APPENDIX F

Analysis of the long term drivers on Māori -

Nicholson Consulting report

Analysing the Impact of Long-term Drivers on Māori

Phase 2 Report

March 2025

nicholson CONSULTING

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Introduction

Purpose of this report

This report provides an overview of the analysis undertaken by Nicholson Consulting to support Te Waihanga (the New Zealand Infrastructure Commission) in understanding how the eight identified drivers of future infrastructure demand disproportionately impact Māori. These drivers are:

1. Renewal of existing infrastructure
2. Shortage of existing infrastructure
3. Population growth and demographic change
4. Economic development and changing standards
5. Resilience to natural hazards
6. Decarbonisation to net zero
7. Technology change
8. Construction price inflation

For each driver a specific case study has been selected to tell the story of how Māori communities, businesses, and individuals have been (or could be) impacted by infrastructure investment as it relates to the driver. This analysis is supported by quantitative and qualitative data, drawing on public and data sources from the Stats NZ Integrated Data Infrastructure (IDI).

In addition to this, the report also identifies areas for further research that were beyond the scope of this analysis or where relevant data was unavailable. These areas present opportunities for Te Waihanga to explore additional ways in which infrastructure demand may impact Māori in the future. It is strongly recommended that any deeper research or analysis on these impacts should involve engagement with Māori to ensure that it reflects the contexts and perspectives of the communities impacted.

This analysis provides Te Waihanga with evidence of the unique challenges and opportunities that Māori face in relation to future infrastructure needs, helping to inform the development of strategies that respond to these considerations.

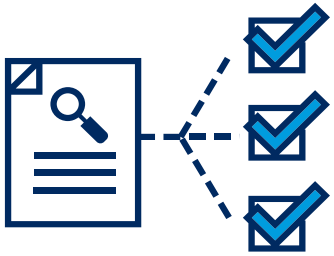
Structure of this report

The following sections of this report present the analyses conducted for each driver, examining their impact on Māori communities through case studies that illustrate real-world challenges and opportunities. The structure of these sections as is follows:

- High level overview of the driver and its relevance to Māori, and introduces the case study that is explored for the specific driver.
- Case study analysis, draws on qualitative and quantitative data (publicly available and/or IDI) to set the context for the case study, explore how Māori communities are/have been disproportionately impacted, and the implications for future infrastructure investment decisions. For some drivers we have also provided a real-world example that highlights the impacts of this driver for Māori.
- A short discussion on potential areas for further exploration, either building on the case study explored in this report or introducing new ideas that were not covered due to scope limitations or data availability.

The appendix section of this report contains the reference list for the data and resources referenced throughout the report.

How case studies were selected



The analysis presented in this report build on the interim report developed by Nicholson Consulting in December 2024. The purpose of this report was to surface available data sources (both publicly available and in the IDI) that would support analyses for each of the drivers as it relates to disproportionate impacts on Māori. In addition to this, several potential case studies for each driver were identified based on the data identified to support Te Waihanga with understanding what areas could be explored for this report.

Given the relatively limited resourcing available for the analysis phase, Nicholson Consulting and Te Waihanga worked collaboratively to prioritise a single case study per driver. Selection was guided by:

- The availability of data to support the development of a comprehensive narrative;
- The extent to which the case study demonstrated infrastructure impacts through the lens of the drivers; and
- The degree to which Māori were disproportionately affected.

Engagement with Māori

As the scope of this analysis was focused on surfacing case studies with available data, engagement with Māori was not undertaken to shape the analysis presented in this report. However, Nicholson Consulting has consulted with internal Te Ao Māori expertise to ensure relevance and integration of Māori perspectives throughout this analysis.

If further analysis is undertaken in relation to the impacts of future infrastructure investment on Māori, Nicholson Consulting strongly recommends that engagement with Māori is prioritised to ensure their perspectives are at the forefront of any future research – this empowers Māori to have authority and agency over the narratives told about their communities, and ultimately lead conversations about their futures and the infrastructure that serves their communities.

Integrating Te Ao Māori perspectives into the case studies

Te Ao Māori (the Māori worldview) shapes how Māori perceive, interact with, and experience the world, influencing their relationships with people, places and te taiao (the environment).

In the infrastructure context, Te Ao Māori perspectives play a critical role in determining how Māori are affected by infrastructure decisions. For example, certain infrastructure decisions may prevent the ability of Māori to exercise kaitiakitanga (guardianship) over te taiao, or disrupt connections to their whenua (land), which are central to maintaining and enhancing Māori wellbeing.

To ensure this context is reflected, Te Ao Māori perspectives have been woven throughout the case studies in this report, with an aim to highlight the ways in which infrastructure drivers create distinct and disproportionate impacts for Māori.

The following sub-sections provide an overview of key Te Ao Māori concepts and terms that have been woven throughout the analysis presented in this report. This background will help to set the scene for the analyses that follow in this report.

Ahi kā/ahi kaa

Ahi kā (or ahi kaa) refers to the practice of maintaining a fire to symbolise ongoing occupation of land - it represents tangata whenua who live in close association with their whenua, keeping the fires burning for their whānau and communities (McCreanor et al., 2021).

The concept of ahi kā is woven throughout the stories in this report, emphasising how infrastructure (such as transport networks) support Māori in maintaining connections to whenua, whānau, and cultural practices, while also enabling Māori businesses to engage in economic activities.

Kaitiakitanga

Kaitiakitanga refers to the concept of guardianship and protection – it can refer to caring for and protection of the environment, people and relationships (Kawharu, 2000). Kaitiaki are the agents (or the “doers”) that perform the task of active guardianship (Paul-Burke and Rameka, 2015).

Infrastructure decisions can have significant impacts on the environments that local iwi depend on to nourish their communities. These decisions must be made with consideration for the role of kaitiakitanga – this is a key consideration we have acknowledged throughout the stories in this report.

DRIVER 1

Renewal of existing infrastructure

Case study: Overview of road condition and its impact on ahi kā

Introduction to the driver and case study

Renewal of existing infrastructure

This driver focuses on maintenance and renewal of existing infrastructure to ensure continued access and service quality. As infrastructure ages, it requires significant investment to prevent deterioration and declining service levels (New Zealand Infrastructure Commission, 2024).

Insufficient investment in infrastructure renewal can disproportionately impact Māori, especially in rural or remote areas where maintenance and upgrades may be less prioritised. Additionally, the opportunity to renew infrastructure to a higher standard can help meet the growing needs of Māori populations, support resilience, economic development, and the protection of culturally significant sites

Overview of road condition and its impact on ahi kā

The case study for this driver examines the importance of road infrastructure in maintaining connections to ancestral lands and maintaining ahi kā. When these roads are in poor condition, it can create a barrier to Māori trying to remain connected to their whenua and whānau back home.

This case study also explores a real-life example in Gisborne/ Tairāwhiti, a region with a large Māori population relative to the national average, and one where road conditions are among the poorest in the country. It looks specifically at State Highway 35 (SH35) as a critical lifeline route for the local Māori community, including Ngāti Porou descendants who rely on this road to travel back home, or within, their whenua.

Good quality road infrastructure can support Māori to return home safely to their ancestral lands

The road network connects people to their communities, employment, education, and many other opportunities (Breitenmoser et al., 2022). Additionally, for Māori living away from their whenua, returning home can often involve travelling via the road network.

While ahi kā does involve occupying the land, on a deeper level, it also encourages Māori to care for their ancestral lands as its kaitiaki; however, for those living away from their ūkaipō or tūrangawaewae for study or work may face challenges in fulfilling this responsibility (Allport et al., 2021). Thus, reliable and well-maintained roads are an important factor in ensuring Māori living away from their whenua can maintain ahi kā.

In a report prepared for NZTA on understanding Māori aspirations for land transport, Breitenmoser et al. (2022) highlighted how Māori felt reliable transport access to rural areas is essential for Māori to maintain connections to their tūrangawaewae and marae, which are central to whakapapa and cultural identity. Regular travel to these places, particularly for significant events like tangihanga, is vital for iwi and individual wellbeing. However, the report highlights how poor rural road conditions and high fuel costs create barriers, sometimes preventing whānau from returning home unless they can share rides. This lack of access can lead to feelings of whakamā (disappointment), and disconnection from whānau and their whenua.

Additionally, the report also highlights how absence of rural public transport creates barriers for Māori in accessing essential services, including shops, schools, and community facilities. For rural Māori living on their whenua, this creates greater reliance on road transport, where the roads tend to be in poorer condition (Davies et al., 2021). These poor road conditions eventually take a toll on both vehicle and inevitably lead to increased vehicle wear and tear, resulting in higher maintenance and repair costs (Davies et al., 2021) – this can disproportionately impact rural Māori, who have lower income rates compared to rural non-Māori (Hauora Taiwhenua Rural Health Network, 2024).

The following page looks at how the road network in Gisborne, particularly State Highway 35 which is known to be of poor condition (Gisborne District Council, 2024), impacts affects access to whenua for both Ngāti Porou descendants living away from home and those residing on their ancestral land.

Where are Māori living across Aotearoa?

According to Census 2023 data, The distribution of Māori across Aotearoa varies significantly by region, with some areas having a much higher proportion of Māori compared to the total national Māori population (887,493 or 17.8% of total population). According to Census 2023 data, Gisborne is the region with the highest proportion of Māori compared to the national population, where more than half of the population (54.8%) is Māori. Northland (37.5%) and the Bay of Plenty (30.6%) also have notably high proportions compared to the national population.

Total Māori population in Aotearoa

887,493

(17.8 % of total national population)

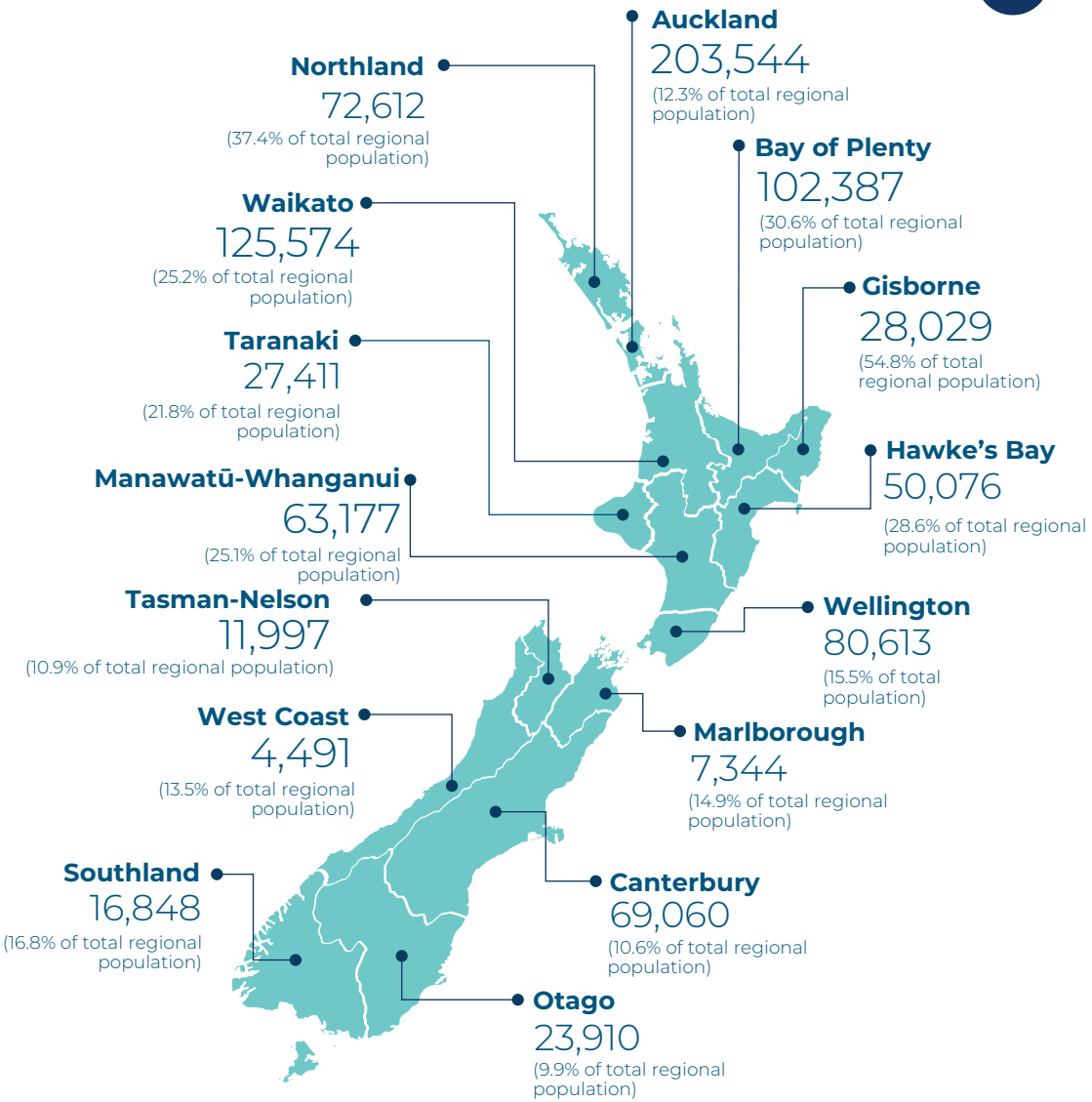


Figure 1: *Distribution of Māori population by region.* ***Source:*** *Census 2023 sub-national population demographics*

What are the conditions of roads across Aotearoa?

Analysing road condition can provide an indication of renewal need. For this analysis, two different measures of road condition have been identified – NAASRA score and Smooth Travel Exposure (STE).

Road roughness – NAASRA

The **NAASRA score** measures of the average roughness of a road., where the higher the number, the rougher the road (NZTA, 2024). In 2023/24, the national average NAASRA was 67.26 (NZTA, 2024).

Table 1 shows that the 5 regions with the highest NAASRA, which indicates that roads in these areas have the greatest need for renewal and maintenance, also have a larger proportion of Māori compared to the national proportion. Gisborne has the highest score in Aotearoa (90.47) for the year 2023/24, indicating higher renewal need due to rougher roads.
While the road roughness in some regions, such as Gisborne, Taranaki and Bay of Plenty (East), improved more than the national average. Other regions such as Northland and Waikato (East) saw worsening road roughness.

Table 2 shows the 5 regions with the lowest NAASRA score. Notably, Bay of Plenty (West) has a relatively low NAASRA (58.71) compared to the national average, which contrasts the high NAASRA score for Bay of Plenty (East). This suggests a disparity in road roughness conditions within the region.

Area	Population demographics	Road roughness in 2023/24 (NAASRA score)		
	Māori (%)	NAASRA score	Difference from previous year	Difference from national average
Gisborne	54.8%	90.47	-4.63	23.21
Waikato (East)	25.3%*	81.44	0.54	14.18
Bay of Plenty (East)	30.6%*	81.21	-1.4	13.95
Taranaki	21.8%	80.19	-1.43	12.93
Northland	37.4%	77.81	1.09	10.56
All New Zealand	17.8%	**67.26**	-0.13	0

Table 1: *The 5 regions with the* ***highest*** *average NAASRA score (i.e., roughest roads), including the national average as a comparison.* ***Source:*** *NZTA National Pavement Conditions Dashboard.*

Area	Population demographics	Road roughness in 2023/24 (NAASRA score)		
	Māori (%)	NAASRA score	Difference from previous year	Difference from national average
Auckland	12.3%	38.05	-0.69	-29.24
Wellington	15.5%	50.06	0.16	-17.20
Southland	16.8%	56.67	0.01	-10.59
South Cantebury	10.6%*	58.32	0.33	-8.94
Bay of Plenty (West)	30.6%*	58.71	-0.10	-8.55
All New Zealand	**17.8%**	**67.26**	**-0.13**	**0**

Table 2: ***The*** *5 regions with the* ***lowest*** *average NAASRA score (i.e., smoother roads), including the national average as a comparison.* ***Source:*** *NZTA National Pavement Conditions Dashboard*

** Note that the proportion stated is for the entire region, and not the area stated in the table.*

Smooth Travel Exposure (STE)

STE indicates the percentage of vehicle travel on roads with roughness better than an upper threshold level (NZTA, 2024). Lower STE indicate that maintenance and renewal aren't keeping pace with the deterioration of the network (DIA, 2013).

Table 3 presents the 5 regions with the lowest STE in Aotearoa for the year 2023/24. Gisborne has the lowest STE (81.0%), followed by Auckland (83.0%) which has seen a -2 percentage point decline, indicating worsening conditions. Canterbury (84.0%), Northland (85.4%), and Otago (85.4%) have slightly better STE but still fall within the lowest-performing regions. Northland and Canterbury have both seen declines (-1.4 and -1.3 percentage points, respectively), suggesting a deterioration in road smoothness.

By comparison, Table 4 presents the 5 regions with the highest STE for the year 2023/24. In particular, the STE for Hawke's Bay (92.1%) and Bay of Plenty (91.7%), regions with a larger proportion of Māori compared to the national proportion, reflect a higher proportion of travel on smoother roads.

Overall, the NAASRA score and STE highlight a disparity in road conditions for the Gisborne and Northland regions, which are continuing to stand out as regions with both rough roads and declining travel quality. The decline in STE across multiple regions suggests that road maintenance efforts may not be keeping pace with wear and tear, with potential infrastructure inequities affecting Māori communities more significantly. This suggests that road renewal and maintenance needs are likely to have a greater impact on regions with larger Māori populations.

Region	Population demographics	STE 2023/24		
	Māori (% of regional population)	STE	Difference from previous year (pp)	Difference from national average (pp)
Gisborne	54.8%	81.0%	0	-4.0
Auckland	2.3%	83.0%	-2	-2.0
Canterbury	10.6%	84.0%	-1.3	-1.0
Northland	37.4%	85.4%	-1.4	0.4
Otago	9.9%	85.4%	-0.4	0.4
All New Zealand	**17.8%**	**85%**	**-1.1**	**0**

Table 3: *The 5 regions with the* ***lowest*** *STE percentage (i.e., a lower proportion of travel on smooth roads).* ***Source:*** *NZTA Road Condition data.*

Region	Population demographics	STE 2023/24		
	Māori (% of regional population)	STE	Difference from previous year (pp)	Difference from national average (pp)
Southland	16.8%	93.0%	-0.2	8.0
Hawke's Bay	28.6%	92.1%	-0.3	7.1
Bay of Plenty	30.6%	91.7%	-0.9	6.7
West Coast	13.5%	90.3%	-0.5	5.3
Malborough-Nelson-Tasman	12.1%	89.8%	0.4	4.8
All New Zealand	**17.8%**	**85%**	**-1.1**	**0**

Table 4: *The 5 regions with the* ***highest*** *STE percentage (i.e., a higher proportion of travel on smooth roads).* ***Source:*** *NZTA Road Condition data.*

Impact of road condition on Māori communities and businesses in Gisborne

The transport network in Gisborne provides important routes for supporting social and economic wellbeing for the community (Gisborne District Council, 2024). However, the condition of the road network in the region has been struggling to keep up with the growing demand for travel - the poor physical condition of these transport assets have highlighted the need for increased investment in maintaining and upgrading transport infrastructure to meet current demands (Gisborne District Council, 2024). These challenges have been exacerbated by a history of underinvestment in the region's transport infrastructure – for State Highway 35 (SH35) specifically, NZTA has stated that the National Land Transport Plan has not been able to fund even the basic maintenance and renewals for this road (Brash et al., 2023a). For those Māori communities who choose to remain on their whenua in Gisborne, lack of investment in road renewal (and resilience) can lead to poor road conditions, which can impact the ability to return home or travel within the region.

Ngāti Porou whānau are reliant on SH35 for access to their whenua

SH35 is an essential connection for communities, whānau, and businesses in Gisborne (NZTA, 2023b), which also links thousands of Ngāti Porou descendants within the rohe and those who regularly return to their whenua and whānau (Wrigley, 2024). However, SH35 is also a coastal route known for its deteriorating condition and safety risks (NZTA, 2023), and has suffered from historical underinvestment (Brash et al., 2023a). Māori communities that are reliant on SH35 are concerned that damage to infrastructure will create separation from their homes and whenua (Brash et al., 2023a). This creates a barrier for the iwi to take care of their whenua, access marae, or return home safely to keep the fires burning (i.e., maintain ahi kā).

Investing in local contractors can support faster connectivity and boost Māori participation

As part of the Ministerial Inquiry into Land Use, the Inquiry panel developed a recommendations report to investigate the impacts of severe weather on Gisborne and Wairoa as a result of weather events (Brash et al., 2023b). The findings in this report highlighted that SH35 is not regularly maintained and is underfunded, and value of investments to date are lost due to government spending being allocated to large contracting companies that are underperforming. The same report also points out that local contractors were much better equipped and responded faster to road infrastructure issues – this places local contractors in the best position to deliver faster and more effective solutions to restore connectivity, and also provides an opportunity for Gisborne to be selected as a region that exceeds the Government's target for Māori participation (Brash et al., 2023b).

Other areas for further exploration

The following areas could be analysed further to understand how Māori may be disproportionately impacted by infrastructure investment related to infrastructure renewal:

- The Rural Supplies Technical Working Group's 2022 report emphasised historic inequities in accessing safe, reliable, and affordable drinking water and wastewater services experienced by many rural marae and papakāinga, and noted that substantial investment is required to ensure they are consistently supplied safe drinking water (Rural Supplies Technical Working Group, 2022). Further analysis could look at how the condition infrastructure has impacted Māori communities to date, both in terms of impacts on people, the environment and cultural practices such as kohi kai (food gathering).
- Māori communities in rural areas face disproportionate transport inequities - Māori tend to live and work in areas that do not have an efficient public transport network, thus relying heavily on car transport, which in itself presents a barrier to Māori given lower incomes on average and high costs associated with car ownership (Breitenmoser et al., 2022). Further analysis could look at the condition of public transport networks in rural regions where Māori make up a larger proportion of the population, and understand how the lack of investment in these networks contributes to higher reliance on cars, further financial strain, and increased risks related to road safety. Examining the impact of this underinvestment on access to essential services and social well-being could also highlight the need for targeted infrastructure renewal to address these inequities.

DRIVER 2

Shortage of existing infrastructure

Case study: An overview of access to healthcare facilities

Introduction to the driver and case study

Shortage of existing infrastructure

This driver focuses on the impact of infrastructure shortages caused by underinvestment or unresponsive planning. When infrastructure does not keep up with demand, it can lead to congestion, poor service quality, and limited access to essential services. Addressing these shortages often requires increased investment or better planning to ensure infrastructure meets current demands and future needs (New Zealand Infrastructure Commission, 2024).

Infrastructure shortages can have a disproportionate impact on Māori communities, particularly in rural areas where access to essential services like healthcare, education and reliable public transport options may be limited.

An overview of access to healthcare facilities

The case study for this driver looks specifically at how infrastructure shortages impact access to essential healthcare services, particularly for rural and remote Māori communities. It looks at geographic disparities in access to emergency healthcare, particularly in areas like Te Araroa, Ruatoria, and Tuai, where many Māori live. The findings highlight how infrastructure shortage challenges in these areas can contribute to delayed care and poorer health outcomes.

Improving access to healthcare facilities to reduce health disparities

Timely access to healthcare facilities such as tertiary hospitals offering advanced level care, full-service emergency departments, is important for Māori due to significant health inequities and disparities that exist in experiences and interaction with the healthcare system. Māori have a greater need for health services but experience more barriers to accessing those services than non-Māori (Espiner et al., 2021).

Emergency departments fill a crucial gap for Māori who experience greater barriers to accessing primary care (Espiner et al., 2021). Māori perceive that hospital-based care is better quality, more affordable and more accessible than finding appropriate times for GP appointments (Barker et al., 2016). This is a wider issue regarding healthcare access but highlights the importance of Māori being able to access hospital environments.

Hospitals are important community infrastructure, they can connect Māori with local healthcare services, provide social and cultural support and services. Hospitals can provide culturally sensitive care for Māori including conversing in te reo, incorporating Māori customs and values, and facilitating space for whānau support (CCDHB, 2017).

Hospitals are crucial in addressing health inequities between Māori and non-Māori, with Māori facing higher rates of chronic disease, injury and lower life expectancy (MoH, 2024).

'In my experience, just being here. There's been a few times where we've needed urgent care and if the hospital wasn't here … my daughter wouldn't be alive if the hospital wasn't here. She stopped breathing when she was seven days old, we rung 111 [emergency number] but because we lived out [rural address], they said the ambulance won't find us in time. We were told to get in the car and drive to the hospital. When we got here, they'd called ahead and there was nurses waiting at the door and everything. She wouldn't be alive if the hospital wasn't here. The service you get when you need it, is amazing'. (F, Māori). (Ram et al., 2024)

The following pages looks at how locational accessibility to healthcare facilities impacts Māori, especially Māori living in rural and remote communities. It examines the effect of travel time and distance on engagement with healthcare services and identifies the towns in the North Island with the greatest distance to emergency departments and explores the demographics of those towns.

Locational accessibility of healthcare services across the motu

Timely access to complex services in New Zealand has been shown to reduce mortality and disability (Lilley et al., 2019). Geographically isolated groups (which often include rural and remote communities with disproportionately higher populations of Māori) bear the burden of poorer access to healthcare facilities that provide more advanced-level care (Lilley et al., 2019). Hospitals across New Zealand are not homogeneous in the services they are able to provide; here we look at aspects of accessibility to different types of hospitals (Brabyn & Skelly, 2002).

While only one facet of accessibility, we examine 'locational accessibility' given its prominent linkage to infrastructure. Locational accessibility refers to the physical proximity of healthcare facilities in accordance with where the population resides within the motu (Brabyn & Skelly, 2002).

Retention of local healthcare services is a geographic access issue; there is a balancing act between "the cost of providing hospital services from small relatively isolated facilities and the advantages in providing fewer large facilities with the capacity for providing more complex services." (Brabyn & Skelly, 2002)

A meta-analysis of studies on access to healthcare services in OECD member countries found that distance and travel time are important considerations for assessing healthcare accessibility for populations living in rural or remote areas (Mseke et al., 2024). The meta-analysis was conducted to understand and quantify the role of distance decay. Distance decay is defined as 'a reduction in health service access with an increase in distance or travel time' (Mseke et al., 2024).

Understanding distance decay was identified as essential for resource allocation and the development planning of new health facilities to promote health and wellbeing in rural and remote communities (Mseke et al., 2024). Travel time especially may be the more meaningful measure (over distance) for when decisionmakers are assessing healthcare infrastructure investment in New Zealand given the challenges in locational accessibility due to natural and population features (Lilley et al., 2019). Through the meta-analysis, evidence of distance decay became apparent in OECD member countries after 30 minutes of travel time. Of the 74 studies examining residential location, 65 (87.8%) showed that where the person lived significantly influenced access to health services. Of these, 55 (84.6%) noted evidence of distance and/or travel time decay (Mseke et al., 2024).

Noting that large scale investment of infrastructure in low populated areas may not be feasible, other avenues in which infrastructure shortages can be addressed can be explored. One such way could be through increasing accessibility to existing hospitals in more densely populated areas. Investment that reduce travel time could be effective, making access to healthcare services easier particularly for rural Māori communities. The meta-analysis provided insights into additional infrastructure related variables that impacted distance decay – road quality, transportation mode (with private cars being preferred), transportation cost, parking charges and public transport safety (Mseke et al., 2024).

Access to Emergency Departments

Almost 1 in 4 New Zealanders are estimated to have access to emergency medical services within 30 minutes and two-thirds (66%) within 45 minutes. For 13% of the population this time increases to 60 to 90 minutes, and 4% are estimated to take greater than 90 minutes.

Locational accessibility to emergency departments services is a prominent issue for the Gisborne (specifically the East Cape) and Hawke's Bay regions. In the North Island, the top five towns with the longest travel time to healthcare facilities offering emergency department services are Te Araroa, Tuai, Ruatoria, Rawene and Waiouru (NationalMap, 2024). Of the aforementioned five towns, four have a majority Māori population:

Town	Māori popn.	% Māori	Distance	Travel Time
Te Araroa*	132	91.7%	173 km	2 h 11m
Ruatoria**	723	95.3%	123 km	1h 44m
Tuai**	183	84.7%	146 km	1h 47m
Rawene*	291	61.4%	124 km	1h 30m
Waiouru**	315	41.2%	106 km	1h 12m

Table 5: The five towns in Aotearoa with the longest travel time to healthcare facilities offering emergency department services.
** Approximate population counts based on 2023 Census.*
*** Approximate population counts based on 2018 Census.*

Relatedly, Te Araroa is located within the East Cape area of New Zealand, an area where approximately 1,500 people reside, 1,383 of whom are Māori (91.6%). There is no emergency department in the East Cape.

These examples indicate that the greatest shortages of accessible emergency healthcare services in the North Island are in predominantly Māori communities, providing a clear picture of disproportionate impact of the existing infrastructure system on Māori.

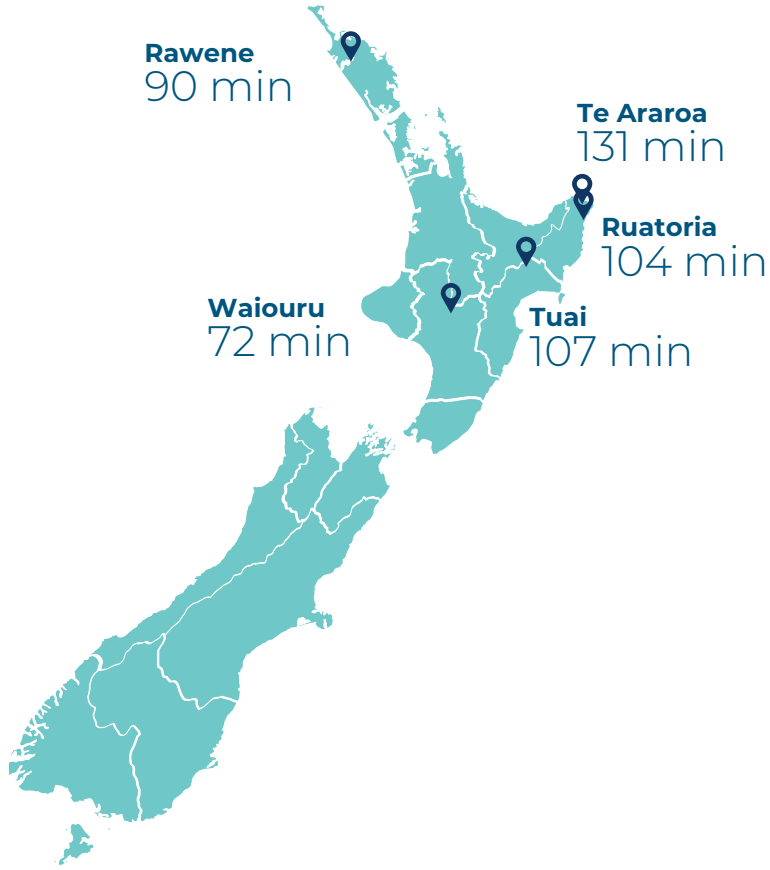


Figure 2: Travel times to emergency departments.
Source: National Map, 2024.

Other areas for further exploration

There are also other focus areas relating to this driver that may be of interest to Te Waihanga to explore, which are out of scope for this analysis – these include:

- **Analysing health care facility accessibility** - To expand and dive deeper into health care accessibility, meshblock level geographical data can be used in conjunction with healthcare facility locations (categorised by levels of care e.g. tertiary health, emergency departments etc.), and road network data. Up-to-date and realistic travel distance and time metrics for communities across New Zealand can be calculated that incorporate recent infrastructure advancements that impact travel. This could be compared to demand for specific health care services such as cancer care, dialysis and so on to understand unmet need for health care infrastructure facilities and services across New Zealand.
- **Understanding the impact of low population density on infrastructure shortages** - New Zealand's population of ~4.9 million people are distributed over an area of 268,021 km, ranking New Zealand at 126th in population density globally. Such low density introduces issues of locational accessibility to infrastructure, an important and potentially causal factor in infrastructure shortages. With finite resources, targeting infrastructure at larger communities, where the potential number of people who can benefit is greater, is a clear method in allocation of resources. Further exploration could be undertaken to understand the real-world impacts of low population density on the availability and accessibility of infrastructure; to identify and explore examples of how combating this challenge has been done successfully and to great effect.

DRIVER 3

Population growth and demographic change

Case study: Diverging demographics and educational infrastructure

Introduction to the driver and case study

Population growth and demographic change

As the population grows and evolves, there is often a need to increase the capacity of infrastructure networks or provide different types of infrastructure to meet new demands. Changes in demographics, such as population size, age structure, and migration patterns, also influence the types and locations of infrastructure required (New Zealand Infrastructure Commission, 2024).

This driver is particularly relevant to Māori communities, as their population structure and demographic trends often differ from the wider population. Māori communities tend to have a younger age profile, with a higher proportion of people in younger age groups compared to the national average. Additionally, Māori populations are often concentrated in rural and regional areas, which can face unique infrastructure challenges due to lower population density and geographical isolation.

Diverging demographics and educational infrastructure

This case study highlights the demographic differences between Māori and the wider population, with Māori communities skewing towards a younger age than the national population. This creates competing infrastructure needs - communities with high proportion of Māori require more investment in educational infrastructure in the short to medium term, while the broader demand for infrastructure related to an aging population grows for non-Māori. The case study includes analysis on the distribution of Māori populations in relation to local schools to understand the demand for educational infrastructure in areas with growing young Māori population.

Diverging Age Demographics

Educational infrastructure needs are diverging across the regions and ethnic communities.

The education system in New Zealand, in this instance the number and location of schools, are intrinsically connected and impacted by shifts in population demographics. Significant shifts in population can occur gradually within large diverse regions but can occur swiftly in smaller more isolated communities (Woodworth, 2024).

Awareness and understanding of these population shifts, which will be further explored in this overview of population growth and demographic change, is important to grasp the nuances in future educational infrastructure needs. Population shifts are not uniform across New Zealand, the needs of one community will not look like the needs of another. Quantifying the population shift and understanding the repercussions on different regional and ethnic communities is crucial in making informed infrastructure investment decisions.

Infrastructure investments are not short term investments and do not take immediate effect. These projects are often a years long process, such as building new school facilities, and foresight based on current state of play supplemented by future population projections is an important tool.

An early indication of diverging age demographics and changes to the population pyramid is New Zealand's birth and fertility rates. The birth rate has fallen consistently since 2009, the last year in which the fertility rate met the replacement rate of 2.1 was 2011 (Brunsdon, 2024).

In the year to March 2024, the fertility rate was just 1.52. The fertility rate varies meaningfully across different ethnicity groups in New Zealand. In 2018, the fertility rate for Māori was 2.14 (just above the replacement rate) while for 'European or Other' it was 1.75. Pasifika had the highest fertility rate of 2.19 and Asian the lowest at 1.4. Regions with a higher population percentage of Māori and Pasifika will have a higher fertility rate overall, and therefore higher births and natural population increase (Brunsdon, 2024). This will lead to a greater demand for schools.

Population Shift

The impacts of population increases, decreases and geographic distribution will impact investment in educational infrastructure.

Total Population Decline

Overall, the total population projections from 2018 to 2043 show a decline in the number of people aged 5 years to 19 years living in New Zealand. This is further explored in the next slide and visualised in slide 27.

Māori Population Growth

Māori population projections from 2018 to 2043 show an increase in the number of Māori people aged 5 years to 19 years living in New Zealand.

School Locations

Areas with existing schools experiencing population decline of school aged children may not be required to be renewed in the future, whereas other areas may need investment in new schools to service a growing population of school aged children.

Actual and projected population growth by the regions

Source: Stats NZ, Census 2013, 2018, 2023 population statistics, and subnational population projections 3018(base) to 2043.

Actual Population Growth – 2013 to 2023

Actual population growth for Māori aged 5 to 19 years over the ten-year period (2013 to 2023) show that all 16 regional councils have experienced a population increase, three regions with a population growth of over 50% - Canterbury (55%), Otago (54%), Marlborough (51%). Wellington has had the slowest increase in young Māori with an increase of 26% in the ten years to 2023. Nationally, the number of young Māori grew by 37%.

Actual population growth for non-Māori aged 5 to 19 years over the same ten-year period show that seven of the 16 regional councils have experienced a population decrease. Gisborne has had the most dramatic decrease in young non-Māori people with an 18% decrease. Canterbury had the highest population growth at 10% followed by Auckland and Waikato, contributing to the 4% national increase.

Projected Population Growth – 2018 to 2043

Regionally, population projections for Māori aged 5 to 19 years for the 25 year period from 2018 to 2043 tell a story of growth. All regions are projected to have an increased number of young Māori residing in their communities. Canterbury is expected to increase the number of Māori aged 5 to 19 by 42%, followed by Tasman and Marlborough at 41% and 39%, respectively.

In contrast, population projections for the same period for non-Māori aged 5 to 19 years, show that all regional councils aside from Auckland will experience a decrease in population. This is most prominent for non-Māori living in Gisborne. It is projected that by 2043 the population of 5 to 19 years in Gisborne will decrease by 57%. The West Coast and Marlborough regions will experience the following two largest decreases in population at 35% and 31%, respectively.

Nationally, Auckland is projected to experience the highest growth in young people aged 5 to 19. In 2023, across all regions Auckland had the highest ratio of young people aged 5 to 19 comparative to the number of schools. The ratios across the regions vary widely with a range of 157 young people per school in the West Coast through to 591 young people per school in Auckland. Nationally the ratio sits at 382 young people per school.

Between the current ratio of young people to schools in Auckland and the projected strong growth of young people in the region over the next 25 years infrastructure investment for renewing and building new infrastructure to address shortages would be expected.

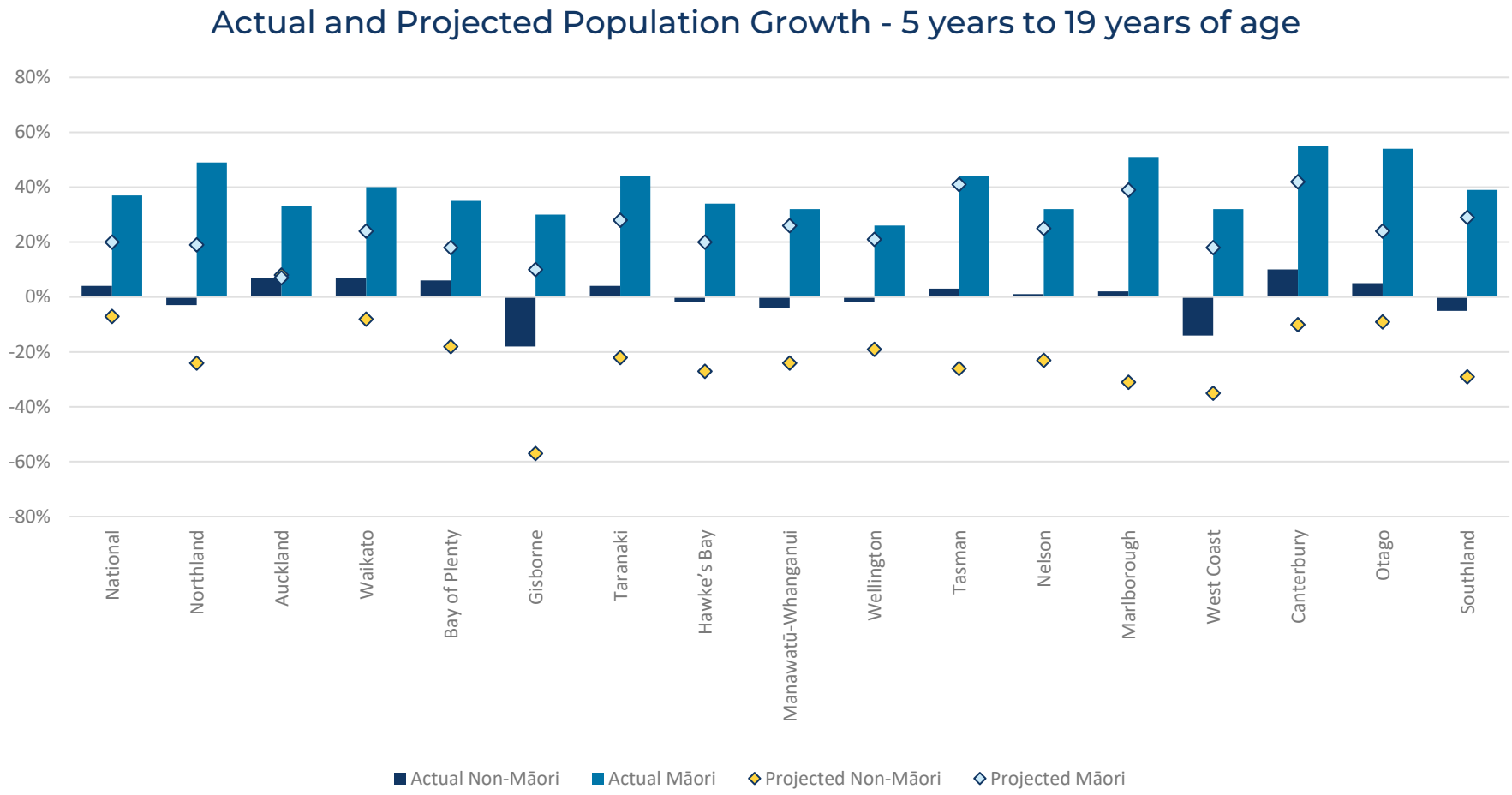


Figure 3: *Actual and projected population growth for Māori population between 5 – 19 years of age, by region.* ***Source(s):*** *Actual - 2013 and 2023 Census Population Statistics. Projected - StatsNZ 2018 to 2043 Population Projections.*

Māori are a younger population

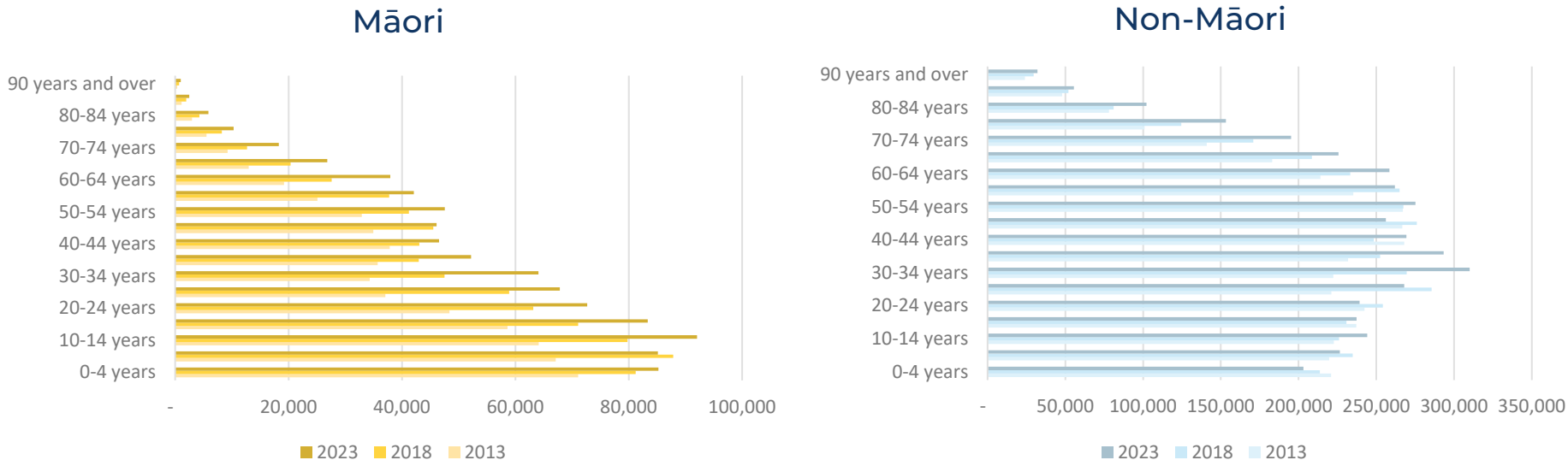


Figure 4: Age distributions for the Māori and non-Māori population. ***Source:*** *Stats NZ, Census 2013, 2018, 2023 population statistics*

The demographics of our communities represent different types of infrastructure need. With finite resources to invest in infrastructure, diverging population demographics present a challenge to the government in respect to where that funding will have the greatest impact. For every dollar of public funding spent on infrastructure to address the renewal of existing schools or building a new school to address shortages of existing infrastructure needs, there is an opportunity cost on what other infrastructure venture that same funding could have been spent on. Examples of opportunity cost could be publicly funded aged-care facilities for the elderly, or maternity healthcare facilities for expecting parents.

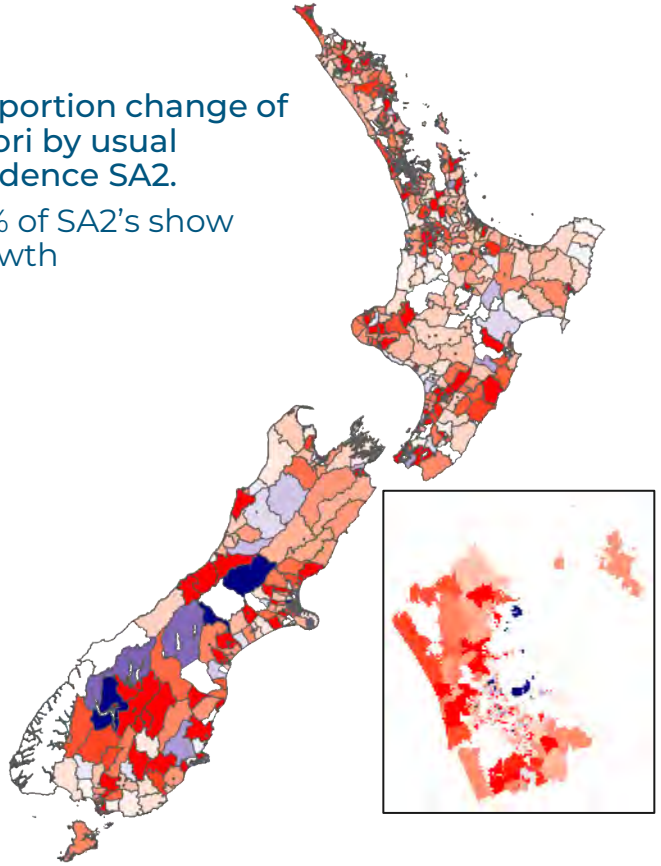
The population demographics of communities, existing infrastructure, existing inequities in accessibility and utilisation should all factor into determining how best this funding can be spent for the short and long term community population needs.

The population structures above tell us that more educational facilities will be needed in areas with high Māori populations in the short term (including culturally appropriate facilities such as Māori Medium Education schools), while in the medium to longer term the government might need to build more aged-care facilities in areas with a high Māori population as we see that population begin to age.

Figure 5: Population change of people aged 5-to-19 years at an SA2* level

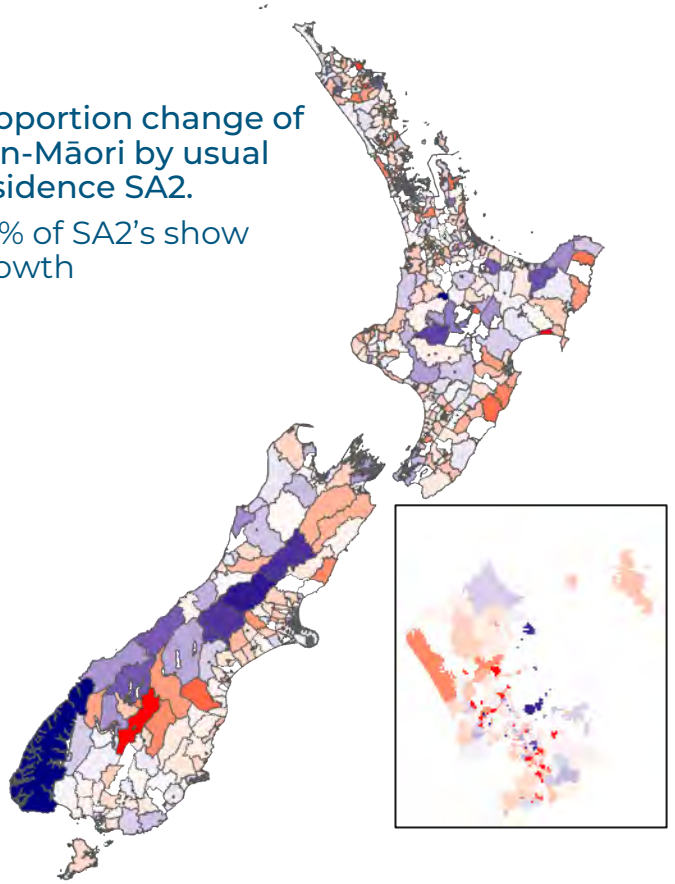
Proportion change of Māori by usual residence SA2.

84% of SA2's show growth



Proportion change of non-Māori by usual residence SA2.

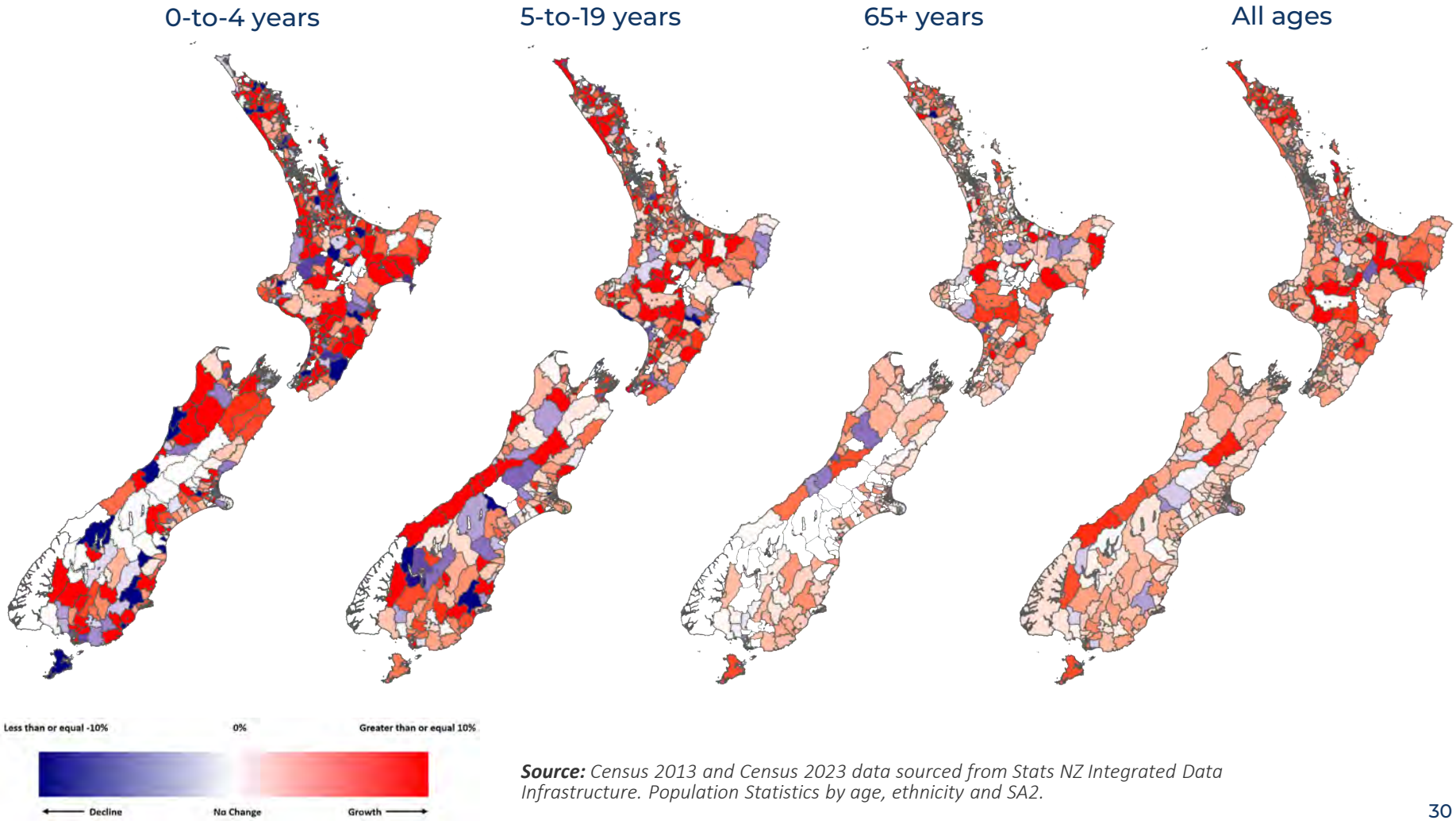
64% of SA2's show growth



Source: *Census 2013 and Census 2023 data sourced from Stats NZ Integrated Data Infrastructure. Population aged 5 to 19 by usual residence SA2.*

**Statisctical Area 2 (SA2)*

Figure 6: Changes in the proportion of Māori at an SA2 level



Source: *Census 2013 and Census 2023 data sourced from Stats NZ Integrated Data Infrastructure. Population Statistics by age, ethnicity and SA2.*

Other areas for further exploration

The following areas could be analysed further to understand how Māori may be disproportionately impacted by infrastructure investment related to population growth and demographic change:

- **Analysing transport infrastructure barriers to education access** – as highlighted by the Sector of Play: Education report (2021) by Te Waihanga, transport infrastructure can be a barrier to safely and efficiently commuting to education (New Zealand Infrastructure Commission, 2021). Additionally, Māori are more likely to experience transport-related social exclusion, missing out on opportunities or engagement due to lack of access to transport. Data related to the transport infrastructure by region as well as travel preferences for Māori students could be analysed to understand how lack of transport infrastructure (e.g., poor public transport connectivity in rural areas) may be a barrier to Māori accessing education.
- **Understanding demand for immersion schooling** - there is growing demand for Māori medium education, with some regions reporting kura with waitlists and insufficient capacity (MoE, 2024). Projections of the number of te reo Māori speakers by 2040 can be produced by the He Ara Poutama mō te reo Māori model (Nicholson Consulting & Kōtātā Insight, 2021), which can be compared against the availability of schools per region that offer total Te Reo Māori immersion learning (such as Kura Kaupapa Māori). It is likely that Kura Kaupapa Māori will have different infrastructure requirements than state schools, which will need to be factored into considerations for infrastructure investment.

DRIVER 4

Economic development and changing standards

Case study: Ōkahu Bay
Stormwater Separation Project

Introduction to the driver and case study

Economic development and changing standards

This driver highlights how economic growth raises expectations for infrastructure quality. As wealth increases, demand grows for safer, more comfortable, and sustainable infrastructure, such as better roads, wastewater systems, and schools. Economic development also shifts the focus towards urban and digital infrastructure, driving updates to design standards. (New Zealand Infrastructure Commission, 2024).

Ōkahu Bay Stormwater Separation Project

This case study looks at the Ōkahu Bay Stormwater Separation Project, a partnership between Ngāti Whātua Ōrākei, Watercare, and Auckland Council, aimed at improving wastewater management and water quality in Ōkahu Bay. The upgrade separated the combined sewer system to meet current wastewater infrastructure standards, reducing harmful overflows and improving the environmental health of the bay. Additionally, the reintroduction of kūtai (mussels) to filter contaminants in the bay is another key initiative in restoring the bay as a pātaka kai for future generations and is an example of how infrastructure investment can incorporate culturally appropriate practices informed by indigenous knowledge.

The case study further reflects on the disproportionate impact outdated infrastructure can have on Māori communities, with examples like the ongoing challenges faced by Ngāti Pareraukawa in Lake Horowhenua.

Māori and the relationship with wai (water)

Te Ao Māori reflects a deeply interconnected worldview – this means all living and non-living things share whakapapa (genealogy) (McAllister et al., 2023). This includes relationships to water, which Māori consider to be a taonga with physical and spiritual properties attached to them (Phillips & Jackson, 2023).

Mauri is a Māori concept used to refer to the life force of an entity, described as the web of connections that sustains life – when mauri is not protected and diminishes, there is no life (Hikuroa et al., 2018). As the kaitiaki of water sources, Māori have an obligation to maintain and protect the mauri of water (Hikuroa et al., 2018).

The ability to gather kaimoana (seafood) is a key indicator of the mauri of the ocean and is closely tied to tikanga Māori such manaakitanga (hospitality) and oranga (health and wellbeing) (Ministry for the Environment & Stats NZ , 2022). When marine environments decline and traditional species are put at risk, this can lead to the loss of mātauranga Māori and customary practices, as well as the loss of culturally significant species due to pollution or overfishing (Ministry for the Environment & Stats NZ , 2022). This not only impacts the environment itself, but also the people and communities who are connected to and rely on this water.

Ōkahu Bay, Tāmaki Makaurau

Ngāti Whātua Ōrakei are tangata whenua of central Tāmaki Makaurau, which includes Ōkahu Bay (Ngāti Whātua Ōrakei, n.d.). For generations, the bay has been an important source of kaimoana – the iwi relied on the bay's rich resources to sustain their community and uphold the practice of manaakitanga by providing kai for guests (Revive Our Gulf, n.d.).

As the kaitiaki of the bay, Ngāti Whātua Ōrakei also have an active responsibility in preserving the mauri of Ōkahu Bay, which includes the protecting the mauri of the environment, the hapū, the community and whānau (Faaui, 2013).

Pollution from combined sewers was one of the factors diminishing the mauri (life force) of Ōkahu Bay.

Ōkahu Bay has suffered from pollution, partly due to the combined stormwater and wastewater systems which often overflowed into the bay after heavy rainfall (Auckland Council, 2018). This caused significant harm to the mauri of the bay, as it impacted the ability for the iwi and local community to connect to the waters and the resources they provide – whether that be through kohi kai (food gathering), recreational activities such as waka ama or swimming, or for other spiritual, social, or cultural wellbeing purposes.

What is the Ōkahu Bay Stormwater Separation Project?

In 2019, Ngāti Whātua Ōrakei partnered with Watercare and Auckland Council to separate and upgrade the century-old combined sewer system to meet current standards for wastewater management and improve the water quality in Ōkahu Bay (Auckland Council, 2019).

This project was an important step in restoring the mauri of Ōkahu Bay, not only by upgrading infrastructure but also by addressing the environmental and cultural impacts of outdated systems. After the completion of the project, only one wet weather flow was recorded in the recent months after the project's completion, which is compared to there being up to 22 wet weather overflows each year between 2019-2022 (Auckland Council, 2021).

Changing standards in wastewater and stormwater systems

Historically, stormwater and wastewater were managed together in combined sewers to prevent urban flooding and reduce waterborne diseases in populated areas (NIWA, n.d.). It was also the preferred system as less pipe was needed, making it a more affordable option (PennState Extension, 2024). However, these systems often overflowed during heavy rainfall, which poses serious environmental and health risks – from the 1950s, separate stormwater and wastewater systems became the standard for sewage management in Aotearoa, however some older areas of the country still have the combined network infrastructure (NIWA, n.d.). The upgrade of Ōkahu Bay's wastewater system is one such example, where efforts to separate stormwater and wastewater reflect the ongoing need in areas of Tāmaki Makaurau (and the rest of the motu) to modernise infrastructure – there are still 5,235 sites in central Tāmaki Makaurau suburbs still connected to a combined network (Auckland Council, 2022).

For Māori, ecological degradation is not just an environmental issue but also a cultural one, impacting relationships with food species, community connections, kinship, mātauranga Māori transmission, health, and iwi development (Poipoia Ltd, 2020). While it is not clear from existing data whether other combined systems are continuing to have a direct impact on Māori communities, these systems still pose a threat to the environments were Māori are kaitiaki.

Given these outdated systems are still present in Aotearoa, infrastructure investment should focus on identifying areas where these systems disproportionately impact Māori communities and the environments they are responsible for as kaitiaki. Additionally, the impacted Māori communities should be consulted in the upgrade of these systems to ensure ecological health of their waters are restored to support Māori connections to water, food sources, and cultural practices.

Infrastructure investment should also consider the potential for culturally-aligned solutions

Known as the "kidneys of the sea," kūtai (mussel) beds remove heavy metals and harmful bacteria, improving water quality while re-establishing a critical food source for the iwi.

A key initiative within the Ōkahu Bay restoration efforts has been the reintroduction of kūtai (mussels) to the bay. In partnership with the Revive Our Gulf initiative, Ngāti Whātua Ōrākei deployed over 60 tonnes of mussels to help filter contaminants, stabilise the seafloor, and restore marine ecosystems. This project is an example of how investment in infrastructure can include environmentally-sustainable options which provide a low-maintenance (and likely lower cost) alternative that improves water quality without the need for extensive built infrastructure. It also is an example of how traditional Māori practices can be woven into resource management practices, and enable Māori to uphold their role as kaitiaki.

This initiative is part of a long-term restoration kaupapa, including replanting the whenua and restoring the mauri of the bay once again. For Ngāti Whātua Ōrākei, this project is about more than water quality — it is also about reviving Ōkahu Bay as a pātaka kai (food store) for future generations. As kaitiaki, they are committed to ensuring their mokopuna can once again gather kaimoana as their tūpuna did.

Other parts of the motu are still affected by wastewater infrastructure issues

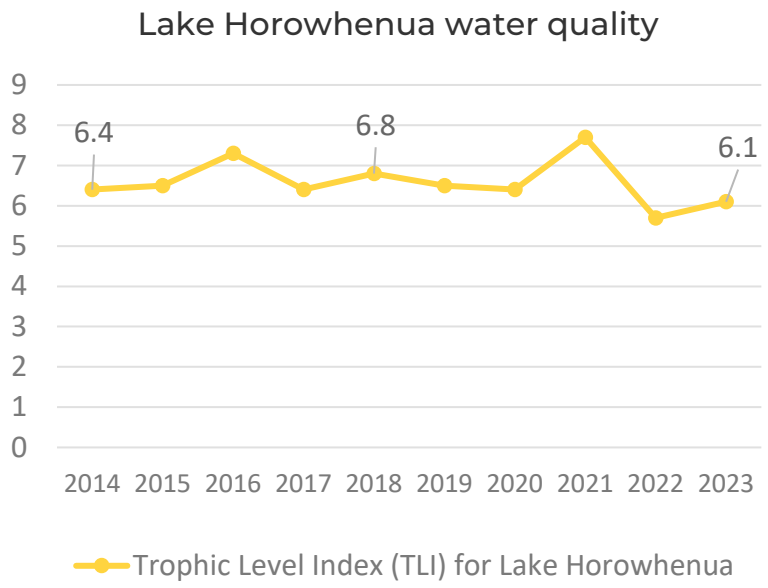


Figure 7: Water quality, measured as the Trophic Level Index (TLI).
Source: Land, Air and Water Aotearoa (LAWA), 2023

While progress has been made in updating infrastructure standards, there is still much work to be done to ensure that practices meet these evolving standards.

Ngāti Pareraukawa, a hapū of Ngāti Raukawa ki te Tonga in Horowhenua, have been dealing with the environmental impact caused by decades of pollution in the Hokio Stream and Lake Horowhenua (Heagney, 2022). These waterways have been subjected to sewage discharge, leachate from Levin's landfill (due to a lack of standards around disposal in the Levin landfill, leading to hazardous chemicals seeping into the water), and stormwater and agricultural runoff. These waters used to be a source of kai, medicine, and recreation for local communities, however ongoing issues around water quality prevent Māori from engaging in these activities (ibid). These water quality issues are still present today – in 2023, Lake Horowhenua had a Trophic Level Index (a measure of water quality) of 6.5, which is considered to be very poor water quality (LAWA, n.d.).

Specific attention is needed in rural areas like Horowhenua, where Māori communities are often most affected by inadequate infrastructure. Infrastructure investment should focus on areas where practices do not currently meet standards for both water quality and long-term environmental and cultural wellbeing. This will require having Māori actively involved in these decisions, as they will have the cultural and environmental knowledge and expertise as kaitiaki to inform infrastructure solutions that benefit both the environment and the people living on it.

An additional consideration is whether it is more cost-effective to meet higher standards upfront, which will likely require greater investment, rather than wait for issues to arise in the future and invest in retro-fitting solutions to address these problems. This option has not been explored in this report, but may be explored for future work.

Other areas for further exploration

The following areas could be analysed further to understand how Māori may be disproportionately impacted by infrastructure investment related to economic development and changing standards:

- At the regional or territorial authority (TA) level, an analysis could be conducted on the regions with the fastest-growing incomes for the Māori population. This would allow for an exploration of how economic growth within these communities is leading to higher expectations for services, improved standards of living, and upgraded infrastructure, including better roads, housing, waste management, and water systems. This can be compared against current standards in the region to understand whether infrastructure investment is keeping up with changing expectations, or where it may not be.
- The above analysis could also be done with Māori-owned businesses – the growth of these businesses can be analysed at a regional level, and compared against infrastructure investments/standards in their region – e.g., the condition of road infrastructure for businesses reliant on road freight, port infrastructure for those reliant on sea freight exports. If Māori businesses are growing at a faster rate than infrastructure investments in the area, this could indicate a mismatch between the economic development and the support infrastructure provides.

DRIVER 5

Resilience to natural hazards

Case study: Coastal risk for Māori communities

Introduction to the driver and case study

Resilience to natural hazards

Resilience to natural hazards focuses on ensuring infrastructure can withstand and recover from events such as earthquakes, storms and floods. While routine infrastructure maintenance is predictable, the timing and scale of natural hazards is not – this makes it difficult to plan for the required investment. Aotearoa is vulnerable to natural disasters, and the damage caused by previous events such as Cyclone Gabrielle can be substantial. Additionally, the impacts of climate change are expected to intensify the severity of these hazards, further challenging infrastructure resilience considerations. (New Zealand Infrastructure Commission, 2024).

Coastal risk for Māori communities

Marae are important cultural infrastructure that is central to Māori culture, identity and spirituality (Bailey-Winiata et al., 2023). These sites can be found in rural or coastal areas, which are often highly susceptible to natural hazards - roads leading to these marae are often impacted by such hazards, creating barriers to access.

This case study looks at how resilience for Māori communities involves being able to gather food and access their marae, making road access an important factor in being able to access these sites. This includes looking specifically at the Bay of Plenty, which has the second most number of coastal marae and kilometres (km) of road network exposed to coastal flooding.

191 marae

in Aotearoa are located in within 1km of coastline. Of these, **41 marae are at risk** of being potentially exposed to a 100-year extreme sea level event (Bailey-Winiata, 2021).

Resilience to natural hazards for some Māori communities includes enabling kohi kai (food gathering) and accessing their marae

Ensuring infrastructure is resilient to natural hazards enables people to remain connected to essential services in the face of these events. For some Māori communities, this can include access to mahinga kai and marae.

Enabling food sovereignty for Māori includes protecting and reconnecting with whenua, moana, māra kai, hunting and gathering, as well as revitalising mātauranga Māori and traditional food production practices (Centre for Social impact, 2023). For Māori communities, climate change risks pose a threat to food security – for example, climate events are impacting access to mahinga kai sites, which has long-term implications for food security and agricultural sustainability (Maxwell et al., 2024).

Marae also serve as hubs for Māori communities to gather, support, and recover during natural disaster events (Bailey-Winiata et al., 2023). During these events, the hau kāinga (home people) open up their marae to manaaki/support those seeking refuge, which includes providing accommodation, food, medical assistance, and post-disaster support such as counselling (Bailey-Winiata et al., 2023).

Coastal hazards can disrupt road access to mahinga kai and marae for Māori communities (NZTA, 2023a). Without resilient coastal roads, these communities risk losing access to essential resources, impacting their ability to gather food, connect with marae, and to more broadly recover from natural hazard events (NZTA, 2023a).

Sea level rise and coastal inundation also pose a threat to many coastal marae across Aotearoa

80% of marae across Aotearoa are built on low-lying coastal land or flood-prone rivers – these locations have historically been chosen for their proximity to kaimoana, enabling whānau to gather seafood and transport it to those living further inland (Bailey-Winiata et al., 2023). However, sometimes this was the only area available for development - due to land alienation as a result of colonisation, Māori were often left with land that Pākehā did not see as having economic potential (such as for agriculture or building work), much of which was also vulnerable to climate change (White, 2018).

Climate impacts like sea level rise and coastal inundation now pose a significant threat to these marae, as well as access to them – for example, whānau from Mirumiru marae on the West Coast of the North Island highlighted how sea level rise has impacted access to their marae and papakāinga areas, where they have observed waves obstructing the access bridge (Rout, 2023).

Māori living on the coastline and critical infrastructure

Coastal risks such as sea level rise and coastal inundation pose a threat to the infrastructure of Māori communities living in coastal areas. Approximately, 14% of Māori households are located in areas highly vulnerable to coastal inundation from projected sea level rise, compared to 12% of all households in Aotearoa (Te Puni Kōkiri, 2023b). The increased likelihood of road damage and infrastructure failure during severe weather events means these communities are more dependent on critical infrastructure such as roads to ensure they can access essential services when they need them most.

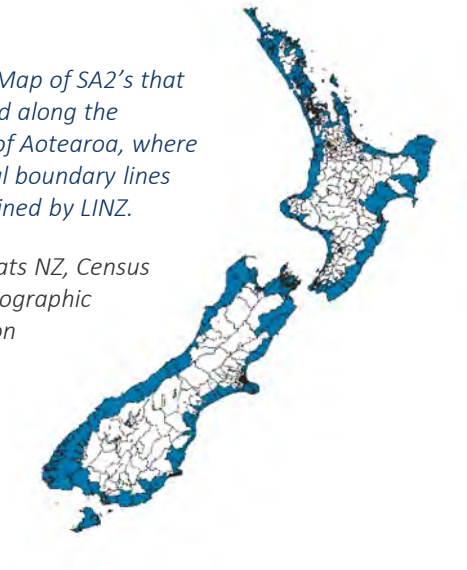


Figure 8: *Map of SA2's that are located along the coastline of Aotearoa, where the coastal boundary lines are as defined by LINZ.*

Source: *Stats NZ, Census 2023 demographic information*

Approximately 1.5 million people are living in the Statistical Area 2 (SA2) geographic units along the Aotearoa coastline*, accounting for almost one third of the population. Of those 1.5 million people, approximately 243,000 are Māori. The top 3 regions with the highest proportion of Māori population living on the coast include:

- Gisborne, where 57% of the coastal population is Māori;
- Northland, where 33% of the coastal population is Māori; and
- Manawatū-Whanganui and Taranaki, where 25% of the coastal population is Māori.

Northland in particular has 1,956 Māori households and 30 marae in SA2s that are highly susceptible to sea level rise, which is the highest number across Aotearoa (Te Puni Kōkiri, 2023b).

This is important contextual information in respect to the following risks to critical coastal infrastructure that could impact the people in these areas:

- Present day risk of coastal inundation in a 1% storm is 1,400km of roads. This increases to around 2,300km in a 0.6m sea level rise – predicted between 2070 and 2130 (NZLC, 2023).
- Low lying airports near the coast are vulnerable to tsunami or storm surge. Sea level rise associated with climate change will exacerbate those hazards. 13 of the 28 domestic and international airports in New Zealand will face higher risks from a 1m sea-level rise (NZLC, 2023).
- Many wastewater treatment plants and some water supply plants on the coast can impact water treatment quality (NZLC, 2023).
- Many older and closed landfills are in coastal or flood-prone areas, vulnerable to flooding/inundation which can contribute to formation and release of toxic leachate. According to a Local Government New Zealand report, there are 100 North Island and two South Island landfills exposed to sea level rise. These are mostly old, closed landfills but there are some operational landfills at risk (NZLC, 2023).

**Coastal boundary lines are as defined by LINZ.*

Te Moana-a-Toitehuatahi - Bay of Plenty

In the Bay of Plenty, there are

46 marae

located within 1km of the coastline, the second most in Aotearoa (Bailey-Winiata, 2021).

The Bay of Plenty also has

392 km

of road network exposed to coastal flooding, the second most in Aotearoa (Ministry for the Environment, 2024).

The Bay of Plenty has a large Māori population compared to the national Māori population – according to the 2023 Census, there were 102,387 Māori residents, making up 30.6% of the region's total population (compared to 17.8% nationally). There are also 46 marae located within 1km of the coastline (Bailey-Winiata, 2021). Additionally, several areas around the coast of the Bay of Plenty are important mahinga kai sites for the local Māori communities, such as Ōhiwa Bay (Paul-Burke et al., 2022) and Waihī Estruary (Taratoa, 2024).

As severe weather damages the roads to these sites (as seen during Cyclone Gabrielle) lack of access to marae and mahinga kai will have an impact on natural hazard resilience for Māori communities. SH2 near Ōpotiki in particular is considered a critical lifeline route for communities, however due to the geotechnical issues on this route it is vulnerable to damage during severe weather events (McCarthy, 2022).

Several marae and mahinga kai areas span this route, meaning road closures (with limited alternative routes) could cut off access when it is needed most.

Marae and mahinga kai have been recognised as important sites that require improved and maintained road access

As part of Arataki, NZTA's 30-year transport plan (2023a), improving and maintaining physical access to marae has been recognised as an important focus for the Bay of Plenty, as damage to the transport network could create a barrier between marae and the wider Māori communities on a more frequent basis for marae on the coast (NZTA, 2023a). To address this in their Regional Land Transport Plan (2024), the Bay of Plenty Regional Council will use public and active travel network and service planning to identify accessibility gaps and develop culturally appropriate solutions (Bay of Plenty Regional Transport Committee, 2024).

Other areas for further exploration

The following area could be analysed further to understand how Māori may be disproportionately impacted by infrastructure investment related to natural hazards resilience:

- As discussed in this section, ensuring resilient transport infrastructure to access marae and mahinga kai is critical to support Māori communities' ability to maintain their cultural practices, food security and connection to their marae in the face of natural hazards. Arataki, NZTA's 30-year transport plan highlights improving or maintaining physical access as a priority. However, the plan also acknowledges that further data is required on the location of marae, their exposure to sea level rise and other land factors, the availability of mahinga kai, and accessibility to marae (NZTA, 2023a). Further analysis should be conducted to understand the location of marae and mahinga kai and how accessible these sites are given vulnerabilities of the road network (and the sites themselves) due to coastal impacts.
- The Climate Hazards Data Tool and report by Te Puni Kōkiri (2023b) outlines the analysis undertaken to understand various climate hazards and their impact on Māori communities, including flooding, extreme rainfall and wet spells, and heatwaves. A potential analysis could include understanding how these climate hazards have an impact on Māori agricultural businesses, particularly those in areas such as Gisborne where there are a high proportion of Māori-owned businesses in the Agriculture, Forestry and Fishing industry (Te Matapaeroa, 2023). This analysis would explore how these hazards impact the resilience of transport networks to support economic activity for these businesses.

In addition to the further analysis above, the analysis of 'Māori living on the coastline' can be recreated at meshblock level rather than SA2 level to get a more granular illustration of Māori living on the coastline and who are at risk of coastal inundation and other coastal related natural hazards.

DRIVER 6

Decarbonisation to net zero

Case study: Māori participation in geothermal energy

Introduction to the driver and case study

Decarbonisation to net zero

Decarbonisation to net zero involves reducing greenhouse gas emissions to avoid the most severe impacts of climate change. Achieving this will require policy interventions to encourage low-emission activities like renewable energy generation and public transport, while reducing reliance on high-emission infrastructure (New Zealand Infrastructure Commission, 2024).

Māori participation in geothermal energy

Geothermal energy has long been an important part of Māori culture, with physical and spiritual practices rooted in kaitiakitanga to ensure its sustainable use for future generations (Taute et al., 2022).

This case study looks at how Māori participation in geothermal energy has expanded active involvement in energy generation. It looks specifically at the Tauhara North No.2 Trust's involvement in the geothermal sector, showing how they utilise their geothermal assets to support renewable energy generation while upholding their role as kaitiaki. Additionally, it looks at how a Māori-owned dairy plant, Miraka, utilises geothermal steam from the Māori-owned Mokai Power Station, which further contributes to decarbonisation efforts. This case study illustrates how Māori are currently contributing to decarbonisation efforts, and how they can gain economic benefit while retaining control over their resources.

Geothermal energy

Geothermal energy plays an increasingly important role in New Zealand's efforts to transition to a low-carbon future. In 2022, geothermal energy accounted for 18.5% of our electricity supply in Aotearoa (New Zealand Geothermal Association, n.d.-d), and this is expected to grow as Aotearoa moves towards adopting cleaner energy.

Relationship between Māori and geothermal resources

Māori have deep connections to geothermal energy sources in Aotearoa, which are commonly found in the Bay of Plenty, Rotorua, and Taupō – these natural resources are considered a taonga by the iwi who are the kaitiaki of them (New Zealand Geothermal Association, n.d.-a).

Impacts of colonisation on connection and governance of geothermal resources

The impacts of colonisation and wrongful land confiscation by the Crown had significant impacts on Māori, which impacted their socio-economic well-being, cultural identity, and ability to sustain traditional ways of life, including access to geothermal resources (New Zealand Geothermal Association, n.d.-b). Treaty settlements, including financial compensation, land and asset returns (which includes geothermal assets) have aimed to redress grievances, support Māori development, and promote cultural revitalisation, enabling some Māori to pursue geothermal projects that benefit their communities and the wider population. (New Zealand Geothermal Association, n.d.-b).

Historically, Māori had little involvement in early government-led geothermal projects – for example, a government-funded project at Ohaaki in the early 1990s, located on land predominately owned by Ngāi Tahu, saw Māori involvement restricted to a peppercorn lease. This long-term lease generated $1 per annum for the land owners, which led to significant economic disadvantages for Māori (Tauhara North No.2 Trust, 2024).

Māori involvement in geothermal today

Today, Māori entities have become increasingly involved in commercial ventures in the geothermal industry (MBIE, 2023). This has enabled Māori to exercise their role as kaitiaki, ensuring the protection and sustainable use of their natural resources (Wilson et al., 2017), but also secure strong commercial outcomes for their people and take on equity ownership as developers in geothermal projects (Blair, 2018).

This involvement positions Māori entities well to contribute to government, local, and regional economic development agency, renewable and geothermal energy targets (Wilson et al., 2017), while also driving Māori economic growth.

Tauhara North No 2 Trust

As its kaitiaki, Tauhara North No. 2 Trust holds significant geothermal investments at the Rotokawa geothermal reservoir

Tauhara North No. 2 Trust represents shareholders of the Tauhara North No. 2 land block in Taupō, who whakapapa to Ngāti Tahu-Ngāti Whaoa.

The Rotokawa geothermal reservoir lies within this land block. This reservoir has been in operation since 1997 (Tauhara North No.2 Trust, n.d.). Rotokawa geothermal reservoir currently powers three power stations - Nga Awa Purua (NAP) Power Station, Rotokawa Power Station, and Ngā Tamariki Power Station. The Trust has varying levels of involvement in the three power stations (Tauhara North No.2 Trust, n.d.):

- **NAP Power Station**: 35% owned by Tauhara North No. 2 Trust, 65% by Mercury Energy
- **Rotokawa Power Station**: The Trust receives a ground lease and royalty payment for the supply of fuel, but has no equity involvement
- **Ngā Tamariki Power Station**: The Trust receives ground lease payments but has no equity involvement

The revenue from their geothermal operations has enabled the trust to diversify its investments into other industries, including the dairy farming industry (Blair, 2018).

Future infrastructure investment in geothermal energy must prioritise sustainable outcomes for Māori

A key factor in sustainable Māori participation is ensuring partnerships with Māori recognise and uphold their interests as kaitiaki of te taiao (the environment), whenua, and tāngata (people), and ensure there is equitable financial outcomes for all parties involved (Tauhara North No.2 Trust, 2024). While the Resource Management Act 1991 requires Māori involvement (either as stakeholders or business partners) in geothermal projects, it does not guarantee Māori values will shape project outcomes – this is because non-Māori partners may lack the understanding needed to integrate them meaningfully (Taute et al., 2023). As such, it is important that infrastructure investment prioritises the active involvement of Māori in geothermal projects to ensure these values are upheld, leading to positive outcomes for Māori (Taute et al., 2023).

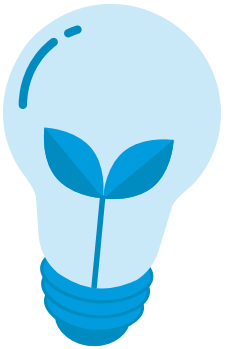
Geothermal energy is also powering world firsts for Māori-owned businesses

Miraka, a dairy factory in Mokai

Investment in Māori geothermal projects can also create both economic and decarbonisation opportunities for Māori-owned businesses in high carbon emitting industries, contributing both to decarbonisation goals and Māori economic growth.

Miraka is a Māori-owned dairy factory located in Mokai, 30km northwest of Taupō, and it is renowned for being the world's first dairy company to use renewable geothermal energy in its processing operations (Cariaga, 2022). Unlike many dairy factories that rely on coal for milk powder production, Miraka utilises geothermal steam, significantly reducing carbon emissions (Wannan, 2022). By using geothermal energy, Miraka emits 92% less manufacturing carbon dioxide emissions than traditional coal-fired factories (Miraka, 2024).

The factory sources its energy from Mokai Power Station, which is a geothermal energy plant owned by Tuaropaki Power Company (New Zealand Geothermal Association, n.d.-c), a Māori-owned power company. These businesses, both located in Mokai, form part of the Mokai Circular System where businesses located in Mokai co-operate to exchange resources such as steam, water and biomass in a circular system (Miraka, 2024).



Miraka has a

92%

smaller carbon footprint compared to coal-fired plants.

Their CO2 emissions savings is equivalent to removing **5,000 cars** from New Zealand roads for one year.

(Miraka, 2024)

Other areas for further exploration

The following areas could be analysed further to understand how Māori may be disproportionately impacted by infrastructure investment related to decarbonisation:

- The cost of delaying effective decarbonisation efforts is rapidly increasing (Climate Change Commission, 2022), which will fall onto future generations if not addressed. As highlighted on page 29 of this report, all regions are projected to have an increased number of young Māori residing in their communities – thus, Māori will likely disproportionately bear the costs of delayed decarbonisation if it is not addressed sooner. As decarbonisation requires significant infrastructure changes to become cleaner, failing to act now will result in the costs of these changes being passed onto future generations. Further analysis could analysis the long-term implications of delaying decarbonisation efforts, which could include analysing the financial, cultural and environmental impacts given Māori interests in te taiao and their role as kaitiaki.
- While renewable energy options are on the rise to support decarbonisation efforts, their developments on Māori land can often create challenges for these projects as they require careful consideration of cultural values – for example, this was seen in the opposition to hydro turbines in Kaipara Bay by the bay's kaitiaki Te Uri o Hau, who were concerned about the bay's mana being compromised if the turbines were installed (McConnell, 2022). Further analysis could involve identifying infrastructure investment in renewable energy developments (such as wind farms or hydro energy developments) on Māori-owned land to date to understand the extent of Māori involvement in the decision-making processes, and assess the long-term economic, cultural, and environmental impacts of these projects. This analysis should include identifying future opportunities for renewable energy infrastructure investments to recognise Māori rights and interests, and ensure more sustainable, culturally-aligned and mutually beneficial outcomes for both developers and Māori.

DRIVER 7

Technology change

Case study: Māori participation in geothermal energy

Introduction to the driver and case study

Technology change

Technology change can drive the demand for new types of infrastructure, alter the needs for existing infrastructure, or reduce the costs for providing it. Major innovations, such as electricity or the internet, often lead to significant infrastructure shifts, though it is difficult to predict these (New Zealand Infrastructure Commission, 2024).

New technology may take time to be widely adopted, as seen with electricity which was not broadly used until decades after its invention. This can be particularly challenging for Māori communities, where digital exclusion is more pronounced. The transition to new technologies may be slower for Māori – while technology change can bring benefits, the pace of adoption can create disparities, which could potentially widen the gap in access to essential services and opportunities.

Ultra-Fast Broadband (UFB) Rollout in Aotearoa

This case study looks at the Ultra-Fast Broadband rollout, specifically the Rural Broadband Initiative and the Marae Digital Connectivity Programme to understand how the roll out of infrastructure to support broadband connectivity impacted Māori and rural communities. This case study provides several learnings that could inform infrastructure investment related to future technology change.

Equitable access to digital technologies enables access to various opportunities and improved wellbeing outcomes

Digital inclusion is closely connected to individual, societal, and economic participation and wellbeing (Digital Government NZ, 2024). When there are disparities in digital technology access, this can further exclude already vulnerable communities and their ability to participate fully in society (LIANZA, 2022).

Māori are among the group of people in Aotearoa who are most at risk of digital exclusion – according to research conducted by Department of Internal Affairs in 2019, Māori households were 16% less likely to have internet access compared to non-Māori (Digital Government NZ, 2021). Additionally, 22% of Māori have below essential digital skills, with this being more common among those on a low household income (32% of people in this category, lack essential digital skills), lower levels of education (28% of people in this category, lack essential digital skills), and people with disabilities (42% of people in this category, lack essential digital skills) (Dickinson, 2025). Rural communities are also among those at risk of digital exclusion in Aotearoa (Digital Government NZ, 2020), an issue that disproportionately impacts Māori as they are more likely to live in rural areas.

Access to the internet is an important element of digital inclusion, and in part is enabled by access to effective telecommunications infrastructure. Lower socio-economic communities, such as Māori and rural populations, are more likely to experience affordability and accessibility issues which indicates service inequality (New Zealand Infrastructure Commission, 2020).

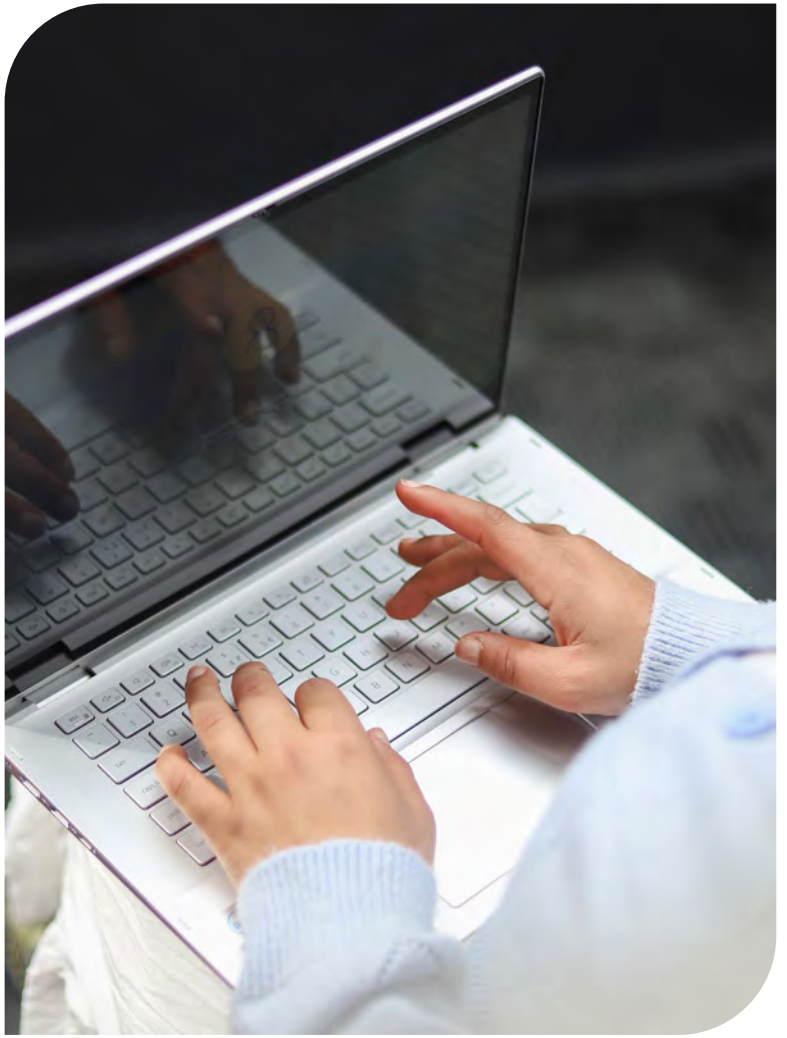
Increasing internet access for Māori and rural communities

When people are digitally excluded, it presents a significant barrier to keeping up with technological progress (NZIER, 2022). Looking back at previous technology change can provide valuable consideration for future technology change, such as the Ultra-Fast Broadband rollout to improve fast-speed internet access.

The Ultra-Fast Broadband rollout in Aotearoa

The Ultra-Fast Broadband (UFB) rollout was one of New Zealand's largest telecommunications infrastructure projects, completed in December 2022, which aimed to provide high-speed fibre-optic internet access to improve connectivity across Aotearoa (MBIE, 2022). However, given the telecommunications sector is largely driven by private investment, infrastructure is not provided in less profitable areas with a small number of users, such as rural locations (New Zealand Infrastructure Commission, 2020).

To ensure equitable access to broadband for these communities, the Rural Broadband Initiative (RBI) was established to expand broadband access to more rural households and improve connectivity in these areas (MBIE, 2022). Additionally, the Marae Digital Connectivity Programme was established to increase broadband coverage to marae, enabling whānau, hapū and iwi to access the opportunities provided by broadband access (TPK, 2024).



Rural Broadband Initiative

The Rural Broadband Initiative (RBI) was introduced to improve internet access in rural and remote areas of Aotearoa, as extending UFB to every rural community was not cost-effective relative to the number of people and businesses it would serve (MBIE, 2022).

Rural households connected to broadband through the RBI contribute to the cost of the infrastructure they use, with a portion subsidised by taxpayers (New Zealand Infrastructure Commission, 2020) - This can be a barrier for low-income users, as the cost of access becomes a barrier to gaining the benefits of having the cell tower infrastructure installed in their area. This affordability issue is even more present for Māori who are located rurally, who have a lower income compared to the total population (Infometrics NZ, 2024). Such barriers can exacerbate digital exclusion issues, making it more difficult for many Māori to keep connected with the digital world.

Marae Digital Connectivity Programme

While it is important to establish the necessary infrastructure for rural marae to connect to, it is equally important to provide ongoing support to ensure marae have the appropriate broadband connections and hardware to effectively access these services.

The Marae Digital Connectivity Programme aims to provide the fastest available broadband connection to marae across Aotearoa by offering government-funded digital hardware and technical support, enabling marae to connect to and effectively use broadband (National Infrastructure, 2024). As a result of the programme, 661 marae are now connected to broadband, and 657 marae now have hardware installed to support connection to broadband (National Infrastructure, 2024).

Research with marae participants highlighted how the improved broadband has helped them connect with their communities both locally and overseas, facilitating communication with family and friends and supporting daily tasks such as online shopping, banking, and study (Research First, 2023).

661 marae

across Aotearoa have been connected to broadband through the Marae Digital Connectivity Programme.

(National infrastructure funding and Financing, 2024)

What learnings from the UFB rollout could apply to future technology change?

As technology continues to evolve, it is important to consider how future changes could impact rural Māori communities, particularly in relation to broadband access and affordability. The following points highlight key learnings from the RBI and Marae Digital Connectivity programmes that could apply to future investments relating to infrastructure and technology change:

Targeted investment to ensure equitable access

Wide rollout programmes such as the UFB rollout should consider the unique needs of communities with lower digital inclusion levels, including rural and Māori populations. These communities will likely require tailored solutions, such as infrastructure that accounts for geographic isolation, cultural factors, and varying levels of digital literacy.

Consider cost as a barrier to adoption

The cost of infrastructure and technology can serve as a barrier to access, particularly for communities that are already disadvantaged or located in rural and remote areas. In the case of rural and Māori communities, which often have lower average incomes and fewer resources, the price of new technology can prevent them from fully participating.

Ongoing support is key

Building the necessary infrastructure is only one part of the solution. For communities less likely to be digitally included, providing ongoing support such as technical assistance and digital literacy programmes can support users to fully benefit from the infrastructure in the long run.

Other areas for further exploration

It is difficult to understand from current data whether future technology change will have a disproportionate impact on Māori. However, the following areas could be analysed in the future:

- A study on reducing healthcare inequities for Māori using telehealth during COVID-19 found that telehealth consultations have the potential to improve access to healthcare for Māori and could be a viable long-term option that can support Māori whānau access to healthcare (Wikaire et al., 2022). However, Māori communities, especially in rural areas, may experience disparities in access to these services if there is not sufficient telecommunications infrastructure or limited internet access to access this service. Future analysis could build off the case study explored for this driver in the report, looking specifically at access to telehealth services and the impacts this had during COVID-19 when face-to-face healthcare was not an option. Research funded by the Health Research Council is currently underway to establish up-to-date robust evidence on equitable telehealth design model, which will support the design of telehealth services that meet the specific care needs of Māori (HRC, n.d.) – information produced from this research will be beneficial to refer to for this analysis.

DRIVER 8

Construction price inflation

Introduction to the driver

Construction price inflation

This driver touches on the rising costs of building and maintaining infrastructure, which tend to increase faster than the general price inflation in the economy. This trend is influenced by slower productivity growth in construction compared to other sectors, along with fluctuations in material and labour costs. To offset these challenges, non-built solutions or better use of existing infrastructure could be considered (New Zealand Infrastructure Commission, 2024).

Construction price inflation can have an impact on all the drivers

Māori-owned businesses are well represented within the construction sector. Māori-owned businesses make up around 14% of the construction sector in Aotearoa in 2021 (Construction Sector Accord, 2024), and around 25% of all Māori-owned businesses in Aotearoa (Te Puni Kōkiri, 2023a). Māori-owned businesses experience several different challenges which could contribute to the pressures of construction price inflation – this includes labour shortages, limited access to capital, low wages in the construction sector for Māori, and competitive profit margins (Construction Sector Accord, 2024).

Current available data does not clearly indicate whether construction price inflation has a directly disproportionate impact on Māori. However, construction price inflation places a strain on the other drivers outlined in this report – rising construction prices place limitations on available infrastructure funding (e.g., to invest in renewal activities that enable ahi kā), which could lead to investment decisions made on the basis of achieving the greatest overall impact. This can make it difficult to address equity concerns, which could potentially exacerbate existing disparities for Māori. As a result, this driver could potentially amplify the challenges Māori face in relation to future infrastructure decisions.

Appendix

Appendix 1 - IDI Disclaimers

Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which is carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/.

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