NEW ZEALAND INFRASTRUCTURE COMMISSION
Te Waihanga

Paying it back:
An examination of the fiscal returns of public infrastructure investment

Te Waihanga Research Insights series

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New Zealand Infrastructure Commission / Te Waihanga

Te Waihanga seeks to transform infrastructure for all New Zealanders. By doing so our goal is to lift the economic performance of Aotearoa and improve the wellbeing of all New Zealanders.
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Contents

Cut to the chase

Money is needed to pay for infrastructure

The value of infrastructure goes beyond dollars and cents or impacts on GDP growth. Infrastructure can improve our connectivity, our health, our productivity, and our wellbeing. Most infrastructure projects provide a mix of monetary and non-monetary benefits. For instance, a new road may reduce the costs to move freight to a port, boosting our export economy. But it will also make leisure trips safer and more convenient, boosting wellbeing.

However, all infrastructure projects, regardless of what types of benefits they provide, still need to be paid for. In some cases, new projects directly generate new revenues that can be used to pay back the up-front costs to build them. Others do not.

Not all projects have to "pay their way". This is particularly the case for public infrastructure investment. For instance, renewal projects, like re-sealing a local road, are unlikely to bring in significant new revenues from users. These projects are important, but we need to pay for them out of our existing revenue streams, which means prioritising them against competing spending priorities.

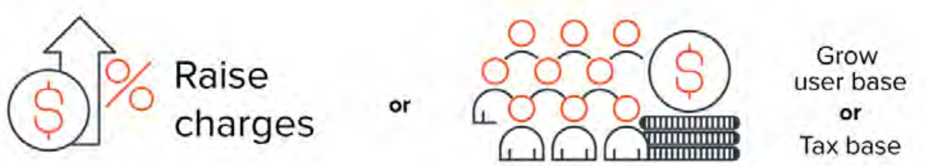
Undertaking projects such as these is fine, so long as our infrastructure spending is consistent and is generally in line with existing revenue streams. However, future infrastructure needs could intensify as we respond to deferred maintenance and renewals, adapt to climate change, and prepare for natural hazards. As a result, we may need to consider ways to generate additional revenues to meet these needs.

We can raise new revenue by charging more or by growing the user or tax base

There are two basic ways that public infrastructure providers can raise additional revenue to pay for increased infrastructure investment.

First, they can **raise charges** on existing users or taxpayers. For example, if central government wanted more revenue to pay for things like roads, hospitals, and schools, it could get it by lifting income taxes, goods and service taxes, or specific charges like fuel excise duty and road user charges. Likewise, if regional councils wanted more revenue to pay for public transport services, they could lift public transport fares or increase rates.

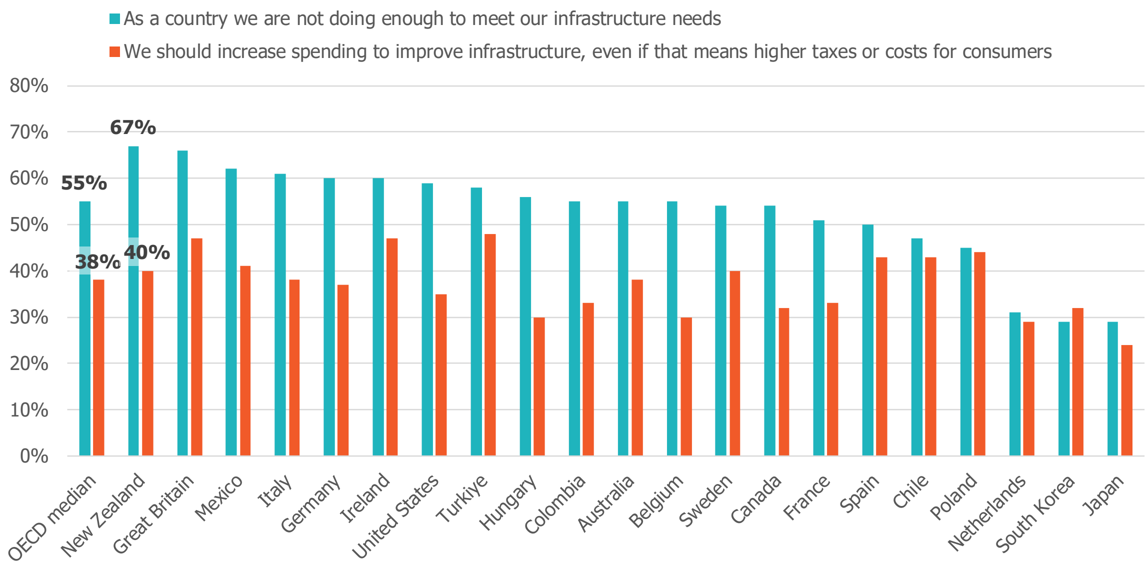
Second, they can use investment to **grow the user base or tax base**, bringing in new revenue from existing charges. For example, central government investment in healthcare and hospitals may make people healthier and enable them to work more. This would in turn increase income tax receipts. Similarly, if councils increase public transport services, this may increase the number of people using buses and paying fares, but also potentially the land values around stations, which could grow the rating base.



Raising charges is difficult for public infrastructure providers

Raising charges for public infrastructure services generally means asking for a greater share of users or taxpayers' income. Raising charges is also more politically contestable, so investment funded directly by higher charges could be more volatile. Public opinion polling shows that while New Zealanders perceive a high degree of infrastructure needs, they are resistant to paying higher charges to fund them (Figure 1).

The public is resistant to increases in charges or taxes to fund growing infrastructure needs
Figure 1: 2024 Ipsos Global Infrastructure Index survey on infrastructure needs



Source: Ipsos Global Infrastructure Index, 2024.

This is particularly true if incomes and productivity are growing slowly, as it means asking for a larger share of users' income for infrastructure.

Public infrastructure providers face growing fiscal challenges

If the public is resistant to paying more for infrastructure services, another option is to reprioritise spending and revenue in other parts of government towards infrastructure.

However, new infrastructure funding will have to compete with other government services that are increasingly putting pressure on government resources. For central government, an ageing population is requiring greater spending on superannuation and health expenditures. Absent a change in revenue settings, net core Crown debt to gross domestic product (GDP) is expected to increase to over 100% in the next 30 years, up from roughly 42% in 2024 (Figure 2A). Councils, similarly, are at or nearing their borrowing limits (Figure 2B).

Government resources to spend on infrastructure are increasingly constrained

Figure 2A: New Zealand net core Crown debt projections as a share of GDP

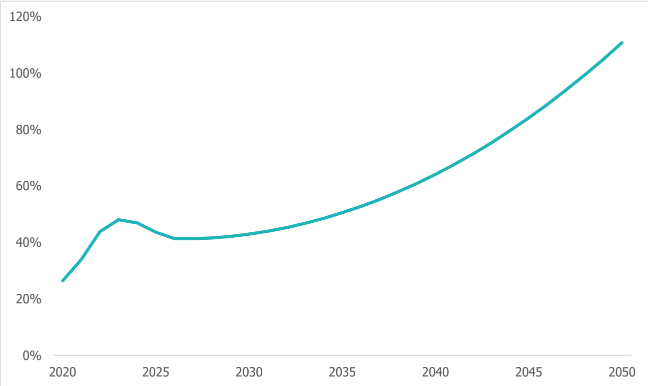
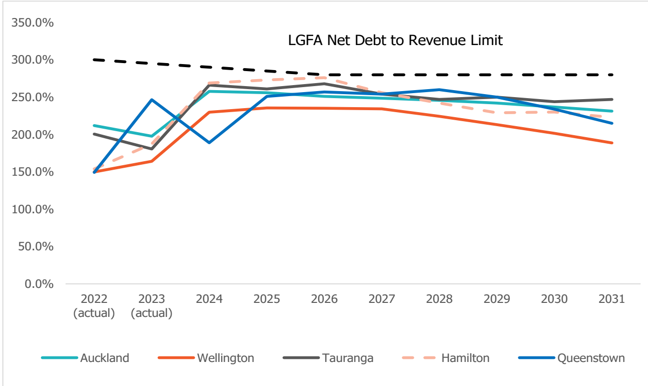


Figure 2B: Estimated select council net debt to revenue ratios in 2021 long-term plans



Source: New Zealand Treasury 2021 Long Term Fiscal Statement, LGFA, Council 2021 long-term plans and Infrastructure Commission analysis.

Can public investment in infrastructure expand our revenue base?

If significant increases in user charge revenue or additional revenue from consolidated funds are unlikely, then the best option available is to invest in infrastructure to grow our revenue base. If we can grow our revenue base, we can generate more revenue from existing charges.

This *Research Insights* report explores the conditions under which new public infrastructure can generate new revenues that can be used to pay back the additional costs of investment. It looks at three case studies on the fiscal returns from new infrastructure investment in different contexts.

First, it examines the fiscal returns from new infrastructure that councils build to service population growth. Second, it examines the fiscal returns from a small number of major transport infrastructure investments that have published business cases that can be used to estimate this. Third, it examines how land value capture tools, like a targeted rate might affect the fiscal returns from major transport projects.

Growth infrastructure pays for itself in some cities, but not others

Councils supply infrastructure, including transport networks, water networks, and community facilities like parks and libraries, to meet demand from population growth. In some places, the cost of providing growth infrastructure is perceived to be straining local government finances. This suggests that increases in their revenue base from population growth may not be sufficient to pay back the cost of the new infrastructure to service growth.

We studied seven large or growing urban councils over a 25-year period to understand whether growth generally paid for growth. To do this, we estimated how much they spent on infrastructure to accommodate population growth, including up-front construction costs and ongoing maintenance, renewal, and operating costs, and how much new revenue they generated from that growth, including development contributions and additional rates revenue on new buildings.

What we found was a nuanced story. Dunedin and Christchurch appear to be able to pay back the costs of growth infrastructure from new revenues, and Wellington seems to get close. However, Auckland, Hamilton, Tauranga, and Queenstown are not likely to recoup the financial costs of their investments from population growth (Table 1). In these cities, part of the cost of growth infrastructure must be paid out of existing council revenue streams.

Table 1: Estimated fiscal cost recovery for council growth infrastructure, 2007–2031, millions of 2023 NZD

	Auckland Council (2012-2031)	Wellington City	Christchurch City	Hamilton City	Tauranga City	Queenstown -Lakes	Dunedin City
Estimated growth costs	$21,427	$873	$2,703	$3,308	$3,280	$1,565	$296
Estimated growth revenues	$9,722	$737	$3,080	$1,156	$1,060	$792	$556
Share of growth costs covered by growth revenues	**45%**	**84%**	**114%**	**35%**	**32%**	**51%**	**188%**

Source: New Zealand Infrastructure Commission's analysis of local government financial data. Auckland data are from 2012 through 2031.

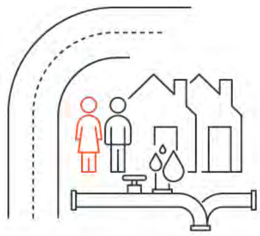
This analysis shows that growth can pay for growth at a council level when:

- **Charges on new development are aligned with the cost of growth infrastructure:** For instance, holding development contribution revenue constant, property rates on new development would have needed to be over 5 times higher in Tauranga and Hamilton, 4 times higher in Auckland, and 2.5 times higher in Queenstown.

- **Asset growth is matched with population growth:** It is easier to make growth pay for growth when population and infrastructure stock are increasing in line with each other – that is, for every 1% increase in population, infrastructure networks should only grow by 1%, or below. Hamilton and Tauranga's investment plans through 2034 suggest that the value of their infrastructure networks will increase roughly 4 times as rapidly as their population.

- **New infrastructure is matched with a lot of private development:** New infrastructure is funded by a combination of development contributions and growth in rates revenue from new development. Development contributions provide an up-front source of revenue while rates provide a long-term flow of funding for maintenance and renewal needs. The number of units determines development contribution revenue, while the value of that development drives rates revenue. Depending upon how much a council relies on development contributions, we estimate that from 2007 through 2031, $30 to $60 of private development would have been required to generate the rate revenue growth to pay for every dollar spent on public infrastructure to service population growth. However, we found that faster-growing councils like Auckland, Hamilton, Tauranga, and Queenstown had private investment levels of around a quarter to half of that level.

Charges on new development are aligned with the cost of growth infrastructure



Asset growth is matched with population growth

New infrastructure is matched with a lot of private development

Selected major transport projects are not expected to pay for themselves

Transport networks are often considered “economic infrastructure”, as investment in transport can increase the movement of people and goods, leading to higher productivity, wages for employees, revenues for businesses. All of these will produce fiscal revenues for central government through increased fuel excise duty, road user charges, income taxes, and GST. In addition, some projects can generate revenues directly from users in the form of tolls or public transport fares. However, while good transport infrastructure can result in higher revenues for public institutions, it is equally possible for the reverse to occur. Projects that do not have enough users or generate enough economic growth relative to the cost to construct, operate and maintain them result in losses that would then need to be funded by local or central government.

We analysed data on whole-of-life costs and benefits for four major transport projects that have published business cases that provide relevant information. Based on this information, we estimate the amount of new tax revenue or user charge revenue that these projects are expected to generate, and compare this against the expected costs to build, maintain, and operate the projects. We compare costs and revenues to understand what share of project costs will be paid back by growth in usage or economic activity.

Based upon the evaluation methods used in each one of these project’s business cases, we estimate that their central and local government funders will receive between 10 and 25 cents in financial return for every dollar that they spend on these projects (Table 2). These may be optimistic estimates, as the costs for some of these projects have increased in delivery stages.

Table 2: Estimated fiscal cost recovery for selected major transport projects (discounted, millions of 2023 NZD)

Project	Base year for analysis	Capital costs	Operational costs	Estimated revenues	Share of costs recovered	Business case benefit-cost ratio
Ōtaki to north of Levin	2018	$1,180	$22	$101–$227	**9%–19%**	**1.2**
Pūhoi to Warkworth	2013	$724	$19	$109	**15%**	**1.1**
Warkworth to Wellsford	2015	$1,007	$36	$93–$110	**9%–11%**	**1.1**
City Rail Link (Crown and Council)	2014	$1,513	$340	$387	**21%**	**1.6**
City Rail Link (Crown only)	2014	$727	$170	$183	**20%**	**1.6**

Source: New Zealand Infrastructure Commission's analysis of published cost-benefit analysis estimates from most current published business cases. Estimated benefit-cost ratios vary from 1.1 (Pūhoi to Warkworth and Warkworth to Wellsford) to 1.6 (City Rail Link). In several cases, costs subsequently rose through delivery stages, meaning that fiscal returns and benefit-cost ratios will be lower in practice. All figures are discounted using the time periods and discount rates used in the business cases.

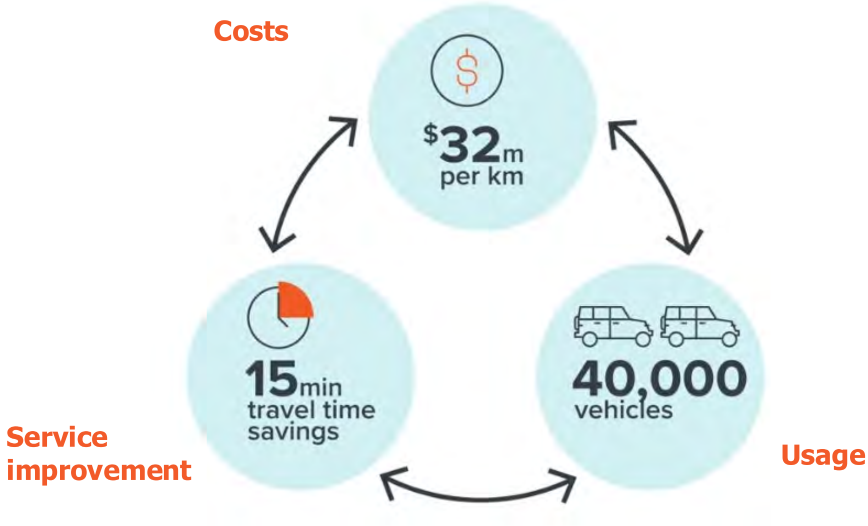
This is a small sample of projects, so caution should be taken when interpreting these results. However, this analysis indicates that the fiscal returns on new transport infrastructure are likely to be higher when:

- **Benefit-cost ratios are much higher than 1:** A strong benefit-cost ratio is more indicative of a project with more benefits, and thus, greater financial returns. However, our analysis suggests that a benefit-cost ratio of just above 1 (indicating that the broader social benefits slightly exceed project costs) is not nearly high enough to guarantee financial return for the government. Our analysis suggests that a project would need a benefit-cost ratio of at least 5, and perhaps as high as 9, to generate enough new revenue to pay back its costs. This is because many of the benefits in a benefit-cost analysis are nonfinancial in nature, such as clean air, noise pollution, and time savings.

- **Projects with more users have higher returns:** Fiscal cost recovery on the Pūhoi to Warkworth motorway is expected to be higher than the Ōtaki to north of Levin and the Warkworth to Wellsford motorways. This is because it carries more vehicles and is closer to its respective major city, meaning that it is more conducive to economic growth. This result is reflected in our previous research on toll roads, which found that greater traffic levels and travel time savings were critical to determining the cost recovery potential for a new road using tolls (Figure 3).

Achieving cost recovery from a toll requires high usage, low costs, and large benefits.

Figure 3: Factors required to achieve 100% cost recovery for a new road using tolls



Source: New Zealand Infrastructure Commission Te Waihanga. (2024a). Buying time: Toll roads, congestion charges, and transport investment.

Value capture potential depends upon population density and project costs

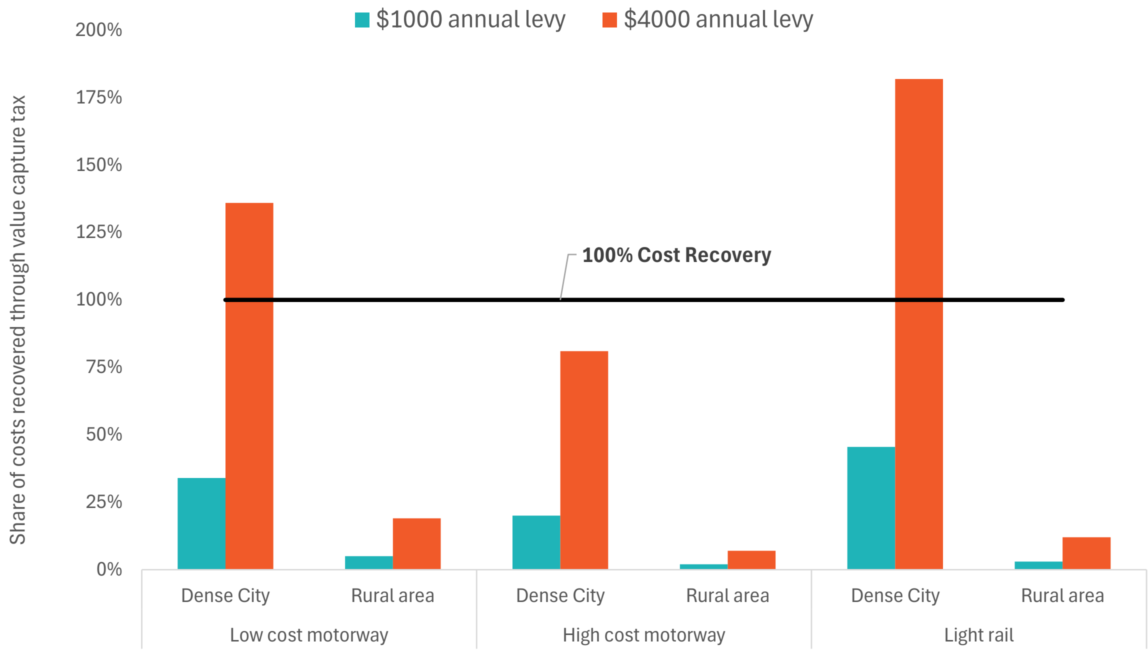
The analysis of local government growth infrastructure and major transport projects is based on current tax settings and existing user charges. However, it is possible that fiscal returns from new infrastructure would be higher if we focused on a tool that could capture the growth in land values, such as a targeted rate or levy.

The benefits of new public infrastructure, especially transport infrastructure, flow through to higher land values. As a result, we show how the fiscal returns change with a complementary targeted rate. We test different scenarios around project cost, characteristics and population density in the area that the project is serving.

We find that value capture can provide meaningful revenue when two conditions are met (Figure 3). First, new infrastructure must be relatively cost-efficient to build. This means that smaller value capture levies are needed to recoup the cost of the project. Second, the area around the project must be densely populated with homes and businesses that can use the project and pay value capture levies to help fund it.

Government resources to spend on infrastructure are increasingly constrained.

Figure 4: Cost recovery potential for a value capture levy for hypothetical infrastructure projects



Source: New Zealand Infrastructure Commission's analysis of hypothetical projects with different cost and benefit profiles, in different types of locations.

Optimising the fiscal returns from new infrastructure projects

Optimising the revenues that we earn from new public infrastructure projects can help us address our infrastructure challenges without needing to increase existing taxes, rates or charges. In this way, we can sidestep the considerable fiscal pressures on local and central government, while still addressing the demand for new infrastructure services. Our research highlights four key lessons for how to maximise revenues from new investment.

1

Project quality matters

Project quality is the most important factor for determining whether new infrastructure can generate enough revenue to pay for itself.

Projects that are cost-effective to build and which serve more users or beneficiaries are more likely to generate positive fiscal returns. Conversely, expensive projects that serve relatively few users will struggle to pay back their up-front costs. This pattern is consistent across different types of projects with different funding tools.

2

The bar is high for projects to fully pay for themselves

Our analysis suggests that cost-benefit analysis can help to identify projects that are likely to have higher returns. Projects with higher benefit-cost ratios tend to also have higher financial returns. Likewise, financial returns from local government growth infrastructure are higher when it serves more new private investment.

In both cases, the bar is high to find projects that can fully pay for themselves. While a benefit-cost ratio over 1 is commonly seen as a threshold for project viability, we estimate that a benefit-cost ratio of at least 5, and perhaps as high as 9, is needed for new transport projects to fully pay for themselves. This is because a lot of the benefits counted in project appraisal do not generate a revenue stream.

Similarly, we estimate that each dollar of local government growth investment must unlock between $30 and $60 worth of new development to fully pay back.

3

Incremental investment tends to have higher returns

Spending a large amount of money up-front does not necessarily mean larger returns. A better approach may be to invest incrementally, expanding networks gradually over time in response to proven demand.

Councils that were able to grow their networks proportionately to population growth were much more likely to come out financially ahead after 25 years. Conversely, major government projects, which represent step change improvements to networks or services, are not expected to pay for themselves.

An incremental approach also enables public infrastructure providers to build a revenue base to deliver projects that don't come with revenue streams, like libraries, events centres, and hospitals, or to support large investments when they are needed.

4

Attaching revenue streams to new projects can help

When we have quality projects that serve demand in a cost-effective way, revenue tools can play an important role in determining how much new revenue we can bring in.

Attaching a revenue stream to an asset ensures the infrastructure provider will have money available to recover up-front construction costs and to fund long-term maintenance and renewal obligations.

For councils, this means considering rates revenue generated from new buildings as well as setting cost-recovering development contributions, development levies or water charges. For central government, this means considering user charges like fuel excise duties, road user charges, tolls, or other ideas like value capture levies, as well as existing taxes.

Introduction

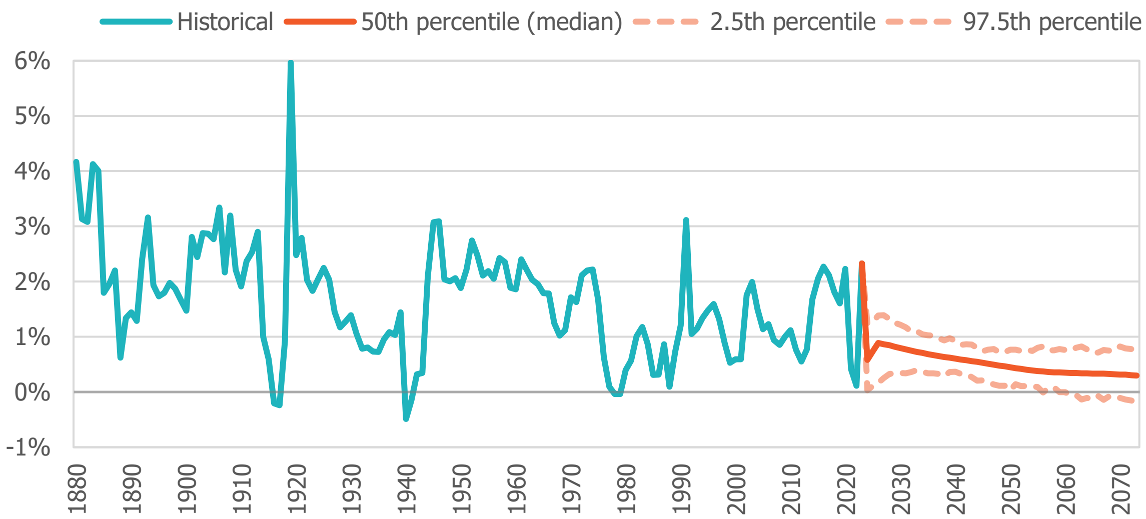
Infrastructure provides many benefits, but it must be paid for

Infrastructure is a series of systems and networks that allow us to be connected, healthier, smarter, and innovative. It is foundational for our wellbeing. Our country clearly understands the value of infrastructure. Since 1990, we've spent about 5.8% of our GDP each year on building, maintaining, and renewing our networks. This is among the highest in the OECD.

Providing infrastructure requires financial resources, not just to build it, but across its entire lifespan, as we maintain and eventually renew it. This is an important consideration as we think long-term about how we meet future infrastructure needs. For example, our ability to pay for infrastructure will depend upon the number of people paying taxes and user charges. Growth is expected to slow over the next 30 to 50 years, which means fewer people to meet maintenance and renewal demands for the infrastructure we build today (Figure 1).

New Zealand's population growth is expected to slow over the next few decades, affecting our ability to pay for infrastructure.

Figure 1: New Zealand population growth rates, historical and projected



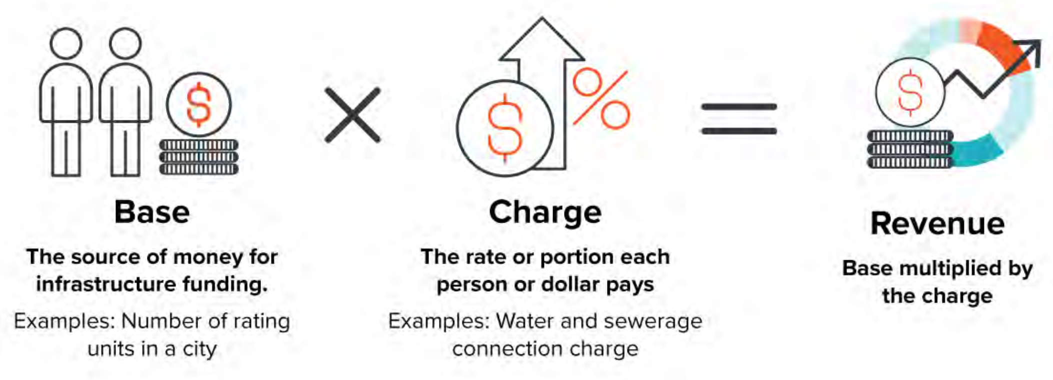
Source: Stats NZ and New Zealand Infrastructure Commission analysis.

In addition to identifying what to build and invest in, it is critical to interrogate how and whether we can meet those needs in a financially sustainable way.

Can we grow our way to more and better infrastructure?

At a high level, how much money we can generate to pay for infrastructure investment is a function of two factors: the **base** from which revenue can be derived and the **charge** that is applied to it. In a business, the base would simply be the customers, and the price would be the charge.

With infrastructure, the base could be as specific as the number of riders on a city's bus system to as broad as the total amount of income generated in the country. The charge is the rate or portion applied to that base, like the price of train tickets or the business tax rate. For example, for a city's bus system, the base is the number of passengers, the charge is the fare they pay. Multiplying these two leads to revenue.



An infrastructure provider may have multiple sources of revenue, directly from users (fares, tolls) or indirectly from general sources (rates, income taxes).

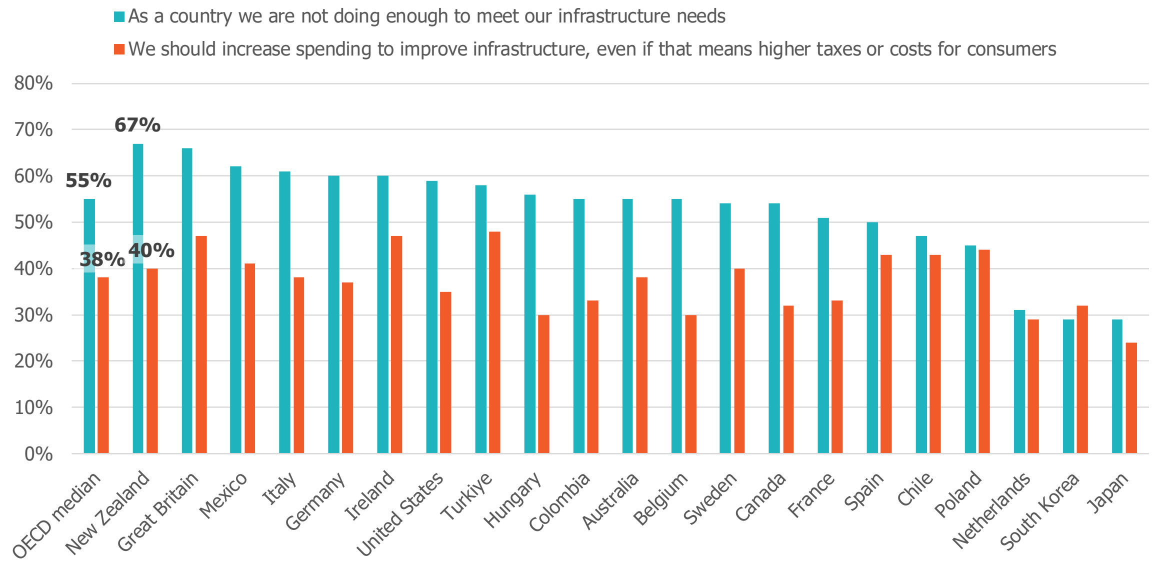
To increase revenue, they have two options.

1. **Raise charges:** For example, to help fund improvements to our public transport, providers can simply raise fares. Similarly, electricity network providers must seek approval from the Commerce Commission to increase rates to fund improvements.
2. **Generate growth in their base:** For instance, a council may invest in a new double decker bus to increase capacity on a route and upzone the areas around stations, and in the process, increase the number of customers paying fares (the base).

Raising charges and rates can be difficult for providers (particularly if their base is not growing) because it means extracting more money from users without a change in their ability to pay. Public infrastructure providers perceive themselves to be in this position and face resistance to increased charges. Public opinion polling shows that a large portion of New Zealanders are resistant to paying higher charges to meet infrastructure needs (Figure 2).

New Zealand wants infrastructure services, but not the costs

Figure 2: 2024 Ipsos Global Infrastructure Index survey on infrastructure needs



Source: Ipsos Global Infrastructure Index, 2024.

As a result, the focus often turns to ways we can increase the base for infrastructure funding sources. If we can increase incomes, economic growth, or population, it will enable us to pay for more infrastructure without significant changes to the level of rates or charges. A rising tide will lift all boats.

Infrastructure can generate economic growth …

There is a large body of research that has found that infrastructure can have a positive effect on a country's economy, and therefore, its base for paying for infrastructure.[1] Infrastructure facilitates the production and provision of goods and services. This in turn can increase wages, productivity, populations, and land values (Haughwout, 2000).

Networks like energy, telecommunications, transport, waste, and water are often referred to as "economic infrastructure" because they keep the gears of our economy turning.

… but growth does not necessarily generate enough revenue

Just because infrastructure generates economic or population growth (an increase to the base) does not mean it will necessarily produce sufficient revenues for infrastructure providers to cover the costs. Consider the example of a local government investing in growth infrastructure to support a new greenfield housing development. The council may cover a portion of the capital cost using development contributions, a one-off fee councils charge for new developments to contribute to the costs of building the infrastructure that supports them.

The new development will increase economic activity in a local area, in the form of more people visiting nearby restaurants or shops. However, local government's main tool for collecting revenue over the long-term is based on the number of properties and their value (rates). It is not directly tied to restaurant or shop spending. If the new development does not contain enough new homes

[1] See Appendix D for a review of this literature.

or generate sufficient uplift in property values or increase the number of businesses (and so business rates), maintaining and renewing the provided infrastructure begins to look more like a financial liability for the council than an asset, where the cost of maintaining the asset is not covered by the additional rating revenue that it created.

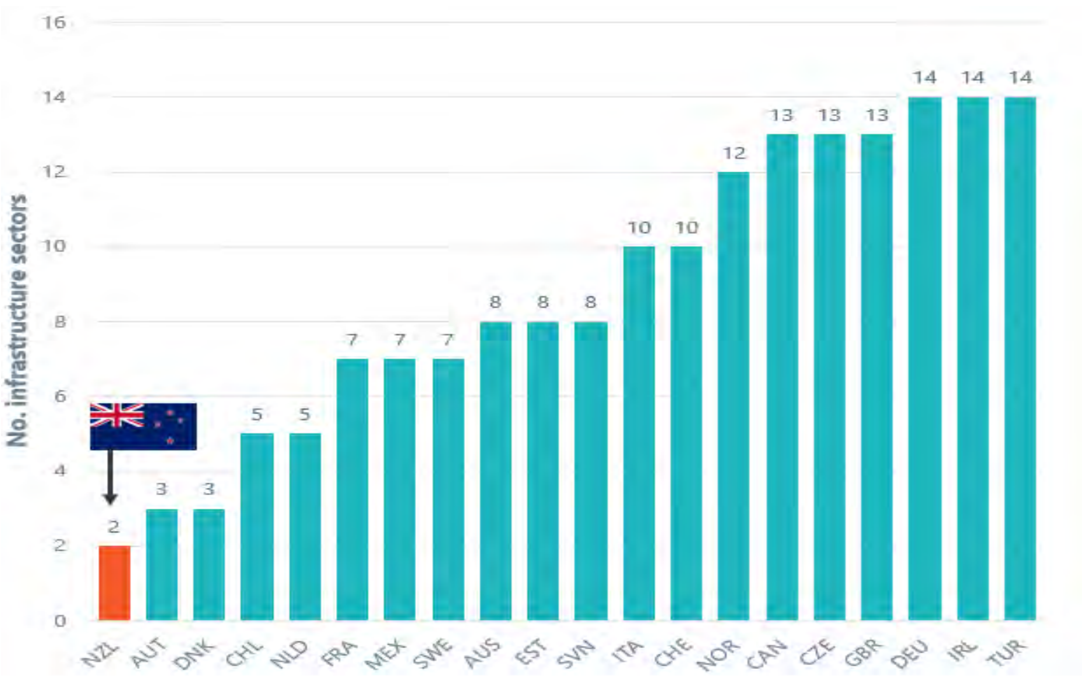
Cost-benefit analysis is often used to evaluate investments

When investing in infrastructure, providers weigh the potential benefits against what it costs to supply it.

For commercial or private providers of infrastructure, this exercise usually puts a large weight on the financial return for the investment, although there are some other factors that may be included. For instance, providers may invest in network redundancy to improve resilience even though the project itself may lose money in isolation. But even then, investment in the reliability of the network can guarantee a stable customer base and attract new customers.

For public infrastructure providers, cost-benefit analysis is a standard approach to understand trade-offs when making an investment. It is a way of bringing together all the benefits and weighs them against the costs. However, New Zealand has a comparatively poor record of properly investigating the economic case for many infrastructure investments. According to the OECD, New Zealand is ranked last in its use of cost-benefit analysis for investment decisions among developed countries (Figure 3).[2]

New Zealand does a comparatively poor job properly evaluating infrastructure projects
Figure 3: Sectors where cost-benefit analysis is usually performed, OECD countries



Source: OECD Governance of Infrastructure survey.

Cost-benefit analysis is useful for understanding whether an investment provides net societal benefit. While this is important, we must also remember that money is needed to build and operate

[2] OECD Governance of Infrastructure Survey: https://infrastructure-toolkit.oecd.org/governance/value-for-money/

infrastructure assets. Societal returns and financial returns for the infrastructure provider are usually not the same thing.

For example, the $1.1 billion Pūhoi to Warkworth motorway's business case estimated that the new road would save users about 10 minutes relative to the untolled route. These travel time savings would be worth about $693 million (in 2023 NZD) to users over the life of the motorway, or 63% of its cost. However, attempts to generate a revenue stream from this benefit would result in a toll that only covers 25% of its cost (New Zealand Infrastructure Commission, 2024a). The additional 'revenue' would need to come from other sources, such as charges levied on people using other parts of the road network or by taxing New Zealanders who may not be using the asset, through general taxation.

For public infrastructure providers, cost-benefit analyses have increasingly incorporated nonmonetizable benefits such as emissions, health, and noise benefits[3]. The inclusion of these benefits means a project might be more likely to be beneficial to society but also reduces the likelihood they will pay for themselves.

We examine the financial returns from new public infrastructure

The societal or economic returns to infrastructure are a necessary condition for an investment to be considered worthwhile. However, in a world of limited fiscal resources, enough of the benefits need to flow through to the provider to adequately fund beneficial infrastructure.

This paper seeks to look one step beyond economic returns to infrastructure by investigating whether our infrastructure investments can produce both economic *and* financial returns for the public. We want to explore whether new infrastructure investment tends to lead to sufficient expansion of the revenue base to pay back the cost of investment.

We approach this question from three angles.

First, we examine local government investment in infrastructure that responds to or enables population growth. There is concern that providing this infrastructure is more expensive than the revenues councils can collect from new developments. We explore this question using a case study approach across seven councils from 2007 through 2031. We identify some common themes and potential rules of thumb about where growth can pay for growth at a local level.

Second, we attempt to calculate the financial returns for a small sample of recent and future large transport investments. If these investments generate significant growth in productivity or populations, we expect to see a financial return that would help cover the project's whole of life costs.

Third, we test whether our results from the first two analyses are simply a function of the existing tax and revenue system. The first two pieces of analysis focus on financial returns through existing local and central government tax and revenue mechanisms. However, much of the literature on infrastructure investment and economic growth has suggested that the benefits of new infrastructure will manifest as increases in land values. We construct a hypothetical model to explore the potential for generating revenues from new land value uplift taxes when new infrastructure is built. By doing so, we can identify the scale of uplift (the base) or the level of charges to enable cost recovery for certain types of transport investment.

[3] See Chapter 3 of the New Zealand Transport Agency Waka Kotahi's Monetised Costs and Benefits manual

The fiscal returns from local government growth infrastructure

Local government is a major provider of infrastructure

New Zealanders use infrastructure owned and operated by local government every day. Local government provides for local roads, water infrastructure, public transport, and other social infrastructure like parks, leisure centres, and libraries. Collectively, this adds up to about 26% of all our infrastructure networks, worth a total book value of $76 billion, excluding land (New Zealand Infrastructure Commission, 2024b).

More than a third of all government infrastructure investment each year is done by local government, an average of $3.8 billion per year since 2002 (New Zealand Infrastructure Commission, 2024b).

Broadly speaking, councils invest in their infrastructure networks for three reasons:

- For renewing existing infrastructure: Ensuring the continued service of locally owned infrastructure consumes a significant amount of council resources.
- To improve levels of service: Councils may choose to make upgrades to their networks that primarily serve existing residents. Examples include adding cycleways, new public transport infrastructure like dedicated lanes, or a new roundabout to improve traffic flow.
- To meet additional demand/growth: New populations put pressure on existing networks, so adding capacity may be required to respond to a growing city. This could include upgrading a wastewater treatment plant that can serve more households.

Each year, councils are required, by law,[4] to report capital expenditure in each of these three categories. Councils generally allocate the expense in categories that describe the primary purpose of a project, recognising there are overlapping components for a given project.

Population growth can provide many benefits to councils…

There are reasons why most cities would rather be growing than shrinking or stagnating. Population growth can lead to greater economic activity in cities, as clustering of people leads to knowledge spillovers and lower transaction costs for businesses, an effect known as agglomeration economies (Glaeser et al., 1992). New businesses form to respond to this growth, bringing a diversity of jobs and rising incomes. Growing and bigger cities are also more productive. The overall vitality of cities improves as a result, leading to greater overall amenity for residents, assuming congestion costs from growth are less than its benefits.

The other benefits are financial. Population and housing growth enables councils to spread the costs of infrastructure provision and services across more households. More residents might also come with net higher revenues if there are scale economies to providing services or if the marginal cost of providing these services to new residents is less than the additional revenue.

[4] See Local Government Act 2002 Amendment Act 2010.

...but it can also be costly

Growing populations can put pressure on existing council infrastructure. This can take the form of congestion on road networks or capacity issues on waste water networks. Councils respond to this by building new infrastructure or upgrading existing infrastructure to increase capacity, both of which require significant council resources.

Across the three categories of capital expenditure, faster-growing councils are committing a greater share of their capital budgets to accommodate growth. This is compared to slower growing councils, which are committing a greater share of their resources to renewing their existing networks (**Table 1**).

Growing councils spend more of their capital budgets on growth infrastructure

Table 1: Population growth and investment types for select councils from 2013 to 2023

Local Authority	Population Growth Since 1996	Share of capital investment allocated to...		
		Growth	Renewals	Increasing levels of service
Auckland	52%	27%	36%	37%
Hamilton City	58%	41%	19%	40%
Tauranga City	95%	38%	18%	44%
Wellington City	27%	5%	51%	44%
Christchurch City	21%	12%	71%	18%
Queenstown Lakes	141%	36%	29%	35%
Dunedin City	8%	5%	65%	31%

Source: New Zealand Infrastructure Commission's analysis of Stats NZ 1996 and 2023 census data and council annual reports.

Beyond the need for more physical infrastructure, additional residents increase demand on existing operating services. More people using city parks necessitates greater park maintenance. It may require additional staffing of facilities.

Finally, as a city grows, residents may like to spend some of the benefits of growth on more infrastructure services and amenities that do not necessarily provide direct revenues.[5] While these may be more discretionary investments unlike a core piece of infrastructure, elected officials responding to residents may feel it important to accommodate these projects.

Providing infrastructure for population growth is putting fiscal pressure on councils

For the fastest growing councils, the demands of population growth can strain council finances. According to data from 2024 long-term plans, councils are preparing to spend almost $24 billion on infrastructure over the next 10 years just to respond to growth pressures. Increased council borrowing for infrastructure has also resulted in the fastest growing councils approaching their borrowing limits (New Zealand Infrastructure Commission, 2024d).

Putting these additional costs onto ratepayers on top of competing priorities can be difficult politically. Councils in the past have reported that the financial pressures of growth infrastructure

[5] This is the result predicted by Arnott and Stliglitz (1979), as well as an updated model by Parker (forthcoming).

have resulted in them not investing in infrastructure or at least taking a cautious approach. A 2015 New Zealand Institute of Economic Research survey of councils found that the cost of growth infrastructure was a very important factor in the rate of residential development they permit (New Zealand Productivity Commission, 2015). This had led some to argue that councils are not incentivised to permit new housing growth.[6]

As a result, many councils try to adopt a "beneficiary pays" approach, where growth infrastructure is paid primarily by new residents and landowners. For the past few decades, this has been done using development contributions, although going forward, these will be replaced by levies on new development. Councils who adopt a beneficiary pays approach for infrastructure can also use targeted rates.

Do the revenues from growth cover the additional costs over a long period of time?

Council expenses to meet population growth and the revenues they receive from it are asynchronous:

- Councils incur large up-front costs to build infrastructure and then pay to operate and maintain that infrastructure.
- Councils collect development contributions when development occurs. They then also receive the incremental rating benefit of new development over a long time.

If councils perceive that growth costs exceed growth revenues, we need to determine whether there is *financing* problem, where costs and revenues are not aligned, or a *funding* problem, where revenues will never cover costs.

To answer this question, we studied whether revenues from new development will cover the costs of growth investment in seven selected councils over the 2007 to 2031 period: Auckland,[7] Wellington, Christchurch, Hamilton, Tauranga, Queenstown, and Dunedin.[8] All of these cities are growing, but at varying rates. Auckland, Hamilton, Tauranga and Queenstown are fast-growing councils investing significant amounts to accommodate growth. Wellington, Dunedin, and to a lesser extent, Christchurch, are growing comparatively slowly.

Once we determine whether growth revenues matched growth costs for these councils, we explore explanations for why or why this could be the case. Building upon these explanations, we estimate some benchmarks to help us understand the level of council investment in infrastructure or development required to make growth pay for growth.

[6] https://www.nzinitiative.org.nz/research/housing-and-local-government/

[7] For Auckland Council, we studied the period 2012 through 2031, since Auckland Council was formed in 2010.

[8] We selected these cities as they were either the fastest growing larger local authorities or the largest populations. Some have unique characteristics that may skew our results, including Christchurch, which was rebuilding post-earthquake during our period of study, and Queenstown, which has a rapidly growing residential population but which is also adding a significant number of holiday homes and accommodation units.

Our approach to estimating financial returns to growth infrastructure

Previous work showed that growth can pay for growth, at least in theory

For a council that is focused on making new development pay for the costs of new growth infrastructure, the question is whether the monetary benefits from growth can sufficiently cover costs. This debate has primarily centred around the capital costs of growth infrastructure although as noted, new residents can impose a variety of other costs on a council.

We are aware of two studies that have attempted to answer this question:

- A 2016 report prepared for the New Zealand Productivity Commission by SGS Economics found that council revenues from growth could indeed cover infrastructure costs for Auckland. It estimated the costs to service new development using a sample of 12 developments drawn from a Centre for International Economics report for Auckland Council report on the costs to service growth (SGS Economics, 2016).

- A separate 2016 report from Morrison Low commissioned by the Ministry of Business, Innovation and Employment created a development contribution model to determine whether revenues could cover growth costs for five councils.[9] The report found that revenues could, in theory, cover the cost of growth over certain periods of time. However, it noted that the councils they studied set their charges well below those in their model, so growth did not pay for growth in practice.

Both these studies are useful to understand whether councils could, in theory, cost recover growth infrastructure using revenues from new development. Our work is additive to these studies because we use actual data. Our work accounts for key factors that could have changed since 2016, such as rising infrastructure construction costs or changing requirements for councils to provide infrastructure in advance of growth, both of which anecdotally have had a meaningful impact on council growth investment.

An overview of our approach and methodology[10]

Council revenues from growth

For our analysis, we focus on two main sources of revenue from growth.

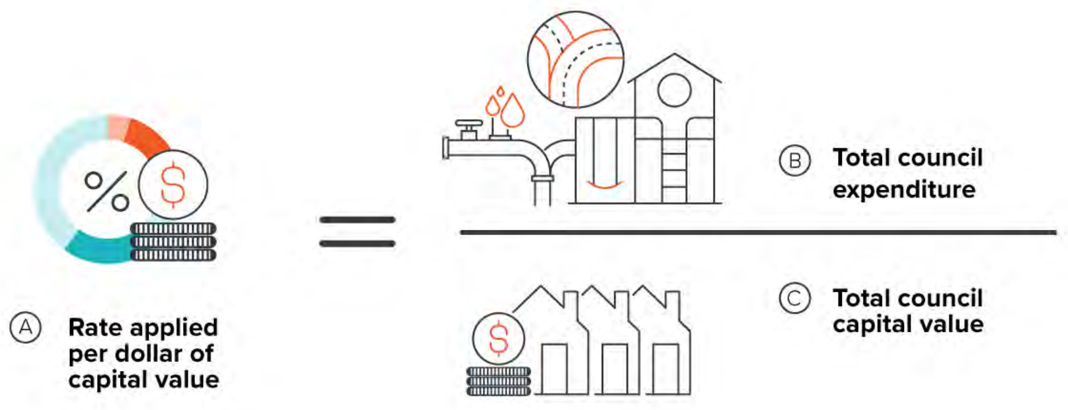
The first is fees the councils charge directly to developers in the form of development or financial contributions.[11] Information on development and financial contribution revenue is available from Stats NZ and council documents. Development agreements can also be material, but information on their use and scale is not publicly available, so we exclude them.

The second source of revenue we examine is the revenue generated by new development through rates. New development leads to a rate revenue benefit for councils. The way councils generate revenue from rates is by setting council expenditure and dividing it by the amount of property value in the council. This sets a "rate in the dollar" tax rate that is applied to the relevant property

[9] See Box 11.2 of New Zealand Productivity Commission, 2015.

[10] A full discussion of our approach, methodology, and assumptions is available Appendix A.
[11] There are three mechanisms by which councils can earn revenues directly from developers. The first are development contributions through its long-term plan (LTP). The second are financial contributions under the Resource Management Act. The third are development agreements, which are ad hoc agreements made with individual developers who propose development not aligned with the council's infrastructure plan or LTP.

type. For example, if a city paid for all its expenditure with one rate applied to all property types, the rate applied to any given property would be:



The rates obligation for an individual home or business is the resulting rate (A) multiplied their own capital value. Total council rate revenue is the rate applied to each property (A) times the total council capital value (C), or, alternatively, total council expenditure (B).

New development increases total council capital value (C). Holding total council expenditure (B) constant, the rate applied to individual property values will fall, and therefore, the rates paid by individual property owners.

Alternatively, if total council capital value (C) increases because of new development, council can increase expenditure (B) without having to change the rate (and therefore tax liability) of individual property owners. This rating benefit could in theory be used to offset growth costs, but it could also manifest in rate cuts or additional operational expenditures.

To calculate this rating benefit, we need to estimate two parameters: the amount of new development added to the council rating base (C), and the rate applied to properties in each council (A). Multiplying these two together is the rating benefit of new development.

To estimate the value added to the city's rating base, we use the value of new and altered building consents (for both residential and non-residential property) added each year. When a building is constructed on a parcel, the improvement value adds to the city's rating base (C).[12] This is a somewhat imperfect measure for increases to the rating base and caveats apply. These are more thoroughly discussed in Appendix A.

We calculate the rate applied to properties in each council using data on the councils' total capital value (C) and its total rates revenue, which as we showed above, is approximated by council expenditure (B). Councils often apply a higher weight the tax rate for businesses than residential property, so we do the same for our analysis.

Our analysis omits two sources of revenue for councils related to growth. The first is new user charge revenue, outside of development contributions, such as parking revenues, public transport fares, and building consent revenues. We omitted these because attributing growth in these revenue sources specifically to new residents is not possible.

[12] Parcel in this context refers to the plot of land delineated by property boundaries.

The second is capital grant revenue received by councils, primarily from the NZ Transport Agency Waka Kotahi (NZTA) for transport projects. This is for two reasons:

- Data availability on these types of grants is not easily available. Moreover, our analysis is primarily concerned about spending (and revenues) from growth, and these grants are generally not categorised by purpose (growth, level of service, or renewal) in the same way as capital expenditure.

- The goal of our analysis is to estimate returns that growth can generate for councils. Councils receive grants from NZTA for transport expenditure, but the revenue for these grants is not directly tied to the growth itself (i.e., new development). Rather, it is a subsidy from other beneficiaries, namely, vehicle users elsewhere in the country. If we were to count NZTA capital grants as a revenue, it would be overstating how much growth actually paid for growth.

Council growth costs

Our analysis attempts to measure four separate council costs to servicing population growth.

The first is the capital costs of growth infrastructure councils build themselves. As noted, councils are required to report how much money they spent and will spend on capital works to meet additional demand in their annual reports and long-term plans (LTPs).

The second is the annual maintenance and renewal cost of the installed growth infrastructure. Councils have this obligation on the infrastructure they build themselves, but also when a piece of infrastructure is built by a developer and "vested" to them. We estimate this as 3.5% of non-depreciated investment cost each year, based upon previous research by the New Zealand Infrastructure Commission.[13] This level of expenditure should be interpreted as the minimum. Infrastructure renewal costs are often higher than depreciation expense for a variety of reasons, such as changing engineering and safety standards and construction cost increases.

The third is the additional growth-related operating expenditure of councils. This is operating expenditure beyond depreciation and maintenance needs. For example, this could include increased rubbish collection or administrative services. We estimate this by estimating a per capita figure for non-capital related expenditure by councils and applying it to the number of new residents in each council.

The fourth is financing costs. Councils usually borrow for growth infrastructure, incurring financing costs. We estimate this cost by calculating interest payments on council capital expenditure on growth infrastructure (the first cost noted above), assuming a 20-year financing period.

Time frame studied

For most cities in our model, we examine a 25-year period from 2007 through 2031, except for Auckland Council which starts in 2012. Prior to 2024, most years are actual spending on growth investment, and if they are not, they are drawn from long-term plans. Beyond 2023, these are estimates from council's 2024 10-year long-term plans.

[13] See Appendix C for a detailed explanation of how this figure is calculated.

A 25-year time frame was chosen because of data availability, but such a long period helps to overcome cyclical periods of investment and development. In theory, the payoff of an asset should match or be shorter than the useful life of the asset.[14]

To answer the question of whether growth pays for growth, we compared the net present value of growth revenues to initial growth infrastructure costs and future maintenance costs, using a 2% real discount rate. Note that in this analysis, we do not include spending on improving levels of service.

Growth infrastructure pays for itself in some cities, but not others

Table 2 shows our estimates for total costs these councils incurred to accommodate population growth, relative to the total revenues they received for the entire study period, which for most councils is 2007 through 2031, but for Auckland is 2012 through 2031. We also provide our estimate for total population growth that occurred over the same period.

Because we omit capital grants from NZTA, these figures are not what councils directly recover for growth-related expenditure, but a measure of long-term financial return for infrastructure investments. Including capital grants would raise the financial return.

[14] Based upon New Zealand Infrastructure Commission (2024b), key local government assets like water, waste, and roads have had estimated depreciation rates between 2.5% and 3.5% since 1990, which is suggestive of modestly longer asset life than 25 years. The use of the 25-time period was primarily for data availability reasons.

Table 2: Total growth costs compared to growth revenues, 2007–2031

	Local Authority (millions 2023 NZD)						
	Auckland (2012–2031)	Wellington	Christchurch	Hamilton	Tauranga	Queenstown	Dunedin
Estimated Growth Costs							
Growth investment	$13,098	$443	$1,344	$2,013	$1,817	$859	$105
Depreciation and maintenance expense (Growth capex and vested assets[15])	$2,970	$108	$538	$404	$492	$249	$46
Additional operational expense	$1,911	$189	$341	$297	$306	$162	$110
Finance costs on growth investment	$3,448	$132	$480	$594	$665	$296	$36
Subtotal growth costs	**$21,427**	**$873**	**$2,703**	**$3,308**	**$3,280**	**$1,565**	**$296**
Estimated Growth Revenues							
Rate revenue benefit	$3,816	$662	$2,508	$456	$483	$438	$507
Developer contributions and growth charges	$5,906	$75	$573	$699	$578	$338	$49
Subtotal growth revenues	**$9,722**	**$737**	**$3,080**	**$1,156**	**$1,060**	**$792**	**$556**
Share of growth costs covered by growth revenues	**45%**	**84%**	**114%**	**35%**	**32%**	**51%**	**188%**
Estimated population growth over study period	33%	23%	20%	47%	56%	122%	14%

*Notes: * Auckland data are from 2012 through 2031. Capital value growth from 2023–2031 averages 2% per year in Dunedin, 3% in Wellington and Christchurch, and 5% in others. Maintenance and renewal expense is estimated as 3.5% of non-depreciated asset value per year. Value of building consents is assumed as a constant historical (2013–2023) share of capital value from 2024 to 2031. Figures are net present value (NPV) with a discount rate of 2%.[16] Sources: New Zealand Infrastructure Commission's analysis of council annual reports, plans, long-term plans, and Stats NZ.*

Over the 25-year period, we find that growth costs were covered by growth revenues in Christchurch and Dunedin and to a lesser extent, Wellington. Council growth investment is not likely to be covered by growth revenues in Auckland, Hamilton, Tauranga, and Queenstown.

We make two general observations. First, councils that matched growth revenues with growth costs tended to rely more on the rating benefit from growth, as opposed to development contributions. Figure 4 shows the rating benefits share of growth revenues for the respective councils. Dunedin, Wellington, and Christchurch had growth revenues that closely or fully matched growth costs, and most of their growth revenues came from growth in their rating base.

[15] Vested assets are "assets transferred to a local authority as a result of a subdivision or development and for which the local authority has given no consideration or reduced consideration in exchange for the asset", Local Government (Financial Reporting and Prudence) Regulations 2014.

[16] Per Treasury's 2024 updated discount rate policy.

Councils that matched growth revenues with growth costs tended to rely more on rates than development contributions.

Figure 4: Rating benefit's share of total growth revenues, by council, 2007–2031

Sources: New Zealand Infrastructure Commission's analysis of council annual reports, Stats NZ population estimates.

Second, growing councils tend to have growth costs that are significantly higher, even when we control for their population growth. Figure 3 shows the same information as Table 2, but normalises growth costs and revenues by the estimated number of new residents over the study period. What we see is that Tauranga, Hamilton, Queenstown and Auckland have growth costs that are, on average, 30% higher than those in Christchurch, and over 2.5 times higher than Wellington and Dunedin.

Growing councils have significantly higher growth costs even when controlling their growing populations

Figure 5: Estimated total growth costs and growth revenues per new resident, 2007–2031

Sources: New Zealand Infrastructure Commission's analysis of council annual reports, Stats NZ population estimates.

What explains the difference between cities?

The previous section determined whether growth-related costs were matched by growth revenues in the seven councils we studied. We found that growth-related costs varied significantly between councils, even when we controlled for different growth rates. This section explores various possible reasons.

Do councils respond to growth in a cyclical way?

One possible explanation for the variation in growth costs between councils could be that councils meet infrastructural demands from populations over the medium term, rather than responding in any given year. They could do this either by adding capacity to their networks in excess of immediate demand population growth or by responding slowly and then catching up over a short window of time. In either case, we would expect to see cycles of investment, with large investment periods followed by slower periods, or vice versa.

However, in places like Auckland, Hamilton, and Tauranga, inflation-adjusted growth investment is expected to increase rapidly and continually for two decades, from 2013 to 2031 (Figure 6). If there is a cyclical pattern to growth investment, the window of time for balancing investment relative to population growth appears to be longer than the 25-year period we are examining.

Growth councils do not appear to be investing in infrastructure in a cyclical pattern

Figure 6: Capital investment to meet additional demand in Auckland, Tauranga and Hamilton, in 2023 NZD

Sources: New Zealand Infrastructure Commission's analysis of council annual reports and LTPs.

Is accommodating growth in low-density areas driving higher costs?

One possible explanation for higher growth costs in growing councils could be about where and how cities accommodate growth through their urban form. Research suggests that infrastructure servicing costs are higher in less dense areas.[17,18] It is possible that cities that are accommodating growth in greenfield or less dense areas will need to supply more new infrastructure than areas that accommodate growth in denser areas with existing infrastructure.

To test this, we isolate the portion of growth costs that are only the capital expenditure by councils and control for growth in populations. We then compare this to the share of new dwellings that were consented in low density areas, defined as having a density of less than 10 people per hectare.

What we find is that for the high-growth councils, we see some evidence of economies to density in providing growth infrastructure. For example, Auckland, whose population has grown at roughly the same pace as Hamilton's, recovers a noticeably higher share of growth costs than Hamilton. This aligns with some of the findings from our recent report on Auckland's infrastructure (New Zealand Infrastructure Commission, 2025).

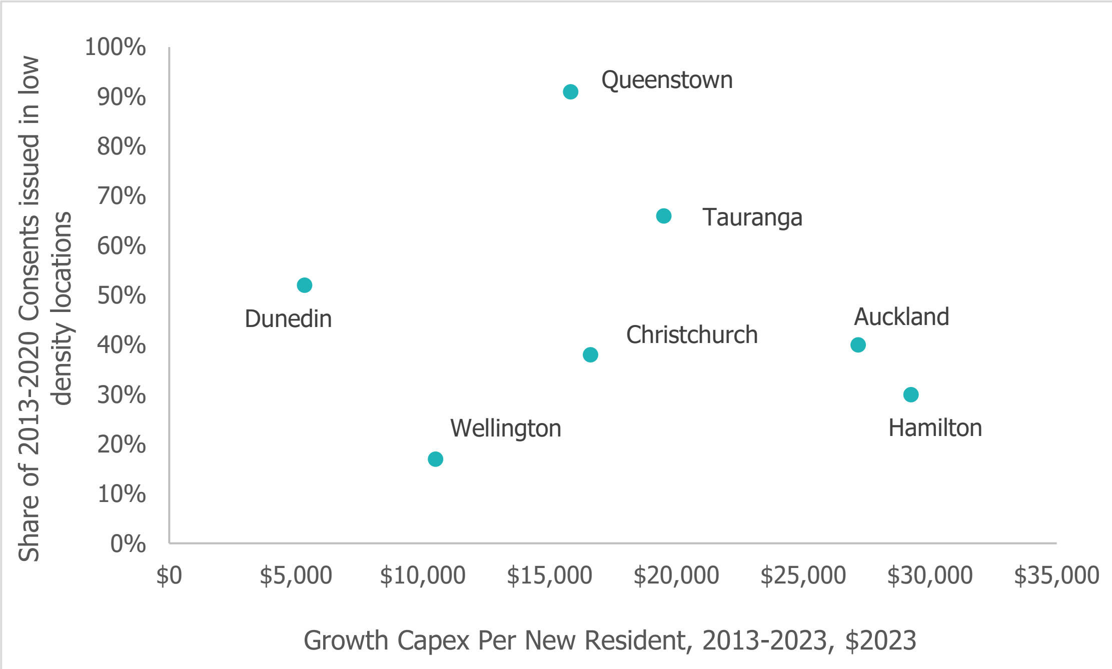
However, we do not see an immediate relationship between council development in low density areas and growth costs. Councils that consented a larger share of new development in less dense areas (such as greenfield areas) did not clearly have higher growth infrastructure costs per new resident (Figure 7).

[17] Infrastructure Victoria, 2023.

[18] Sense Partners, 2024.

There does not appear to be a clear link between higher growth costs and councils consenting in low-density dwellings.

Figure 7: Growth infrastructure expense per new resident versus share of consents issued in low-density locations, 2013–2023



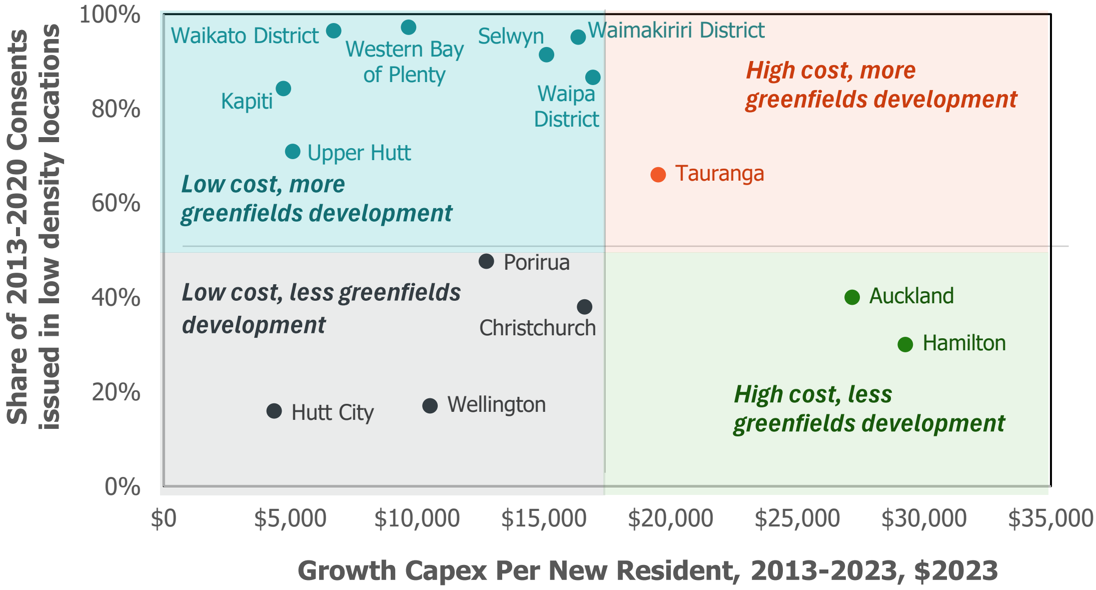
Note: A low-density area is defined as fewer than 10 people per hectare, as measured in 2007.
Sources: New Zealand Infrastructure Commission's analysis of council annual plans, LTPs and Stats NZ data.

We then expand our sample of councils, since the cities in our sample are parts of a larger labour market area. For instance, Wellington City is only one city in the greater Wellington area. After including all Tier 1 areas, we reach the same conclusion.

We do, however, see that growth costs per new resident are similar within regional areas. For instance, Upper Hutt, Kāpiti, Porirua, Hutt City, and Wellington all have lower growth infrastructure costs per new resident, while the areas around Christchurch all have similar growth costs (Figure 8).

We do not see a clear link between council growth costs and more consents in low density places for wider labour market areas.

Figure 8: All tier 1 councils: growth infrastructure spending per capita versus the share of consents issues in low-density locations, 2013–2023



Note: A low-density area is defined as fewer than 10 people per hectare, as measured in 2007.
Sources: New Zealand Infrastructure Commission's analysis of council annual plans, LTPs and Stats NZ data.

It is possible that the time period studied could affect the results of this analysis. We cannot rule out that density has no effect on costs, only that there is not an immediately clear relationship between high growth costs and very low-density development. A deeper look into this question could be an area for future research.

Do councils with infrastructure capacity tend to spend less?

Another hypothesis is that councils that have capacity on their networks should, in theory, be able to spend less in aggregate to accommodate new growth.

As part of Housing and Business Development Capacity Assessments prepared by councils, there is information available on where councils think there is capacity on their network. For example, Auckland's assessment from 2023 showed that there were wastewater capacity issues in much of the inner isthmus in the short-term (0–3 years), but this would be relaxed by the completion of the Central Interceptor in the medium and long term.[19,20] The level of information on infrastructure capacity in Auckland appears to be an outlier.

Rules of thumb for making growth infrastructure pay

Is there any way to know *beforehand* whether planned growth investment for councils is going to be financially sustainable without significant increases to charges? Our analysis points to two potential rules of thumb.

[19] See pages 69 onwards of Auckland Council, 2023.

[20] https://www.watercare.co.nz/builders-and-developers/consultation/network-capacity-in-auckland

The change in infrastructure stock relative to population growth

Responding to population growth is difficult, not only because population growth is difficult to predict, but also because growth can be concentrated in certain areas that put pressures on existing networks.

While we don't know what the ideal approach to addressing population growth is for a council, we do know how countries have generally expanded their infrastructure stocks in response to population growth in the past. Our September 2024 *Paying it Forward: Understanding our long-term infrastructure needs* report[21] examined the relationship between population growth and infrastructure investment across 87 countries, including 30 OECD countries from 1960 to 2022. We found that a 1% increase in population growth has corresponded to an increase in public capital stocks of roughly 0.8%, very nearly a 1-to-1 ratio.

In Table 3, we compare the growth in asset bases[22] in public capital stocks excluding land for our studied councils, ordered by the projected population growth.[23]

This analysis shows that on a non-depreciated basis, the high-growth councils plan on making significant additions to their asset bases in response to projected population growth over the next 10 years. For some councils like Tauranga and Hamilton, the ratio of network growth to population growth is well above 2, while Auckland and Queenstown are just under.

Table 3: Council growth capex in response to population growth, 2023–2033, in 2023 NZD

Local Authority	Public capital stock excl. land in 2023 ($m)	Spending on growth investment 2023-2033 ($m)	Increase in stock without depreciation, 2023-2033	Projected population growth, 2023-2033	Ratio of infrastructure stock growth to population growth
Queenstown Lakes	$2,774	$745	27%	14%	1.9
Auckland	$49,658	$11,080	22%	14%	1.6
Tauranga City	$4,097	$1,281	31%	8%	3.9
Hamilton City	$4,150	$1,858	45%	11%	4.0
Christchurch City	$13,883	$561	4%	12%	0.3
Wellington City	$6,824	$550	8%	9%	0.9
Dunedin City	$3,215	$78	3%	3%	1.0

Note: Estimates of growth investment are for 2023 through 2031 for Dunedin, as 2024 LTPs are not available.
Source: New Zealand Infrastructure Commission's analysis of council annual reports, 2021 and 2024 LTPs, Stats NZ Local Authority population projections.

The slower growing councils, on the other hand, display a ratio of network growth to population growth that is much closer to 1. We also know that these councils were also more likely to make their growth investments be financially sustainable over the 2007 to 2031 period. This suggests that

[21] New Zealand Infrastructure Commission, 2024c.

[22] The figures in Table 3 show asset growth on a non-depreciated basis. Over the 2023 to 2033 period, growth investments over the period will depreciate to a certain extent. For simplicity, and since the time frame is relatively short (10 years), we assume the increase in assets is proxied by the 2023 level of assets plus additional growth expenditure planned.

[23] This is a wider definition of infrastructure assets than found in our *Build or maintain? New Zealand's infrastructure asset value, investment, and depreciation, 1990–2022* report (New Zealand Infrastructure Commission, 2024b). That definition excluded items such as park improvements, marinas, library books, art, and heritage assets.

a council wanting to make growth pay for growth should aim to keep this ratio as close to 1 or lower as possible.

The ratio of private investment to infrastructure investment

Our analysis has highlighted that the amount of money a council spends on growth infrastructure must be matched by both development contribution revenue and long-term rates revenue to be financially sustainable for the council.

For instance, in inflation-adjusted terms, we estimate that Tauranga built over $1.2 billion of growth infrastructure from 2007 through 2023. The estimated improvement value added to the city's rating base (measured by the value of building consents) totalled about $12.2 billion over the same period. This means that for every $1 on growth capex it spent was matched by an increase in the value of its rating base of $9.60 (Figure 9).

While this sounds like a good investment, consider that rate revenue (the long-term funding source for infrastructure) for a council is approximately 0.3%[24] of property value each year. As a simple example, suppose Tauranga installed $100 million of growth infrastructure to leverage $960 million worth of development. Over a 20-year period, the rate revenue from this development would only total about $58 million. And this does not even account for the required maintenance and renewal costs, finance costs, or other operating costs associated with that $100 million.

We estimate that effective tax rates on new development would have needed to be almost 6 times higher for residential and non-residential properties in Tauranga to make growth pay for growth along with its revenue collected from development contributions. In Auckland, rates would have needed to be 4 times higher. In Hamilton and Queenstown, rates would have needed to be 4 and 2.5 times higher, respectively.[25,26]

Figure 9 shows the ratio of non-infrastructure (mostly private) investment, as proxied by the value of building consents issued, to the total amount of growth infrastructure investment made by councils in our sample cities from 2007 through 2023. Councils that had a higher ratio were much more likely to match growth revenues with costs.

[24] In Tauranga, we estimated an average effective tax rate of property value of approximately 0.3%.

[25] In Hamilton, this is largely because of the choice to rate based only upon land value from 2007 through 2015, which means the benefit from development was largely only from subdivision (the number of ratable parcels), rather than building improvements to land (and so the tax generated from each dwelling).

[26] Details of these analyses can be found in Appendix A.

Councils that had significant development relative to their expense on growth infrastructure were more likely to match growth revenues with costs

Figure 9: Ratio of the real value of building consents to council capital expense on growth infrastructure, 2007–2023

Sources: New Zealand Infrastructure Commission's analysis of council annual plans, LTPs, and Stats NZ data.

To make growth investment financially sustainable, the amount of private investment required will depend upon the revenue tools the council uses. While both rates and development contributions are associated with new development, a council that relies more on development contributions will require more physical units to be built than adding development of a specific dollar value, while a council that uses mostly general rates to pay for growth will rely more heavily on increases to its rating base in dollar terms. This is particularly the case if there is a large differential between residential and non-residential rates.

Using the analysis from Table 2, we ask the question: "How much value would have been required for each city's rating base (as proxied by building consents) to make growth pay for growth?". We do this by simulating growth in building consents over the 2007 through 2031 period so that the total revenues from growth equalled expense on growth investment.

Charges on new development are aligned with the cost of growth infrastructure

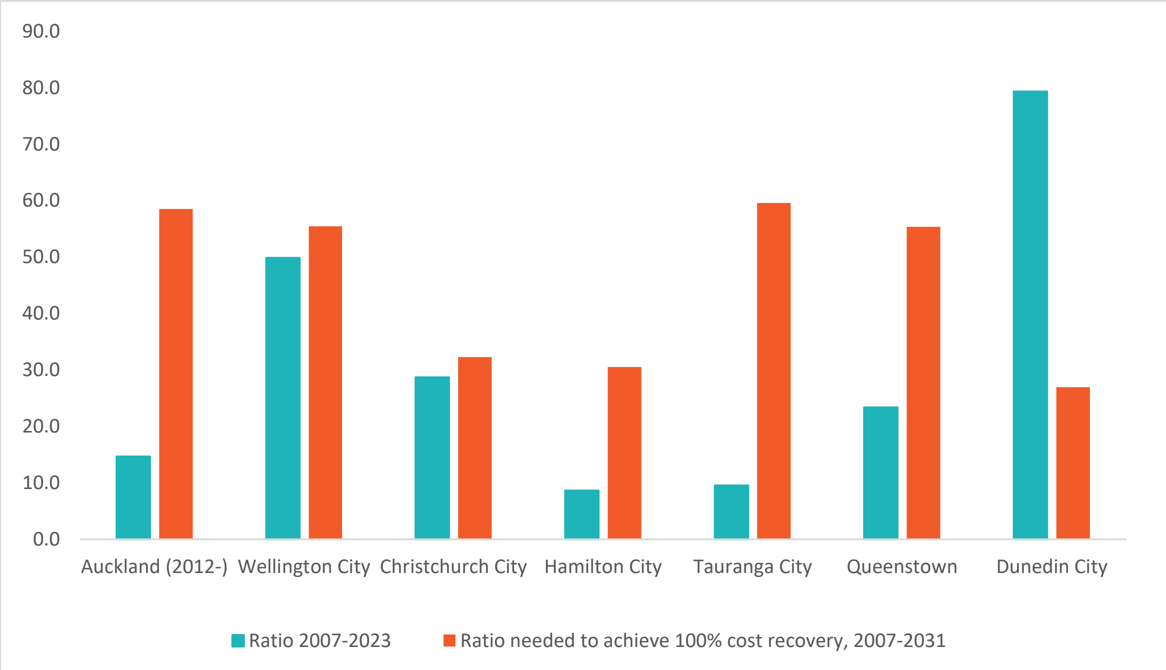
Asset growth is matched with population growth

New infrastructure is matched with a lot of private development

For the years 2007 through 2031, holding growth infrastructure expense constant, we estimate that to make growth pay for growth, roughly $30 to $60 worth of development would have been required for every dollar of public investment in growth infrastructure, depending upon how much the council relies on rates versus development contributions[27,28] (Figure 10). This analysis suggests that to make growth pay for growth in places like Hamilton, Tauranga, and Auckland, the level development needs to be significantly higher than what it was historically (from 2007 through 2023) to cover costs.

Councils would have needed anywhere between $30 and $60 worth of development for every $1 they spent on growth infrastructure to make growth revenues match costs.

Figure 10: Estimated ratio of private to public investment required to make growth pay for growth from 2007 to 2031



Note: Future capital value growth for both residential and non-residential property from 2023–2031 is projected as 2% per year in Dunedin, 3% in Wellington and Christchurch, and 5% in others. The future value of building consents (2023–2031) is assumed as a constant historical (2013–2023) share of capital value.
**Hamilton's ratio includes consents from 2007 through 2015, even though the council received little rating benefit from improvements to land directly because its rates were based upon land values.*
Source: New Zealand Infrastructure Commission's analysis of Stats NZ data, council annual reports and LTPs.

The optimal ratio will depend upon the council and these figures should only be used as a rough guide. They provide a benchmark for understanding potential financial returns for council. For instance, if a council were planning growth investments on par with total private investment (i.e., a 1 to 1 ratio), unless it was able to collect a significant development contribution, it would be unlikely to make such an investment financially sustainable in the long term.

Finally, it is important to note that this is solely the requirement to pay infrastructure in response to population growth. Councils also invest significant amounts on infrastructure to improve levels of service. Ensuring the required private investment to generate rating benefit for those investments is in addition to the figures above.

[27] Alternatively, one could consider this ratio as the amount of private investment required to keep average city-wide rates the same while accommodating the required expenditure on growth investment.

[28] Additional details on this calculation are described in Appendix A.

The fiscal returns from major transport investments

Our transport network consists of state highways, local roads, rapid transit lines, freight and passenger rail, and airports. It is our single largest network by value, worth over $75 billion NZD. The majority of this is roads, with state highways valued over $37 billion and local roads valued at over $30 billion (New Zealand Infrastructure Commission, 2024b).

We commit more of our infrastructure budgets to transport investment than to any other network. Between 2003 and 2022, total infrastructure investment averaged 5.8% of GDP. Over a fifth of this was investment in transport infrastructure. Investment in state highways and local roads equalled 0.5% of GDP each, and investment in rail and other transport infrastructure was 0.2% of GDP (New Zealand Infrastructure Commission, 2024b).

Our transportation networks connect us to family, friends, workplaces, and amenities. Minimising the costs of connecting with these aspects of our lives improves our wellbeing.

We also invest in transport networks because of its effect on our economy. Our transport networks are foundational for moving people, goods, and services essential for the functioning of an economy.

For this reason, transport networks are often considered "economic infrastructure" because of their importance to the economy. Transport infrastructure development can affect economic development in several ways. It can improve labour and capital productivity, decrease input costs by increasing transport efficiency, and boost overall demand for goods and services (Zhang and Cheng, 2023).

Transport investment should, in theory, generate fiscal returns

Some infrastructure networks generate benefits beyond what users receive. The way we fund these networks can sometimes reflect this. For example, we fund our schools largely with general tax revenue because the benefits of education to society are wider than just to the students.

We often make transport investments with an eye on the benefits beyond the direct users (drivers, passengers, bus riders). For instance, the 2021 Government Policy Statement on Land Transport highlighted the importance the transport system for economic networks as a key strategic priority.[29]

However, New Zealand's standard framework for evaluating transport projects focuses primarily on user benefits. The NZTA's evaluation manual for evaluating the benefits of transport investments[30] states that most of the benefits accrue directly to users in the form of travel time savings or trip reliability benefits, rather than wider economic benefits such as the productivity benefits from

[29] Government Policy Statement on Land Transport 2021/22-2030/31: https://www.transport.govt.nz/assets/Uploads/Paper/GPS2021.pdf

[30] NZTA, Monetised Benefits and Costs Manual, July 2024: https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

density and clustering of activity or increases to the labour supply. Only the most significant infrastructure improvements are likely to generate wider economic benefits.[31]

This is reflected in how we have historically funded our transport investments through fuel excise duties, road user charges, and vehicle registration fees. The Commission's previous research has demonstrated that user charges such as tolling can contribute to a material portion of a road's cost, but only for high-traffic roads that deliver large user benefits (New Zealand Infrastructure Commission, 2024a).

Beyond direct user benefits, transport infrastructure investment has been linked to economic growth, which could expand the revenue base. Appendix D reviews the literature on this subject, finding that wider economic returns to transport investment depends upon several factors, such as location, sectors, and maturity of the existing network.

Estimating the financial returns from land transport investments

To examine the extent of government revenues collected from users and beneficiaries for a given transport investment, we examined the business cases for a select number of land transport projects, either completed, under construction or in the planning stages.

The projects selected largely reflect the publicly available nature of their business cases. This experience aligns with the Commission's work on infrastructure project transparency, which found that most business cases are not publicly available.[32] We also chose these projects because each reported roughly the same set of calculated benefits streams:

- Ōtaki to north of Levin (O2NL) motorway: a 24-kilometre, four-lane motorway and shared use path. According to its 2022 detailed business case,[33] the project has estimated whole-of-life costs of $1.2 billion and delivers $1.5 billion in total benefits in 2018 NZD.

- Pūhoi to Warkworth motorway: an 18.5-kilometre, four-lane motorway, the first section of the Ara Tūhono, Pūhoi to Wellsford Road of National Significance. Opened in 2023, its 2015 business case estimated benefits including wider economic benefits of $828 million compared to $744 million in total costs in 2013 NZD.[34]

- Warkworth to Wellsford motorway: the second proposed leg of the Ara Tūhono, Pūhoi to Wellsford Road of National Significance. The indicative alignment in its detailed business case for route protection shows a 26-kilometre, four-lane motorway. Its business case estimated costs of $1.043 billion against $775 million in benefits (including wider economic benefits) in 2017 NZD.[35]

- City Rail Link (CRL): a mostly tunnelled 3.5-kilometre rail link connecting the Britomart Transport Centre to the North Auckland Line. The project includes constructing two new

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[31] Page 89 of NZTA's Monetised Costs and Benefits Model: https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

[32] Massey University and New Zealand Infrastructure Commission, 2024.

[33] https://www.nzta.govt.nz/assets/projects/o2nl-new-highway/technical-reports/O2NL-Final-DBC-board-endorsed-August-2022.pdf

[34] https://www.nzta.govt.nz/assets/projects/puhoi-warkworth/docs/puhoi-to-warkworth-business-case-for-implementation.pdf

[35] https://www.nzta.govt.nz/assets/projects/ara-tuhono-warkworth-to-wellsford/detailed-business-case-oct-2019.pdf

underground stations. It's 2015 business case listed total costs of $1.9 billion and against $2.9 billion in benefits in 2014 NZD.[36]

We note that the cost and benefit estimates for these projects have in some cases been updated:

- The O2NL motorway's costs have increased in nominal terms, but only slightly in inflation-adjusted terms.
- The Pūhoi to Warkworth motorway was completed in 2023 for $877.5 million, or $903 million in 2024 NZD. This is approximately the same cost, adjusting for inflation, as its 2015 business case.
- There have been no public updates to the Warkworth to Wellsford motorway's costs since its business case.
- The cost of CRL is multiples higher than what was listed in its business case. In 2024 NZD, the project's cost has grown from $2.5 billion ($1.9 billion in 2014 NZD), to $5.7 billion, an increase of over 225%. At the same time, a 2018 update to the economic case for CRL estimated total benefits to be $5.6 billion in 2024 NZD ($4.49 billion in 2018 NZD).[37] This is suggestive of a project with a benefit-cost ratio closer to 1, rather than the 1.6 in its original business case. Because we rely on the original business case, this also means our results on the fiscal returns for CRL are overstated.

We opt to use the benefits and costs listed in the business case to ensure an "apples to apples" comparison across projects as the completed and under-construction projects have a different degree of information known to project proponents compared to those in the planning stage. The goal of our exercise is to identify trends and explanations for what might make a project more financially advantageous relative to another, so the use of analysis from a similar stage of project planning is important. We also do not have full information on final costs for each project, as some of them are in-progress while others are completed.

For all these projects, the key method of estimating project benefits is cost-benefit analysis. Cost-benefit analysis is designed to measure more than the financial or economic benefits of an investment. It is more holistic as it captures monetary and non-monetary benefits. Our examination seeks to analyse benefit streams that are included in cost-benefit analysis and determine which ones lead to increases in user charges or tax revenues.

All projects use a standardised evaluation methodology prescribed by the NZTA's Monetised Benefits and Costs model (MBCM).[38] This framework lays out 12 monetised benefits. Some of these benefits will provide the government with a direct fiscal return which we estimate through the following pathways:

- Increases in user charges: Upon completion of a transport network upgrade, the reduced cost of transport may lead to increased usage. For a motorway, this could lead to increased fuel excise duty and road user charges revenue flowing to the Crown as vehicle kilometres travelled increases. Some transport projects will induce a greater amount of driving, leading to more consumption of petrol and road user distance licenses. This will also lead to additional fuel excise duty and road user charges revenue. This will only happen, however,

[36] https://www.cityraillink.co.nz/crl-business-case

[37] https://www.transport.govt.nz/assets/Uploads/PapersrelatedtoCityRailLinkFunding.pdf

[38] https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual.pdf

if there is a net gain in travel demand across the entire network.[39]

- Healthcare system savings: Improving the quality and safety of transport systems can reduce the number of accidents occurring. Fewer accidents will lead to fewer hospitalisations. Fewer hospitalisations will lead to fewer claims being paid by the Accident Compensation Corporation (ACC). ACC is a separate Crown entity, but it is also considered a contingent liability for the Crown.

- Labour supply benefits: Reducing the cost of transport can lead people who were otherwise unemployed to work more. For those who are using transport links for work trips, like a freight lorry, they may be able to accomplish more if travel times are reduced. These can lead to increased wage tax revenue for the Crown.

- Productivity and agglomeration benefits: The clustering of activity in towns and cities is dependent on effective transport systems. If a transport link upgrade increases this clustering, it can boost economic productivity. For instance, lowering the cost of transport can allow people to be linked to higher paying jobs. This could be a revenue stream for the government through increased wages or business taxes.

- Increased output in imperfectly competitive markets: In a perfectly competitive market, firms can only price goods and services at the cost it takes to produce them. However, for a variety of reasons, the structure of markets allows firms to charge markups. If transport investment enables a worker to work more, the value of that extra work is more than just the price of its extra output. That hour of work produces value to the market that is the cost of the input plus the mark up. That extra mark up accrues to the firm's bottom line and could be captured by business taxes.

- Direct charges: We also capture revenues directly charged to fund the project. This could include tolls or value capture estimates.

Most of the above benefits are wider economic benefits from transport investment, rather than direct user benefits. This suggests that attempting to estimate the financial return of projects is largely a question of the wider economic benefits they bring.

Given the limited set of projects we were able to find consistent and easily accessible business cases for, these results should be taken with caution. Analysis of a different set of projects may lead to different conclusions.

The selected transport projects do not pay for themselves

Our estimates for the fiscal return to these projects are listed in Table 4.

Based on these estimates, the selected land transport infrastructure projects do not return financial revenues which cover costs, at least over the periods studied in their business cases. However, in all cases, the revenues directly from the project do cover ongoing maintenance and operational expenses.

[39] Note that benefits from lower vehicle operating costs, such as costs for fuel, maintenance, tyres and oil, are separate from this benefit. Lower fuel costs could offset the benefit from greater usage.

Table 4: Estimated share of costs recovered for transport projects (millions in 2023 NZD)

Project	Base year for costs and benefits	Capital cost	Operation costs	Estimated revenues	Share of costs recovered	Business case benefit-cost ratio
Ōtaki to north of Levin[a,b]	2018	$1,180	$22	$101[a]–$227[b]	**9%–19%**	**1.2**
Pūhoi to Warkworth	2013	$724	$19	$109	**15%**	**1.1**
Warkworth to Wellsford[c]	2015	$1,007	$36	$93–$110	**9%–11%**	**1.1**
City Rail Link (Crown and Council)[d]	2014	$1,513	$340	$387	**21%**	**1.6**
City Rail Link (Crown only)[e]	2014	$756	$170	$183	**20%**	**1.6**

[a] Preferred method includes calculating labour supply benefits as 5% of total benefits. The business case did not include wider economic benefits (WEBs).
[b] Alternative method includes calculating work trip benefits to travel time savings and travel time reliability. The business case did not include WEBs.
[c] Upper bound of revenues represents the upper bound of WEBs in the business case. Lower bound reflects the lower bound estimate.
[d] Method includes quantification of the same benefit streams as the other projects, plus an estimate of operating revenues included in the business case, which includes farebox revenues and development contributions.
[e] Method includes only the Crown's share of CRL costs (50%). Operating revenues are assumed to be council revenues.

Based on this analysis, we make some additional general observations.

First, these results suggest that these projects will require subsidies outside the project itself to make them financially viable, meaning those who do not benefit from the project will be paying a large portion of its costs. Alternatively, estimated financial deficits arising from these projects could be covered by reduced capital expenditure elsewhere in the future. These projects are not expanding the revenue base available to fund future infrastructure – they are doing the opposite.

It is not necessarily a problem when a single project does not generate net positive financial returns, so long as other parts of the network are generating positive financial returns. But over the long term, continuing to invest in these types of projects will put pressure on the transport funding system, absent increases in user charges such as fuel excise duties, road user charges, and public transit fares. We are already seeing this occur in the National Land Transport Fund (NLTF). Over the past five years, the Crown has either granted or loaned to the NLTF almost $9 billion. From 2024 through 2028, a further $13 billion will be contributed by the Crown.[40]

Another observation from these case studies is that benefit-cost ratios appear to be related to financial returns. Projects with lower benefit-cost ratios in their business case tend to have lower expected financial returns. The motorway projects, which have ratios of 1.1 and 1.2, all achieve a level of cost recovery below the CRL, which achieves moderate cost recovery with a benefit-cost ratio that is 30% to 45% higher. However, we note that if the true cost of CRL were used, it would achieve a similar benefit-cost ratio as the other projects, and similar levels of cost recovery.

This makes sense intuitively as to have a higher benefit-cost ratio, a project either must have higher monetised benefits or lower costs. Higher monetised benefits will result in higher revenues flowing to the government, increasing the share of the cost covered. Conversely, lowering the project cost will decrease the amount that the existing revenues must cover. Either of these will result in greater financial returns to the government.

Most of the financial benefit in our analysis is derived from indirect wider economic benefits, which are relatively small compared to direct user benefits, such as travel time savings. Our analysis suggests that in order for projects to provide positive financial returns, benefit-cost ratios would need to be anywhere between 5 to 9, depending upon whether they are matched with a direct revenue source such as a toll or development contributions.

Finally, our analysis highlights that projects that have a greater number of beneficiaries are more likely to lead to a better fiscal return. The clearest case is the CRL, which is located in the country's largest city, and will serve one of the most densely populated areas in the country. The number of passenger trips was estimated in the original business case to be over 30,000 in just a 2-hour morning period. The scale and density of this demand translates into greater economic clustering effects, and financial revenue.

We also see this play out with the selected motorways. Even though the Pūhoi-Warkworth cost recovers at a lower level than the CRL, it does comparatively better on the like-for-like measured analysis than the Ōtaki to north of Levin (O2NL) or the Warkworth to Wellsford motorways. This is because it is projected to carry more vehicles and is closer to its respective major city.

[40] See page 258: https://budget.govt.nz/budget/pdfs/estimates/v1/est24-v1-trans.pdf

Would estimated financial returns be higher if we used different evaluation methods?

We used the NZTA MBCM as a method for evaluating project benefits. The MBCM methods have been tested and adjusted by transport appraisal practitioners for many years. However, MBCM is not the only method for evaluating economic benefits of transport investment.

Economic impact analysis, another way of evaluating projects, estimates the effect that a project or programme will have on the structure of the economy, or on the economic welfare of groups of people. These methods often measure different benefits than traditional cost-benefit analysis (Wallis, Wignall and Parker, 2012). Like our approach above, we find that using this method, financial returns are heavily dependent on the project (see Appendix C).

- A 2023 study of the economic impacts (using a computable general equilibrium (CGE) model) of a proposed four-lane motorway through Northland point to a financial return that would be insufficient to cover even the interest costs on the project (NZIER, 2024).
- Conversely, a 2022 study of the Waikato Expressway's annual economic impact (using a CGE model) suggest that over 50% of the project's costs could be recovered in new tax revenue generated by new economic activity (Principal Economics, 2022).

These results suggest the level of fiscal return could be higher with a different method, but the general observations we found around the importance of higher benefit-cost ratios and beneficiaries still hold.

Transport investment also leads to wellbeing benefits, which we must pay for

Our review of these transport projects suggests that they do not pay for themselves even after considering the financial gain from wider economic benefits. They will require non-beneficiaries to subsidise their construction and ongoing costs.

Given this result, we might reconsider some transport investments less as financial investments that enhance our revenue base, and more as investments that improve our wellbeing or consumption investments. Being able to get somewhere easier and more efficiently undoubtedly does this.

Another way to view these transport investments could also be less through a financial lens for governments but as a vehicle to drive increased economic activity for the private sector. If this is the case though, we might consider evaluating transport investment alongside other policies for spurring private sector growth. This could be an area for future research.

Our ability to fund these investments needs to be considered against other priorities, like maintaining and improving what we already have. And because these types of investments do not pay for themselves, if we are intent on doing them, they will have to come at the expense of either expanding our budgets by committing a greater share of our wallets to infrastructure or cutting back on other projects. A large portfolio of these types of investments will require infrastructure user charges to increase significantly to pay for the additional investment.

The fiscal impacts of value capture mechanisms

The previous sections have highlighted that generating financial returns from infrastructure projects is not guaranteed.

However, most of the revenue generated in our analysis in the previous section results from growth in economic activity, which central government usually captures in the form of taxes on transactions (GST and other consumption taxes) or income (personal and business income taxes). Theory suggests that many of the benefits from public investment accrue to land values.[41] This raises the question of whether the low financial returns could be improved if we opted for a different taxing instrument.

One such tool could be value capture. Value capture tools generally attempt to monetise land value uplift because of increased economic or amenity benefits. In New Zealand, our existing value capture tools are beneficiary pays taxing instruments that are used to recover the cost of an investment retroactively.

There are several ways to collect revenue or realise the benefits from land value uplift:

- targeted rates or levies (such as those enabled by the Infrastructure Funding and Financing Act 2020)
- development contributions or agreements
- strategic land management, such as buying and selling land after a return is made, although this is rarely used.

Other mechanisms used by other governments around the world include charges for development rights on a piece of land or some form of capital gains tax, where land value gains are taxed when they are sold.

The link between land value, economic growth, and infrastructure

Land value uplift sits directly alongside the question of whether new infrastructure can pay for itself out of new revenue streams.

The value of a piece of land can be thought of as a proxy for several economic and wellbeing benefits people receive from living in a certain place. For instance, the value of a piece of land in a CBD reflects the benefit of reduced transportation costs to work and other amenities (Alonso, 1964; Muth, 1969).

It also reflects the economic potential of the land. For instance, that same piece of land in a CBD could be used for an office building that serves as the headquarters for a multinational company. The workers in that building produce valuable services, the proceeds from which can be used to pay rental income.

[41] See Haughwout (2000) and Arnott and Stiglitz (1979).

Nunns and Baker (2015) provide a review of the significant body of work on value uplift from transit infrastructure. They find the impact of rapid transit on property values varied widely, from -21% to 160%. The median uplift from a rapid transit project increased property values 5.0% and the average was 11.8%.[42]

Mohamed et al. (2013) also identify specific factors that lead to this variation for rail infrastructure. These include the measurement of the value of property, the type of property (residential or commercial), the type of rail infrastructure (heavy or light), the distance from stations, and how the examined uplift of areas compared to unaffected area. The study found that land value uplift was higher when the infrastructure was commuter or light rail and generally found that commercial properties experienced higher uplift.

New Zealand-specific evidence on land value uplift from infrastructure is somewhat limited.

A key piece of research on the impact on land values from infrastructure investment comes from Grimes and Liang (2010). They studied the land value uplift caused by Auckland's Northern Motorway from 1995 through 2000 and found that it increased property values by almost $4 billion (in 2024 NZD) on Auckland's North Shore.

A cost-benefit analysis commissioned by the Ministry for the Environment on the National Policy Statement on Urban Development (NPS-UD) in 2020 estimated that land values in Wellington were between 4% and 22% higher on a square-metre basis if the property was located closer to a public transit station, but between 6% and 12% lower if they were located near a motorway or road.[43]

Estimating the financial returns from potential value capture instruments

What is the revenue potential for value capture, and what are the conditions under which value capture tools could cover the cost of a given piece of transportation infrastructure?

We developed a simple model to answer these questions. Using information on historical infrastructure costs for motorways, tunnels, and rail projects, we attempt to estimate cost-recovery potential for value capture in four hypothetical cities.

- **Dense city:** This is a city that has a higher population density and average values per hectare similar to places like Wellington and Auckland.
- **Mid-sized city:** This is a less dense city that has average value per hectare values that look like those in Christchurch, Hamilton, Tauranga, Lower Hutt, and Dunedin.
- **Small city:** This city is even less dense and has average values per hectare of cities like Palmerston North, Napier, New Plymouth, Whangārei, Rotorua, and Hastings.
- **Rural area or small town:** This could be a rural area, or a smaller town surrounded by a rural setting. This is a low population density area, and its average value per hectare is a mix of rural areas like parts of Canterbury and smaller towns and cities, such as Levin, Timaru, and Blenheim.

[42] A mean value that is more than twice the median comes from there being some properties that gain a great deal (a long upper tail to the distribution).

[43] See PwC, 2020.

We model hypothetical costs of three types of projects:

- A low-cost, four-lane motorway, with estimated costs equivalent to the 20th percentile per kilometre cost of New Zealand motorways built from 2000 through 2020. This is approximately $33 million per kilometre (in 2023 NZD). This can be thought of as a motorway with straightforward engineering, perhaps in an undeveloped landscape, similar to the 2017 Christchurch Southern Motorway Stage 2.

- A high-cost, four-lane motorway, with estimated costs equivalent to the 80th percentile per kilometre cost of New Zealand motorways built from 2000 through 2020. This is approximately $93 million per kilometre (in 2023 NZD). This is a more complex motorway project, usually in more urban areas, such as the widening of SH1 from Manukau to Papakura in Auckland.

- At grade rail, such as light rail, with cost per kilometre and station cost equivalent to the average costs experienced in other countries. This is approximately $71 million per kilometre of track (in 2023 NZD) plus $134 million per station.

Land costs are in addition to these costs and are calculated by estimating the average per hectare value of land in each of these respective cities and multiplying it by the land requirements for these projects. For simplicity, we estimate that a motorway will require a 30-metre corridor of land across its entire length, while a rail line will require 15 metres.

In our model, the beneficiaries of the project are largely confined to a catchment area around motorway exits or a rail station. We assume this catchment area is a circle with a 1.5-kilometre radius. Grimes and Young's (2010) work found that land value uplift of Auckland's Northern Motorway was significantly less beyond 2 kilometres from an exit but could extend to as far as 7 kilometres from an exit. The cost-benefit analysis of the NPS-UD in 2020, on the other hand, found that living anywhere near a state highway was associated with lower land values. We sensitivity test our conclusions here with a 2.5-kilometre catchment area for motorways in Appendix C.

Our model assumes that this benefit catchment area will fall in areas with varying densities, depending upon the type of city. Table 5 lists our assumptions for the catchment area by type of city and density level.

Table 5: Hectare types benefitting from infrastructure by city type

Density type	Dense city	Mid-sized city	Small city	Rural area or small town
Rural (<=1 pop/ha)	0%	0%	25%	75%
Lifestyle block (1-10 pop/ha)	0%	25%	75%	25%
Suburban (10-100 pop/ha)	75%	75%	0%	0%
City centre (>100 pop/ha)	25%	0%	0%	0%

To demonstrate how this works, for a motorway with 5 exits, the total catchment area is 3,534 hectares ((π*1.5^2) * 5 exits) * 100)). If this project were to occur in a dense city, we assume 2,651 of these hectares (75%) would occur in an area of suburban density, and 884 (25%) will occur in a city centre.

We test two value capture tools. The first is a *targeted rate or levy* on benefit catchment areas around rapid transit stations or motorway exits. This levy would apply to the affected properties for 30 years, similar to Infrastructure Funding and Financing Act 2020 levies.

The second is a *one-time value uplift mechanism*, where the beneficiaries of land value uplift would be required to remit a portion of the uplift to help fund the project. This is somewhat similar to a development contribution, but unlike a development contribution, it is not constrained to cost recovery. Such a revenue tool does not exist in New Zealand and would require legislative changes to implement.

This model is not meant to estimate revenue potential for a specific project in a specific area. Instead, the goal of this model is to give us a general understanding of value that must be generated from an infrastructure project to achieve certain levels of cost recovery, and which conditions are those most likely to happen.

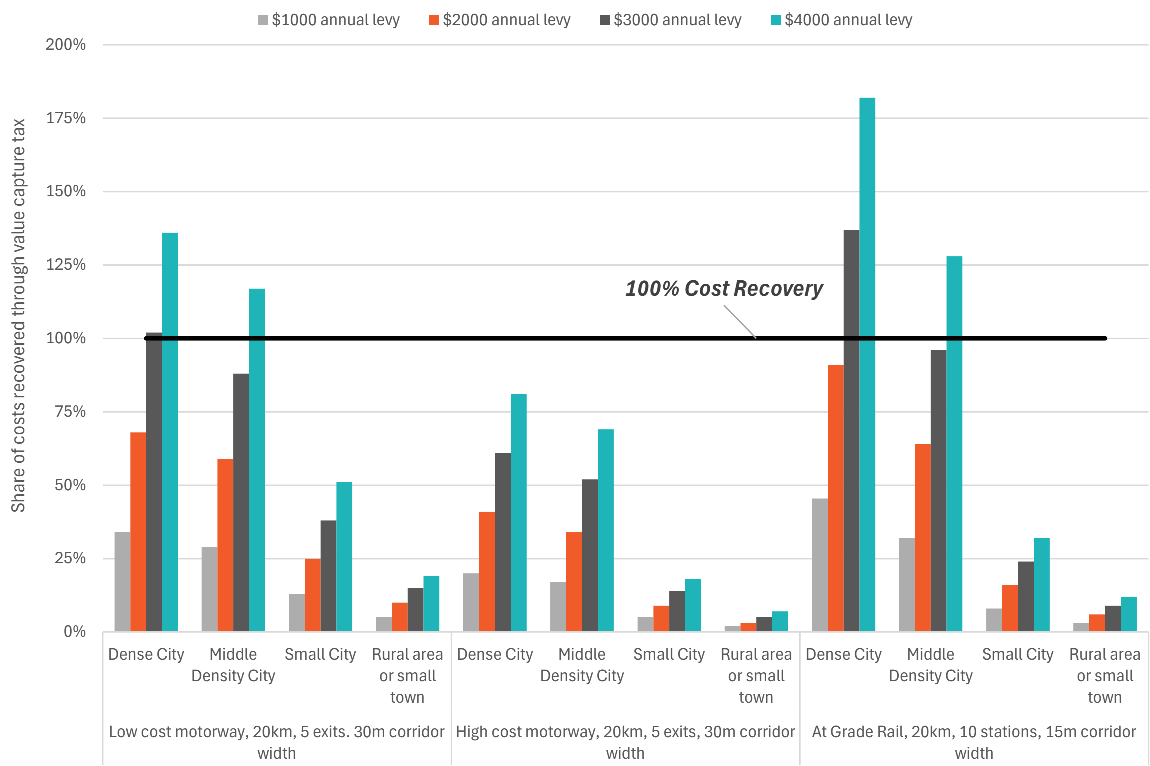
More detail on our model can be found in Appendix C.

Revenue potential varies by location and project costs

Beginning first with the levy, we estimate cost recovery potential for various 30-year levies ranging from $1,000 per year to $4,000 per year for the beneficiary properties. The results of our analysis are set out in Figure 11. What we find is that there are only a few circumstances where a levy such as these would fully recover the cost of an infrastructure project (Figure 11).

A targeted levy on land values could achieve reasonable cost recovery, but primarily in denser cities

Figure 11: Cost recovery potential for a targeted levy for various infrastructure projects



Notes: Assumes 1.5-kilometre benefit catchment radius around exits/stations. Infrastructure costs are based upon typical costs per kilometre (4 lanes) for motorways and rail. Make-up of catchment area differs by city: dense city catchment areas are 75% city centre, 25% suburban; middle cities are 75% suburban, 25% lifestyle blocks; small councils are 25% suburban, 75% lifestyle block; and rural areas are 25% lifestyle blocks and 75% rural
Source: New Zealand Infrastructure Commission's analysis and modelling using data from CoreLogic and Stats NZ populations by Statistical Areas.

Our model suggests that motorways are difficult to fully cost recover using a levy. In a dense city, the biggest hurdle is the cost of land. In a less dense city, the lack of benefitting properties makes the financial maths challenging.

For a low-cost motorway, the density inherent to the dense city means a $1,000 or $2,000 annual levy achieves reasonable cost recovery (34% and 68% respectively). As scale of density decreases, levy revenues fall, and with it, cost recovery potential: even a $4,000 annual levy is unable to recover 20% of a low-cost motorway placed in a rural area.

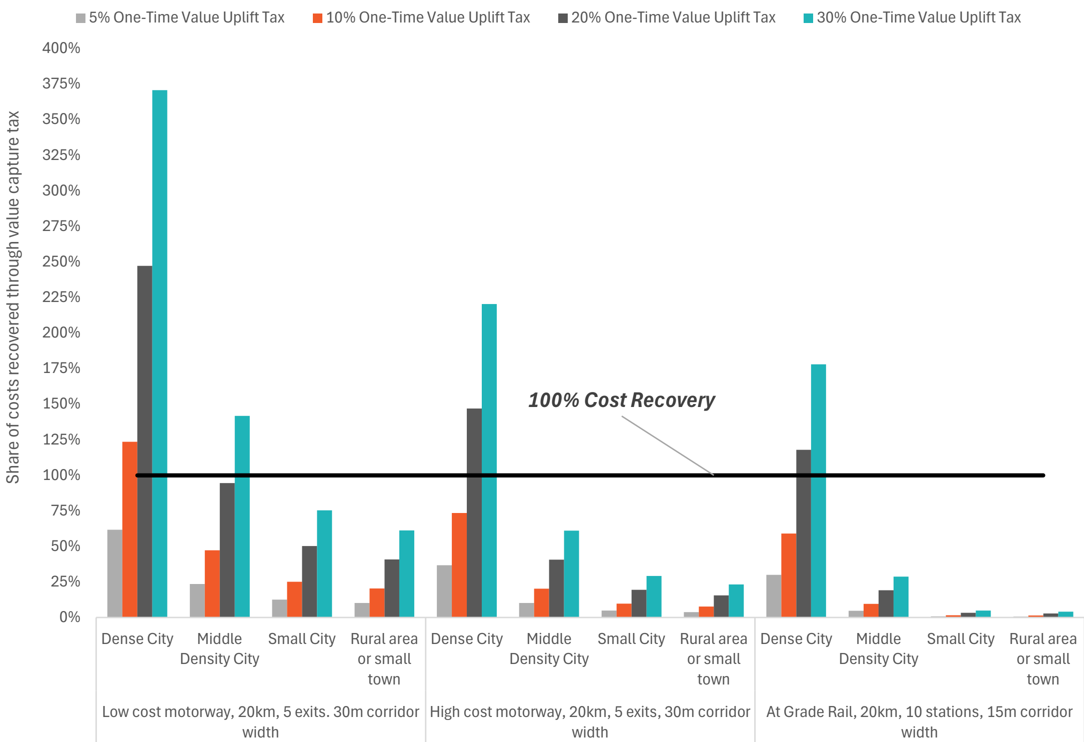
No city-levy combination can fully cost recover a higher-cost motorway, with a $4,000 annual levy in a hypothetical dense city only recovering 80% of costs.

For at-grade rail, because there are more access points (10 stations as opposed to 5 exits), and less land costs (a smaller required corridor), cost recovery via a levy mechanism is higher. All levy combinations either fully cost recover or achieve a respectable level of recovery. Our model also suggests that a smaller city, like Hamilton or Tauranga, might expect reasonable cost recovery levels with a $1,000 or $2,000 annual levy.

We also test the revenue potential of a one-time value uplift mechanism or tax. Following the literature on land value uplift, our model assumes uplift of 10% for residential and industrial parcels, and 15% for commercial parcels.

A one-time value uplift tax can achieve cost recovery, but only in denser places

Figure 12: Cost recovery potential for one-time value uplift tax for various infrastructure projects



Notes: Assumes 2.5-kilometre benefit catchment radius around exits/stations. Infrastructure costs are based upon typical costs per kilometre (4 lanes) for motorways and rail. Make-up of catchment area differs by city: dense city catchment areas are 75% city centre, 25% suburban; middle cities are 75% suburban, 25% lifestyle blocks; small councils are 25% suburban, 75% lifestyle block; and rural areas are 25% lifestyle blocks and 75% rural.
Source: New Zealand Infrastructure Commission's analysis and modelling using data from CoreLogic and Stats NZ populations by Statistical Areas.

We find that after including land costs, a one-time value uplift tax would need to be set at an elevated level to achieve cost recovery. Like the levy model, cost recovery is best in dense cities, and greater for a rail line due to the greater number of access points.

Beyond dense cities, a one-time value uplift tax would not achieve significant cost recovery, with the maximum being a 30% land-uplift tax achieving 35% cost recovery for a low-cost motorway in a medium sized city. For small cities and rural areas, the cost recovery potential is limited (less than 5%).

Further, the scope for revenue potential is relatively small in rural areas, even if we assume very large levels of land value uplift. For instance, even if a high-cost motorway resulted in a doubling of land values in the catchment area of a hypothetical rural area and small town, our model predicts that a 20% one-time uplift tax would only recover 10% of the project's cost.

Some of these levies or one-time tax obligations are large in dollar terms. For instance, in a dense city, a 5% value uplift tax on a residential suburban property would be approximately $9,100 but only recover 13% of a 20-kilometre higher cost motorway. A 20% uplift tax that covers 53% of project costs is more than $36,000. Alternatively, the same home could pay over $15,000 in levies, in discounted terms, over 30 years to achieve 20% cost recovery.

Value capture revenue potential depends upon land use and density

Our model demonstrates that revenue potential for value capture is a direct function of the number of people or the land area that the infrastructure benefits. Infrastructure projects in dense cities are easier to cost recover using value capture because first, there are more people and parcels to pay levies, and second, even a small amount uplift across more parcels leads to greater revenue potential.

In areas without density, the scale of the value and benefit created needs to be significantly higher to lead to meaningful cost recovery. Because there are fewer people to benefit from the infrastructure investment, levies need to be much higher. Further, land values in rural areas are lower, so to deliver significant amounts of revenue, these areas would need to experience land value uplift that transform catchment areas from rural areas to areas resembling a city. This suggests that the benefit of the infrastructure would need to be significant.

Together, these findings suggest a close relationship between land-use policy and value capture revenue potential. For a levy, enabling more development increases the potential revenue base or makes the required levy smaller across all benefitting properties. For a one-time value uplift tax, if land-use changes are signalling future infrastructure provision, particularly in undeveloped, rural areas, revenue potential will be markedly less if the tax is implemented after the land-use change.

Discussion

Our key findings

Our research sought to understand whether public infrastructure investment can expand our revenue base, but also the conditions under which it would be more likely.

We found that for local government, infrastructure investment that enables or responds to population growth can be paid for by revenues from growth. However, this is more challenging in places that are growing fast but expanding their infrastructure networks even faster.

We also showed that, based on outputs from typical transport appraisal methods, major transport projects do not necessarily pay for themselves and will require significant financial support from non-users. This could be in the form of user charge revenue from other parts of the network, or general taxation.

Finally, to test whether the results for central and local government could be improved with a different funding tool, we demonstrated the revenue potential for land value capture and found that it will only make a difference when there are more beneficiaries of a given piece of infrastructure, which aligns with our findings from our local and central government case studies.

Not everything boils down to dollars and cents…

Most infrastructure projects are not solely constructed to generate or respond to growth. The reality is that projects have elements that are designed to improve levels of service or other goals in mind, such as safety or network reliability.

Similarly, not every infrastructure project will deliver significant financial returns or GDP growth. For instance, a piece of social infrastructure like a library or leisure centre is not usually expected to generate major economic uplift to a city. We often don't charge the full cost of these projects as admission fees either. These pieces of infrastructure are important because they provide amenity and quality-of-life improvements.

Our analysis has demonstrated some projects we might think of as offering significant economic returns (i.e., GDP growth and productivity) should be thought of more as amenity or consumption investments. Rather than thinking of these investments as having a transformational impact on our economy that expands our funding base for infrastructure, we should consider prioritising them the same way we do for other quality-of-life investments.

…but we need a financially sustainable approach to investment

All infrastructure projects, whether they are for economic growth purposes or to improve levels of service, resilience, or higher safety standards, still need to be paid for.

In isolation, an investment that does not yield net positive financial returns may not create a concern at a network level. However, if we undertake many such investments, it will put financial pressure on the system, which will inevitably lead to higher charges and a greater share of our wallets being committed to the network.

If we consider whether the investment will provide financial returns in addition to other societal and economic returns, we can ensure future generations can maintain and renew the assets we build today and allow them to address their own priorities into the future.

To ensure better financial sustainability across our investment portfolio, our case studies brought forward a few key themes as outlined below.

Project quality matters more than revenue tools

A key insight of our work is that the most important factor for determining whether growth pays for growth is the proportion of a project's costs to its benefits or beneficiaries, rather than the choice of available funding tools.

Growth paid for growth for local government when growth costs were matched by sufficient development. For central government transport investment, a better financial return arose when there were more beneficiaries of a project. Likewise, with value capture, we found that a project that has greater number of beneficiaries is likely to generate more land-value uplift and therefore, revenue.

To understand whether growth will pay for growth, project proponents need to thoroughly evaluate project benefits relative to costs. Our study of a select number of transport projects showed that cost-benefit analysis is directionally a good approximation of the financial benefits of a project.

Further work could explore the specific conditions that could lead to higher financial returns. For instance, we identified that councils with a significant growth infrastructure spending relative to new development made it difficult to make growth pay for growth, but future work could explore why spending on growth infrastructure does not appear to be linear as population grows.

The bar is high for projects to fully pay for themselves

Once we identify higher-quality projects, to ensure higher financial returns, our analysis points the need for higher bar, or even a different type of analysis, than typical economic appraisal. In many applications, having a benefit-cost ratio of greater than 1 would indicate a indicate a project that provides net benefits to society.

However, for the small set of transport projects we analysed, to generate a net positive financial return from the project itself, benefit-cost ratios would need to exceed 5 and could be as high as 9 for projects without a direct revenue stream.

For local government growth infrastructure, our analysis found that $30 to $60 of private investment for every dollar of public investment in buildings would have been required to make growth pay for growth, depending on how much the council wants to rely on development contributions. While this ratio will not be the same for every council going forward, it provides a useful benchmark for analysing future financial sustainability of growth investment.

Incremental investment is more likely to pay for itself

What does our work say about the types of projects that are likely to clear that higher bar? A theme that runs through each of our case studies is that spending more money does not necessarily mean larger returns. Large infrastructure investment programmes are very expensive and generating fiscal returns to make them pay for themselves is difficult.

Our analysis has hinted at the need for infrastructure providers to be more cautious about significant investment programmes, particularly well in-advance of demand. At the local government level, councils that were able to incrementally add growth investment while still growing were much more likely to come out financially ahead after 25 years, as compared to those that were adding significant amounts to their network in response to growth.

Consider the case of Tauranga and Wellington. Tauranga's population grew more than 3 times faster than Wellington from 2007 to 2023, requiring comparatively more investment in growth infrastructure. However, its spending on growth infrastructure was 7.5 times that of Wellington over that period. This rendered it unable recover the costs of growth solely revenues from new development, meaning existing ratepayers were likely bearing some of the costs. .

For our transport case studies, all of the projects we studied were significant investments, and none returned a positive financial return. Future research could expand the sample to smaller projects to see if these are more financially advantageous on an isolated basis.

Another benefit to an incremental approach to network expansion it allows infrastructure providers to test demand over time, and build the revenue base required for eventual large, lumpy capital expenditures.

Projects that come with new revenue streams are more likely to pay back

Much of our analysis focused on financialising the benefit streams from infrastructure. One reason why some of our case studies showed negative financial returns is because most of their benefits are not financialised. For instance, the transport projects we examined suggested significant benefits to people by saving them time. However, these particular benefits are not providing revenues for the Crown unless the road was tolled.

We show that assets that financialise as many of these benefits as possible are more likely to generate financial return over the long-term.

For councils, this means that there should be a focus on all types of revenue generated from development, not just on setting a cost-recovering development contribution. Even if councils did collect enough in development contributions for capital costs, if enough value is not added to its rating base, the asset becomes an underfunded liability.

This is also the case with central government transport investment. Though our analysis showed that revenues from our specific projects would cover maintenance and operating costs, they would not generate nearly enough to fund an eventual renewal of the asset.

However, as our value capture modelling and previous research[44] has shown, the ability to financialise benefit streams will always be a function of the scale of benefits it brings. Greater benefits or beneficiaries will make it easier for a provider to charge a toll, higher development contribution, or levy a targeted rate to pay for infrastructure.

[44] See New Zealand Infrastructure Commission, 2024a.

Appendix A: Local government growth infrastructure analysis

This Appendix describes the methodology and data used in our analysis of local government growth infrastructure investment.

The cities used in our analysis are Auckland, Christchurch, Wellington, Hamilton, Tauranga, Queenstown, and Dunedin. All figures in the analysis are converted to 2023 NZD using the GDP deflator, calculated from real and nominal production method GDP from Stats NZ. The analysis uses a 2% real discount rate across all calculations per Treasury's guidance on public sector discounting for assets with 1 to 30 years.[45]

Primary methodology and data sources

The analysis is constructed to compare the net present values of three separate cost inputs and two different revenue inputs.

The cost of growth in this analysis are estimated to be the following:

- **C.1: Capital expenditure to meet additional demand.** This is the cost of providing infrastructure whose main purpose is to service new populations to a city.

- **C.2: Additional depreciation and maintenance expense.** This is the annual operating expenditure that councils must account for on installed growth infrastructure and assets vested in council.

- **C.3: Additional operational expenditure from growth.** This is the cost of providing additional services, such as administrative services or additional rubbish collection, new residents to a city may require. This also includes the costs of financing growth investment.

The revenues in this analysis are estimated to be the following:

- **R.1: Development and financial contributions.** These are the mechanisms councils use to recover costs of growth infrastructure by charging a fee to developers, payable on building consent.

- **R.2: Rates benefit from growth.** This is the additional rate revenue that a council receives from the growth that is facilitated by their additional infrastructure expenditure.

The calculation of each of these inputs is discussed below.

C1. Capital expenditure to meet additional demand

Council annual reports and long-term plans (LTPs) report applications of the capital funding. These are reported in three broad categories:

[45] https://www.treasury.govt.nz/information-and-services/state-sector-leadership/guidance/reporting-financial/discount-rates

1. to meet additional demand due to population growth
2. to improve levels of service
3. to replace existing assets.

These categories are required by regulations for local government financial reporting. Councils generally allocate the expense in categories that describe the primary purpose of a project, recognising there are overlapping components for a given project. For instance, a growth investment may include a level of service component.

As such, the figures carry a degree of uncertainty about the exact amount of investment in growth infrastructure. This paper takes this information as an input and does not interrogate the process for categorising capital expense in each of the categories.

The total cost of capital expenditure in each year of the analysis is collected directly from council annual reports and LTPs. However, the data used differ slightly depending upon the period:

- **2007 through 2012:** Prior to 2012, councils were not required to report the three application categories of capital expenditure. As such, a combination of figures was used to approximate expenditure for growth capital expenditure. Most of these figures are estimates or forecasts derived from LTPs, rather than actual figures:
  - Some councils reported expenditure on growth prior to it being a requirement.
    - Tauranga reported "Total new or upgraded assets-growth" in its 2006 and 2009 LTPs for each area of council activity. Christchurch reported similar in its 2006 and 2009 LTPs.
    - Queenstown reported growth capital expenditure by "cost driver" in its 2009 and 2006 LTPs. In 2009, this data was reported as a figure and in 2006 was reported by council activity.
    - Hamilton's 2009 LTP included information about growth infrastructure for each of its council activities over the ten years of its plan.
  - Council development contributions policies laid out all capital expense for growth infrastructure. In these cases, two methods were applied.
    - Hamilton's 2006 LTP includes information about the projects related to growth infrastructure investment across council activities for the purposes of developing its policy. It then attributed a certain portion of that figure for growth beneficiaries. For our analysis, the first figure was used.
    - Dunedin did similar in its 2006 LTP. In its 2009 LTP, it included an aggregate number.
    - Wellington reported a "total growth component" figure across its 10-year LTPs for 2006 and 2009. In these cases, this ten-year figure is divided by 10 to estimate an approximate annual growth investment figure.
  - Auckland Council, in its current form, did not exist prior to 2011. As such, our analysis begins in 2012 for Auckland.

- **2012 through 2024:** These figures are actual expenditure collected from council annual reports from 2012 through 2023.

- **2025 through 2031:** These figures are pulled from council 2024–2034 council long-term plans. As such, they are not actuals but estimates or forecasts.

The total value of the growth investment presented in Table 2 is the net present value of the total expense across all time periods, with a 2% discount rate, reflecting the Treasury's recent guidance on public sector discounting.[46] For most cities, this is 2007 through 2031, except Dunedin who had not finalised their 2024 data as of February 2025. Auckland Council did not exist prior to 2011, so their data is for 2012 through 2031.

C2. Additional maintenance and depreciation expense

When councils build or are vested new growth infrastructure, they are required to spend a certain amount maintaining it and covering depreciation expenses.

We estimate the annual depreciation and maintenance expense as 3.5% of the asset's initial value each year. This figure is informed by the following data:

- Data used in the New Zealand Infrastructure Commission's *Build or Maintain? New Zealand's infrastructure asset value, investment, and depreciation, 1990–2022* report included estimates of local government spending on renewal expenses for local government water, roads, and state highways from 2012 through 2022. This ranged from about 1.6% of asset value for state highways, 2.6% for water, and 3.7% for local roads.

- Work commissioned by the New Zealand Infrastructure Commission in September 2023 by Scarlatti as part of our Workforce Capacity study contained estimates for maintenance and renewal spending as a share of asset values. These differ by asset but were about 1.4% for major local government assets.[47]

- The 2017 Morrison Low report on council's ability to cover growth costs used a figure of 0.86% of asset value for maintenance plus an additional 1.5% for depreciation costs.

To calculate any given year's required maintenance and renewal expense, the following calculation was made:

- Exclude an estimate of land value from the value of growth expenditure for a given year. The method for this is described below in the discussion of how land is excluded from vested assets.

- Multiply the value of growth expenditure (excluding land) the year immediately previous by 3.5% (since there is no required maintenance and renewal expense in year 1).

- To that figure, add the maintenance and renewal expense requirement for growth infrastructure from previous years.

An example for Wellington is below.

[46] https://www.treasury.govt.nz/information-and-services/state-sector-leadership/guidance/reporting-financial/discount-rates

[47] See page 73 of Scarlatti Alta, 2023.

Table A1: Example of calculating maintenance and renewal expenses for Wellington

Year	Capex for growth infrastructure (excl. land)	Required M&R expense that year's capital expense	Required expense for current year
2007	$4.3m	$0.155m ($4.3m * 3.5%)	$0
2008	$4.2m	$0.147m ($4.2m * 3.5%)	$0.155m (2007)
2009	$4.0m	$0.143m ($4.0m * 3.5%)	$0.302 (2007+2008)
2010	$10.8m	$0.378m ($10.8m * 3.5%)	$0.445 (2007+2008+2009)

The total required renewal and maintenance expense for the whole period is the net present value (using the Treasury's recommended 2% discount rate) of the cumulative sums from the fourth column above.

We are assuming that the physical asset base is approximated by the cost of growth investment each year minus the value of land. This figure may include land acquisition, earthworks, and planning and design, which are not depreciable and do not have long-run maintenance costs. This means that our total renewal and maintenance expense may be an overestimate. We consider this will be moderated by our chosen depreciation plus maintenance rate of 3.5%, which could be low given local road and water depreciation-only (i.e., not including maintenance) rates are 2.6% and 3.7% historically. This growth investment also includes physical buildings, which generally have higher depreciation rates than 3%.

Not all of its assets are purchased by the council. Some are gifted to (or "vested in") it. We will talk about what these vested assets are (and sources of data) in more detail in the section below. Because of this, we have to account for the additional maintenance and renewal costs that vested assets create for council.

It is not stated in the data whether these vested assets are land or capital assets. Therefore, we remove an estimate of the share of land from total vested asset value. To do this, we assume that any new asset vested to council will have the same land share as the overall council asset base. We gathered data on council assets from their annual reports for 2023 and isolated land shares. Across all councils in our sample, we estimate the average land share was 22% of total assets. As with the other council assets, we apply a 3.5% rate of depreciation and maintenance to the non-land value of vested assets.

C3. Additional operational expense from growth

Population growth can lead to additional demands on city services. For instance, if a council builds a new bus rapid transit line and purchases new buses for growing populations, it needs to hire workers to operate it. It is unclear what the scale of this could be, as the 2017 Morrison Low report indicated, while this was a cost of growth, councils did not have a clear understanding of these costs.

Our approach to including these in our analysis follows the method used in the Morrison Low report.[48] This approach effectively involves calculating council expenditure items unrelated to capital assets and then estimating a rates requirement on that figure.

C3.1. Non-capital council expenditure

There are a number of steps we need to go through to calculate additional non-depreciation/non-maintenance operational expenses. We ask:

- What is additional operating expenditure?
- What is expenditure to cover the costs of financing earlier non-growth expenditure?
- What is being spent on maintenance and depreciation of existing assets?

The net non-capital expenditure generated by growth (NE) for a given year (t) is, therefore, total expenditure (TE) less the expenditure on financing costs (F), depreciation (D) and maintenance (M):

$$NE_t = TE_t - F_t - D_t - M_t \quad (1)$$

This figure gives us an estimation of what the council spends to supply non-capital related services to its residents.

The next step is to effectively recalculate a rates requirement for this non-capital related services budget.

C3.2. Determine non-capital, non-rates revenue

The first step is to determine what revenues are associated with operations of a council that are unrelated to capital. These can be thought of as revenue from fees and other regulatory income (like building consents).

To estimate this, we subtract from total income total rates revenue for the council. We do this because the total rates revenue reported by a council reflects all types of expenditure (capital and non-capital) since rates are determined by expenditure.

Next, from total income, we remove capital income used to either fund or finance the building or acquisition of capital assets. Capital income is defined as:

- **Development contributions and financial contributions:** The purpose of "development contributions" is defined in the Local Government Act 2002 Amendment Act as to "enable territorial authorities to recover from those persons undertaking development a fair, equitable and proportionate portion of the costs of capital expenditure necessary to service growth" (section 197AA). To levy these, the Act requires councils to develop a development contribution policy through its annual plan or LTP process. "Financial contributions" are related, but not the same as development contributions. The Resource Management Act enables councils to require a contribution of money, land or a combination of the two. For brevity, we will describe the combination of these two as development contributions.

- **Vested assets:** The Local Government (Financial Reporting and Prudence) Regulations 2014 define a "vested asset" as "an asset transferred to a local authority as a result of a subdivision or development and for which the local authority has given no consideration or

[48] Our method diverges slightly from theirs. "Additional operating costs associated with growth" includes maintenance and depreciation expense in that report. Our analysis accounts for these costs separately.

reduced consideration in exchange for the asset" (section 3).

- **Capital grants and subsidies:** The Office of the Auditor General describes these as follows: "grants and subsidies that councils receive are from central government. Waka Kotahi co-funds councils' public passenger transport and roading activities. Central government has made several other funds available that councils could apply for, including: "shovel ready" funding; the Strategic Tourism Assets Protection Programme funding; Jobs for Nature; and Provincial Growth Funding and the "better off" funding that was made available through the previous government's Three Waters Reform Programme" (*Insights into local government: 2023*, para. 2.47[49]).

This non-capital, non-rates revenue can be mathematically shown as, the total income (TI) less the income that comes from existing rates (RI), development contributions (DC), vested assets (V), and subsidies and grants (G):

$$OI_t = TI_t - RI_t - DC_t - V_t - G_t \quad (2)$$

C3.3. Net non-capital expenditure funded by rates

The additional non-capital operating expenditure funded by rates is effectively the net expenditure (equation 1) minus other income (equation 2). Another way of interpreting this is the rating requirement for council non-capital expenditure after accounting for revenue such as parking, fees, and regulatory income.

We scale this resulting figure on a per-capita basis. To do this, we divide additional expenditure by the additional population creating the need for additional expenditure.

Previous population growth figures come from Stats NZ's subnational population estimates for 2007 through 2023.[50] To predict population growth from 2023 through to 2034, we used Stats NZ's subnational population projections. Note that the latest subnational population projections data available[51] from Stats NZ are made from a 2018 base (i.e., Census 2018). Therefore, we scale the projections to match the 2023 actuals. Since the population projections happen only in five-year increments (2023, 2028, and 2033), years in between were interpolated using a linear trend.

Our process for calculating net additional operating expenditure funded by rates is summarised in Table A2, along with a worked example for Hamilton in 2023.

[49] https://oag.parliament.nz/2024/local-govt/part-2

[50] https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2024-2018-base/

[51] https://datainfoplus.stats.govt.nz/Item/nz.govt.stats/d8d727cd-76e5-48b9-bfcf-31d7d0a81bf1/2

Table A2: Steps to calculate required rates, with a worked example for Hamilton 2023

Step	Description	2023 Figure
1	Total expenditure	$378.7m
2	*Finance cost*	*$40.8m*
3	*Depreciation*	*$89.2m*
4	*Maintenance cost*	*$17.2m*
5	**Non-capital expenditure (1 – 2 – 3 – 4)**	**$231.5m**
6	Total income	$523.2m
7	*Rates income*	*$238.2m*
8	*Development contributions*	*$36.5m*
9	*Vested assets*	*$64.2m*
10	*Subsidies and grants for capex*	*$72.2m*
11	**Other income (6 – 7 – 8 – 9 – 10)**	**$112.0m**
12	**Non-capital expenditure funded by rates (5 - 11)**	**$119.5m**
13	Population estimate for 2023	185,300
14	**Net rates expenditure per capita (12 ÷ 13)**	**$644**

This process was completed for the seven councils in our analysis for the years 2018 through 2023. Because the per capita estimates are volatile across councils and years, we take the median value across all the councils and years (after inflation adjusting all figures). **The figure used was $440 per capita across all councils.**

To determine the level of expenditure for each council, we then applied this per capita figure to the population growth estimates in each council.

Finally, to calculate the additional costs of growth, we took the following steps:

- calculated the annual change in population from 2006 through 2031
- multiplied the per capita expenditure figure of $520 by the change in population
- calculated the cumulative sum of all years between 2007 and 2031
- calculated the net present value of the cumulative sums using a 2% discount rate.

C3.4. Financing costs of new growth infrastructure

There are financing costs associated with building growth infrastructure as councils typically borrow money to make these investments. Financing expense is considered an operating cost, rather than a capital cost. Councils borrow money not just for growth investment, but for renewals and level of service improvements. We do not know the exact financing cost specifically for growth investment. As such, we were required to make an estimate.

Calculating financing costs requires knowing the borrowed principal, the term, and the interest rate. We assume the borrowed principal in each year is the amount of growth capex a council takes on in that year.

For the term, we know that typical local government borrowing is short-term, about 4 to 5 years.[52] However, this does not mean the financing period is 4 or 5 years. Councils will borrow for that term but then refinance the existing stock at the end of term. They typically match repayment periods to the life of the asset. For example, for an asset with a life of 20 years, council will refinance their loan 3 or 4 times. For our model, we assume the financing period is 20 years.

For the interest rates councils face, while most report their interest rate on new borrowing in their Annual Plans, this is the interest rate for the term borrowing, not for the entire 20-year period. For simplicity of modelling across 7 councils with 25 years of data, we assume that borrowing each year faces a single effective rate for 20 years. This rate is approximated by using the 20-year New Zealand Government bond (NZGB) yield plus a differential to account for the additional cost councils will face (i.e., the spread). The process for this is as follows:

- Calculate the spread on a 20-year NZGB and a 10-year NZGB for the period 2017 to 2024.
- Use the average spread between the two as a proxy for the spread from 2007 to 2017 (about 40 basis points).
- Using projections of the 10-year NZGB from Treasury's Budget Fiscal Strategy Model,[53] construct a 20-year NZGB series from 2025 to 2031 using the average spread between the 20- and 10-year NZGB from 2017 to 2024.
- Calculate the spread between the 10-year NZGB and Local Government Funding Agency (LGFA) bonds from 2007 to 2024.
- Add this spread to the 20-year NZGB actual (2017 to 2024) and estimated series (2007–2017 and 2025–2031).
- Add an additional 20 basis points to account for LGFA's lending margin.

This leads to an effective 20-year interest rate that is approximately 115 basis points above the 10-year NZGB rate. Table A1 below shows our estimated 20-year effective council interest rates.

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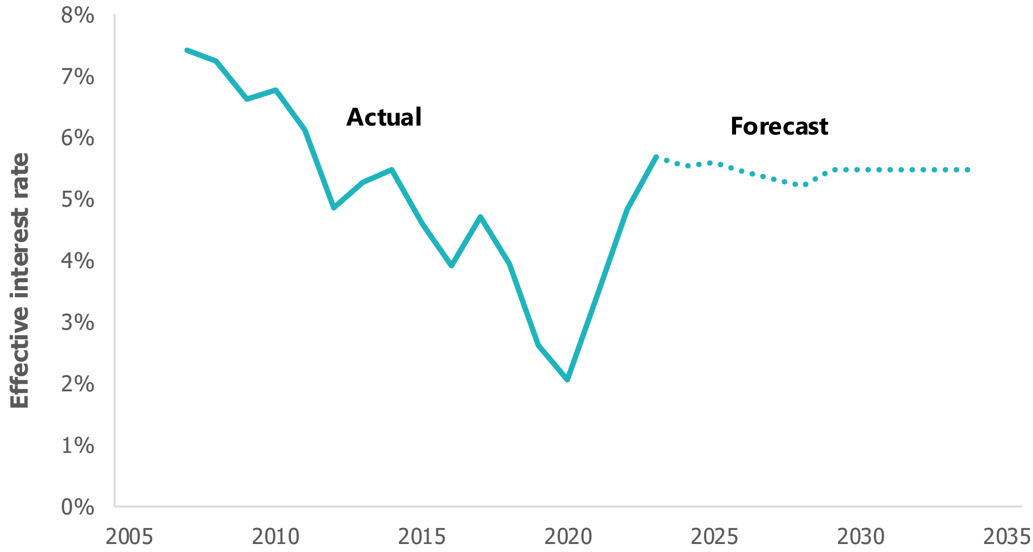
[52] See New Zealand Infrastructure Commission, 2024d.

[53] https://www.treasury.govt.nz/information-and-services/financial-management-and-advice/fiscal-strategy/fiscal-strategy-model

Figure A1: Estimated 20-year effective council interest rates



Sources: The Treasury New Zealand's Budget Fiscal Strategy Model, Investing.com, LGFA and New Zealand Infrastructure Commission analysis.

R1. Development and financial contributions

Development contribution figures are drawn from Stats NZ Local Authority Financial Statistics for the period 2007 to 2021. For Auckland, Watercare's Infrastructure Growth Charges are added to the council's total.[54] For the 2024 through 2031 period, data are pulled from council 2024–2034 LTPs. For Auckland, infrastructure growth charges from Watercare are added, drawn from the 2021–2041 asset management plan.

All of these figures are converted to 2021 NZD. The flow of these revenues is converted to net present value with a 2% discount rate.

R2. Rating benefit from growth

R2.1. Overall methodology

Councils have dozens of different charges and rates. To simplify and enable our comparison between councils, we calculate the average tax liability on business and residential property.

The general methodology for calculating the rate benefit from new growth has three steps:

Step 1: Estimate an average effective marginal tax rate for each city.

Step 2: Weight the average effective tax rate by a differential for residential and non-residential property.

Step 3: Apply weighted effective tax rates to building consents.

In the next sections, we set out our method for each in turn.

[54] See the following for 2023–2031: https://ourauckland.aucklandcouncil.govt.nz/media/yoohwxhv/watercare-amp-2021-2041.pdf Prior to 2023, Watercare annual reports are used.

Step 1: Estimate an average effective marginal tax rate for each city.

Councils set several different rates and charges on properties. These include: (i) general rates, (ii) targeted rates, (iii) water and sewerage rates, and (iv) uniform annual charges. The sum of all these taxes applied at the property level is considered the tax liability applied to each property in the city.

To calculate the average annual effective tax rate on property by city each year, we divide the total rates income (derived from either Stats NZ's Local Authority Financial Statistics for historical years and LTPs for projection years) divided by the council's aggregate capital value in that year.

Step 2: Weight the average effective tax rate by a differential for residential and non-residential property.

Councils also apply rating differentials across different types of property. For instance, for general rates in Wellington, commercial properties pay a tax rate that is more than 3 times higher than residential properties.

To account for this differential, we apply a revenue-weighted average differential to the average effective marginal tax rate calculated in Step 1:

- Using data from council annual plans and rating policies, we calculate the differential between the two largest categories of property. For most councils, this was the residential rate and the commercial/industrial/business rate. We collected this data from 2007 through 2024 for most councils, except for Auckland Council, which is 2012 through 2024.
- Apply a simple average across all years to determine an average differential across the period.
- Determine the share of general rate revenue collected from each property type.
- Apply those weighted shares to the city-wide average effective tax rates to determine an average effective tax rate on residential and non-residential property.

Table A3 below shows an example of Auckland:

Table A3: Calculating the weighted average effective tax rate, example of Auckland

Year	(A) Tax rate in the dollar (urban business)	(B) Tax rate in the dollar (urban residential)	(C) Average share of general rate revenue (urban business)[1]	(D) Average share of general rate revenue (urban residential)[1]	(E) Weighted average effective tax rate (non-residential)	(F) Weighted average effective tax rate (residential)
2016	0.66%	0.26%	32.1%	57.1%	0.77%	0.29%
2017	0.63%	0.27%	32.1%	57.1%	0.49%	0.18%
2018	0.71%	0.26%	32.1%	57.1%	0.51%	0.19%
2019	0.51%	0.18%	32.1%	57.1%	0.53%	0.20%
2020	0.52%	0.19%	32.1%	57.1%	0.56%	0.21%
2021	0.49%	0.20%	32.1%	57.1%	0.43%	0.16%
2022	0.60%	0.21%	32.1%	57.1%	0.46%	0.17%
2023	0.43%	0.16%	32.1%	57.1%	0.50%	0.19%
2024	0.47%	0.18%	32.1%	57.1%	0.48%	0.18%

[1] *This is defined as the simple average of the revenue share in the first year of data (2016 in Auckland's case) and the last year (2024).*

- *Column F is calculated using the following formula:*
  $Weighted\ average\ effective\ tax\ rate\ (F) = \frac{City\ average\ effective\ rate}{C*\left(\frac{A}{B}\right)+D}$
  Where $\frac{A}{B}$ *is the business/residential differential.*
- *Column E is simply Column F (the residential rate) times this differential.*

Step 3: Apply weighted effective tax rates to building consents

We apply the weighted effective tax rates on residential and non-residential property in step 2 to the value of new building consents for residential and non-residential property.

The rating benefit in a given year is the effective tax rate in that year multiplied by the consent value in that year, plus the rating benefit from previous years. This is because the value of new development benefits not just the current years' tax base but all subsequent years, unless it is destroyed.

The final aggregate rating value is the sum the cumulative rating benefit across all years, discounted using a 2% discount rate.

These calculations rely on three pieces of information: the capital value of the properties in a city, the total rates revenue, and the value of new and altered building consents.

R2.2. Sources of data and assumptions

Capital value

Historical capital values for each council are drawn from two sources.

For the 2012 to 2021 period, we draw from a Core Logic dataset of aggregate property values by the Statistical Area 2 level. This dataset contains the capital values of councils on a three-year cycle. For example, we know Auckland's rateable total capital value was revalued in 2014 at approximately $379 billion. However, the dataset does not list the actual capital value used for the next two years. In 2017, Auckland was revalued at $626 billion.

To solve the interim years, we assume capital values are the same as the original valuation year. For example, if there was a valuation in 2016, we hold this value constant for 2017 and 2018. We acknowledge this leads to an underestimate of capital value in those years as value is often added in the interim years but is unlikely to make a meaningful impact on the overall estimate of rate benefit.

Prior to 2012, capital values are drawn from council annual plans or reports or back calculated. If capital values were not listed, council rating policies list revenues sought and a rate, expressed as a share of capital value. From this, we calculate capital value by the revenue sought by the rate. More specifically, we divide total revenue sought by the rate per dollar of property value.

To estimate future capital values beyond 2021, we applied an annual growth rate assumption but only reflected every three years to reflect valuation cycles. In effect, this is applying a compounding growth rate over three years to the starting year's valuation.

The growth rate assumptions we used are below:

- Auckland, Hamilton, Tauranga and Queenstown: 5% per annum
- Wellington, Christchurch: 3% per annum
- Dunedin: 2% per annum.

Total rates revenue

Data for rates revenue from 2007 through 2023 are drawn from Stats NZ Local Authority Financial Statistics.

For 2024 through 2031, rates revenue data are pulled from council 2024–2034 LTPs.

Value of building consents as a measure of the increase to the rating base

To approximate the value added to a council's tax base from growth, we use the value of new and altered building consents for residential and non-residential property from Stats NZ. This is an imperfect measure for three reasons.

First, because we only focus on building consent value, we are not considering the effect on capital values from demolished properties. In effect, our measure is really looking at the gross addition to the rating base, not the net addition.

Second, our method does not allow for any increases from the rating base from subdivision.

We assume these first two omissions roughly offset in impact; however, we note that the first issue could be particularly acute in Christchurch post-earthquake.

A third issue with using this data is that it assumes that developing a building on a piece of land has no impact the value of the land itself. The literature suggests that the benefits of amenity and public capital most likely accrue to land values, so using only building consents could be an underestimate of the effect of development on the rating base.[55]

We did not attempt to measure land value uplift resulting from population growth (which requires investment in growth infrastructure) for two reasons:

- Measurement of land value uplift in each of these cities from population growth and development (rather than zoning changes or scarcity rents) would require more data and a

[55] See Haughwout (2000) and Arnott and Stiglitz (1979).

separate modelling framework.

- We consider there are two channels development that can drive increases in land values: through amenity or consumption, and production.
  - The literature has shown that consumption agglomeration effects in New Zealand are quite small (Donovan et al, 2022). This is because while there are benefits to agglomeration in cities from amenity, they are also offset by factors such as crime and congestion (Tabuchi and Yoshida, 2000).
  - Production agglomeration effects, particularly in the time span we observe in our analysis, are likely to be small in relative terms. Production agglomeration benefits appear to have declined in recent years in cities based upon a review of the literature on urban agglomeration (Donovan et al., 2021).

Because we use the value of all building consents, not just residential consents, we are attributing a benefit of growth to buildings that may not be associated with new residents at all. However, we consider that limiting this measure to only residential dwellings would undercount the rate benefit of growth, since other types of development, such as new commercial buildings arise out of the growth of a city's population.

To forecast building consents from 2023 to 2031, we use the following approach.

- Calculate the ratio of building consent value to capital value for a given year.
- Calculate the average ratio across the years 2013 through 2023.
- Apply that ratio to the projected capital values described above.

Scenario analyses

Ratios of private to public investment to make growth pay for growth

Councils would have needed anywhere between $30 and $60 worth of development for every $1 they spent on growth infrastructure to make growth revenues match costs.

Figure 10 in the body of the report estimates the amount of private investment that would be required to make growth revenues align with expenditure over the period 2007 through 2031.

This analysis draws upon our main analysis and completes a scenario analysis wherein building consents were much higher (or lower) than they were for the period. As in our main analysis, this scaled hypothetical building consent figure is multiplied by average effective tax rates on both residential and non-residential property to generate rating base revenue benefit.

The specific steps are as follows:

(1) Determine the value of new building consents (in 2023 NZD) relative to capital expenditure on growth for the 2007 through 2031 period from our base analysis. This produces an estimate of the share of growth revenues that can cover growth expenditure (as in Table 2 in the body of the report25).Table 2: Total growth costs compared to growth revenues, 2007–2031

(2) Apply a scaling factor the annual building consent data each year such that "growth paid for growth" or growth revenues covered 100% of growth costs. For some cities where growth has paid for growth in our main analysis, this scaling factor would be less than one. This scaling factor is applied equally to residential and non-residential

building consents.

(3) Determine the ratio of aggregate hypothetical building consent value to actual growth capital expenditure.

Note that for two councils, things are slightly different. First, for Auckland, the period studied is 2012 through 2031 since we do not have growth expenditure figures prior to that (Auckland Council was established in 2010. Prior to that the Auckland Region had seven city and district councils, plus the Auckland Regional Council).

Second, because Hamilton used land values as the basis for rating, it did not receive much direct rating benefit from improvement value from 2007 through 2015.[56] We calculate the hypothetical ratio using scaled building consents from 2006 through 2031 anyway, as if they did realise rating benefit. We did this because we assume that development that occurred prior to 2016 added to its capital value in those years, but it did not flow through to rates revenue. As such, for Hamilton, the results of this analysis should be interpreted as if Hamilton did have a rating system based upon capital value for the entire period. This being said, our base analysis does not attribute rating benefit revenue to Hamilton in those years. We find that to make growth pay for growth in Hamilton, consented value would have needed to be over 3 times higher than it was (and what was forecasted) from 2016 through 2031.

Analysis of rates needed to make growth pay for growth

In the body of the report we note that rates would have needed to be multiples higher in Tauranga, Hamilton, and Auckland to pay for growth.

To arrive at this figure, the process was similar to the analysis above. We begin with our base analysis and results and simply scale upward the effective tax rates on residential and non-residential property such that growth revenues from rates and development contributions cover growth costs.

[56] The value of improvements is simply the difference between your capital value and land value. Although it reflects the value added by structures on the property, it does not represent a replacement cost to build or the insurance value of buildings. (https://hamilton.govt.nz/property-rates-and-building/property/property-revaluations/)

Appendix B: Estimating the fiscal returns to transport investments

This Appendix describes the methodology used to calculate the fiscal returns from current and future major transportation projects.

The information to determine the fiscal returns is drawn from business cases for the respective projects. All of these projects follow the New Zealand Transport Agency's (NZTA) Monetised Benefits and Costs Manual (MBCM) for project appraisal.[57] This is useful because the same benefits are quantified across all projects. Therefore, we will use this framework to structure our discussion in this appendix.

All calculations are done on a net present value basis using the discount rates and time frames identified in each business case. They are also presented in inflation-adjusted terms, using a base year used in the respective business case.

How we calculated fiscal returns

It is useful to look at where the benefits of infrastructure accrue when examining the scope for fiscal returns. In our analysis, we have identified three potential sets of benefits from transport investments that could yield fiscal returns:

1. travel time savings
2. improved health and safety
3. wider economic benefits (WEBs).

We describe each of these, and how we measure their impact on the fiscal benefit of new investments, in turn below.

1. Travel time savings

A major benefit of transport infrastructure investments in a mature system are savings in the time people spend travelling. The value of travel time savings is an opportunity cost to both individuals and businesses, and that therefore any reduction in travel time can be represented as a cost saving. There will also be additional trips induced by the fact there is now a new and or improved transport link with lower travel times.

This will have two effects. First, it will reduce the travel time savings of existing trips because of greater congestion (or, rather, a lessening in the reduction in congestion the new infrastructure creates). Second, the new users will gain some benefit from taking the trip, over what they would be doing otherwise. Note that the benefit to society is not the value of this new trip, but rather the

[57] https://www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual

Like our analysis, the MBCM manual also highlights the different-but-complementary nature of financial and economic analysis: "economic analysis compares the benefits and costs of an activity to society and the economy as a whole, while financial analysis compares only the financial revenue and costs of the activity" (p. 28). Particularly relevant for this paper is the following definition: "In the context of appraising transport activities, financial analysis focuses on the revenue generated from the activity and financial costs to implement, maintain, renew, and operate a facility or service. Revenue may also include funding contributions from users or third parties in relation to the activity" (ibid).

net benefit over what they would otherwise be doing. This baseline scenario is called the 'do-minimum' in NZTA's MBCM guidance.

There are three mechanisms through which reduced travel times generate social and economic benefits, with different potential impacts on the financial revenue:

1. the consumption benefit to individuals in terms of the value of their time
2. the influence on labour supply by reducing the costs of getting to work
3. a reduction in costs for business.

The private benefits to individuals of spending less time driving, and more time on something else, are generally not priced and so not taxed.[58] If they are priced, through tolls or tickets, they can be added to the financial benefits.

Travel time savings can also result in productivity and output increases, which can translate to greater income and company tax revenue. In the MBCM, these benefits are captured as part of Wider Economic Benefits (WEBs), rather than travel time savings benefits. In our calculations, where WEBs were calculated, we used those figures to calculate the benefits from rising productivity and output.

However, in instances where WEBs were not calculated, we attempted to attribute some fiscal benefit to work trips that could be completed due to travel time savings. We note, however, it is possible that the travel time benefits realised by users are not used to complete additional work trips or work more. If this is the case, these travel time benefits would not result in any additional revenue for the Crown.

This estimation was done for the Ōtaki to North of Levin (O2NL) motorway. The O2NL business case[59] includes information on vehicle kilometres travelled (VKT) compared to the do-minimum. It also contained information on the traffic composition (75% Rural Strategic and 25% Urban Arterial).

Calculating kilometres travelled for work trips

To calculate how many of the VKT related to work activity (as opposed to personal uses, including commuting to and from work), we can build it up using values providing in NZTA's MBCM guidance.

We start with figures for overall VKT and traffic composition provided in the O2NL business case. This allows us to calculate how many VKT occur on Urban Arterial and how many on Rural Strategic roads.[60] Specifically, we calculate:

$$VKT_r = VKT_{TOT} \times S_r \qquad (3)$$

where

VKT_r = the miles on each road type r (Urban Arterial or Rural Strategic)

VKT_{TOT} = total VKT (from the business case)

[58] One exception is the case of toll roads. If the new road were faster and had a toll on it, and the toll is not more than the valuation the driver puts on the time saving, this is both an opportunity to finance the infrastructure both directly through the toll and indirectly through the GST levied on the toll.

[59] https://www.nzta.govt.nz/assets/projects/o2nl-new-highway/technical-reports/O2NL-Final-DBC-board-endorsed-August-2022.pdf

[60] These are terms for different types of roads in the MBCM.

S_r = share of traffic on road type r (from the business case)

Because some types of vehicles are more likely to be used for work purposes, and to use particular types of road, we need to account for this in our calculations. The MBCM provides information on these (and other) aspects that we can use.

To use these figures, we need to work out how many VKT are done by different types of vehicle on each the type of road. Table A47 of the MBCM provides shares of five types of vehicles (cars, light commercial vehicles, medium commercial vehicles and two types of heavy commercial vehicles).

Table B1: Travel composition by vehicle class (%) *(Excerpt from MBCM Table A47)*

	Road type	
Vehicle class	Urban Arterial roads	Rural Strategic roads
Car	85	78
Light commercial vehicle	10	10
Medium commercial vehicle	2	4
Heavy commercial vehicle I	1	4
Heavy commercial vehicle II	2	4
Total	100	100

Source: NZ Transport Agency Waka Kotahi Monetised Benefits and Costs Manual.

We calculate the VKT for vehicle class v on road type *r*, by multiplying the VKT on each road type from equation (3) by the share of vehicle class v on road type *r*. That is,

$$VKT_{vr} = VKT_r \times S_v^r \quad (4)$$

We can convert these numbers into work hours by using the MBCM figures for travel purpose by vehicle class and road type (their Table A50, relevant excerpts from which we provide in Table B1).

Table B2: Travel purpose shares (Excerpt from MBCM Table A50)

	Travel Purpose (%)			
	Work	Commute	Other	Total
Urban arterial roads				
Car	15	15	70	100
Light commercial vehicle	50	10	40	100
Medium and heavy commercial vehicle	85	5	10	100
Regional strategic roads				
Car	30	10	60	100
Light commercial vehicle	55	5	40	100
Medium and heavy commercial vehicle	85	5	10	100

Source: NZ Transport Agency Waka Kotahi Monetised Benefits and Costs Manual.

To obtain the VKT for work purposes by each vehicle class on each road type, we simply multiply the VKT by each vehicle class on each road type from (4) by the share of these that are for the purpose of work from Table B12. That is:

$$VKT_{vr}^{W} = VKT_{vr} \times S_{vr}^{w} \quad (5)$$

The time-saving benefits provided in the business case are set out in terms of three sample journeys (see the first two columns of Table B3). We use these and the values created using equation (5) to estimate total time savings for work trips in a year from the motorway, $TTSW$, as:

$$TTSW = \sum_{vr} VKT_{vr}^{W} \times \left[\frac{(TS_1 + TS_2 + TS_3)/3}{(JD_1 + JD_2 + JD_3)/3}\right] / 60 \quad (6)$$

where TS_j is the time saving for journey j, and JD is the journey distance. This is essentially a product of the total VKT for work purposes for each vehicle class multiplied by an average of time savings per kilometre (divided by 60 to convert it into hours). We do not know how many trips occur will be on each sample journey (much less how many be each vehicle type), and the savings per kilometre are not the same for each journey. Therefore, we take the average saving for a kilometre across all three of the journeys (the average time saving divided by the average journey length). This implicitly weights savings on longer journeys more heavily in the calculation (as there are more kilometre on them) than shorter ones.

Table B3: Time savings for sample journeys on Ōtaki to North of Levin motorway

Trip	Time saving	Distance of journey
1. Taylors Rd to SH1 North of Levin	9.8 minutes	34.4km
2. Taylors Rd to Levin	4.3 minutes	20km
3. Taylors Rd to SH57 north of Levin	11.1 minutes	28.1km

Finally, we calculate the total value of wages earned on those extra hours saved. Table 16 in the MBCM breaks this down by road type (Urban Arterial versus Rural Strategic) and the time of day. We use the "weekday" figure, deflated to 2018 NZD to reflect O2NL's business case.

Table B4: Composite values of travel time (Excerpt from MBCM Table 16)

	Composite value of time ($/hr/vehicle), $2021	Composite value of time ($/hr/vehicle), $2018
Urban arterial (weekday, all periods)	$37.55	$35.22
Rural strategic (weekday)	$50.70	$47.56

Source: NZ Transport Agency Waka Kotahi Monetised Benefits and Costs Manual.

To calculate the tax benefit of extra wages earned from travel time savings, we multiply the value of total wages by the effective tax rate on income from the Internal Revenue Department (IRD).[61] This number was 21.8% in 2022.

Additional FED and RUC revenue

As we noted above, improving vehicle transport links will likely enable more vehicles to flow through the network as congestion is relieved. There could also be induced demand effects for the new road. As more vehicles use the new road, there is likely to be additional fuel excise duty (FED) and road user charges (RUC) from this growth. We note, however, that additional revenue will only

[61] https://www.ird.govt.nz/about-us/tax-statistics/revenue-refunds/income-distribution/tax-on-taxable-income-datasets

be realised if there is induced demand on the specific part of the network that exceeds any offsetting decline in demand on other parts of the network.[62]

For our three case studies, three different approaches were taken to calculate this.

Ōtaki to North of Levin

For the O2NL motorway, the base of additional FED and RUC revenue comes from VKT projections for the new motorway.

NZTA's Vehicle Emissions Prediction Model 6.3 lays out the share of VKT in New Zealand by different types of vehicles.[63] We apply these shares to the VKT from the O2NL business case for cars, hybrids, all types of diesel vehicles, and electric cars.

For FED, we assume average fuel consumption of 0.091 litres per kilometre for a non-hybrid vehicle and 0.086 litres per kilometre for hybrid vehicles. Once applying these fuel consumption rates to VKT calculations for cars and hybrids, we simply multiply the FED rate of $0.70 per litre.

For RUC, we apply the various RUC rates to the VKT directly.

The sum of these two sources of revenue, above the do-minimum, is the FED and RUC revenue generated from the new motorway.

Pūhoi to Warkworth

To calculate additional FED and RUC revenue for this stretch of new motorway, we began with projections of traffic volumes from the road's 2015 business case.[64] These traffic volumes are expressed as annual average daily traffic (AADT).

From there, we estimate VKT for the do-minimum and the new route, approximating the distance of the new motorway as 18.5 kilometres and 19.5 kilometres for the do-minimum. We then multiply the AADT figure by the number of kilometres. This is an estimate, although we note that there are no exits on this new route, so users are primarily travelling the entirety of its length.

After we calculated the VKT for the new route and the do-minimum, we use the same methodology as the O2NL to determine additional FED and RUC revenue.

Warkworth to Wellford

While the 2015 detailed business case signals that traffic could exceed 30,000 AADT by 2046, there is not enough detail to calculate growth in FED and RUC like the examples above.[65]

As a best-attempt exercise for Warkworth to Wellsford, we used the calculation of new FED and RUC revenue for Pūhoi to Warkworth. These two routes will sit along the same corridor. However, the Pūhoi to Warkworth route does carry more vehicles per day than Warkworth to Wellford at present (21,000 versus 13,400). Even once the Warkworth to Wellsford section is complete, it is expected to carry about 40% less traffic.

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[62] The new infrastructure may *reduce* some fuel usage if it makes vehicles' fuel use more efficient (i.e., cars not sitting idling or having to speed up and slow down).

[63] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/environment-and-sustainability-in-our-operations/environmental-technical-areas/air-quality/vehicle-emissions-prediction-model/

[64] https://www.nzta.govt.nz/assets/projects/puhoi-warkworth/docs/puhoi-to-warkworth-business-case-for-implementation.pdf

[65] https://www.nzta.govt.nz/assets/projects/ara-tuhono-warkworth-to-wellsford/detailed-business-case-oct-2019.pdf

We derive our estimate in the following way:

- For Pūhoi to Warkworth, calculate the estimate for additional FED and RUC revenue as a share of total travel time savings and travel time reliability benefits in the business case.

- Apply this ratio to the estimated travel time and travel time reliability benefits in the Warkworth to Wellsford business case.
    - We note that the travel time savings benefits in in 2015 NZD for Pūhoi to Warkworth are $586 million, while the same figure for Warkworth to Wellsford is $591 million.

We supplemented this estimate by using the ratio of the respective motorway lengths (16.4 kilometres for Pūhoi to Warkworth and 18.7 kilometres for Warkworth to Wellsford).

From these two estimates, we use the midpoint, which yields a figure of approximately $54.8 million in 2015 NZD, discounted.

2. Improved health and safety

Safety improvements on an upgraded transport link can reduce accidents and deaths. Project appraisals often attempt to quantify these benefits.

For two of the projects (Ōtaki to North of Levin (O2NL) motorway and Warkworth to Wellsford), we were able to convert estimated deaths or serious injuries (DSIs) avoided to a fiscal impact by using an estimate from Treasury's CBAx tool for health system savings for deaths and fatal injuries.[66] These are estimated as $16,400 for fatal crashes and $20,500 for serious crashes in 2023 NZD. Some adjustments were required:

- For the O2NL motorway, the business case estimated 35 to 40 DSIs avoided every 5 years. The evaluation period was 60 years. We convert the 35 to 40 DSIs to an average of 7 to 8 per year and then spread those equally across the 60-year time horizon. To each year, we multiply the CBAx estimate and then convert to net present value using the discount rate in the business case (4%).

- For Warkworth to Wellsford, the business case states that 174 DSIs would be avoided over a 30-year period. We transform this into an average of 5.8 DSIs avoided per year and spread that over the 40-year evaluation period. As with O2NL, we then multiply this annual DSI by the CBAx estimate. The business case states that benefits accrue between years 7 and 40 with a 6% discount rate. We calculate the fiscal benefit by simply summing the first 6 years and then discounting the remaining.

For the other projects, we needed to use a more approximate approach. The value of injury from the MBCM is estimated as $12.5 million per fatality, $660,100 for serious injuries, and $68,000 for minor injuries. These are drawn from surveys completed of individuals (Denne et al., 2023). They do not reflect the costs saved for the national health system. Nor are they estimates of lost earnings.

This presents a challenge for us. As an imperfect solution, we used information provided from the technical notes for evaluation of health and safety benefits from active modes.[67] This methodology suggests that health system savings costs from active modes account for approximately 6.3% of

[66] https://www.treasury.govt.nz/publications/guide/cbax-spreadsheet-model

[67] https://www.nzta.govt.nz/assets/resources/Monetised-benefits-and-costs-manual-technical-notes/health-and-active-modes-impacts-march-2020.pdf

total estimated economic benefits of health improvements (Table 4.1.4). Most benefits are healthy life quality and expectancy benefits.

To estimate fiscal benefits to the health system from lives saved, we apply this 6.3% share to the value of health benefits and accident cost savings.

This blunt approach likely leads to an overestimate of the benefits to the health system. For O2NL and Warkworth to Wellsford, it leads to an estimate that is approximately 2 to 3 times higher than the CBAx approach.

We note that fiscal benefits could extend beyond those we estimated because lives saved are individuals who could work over the evaluation period and provide tax revenue. We consider this omission to be relatively small, since accident cost savings are 10% or less of total benefits. The wage benefit would only be a portion of this, and beyond this, the tax benefit would be even smaller.

3. Wider economic benefits

Wider economic benefits (WEBs) are impacts that can result from investments in transport infrastructure. They are generally considered impacts that are in addition to those benefits realised by transport users themselves.

We consider these benefits the primary way that a piece of transport infrastructure is likely to generate economic growth and fiscal returns. A significant amount of work has been undertaken in the development of transport appraisal to separate these economic benefits from transport user benefits, such that economic benefits are not double counted. In other words, the economic growth case for transport infrastructure should primarily be demonstrated by wider economic benefits, rather than conventional direct transport user benefits.

For our analysis, we focus on four WEBs covered in the MBCM.

- *Productivity gains from agglomeration and land usage*: transport investment can reduce the costs of transport for goods and labour. Investments can lead to clustering which enhances productivity and output.
- *Employment impacts:* a new transport link can make it easier for people to get to work, which may affect an individual's decision to work more. It can also lead to new employment opportunities when there is unemployment.
- *Imperfect competition:* when transport investments are made, travel time savings for work purposes will lead to a productive use, the value of which is commensurate with a worker's wage in a perfectly competitive market. However, when there are imperfectly competitive markets, the value of output produced by an extra hour of labour is higher than the wage. (Kernohan and Rognlien, 2011). The value of this economic impact is the difference between the wage and the markup.
- *Regional economic impacts:* the benefits are largely the result of increased tourism spending.

Our approach to quantifying revenues for these benefits is the following:

- For agglomeration WEBs, we simply apply the average effective tax rate on personal income from the Internal Revenue Department. This was approximately 22% in 2022.

- For imperfect competition benefits, we apply the company tax rate of 28% to any benefits. This assumes that the benefits will be realised in the form of higher net income for companies.

- For employment WEBs, the benefit is assumed to be the tax wedge on increased employment because per Kernohan and Rognlien (2011), there is no welfare gain for the individual themselves. The benefit purely accrues in the form of tax revenue. As such, no tax rate is applied, and the full benefit is counted as tax revenue.

- For regional economic impacts, we apply the GST rate of 15% to any estimates. The benefit for this benefit is the gross value added from foreign tourism. This is the equivalent of gross revenue minus intermediate inputs. Increased tourism could lead to greater employee compensation and profits, so our method may be an underestimate.

In general, our fiscal impacts estimate for economic benefits from transport investment is primarily based upon wider economic benefits. Where these are not specifically identified, it is a suggestion that the economic benefits (rather than direct user benefits) are not large.

We consider that our quantification of fiscal benefits of WEBs to be more of an upper bound. For example, assuming that all increased output in imperfect competition will actually correlate to increased profit, and hence tax, is a "best-case" scenario. It's entirely possible some businesses, even when faced with lower transport costs, will not choose to increase output (or at least not to the full extent possible).

Alternative approaches to quantifying WEBs

Where WEBs were not reported, we tried to present alternative findings. For instance, for the O2NL motorway, WEBs were not reported, but we attempted to estimate benefits of work travel time savings (as discussed above). We also put forward another rudimentary estimate of labour supply benefits WEBs, which are typically about 5 to 10% of total benefits.

For the Warkworth to Wellsford Business Case, the specific WEBs for the entire Pūhoi to Whangārei corridor are listed. However, a further table lays out the *total* WEBs by each section. For this case, we assumed that the share of total WEBs for each section applied to the specific WEBs for the whole corridor. For instance, the Warkworth to Wellsford section accounts for $79 million of the $700 million WEBs for the whole corridor. We applied this ratio to the estimated WEBs for Tourism, Productivity, and Labour Supply WEBs for estimated by NZTA for the whole corridor.

For the City Rail Link, we explored an alternative approach. Page 74 of its business case states:

> Industries which cluster in the CBD will be 'winners' from the City Rail Link, but the largest single beneficiary is Central Government. Over the 40-year period, Central Government would collect around $1.4 billion (in undiscounted terms) in taxation revenue as a result of the City Rail Link.

It is difficult to ascertain how this revenue figure was derived as it is not explained in the business case. The mention of businesses clustering suggests that this is the result of agglomeration economies or general wider economic benefits. The business case contains estimates of agglomeration WEBs, which range from $555 to $1.4 billion in discounted terms over 40 years.

We attempted to discount the $1.4 billion tax revenue figure across 40 years at a 6% discount rate, assuming an annual average revenue take of $35 million ($1.4 billion divided by 40 years). This results in a discounted revenue figure of approximately $530 million. The only way we could align the narrative statement on tax revenue with the WEBs estimates is to assume the upper end of the

WEBs range, and a very high tax rate (above 37%). We ultimately decided against using this figure for this reason.

Does a different method of modelling benefits matter?

The NZTA MBCM is a standardised methodology for measuring the benefits of transport proposals. While its development is underpinned by a significant body of research on identifying and quantifying the benefits of transport, it is not the only way to evaluate economic benefits.

Another tool, economic impact analysis, estimates the effect that a project or programme will have on the structure of the economy, or on the economic welfare of groups of people. Economic impacts are usually expressed in terms of number of jobs, income effects, tax revenue, and goods/services output broken down by sector and/or location.

No method for evaluating economic impacts is perfect but extra care usually needs to be taken with economic impact analysis than traditional methods like the MBCM. If resources used to fund a project are being utilised elsewhere in the economy, an evaluation of a project must be made on a net-of-costs basis. Further, researchers must consider whether the benefits of the project are already being realised elsewhere in the economy. Absent these considerations, economic impact analysis can lead to much higher purported benefits than the MBCM.

Notwithstanding these caveats, it is possible to make revenue estimates from economic impact analyses. Two case studies are below.

NZIER report on the Northland Expressway

In 2023, the New Zealand Institute for Economic Research (NZIER) completed a study on the economic benefits of the Northland Expressway, a proposed four-lane motorway extending from Auckland through to either Whangārei or Kaikohe.[68] That report used traditional transport evaluation methods as well as an economic impact analysis and found that benefits measured by the latter were much higher.

Our analysis for two sections of that motorway (Pūhoi to Warkworth and Warkworth to Wellsford) found that the financial returns on those investments would cover less than 20% of their whole-of-life costs.

Using an economic impact analysis approach, the NZIER study finds that $221 million in annual tax revenue would accrue to the Crown for a hypothetical motorway from Auckland to Kaikohe.[69]

Based upon per-kilometre costs of $30 to $60 million,[70] the report estimates a cost of $5.5 to $11 billion for completing the existing motorway from Warkworth to Kaikohe.

Determining financial returns from this study is difficult for a few reasons:

- The annual tax revenue estimate corresponds to a motorway that includes the already-constructed Auckland to Warkworth section, in addition to a hypothetical Warkworth to

[68] See NZIER, 2024.

[69] See slide 26 of the report's summary: https://www.parliament.nz/resource/en-NZ/54SCTIN_EVI_483f926f-e5a3-4c60-bf75-08dc6a5b5565_TIN1323/0d03f8fbacd7d61e45d11ca17db435afb6288787

[70] In our *Buying time: Toll roads, congestion charges, and transport investment* report (New Zealand Infrastructure Commission, 2024a), we used data gathered from New Zealand and international benchmarks for motorway construction and estimated that a low-cost motorway had costs of approximately $32 million per kilometre and a high-cost motorway would have costs of $94 million per kilometre.

Kaikohe extension. The cost estimate includes only the cost for a Warkworth to Kaikohe extension. Our work above highlighted that the sections closest to Auckland had the greatest economic benefits using traditional methods, so this mismatch between revenue and costs could be material.

- The timing of the costs and benefits flows is unknown. The annual $221 million revenue estimate only accrues when the full motorway is complete, but it will be less as the project is being completed, which could take more than 10 years.
- The cost estimates likely do not include operational and maintenance expenses so the $5.5 to $11 billion cost estimate is not representative of the whole of life cost of the project, which is standard in traditional transport appraisal.
- Time period for considering costs and benefits is unknown. In our case studies above, the period ranged from 30 to 60 years.

Notwithstanding these hurdles, we can reasonably infer that the financial returns will not be sufficient to cover this motorway's costs.

For instance, if this motorway were to be financed, depending upon interest rates and maturity,[71] the annual interest costs alone would be between $100 to $200 million per year if the cost is $5.5 billion, and between $250 and $400 million if the cost is $11 billion. This implies that the full capital cost, plus potentially interest expense, would need to be funded from elsewhere.

Principal Economics report on the Waikato Expressway

In 2022, Infrastructure New Zealand commissioned Principal Economics to study the economic impacts of delays in moving forward on infrastructure projects.[72] As part of that study, an economic impact analysis was completed estimating the benefits of the full Waikato Expressway on the New Zealand economy. Using a computable general equilibrium (CGE) model, they find the annual GDP impact of the expressway of $281 million (in 2022 NZD).

We apply revenues as a share of GDP from the OECD[73] for taxes on goods and services (11.7%) and income (19.3%) to this $281 million figure to estimate approximately $92 million in annual tax revenue in 2023 NZD.

We could not find information on the full whole-of-life costs for all sections of the Waikato Expressway. Using data from NZTA's project websites, we found the following *construction* costs for the various sections, whose total is over $2.5 billion in 2023 NZD.

[71] We assume a financing period of 30 years, and a nominal interest rate of between 4% and 5%.

[72] See Principal Economics, 2022

[73] https://www.oecd.org/en/data/datasets/global-revenue-statistics-database.html

Table B5: Constuction costs for sections of the Waikato Expressway, 2023 NZD

Section	Cost (millions, in 2023 NZD)	Source
Mercer	$127.0	https://www.beehive.govt.nz/speech/opening-sh1-mercer-longswamp
Longswamp	$135.5	https://www.nzta.govt.nz/projects/waikato-expressway/longswamp/
Rangiriri	$152.1	https://www.nzta.govt.nz/projects/waikato-expressway/rangiriri/
Ohinewai	$39.8	https://en.wikipedia.org/wiki/Waikato_Expressway
Huntly	$451.1	https://www.nzta.govt.nz/projects/waikato-expressway/huntly/
Ngāruawāhia	$213.7	https://www.nzta.govt.nz/projects/waikato-expressway/ngaruawahia/
Te Rapa	$223.9	https://www.nzta.govt.nz/projects/waikato-expressway/te-rapa/
Hamilton	$884.9	https://www.nzta.govt.nz/projects/waikato-expressway/hamilton
Cambridge	$316.9	https://www.nzta.govt.nz/projects/waikato-expressway/cambridge/
Total	**$2,545.1**	

Source: New Zealand Infrastructure Commission's analysis of NZTA project websites.

Depending upon the temporal flows of the costs and benefits of the motorway (the sections were completed at different times), this analysis suggests there could be comparatively high cost-recovery potential for the motorway. For instance, 40 years' worth of tax revenue in net present value terms with a 5% discount rate would lead to revenues covering over 50% or more of the cost.

NZIER report on the Cambridge to Piaere and Warkworth to Wellsford motorways

Another study by NZIER examined the economic benefits (using a CGE model) of both the Cambridge to Piaere (C2P) extension of the Waikato Expressway as well as the Warkworth to Wellsford motorway (NZIER, 2023). That report found:

- Over a 20-year period, the discounted impact on real GDP of the Cambridge to Piaere extension would total over $6.1 billion to New Zealand.

- Over a 20-year period, the discounted impact on real GDP of the Warkworth to Wellsford motorway would total over $6.3 billion.

If these results were used, it would imply a significant share of these road investments could be recovered by additional tax revenue. However, we note that this study predicts benefits significantly higher other studies:

- The C2P motorway is one 16-kilometre section of the entire Waikato Expressway, which is over 100 kilometres long in total. Principal Economics estimated the annual real GDP impact of the *entire* expressway at $334 million (in 2023 NZD) while NZIER estimated that C2P alone would add $487 million.

- The Warkworth to Wellsford business case estimated wider economic benefits of the motorway to *total* $240 million (in 2023 NZD) across 40 years. The NZIER report's agglomeration estimate across only 20 years was $1.18 billion.

The wide range of results across all of these studies highlight the importance of the MBCM model as a standardised approach for appraising transport projects.

Appendix C: Value capture model

In this Appendix, we describe the methodology, input assumptions, and data sources used for our value capture model.

Data sources

The key source of data for the model is land and property value data. This data is drawn from a CoreLogic dataset provided to the Commission. It contains information of aggregated land area, properties, land values, and capital values for each Statistical Area 2 (SA2) in New Zealand.

Additional data important for the model include:

- *Population data at the SA2 level drawn from Stats NZ*. We matched SA2 identifiers in our valuation data, which were 2021 SA2s, using concordance tables provided by Stats NZ.

- *Infrastructure project costs:* In our model, we use input assumptions for the cost of various infrastructure projects. We use these costs to calculate per kilometre estimates. The data are from a variety of sources:
    - For motorways, road tunnels, and rapid transit stations, the New Zealand Infrastructure Commission has collected data for New Zealand projects, dating back to 2000.
    - For at grade and light rail costs, we use data from the Eno Center for Transportation database, a collection of projects worldwide.[74] We convert these to inflation-adjusted NZD, and create 10%, 50% and 90% percentiles for each country.

Input assumptions

Our value capture model estimates revenue potential for two value capture tools: a targeted infrastructure levy and a one-time tax on the land value uplift.

For both models, we make similar input assumptions.

For project costs, we used the following per kilometre costs, drawn from New Zealand and international benchmarks.

Table C1: Assumed costs for infrastructure projects used in our model

Project type	Cost in 2023 NZD
Low-cost motorway	$32.48m per km
High-cost motorway	$93.34m per km
At grade light rail	$71.80m per km
Transit stations	$134.40m each

To incorporate land costs into our model, we made the following assumptions for each type of project.

[74] https://projectdelivery.enotrans.org/transitcostsexplorer/

Table C2: Assumed lengths and land requirements for modelled infrastructure projects

Project type	Length	Corridor Width	Total Land Requirement (Hectares)
Low-cost motorway	20 km	30 metres	60
High-cost motorway	20 km	30 metres	60
At grade light rail	20 km	15 metres	30

Rather than use specific cities to estimate land value uplift, we create example cities that are based upon New Zealand cities. These cities are generated based upon the density of their populations and average values per hectare. In these hypothetical cities, property values are estimated to be the average of given property values across the selected cities. For example, the value of a residential property in a suburban neighbourhood in a dense city is effectively the average per hectare land value of such a property in Auckland or Wellington.

The city categories used in the model are as follows:

Table C3: New Zealand city property and density characteristics used to create hypothetical cities

City	New Zealand cities included
Dense city	Auckland, Wellington
Middle density city	Christchurch, Hamilton, Tauranga, Lower Hutt, Dunedin
Small city	Palmerston North, Napier, New Plymouth, Whangārei, Rotorua, Hastings
Rural area or small town	All other locations

The benefits of infrastructure affect land values depending upon the density of the parcel, and the type of property. For example, the land value uplift of an infrastructure project is likely to be different on a residential property in a dense area of a city versus a commercial property in a rural area.

To give precision to our model, we use 8 different types of property in 4 different density types (32 different varieties of property). The density types are defined below. The property types are the categories used by CoreLogic in their dataset.

Table C4: Density and property types used in land value uplift model

Density types	Property types
Rural (<= 1 pop/ha)	Residential
Lifestyle block (1-10 pop/ha)	Commercial
Suburban (10-100 pop/ha)	Industrial
City centre (>100 pop/ha)	Rural
	Recreational
	Other
	Community
	Unknown

In our model, a key input assumption is the catchment area. While this could hypothetically be along the entire infrastructure corridor, most research has defined the benefit catchment areas based on proximity to access points, in this case, train stations or motorway exits.[75] For our model, we assume a circular catchment area with a 1.5-kilometre radius around each access point although we sensitivity test our results with a large catchment area.

A key aspect of the model is providing assumptions about where the catchment area will be in the respective cities. We make the following assumptions about the share of the 1.5-kilometre radius that falls in given density areas.

Table C5: Assumed affected areas by city and density type

City	Rural	Lifestyle block	Suburban	City centre
Dense city	0%	0%	75%	25%
Middle density city	0%	25%	75%	0%
Small city	25%	75%	0%	0%
Rural area or small town	75%	25%	0%	0%

As an illustrative example, since our model of a motorway assumes 5 exits, the total catchment area is 3,534 hectares ((π*1.5^2) * 5 stations) * 100)). If this project were to occur in a dense city, we assume 2,651 of these hectares (75%) would occur in an area of suburban density, and 884 will occur in a city centre.

Finally, for a hypothetical one-time land value uplift tax, which we define as a tax on the increase in land value due to infrastructure being built, we needed to make assumptions about the scale of uplift. As the literature review in the main report suggests, there is a wide range of estimates, but they tend to converge around 10% to 15% land value uplift directly attributed to infrastructure.[76]

Therefore, we assume the following land value uplift growth for all city types:

- for residential properties: 10%
- for commercial properties: 15%
- for industrial properties: 10%
- for all others: 0%.

This percentage uplift applies linearly across the catchment area for simplicity of our model. Research on land value uplift has highlighted that there is a non-linear decay in value growth. This figure can be considered an average across the catchment area, but our results could be skewed depending upon the assumption around the type of properties located closer or further from exits/stations. If higher value or denser areas are concentrated next to the stations, our results will be underestimated.

To estimate land acquisition costs, we multiply the land requirement (30 or 60 hectares, depending on the type of project) by the average land value in each of our respective cities in the affected density areas.

For example, a 20-kilometre motorway in a dense city will require 60 hectares of land, 75% of which will be in a suburban area (45 hectares) and 25% will be in a city centre (15 hectares). In our data, the average value per hectare in areas with suburban density for a dense city is approximately $12

[75] See Nunns and Baker, 2015.

[76] See Nunns and Baker, 2015.

million, whereas within city centre density areas, the average value per hectare is $39 million. In this example, the total land cost would be about $1.1 billion (45 multiplied by $12 million, plus 15 multiplied by $39 million). Note this value only includes the value of acquiring land and does not include any additional costs, such as buildings which would be demolished.

Total project costs and revenues are calculated on a net present value basis using a 5% discount rate. For the levy model, we assume a 30-year levy collection period, consistent levies recently implemented as part of Infrastructure Funding and Financing Act 2020 projects.

Core calculations

The calculation of revenue potential is done separately for both the targeted levy and value-uplift tax model.

Targeted levy model

For the targeted levy model, first, we determine how many hectares are affected based on the catchment area and determine where the catchment area is in a respective city.

Since the levy revenue is determined by the *number* of properties in that catchment area, a critical data point is estimating the affected *number* of properties. To do this, from our Core Logic dataset, we know the number of properties (by property type) in each SA2. We determine an average number of properties per hectare based upon this data, based upon the location of the SA2. We calculate this average based upon the hypothetical city types in our model, but also for the type of density *within* those cities (rural, lifestyle block, suburban, or city centre).

We determine the number of affected properties by multiplying this average number of properties per hectare by the number of hectares in the catchment area.

From this point, we estimate the revenue collected by various levy amounts by multiplying the size of the levy by the number of effected properties. This is done over 30 years, and the net present value is calculated and compared to the total present value of the capital cost of the infrastructure.

One-time value uplift tax model

In our simple model, we assume the value uplift attributed to the new piece of infrastructure is one-time and does not have an effect over multiple years.

To calculate revenue potential, we multiply the assumed value uplift percentages to the total land value in the affected catchment area. We lay out an example below:

- In a dense city, the catchment area around a 1.5-kilometre catchment area around 5 exits is 3,534 hectares. This benefit area is split between 2,651 hectares in suburban areas and 884 hectares in the city centre (75%/25%).
- Average per hectare land values in our dense city are calculated based upon densities (suburban and city centre) and property types (residential, commercial, industrial, other). For example, we calculate the average value per hectare of a residential property in a suburban part of the dense city.
- The data on average property values per hectare by density and property type is summarised below.

Table C6: Average property values per hectare for a Dense City in our model, but density and property type

Average property values per hectare, Dense City				
	Rural (<= 1 pop/ha)	Lifestyle Block (1-10 pop/ha)	Suburban (10-100 pop/ha)	City Centre (>100 pop/ha)
Residential	$2,317,161	$7,522,672	$17,020,415	$19,406,977
Commercial	$9,064,602	$10,969,988	$26,403,678	$60,684,872
Industrial	$5,486,664	$5,582,821	$6,900,214	$30,063,835
Rural	$124,542	$892,997	$1,418,983	$33,797,630
Recreational	$42,337	$363,228	$1,092,051	$2,303,313
Other	$38,465	$323,505	$2,673,513	$9,276,902
Community	$122,676	$1,208,889	$2,757,569	$5,286,673
Unknown	$3,052,653	$752,626	$3,621,620	$0

- Based upon the characteristics of the dense city, we calculate the share of hectares that falls into each one of these. The table below shows and example for the dense city. For example, 45% of city centre hectares are residential properties, and 49% are commercial.

Table C7: Share of total hectares by density and property type in a Dense City in our model

Share of total hectares in each property and density type				
	Rural (<= 1 pop/ha)	Lifestyle Block (1-10 pop/ha)	Suburban (10-100 pop/ha)	City Centre (>100 pop/ha)
Residential	1%	12%	62%	45%
Commercial	0%	3%	3%	49%
Industrial	1%	9%	2%	1%
Rural	84%	58%	9%	0%
Recreational	8%	9%	12%	3%
Other	2%	6%	6%	1%
Community	4%	4%	4%	1%
Unknown	0%	1%	1%	0%

- We multiply the catchment area hectares in the respective densities by the percentages above. For example, in the city centre, we multiply 884 hectares by 45% to determine the residential property hectares in the city centre affected by the infrastructure development.

- We multiply the affected hectares by the average property values per hectare. This generates an aggregate property value affected.

- The estimated land value uplift percentages (10–15%) are applied to these values.

- The value uplift tax is applied to this total value uplift to determine revenue potential.

Sensitivity testing

A key assumption of our modelling is the benefit catchment area. In our base model, we assume a 1.5-kilometre circular benefit catchment area around stations and motorway exits. Our 1.5-kilometre area was selected based upon the literature, which shows that land value uplift typically decays beyond 800 metres (Nunns and Baker 2015, Mohammed et al., 2013).

It is possible that the catchment area is wider than this, particularly for motorways since vehicles can travel well beyond exits.

To test how sensitive our model is to changing catchments, we applied a 2.5-kilometre catchment for motorways to see how our results changed. The results of this sensitivity analysis are below for a one-time value uplift tax of 5%.

Figure C1: **Degree of cost recovery sensitivity test of a 1.5km vs a 2.5km radius catchment area**

We find that expanding the catchment area by this amount increases the cost recovery potential by roughly three times. This effect is slightly larger for dense cities versus rural areas.

This is a general finding that could apply across all the parameters in the model. In general, our results are much more sensitive to assumptions in the denser or high value places than they are in rural areas. Changing the catchment area for the rural areas does not meaningfully change cost-recovery.

A further iteration of this model would account for decay across the entirety of the catchment area. What this means is that land values increase by 10%–20% (depending upon the property) within the catchment area uniformly, and 0% outside of it. We consider that our 1.5-kilometre catchment with a uniform land value uplift proxies as an average for a wider catchment with a wider distribution of land uplift values.

Appendix D: Literature review on the economic benefits of infrastructure investment

Whether infrastructure can provide financial returns will depend upon whether infrastructure investment leads to economic growth. This question has been studied at length over the past 30 years and is reviewed here.

There is very little argument that without any infrastructure networks, modern economies would not be possible. What much of the literature has focused on is whether an increase public infrastructure leads to economic growth?

In other words, research has not focused necessarily on whether having any infrastructure is important, but whether adding to it is beneficial. In this context, the existing amount of infrastructure is important. A city or country that has no infrastructure may benefit more from adding to its network than one that has mature networks. In places with mature networks, the research tends to focus on whether infrastructure investment is *net positive* for the economy, given that infrastructure construction diverts resources from other uses.

Theoretical questions discussed in the literature

The relationship between infrastructure and the economy isn't always straightforward, so much of the literature tests various relationships.

The first area of debate involves how infrastructure contributes to growth. The standard approach is to treat infrastructure investment as an input to the economy, similar to labour and capital.[77] Alternatively, infrastructure can be thought of as something that is not a separate input but something that enhances workers and capital's ability to produce goods and services.[78] Another approach is to consider the specific services that infrastructure provides, like transport or connectivity.[79]

Another issue is determining the direction of causality, that is, does infrastructure cause economic growth, or do places that are growing lead demand for more infrastructure? Early works treated the causality as one-way, meaning infrastructure causes growth.[80] However, later works, particularly Holtz-Eakin (1989)[81] have found that accounting for growth in an area is important for isolating the effects of infrastructure. There have been numerous methods to account for this (see Egert et al., 2009 for further discussion).

The more recent literature appears to agree that careful studies examining the link between growth and infrastructure investments must control for this causality issue. However, there is continued debate on the best theoretical model to think of infrastructure's influence on the economy.

[77] Aschauer, 1989.
[78] Dugall et al. 1999.
[79] Fernald, 1999.
[80] Aschauer, 1989.
[81] https://www.nber.org/system/files/working_papers/w4122/w4122.pdf

The effects of infrastructure on economic growth depend upon a variety of factors

Over the years, there have been reviews of the extensive body of research examining the link between public investment and economic growth. Bom and Ligthart's (2014) extensive meta-analysis of 68 different studies found that a 1% increase in infrastructure stocks lead to an increase in economic output by 0.08% in the short run and 0.12% in the long run.

The economic returns of infrastructure investment will depend upon a variety of factors. Romp and de Haan (2005), Straub (2011), and Egert et al. (2009) all provide good overviews. In general, there are some common themes.

The effect of infrastructure spending on growth varies across several factors:

- **Locations:** Estimates range from negligible for US states,[82] small for France and Italy,[83] to sizeable across OECD countries as a whole.[84]
- **Sectors:** For instance, Chandra and Thompson (2000) find very little impact of highways on aggregate economic growth in US states but find that a new highway in a rural area reduces earnings for those working in farming, government, and retail industries while increasing them for manufacturing.
- **Maturity of the network:** In general, the larger and better the quality of the existing network, the lower the impact of new additions.[85] Ramey (2020) found that economic multipliers are greater when a country has below the socially-optimal amount of public infrastructure.[86] The Eddington Transport Study from the UK in 2006 surveyed the literature the economic benefits of transport investments, and found that in mature networks, "there is considerably less scope for transport improvements to deliver the periods of rapid growth seen historically".[87]

Specific evidence linking economic output and infrastructure investment for New Zealand is lacking. Egert et al. (2009) find strong positive returns to investment for roads and rail, but negative returns to investments in motorways, electricity generation, and telephone lines for the period 1960 to 2005. Analysis by the New Zealand Treasury in 2021 found that economic multipliers for government investment to be above 2 in the long term.[88]

Overall, the extensive research on the relationship between economic growth and infrastructure investments can be positive across entire networks but project, location, and maturity of network will affect the returns of any single project or portfolio of projects. In other words, there is more positive evidence of economic benefit at a macro level than a micro level.

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[82] Holtz-Eakin & Schwartz, 1995.

[83] Cadot et al. (1999) and Cadot et al. (2002), Bonaglia et al. (2000).

[84] Kamps, 2004.

[85] Albala-Bertrand & Mamatzakis (2004) in Chile, Canning & Bennathan (2000) across many countries, Fernald (1999) in the US for road networks, Holtz-Eakin & Schwartz (1995).

[86] Ramey, 2020.

[87] Eddington, 2006.

[88] Lyu, 2021.

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