 20: Emissions by business units

	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
Scope 1	60.97	67.08	50.66	-16.94%
Scope 2	82.35	77.16	85.15	+3.42%
Scope 3	104.22	93.90	107.35	+3.02%
GROSS EMISSIONS	**247.54**	**238.14**	**243.17**	**-1.77%**

Table 21: Emissions by scopes[6]

	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
ELECTRICITY	**89.41**	**83.77**	**92.46**	**+3.42%**
Streetlights	*30.71*	*23.27*	*22.77*	
Other	*51.64*	*53.88*	*62.38*	
Transport and distribution losses	*7.06*	*6.62*	*7.31*	
TRANSPORT	**62.90**	**70.86**	**50.66**	**-19.49%**
Petrol	*34.50*	*36.40*	*27.65*	
Diesel	*26.47*	*30.68*	*23.01*	
Flights	*1.93*	*3.78*	*0*	
WASTEWATER	**47.12**	**35.39**	**45.95**	**-2.49%**
WATER SUPPLY	**46.04**	**46.05**	**52.04**	**+13.04%**
WASTE	**2.07**	**2.07**	**2.07**	**0%**
REFRIGERANT	**0.00**	**0.00**	**0.00**	**0%**
GROSS EMISSIONS	**247.54**	**238.14**	**243.17**	**-1.77%**

Table 22: Emissions by sources

	t Co_2e – 2018	t Co_2e – 2019	t Co_2e – 2020	Evolution 2018 - 2020
GROSS EMISSIONS	**247.54**	**238.14**	**243.17**	**-1.77%**
Sequestration (forests)	*-2,511.26*	*-2,428.98*	*-2,332.09*	*-7.13%*
Harvest emissions	*4,950.74*	*2,262.39*	*2,754.62*	*-44.36%*
TOTAL	2,439.48	-166.59	422.53	-82.68%
NET EMISSIONS	**2,687.02**	**71.54**	**665.70**	**-75.23%**

Table 23: Forestry

	2018	2019	2020	Evolution 2018 - 2020
Gross emissions per FTE (t CO_2e) 2018: 41 FTE 2019: 44 FTE 2020: 48 FTE	6.04	5.41	5.07	-16.31%
Gross emission per capita (kg CO_2e) 2018: 10,920 2019: 11,100 2020: 11,245	22.67	21.45	21.62	-4.86%

Table 24: Emissions per FTE and per head of population

	tCH_4 – 2018	tCH_4 – 2019	tCH_4 – 2020	Evolution 2018 - 2020
Waste	2.07	2.07	2.07	0%
Wastewater	23.56	17.69	22.97	-2.49%
Total	25.63	19.77	25.05	-2.29%

Table 25: Biogenic methane emissions

9 Targets

Carbon targets have been set up. They are ambitious but also, achievable and realistic. Being small councils, we must be aware of our limits.

During the period 2020 – 2030, Carterton and South Wairarapa District Councils aim to:

- Reduce their gross greenhouse gas emissions;
- Increase the reservoirs, therefore the amount of greenhouse gas sequestered every year;
- Reduce biogenic methane by 10% below 2017 levels.

9.1 International targets – Paris Agreement

The Paris Agreement was adopted by Parties under the United Nations Framework Convention on Climate Change (UNFCCC) on 12 December 2015. It commits all countries to take action on climate change. New Zealand ratified the Paris Agreement on 4 October 2016.

The purpose of the Paris Agreement is to:

- keep the global average temperature well below 2°C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5°C;
- strengthen the ability of countries to deal with the impacts of climate change;
- make sure that financial flows support the development of low-carbon and climate-resilient economies.

By ratifying the agreement New Zealand commits to having an emissions reduction target and regularly updating it. Ratification also commits us to:

- continue to regularly report on our emissions and how we're tracking towards meeting our target;
- continue to provide financial support to assist developing countries' mitigation and adaptation efforts;
- plan for adaptation.

9.2 National targets – Climate Change Response (Zero Carbon) Amendment Act

The Climate Change Response (Zero Carbon) Amendment Act sets a greenhouse gas reduction targets and require that:

- net accounting emissions of greenhouse gases in a calendar year, other than biogenic methane, are zero by the calendar year beginning on 1 January 2050 and for each subsequent calendar year;
- emissions of biogenic methane[7] in a calendar year:
    - are 10% less than 2017 emissions[8] by the calendar year beginning on 1 January 2030;
    - are 24% to 47% less than 2017 emissions by the calendar year beginning on 1 January 2050 and for each subsequent calendar year.

The 2050 target will be met if emissions reductions meet or exceed those required by the target.

[7] Methane produced from biological sources (plant and animal).

[8] 2017 emissions mean the emissions of biogenic methane for the calendar year beginning on 1 January 2017.

9.3 Councils' targets

Carterton and South Wairarapa District Councils aimed to set up greenhouse gas emissions targets in order to comply to Climate Change Response (Zero Carbon) Amendment Act and to the Paris agreement.

The targets must be ambitious but also, achievable and realistic. Being small councils, we have to be aware of our limits.

During the period 2020 – 2030, Carterton and South Wairarapa District Councils aim to:

- Reduce their gross greenhouse gas emissions;
- Increase the reservoirs, therefore the amount of greenhouse gas sequestered every year;
- Reduce biogenic methane[9] by 10% below 2017 levels.

To be able to be able to achieve these targets, the councils set up an action plan that is exposed in the following part of the strategy. The actions are intended for:

- the councils;
- the community;
- the businesses.

The greenhouse gas inventories will allow the councils to keep track and record of their emissions and make sure the councils are in the right direction.

[9] Biogenic methane is produced from biological (plant and animal) sources.

10 Conclusion

By writing this ambitious strategy and action plan, Carterton District Council and South Wairarapa District Council are compliant to:

- the Paris Agreement;
- the Climate Change Response (Zero Carbon) Amendment Act;
- the New Zealand Local Government Leaders' Climate Change Declaration.

Indeed, the councils:

- Wrote a Climate Change Strategy in order to reduce their greenhouse gas emissions;
- Committed to regularly report on their greenhouse gas emissions;
- Set up carbon reduction 2030 targets that are compliant to the Climate Change Response (Zero Carbon) Amendment Act:
    - Reduce gross greenhouse gas emissions;
    - Increase the reservoirs, therefore the amount of greenhouse gas sequestered every year;
    - Reduce biogenic methane by 10% below 2017 levels.

This strategy was adopted in February 2020 for CDC and March 2020 for SWDC. This version is the first review of the Ruamāhanga Strategy (April 2021).

11 Contacts and workgroups

The councils are part of many groups to improve its efficiency in climate change mitigation:

- the Wellington Region Climate Change Forum;
- the Wellington Region Electric Vehicle Working Party;
- the Climate Change Officer Network (across New Zealand);
- The Enviroschools Climate Change Group;
- Wairarapa Climate Change Caucus.

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