NEW ZEALAND INFRASTRUCTURE COMMISSION
Te Waihanga

Understanding capacity upgrade pressures across infrastructure networks

Te Waihanga technical report

New Zealand Infrastructure Commission / Te Waihanga

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Introduction

As part of the National Infrastructure Plan, we have prepared and published Forward Guidance on projected future capital investment demands to renew, replace, expand, and improve infrastructure networks over the next 30 years. A key finding is that most forecast investment demand, in most sectors, relates to the need to renew and replace existing infrastructure that is wearing out. However, there is expected to be ongoing demand for capacity expansion to accommodate increased infrastructure use, as well as level of service/quality improvements. This will drive the need for new projects to expand or improve services.

This technical report outlines how we analyse potential future capacity upgrade pressures across infrastructure networks and how capacity upgrade demands relate to the investment demand forecasts in our Forward Guidance. It illustrates this approach through case studies of two sectors – public hospital and land transport (road and urban public transport projects) – where demand growth may drive the need for increased capacity. This report provides analytical underpinnings for our National Infrastructure Plan advice on major transport and hospital investment requirements in the next decade.

Prioritising and sequencing major infrastructure upgrades

To balance affordability without compromising economic or social outcomes, infrastructure capacity upgrades should be aligned with demand growth. In New Zealand, like other OECD countries, past growth in the size and value of infrastructure networks has marched hand-in-hand with population and economic growth (New Zealand Infrastructure Commission, 2024b). Sometimes, infrastructure responds to demand, and in other cases it shapes the timing and location of demand. But what's important is that it doesn't get too far behind – or too far ahead.[1]

Where there is a need to expand the capacity of existing infrastructure or expand services, we respond with infrastructure projects. Most projects are small, like resealing a road or building a new classroom at a school.

However, when key parts of an infrastructure network hit capacity or reach the end of their life, we may need to invest in a large upgrade to avoid bottlenecks. Recent examples include Auckland's City Rail Link and Transpower's North Island Grid Upgrade, which relieved expected capacity constraints that couldn't be solved through cheaper options (Commerce Commission, 2015; Sinclair Knight Merz, 2022). These projects can offer significant benefits but are also costly and risky to pursue. When they go wrong, the entire country bears the costs (Boshier, 2022). And even if major projects succeed, financial and market capacity constraints mean we can only do a few at a time.

This means that we need to prioritise and sequence major infrastructure upgrades, ensuring that they are done when needed, not far in advance of demand, and that investment is balanced across different regions that are experiencing demand growth. Sometimes, this will mean building lower-cost 'bronze' solutions faster or upgrading networks in stages rather than leaving problems or opportunities unaddressed while we wait for the 'platinum' solution to be fundable.

[1] Availability of revenue – whether that's central government taxes, local government rates, or user charges – acts as a 'speed limit' on the pace of investment. In the short term, debt or other measures like asset recycling can enable temporary increases in spending. But as both central and local government are moving towards limits on their borrowing capacity, there will be a need to repay past liabilities rather than increase them further.

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A framework for responding to capacity pressures

When we expect to face capacity pressures on existing infrastructure, we need to manage existing assets and invest in a way that maximises the overall value of the existing network and major new investments in the network, within our fiscal and delivery capacity constraints.

In this section, we lay out a framework for responding to capacity pressures on networks. Consistently applying these options through asset management and investment planning helps to ensure projects are optimised, timed, and funded to deliver maximum public value. Key options include:

- **Intervention hierarchy**: Low-cost steps should be taken to maximise value from existing assets prior to progressing major new builds
- **Thresholds for major capacity upgrades**: These provide measurable, evidence-based signals for when and where it may be needed to progress major capacity upgrades
- **Policies to align demand**: Coordinated pricing and land-use policies can shorten the lag between investment and utilisation, helping to optimise benefits from investment
- **New revenue options**: Even after optimisation, staging, and prioritisation, some major projects may still exceed available budget envelopes. In these cases, new revenue mechanisms can enable delivery.

Each of these approaches and their connections is discussed below.

The intervention hierarchy: Optimise what you've already got

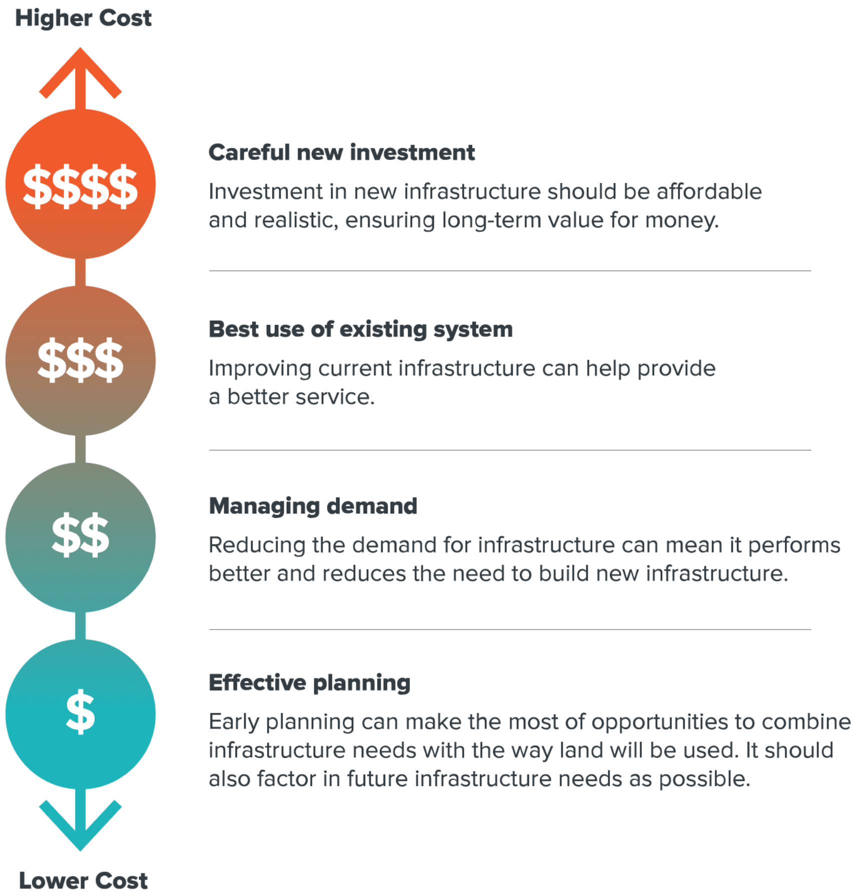
Swiss rail engineers follow a principle that is summarised as 'organisation before electronics or concrete'.[2] Rather than solving every problem with new infrastructure, they focus first on optimising timetables, ticketing, and signalling technology. This means that when they *do* build new rail lines or new tunnels, those assets are well used from day one. The result is that Switzerland has one of the best, and best-used, public transport networks in the developed world.

This is an example of an intervention hierarchy, or a structured approach for making the most of existing assets before committing to large upgrades. Lower-cost options should be implemented first, provided they don't preclude future upgrade options (Figure 1). This starts with better planning and demand management, followed by targeted maintenance, operational improvements, and low-cost upgrades that modestly lift capacity, improve service quality, or extend asset life.

Low-cost interventions help to defer major investments, not avoid them. They are designed to maintain and enhance services while lining up funding for future upgrades. As in the Swiss rail network, consistent implementation of the intervention hierarchy means that when a new asset is built, it enters service with strong demand and integrates effectively with existing networks.

[2] https://www.theglobeandmail.com/opinion/article-what-north-america-can-learn-from-the-greatest-transportation-system/

Figure 1: Intervention hierarchy for addressing infrastructure needs



Source: New Zealand Infrastructure Commission (2022), Section 7.1.

Thresholds for major capacity upgrades: Build at the right time

Infrastructure projects should not be late, nor should they be early. Late projects create bottlenecks that constrain economic growth, while projects that are early, in the wrong place, or oversized divert scarce resources from higher-value uses. Having optimised existing networks through application of the intervention hierarchy, agencies need clear signals for when to commit to the next capacity step.

Capacity and cost thresholds provide measurable, evidence-based signals for when and how to invest in a major capacity upgrade. They can help to guide choices about timing, staging, and scale of investment. Capacity thresholds include measures of current and projected capacity utilisation of infrastructure assets, while cost thresholds include unit cost comparisons against a competitive or affordable benchmark.

There are multiple drivers of investment. Infrastructure projects may seek to renew or replace existing assets that are wearing out, improve gaps in quality or functionality of existing assets, or increase capacity to accommodate additional demand. Often, projects are seeking to accomplish multiple purposes. They also must be financially sustainable, relative to available budgets and appropriate cost benchmarks.

Ideally, cost-benefit analysis should be used to help identify projects that best balance up different outcomes against cost. In practice, unless many options are considered and evaluated, it may not succeed in finding the best balance. In this context, capacity and cost thresholds can help to identify when it is appropriate to focus on capacity enhancements, as opposed to quality improvements, and how large a capacity response is warranted over time.

Capacity and cost thresholds therefore complement good project planning, rather than replacing it. They act as a screening tool to set longer-term expectations for when projects are likely to be needed, what scale of response is appropriate, and whether fiscal conditions allow delivery. However, funding commitments should still rely on a robust business case process that tests strategic alignment, value for money, and deliverability.

Policies to align demand: Making the most of new capacity

Even when projects are built at the right time, their value depends on how quickly and fully they are used. Coordinating infrastructure delivery with policies that shape demand for new assets, such as land use and pricing policies, helps shorten the lag between investment and use.

Land-use policies and network pricing can ‘crowd in’ demand to new infrastructure (Clark, 2026). More people living and working near infrastructure means higher asset utilisation. Spatial planning and enabling more development around new transport facilities can help to achieve this. Similarly, time-of-use road pricing, peak/off-peak public transport fare differentials, and parking management policies can lift utilisation when designed well. These demand-shaping policies complement funding tools, ensuring that investments are both well used and financially sustainable.

New revenue options: Finding funding for high-value projects

Some major projects may still exceed available budget envelopes, even after taking the above steps. In these cases, new revenue mechanisms become the final lever for delivery. This means targeted user charges or cost-recovery levies added on top of existing taxes and rates to generate dedicated revenue for a project.

The quality of a project determines its revenue potential. Where users are willing to pay for spending that goes well beyond existing taxes and charges, it signals that benefits are clear and valued. Conversely, weak revenue potential is a warning that a project may not deliver sufficient value. If costs cannot be covered even with reasonable charges, it is better to wait until demand strengthens or to pursue a more affordable alternative. Used sparingly and transparently, new revenue mechanisms on high-quality projects allow further projects to proceed without compromising fiscal discipline.

We’ve used these mechanisms in the past. Historical examples include the 1959 Auckland Harbour Bridge, which required a large toll to pay for it, and the initial extension of electricity supply in the 1920s, which required new ratepayer levies (New Zealand Infrastructure Commission, 2024a, 2025b). In both cases, users were willing to pay significantly more for a transformational uplift in services. More recently, users have been willing to pay modest tolls to bring forward construction of roads like Auckland’s Northern Gateway and Tauranga Eastern Link.

Connecting this framework and our Forward Guidance

In this technical report, we apply this framework analytically to two case studies to demonstrate how infrastructure providers can consider the timing of major capacity upgrades against current and projected future demand.

The backdrop for demand we use is the Commission’s Forward Guidance. Our Forward Guidance, which is featured in the National Infrastructure Plan, is a forecast that is designed to give decisionmakers information about long-term demands for infrastructure investment. Most useful for this exercise, it shows what we estimate to be the public's long-run willingness to invest in improvements or expansions to various networks. If we see that investments in capacity are well in excess of our Forward Guidance, it might signal that they are being built in advance of demand or willingness to pay.

We completed this analysis for two sectors: hospitals and land transport.

In hospitals, demographic shifts are expected to drive greater demand for health infrastructure. Our analysis provides our advice of when investment in new hospital capacity may be required in response, as well as where we think it may occur at a regional level.

In land transport, population growth is expected to be the primary driver of demand growth, although there is uncertainty about the pace and location of growth. In recent years, a number of major transport projects (both road and rapid transit infrastructure) have been proposed and are in various stages of planning. These projects significantly increase network capacity relative to current roads or public transport services, as well as improving service quality and reliability. Our analysis gives insight how ways to sequence these investments in line with demand growth while balancing affordability of investment.

Hospitals

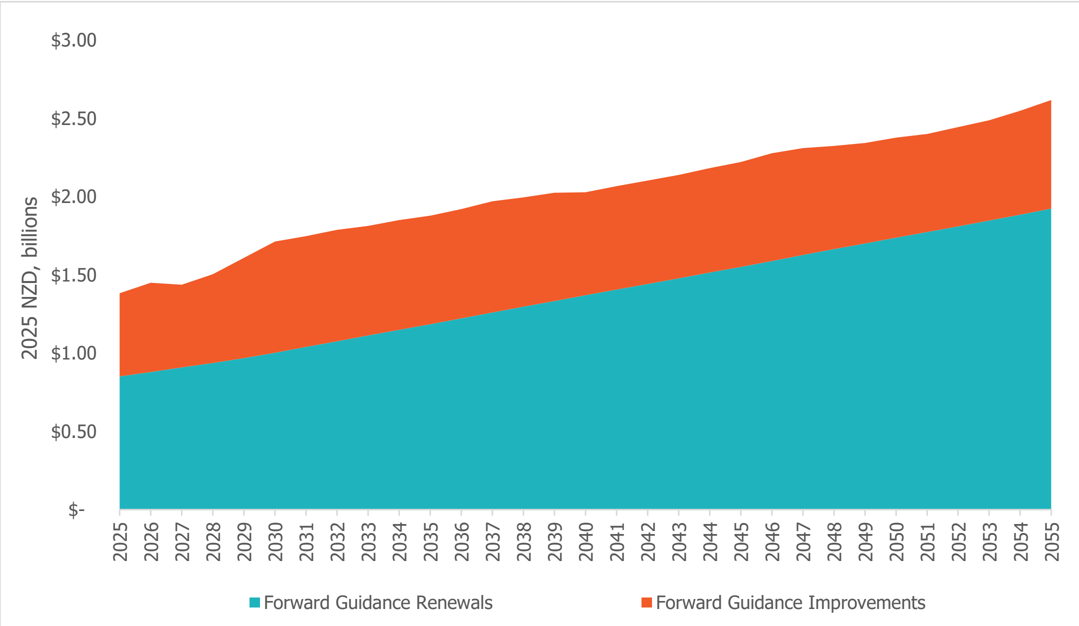
Analysis of regional demand for public hospitals

What does the Forward Guidance suggest?

Our Forward Guidance suggests that in aggregate, the country is likely to demand approximately $17 billion of capital expenditure within the health sector across the next 25 years. On a year-by-year basis, this represents an average expenditure level of 0.35% of GDP. This is an uplift in investment from the last decade, where spending has averaged approximately 0.2% of GDP. For context, the difference between our forecast and 0.2% of GDP is over $600 million annually.

Like most sectors, most investment demand is forecast to be for renewal and replacement of our existing health infrastructure. Capacity upgrades are driven mostly by demographic change, as an ageing population is expected to increase demand for health facilities (Figure 2).

Figure 2: Our Forward Guidance for hospital and health facility investment, 2025–2055

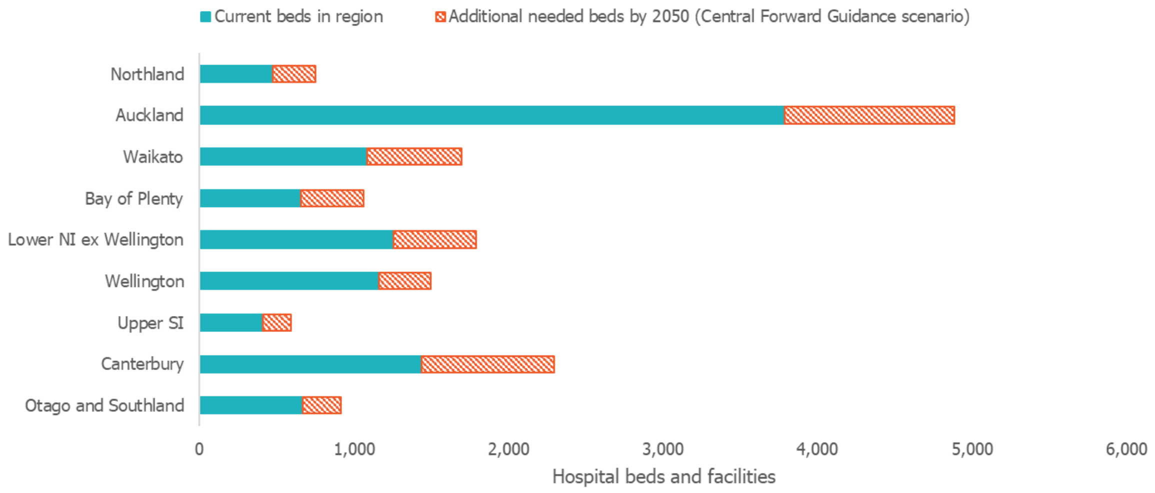


Source: New Zealand Infrastructure Commission analysis from our Forward Guidance. See New Zealand Infrastructure Commission (2026) for more information.

Average annual renewal expenditure over this period is expected to hover around 0.23% of GDP (with an average annual expenditure level of $1.37 billion), and average annual improvements expenditure over the same period is expected to average approximately 0.12% of GDP (which is an average annual expenditure level of $0.66 billion).

We forecast that this future capital expenditure allocated to improvements translates to an additional 4,549 hospital beds spread across the country (Figure 3).

Figure 3: Forecasted distribution of hospital bed and facility growth, 2050, according to the Commission's Forward Guidance



Source: New Zealand Infrastructure Commission analysis. Note: Regions combined for ease of readability. 'Lower NI' is comprised of Gisborne, Hawke's Bay, Taranaki, and Manawatū-Whanganui. 'Upper SI' is comprised of Tasman, Nelson, Marlborough and West Coast.

The methodology for producing this analysis and the capacity estimates in the National Infrastructure Plan can be found below.

Inputs to our analysis

Key assumptions for converting investment demand to physical capacity needs

Our health sector demand forecasts rely on the central demographic scenario outputs from our Forward Guidance modelling, alongside some key assumptions.

Gross floor area (GFA) per bed

Note that GFA includes the entire range of facilities that would exist in hospital infrastructure. This includes the floorspace explicitly used for the bed, but also parking lots, administrative space, and other areas within the hospital.

Our analysis has used a figure of 202 m^2 GFA per hospital bed. This figure is drawn from NZIER (2023), which uses data on New Zealand's current hospital stock to estimate this value.

Their justification began by first analysing the (at then 2023) current counts of hospital beds from Health New Zealand. This suggested that New Zealand had 10,910 beds, spread across 68 hospitals.[3] For this bed count, total GFA was approximately 2,203,300 m^2.

This results in an average 242 m^2 of GFA per bed. However, as NZIER noted in their analysis, the distribution of GFA per bed was not always consistent between hospitals. There was a general trend of larger hospitals having a lower GFA per bed, simply due to the economies of scale associated with bigger campuses. Going forward, capacity demands are likely to be met through larger hospitals. As a result, a scaled down value of 202 m^2, derived from averaging the bed GFA

[3] https://www.health.govt.nz/regulation-legislation/certification-of-health-care-services/certified-providers/public-hospitals

from New Zealand hospitals with greater than 50 beds, was used for the prior analysis. We have used that figure in this analysis.

Costs per square metre of floor area

Our analysis has used a capital expenditure figure of NZ$20,000 per square metre of floor area. The value used is the same cost estimate that was used within the Whangarei Hospital Redevelopment Business Case, which is specifically for a new build hospital (NZIER, 2023).

Consistent with our Forward Guidance, it is likely that there will be high bed demand across the country, and some regions will effectively require an expansion of capacity commensurate with an entirely new hospital. This led us to conclude that applying a new build out cost estimate from a recent business case reflected the most reasonable scenario.

We also considered a range of other figures when settling on this value:

- International hospital upgrade costs: A 2022 high-level benchmarking study estimated that hospital projects in OECD countries cost an average of around US$7,970 per square metre and found that recently completed New Zealand hospital projects were similar in cost. This equates to approximately NZ$12,300 per square metre (Oxford Global Projects, 2022).
- New Zealand hospital upgrade costs: NZIER (2023) derived a weighted average cost of NZ$15,136 per square metre from Health New Zealand campus floorspace distributions, and building specific unit cost assumptions. NZIER also cited further datapoints from the Ministry of Health/Health New Zealand's National Asset Management Programme (NAMP) for new build unit costs range from NZ$12,107 (for secondary hospitals) to NZ$16,042 (for tertiary hospitals) per square metre.

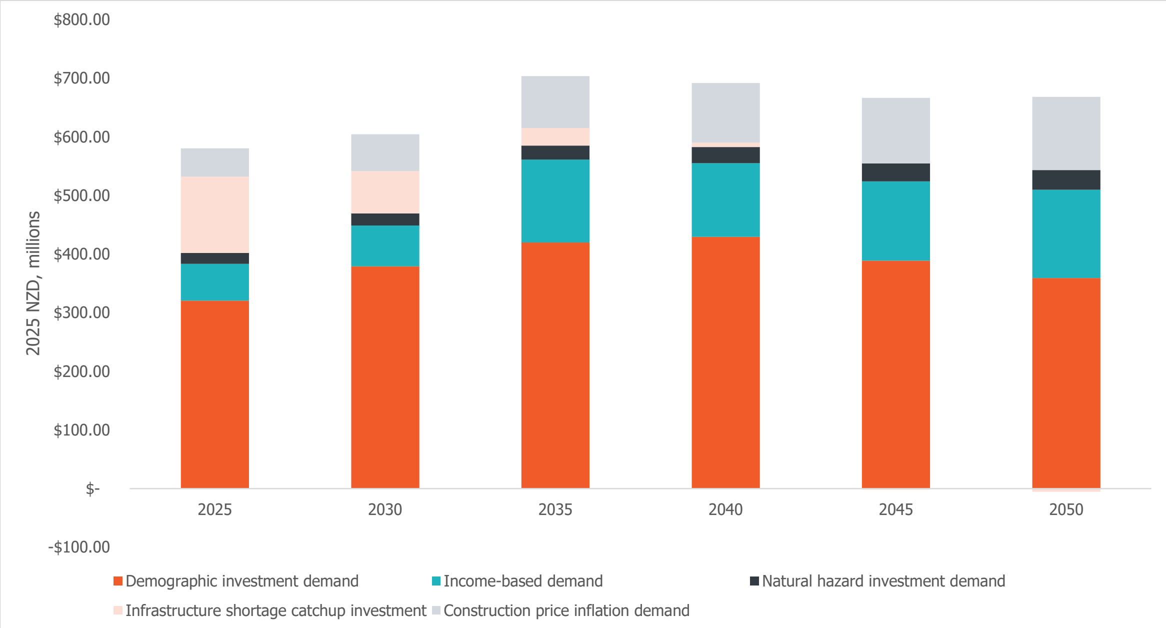
We sensitivity test unit cost assumptions in subsequent sections.

Investment demand/requirements

We draw high level estimates for investment demand from our Forward Guidance. Our forecasts for expected capital expenditure within the health sector can be divided into two high-level categories: renewals (effectively equivalent replacement of end-of-life assets) and improvements (corresponding to demographic, income and other improvements to the stock, such as natural hazard resilience). Our Forward Guidance treats cost inflation as a separate driver of demand, and we allocate it proportionally between improvements and renewals.

Of relevance to this analysis is the improvements forecast. Approximately 60% of our forecast for hospital improvement investment is driven by changes in population demographics (Figure 4).

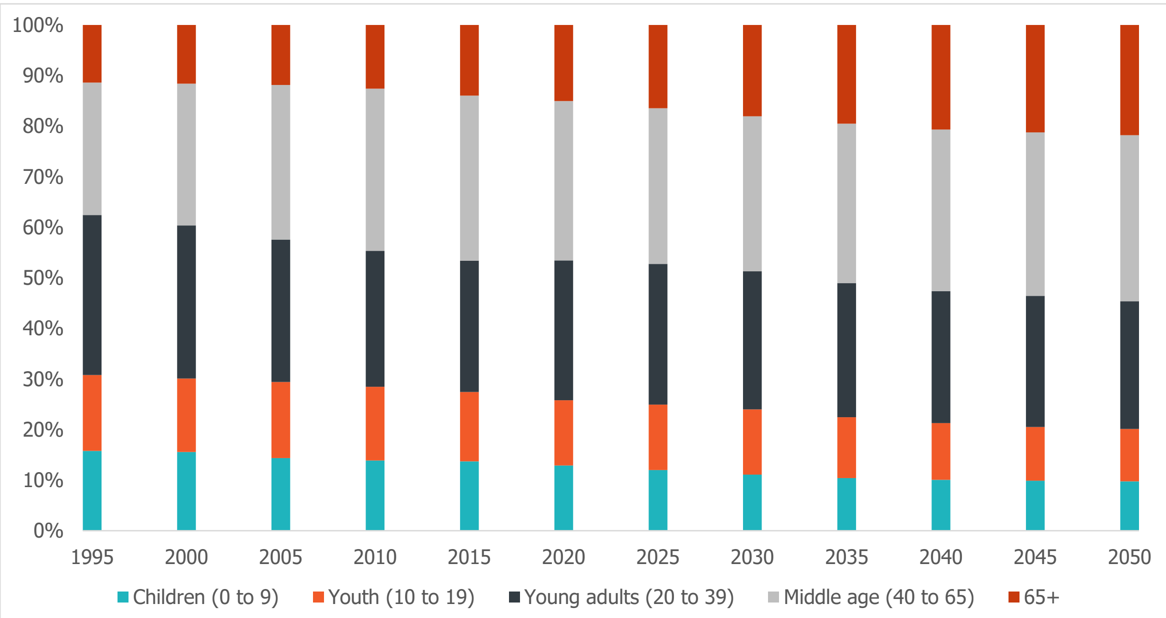
Figure 4: Drivers for improvements in hospital capital expenditure, 2025–2050



Source: New Zealand Infrastructure Commission analysis from our Forward Guidance. See New Zealand Infrastructure Commission (2026) for more information.

This is almost entirely additional demand driven by a growing ageing population (Figure 5). It is forecast that the 65+ demographic is likely to grow over time, with it increasing from 15% of the total population in 2020 to 22% in 2050 under Stats NZ's central population projection. This means increasing from approximately 790,000 people in 2020 to 1.4 million by 2050.

Figure 5: Shares of population in each age group, aggregated from Stats NZ historical and forecast data, 1995–2050.



Source: New Zealand Infrastructure Commission analysis of Stats NZ population estimates and projections.[4]

[4] Stats NZ Population estimates by age and sex (1991+) and Stats NZ National population projections, by age and sex, 2024(base)-2078.

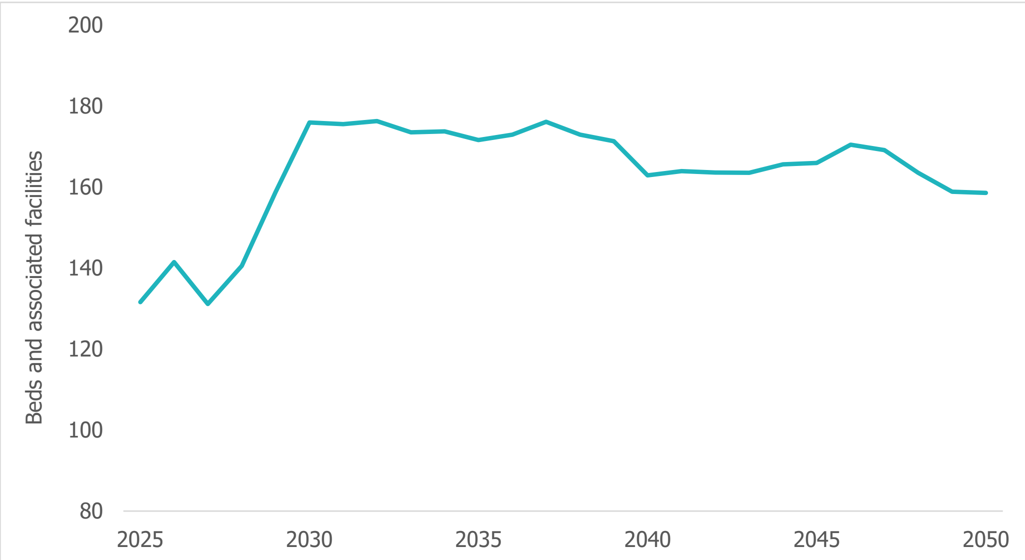
Capacity analysis for hospital demand

Using our Forward Guidance, alongside our assumptions, we estimate an approximate additional level of health infrastructure the country would demand in the near future.

The analysis for this is straightforward. We derive our improvements forecast for hospital infrastructure. This approximates expansion to the network beyond renewals. From this information, we simply apply estimates of unit costs per square metre of gross floor area ($20,000) to estimate total gross floor area enabled by our Forward Guidance. The final step is applying our assumption of gross floor area per bed (204 m^2) to estimate final bed and facility need to meet additional demand.

Figure 6 summarises the results of this analysis. While we have focused on hospital beds as our primary measure, this measure also includes spend with associated facilities (such as utilities, parking, outpatient service, etc), as the gross floor area figure before is derived from total area from all facilities divided by beds.

Figure 6: Forecast for annual beds and facilities required under our Forward Guidance, 2025–2050



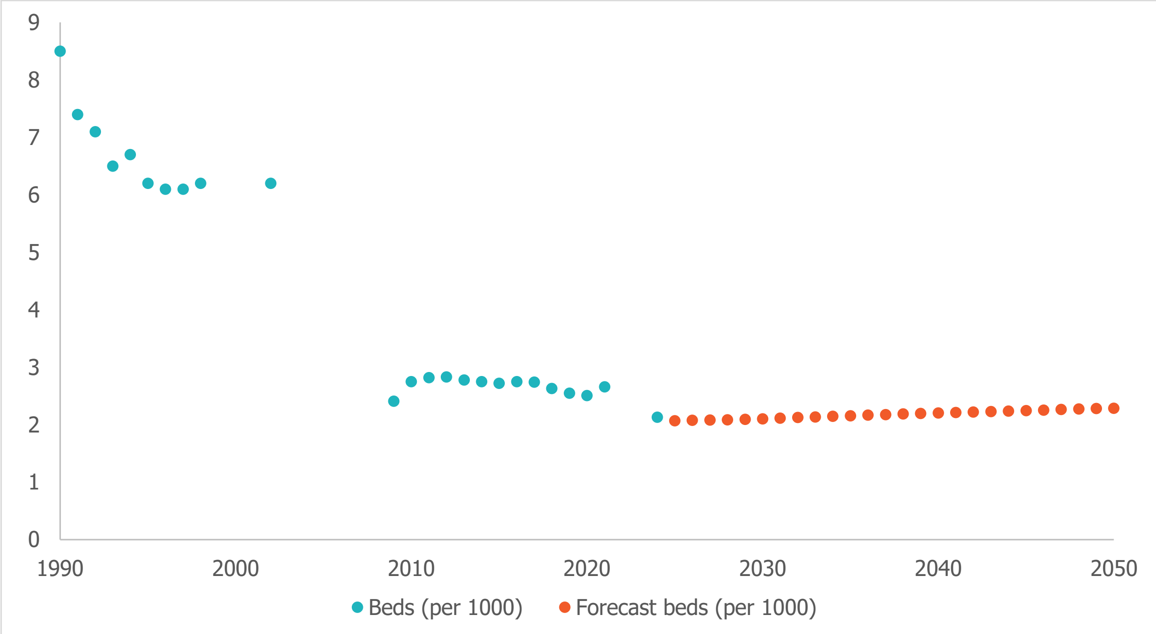
Source: New Zealand Infrastructure Commission analysis.

On average, our forecasts suggest that to keep pace with demand, we should be building approximately 160 beds per annum. By 2050, this results in expanding the health network's capacity by around 4,550 beds.

This assumes a central scenario for our Forward Guidance, which is informed by the median (50th percentile) Stats NZ demographic forecast. We detail sensitivity tests towards the end of this section.

This suggests a small increase in the number of beds per population over this period, partly reversing the long-term trend towards fewer hospital beds per capita (Figure 7). We consider it is unlikely that we would need to return to the higher ratios of hospital beds per capita that we observed prior to the early 1990s. This is because New Zealand has followed a global trend in which richer and more developed countries have relied less and less on hospital beds to provide care (New Zealand Infrastructure Commission, 2025a).

Figure 7: Historical and forecasted hospital bed counts per 1,000 people



Source: New Zealand Infrastructure Commission analysis and World Bank Group data on hospital beds.[5] *Note: Data are actuals from 1990 to 2024 and projections from 2025 onwards based upon our Forward Guidance.*

Regional forecasting

We also considered how these new beds might be distributed across the country.

A separate piece of analysis, additional to our Forward Guidance, was undertaken to estimate how infrastructure networks would grow and change over time. This analysis can be found in a technical report published by the Commission (Motu Economic and Public Policy Research, 2026).

At a high level, this analysis uses information about the location of infrastructure across New Zealand relative to population patterns, estimating how infrastructure networks respond to increases to population spatially. A key result for hospitals is that historically, New Zealand has tended to supply 4% more health facilities when the population in a local area increases by 10% (i.e., the elasticity of health facilities to population).

We combine this information with Stats NZ projections at the local and regional level to make spatial forecasts about future infrastructure provision. The main output of the combination of these two pieces of information is an estimate of the total size of the network by region in years 2023 and 2048. We convert this information into relative shares. For instance, after forecasting the total size of the network in 2048 for New Zealand, as well as regions like Auckland, we simply divide one by the other to determine Auckland's 2050 share of the network. In our analysis, the modelling projects that by 2048, Auckland region's share of the total healthcare asset value will have grown by almost 3%.

Our methodology is as follows:

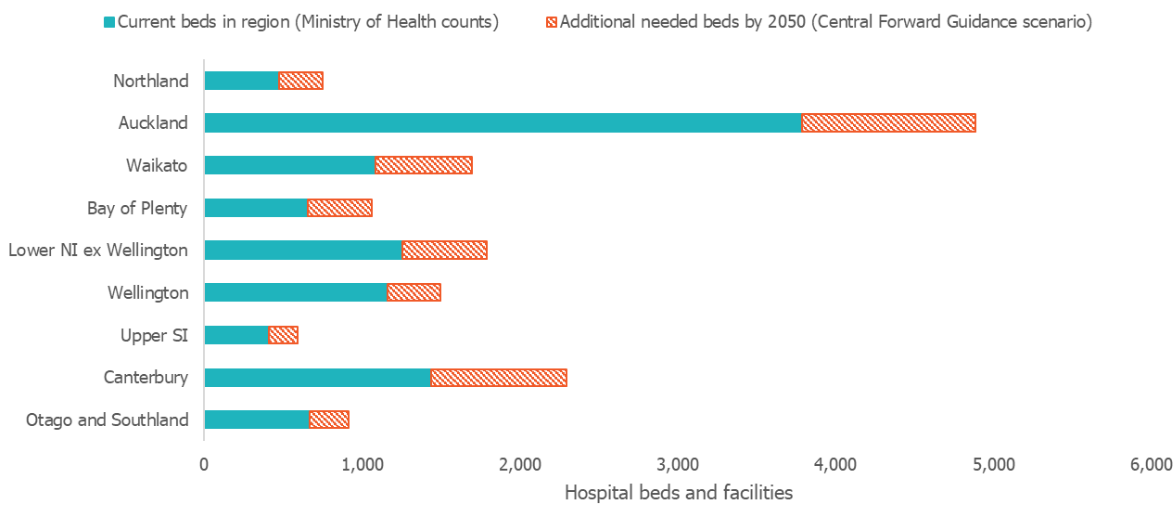
- First, we estimate the level of capital expenditure within the health sector on a national level using our Forward Guidance. This reflects the country's expected demand for hospital investment over time.

[5] World Bank Group. Hospital beds per 1000 people. https://data.worldbank.org/indicator/SH.MED.BEDS.ZS?locations=NZ

- Second, we separate each year's forecast expenditure into improvements (which effectively reflects new infrastructure) and renewals (which encompasses renewal and replacement of the pre-existing stock)
- Third, we combine the total national improvement expenditure over the 25-year period into a single figure, such that we simply need to disaggregate a single figure
- Fourth, we apply the 2048 regional split shares to this aggregate figure. Doing so projects the total amount of improvement expenditure that would occur in each region between 2025 and 2048
- Fifth, we then translate this expenditure figure into hospital infrastructure, utilising our GFA and cost assumptions.

Finally, we combine this with the present levels of beds in each region to get a projection for the total amount in 2050. The present stock levels were obtained from current Ministry of Health counts.[6] Figure 8 presents these combined figures.

Figure 8: Projected distribution of hospital beds and facilities across regions 2025–2050



Source: New Zealand Infrastructure Commission analysis. Note: Regions combined for ease of readability. 'Lower NI' is comprised of Gisborne, Hawke's Bay, Taranaki, and Manawatū-Whanganui. 'Upper SI' is comprised of Tasman, Nelson, Marlborough and West Coast.

We estimate that each region requires a relatively significant uplift, of at least 30% of the current capacity. Auckland, Waikato, and Canterbury stand out as the top three areas which require the most investment, reflecting projected population growth and ageing in these regions.

Further sensitivity analysis is discussed in the following section.

Sensitivity analysis

When sensitivity testing our results, we found some areas which warrant additional discussion.

Gross floor area assumptions

[6] Ministry of Health, Certified Public Hospital Providers. https://www.health.govt.nz/regulation-legislation/certification-of-health-care-services/certified-providers/public-hospitals

We have tested our analytical assumptions with some international comparisons to confirm whether the values used in the analysis exist within reasonable bounds, and whether any efficiencies can be realised to achieve the country's demands at a more rapid pace.

First, we test our GFA value. The value used in the base analysis was taken from the NZIER research. We have performed a scan of international comparisons to take a wider view of the potential bounds for GFA per bed. Our international survey is not intended to be comprehensive, but to simply put potential bounds around our GFA assumption. Alongside these international comparisons, we also test using the New Zealand 'average' value of 242 m^2.

Table 1: Suggested GFA per bed comparisons

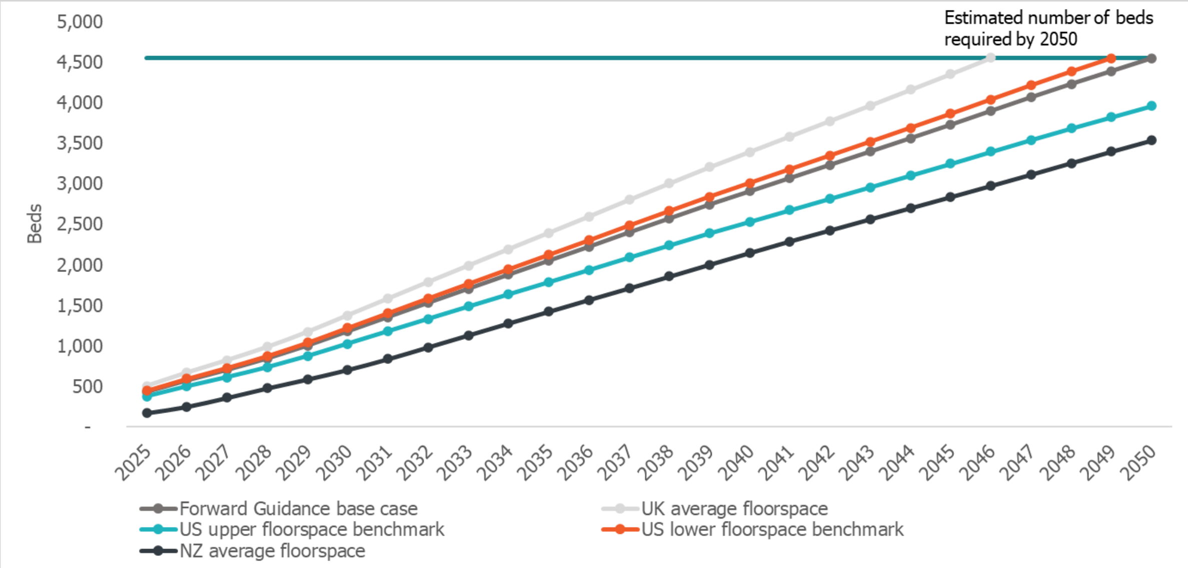
Country	**GFA per bed**	**Source and comments**
United Kingdom	173 m^2	GFA per bed was derived by combining the gross internal area of the NHS estate (27.2 million m^2)[7] as well as the total hospital beds per 1,000 (2.44).[8] Note that this GFA measure encompasses the entire NHS estate, which includes administrative areas, carparks, as well as clinical space.
United States	195 m^2 to 232 m^2	A strategic facility master plan for Connecticut's Saint Mary's hospital suggested benchmark BGSF (building gross square feet) per bed figures to be between 2,100 and 2,500 feet squared (approximately 195 and 232 metres squared).[9] This GFA measure encompasses the Acute Care campus and does not include parking and other external infrastructure.
New Zealand	242 m^2	This is the average GFA value for New Zealand as suggested by NZIER's (2023) analysis of health asset register data.

New Zealand appears to have a reasonable level of GFA allocated per bed. Note that GFA per bed does not simply consider room size but reflects the size for the entire hospital campus (therefore, floorspace used for utilities, outpatient services, and so on are accounted for). In general, larger campuses will have less total GFA per bed due to economies of scale.

Figure 9 highlights the timeline changes if the country were delivering beds under alternative GFA allocations.

[7] https://www.england.nhs.uk/long-read/delivering-productivity-through-the-nhs-estate/)
[8] https://www.oecd.org/en/data/indicators/hospital-beds.html
[9] https://portal.ct.gov/-/media/AG/CurrentIssues/SMHS/cd/20141013AttachmentESMHSsanswerstoOCHAInterrogatoriesSMHFinalReport93013MasterFacilityPlanpdf.pdf

Figure 9: Projected new hospital beds and facilities with differing floorspace (GFA) per bed assumptions



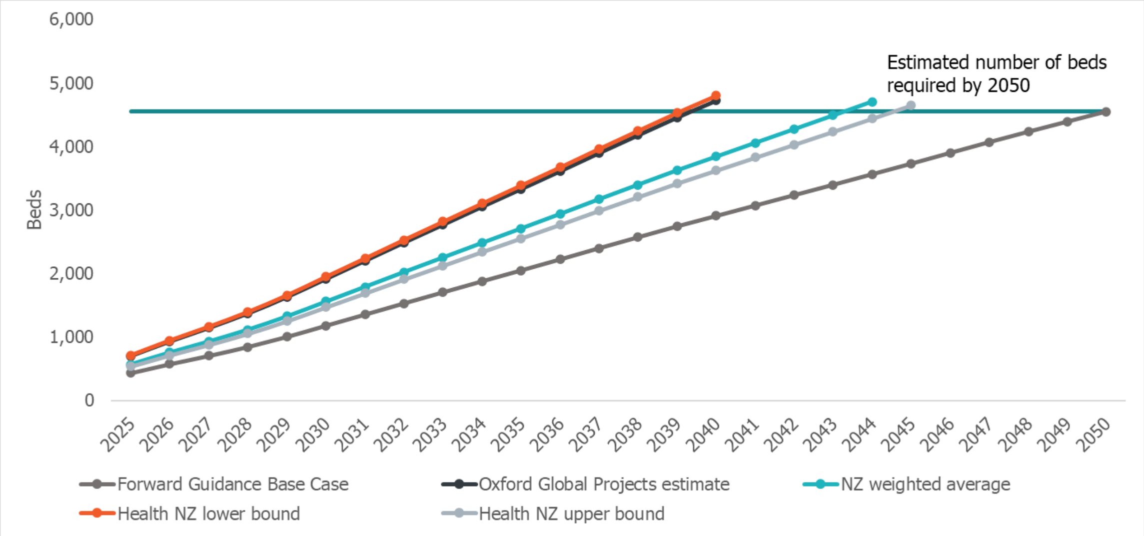
Sources: New Zealand Infrastructure Commission analysis, Australian Health Facility Guidelines, Pingel (2021), and Rashid (2014).

Depending on the actual GFA per bed allocation used within the range, the Commission's Forward Guidance could be delivered anywhere between 4 years early, to 6 years later than our Base Case. Assuming a constant cost per square metre, a lower GFA requirement per bed will lead to the Commission's Forward Guidance for bed demand being met sooner.

Looking at GFA per bed is also only one half of the equation. We also sensitivity test unit costs to build new hospital space. As noted above, we have taken a high estimate of unit costs to build new hospitals, relative to international benchmarks and some recent New Zealand projects.

Figure 10 shows that if efficiencies were realised throughout the design and delivery process, resulting in lower unit costs, New Zealand could deliver the demanded capacity upgrades for less. As an example, if New Zealand were able to reduce cost per GFA down to the benchmark OECD level (while holding constant our 202 m^2 per bed assumption), New Zealand would be able to deliver 10 years faster, achieving the 2050 demand by 2040.

Figure 10: Projected new hospital beds and facilities with differing cost per square metre assumptions



Sources: New Zealand Infrastructure Commission analysis, based on unit cost benchmarks from Oxford Global Projects (2022) and NZIER (2023).

Alternative population scenarios

The above analysis relies upon the Commission's central Forward Guidance scenario, which is built from Stats NZ's median population projection.

We tested our results using different population projections from Stats NZ. Figure 11 demonstrates the various sensitivity tests around those projections. Under these sensitivity tests, there are two dimensions:

- The overall investment forecast which is driven by Stats NZ national population projections.
- The projected shares of that investment, which are driven by Stats NZ's regional population projections. Table 2 shows how these shares change with different projections.

The Low Scenario below corresponds to Stats NZ's 5th percentile national estimate and their low forecast regionally. The High Scenario is Stats NZ's 95th percentile national estimate and their high forecast regionally.[10]

[10] Stats NZ national population projections, 2024(base)–2078 and Subnational Population Projections, 2023(base) –2053. Note that while the national projections give a projection for a range of scenarios, the regional projections only present three scenarios, 'low', 'mid', and 'high'.

Figure 11: Distribution of projected new hospital beds and facilities depending upon Stats NZ population projections, 2025–2050

Source: New Zealand Infrastructure Commission analysis. Note: Regions combined for ease of readability. 'Lower NI' is comprised of Gisborne, Hawke's Bay, Taranaki, and Manawatū-Whanganui. 'Upper SI' is comprised of Tasman, Nelson, Marlborough and West Coast.

In general, this does not drastically change our results. Across the 30-year period, the scenarios lead to 200 fewer beds on the low end to 220 additional beds on the high end. This effectively translates to approximately a 1.5 year plus-minus deviation across the 30-year period, or a 5% swing in both directions.

We note that the High Scenario leads to fewer beds required. This is because while New Zealand's total population is higher in this scenario, the population groups that use hospitals the most (young children and those aged 65 and over) make up a smaller share of the population than in lower-growth scenarios. This translates into less growth in the overall network required.

Table 2 details how the regional shares shift depending upon regional population projections. While we see some deviation, most regions have relatively consistent capital shares. This implies that for the most part, by 2048, while there will be growth in the hospital network, most of the existing stock as it exists today will exist in 2048, and increases in relative regional demand are more around the margin. The larger/denser regions are more likely to require a rising share of total hospital capacity, reflecting how a changing population would redirect demand across the country.

Table 2: Modelled regional share of public hospital capital stock under low, central and high growth regional population scenarios

	Regional share of total hospital capital stock		
Regional council	**Low-growth scenario**	**Central-growth scenario**	**High-growth scenario**
Northland region	6.2%	6.1%	6.1%
Auckland region	24.6%	25.2%	25.3%
Waikato region	13.6%	13.3%	13.2%
Bay of Plenty region	8.9%	8.9%	9.0%
Gisborne region	1.4%	1.4%	1.4%
Hawke's Bay region	2.6%	2.6%	2.5%
Taranaki region	2.6%	2.5%	2.6%
Manawatū-Whanganui region	4.8%	4.9%	5.0%
Wellington region	7.2%	7.3%	7.2%
West Coast region	0.8%	0.9%	0.9%
Canterbury region	18.9%	18.7%	18.7%
Otago region	3.2%	3.2%	3.3%
Southland region	2.1%	2.1%	2.1%
Tasman region	0.9%	0.9%	0.9%
Nelson region	1.2%	1.2%	1.2%
Marlborough region	0.8%	0.8%	0.8%

Source: New Zealand Infrastructure Commission analysis based upon data provided from Motu Economic and Public Policy Research (2026).

We note that for this analysis, the relatively small changes in the shares reflect two factors. The first is that the results largely demonstrate the *relative* changes between regions of Stats NZ's subnational population estimates. In other words, what these results show is, partly, the regional distributional differences between the High and Low Scenario. Second, they reflect the fact that from our analysis, we found the elasticity of health facilities to population is less than 1. This means that even when a region is growing faster than another, the corresponding predicted hospital demand is not one-for-one.

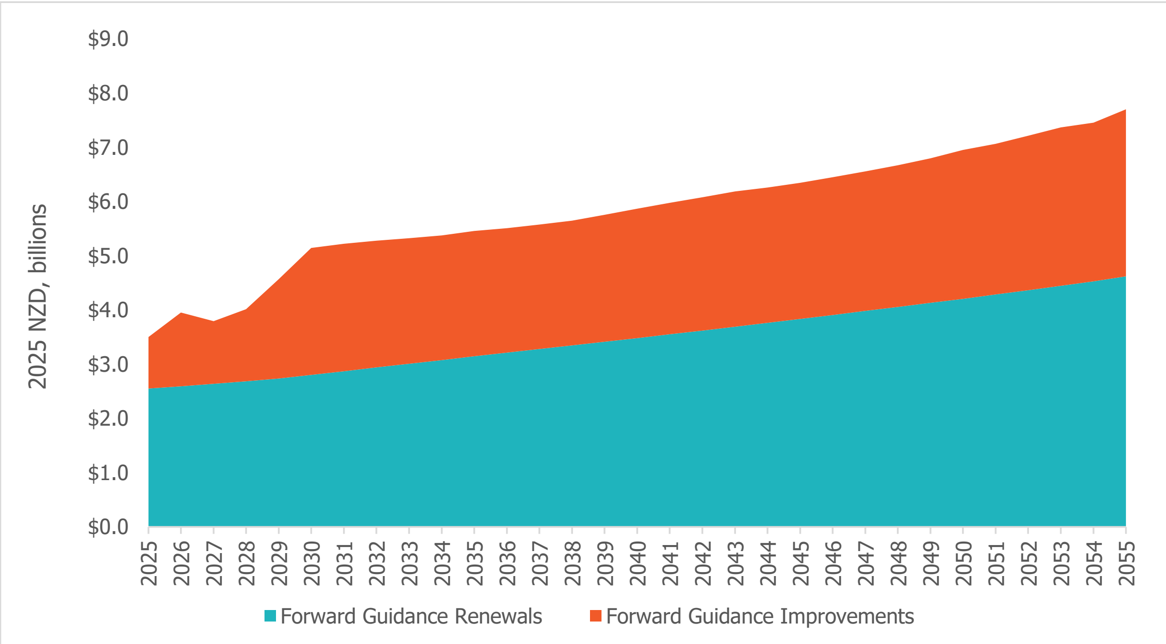
Land transport

Analysis of timing for major road and urban rapid transit capacity upgrades

What does the Commission's Forward Guidance suggest?

The Commission's Forward Guidance suggests that in aggregate, the country is likely to demand approximately $181 billion of capital expenditure across the land transport sector over the next 30 years. This includes expenditure for state highways, local roads, rail, active modes, and public transit. This expenditure captures renewals for current transport infrastructure), as well as improvements (which can be seen as the 'new' infrastructure investment component) (Figure 12).

Figure 12: Commission's Forward Guidance for Land Transport investment, 2025–2055

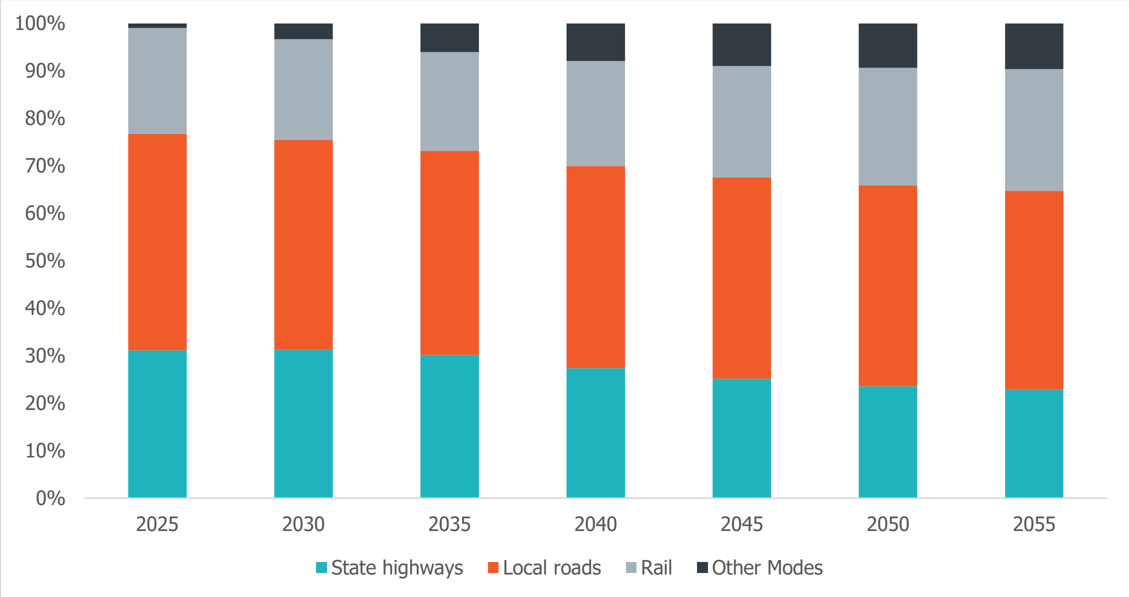


Source: New Zealand Infrastructure Commission analysis from our Forward Guidance. See Forward Guidance Model Technical Report, Infrastructure Commission 2026 for more information.

This represents an average annual expenditure level of 1% of GDP. This is a moderation of investment seen in the last decade, where we were spending approximately 1.2% of GDP.

While the overall Forward Guidance is at approximately 1.0% of GDP, each subsector has different dynamics. Broadly speaking, over the next 30 years, our Forward Guidance suggests that active modes and transport will become more prominent, due to demand shifts resulting from emissions goals, while state highways investment should moderate (Figure 13).

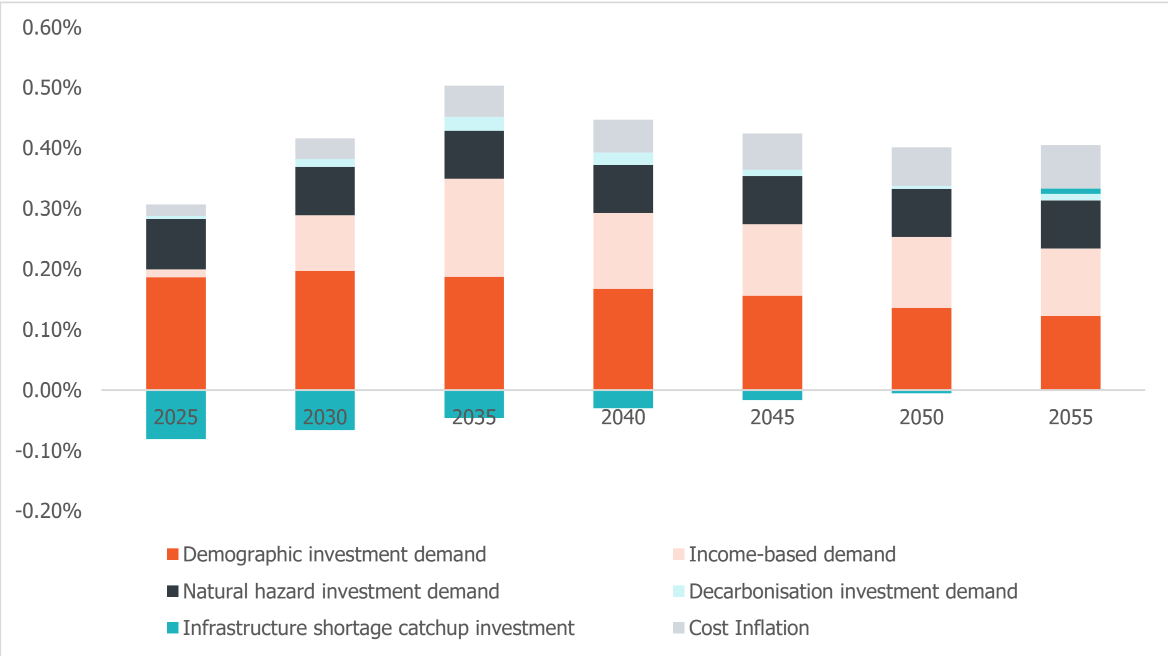
Figure 13: *Composition of investment in the Commission's Forward Guidance for each subsector in land transport, 2025–2055*



Source: New Zealand Infrastructure Commission analysis from our Forward Guidance. See New Zealand Infrastructure Commission (2026) for more information.

Across the land transport network, the Commission's Forward Guidance is for average annual investment in improvements of around 0.4% of GDP per year. The largest drivers are demographic demand, although its importance declines over time, reflecting slowing population growth in the years beyond 2030. Investment to meet decarbonisation goals is an important driver of demand, but small on net; the active mode and public transport investment requirement is largely offset by downward pressure required on the state highway network.

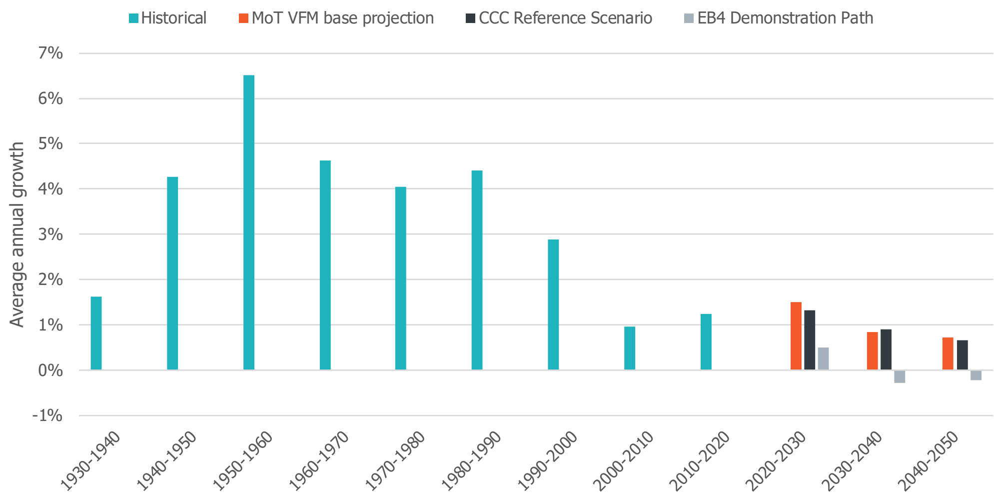
Figure 14: Decomposition of improvements demand projected by the Commission's Forward Guidance as a share of GDP, 2025–2055



Source: New Zealand Infrastructure Commission analysis from the Commission's Forward Guidance. See New Zealand Infrastructure Commission (2026) for more information.

Slowing demand for improvement investment reflects a persistent trend towards slowing traffic growth. Figure 15 shows that network-wide vehicle traffic growth has slowed dramatically since the 1990s. Consistent with trends in other developed countries, per-capita transport volumes are no longer growing, meaning that overall growth in demand only reflects population growth (Bureau of Infrastructure, Transport and Regional Economics, 2015). As a result, projections from the Ministry of Transport and Climate Change Commission are for slow growth in transport demand, or potentially even declining demand. At the same time, both per capita and total demand for active and public transport could increase, depending upon urbanisation patterns and policy choices around emissions targets.

Figure 15: Historical and projected average annual growth in vehicle kilometres travelled, 1930–2050



Source: Historical vehicle kilometres travelled estimates are from the New Zealand Infrastructure Commission (2025b)*; forecasts are from the Ministry of Transport's Vehicle Fleet Model*[11] *and Climate Change Commission's scenarios dataset for advice on New Zealand's fourth emissions budget.*[12]

A more thorough discussion of the Commission's Forward Guidance for the land transport can be found in our Summary Report.[13]

Major road capacity upgrades

Overview of case study projects

Over the last 20 years New Zealand has tripled the length of its motorway and expressway network. This involved building around 300 km of new four-lane divided highways (New Zealand Infrastructure Commission, 2025b). The Government has recently announced further investment in 17 new 'Roads of National Significance' (RONS), with a total length of over 200 km.[14]

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[11] https://www.transport.govt.nz/statistics-and-insights/vehicle-fleet-model/sheet/updated-future-state-model-results

[12] https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/preparing-advice-on-emissions-budgets/advice-on-the-fourth-emissions-budget

[13] *Forward Guidance: Summary results and findings.* New Zealand Infrastructure Commission. February 2026. https://media.umbraco.io/te-waihanga-30-year-strategy/xwxn2h2y/infrastructure-needs-analysis-summary-results-and-findings.pdf

[14] https://nzta.govt.nz/planning-and-investment/roads-of-national-significance

These new roads are mostly intended to be four-lane divided highways that increase traffic capacity relative to current roads. While the cost of these projects is mainly driven by the increased capacity they offer, they also provide other benefits such as improved safety, speed, and resilience. Our analysis focuses on the timing of capacity upgrades. Other benefits could create a rationale for earlier project timing, although there are also typically lower-cost options for delivering safety, speed, and resilience benefits.[15]

Three of these roads have received full funding commitments and are in pre-implementation or construction. However, other projects only have part-funding commitments, and are not expected to be fully fundable within available land transport revenues in the near to medium term. The medium-term investment challenge is therefore to right-size and sequence these projects so they are affordable, deliverable, and built in line with need.

Indicative road capacity assumptions

For high-level, indicative analysis of when traffic volumes may exceed the capacity of existing roads, we summarise information on road capacity from relevant traffic engineering sources, including Austroads traffic engineering guidance and NZ Transport Authority Waka Kotahi (NZTA) (2025a, 2025b) *Monetised Benefits and Costs Manual* (MBCM). Where needed we supplement or cross-check this against international sources like the US *Highway Capacity Manual* (HCM) (National Academies of Sciences, Engineering, and Medicine, 2022), European guidance, and engineering studies.

We start by outlining indicative maximum hourly traffic capacity in passenger-car equivalent (PCE) terms, then outline adjustments for heavy vehicles, which use more capacity than light vehicles. Finally, we describe adjustments for maximum desirable volume/capacity ratios.

In doing so, we note that capacity figures are indicative, and actual road capacity may also be influenced by other factors, like road layout, curves, presence of vehicle accesses, and intersection capacity. Our analysis focuses on traffic capacity, rather than safety. Divided-highway designs are safer than undivided highways, but safety can be enhanced on undivided highway with low-cost measures like passing lanes, curve straightening, and widening for painted medians.

Table 3 summarises indicative hourly capacity for four different road configurations:

- 2-lane undivided highways
- 2+1 highways, which are divided highways with alternating passing lanes
- 4-lane divided highways
- 6-lane divided highways.

As most proposed major roads are replacing or supplementing existing two-lane roads, the key threshold generally relates to the capacity of a two-lane road. Austroads (2020) engineering guidance states that: ‘the capacity of a two-lane highway is 1,700 passenger cars per hour (pc/h) for each direction of travel and is nearly independent of the directional distribution of traffic. For

[15] While divided highways / motorways have the best safety records, installing wire-rope median barriers and other low-cost safety interventions on lower-capacity roads can result in similar safety performance. https://nzta.govt.nz/assets/Safety/docs/road-to-zero/median-barriers-separating-fact-from-fiction-wsp-research.pdf
On past projects, NZTA has focused on traffic volumes relative to capacity of the existing road, road safety (as measured by death and serious injury trends), and road reliability (frequency of road closures due to various events). See EG: https://www.nzta.govt.nz/assets/projects/ara-tuhono-warkworth-to-wellsford/detailed-business-case-oct-2019.pdf

extended lengths of two-lane highway, the capacity will not exceed 3,200 pc/h for both directions of travel combined.'

By comparison, 2+1 road layouts provide slightly lower capacity despite increased width, as traffic flow tends to break down at merge points. This road type is best used as a safety intervention in environments where traffic volumes are unlikely to rise above its capacity. Other divided highway types offer higher capacity. 4-lane divided highways offer almost three times as much traffic capacity as 2-lane undivided highways, and 6-lane divided highways are a further step up. This reflects availability of continuous passing opportunities.

Table 3: Hourly road capacity, in passenger-car equivalent terms

Road type	One-directional capacity (PCE/hour/direction)	Bidirectional capacity (PCE/hour/road)	Source and notes
2-lane highway	1,700	3,200	Austroads (2020); US and Swedish guidance provides similar or slightly higher figures (National Academies of Sciences, Engineering, and Medicine, 2022; Trafikverket, 2014)
2+1 road	1,500	3,000	Bergh et al (2016); NZTA research provides a slightly higher figure (Kirby et al., 2014)
4-lane divided highway	4,400	8,800	Austroads (2020) figure for a 4-lane divided highway with 100 km/hr free-flow speed; Austroads and NZTA (2025b) guidance provides slightly higher figures for 4-lane motorways
6-lane divided highway	6,600	13,200	Austroads (2020) figure for a 6-lane divided highway with 100 km/hr free-flow speed; Austroads and NZTA (2025b) guidance provides slightly higher figures for 6-lane motorways

The above figures are stated in terms of passenger-car equivalents. Road capacity estimates must be adjusted for the mix of heavy and light vehicles, which varies by location. Heavy vehicles consume more road capacity than light vehicles as they take up more space and accelerate slower.

Table 4 summarises heavy vehicle equivalency factors from the Ministry of Transport's Cost Allocation Model, which is used to set road user charge rates for different types of vehicles (Minister of Transport, 2020). We use the higher ratio of 3 in our analysis. In doing so, we note that this is a network-wide average and that passenger car equivalency ratios for heavy vehicles can vary between road type and between flat and hilly terrain.[16]

According to NZTA's (2025b) *Monetised Benefits and Costs Manual*, rural roads tend to have a higher share of medium and heavy vehicles than rural roads (see Table A47). MBCM information

[16] NZTA. 2024. Monetised Benefits and Costs Manual: Volume 2: Appendices. Tables A58 and A60. https://www.nzta.govt.nz/assets/resources/monetised-benefits-and-costs-manual/Monetised-benefits-and-costs-manual-v1.7.3-volume-2-appendices.pdf

suggests that two-lane roads would have an hourly vehicle capacity of around 2,900 vehicles in urban arterial settings (5% MCV/HCVI/HCVII) and 2,700 vehicles in rural strategic road settings (12% MCV/HCVI/HCVII).[17] However, as we have actual heavy vehicle traffic count data for specific roads, we use that for a more detailed set of vehicle capacity estimates.

Table 4: Passenger-car equivalency ratios for heavy vehicles

Vehicle type	Passenger car equivalency ratio
Rigid truck	2
Truck towing a heavy trailer	3

Source: Ministry of Transport (2020).

The above figures relate to maximum road capacity. Maximising throughput of a road entails some reduction in speed and reliability relative to free-flow conditions. But beyond a certain point, increasing traffic volumes reduces throughput as traffic speeds fall to a low level. This is known as the speed-flow relationship (Litman, 2025; Small & Verhoef, 2007; Wallis & Lupton, 2013).

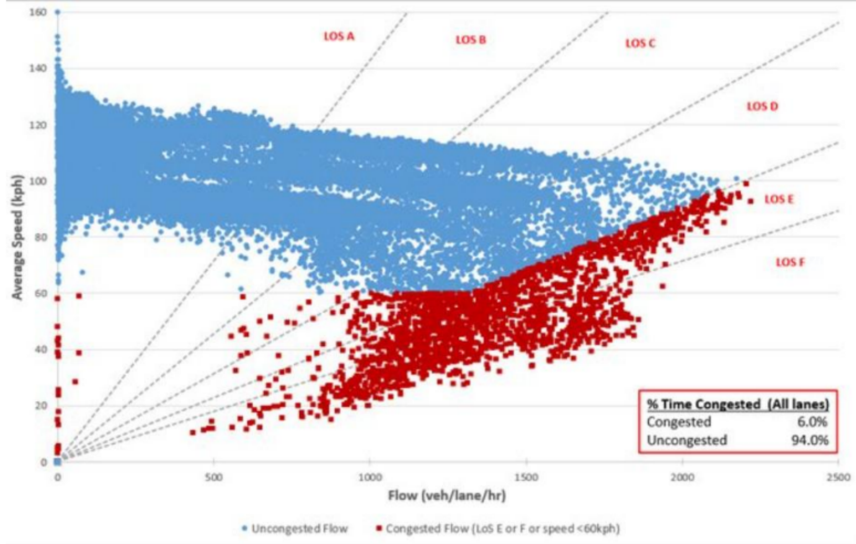
Engineering studies find that road throughput is optimised at traffic level of service (LOS) C/D, where traffic volumes are high enough but not too high. Figure 16 illustrates this, showing how flow on the Irish motorway network generally increases up to LOS C/D and then declines after this point.

Austroads (2020) suggests that, for 4-lane roads, ideal volume-to-capacity (V/C) ratios are no more than 90% (corresponding to LOS D).[18] NZTA's (2025b) MBCM guidance indicates that, for two-lane roads, the 'ideal capacity' is 2,800 PCE per hour in both directions of travel. This is 87.5% of the maximum capacity of 3,200 PCE per hour outlined by Austroads.

Based on these sources, we set a maximum tolerable V/C ratio of 87.5%, which is consistent with maximising throughput. We note that this is potentially conservative, as our analysis focuses on weekday peak hour traffic, meaning that V/C ratios will be considerably lower, on average, during other periods. However, there will also be some individual periods (e.g., holiday traffic) where V/C ratios will be higher than this target.

[17] 'MCV' stands for medium commercial vehicle, while 'HCVI' and 'HCVII' refer to two categories of heavy commercial vehicles.
[18] See Tables 5.5 and 5.6, showing V/C ratios for LOS D.

Figure 16: Speed/flow curve relative to traffic level of service for Irish motorways



This figure illustrates the relationship between traffic flow and speed measured on Irish Highways. Each dot reflects a particular time and location. Blue indicates uncongested flow (LOS A-D) and red indicates congested flow (LOS E-F).

Source: de Paor et al (2018).

Road traffic volumes – current and projected

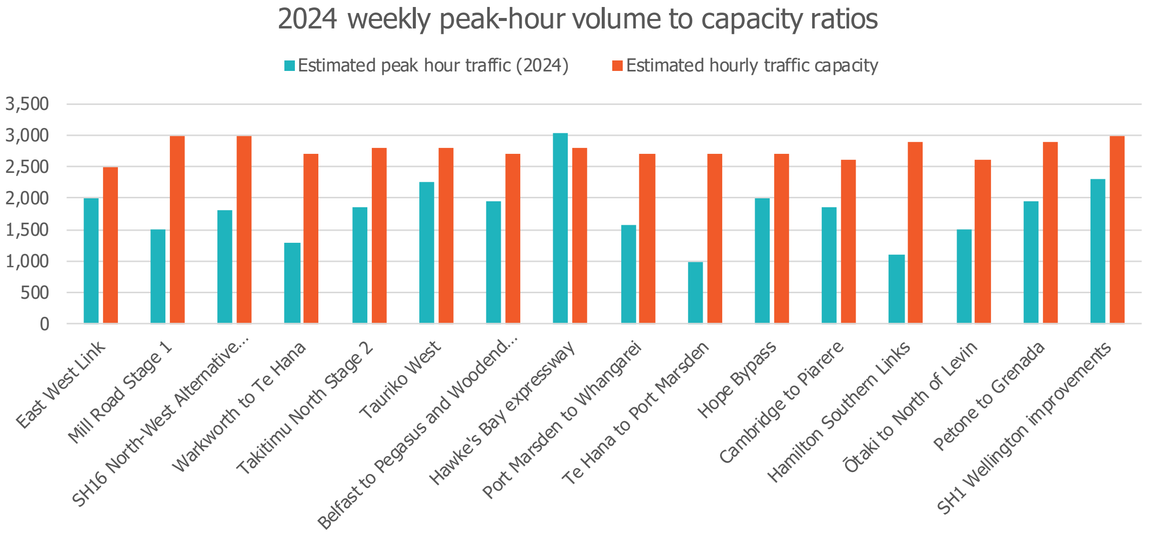
We estimate current (2024) average weekday peak-hour traffic volumes for each road, based on the nearest representative traffic counting site.[19] We compare this against estimated peak-hour traffic capacity based on the observed mix of heavy and light vehicles at that counting site. To make these estimates, we draw upon hourly traffic count data (publicly available for 2018-2022; we use 2019 as a reference year) and daily traffic count (publicly available for 2018-2024; we use 2024 as a base year). Key data and calculations are summarised in Appendix A.[20]

Figure 17 compares estimated peak hour traffic volumes with indicative hourly traffic capacity. In most cases, existing (2024) traffic volumes are far below the estimated capacity of a two-lane road. Figure 18 estimates current (2024) volume-to-capacity (V/C) ratios for a two-lane road in each location. In most cases, V/C ratios are below the maximum desirable level of 87.5% (the orange line on the chart).

[19] In one case (Petone to Grenada) there is no relevant traffic count site as this is a new link road that would divert some traffic off existing roads. In that case, we also draw upon previously published traffic modelling. In several other cases, there are several alternative counting sites that we use as sensitivity tests for our primary analysis.

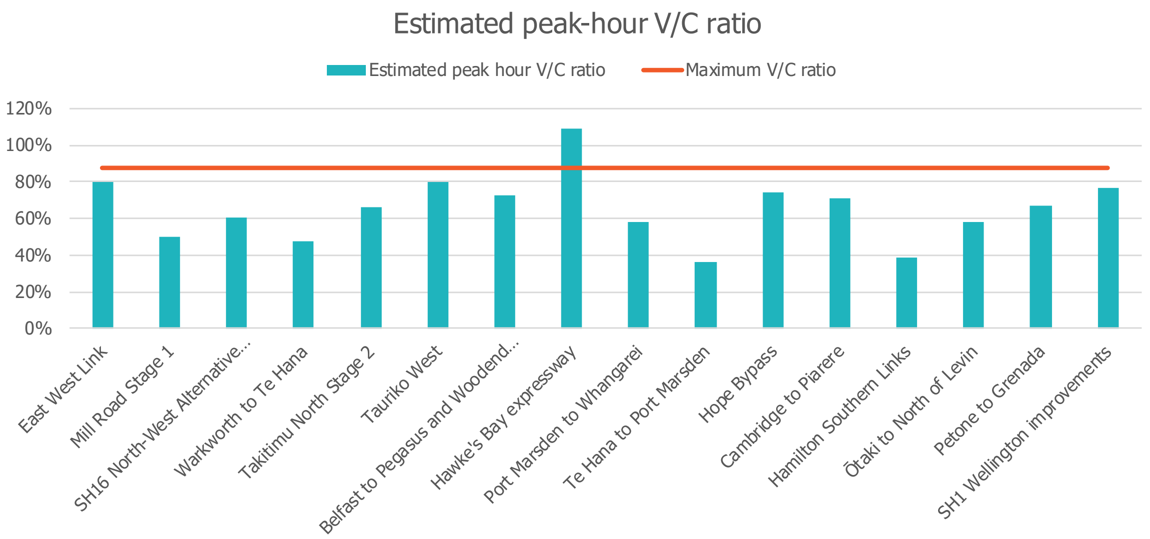
[20] Traffic count data can be seen here: https://experience.arcgis.com/experience/a09cd3ec9bdd4068b45c818a69601775/#data_s=id%3AdataSource_1-192bc37795e-layer-3%3A1502

Figure 17: Current (2024) average weekday peak hour traffic volumes relative to indicative hourly capacity of a two-lane road



Source: New Zealand Infrastructure Commission analysis of NZTA state highway traffic volume data. See Appendix A for further details of counting sites that were used.

Figure 18: Current (2024) volume to capacity ratios for a two-lane road configuration



Source: New Zealand Infrastructure Commission analysis of NZTA state highway traffic volume data. See Appendix A for further details of counting sites that were used.

Roads with lower volume-to-capacity ratios have more headroom for growth before requiring upgrades. We therefore undertake a high-level scenario-based analysis of when these roads may exceed the capacity of current infrastructure and require capacity upgrades.

Our traffic growth scenarios are based on a combination of regional population growth and assumptions about higher or lower growth in per-capita traffic volumes. Table 5 summarises these scenarios for each New Zealand region. In all regions, there is a wide range of possible traffic growth scenarios. Underlying assumptions are summarised in Appendix A.

As previously shown, nationwide traffic volumes are expected to grow in line with population. We therefore expect regional population growth to be the underlying driver of traffic growth on regional roads. We also consider the possibility for traffic on specific parts of the road network to grow faster than the regional average. This could happen due to, for instance, changing housing development patterns or entry of new regional industries. However, we do not consider certain 'downside' scenarios for growth, like network-wide reductions in vehicle traffic, or certain 'upside' scenarios that result from highly place-specific demands.

Table 5 also compares future growth scenarios with observed growth in regional vehicle kilometres travelled from 2011 to 2025. On average, traffic growth is expected to be slower in the future, reflecting gradually slowing population growth, but our scenario range is generally wide enough to encompass recent VKT trends.

Table 5: High-level scenarios for average annual traffic growth rates, by region, 2025–2055

Region	Combined scenarios for average annual traffic growth, 2025–2055			2011–2025 regional VKT growth
	Low	Medium	High	
Northland region	0.3%	1.0%	1.9%	2.0%
Auckland	0.7%	1.3%	2.2%	0.7%
Waikato region	0.6%	1.3%	2.2%	1.8%
Bay of Plenty region	0.7%	1.4%	2.2%	1.7%
Gisborne region	-0.2%	0.5%	1.5%	0.7%
Hawke's Bay region	0.0%	0.8%	1.7%	1.4%
Taranaki region	-0.1%	0.7%	1.6%	1.6%
Manawatū-Whanganui region	-0.1%	0.6%	1.5%	1.8%
Wellington region	-0.1%	0.7%	1.6%	0.3%
Tasman region	0.2%	0.9%	1.7%	1.6%
Nelson region	-0.2%	0.5%	1.4%	1.6%
Marlborough region	-0.2%	0.5%	1.4%	1.6%
West Coast region	-0.8%	0.0%	0.9%	0.8%
Canterbury region	0.5%	1.2%	2.0%	1.9%
Otago region	0.3%	1.0%	1.9%	1.9%
Southland region	-0.1%	0.6%	1.6%	0.9%

Source: New Zealand Infrastructure Commission analysis. See Appendix A for further explanation of scenario assumptions.

Major road capacity upgrade timing scenario and sensitivity analysis

To estimate indicative timing to exceed the capacity of a two-lane road, we combine base year volume-to-capacity ratios from Figure 18 with regional traffic growth scenarios from Table 5. For each road, this produces an indicative timing range for when peak-hour capacity thresholds may be reached. The midpoint of this range reflects the 'medium' traffic growth scenario, while the starting and ending point of the range reflect the 'high' and 'low' scenarios. We also sensitivity test key assumptions and report implications for timing scenarios.

As a simple example, a road that currently operates at a peak-hour V/C ratio of 80% would exceed the optimal V/C ratio of 87.5% if traffic volumes grew by 10%.[21] If traffic volumes were growing by 1% annually, then the road would be expected to reach capacity in around 10 years. However, if

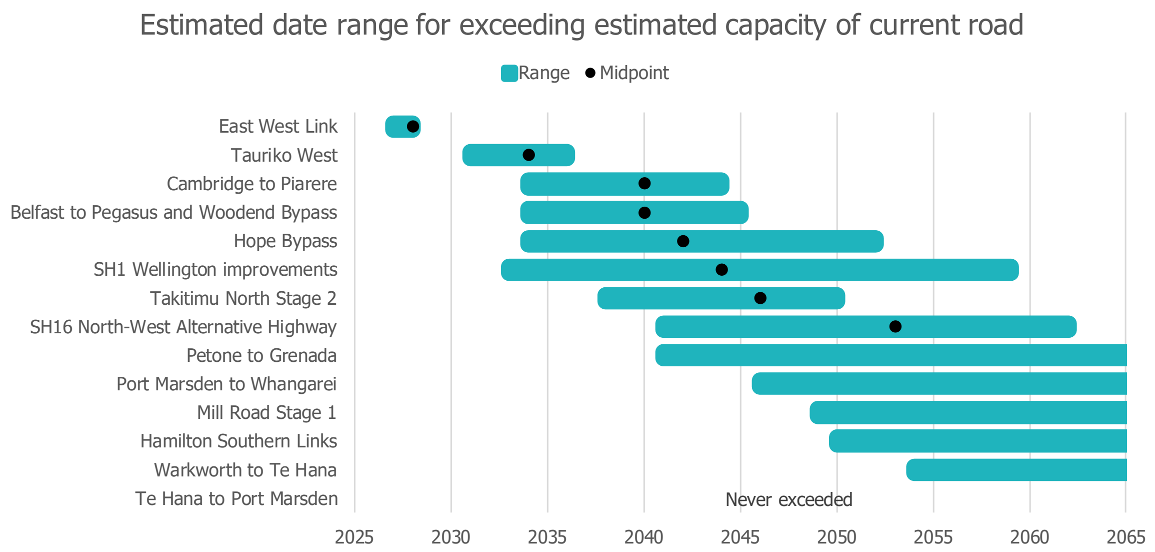
[21] 10% growth in traffic volumes would result in an 88% V/C ratio.

traffic volumes were growing 0.5% annually, the road would take around 20 years to reach capacity.[22]

Figure 19 summarises our main analysis. Roads with higher starting V/C ratios are expected to hit capacity thresholds faster than roads that currently have lower V/C ratios. Similarly, roads in higher-growth regions are expected to reach capacity thresholds faster than roads in slower-growth regions. This high-level analysis suggests that major road capacity upgrades could potentially be sequenced gradually over a multi-decade period, in line with demand growth.

As previously noted, this focuses solely on demand for capacity upgrades, noting that safety, speed, and resilience issues could be addressed through other means[23] or by progressing major upgrades slightly earlier than indicated by capacity pressures.

Figure 19: Estimated timing for exceeding estimated capacity of current road



Source: New Zealand Infrastructure Commission analysis. Note: The 'midpoint' timing reflects the date at which traffic volumes are projected to exceed the ideal capacity of a two-lane road under the central scenario for traffic growth. The start of the range reflects the projected date under the high scenario for traffic growth, and the end of the range reflects the projected date under the low scenario for traffic growth.

We sensitivity test key model assumptions to understand how these results might change if we made different assumptions about road capacity and traffic volumes. Our model assumptions are realistic but indicative, meaning that actual outcomes for specific roads are likely to be different in practice. Sensitivity testing is therefore important for helping to understand how uncertain our central results are.

We report two categories of sensitivity tests.

Table 6 first presents three sensitivity tests of alternative assumptions about road capacity thresholds. Key findings from this sensitivity analysis are as follows:

- Tolerating higher peak volume-to-capacity ratios (95% of maximum throughput rather than 87.5%) would delay capacity upgrade timing by 5+ years for these roads. This

[22] This is simplification; compounding growth means that capacity thresholds would be reached slightly faster than this.
[23] This could include passing lanes, curb straightening, or barriers.

highlights the option to defer capital investment to manage budget constraints, at a cost to level of service.

- Lower tolerance for peak volume-to-capacity ratios (80% rather than 87.5%) would bring forward capacity upgrade timing by 5+ years for these roads. This highlights the degree to which investment may be accelerated to achieve earlier level of service benefits.
- Applying indicative capacity reductions to roads that follow winding or curved routes for safety reasons would bring forward upgrade timing for these roads by 10 years, or potentially more in some cases.[24]

Table 6: Estimated timing for exceeding capacity of current road: Sensitivity tests on road capacity assumptions

Road	**Central scenario: 87.5% V/C tolerance**	**Sensitivity 1: Higher V/C tolerance (95%)**	**Sensitivity 2: Lower V/C tolerance (80%)**	**Sensitivity 3: 10% capacity reduction for winding roads**
East West Link	2028 (2027 to 2028)	2033 (2030 to 2035)	2025 (2025 to 2025)	2028 (2027 to 2028)
Tauriko West	2034 (2031 to 2036)	2040 (2034 to 2043)	2028 (2027 to 2028)	2034 (2031 to 2036)
Cambridge to Piarere	2040 (2034 to 2044)	2047 (2038 to 2053)	2033 (2030 to 2035)	2032 (2030 to 2034)
Belfast to Pegasus and Woodend Bypass	2040 (2034 to 2045)	2048 (2038 to 2056)	2033 (2030 to 2035)	2040 (2034 to 2045)
Hope Bypass	2042 (2034 to 2052)	2054 (2038 to After 2065)	2032 (2029 to 2034)	2042 (2034 to 2052)
SH1 Wellington improvements	2044 (2033 to 2059)	2058 (2038 to After 2065)	2031 (2028 to 2033)	2044 (2033 to 2059)
Takitimu North Stage 2	2046 (2038 to 2050)	2052 (2041 to 2059)	2039 (2034 to 2042)	2038 (2033 to 2041)
SH16 North-West Alternative Highway	2053 (2041 to 2062)	2061 (2045 to After 2065)	2045 (2037 to 2051)	2053 (2041 to 2062)
Petone to Grenada	After 2065 (2041 to After 2065)	After 2065 (2047 to After 2065)	2051 (2036 to After 2065)	2048 (2035 to After 2065)
Port Marsden to Whangarei	After 2065 (2046 to After 2065)	After 2065 (2050 to After 2065)	2056 (2041 to After 2065)	2054 (2040 to After 2065)
Mill Road Stage 1	After 2065 (2049 to After 2065)	After 2065 (2053 to After 2065)	2059 (2044 to After 2065)	After 2065 (2049 to After 2065)
Hamilton Southern Links	After 2065 (2050 to After 2065)	After 2065 (2058 to After 2065)	After 2065 (2049 to After 2065)	After 2065 (2048 to After 2065)
Warkworth to Te Hana	After 2065 (2054 to After 2065)	After 2065 (2054 to After 2065)	2061 (2045 to After 2065)	2059 (2045 to After 2065)
Te Hana to Port Marsden	After 2065 (After 2065 to After 2065)	After 2065 (After 2065 to After 2065)	After 2065 (After 2065 to After 2065)	After 2065 (After 2065 to After 2065)

Source: New Zealand Infrastructure Commission analysis. Note: The 'midpoint' timing based on the central demand growth scenario is shown in the first row in each line, while the range from high demand growth scenario to low demand growth scenario is shown in parentheses below. All results are shown relative to our main traffic volume scenarios.

Table 7 next presents three sensitivity tests of alternative assumptions about traffic volumes. Key findings from this sensitivity analysis are as follows:

[24] Following NZTA's Monetised Benefits and Costs Manual, we indicatively identified several roads as having curved alignments (Cambridge to Piarere, Takitimu North Stage 2) or winding alignments (Port Marsden to Whangarei, Warkworth to Te Hana, Te Hana to Port Marsden). A full analysis would require calculation of speed reductions flowing through to capacity reductions, and as a result we have used an indicative capacity reduction of 10%, averaged across the corridor.

- In some cases, traffic volumes vary along the corridor. Our central estimates are based on a 'best guess' counting site based on flows through the corridor, but in several cases there are alternative counting sites that result in earlier timing assessments[25]
- Increased volumes could in some cases be accommodated through greater peak spreading, as the 'peakiness' of traffic volumes varies between different roads. If we assess road capacity against the peak four hours of the day, rather than the single peak hour, it delays capacity upgrade timing by 5-10 years for some roads, while having little impact on capacity upgrade timing for other roads.
- Large positive demand shocks could bring forward capacity upgrade timing considerably. This is most likely to happen on roads near existing urban areas that are experiencing significant housing growth from a low base. As an indicator of sensitivities, we found that increasing existing traffic volumes by 10% shifted forward capacity upgrade timing considerably, with larger impacts on roads that are currently expected to take longer to hit capacity thresholds.

[25] This is a particular issue for the SH1 Wellington Improvements, as traffic volumes vary as traffic enters and exits the corridor and as capacity constraints also vary up and down the corridor. Our central analysis uses a counting site (Ruahine St) that seems to reflect through-traffic potential, rather than short-distance local travel.

Table 7: Estimated timing for exceeding capacity of current road: Sensitivity tests on traffic volume assumptions

Road	Central scenario: Weekday peak hour, main traffic counting site	Sensitivity 1: Alternative traffic counting site	Sensitivity 2: Weekday peak 4 hours	Sensitivity 3: +10% demand shock
East West Link	2028 (2027 to 2028)	2028 (2027 to 2028)	2029 (2027 to 2029)	2025 (2025 to 2025)
Tauriko West	2034 (2031 to 2036)	2034 (2031 to 2036)	2037 (2032 to 2039)	2028 (2027 to 2028)
Cambridge to Piarere	2040 (2034 to 2044)	2040 (2034 to 2044)	2044 (2036 to 2049)	2033 (2030 to 2035)
Belfast to Pegasus and Woodend Bypass	2040 (2034 to 2045)	2040 (2034 to 2045)	2051 (2039 to 2059)	2032 (2030 to 2034)
Hope Bypass	2042 (2034 to 2052)	2042 (2034 to 2052)	2053 (2038 to After 2065)	2032 (2029 to 2033)
SH1 Wellington improvements	2044 (2033 to 2059)	2028 (2026 to 2029)	2046 (2034 to 2063)	2030 (2028 to 2032)
Takitimu North Stage 2	2046 (2038 to 2050)	2046 (2038 to 2050)	2051 (2041 to 2057)	2039 (2033 to 2041)
SH16 North-West Alternative Highway	2053 (2041 to 2062)	2032 (2029 to 2033)	2056 (2043 to After 2065)	2045 (2037 to 2050)
Petone to Grenada	After 2065 (2041 to After 2065)	After 2065 (2041 to After 2065)	After 2065 (2043 to After 2065)	2050 (2035 to After 2065)
Port Marsden to Whangarei	After 2065 (2046 to After 2065)	After 2065 (2046 to After 2065)	After 2065 (2051 to After 2065)	2055 (2040 to After 2065)
Mill Road Stage 1	After 2065 (2049 to After 2065)	After 2065 (2049 to After 2065)	After 2065 (2049 to After 2065)	2058 (2044 to After 2065)
Hamilton Southern Links	After 2065 (2050 to After 2065)	After 2065 (2050 to After 2065)	After 2065 (2055 to After 2065)	2060 (2045 to After 2065)
Warkworth to Te Hana	After 2065 (2054 to After 2065)	After 2065 (2054 to After 2065)	After 2065 (2055 to After 2065)	After 2065 (2049 to After 2065)
Te Hana to Port Marsden	After 2065 (After 2065 to After 2065)	After 2065 (After 2065 to After 2065)	After 2065 (After 2065 to After 2065)	After 2065 (After 2065 to After 2065)

Source: New Zealand Infrastructure Commission analysis. Note: The 'midpoint' timing based on the central demand growth scenario is shown in the first row in each line, while the range from high demand growth scenario to low demand. growth scenario is shown in parentheses below. All results are shown relative to our indicative road capacity estimates and an 87.5% V/C tolerance.

Unit costs to deliver road capacity upgrades

We now consider the cost of delivering major capacity upgrades and how this compares with the Commission's Forward Guidance for state highway improvement capital investment.

To inform this indicative analysis, we compile estimates of the cost to build major motorway/expressway upgrades in New Zealand and other OECD countries. We draw upon past Infrastructure Commission research, which compared the actual or estimated unit costs (on a $/lane-kilometre basis) to build pre-2022 motorways/expressways in New Zealand against comparably-scoped projects in other OECD countries (New Zealand Infrastructure Commission, 2022; Oxford Global Projects, 2022). We update this with new estimates of the unit cost for newly proposed major roads projects, based on cost estimates and project scope information published by NZTA.[26] All costs are adjusted to June 2025 prices using Statistics New Zealand's Capital Goods Price Index for civil construction. Appendix A summarises our estimates and assumptions for New Zealand road projects.

As a further point of reference, we note that in May 2025, NZTA published a standardised design solutions manual for the RoNS, including indicative target costs that it recommends as a benchmark (NZ Transport Agency Waka Kotahi, 2025c). These benchmarks apply when structures and tunnels comprise less than 5-7.5% of project length and are higher for the Upper North Island, which has more challenging terrain. They are:

- Upper North Island: $14-17 million per lane km (4 lane motorway = $56-68m per km)
- Lower North Island: $11-14 million per lane km (4 lane motorway = $44-56m per km).

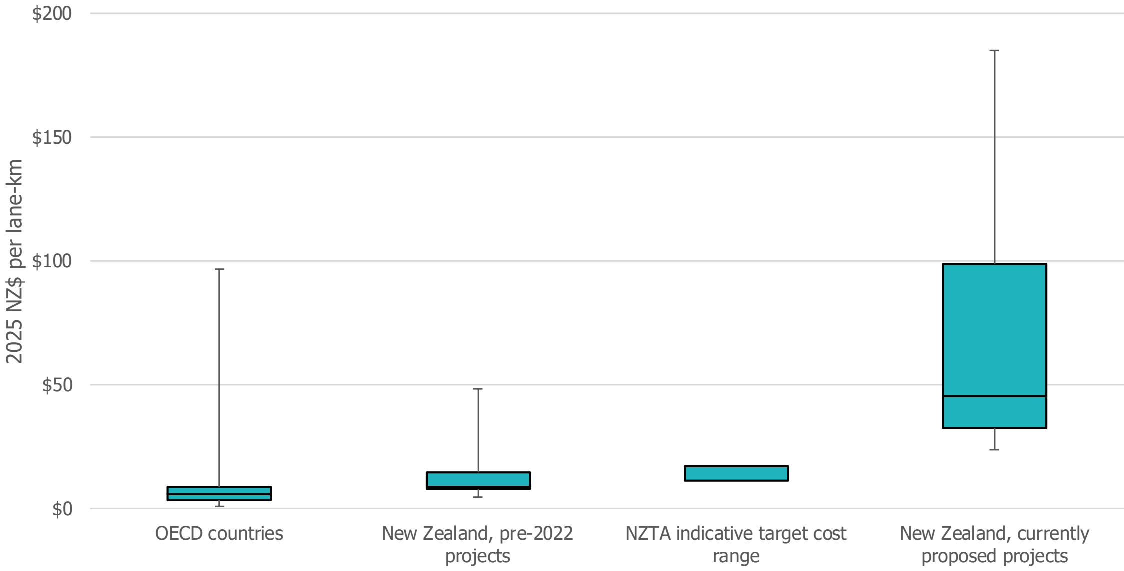
Figure 20 compares the unit cost ranges we observe in each case. NZTA's target cost range is similar to the inflation-adjusted cost range for past New Zealand road projects, albeit at the upper end of the range. It is near the top end of inflation-adjusted road construction costs in other OECD countries.

By comparison, current midpoint cost estimates for proposed RoNS projects appear to be considerably higher. All projects appear to have unit costs that are outside NZTA's target cost range. The reasons for this are unclear. Discussions with NZTA suggest that this could be partly due to their inclusion of generous contingency or future cost escalation allowances in the published cost ranges. However, these factors, by themselves, seem unlikely to explain the full magnitude of the difference.[27]

What this means is that the cost of a programme of major road capacity upgrades will be very different depending upon whether costs trend towards NZTA's indicative target cost range, or towards the cost ranges that have been published for specific roads.

[26] NZTA has generally published a range for project construction costs. We use the lower end of this range.
[27] A simple example suggests why this is unlikely. In recent decades, civil construction prices have risen by around 3% per annum. As a result, a project that is expected to be built 20 years in the future would be expected to cost 80% more in future due to inflation than the same project built today. This suggests that escalation over a multi-decade period might be sufficient to explain escalated unit costs that are around twice as high as present-day costs, but not costs that are considerably higher than that.

Figure 20: Comparison of estimated unit cost ranges for motorway and expressway projects in New Zealand and other OECD countries



Source: New Zealand Infrastructure Commission re-analysis of project cost data from New Zealand Infrastructure Commission (2022) to adjust costs to 2025 values, plus analysis of NZTA indicative target costs and NZTA information releases on current RONS projects. See Appendix A for a more detailed discussion of sources and assumptions. Unit cost estimates for currently proposed projects exclude the SH1 Wellington Improvements and East West Link projects as these have unusual scope elements relative to other roads. Note: Chart is a 'box and whiskers' plot. The shaded box shows the range from 25th percentile unit cost to 75th percentile, with the black line in the middle of the range showing the median unit cost. Whiskers show the 2nd percentile and 98th percentile unit costs.

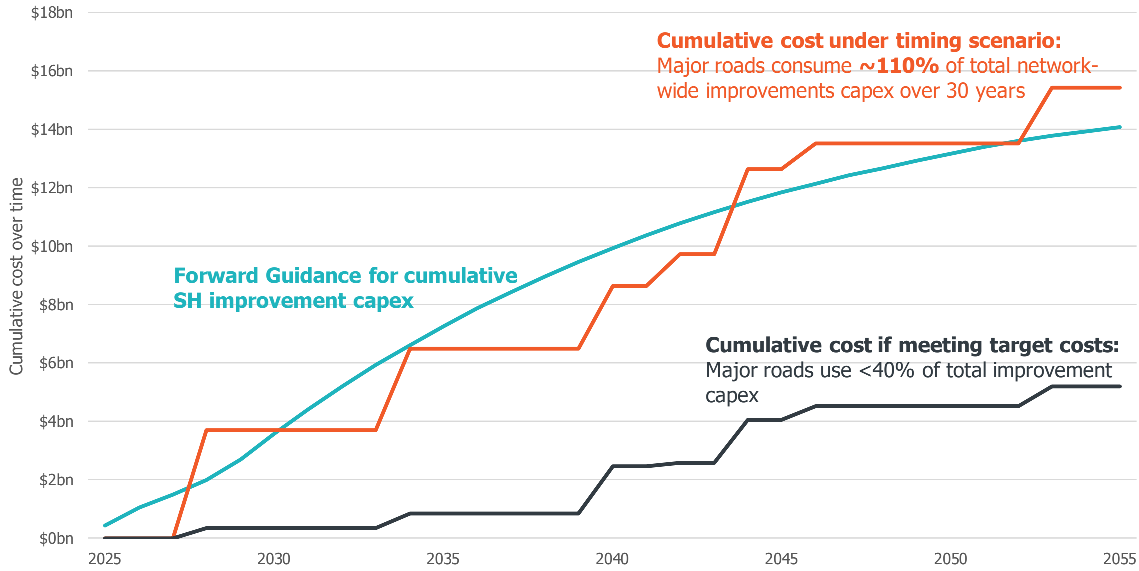
Reconciliation of project timing scenario with Forward Guidance

To conclude, we show how the major upgrade timing scenario described above aligns with our Forward Guidance for state highway upgrades and improvements. To do so, we compare cumulative capital costs of major upgrades over time against Forward Guidance capital investment projections. For indicative purposes, we show the midpoint timing scenario shown in Figure 19 as it is most consistent with the medium population growth and economic growth scenarios used in our central Forward Guidance investment path.

Figure 21 summarises the resulting comparison of cumulative capital expenditure over time. The blue line shows cumulative state highway improvement capex from our Forward Guidance, while the other lines show cumulative capital costs for major road upgrades under our midpoint timing scenario. The orange line shows cumulative major road capacity upgrade costs if new roads are built at the midpoint costs published by NZTA, while the black line shows cumulative upgrade costs if costs fall at the upper end of NZTA's target cost range.

This comparison suggests that a programme of major road capacity upgrades can be delivered within Forward Guidance for state highway upgrades if two conditions are met. First, major road capacity upgrades must be built roughly in line with demand growth, rather than well in advance of demand. If safety, speed, or resilience issues arise on roads that are well below capacity thresholds, lower-cost interventions should be applied instead. Second, major road capacity upgrades must be delivered at a unit cost that is consistent with NZTA's target cost range and past projects. If some projects are considerably more expensive, then they may require scope changes or higher levels of demand to be cost-effective to build.

Figure 21: Comparison of Forward Guidance with major road capacity upgrade timing scenario



Source: New Zealand Infrastructure Commission analysis.

Rapid transit projects

Overview of case study projects

Over the last 20 years New Zealand has made significant investments in rapid transit infrastructure and services, mainly in Auckland. This includes Auckland's Northern and Eastern Busways, rail electrification and network improvements in Auckland, and the in-progress City Rail Link. Smaller improvements have been built in Wellington, Christchurch, and other cities.

Further improvements are being investigated. NZTA is currently investigating a proposed Northwestern Busway in Auckland. Through two rounds of the Infrastructure Priorities Programme, we have also received and assessed rapid transport infrastructure proposals in Auckland, Christchurch, Hamilton, Tauranga, and Queenstown.[28]

These rapid transit proposals involve increasing the capacity, speed, and reliability of public transport services on specific corridors. However, scope varies by location, with some proposals focusing on improving bus infrastructure (e.g., in-street bus rapid transit or separate busways) and others considering options for rail infrastructure (e.g., at-grade light rail or grade-separated metro rail). Our analysis focuses on the timing of capacity upgrades – i.e., when public transport patronage may exceed what can be accommodated using low-cost infrastructure like bus lanes.

At present, none of these proposals have received full funding commitments. Cumulatively, they are unlikely to be fully fundable within available land transport revenues in the near to medium term. The medium-term investment challenge is therefore to right-size and sequence these projects so they are affordable, deliverable, and built in line with need.

Indicative rapid transit capacity assumptions

For high-level analysis of when public transport patronage may exceed the capacity of existing infrastructure, we provide indicative ranges for hourly public transport infrastructure capacity for

[28] Rapid transit upgrades have previously been proposed for Wellington, but have not been submitted to the Infrastructure Priorities Programme for assessment.

different infrastructure and vehicle options. These are based on local estimates from Auckland Transport and NZTA, cross-checked against our calculations using parameters from the US *Transit Capacity and Quality of Service Manual* (National Academies of Sciences, Engineering, and Medicine, 2013).

We summarise indicative hourly passenger capacity ranges for five infrastructure and vehicle options:

- buses in general traffic lanes
- buses with in-road bus lanes
- busways in segregated corridors
- light rail with in-road infrastructure
- heavy or light rail with a fully segregated corridor.

In doing so, we note that capacity figures are indicative, and actual passenger capacity may also be influenced by corridor-specific factors. Our analysis focuses on passenger capacity, rather than other issues like speed or reliability. We note that infrastructure options that provide more separation from traffic and more station capacity (for example, due to longer stations with more passing room) also tend to improve speed and reliability.

The passenger capacity of a given public transport corridor is a function of (1) how many people each vehicle can fit and (2) how many vehicles per hour can move through the corridor.

Hourly vehicle capacity is primarily a function of the capacity of stops/stations rather than running-way capacity.[29] Stop/station capacity is influenced by the following factors:

- Number of loading areas in stops/stations: More loading areas means more vehicles can be accommodated, provided that there is passing space
- Dwell time at stops: More time to load/unload vehicles reduces capacity; dwell time is in turn influenced by choice of on-board or off-board ticketing and vehicle layout
- Re-entry delay from stops and signal delay at nearby intersections: More friction from adjacent traffic and less green time at nearby signals reduces capacity.

Terminal capacity constraints at the start and end of the route can also limit vehicle throughput along the route.

Infrastructure factors that affect corridor capacity can be site-specific. As a result, we provide capacity ranges based on information published by Auckland Transport and NZTA (2025), rather than a single number. In doing so, we note that it is often possible to solve some of these capacity constraint issues through targeted investment.

Table 8 summarises indicative hourly passenger estimates for different public transport infrastructure options. We report hourly capacity for each infrastructure option as a range,

[29] A simple example illustrates why this is the case. As noted above, a two-lane road can carry 3,200 passenger-car equivalent vehicles per hour, or around 1,600 PCEs per direction per hour. Based on vehicle equivalency factors, this would equate to over 500 buses per hour per direction. Because a single bus may be able to carry around 60 people, a two-lane road could in theory move 30,000 bus passengers per direction per hour. However, this theoretical capacity could only be realised if 8 people were able to board and alight from these buses every second. A more realistic expectation is that it takes 1-2 seconds per boarding or alighting passenger, plus additional time for buses to enter and exit stops and open and close doors. See Exhibit 2-13 in https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_6-b.pdf

reflecting varying assumptions about the hourly vehicle throughput of stops/stations on the route.

Table 8: Indicative estimates of hourly passenger capacity for different public transport infrastructure options

Infrastructure and vehicle type	Indicative vehicle capacity	Indicative vehicles per hour		Indicative hourly passenger capacity	
		Ideal frequency	Stretch frequency	Low	High
Bus in general traffic lane	60	15	30	900	1,800
Bus lane – in road	60	30	40	1,800	2,400
Busway – segregated corridor	80	60	90	4,800	7,200
Light rail – in road	336	24	30	8,100	10,100
Light rail – segregated corridor	480	30	40	14,400	19,200

Source: Adapted from Auckland Transport and NZ Transport Agency Waka Kotahi (2025). Note that Auckland Transport estimates have been corrected slightly from original published version, following our review of the calculations underpinning the published chart.

Table 9 shows how Auckland Transport's (AT) high-end estimates compare with alternative estimates, including our own indicative estimates based on information from the US *Transit Capacity and Quality of Service Manual* (see Appendix B for details of calculations) and indicative capacity estimates in the Northwest Busway Indicative Business Case. All three sets of estimates are similar, with the exception of the high end of capacity for a fully separated rail corridor. In that case the Commission's estimate is higher than the AT estimate, although it is similar to AT's estimate for heavy rail corridors (not reported in these tables).

In particular, all three sources provide similar estimates for the maximum capacity of an in-road bus lane, which is the most relevant capacity threshold for most New Zealand contexts.

Table 9: Comparison of indicative hourly passenger capacity estimates for public transport infrastructure options

System type	AT Rapid Transit Programme ('stretch' capacity)	Infrastructure Commission high-capacity estimate	NZTA Northwest Busway IBC
Bus in general traffic lane	1,800	1,400	N/A
Bus lane – in road	2,400	2,400	2,200
Busway – segregated corridor	7,200	7,100	9,000
Light rail – in road	10,080	10,900	9,500
Light rail – segregated corridor	18,000	25,900	13,500

Sources: Adapted from Auckland Transport and NZ Transport Agency (2025), NZ Transport Agency Northwest Busway IBC, and Infrastructure Commission calculations based on National Academies of Sciences, Engineering, and Medicine (2013). *Note that Auckland Transport estimates have been corrected slightly from original published version, following our review of the calculations underpinning the published chart.*

Public transport volumes – current and projected

We draw upon business case forecasts or related modelling published by the Auckland Forecasting Centre[30] to understand potential future growth in public transport patronage on these specific public transport corridors. However, we found that rapid transit business cases do not typically present demand modelling in a consistent format, and do not typically report uncertainty ranges for demand growth. As a result, it was necessary to adjust business case figures to provide a reasonably comparable set of demand forecasts, and add indicative uncertainty ranges for demand growth.

An important note is that business case forecasts generally relate to scenarios where infrastructure and services are improved, rather than a 'do-minimum' scenario where infrastructure is not improved. Improvements to speed, reliability, and capacity are generally expected to boost patronage, for instance by attracting more users from congested roadways. In some cases, like the City Centre to Māngere corridor, multiple infrastructure scenarios have been modelled, and as a result we have taken the middle of the range of options. A full analysis of the costs and benefits of competing upgrade options is out of scope for this high-level timing analysis.

We made four key adjustments, which are outlined in more detail in Appendix B.

First, we converted or adjusted public transport patronage forecasts to hourly passenger volumes in the inbound direction at the peak-load point. This is a key figure for transport agency capacity planning, but some business cases provided daily or two-hourly patronage figures. We note that a focus on peak-hour volumes may be conservative as high occupancy at peak times may be desirable if it is associated with better capacity utilisation in off-peak times.

Second, as forecasts were generally provided only for selected model years, we used straight-line interpolation or extrapolation to fill in patronage projections for intermediate dates.

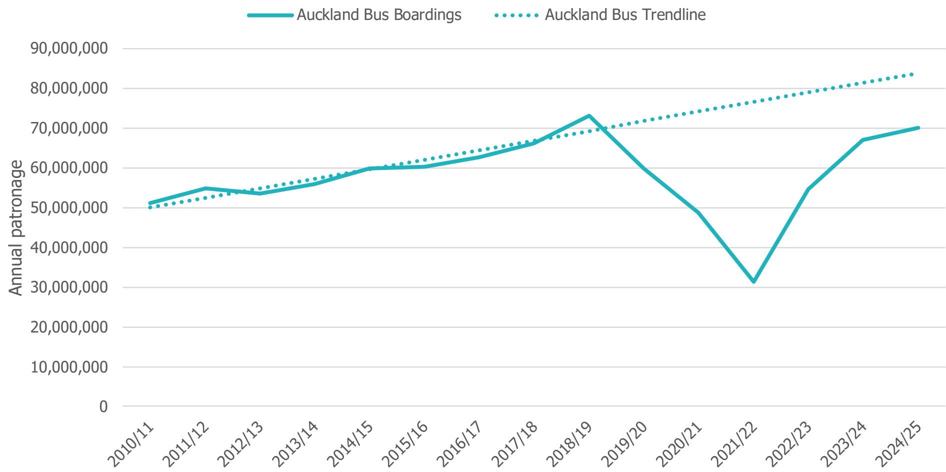
Third, as business case forecasts were based on models calibrated using pre-Covid data and not explicitly adjusted for post-Covid changes in public transport patronage, we adjusted for post-Covid changes to public transport patronage trends using regional data. This resulted in modest negative or positive changes, depending upon region.

Figure 22 shows bus patronage trends in three of the five regions where we have case study projects.[31] In Auckland, 2024/25 bus patronage was 4% below 2018/19 (pre-Covid) levels, and 16% below the pre-Covid trend. We therefore adjust forecast patronage down by 10% (the average of these two figures) for Auckland projects. In Canterbury, 2024/25 bus patronage was 11% above pre-Covid levels and 3% above the pre-Covid trend-line. We therefore adjust forecast patronage up by 3% (the lower of the two figures). In Otago, 2024/25 bus patronage was 36% above pre-Covid levels and 39% above the pre-Covid trend-line. We therefore adjust forecast patronage up by 36% (the lower of the two figures).

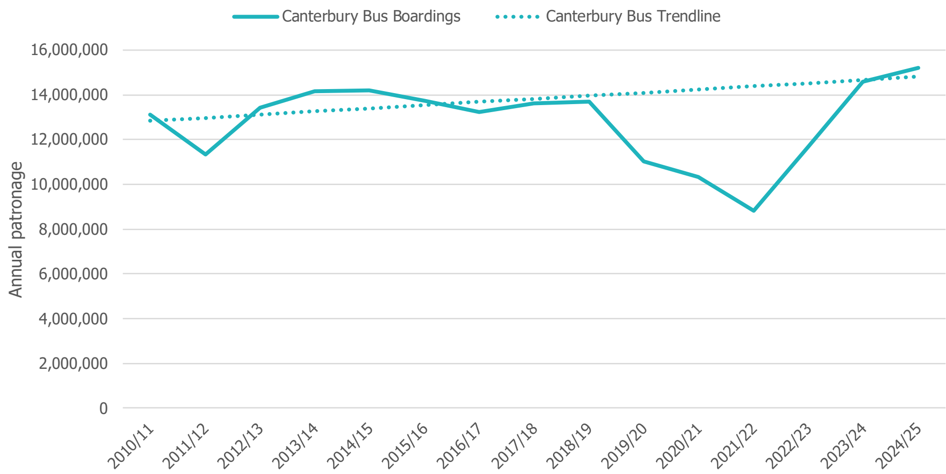
[30] https://mahere.at.govt.nz/AFCDemandForecasts/
[31] We focused on bus patronage, rather than rail patronage, as it is more relevant for the specific corridors that we are analysing. Rail patronage appears to be more negatively affected by Covid, although this is due in part to ongoing track maintenance that has reduced rail services.

Figure 22: Post-Covid changes in bus patronage, by region

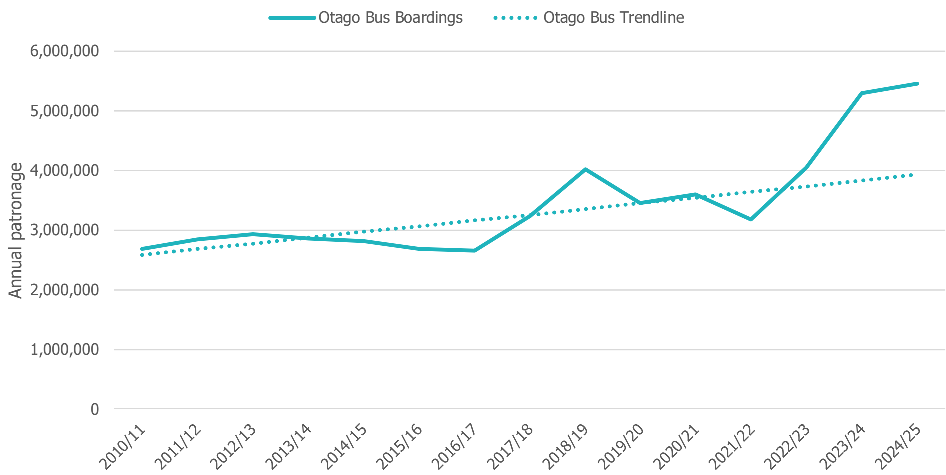
Panel A: Auckland



Panel B: Canterbury



Panel C: Otago



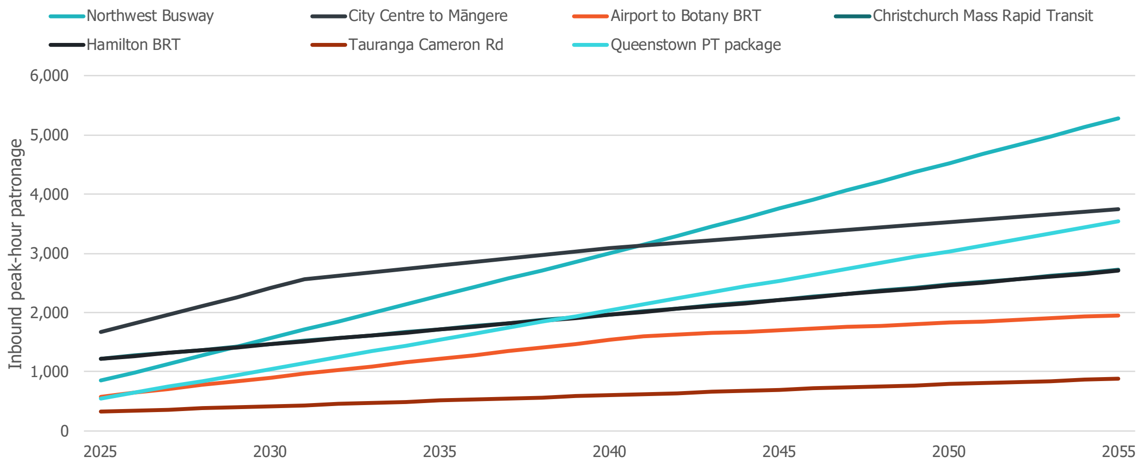
Source: New Zealand Infrastructure Commission analysis of NZTA public transport patronage data.[32]

Figure 23 summarises the resulting peak-hour patronage projections for each corridor included in our analysis. Projected patronage levels and growth trajectories vary between projects. We

[32] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools

compare these projections with the capacity of 'basic' in-street bus lanes (2,400 passengers per hour) to understand when corridors may reach capacity.

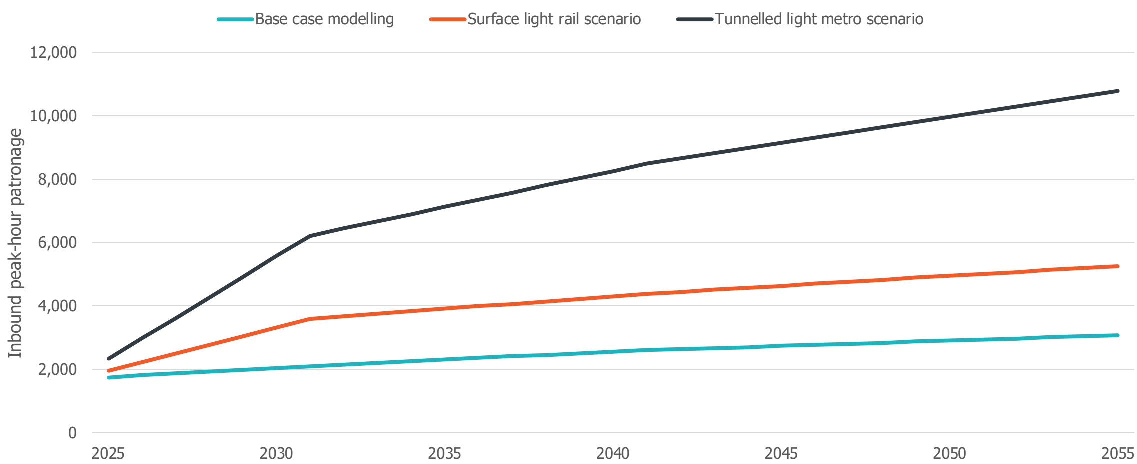
Figure 23: Peak-hour patronage projections, by corridor and year



Source: New Zealand Infrastructure Commission analysis of business case forecasts and Auckland Forecasting Centre forecasts.

In one case, the City Centre to Māngere corridor, business case and Auckland Forecasting Centre projections show how infrastructure quality can have a material impact on patronage and hence perceived capacity demands. Figure 24 shows that higher-quality infrastructure is expected to significantly lift patronage relative to the base case scenario or a lower-quality infrastructure upgrade. This reflects changes induced by faster and higher-capacity public transport services. To be conservative, we use a patronage scenario that is midway between the base case modelling (blue line) and modelled patronage with surface light rail infrastructure (orange line), and sensitivity test those two scenarios.

Figure 24: Peak-hour patronage scenarios for the City Centre to Māngere corridor



Source: New Zealand Infrastructure Commission analysis of business case forecasts and Auckland Forecasting Centre forecasts. The forecasts presented here are not adjusted for the estimated impact of Covid.

Finally, we constructed sensitivity ranges around baseline patronage projections based on the same assumptions for faster or slower regional population growth and faster or slower growth in per-capita travel volumes we used in our analysis of major road capacity upgrades. We also added scenarios for over- or under-estimation in public transport demand that widened this range further.

In doing so, we note that while public transport patronage has generally tracked regional population growth in recent decades, the strength of this relationship varies between different regions. Table 10 shows that bus patronage has grown faster than population in several regions, like Auckland, Bay of Plenty, and Otago, and slower than population in others, like Canterbury, Waikato, and Wellington. At the national level, it has grown slightly faster than population. This means that our uncertainty ranges may still be too narrow.

Table 10: Average annual change in total bus patronage and per-capita bus patronage, by region, 2011–2025

Region	Share of national bus boardings	Pre-Covid period (2011–2019)		Whole period (2011–2025)	
		Total bus patronage	Per-capita bus patronage	Total bus patronage	Per-capita bus patronage
Auckland	54%	4.6%	2.7%	2.3%	0.7%
Bay of Plenty	3%	1.1%	-0.9%	2.9%	1.2%
Canterbury	12%	0.6%	-1.0%	1.1%	-0.5%
Otago	4%	5.1%	3.3%	5.2%	3.6%
Waikato	3%	-1.0%	-2.8%	-0.3%	-2.0%
Wellington	20%	0.4%	-0.8%	0.6%	-0.2%
Other regions	3%	0.5%	-0.7%	1.5%	0.4%
New Zealand total		2.8%	1.2%	1.8%	0.3%

Source: New Zealand Infrastructure Commission analysis of NZTA public transport patronage data[33] and Stats NZ subnational population estimates.[34]

Noting that caveat, Table 11 summarises the range we applied to baseline patronage projections for projects in different regions. The lower end of this range reflects slower-than-expected regional population growth, slower growth in per-capita public transport use, and slight over-estimation of baseline demands. The higher end of this range reflects faster-than-expected regional population growth, faster growth in per-capita public transport use, and slight under-estimation of baseline demands.

Table 11: Range around baseline patronage projections, by period

	2030 patronage as share of central forecast		2050 patronage as share of central forecast	
Regional population scenario	**Low**	**High**	**Low**	**High**
Per-capita patronage scenario	**Low**	**High**	**Low**	**High**
Travel demand over-estimation scenario	**Low**	**High**	**Low**	**High**
Region				
Auckland	-14%	11%	-24%	31%
Bay of Plenty region	-14%	11%	-24%	31%
Canterbury region	-14%	11%	-25%	32%
Otago region	-14%	11%	-25%	33%
Waikato region	-14%	11%	-25%	32%

Source: New Zealand Infrastructure Commission assumptions based on Stats NZ population projections and supplementary assumptions. Scenario assumptions are explained in further detail in Appendix B.

[33] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools
[34] https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2025/

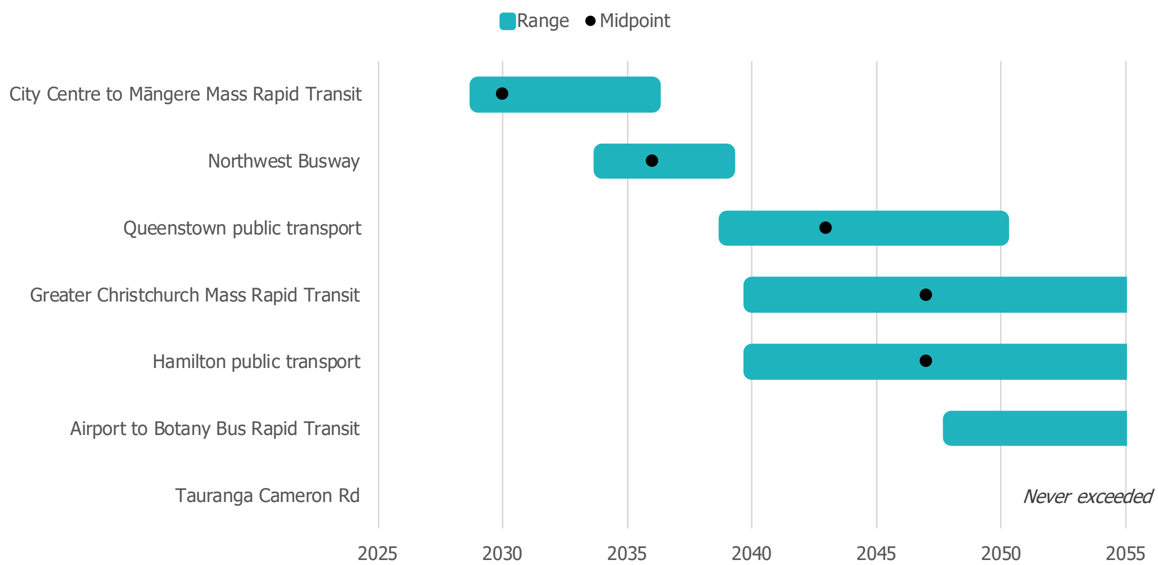
Major rapid transit capacity upgrade timing scenario and sensitivity analysis

To estimate indicative timing of when the capacity of in-street bus lanes will be exceeded, we combine baseline patronage projections from Figure 23 with the scenario ranges summarised in Table 11. This produces a range of potential patronage growth scenarios for each public transport corridor. We then compare this against the high estimate for bus lane capacity, summarised in Table 5 to identify an indicative timing range for when peak-hour capacity thresholds may be reached. The midpoint of this range reflects the 'medium' patronage growth scenario, while the starting and ending point of the range reflect the 'high' and 'low' scenarios. We also sensitivity test key assumptions and report implications for timing scenarios.

Figure 25 summarises our main analysis. Corridors with higher starting patronage are expected to hit bus lane capacity thresholds faster than lower-patronage corridors. Similarly, corridors with stronger patronage growth potential are expected to reach capacity thresholds more rapidly.

This high-level analysis suggests that major rapid transit capacity upgrades could potentially be sequenced gradually over a multi-decade period, in line with demand growth. As previously noted, this focuses solely on demand for capacity upgrades, noting that speed and reliability issues could be addressed through other means, like lower-cost bus infrastructure improvements, or by progressing major upgrades slightly earlier than indicated by capacity pressures.

Figure 25: Estimated timing range for exceeding bus lane capacity



Source: New Zealand Infrastructure Commission analysis. Note: The 'midpoint' timing reflects the date at which public transport volumes are projected to exceed the capacity of a bus lane under the central scenario for patronage growth. The start of the range reflects the projected date under the high scenario for patronage growth, and the end of the range reflects the projected date under the low scenario for patronage growth.

We sensitivity test key model assumptions to understand how these results might change if we made different assumptions about bus lane capacity and public transport patronage trends. Our model assumptions are realistic but indicative, meaning that actual outcomes for specific public transport corridors are likely to be different in practice. Sensitivity testing is therefore important for helping to understand how uncertain our central results are.

We report two sets of sensitivity tests.

First, Table 12 presents three sensitivity tests of alternative assumptions about bus lane capacity thresholds. Key findings from this sensitivity analysis are as follows:

- Using a lower hourly passenger capacity threshold of 2,100 passengers per hour (halfway in between Auckland Transport's 'ideal' and 'stretch' capacity estimates) would bring forward capacity upgrade timing by a few years in most cases, with larger impacts on corridors that are currently estimated to be further away from capacity thresholds
- Tolerating a higher degree of peak spreading (where some people shift into shoulder peak periods because vehicles are full at peak times) would delay capacity upgrade timing by around 5 years, with varying impacts on different corridors.[35]

Second, Table 13 presents three sensitivity tests of alternative assumptions about public transport patronage. Key findings from this sensitivity analysis are as follows:

- Removing the adjustments we made for post-Covid changes in public transport patronage accelerates capacity upgrade timing by several years for Auckland corridors, while delaying timing in other regions
- Slower-than-expected patronage growth would delay capacity upgrade timing. As an indicative scenario, if public transport patronage growth turned out to be 25% slower than the business case projections, timing would be delayed by 3-6 years for corridors that are currently expected to reach capacity thresholds earlier, and 10 or more years more for corridors that are further away from capacity thresholds
- Over-estimation of starting patronage would also delay capacity upgrade timing. As an indicative scenario, if starting patronage was 10% lower but the projected growth trend was the same from that point, then timing would be delayed by around five years in most cases.

Table 12: Estimated timing for exceeding bus lane capacity: Sensitivity tests on bus lane capacity assumptions

Rapid transit corridor	**Central scenario: 2400 pax/hour**	**Sensitivity 1: Lower capacity threshold (2100 pax/hour)**	**Sensitivity 2: Peak spreading tolerance (2800 pax/hour)**
City Centre to Māngere	2030 (2029 to 2036)	2028 (2027 to 2030)	2034 (2031 to 2049)
Northwest Busway	2036 (2034 to 2039)	2034 (2032 to 2037)	2038 (2036 to 2043)
Queenstown PT package	2043 (2039 to 2050)	2040 (2037 to 2046)	2047 (2042 to After 2055)
Christchurch Mass Rapid Transit	2047 (2040 to After 2055)	2041 (2036 to 2055)	2053 (2044 to After 2055)
Hamilton BRT	2047 (2040 to After 2055)	2042 (2036 to 2055)	2054 (2044 to After 2055)
Airport to Botany BRT	After 2055 (2048 to After 2055)	2055 (2043 to After 2055)	After 2055 (2054 to After 2055)
Tauranga Cameron Rd	After 2055 (After 2055 to After 2055)	After 2055 (After 2055 to After 2055)	After 2055 (After 2055 to After 2055)

Source: New Zealand Infrastructure Commission analysis. Note: The 'midpoint' timing based on the central demand growth scenario is shown in the first row in each line, while the range from high demand growth scenario to low demand

[35] In the absence of information on hourly passenger volumes, we model peak spreading tolerance by applying a higher threshold for peak hour passengers. A higher threshold of 2,800 passengers per hour means that roughly one in seven people who would prefer to travel in the peak hour would have to shift into shoulder peak periods.

growth scenario is shown in parentheses below. All results are shown relative to our main public transport patronage scenarios.

In addition, we sensitivity tested different business case forecasts for the City Centre to Māngere corridor. Holding all other assumptions constant, we find that using 'base case' modelling with no infrastructure or service upgrades results in a midpoint timing of 2041 (range 2035 to after 2055). Conversely, using modelling that assumes an upgrade to surface light rail results in a midpoint timing of 2028 (range 2027 to 2029). This highlights that modelling can be sensitive to service and infrastructure assumptions (Table 13).

Table 13: Estimated timing for exceeding bus lane capacity: Sensitivity tests on patronage trend assumptions

Rapid transit corridor	Central scenario: Business case patronage projection adjusted for post-Covid trend	Sensitivity 1: Business case patronage projection, no Covid adjustment	Sensitivity 2: 25% reduction in rate of patronage growth	Sensitivity 3: 10% reduction in the starting level of patronage
City Centre to Māngere	2030 (2029 to 2036)	2029 (2028 to 2031)	2033 (2030 to 2053)	2031 (2030 to 2039)
Northwest Busway	2036 (2034 to 2039)	2034 (2033 to 2037)	2042 (2038 to 2050)	2036 (2034 to 2040)
Queenstown PT package	2043 (2039 to 2050)	2051 (2045 to After 2055)	2055 (2046 to After 2055)	2044 (2040 to 2051)
Christchurch Mass Rapid Transit	2047 (2040 to After 2055)	2048 (2040 to After 2055)	2055 (2043 to After 2055)	2049 (2041 to After 2055)
Hamilton BRT	2047 (2040 to After 2055)	2049 (2041 to After 2055)	After 2055 (2044 to After 2055)	2049 (2041 to After 2055)
Airport to Botany BRT	After 2055 (2048 to After 2055)	After 2055 (2044 to After 2055)	After 2055 (After 2055 to After 2055)	After 2055 (2049 to After 2055)
Tauranga Cameron Rd	After 2055 (After 2055 to After 2055)	After 2055 (After 2055 to After 2055)	After 2055 (After 2055 to After 2055)	After 2055 (After 2055 to After 2055)

Source: New Zealand Infrastructure Commission analysis. Note: The 'midpoint' timing based on the central demand growth scenario is shown in the first row in each line, while the range from high demand growth scenario to low demand growth scenario is shown in parentheses below. All results are shown relative to our indicative bus lane capacity estimate of 2400 passengers per hour.

Unit costs to deliver rapid transit capacity upgrades

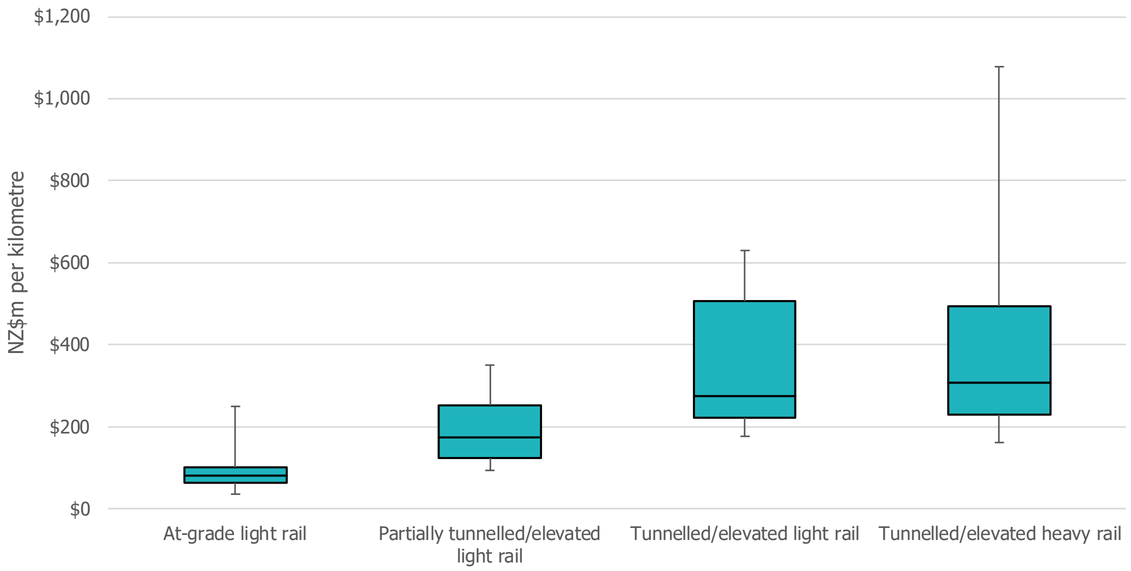
We now consider the cost of delivering major rapid transit upgrades and how this compares with our Forward Guidance for public and active transport improvement capital investment.

To inform this indicative analysis, we analyse data on the unit cost to build different types of rail-based rapid transit infrastructure in OECD countries (Aevaz et al., 2021),[36] and supplement this with high-level analysis of unit cost of completed or proposed busway projects in New Zealand, based on cost and scope information published by NZTA. All costs are converted to NZD using the World Bank's Purchasing Power Parity exchange rates and adjusted to June 2025 prices using Statistics New Zealand's Capital Goods Price Index for civil construction. Appendix B summarises our estimates and assumptions for New Zealand busway projects.

[36] https://projectdelivery.enotrans.org/

Figure 26 compares unit cost ranges (in NZD per kilometre) for different types of rail infrastructure in OECD countries. These range from at-grade light rail to tunnelled / elevated heavy rail. Costs vary significantly depending upon infrastructure type. For instance, the median tunnelled/elevated light rail project costs around 3.5 times as much as the median at-grade light rail project. Costs can also vary considerably within project categories.

Figure 26: Box and whiskers plot showing costs for light and heavy rail projects in OECD countries

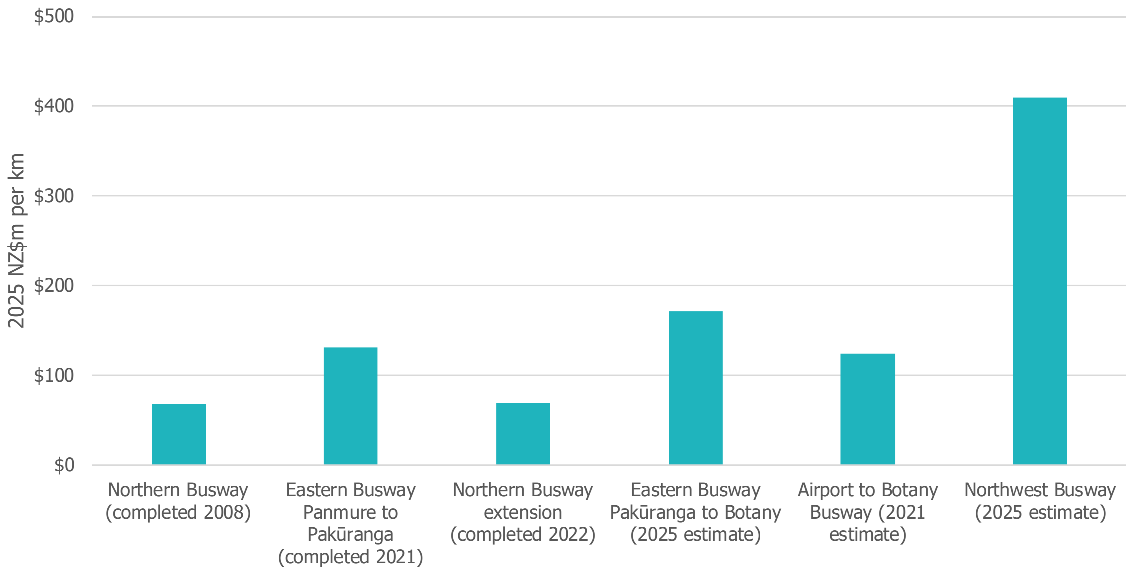


Source: New Zealand Infrastructure Commission re-analysis of project cost data published by the Eno Center for Transportation (Aevaz et al., 2021) *to adjust costs to 2025 NZD values and group by project category. See Appendix B for further details and caveats to these comparisons. Note: Chart is a 'box and whiskers' plot. The shaded box shows the range from 25th percentile unit cost to 75th percentile, with the black line in the middle of the range showing the median unit cost. Whiskers show the 5th percentile and 95th percentile unit costs.*

Figure 27 shows actual and estimated unit costs (in NZD per kilometre) of completed, in-progress, and proposed busway projects in New Zealand. New Zealand has historically built busways at an inflation-adjusted cost of around $70 m to $170 m per kilometre. However, a proposed project, Auckland's Northwest Busway, has current estimated costs above $400 m per kilometre, roughly four times the historical average. The reasons for this are unclear. Discussions with NZTA suggest that this could be partly due to their inclusion of generous contingency or future cost escalation allowances in the published cost ranges. However, these factors, by themselves, seem unlikely to explain the full magnitude of the difference.[37]

[37] A simple example suggests why this is unlikely. In recent decades, civil construction prices have risen by around 3% per annum. As a result, a project that is expected to be built 20 years in the future would be expected to cost 80% more in future due to inflation than the same project built today. This suggests that escalation over a multi-decade period might be sufficient to explain escalated unit costs that are around twice as high as present-day costs, but not costs that are considerably higher than that.

Figure 27: Inflation-adjusted per-kilometre costs to build busways in New Zealand



Source: New Zealand Infrastructure Commission analysis of contract cost data or business case estimates released by transport agencies, adjusted to 2025 values using Stats NZ's civil construction capital goods price index. See Appendix B for further details and caveats to these comparisons.

Rapid transit infrastructure seems to cost a bit more in New Zealand than other OECD countries. Busway construction costs in New Zealand are in the upper half of the at-grade light rail cost range in other OECD countries, even though light rail is a higher-standard type of infrastructure. A 2022 cost benchmarking study found that while New Zealand seems to build rapid transit stations at a comparable cost to European countries, underground rail costs are much higher (New Zealand Infrastructure Commission, 2022). For rail tunnel projects, we would expect a cost premium of around 80% based on New Zealand's location in the 'Ring of Fire'.[38]

We use this information to help define scenarios for costs to deliver rapid transit projects in the New Zealand context. As one point of reference, we use business case or other publicly-available information on expected costs for rapid transit projects, based on preferred options that have been outlined in those reports.

As our benchmarking analysis suggests that New Zealand's rapid transit costs are higher than other OECD countries, we also consider an alternative scenario in which project costs are closer to the international norm. In this scenario, we use a per km cost of NZ$140 m per km for busway projects (equal to the 75th percentile of costs for completed New Zealand busway projects) and a per km cost of NZ$250 m for projects that could be built as at-grade light rail (equal to the 95th percentile of costs for at-grade light rail, or the 75th percentile of costs for partly tunnelled/elevated light rail projects, in other OECD countries).

Reconciliation of project timing scenario with Forward Guidance

To conclude, we show how the major upgrade timing scenario described above aligns with the Commission's Forward Guidance for public and active transport upgrades and improvements. To do so, we compare cumulative capital costs of major upgrades over time against Forward Guidance capital investment projections. For indicative purposes, we show the midpoint timing

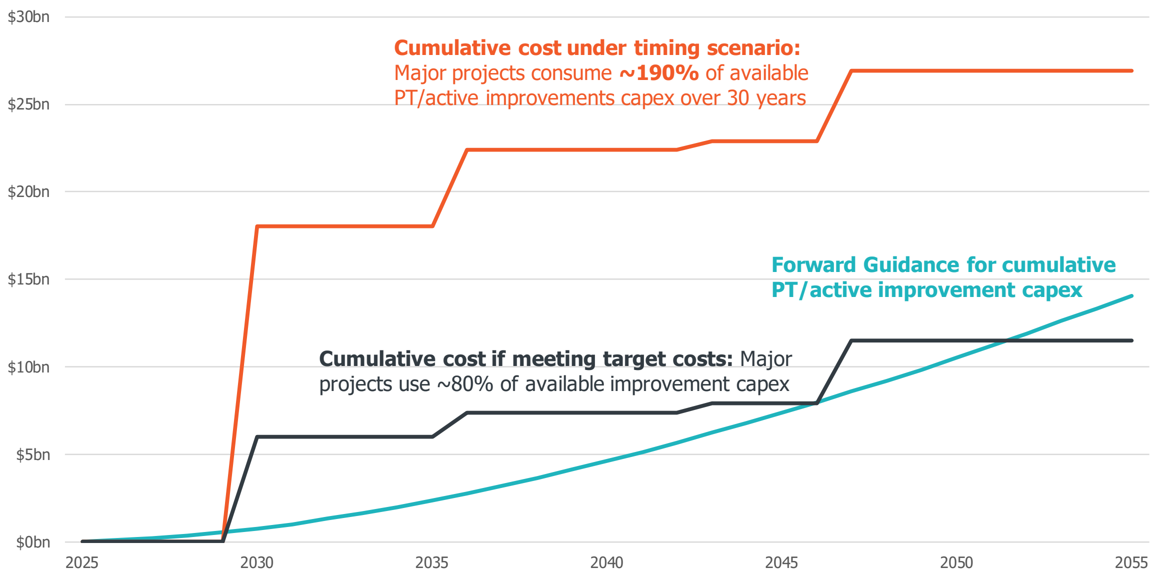
[38] Calculated based on regression model coefficients reported in Table 4 in Appendix 1 in New Zealand Infrastructure Commission (2022). The ~80% cost premium for Ring of Fire countries over non-Ring of Fire countries is calculated as exp(-0.951-(-1.550))-1.

scenario shown in Figure 28 as it is most consistent with the medium population growth and economic growth scenarios used in our central Forward Guidance investment path.

Figure 28 summarises the resulting comparison of cumulative capital expenditure over time. The blue line shows cumulative public and active transport improvement capex, while the other lines show cumulative capital costs for major rapid transit capacity upgrades under our midpoint timing scenario. The orange line shows cumulative rapid transit upgrade costs if new projects are built at higher costs, while the black line shows cumulative upgrade costs if costs are more reasonable.

This comparison suggests that a programme of major rapid transit capacity upgrades can be delivered within the Commission's Forward Guidance if two conditions are met. First, major capacity upgrades must be built roughly in line with demand growth, rather than well in advance of demand. As part of this approach, corridors will need to be delivered incrementally, starting with highest-demand segments. If safety, speed, or resilience issues arise on roads that are well below capacity thresholds, lower-cost interventions should be applied instead. Second, major rapid transit capacity upgrades must be delivered at a unit cost that is more consistent with international costs and past New Zealand projects. If some projects are considerably more expensive, then they may require scope changes or higher levels of demand to be cost-effective to build.

Figure 28: Comparison of Forward Guidance with major road capacity upgrade timing scenario



Source: New Zealand Infrastructure Commission analysis.

Waitemata Harbour Crossing

Overview of proposal

The Auckland Harbour Bridge was opened in 1959 as a four-lane vehicle bridge and expanded with an additional four traffic lanes in 1969. In 2008 it was augmented with the Northern Busway, which runs in a separate corridor north of the Bridge and carries a growing share of total people moving across the harbour. It is a critical national transport link that currently carries more people and vehicle traffic than any other transport corridor. This includes around 160,000 vehicles per day, including 13,000 heavy goods vehicles,[39] and around 50,000 passengers on the Northern Busway.

[39] https://experience.arcgis.com/experience/a09cd3ec9bdd4068b45c818a69601775

The bridge faces several mounting challenges, including:

- **Maintenance**: Ageing infrastructure with increasing failure risk
- **Resilience**: Vulnerability to disruption and limited redundancy
- **Capacity**: Physical limits on vehicle and bus throughput, as bridge usage is expected to rise to 185,000 vehicles and 85,000 busway passengers per day by 2041.[40]

Over the last 35 years, repeated investigations have identified a potential need for a replacement or additional Waitematā Harbour crossing. However, the solutions they have identified are too large to fund through normal transport revenue streams (and hence would also go outside our Forward Guidance for land transport investment). For example, a recent (2024) business case identified a preferred 'stage 1' option with a capital cost of $22.9-27.2 billion, which would result in a significant improvement to the cross-harbour link rather than a simple like-for-like replacement.[41]

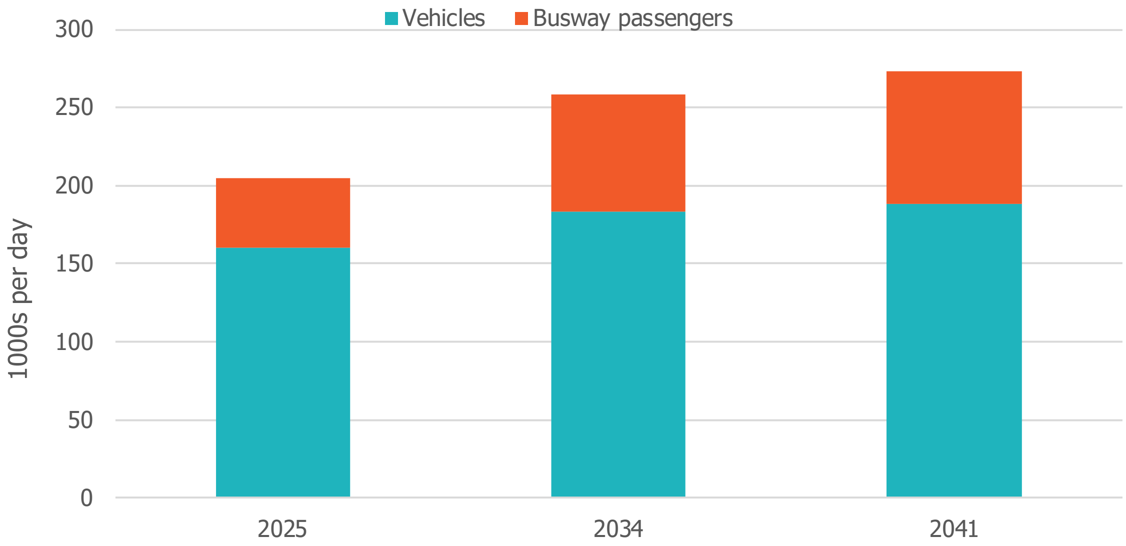
To date, no proposed Waitematā Harbour Crossing option has received a full funding commitment. The medium-term investment challenge is therefore to identify how much new revenue can be raised from new funding sources like tolls to help set an affordability envelope to guide project business casing, and identify lower-cost solutions that can be progressed while awaiting funding to be available.

Current and projected transport volumes

Figure 29 summarises Auckland Forecasting Centre baseline projections for growth in traffic and public transport volumes across the Auckland Harbour Bridge. Public transport volumes are expected to grow faster than traffic volumes, as the Busway has more capacity to accommodate growth. Moreover, this projection does not incorporate the impact of policies like time-of-use pricing, which will shift demand for different transport options and time periods, or the impact of other infrastructure upgrades, which might also shift demand.

[40] https://mahere.at.govt.nz/AFCDemandForecasts/
[41] https://www.rnz.co.nz/news/national/535041/tunnel-and-bridge-options-in-22-billion-waitemata-plan

Figure 29: Vehicles and busway passengers crossing the Auckland Harbour Bridge each day (2025–2041)



Source: New Zealand Infrastructure Commission analysis of forecasts published by Auckland Forecasting Centre.[42]

Lower-cost options for extending the life of the Auckland Harbour Bridge

There are three broad options for managing demand and extending the life of the existing Bridge, and hence delaying the date at which major capital investment may be needed:

- Time-of-use pricing to manage peak-period traffic demand and improve reliability
- Interim busway and shoulder-running upgrades to increase busway capacity
- Enhanced maintenance and asset monitoring to reduce failure risk and extend the bridge's service life.

The transport capacity of the existing bridge and busway is limited by three factors.

The first factor is traffic lane capacity on the bridge. The bridge has eight traffic lanes in total, with a movable barrier that provides higher southbound capacity in morning peak periods and higher northbound capacity in evening peaks. Table 3 indicates that motorway lanes have a maximum capacity of around 2,200 passenger cars per lane per hour. Based on a heavy vehicle equivalence factor of 3 (Table 4), a heavy vehicle share of around 8% of total traffic (13,000 heavy vehicles out of a total of around 160,000 vehicles), and an ideal V/C ratio of 87.5%, this suggests the Auckland Harbour Bridge has an ideal hourly traffic capacity of around 13,300 vehicles.

The second factor is the limit on the number of buses that can be accommodated in the city centre. As noted above, public transport corridor capacity is limited by stop/station capacity rather than running way capacity. Analysis undertaken in previous business cases suggests that the key constraint to increasing throughput on the Northern Busway is the capacity of the city centre street network and bus stops. A 2020 business case investigation estimated that this would

[42] https://mahere.at.govt.nz/AFCDemandForecasts/

limit the busway to around 110 city centre-bound double-decker buses per hour.[43] This results in passenger capacity of around 9,400 passengers per hour.[44]

The third factor is bridge structural limits that constrain the size and weight of vehicles that can travel on the bridge. The clip-ons used by buses and other heavy vehicles are subject to weight restrictions.[45] This means that higher-capacity public transport vehicles such as Brisbane Metro-style articulated buses carrying ~180 passengers and weighing around 30 tonnes[46] are unlikely to be viable on the current structure.

At present, there are options for managing increased traffic volumes over the bridge. Peak-time vehicle traffic volumes are currently closer to capacity than public transport volumes. Increased transport volumes can currently be accommodated through a combination of peak spreading and increased busway utilisation (which will require bus capacity changes in the city centre). However, ongoing growth in demand means that these limits will at some point be reached.

Time-of-use pricing can alleviate peak-time traffic congestion. It is expected to reduce peak-period car volumes while increasing demand for the Northern Busway by around 15%. This will delay traffic capacity constraints but bring forward the date at which the Northern Busway will reach capacity. Moreover, time-of-use pricing is likely to affect the mix of heavy vehicles on the bridge, as freight operators typically have a higher value-of-time threshold than many car commuters and are more willing to pay for peak-time reliability and time savings. This could affect the maintainability or resilience of clip-ons.

While this is a high-level analysis, it identifies the presence of multiple interacting constraints that must be navigated to extend the life of the existing bridge.

Analysis of tolling revenue potential

When or if it is not possible to further extend the life of the existing bridge, funding will be needed for a replacement or new crossing. Just as the original Auckland Harbour Bridge was funded through tolls, new revenue sources are likely to be needed for a new crossing.

We therefore undertook a high-level, indicative analysis of toll revenue potential for a cross-harbour link. This type of analysis can help to guide business case investigations, for instance by establishing an affordability envelope for proposed solutions.

This analysis builds upon previous Commission research on toll revenue potential for new roads (New Zealand Infrastructure Commission, 2024a). In that research, we developed and validated a simple model of toll revenue potential that accounted for how users might respond to a toll by diverting onto a parallel untolled route. We employ this model, with some extensions and sensitivity tests on key model assumptions, for this analysis.[47]

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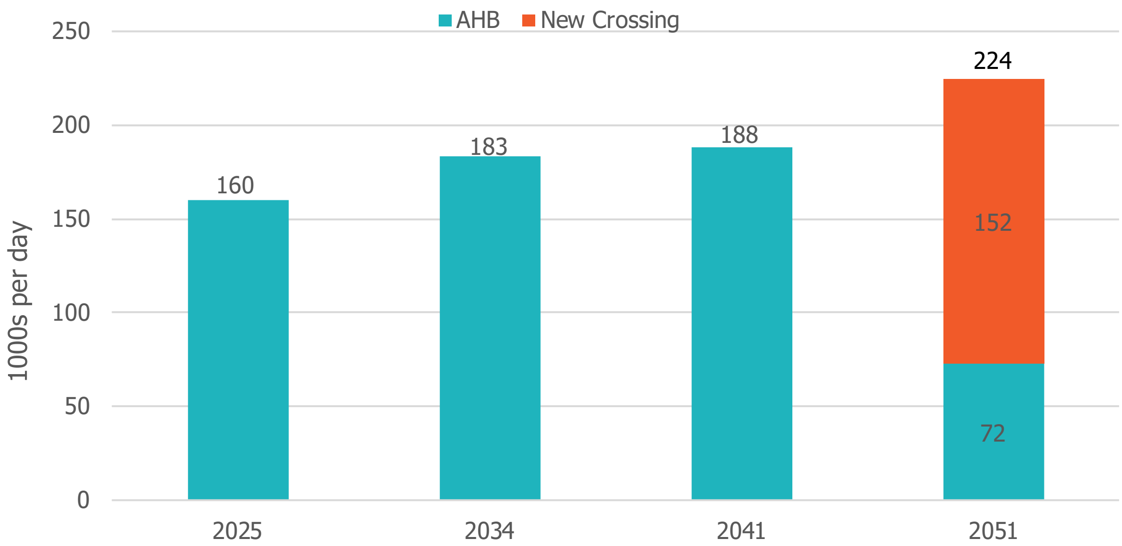
[43] https://nzta.govt.nz/assets/projects/awhc/docs/Additional-Waitemata-Harbour-Connections-Full-Business-Case-November-2020.pdf
This is higher than our estimate of busway capacity as it assumes that buses would distribute onto multiple city centre streets rather than concentrating on a single corridor.
[44] Assuming average double-decker bus occupancy of around 85 passengers.
[45] Weight constraints on the bridge are managed through the permit system outlined in **Sections 5.1–5.11**, with specific conditions imposed by the road controlling authority based on structural assessments. See: https://www.nzta.govt.nz/resources/rules/vehicle-dimensions-and-mass-2016/
[46] https://www.hess-ag.ch/en/products/lightram-25/
[47] We use the same model assumptions, with several variations. First, we assume a toll is in place for 35 years, rather than 25 years, due to the long-lived nature of a new crossing. Second, we assume a 5% real

Toll revenue potential is higher when traffic volumes are higher, and when vehicle users are willing to pay more to use the infrastructure. Willingness to pay is in turn influenced by how good the tolled route is relative to the alternatives.

Projected traffic volumes

We use forecasts produced by the Auckland Forecasting Centre as a basis for understanding traffic volumes over a new crossing.[48] Figure 30 extends Figure 29 to include a 2051 model year that included the impact of a new vehicle crossing on traffic volumes. Total traffic across the new and existing bridge is forecast to increase to around 224,000 vehicles per day, most of which would use the new crossing rather than the existing one.[49] We use the 2051 model year as the basis for our tolling revenue analysis, and extrapolate future growth in traffic volumes after that point.

Figure 30: Vehicle travel over the Auckland Harbour Bridge and new crossing



Source: New Zealand Infrastructure Commission analysis of forecasts published by Auckland Forecasting Centre.[50]

Tolling only the new crossing

We begin by considering what would happen if the new crossing was tolled while the existing bridge was not tolled. In this scenario, users could choose between two harbour crossings that started and ended in similar places. The new crossing may offer minor travel time improvements, but many users would divert back to the existing crossing in response to even a small toll.

Table 14 summarises illustrative scenarios for tolling only the new crossing, depending upon how much time users could save by using the new crossing as opposed to the existing bridge. In this scenario, the toll would only apply to the approximately 152,000 users of the new crossing. Using

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discount rate, which sits at the midpoint between Treasury's guidance for a commercial investment and a non-commercial investment and is slightly higher than government bond rates. Third, we assume traffic volumes grow in line with Stats NZ's 90th percentile population projection, rather than the median projection, because Auckland has higher population growth rates than the country as a whole. Fourth, we update value of travel time saving parameters to 2025 New Zealand dollars.

[48] https://mahere.at.govt.nz/AFCDemandForecasts/

[49] This reflects, in part, the fact that the new crossing is intended to serve regional traffic while the existing bridge would serve city centre-bound traffic.

[50] https://mahere.at.govt.nz/AFCDemandForecasts/

a logit-based model to simulate potential demand response to a toll, we estimate revenue-maximising light vehicle tolls for different time saving scenarios. For instance, if the new crossing was five minutes faster than the existing bridge, then the revenue-maximising toll would be around $2.20. At this level, however, 45% of users would divert to the existing bridge. After accounting for GST, toll administration costs, and traffic growth in future years, this would result in net present value (NPV) revenues of only $0.7 billion.

The diverted traffic is likely to be feasible to accommodate within the capacity of the existing bridge. For instance, even if 71% of traffic diverted to the existing bridge (the highest scenario for diversion), traffic volumes on the existing bridge would remain under forecast 2041 levels.

Other travel time saving scenarios result in slightly more or less revenue, but in all plausible cases revenues are unlikely to be sufficient to cover the cost of a new crossing.

Table 14: Revenue scenarios from tolling only the new crossing

Travel time saving relative to existing bridge (minutes)	Base vehicle trips	Revenue-maximising light vehicle toll ($)	Share of vehicles diverted to untolled bridge in response to revenue-maximising toll	Net present value of toll revenues (35-year period, 5% discount rate)
1	151,930	$1.40	71%	$0.1bn
2	151,930	$1.56	64%	$0.2bn
3	151,930	$1.75	57%	$0.3bn
4	151,930	$1.98	51%	$0.5bn
5	151,930	$2.23	45%	$0.7bn
6	151,930	$2.51	40%	$0.9bn
7	151,930	$2.82	35%	$1.2bn
8	151,930	$3.14	32%	$1.5bn
9	151,930	$3.48	29%	$1.8bn
10	151,930	$3.84	26%	$2.1bn

Source: New Zealand Infrastructure Commission analysis based on toll revenue model outlined in New Zealand Infrastructure Commission (2024a).

Tolling both new and existing crossings

We now consider the revenue potential from tolling both the new and existing crossing. The rationale for tolling both crossings would be that a new crossing would indirectly benefit people using the existing crossing, for instance by reducing the congestion that they experience or improving the bridge's resilience or maintainability. Moreover, people seeking to avoid the toll would still have the option of diverting to an alternative route (the Western Ring Route) or shifting to public transport.

It is more challenging to analyse this option, as resulting changes in travel demands would affect the performance of the broader Auckland transport network. For instance, significant diversion of traffic to the Western Ring Route may increase congestion delays on that route. This means that the simple logit-based route choice model may not provide meaningful results, as it assumes that travel times on alternative untolled routes are unaffected by traffic diversion from the tolled route.

We therefore extend our modelling framework, building upon analysis and parameters from the Commission's previous work (2024a). Rather than employing a single model, we apply two simple models and consider them alongside each other.

First, we extend the simple logit-based route choice model by disaggregating travel demand by destination. We distinguish between city centre-bound trips, where the 'untolled alternative' is switching to public transport, and other regional destinations, where the Western Ring Route is the untolled alternative. This model requires three key assumptions: (1) the share of vehicles travelling to each destination, (2) what alternative travel option is available for each destination, and (3) how much time the tolled crossing saves relative to the alternative travel option. Table 15 summarises our central assumptions.

Second, we use an elasticity model to estimate potential reduction in vehicle travel demands across the tolled crossings. Elasticity models scale down vehicle volumes in proportion to the percentage increase in the overall time and money 'cost' of travel.[51] Larger tolls result in a greater percentage reduction, but this impact is predicted to vary depending upon the overall length and cost of the trip. This model requires two key assumptions: (1) the share of vehicles making relatively short or long trips across the harbour and (2) average generalised cost for each category of trips. Table 16 summarises our central assumptions.

As this is a high-level analysis, we highlight that our modelling input assumptions are indicative rather than fully realistic and present sensitivity testing of these input assumptions.

Table 15: Key input assumptions for logit-based toll revenue model

Trip destination	City centre-bound trips	Regional trips
Share of vehicles travelling to this destination (1)	32%	68%
Alternative travel option	Public transport (Northern Busway)	Western Ring Route
Time saved by using crossing, relative to alternative option (2)	10 min	22 min

Notes: (1) We assume that vehicles forecast to use the existing AHB are travelling to city centre or nearby destinations, while vehicles forecast to use the new crossing are travelling to other regional destinations (see Figure 30). (2) We estimate time savings for city centre-bound trips (relative to using the Busway) by comparing current Google Maps road and public transport travel times from Constellation Drive to Queen Street.[52] We estimate time savings for regional trips by comparing current Google Maps road travel times from Constellation Drive to Greenlane.[53]

[51] More precisely, predicted vehicle traffic in response to a toll is modelled as $V_{toll} = V_{no\ toll} * \left(\frac{GC_{toll}}{GC_{no\ toll}}\right)^{\varepsilon}$, where 'V' refers to traffic volumes, 'GC' refers to generalised cost of travel, and ε is the elasticity of travel demand with respect to generalised cost. 'Generalised cost' sums together the financial cost of travel (including tolls) and travel times, valued using value of travel time saving parameters published by NZTA. 'Buying time' includes a model extension that uses an elasticity model to estimate potential induced traffic resulting from a new toll road. Following NZTA research, it uses a generalised cost elasticity (ε) of -1.0 (Byett et al., 2024). (See Table B.6.) This means that a 10% increase in travel costs is predicted to lead to a 10% decrease in travel volumes on a route.

[52] Google Maps indicates March road travel times range from 12-26 minutes in the midday period and 22-45 minutes in the AM peak. March public transport travel times are estimated at around 23 minutes in the midday period and 27 minutes in the AM peak, i.e., potentially faster than road travel. However, buses also require more access and waiting time, and as a result we assume an overall time premium of around 10 minutes.

[53] Google Maps indicates March road travel times range from 16-26 minutes in the midday period and 24-40 minutes in the AM peak if using the Auckland Harbour Bridge. They range from 26-40 minutes in the

Table 16: Key input assumptions for elasticity-based toll revenue model

Trip category	Short trips	Long trips
Share of trips in this category (1)	50%	50%
Average generalised cost for this trip category (minutes) (2)	30 min	50 min
Average generalised cost for this trip category ($) (3)	$15.10	$25.10

Notes: (1) We did not have detailed origin-destination information for cross-harbour trips, although we note that this could be sourced from transport model forecasts. We drew upon high-level origin-destination forecasts published by the Auckland Forecasting Centre to help understand the rough distribution, and sensitivity tested this ratio.[54] (2) We used current Google Maps road travel time estimates to get a rough indication of the distribution of travel times for shorter or longer trips. Our 'short trip' estimate is roughly consistent with a modestly congested trip from Constellation Drive to the city centre, while our 'long trip' estimate is roughly consistent with a modestly congested trip from Constellation Drive to Penrose. (3) We converted travel time to dollars using a weighted average value of travel time of $30.10/hour, based on NZTA's value of travel time savings parameters and the forecast mix of trip purposes using the crossing.

Based on these high-level modelling assumptions, we estimate the net present value of toll revenues that could be earned from tolling both crossings at various levels. As noted above, higher tolls result in more trip diversion to other routes or public transport.

Figure 31 summarises our key results. It shows total whole-of-life toll revenues (vertical axis) that might be achieved by varying light vehicle tolls (horizontal axis). The three solid lines on the chart show three scenarios:

- **Blue line**: How much revenue could be raised if there was no demand response to tolls, i.e., if all drivers continued to use the crossing and pay the toll. This is the theoretical 'upper bound' on revenue potential.
- **Orange line**: Modelled revenue based on the elasticity model of demand response
- **Black line**: Modelled revenue based on the logit model of demand response.

The elasticity model and logit model approaches produce very similar results up to a toll of around $9. Past this point, the elasticity model predicts that revenues will continue to rise, albeit more gradually, while the logit model predicts that revenues will decline to accelerating diversion away to other travel options. This reflects different modelling assumptions about the availability and quality of alternative options. The logit-based model will over-estimate the share of people who will shift to alternative routes, as it does not account for the fact that these routes will become more congested in the process. By contrast, the elasticity-based model will under-estimate travel diversion at high toll levels, as it does not explicitly compare the option of shifting to another route.

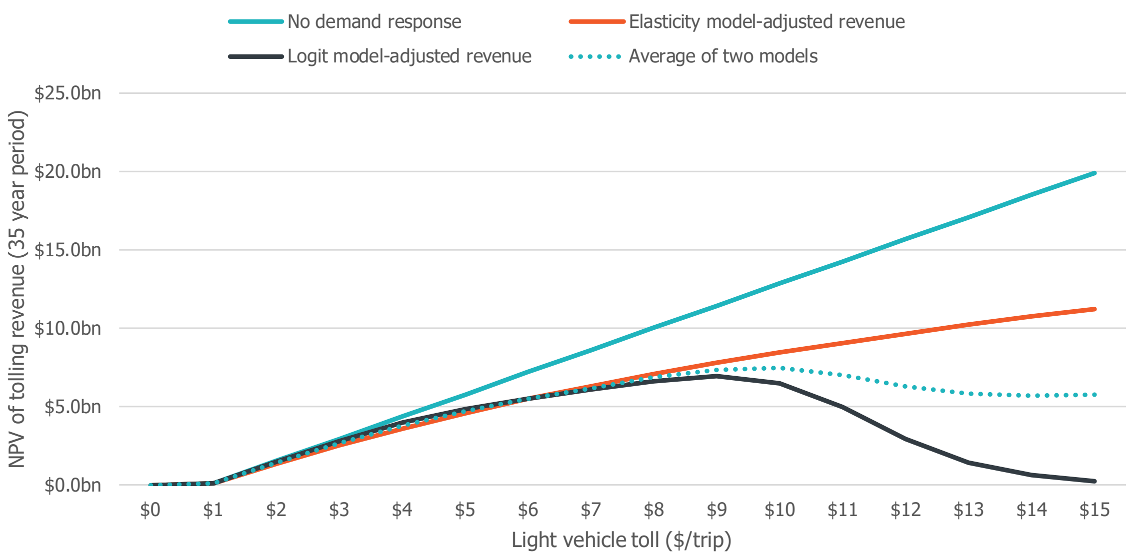
A pragmatic assessment is that actual outcomes are likely to lie somewhere between the two models. This would suggest a revenue-maximising light vehicle toll somewhere in the range of $8 to $12 per trip, with a 'best guess' estimate of around $10.

A $10 toll would raise whole-of-life revenue of between $6.5 billion (logit model) and $8.4 billion (elasticity model)

midday period and 40-75 minutes in the AM peak. Taking the midpoint of these ranges, this suggests a time penalty of perhaps 12 minutes in the midday period and perhaps 26 minutes in the morning peak. We take a figure near the upper end of this range to reflect the fact that diverting significant traffic to the Western Ring Route is likely to congest it further.

[54] https://mahere.at.govt.nz/AFCDemandForecasts/ODExplorer/

Figure 31: High-level analysis of potential toll revenues from tolling both new and existing Waitematā Harbour crossings



Source: New Zealand Infrastructure Commission analysis.

Sensitivity analysis of tolling potential

Our central results above are based on several key input assumptions. As a result, we sensitivity test key assumptions to understand their impact on estimated revenues. We report three sets of sensitivity tests. First, for both models, we sensitivity test tolling period assumptions and discount rate assumptions to show how a longer or shorter tolling period or a higher or lower discount rate affects estimated whole-of-life revenues. Next, we sensitivity test key model assumptions for each of the two models, reporting results separately.

We do not report traffic volume sensitivity tests. Given our simple model setup, a change in traffic volumes would result directly in an equal percentage change in estimated tolling revenues.

All results are reported for our estimated 'best guess' revenue-maximising light vehicle toll of $10.

Table 17 shows sensitivity tests for tolling period and discount rates. We test 25-year and 50-year tolling periods and 3% and 7% discount rates. As expected, longer tolling periods and lower discount rates lead to higher estimates of NPV toll revenues, and vice versa. Moreover, extending the tolling period has a larger impact on NPV toll revenues (and hence the ability to fund a larger project) if a lower discount rate is used.

Table 17: High-level analysis of whole-of-life (NPV) toll revenues from a $10 toll: Tolling period and discount rate sensitivity tests

Scenario	**Elasticity model estimate**	**Logit model estimate**
Central assumption: 35-year period, 5% discount rate	*$8.4bn*	*$6.5bn*
Sensitivity 1: 25-year period, 5% discount rate	$7.1bn	$5.4bn
Sensitivity 2: 50-year period, 5% discount rate	$9.6bn	$7.4bn
Sensitivity 3: 35-year period, 3% discount rate	$11.3bn	$8.6bn
Sensitivity 4: 35-year period, 7% discount rate	$6.6bn	$5.0bn
Sensitivity 5: 25-year period, 7% discount rate	$5.8bn	$4.5bn
Sensitivity 6: 50-year period, 3% discount rate	$14.0bn	$10.7bn

Source: New Zealand Infrastructure Commission analysis. Note: All sensitivity tests in this table are based on the central assumptions for other model assumptions outlined above.

Table 18 shows sensitivity tests of key logit model assumptions. Our results are insensitive to all assumptions <u>except</u> our assumption about how much time crossing users would save relative to the alternative route. If alternative routes resulted in a much lower time penalty relative to the harbour crossing, then the tolls that people would be willing to pay would be lower. This seems to be most important for regional trips that might otherwise have to use the Western Ring Route, as the Northern Busway already provides a reasonably time-competitive alternative for city centre-bound trips.

Table 18: Logit model estimates of whole-of-life (NPV) toll revenues from a $10 toll: Model input assumption sensitivity tests

Scenario	**Description**	**NPV toll revenues**
Central assumptions	*Table 15 assumptions for trip destination split and time savings relative to alternative route*	*$6.5bn*
Trip destination split: 5% more city centre-bound trips	Increase city centre-bound trips from 32% to 37% of total cross-harbour trips	$6.0bn
Trip destination split: 5% more regional trips	Increase regional trips from 68% to 73% of total cross-harbour trips	$6.9bn
Time savings: Increase time savings relative to alternative route by 20%	Increase time savings to 12 minutes for city centre-bound trips and 26.4 minutes for regional trips	$8.4bn
Time savings: Reduce time savings relative to alternative route by 20%	Reduce time savings to 8 minutes for city centre-bound trips and 17.6 minutes for regional trips	$2.1bn
Time savings: Reduce time savings for city centre-bound trips by 20% and increase them by 20% for regional trips	Reduce time savings to 8 minutes for city centre-bound trips and increase them to 26.4 minutes for regional trips	$8.4bn

Source: New Zealand Infrastructure Commission analysis. Note: All results in this table use a 35-year tolling period and a 5% discount rate.

Table 19 shows sensitivity tests of key elasticity model assumptions. Our results are insensitive to reasonable changes in key assumptions.

Table 19: Elasticity model estimates of whole-of-life (NPV) toll revenues from a $10 toll: Model input assumption sensitivity tests

Scenario	Description	NPV toll revenues
Central assumptions	*Table 16 assumptions for trip category split and average generalised costs*	*$8.4bn*
Trip category split: 10% more short trips	Increase short trips from 50% to 60% of total cross-harbour trips	$8.3bn
Trip category split: 10% more long trips	Increase long trips from 50% to 60% of total cross-harbour trips	$8.6bn
Generalised cost: Increase baseline generalised cost by 20%	Increase generalized cost to 36 minutes for short trips and 60 minutes for long trips	$9.0bn
Generalised cost: Reduce baseline generalised cost by 20%	Reduce generalized cost to 24 minutes for short trips and 40 minutes for long trips	$7.8bn

Source: New Zealand Infrastructure Commission analysis. Note: All results in this table use a 35-year tolling period and a 5% discount rate.

Comparison with tolls charged on international comparators

Finally, as a sense-test on our high-level estimates of revenue-maximising tolls, we review tolls for 17 selected crossings in several other OECD countries. We focus on bridges that are broadly similar in length to the Waitematā Harbour Crossing and similar in terms of the availability of alternative travel options (i.e. the need to divert a relatively long distance to avoid the toll).

Table 20 summarises data for these crossings. The median crossing had a length of around 2.2 kilometres, carried around 75,000 vehicles per day, and charged an average light vehicle toll of around $12. Per-trip tolls ranged from a low of around $3 to a high of around $34 depending upon payment options. Depending upon payment and time options, only two bridges had tolls over $15, while only 3 had tolls less than $5.

Our estimates for revenue-maximising tolls for a Waitematā Harbour Crossing are therefore consistent with international examples.

Table 20: Tolls charged on selected comparable crossings in other OECD countries

Crossing	Country	Length (m)	Approximate daily traffic volume	Light vehicle toll, approximate (NZD)
Sydney Harbour Bridge	Australia	1,149	160,000	$3.40 ($3.00-$4.40)
Gateway/Sir Leo Hielscher Bridges	Australia	1,600	100,000	$6.20
Ambassador Bridge	Canada	2,286	8,000	$12.70
Peace Bridge	Canada	1,770	3,000	$12.70
Pont de Normandie	France	2,141	25,000	$12.70
Humber Bridge	UK	2,220	17,500	$3.10 ($3.00-$3.30)
Mersey Gateway/Silver Jubilee Bridge	UK	2,200	75,000	$5.70 ($4.70-$6.60)
Tamar Bridge	UK	335	44,000	$5.00 ($3.30-$6.60)
Golden Gate Bridge	USA	2,737	90,000	$15.00 ($14.30-$15.70)
Tacoma Narrows Bridge	USA	1,810	90,000	$8.10 ($6.60-$9.50)
George Washington Bridge	USA	1,450	275,000	$27.90 ($21.70-$34.10)
Delaware Memorial Bridge	USA	3,650	100,000	$8.10 ($7.30-$8.80)
San Francisco-Oakland Bay Bridge	USA	7,180	250,000	$12.40
Verrazano Narrows Bridge	USA	4,260	200,000	$14.30 ($10.90-$17.60)
Richmond San Rafael Bridge	USA	5,499	35,000	$12.40
Benicia Martinez Bridge	USA	2,740	35,000	$12.40
Carquinez Bridge	USA	1,065	40,000	$12.40

Source: New Zealand Infrastructure Commission analysis of publicly available data. The figure listed here is the average of the highest and lowest available toll which might depend upon the time of day, and whether people are paying by cash or electronic payment systems. Figures are converted from local currency to NZD using the World Bank's PPP Exchange Rate Conversion Factors.[55] Tolls are rounded to the nearest 10 cents after currency conversion.

[55] https://data.worldbank.org/indicator/PA.NUS.PPP

Appendix A: Major road projects

Estimating peak-hour traffic volumes

We gathered data on daily traffic volumes, hourly traffic volumes, and heavy vehicle mix for representative traffic counting sites for all RoNS projects. We chose the nearest relevant traffic counting site on the state highway network, or, in several cases, on the local road network.

On an online mapping tool, NZTA publishes annual average daily traffic counts (total vehicles and heavy vehicle share) for state highway counting sites.[56] At the time the analysis was completed, these were available for the 2024 calendar year. However, as noted above, traffic capacity is better analysed on an hourly basis, rather than a daily basis. As a result, we use hourly traffic count data published by NZTA for an earlier calendar year (2019) to estimate the ratio of weekday peak hour traffic volumes to average daily traffic volumes.[57] We then apply this ratio to 2024 average daily traffic counts to hourly counts.

This calculation assumes that changes in daily traffic volumes since 2019 have been reasonably uniform across different time periods. If actual growth has been more concentrated in peak periods, then our timing estimates will be slightly too late. Conversely, if actual growth has been spread more outside of peak periods, then our timing estimates will be slightly too early.

Traffic counting sites in use

The following table lists the traffic counting sites that we used for each of the RoNS projects, including both funded and unfunded projects. In two cases (East West Link and Mill Road) we used local road traffic counting sites from Auckland Transport. For the Auckland Transport counting sites, we have average daily traffic volumes but not hourly volumes. As a result, we use hourly traffic breakdowns for other state highway sites in the regions.

One RoNS project (Petone to Grenada) does not have a relevant traffic counting site as it would be a new link that would divert part of the traffic on an existing link. In that case, published Investment Case documentation states that the project would result in '6,600 fewer vehicles per day on congested sections of SH1 and SH2'. However, previously published modelling reports suggest that total traffic demand for the Petone to Grenada road could be much higher than this figure.[58] To obtain an estimate for this site, we use forecast daily traffic volumes for 2031, adjusted for the difference between forecast do-minimum traffic volumes on SH1/SH2 and actual 2024 traffic volumes.[59]

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[56] https://experience.arcgis.com/experience/a09cd3ec9bdd4068b45c818a69601775/#data_s=id%3AdataSource_1-192bc37795e-layer-3%3A1502

[57] Hourly traffic count data is available from 2018 to 2022. We chose 2019 as it is the last calendar year before the Covid-19 pandemic.

[58] NZTA. 2015. 'Petone to Grenada Link Project – Transport Modelling Assessment of Options For North of Tawa'. https://www.gw.govt.nz/assets/Documents/2015/04/2015.174a2.pdf

[59] Depending on which project option is selected, traffic on the P2G link road is forecast to be between 31,600 and 32,800 vehicles per day in 2031 (around 5.1% of which are forecast to be heavy vehicles). In the do-minimum scenario, there are 86,800 daily vehicles forecast on the SH2 corridor between Petone and Ngauranga and 83,100 daily vehicles forecast for SH1 between Ngauranga and Johnsonville. By comparison, in 2024 actual daily traffic was 69,861 vehicles on SH2 (80% of forecast 2031 volumes) and 71,486 vehicles on SH1 (86% of forecast 2031 volumes). Based on these ratios, we estimate daily traffic demand for the P2G link road to be up to around 26,700 vehicles as at 2024.
However, this figure is potentially too high. Ramp counters on SH1 and SH2 suggest there are currently

Table 21: Traffic counting sites used for analysis

Road name	Region	Year	Counter name	Counter ID
East West Link	Auckland	2024	NEILSON ST between EDINBURGH ST and WIDTH CHANGE (SUMP LHS)	N/A
Mill Road Stage 1	Auckland	2024	REDOUBT RD (MANUKAU HEIGHTS) (SE), between MURPHYS RD and KINNARD LANE	N/A
SH16 North-West Alternative Highway	Auckland	2024	SH16 Nth of Access Rd	01600027
			Alt site: SH16 Nth of Coatesville Riverhead Highway	*01600024*
Warkworth to Te Hana	Auckland	2024	P2W - SH1 Nth of Kaipara Flats Rd	01N00362
Takitimu North Stage 2	Bay of Plenty region	2024	TE PUNA - Telemetry Site 65 - West of Snodgrass	00200141
Tauriko West	Bay of Plenty region	2024	120m west of Route K RAB	02900020
Belfast to Pegasus and Woodend Bypass	Canterbury region	2024	Woodend - At School	01S00316
Hawke's Bay expressway	Hawke's Bay region	2024	TARADALE - Telemetry Site 58	00200656
Port Marsden to Whangarei	Northland region	2024	Nth of Maungakaramea Rd Puwera	01N00274
Te Hana to Port Marsden	Northland region	2024	Sth of Mangawhai Rd	01N00340
Hope Bypass	Tasman region	2024	Richmond 3 Bros (Humes)	00600130
Cambridge to Piarere	Waikato region	2024	KARAPIRO - Telemetry Site 20	01N00580
Hamilton Southern Links	Waikato region	2024	285m Sth of Dixons Rd	00300003
Ōtaki to North of Levin	Wellington region	2024	OHAU - Telemetry Site 56	01N00988
Petone to Grenada	Wellington region	N/A	No relevant counter site – proxy data drawn from publicly-available traffic modelling reports plus nearby traffic counts on SH2/SH1	
SH1 Wellington improvements	Wellington region	2024	Ruahine St (Sth of Goa St)	01N01077
			Alt site: Patterson St (Sth of Basin Reserve)	*01N01076*

Sources: NZTA and Auckland Transport traffic counting data.[60]

Average daily traffic volumes in 2024 calendar year

The following table summarises 7-day average daily traffic volumes at counting sites for each major road project, as well as heavy vehicle shares.

unlikely to be this many vehicles travelling down SH1 and up SH2, or vice versa. Furthermore, 2015 traffic modelling suggests that the P2G link road would divert up to 13,000 vehicles a day off SH1/SH2 through Ngauranga Gorge – around twice as many as the current Investment Case suggests will be diverted.

[60] https://www.nzta.govt.nz/resources/state-highway-traffic-volumes
https://at.govt.nz/about-us/reports-publications/traffic-counts

Table 22: 2024 average daily traffic volumes

Road name	7-day average daily traffic (2024)	7-day average heavy vehicle share (2024)
East West Link	25,430	15.1%
Mill Road Stage 1	18,892	2.8%
SH16 North-West Alternative Highway	23,001 (alt counting site: 30,160)	3.0% (alt counting site: 4.1%)
Warkworth to Te Hana	16,375	9.9%
Takitimu North Stage 2	20,595	7.5%
Tauriko West	25,071	7.5%
Belfast to Pegasus and Woodend Bypass	20,912	10.1%
Hawke's Bay expressway	31,715	7.4%
Port Marsden to Whangarei	17,852	8.2%
Te Hana to Port Marsden	13,080	9.4%
Hope Bypass	21,190	10.1%
Cambridge to Piarere	22,625	11.8%
Hamilton Southern Links	13,554	5.4%
Ōtaki to North of Levin	19,263	10.7%
Petone to Grenada	26,800 (est)	5.1% (est)
SH1 Wellington improvements	34,190 (alt counting site: 38,328)	2.8% (alt counting site: 2.8%)

Sources: NZTA and Auckland Transport traffic counting data.[61]

Peak hour traffic volumes as a share of daily traffic volumes

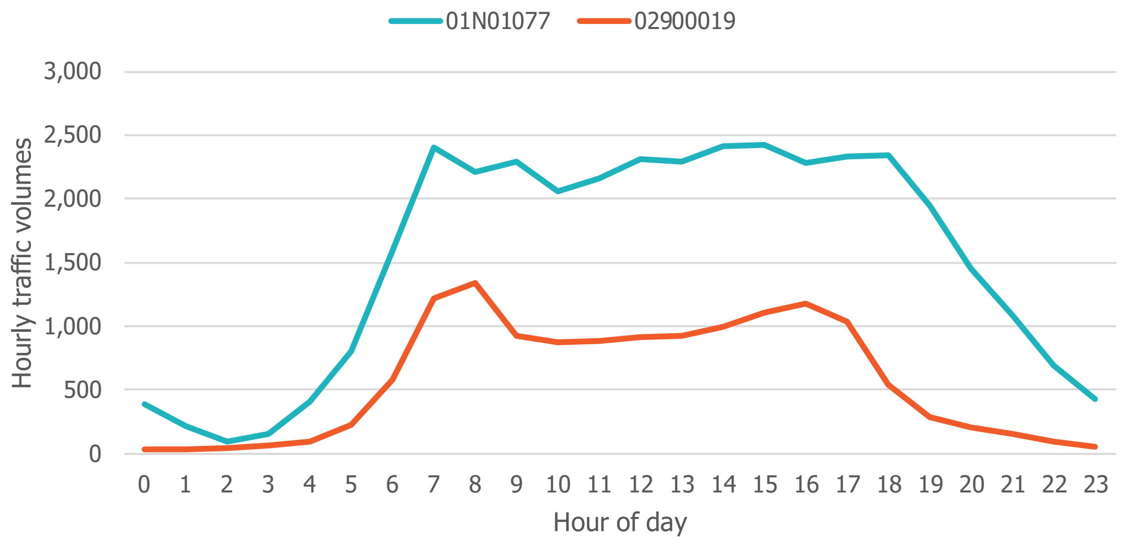
For the state highway traffic count sites, we calculate 7-day and 5-day average hourly traffic volumes by summing up and averaging NZTA published data on traffic volumes for 15-minute periods. We then use this information to calculate the following key ratios:

- ratio of weekday peak traffic to 7-day average daily traffic volumes
- ratio of weekday peak four-hour traffic volumes to 7-day average daily traffic volumes
- directional split of traffic during peak hours (where available).

Figure 19 shows weekday average hourly traffic volumes for two selected counting sites in Wellington (SH1 at Ruahine St, blue line) and Tauranga (SH29 near the Route K roundabout, orange line). The Wellington site exhibits more peak spreading, meaning a lower ratio of peak-hour to daily traffic volumes.

[61] https://www.nzta.govt.nz/resources/state-highway-traffic-volumes
https://at.govt.nz/about-us/reports-publications/traffic-counts

Figure 32: Weekday average hourly traffic volumes for selected counting sites, 2019



Source: New Zealand Infrastructure Commission analysis of NZTA state highway traffic count data.[62]

Figure 33 summarises the resulting ratios that we calculated. We report estimates for the weekday peak hour (generally, although not always, in either the AM peak or PM peak) and the four weekday peak hours (generally combining AM and PM peaks). We use peak hour ratios for our main results, and sensitivity test the 4-hour peak ratio.

We also estimate the directional split of traffic in the peak hour. This is helpful as a cross-check to understand whether traffic volumes are highly imbalanced. Our indicative hourly traffic capacity estimates are valid as long as traffic flows are no more than 60%/40% in one direction or another. All the counting sites are within this threshold or very close to it.

[62] https://www.nzta.govt.nz/resources/state-highway-traffic-volumes

Figure 33: 2019 estimated weekday peak to 7-day average traffic ratios

Road name	Weekday peak hour to 7-day traffic ratio	Weekday 4 peak hours to 7-day traffic ratio	Directional split of peak hour traffic
East West Link (note 1)	8.3%	8.2%	
Mill Road Stage 1 (note 1)	8.3%	8.2%	
SH16 North-West Alternative Highway	7.9%	7.6%	46%
Warkworth to Te Hana	7.8%	7.6%	49%
Takitimu North Stage 2	9.0%	8.4%	57%
Tauriko West	8.6%	8.3%	54%
Belfast to Pegasus and Woodend Bypass	9.3%	8.4%	61%
Hawke's Bay expressway	9.6%	9.0%	56%
Port Marsden to Whangarei	8.8%	8.1%	46%
Te Hana to Port Marsden	7.5%	7.3%	54%
Hope Bypass	9.4%	8.8%	42%
Cambridge to Piarere	8.2%	7.8%	49%
Hamilton Southern Links	11.0%	9.9%	38%
Ōtaki to North of Levin	7.8%	7.5%	49%
Petone to Grenada (note 2)	7.3%	7.1%	
SH1 Wellington improvements	6.7%	6.6%	51%

Source: NZTA and Auckland Transport data; New Zealand Infrastructure Commission estimates. Notes: (1) We used hourly traffic ratios from nearby state highway sites on SH20 as a proxy for these sites. (2) For this site, we used the average ratios for the two other sites in the Wellington region (Ōtaki to North of Levin and SH1 Wellington improvements).

Traffic growth scenarios

For each road, we consider a range of scenarios for future traffic volume growth. In the absence of site-specific modelling, we consider scenarios based on (a) how rapidly regional population is projected to grow and (b) how rapidly per-capita vehicle traffic might grow. These scenarios are indicative, and site-specific factors mean that actual traffic growth could be higher or lower than considered in these scenarios.

At the network level, we consider these scenarios to be on the optimistic side, as they assume ongoing growth in per-capita traffic volumes over the next 30-40 years. This contrasts with historical vehicle-kilometre travelled statistics and future vehicle-kilometre travelled projections, which suggest that per-capita traffic volumes have been flat for over 20 years and are forecast to continue to be flat or declining.

Regional population scenarios

We use Stats New Zealand's latest regional population projections to understand how rapidly travel demands may grow in different regions. In doing so, we assume that a larger regional population will flow through directly to increased travel demand for major state highway routes in that region.

Stats NZ's subnational population projections cover the 2023–2053 period, and provide low, medium, and high scenarios that reflect different assumptions about migration and fertility. Because our analysis period extends beyond 2053, we extrapolate growth trends forward from 2053.

The following table summarises average annual population growth rates projected for each region for the 2025–2055 period. Regions with RoNS projects tend to have higher-than-average projected population growth. However, the range between low and high population projections can be quite wide even in high-growth regions.

Table 23: Projected average annual regional population growth rate, 2025–2055

Region	Low scenario	Medium scenario	High scenario
Northland region *	0.3%	0.8%	1.2%
Auckland *	0.7%	1.1%	1.4%
Waikato region *	0.6%	1.0%	1.4%
Bay of Plenty region *	0.7%	1.1%	1.5%
Gisborne region	-0.2%	0.3%	0.7%
Hawke's Bay region *	0.0%	0.5%	0.9%
Taranaki region	-0.1%	0.4%	0.8%
Manawatū-Whanganui region	-0.1%	0.4%	0.8%
Wellington region *	-0.1%	0.4%	0.8%
Tasman region *	0.2%	0.6%	0.9%
Nelson region	-0.2%	0.3%	0.7%
Marlborough region	-0.2%	0.3%	0.7%
West Coast region	-0.8%	-0.3%	0.2%
Canterbury region *	0.5%	0.9%	1.3%
Otago region	0.3%	0.8%	1.2%
Southland region	-0.1%	0.4%	0.8%

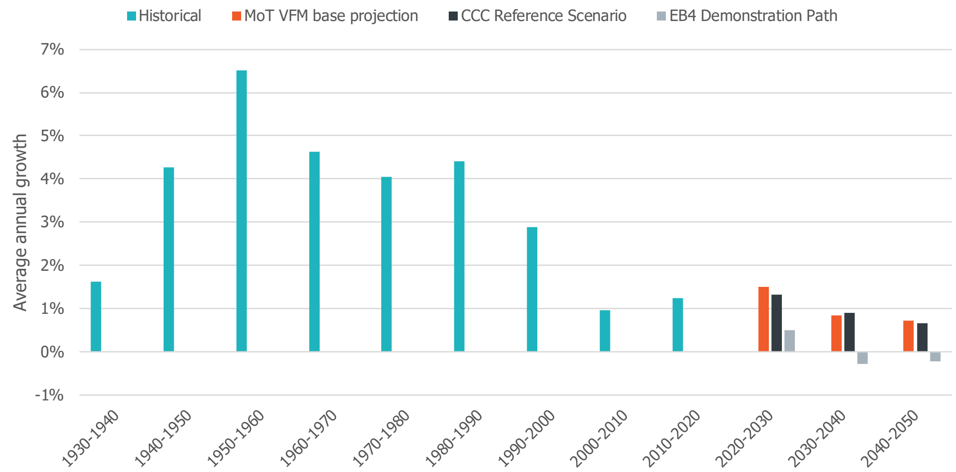
Source: New Zealand Infrastructure Commission analysis of Stats NZ subnational population projections.[63] *Note: * indicates regions with RoNS projects.*

Scenarios for per-capita vehicle travel

Figure 34 presents average annual growth in vehicle kilometres travelled at a national level. Traffic growth has slowed substantially since the 1990s and is expected to continue growing more slowly in future decades.

[63] https://www.stats.govt.nz/information-releases/subnational-population-projections-2023base-2053/

Figure 34: Historical and projected average annual growth in vehicle kilometres travelled, 1930–2050



Source: Historical vehicle kilometres travelled estimates are from New Zealand Infrastructure Commission (2025b)*; forecasts are from the Ministry of Transport's Vehicle Fleet Model*[64] *and Climate Change Commission's scenarios dataset for advice on New Zealand's fourth emissions budget.*[65]

Going forward, Ministry of Transport and Climate Change Commission projections suggest that per-capita traffic volumes will remain flat, or even decline in some scenarios. The following table summarises historical trends in VKT per capita and forward projections.

Table 24: Average annual growth in per-capita vehicle kilometres travelled, historical and projected

	Average annual change	**Source**
Historical VKT per capita (2000–2023)	-0.04%	New Zealand Infrastructure Commission (2025b)
Forward projections (2022–2050)		
Ministry of Transport (2024)	0.02%	Ministry of Transport Vehicle Fleet Model[66]
Climate Change Commission reference scenario (2024)	-0.03%	Climate Change Commission modelling[67]
Climate Change Commission EB4 scenario (2024)	-1.06%	Climate Change Commission modelling[68]

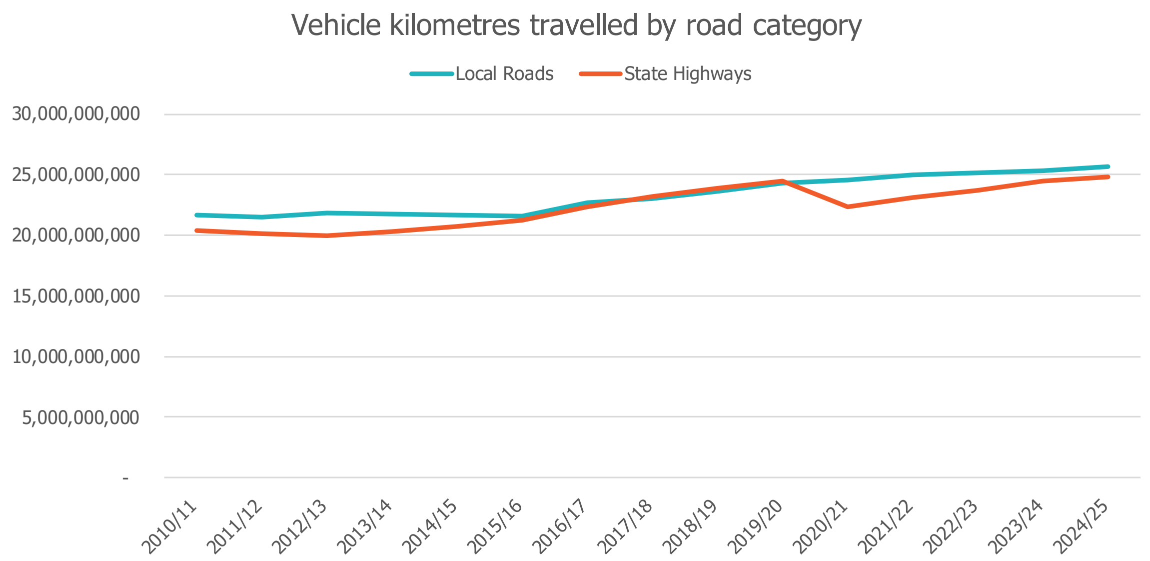
Source: New Zealand Infrastructure Commission analysis based on Stats NZ national population estimates and projections, plus sources above.

We also consider whether there are meaningful deviations between national trends and trends at a regional level or road classification level. Figure 35 shows that traffic growth has been balanced

[64] https://www.transport.govt.nz/statistics-and-insights/vehicle-fleet-model/sheet/updated-future-state-model-results
[65] https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/preparing-advice-on-emissions-budgets/advice-on-the-fourth-emissions-budget
[66] https://www.transport.govt.nz/statistics-and-insights/vehicle-fleet-model/sheet/updated-future-state-model-results
[67] https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/preparing-advice-on-emissions-budgets/advice-on-the-fourth-emissions-budget
[68] https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/preparing-advice-on-emissions-budgets/advice-on-the-fourth-emissions-budget

between state highways and local roads over a shorter period (2011–2025). Over this period, local road traffic volumes grew at an average rate of 1.2% per annum, while state highway traffic volumes grew by 1.4% per annum.

Figure 35: Vehicle kilometres travelled by road category, 2011–2025



Source: NZTA transport monitoring data.[69]

Regional traffic growth trends can differ from the national average. We used NZTA regional traffic volume data and Stats NZ subnational population estimates to calculate the average annual percentage growth rate in regional traffic volumes and per-capita regional traffic volumes. Table 25 summarises our estimates. We note that there is some variation in regional trends in per-capita VKT growth. In some regions, per-capita travel has been declining (e.g., Auckland, -0.8% per annum decline; Wellington, -0.5% per annum decline); in others, it has been rising (e.g., Canterbury, +0.3% per annum; Manawatū-Whanganui, +0.9% per annum). Moreover, regional trends in per-capita state highway VKT show more variance than regional trends in overall per-capita VKT.

[69] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools

Table 25: Average annual growth in total and per-capita VKT, by region and road category, 2011–2025

Region	Average annual growth in total VKT			Average annual growth in per-capita VKT		
	Local Roads	State Highways	All Roads	Local Roads	State Highways	All Roads
New Zealand	1.2%	1.4%	1.3%	-0.2%	0.0%	-0.1%
Auckland	0.4%	1.3%	0.7%	-1.2%	-0.3%	-0.8%
Bay of Plenty	1.7%	1.8%	1.7%	0.0%	0.1%	0.0%
Canterbury	1.8%	2.0%	1.9%	0.2%	0.4%	0.3%
Gisborne	0.5%	0.9%	0.7%	-0.4%	0.0%	-0.2%
Hawkes Bay	1.5%	1.4%	1.4%	0.5%	0.4%	0.5%
Manawatū-Whanganui	1.2%	2.2%	1.8%	0.4%	1.3%	0.9%
Marlborough-Nelson-Tasman	2.5%	0.8%	1.6%	1.3%	-0.4%	0.4%
Northland	1.6%	2.4%	2.0%	0.0%	0.9%	0.5%
Otago	1.6%	2.1%	1.9%	0.1%	0.6%	0.4%
Southland	0.6%	1.2%	0.9%	0.0%	0.6%	0.3%
Taranaki	2.3%	1.2%	1.6%	1.1%	0.1%	0.5%
Waikato	2.4%	1.3%	1.8%	0.7%	-0.4%	0.0%
Wellington	0.8%	-0.3%	0.3%	0.0%	-1.1%	-0.5%
West Coast	1.1%	0.7%	0.8%	0.8%	0.4%	0.5%

Source: New Zealand Infrastructure Commission analysis of NZTA transport monitoring data[70] and Stats NZ subnational population estimates.[71]

This data suggests that a prudent approach might be to assume no growth in VKT per capita in future, and sensitivity test scenarios for positive or negative growth. However, we adopt a different approach, assuming a central scenario where traffic growth at these state highway sites will rise faster than regional population. This could reflect land use change in these areas or localised shifts in travel patterns. However, we note that, were traffic at these sites to grow faster than regional population over the longer term, it would be balanced by slower growth on other roads.

Table 26 summarises the three scenarios that we use for per-capita traffic growth. In addition to the central scenario, we consider a low scenario where per-capita traffic does not grow (consistent with network-wide projections) and a high scenario where per-capita traffic grows three times as rapidly the central scenario (consistent with a specific location experiencing very rapid and sustained demand growth).

[70] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools
[71] https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2025/

Table 26: Scenarios used for future changes in per-capita traffic volumes on state highway sites

Scenarios	Average annual change, 2025–onward	Notes
Central	0.25%	Consistent with shorter-term trend for state highway VKT to grow more rapidly than local road VKT
Low	0.00%	Aligns with network-wide projections for VKT per capita
High	0.75%	Upside scenario that matches shorter-term state highway VKT trend in some regions with unusually high growth

Source: New Zealand Infrastructure Commission analysis.

Combined scenarios for traffic growth

We then combine regional population scenarios with scenarios for per-capita VKT growth to obtain an overall scenario range for traffic growth rates for state highway sites in different regions.

The low end of the scenario range combines low scenarios for both regional population growth and growth in per-capita VKT; the medium scenario combines medium regional population growth with the central scenario for per-capita VKT growth, and the high scenario combines high scenarios for both regional population growth and per-capita VKT growth. Table 27 summarises these scenarios.

Table 27: Projected average annual traffic growth rates combining population and per-capita VKT scenarios, 2025–2055

Regional population scenario	Low	Medium	High
Per-capita VKT scenario	**Low**	**Central**	**High**
Region			
Northland region *	0.3%	1.0%	1.9%
Auckland *	0.7%	1.3%	2.2%
Waikato region *	0.6%	1.3%	2.2%
Bay of Plenty region *	0.7%	1.4%	2.2%
Gisborne region	-0.2%	0.5%	1.5%
Hawke's Bay region *	0.0%	0.8%	1.7%
Taranaki region	-0.1%	0.7%	1.6%
Manawatū-Whanganui region	-0.1%	0.6%	1.5%
Wellington region *	-0.1%	0.7%	1.6%
Tasman region *	0.2%	0.9%	1.7%
Nelson region	-0.2%	0.5%	1.4%
Marlborough region	-0.2%	0.5%	1.4%
West Coast region	-0.8%	0.0%	0.9%
Canterbury region *	0.5%	1.2%	2.0%
Otago region	0.3%	1.0%	1.9%
Southland region	-0.1%	0.6%	1.6%

*Source: New Zealand Infrastructure Commission analysis. Note: * indicates regions with RoNS projects.*

Unit cost estimates for motorway and expressway projects

Our unit cost estimates for motorway and expressway projects build upon the Commission's previous research on high-level international cost benchmarking for infrastructure projects (New Zealand Infrastructure Commission, 2022; Oxford Global Projects, 2022). In that research, we compiled unit cost estimates for 33 New Zealand motorway and expressway projects completed or proposed between 2000 and 2022 and compared these costs against a set of similar road projects in other OECD countries.

Our New Zealand benchmarking dataset is comprehensive, including almost all major motorway and expressway extensions completed this century. Unit cost estimates are based on the best publicly available information on actual or estimated project cost and project scope. Estimates for individual projects are unlikely to be exact, and hence we average across projects rather than focus on individual projects in isolation. We emphasise that this is a high-level comparison that does not attempt to adjust for detailed project characteristics. Table 29 presents these estimates.

For this analysis, we extended this high-level comparison to include unit cost estimates for proposed Roads of National Significance projects. To construct this comparison, we relied upon high-level information published by the NZTA as of late 2025.[72] This information included brief 'Investment Cases' that describe the projects, usually including the project context, scope, and length, and provide an indicative cost range for the project. The cost range seemingly ranges from a 'best estimate' of cost to an upper percentile cost estimate (e.g., a P95 estimate). Cost estimates were assumed to be based on 2025 NZD, although this was not clearly specified in the Investment Case documents. Table 30 presents these estimates.

Based on this information, and other publicly available information where needed, we constructed 'best guess' estimates of project cost, project size, and unit costs. Where possible, we applied broadly comparable assumptions as in our previous research, but we note that our estimates may not be perfectly comparable. As a result, this is best interpreted as a high-level, directional comparison.

To normalise costs to 2025 NZD values, we use Statis New Zealand's Capital Goods Price Index for Civil Construction. This controls for the impact of inflation for past projects and past estimates.[73] We convert costs for international projects to New Zealand dollar equivalents using the World Bank's purchasing power parity exchange rates, which control for differences in price levels for tradeable and non-tradeable goods between countries.[74]

To conclude, Table 28 summarises our comparative data on unit cost ranges for motorway and expressway projects in New Zealand and other OECD countries. We emphasise that these are high-level estimates and that data for individual projects is unlikely to be exact.

Table 28: Comparison of unit cost range for motorway/expressway projects in New Zealand and other OECD countries

Category	Number of projects	Unit cost distribution (2025 NZD/lane per km)		
		25th percentile	50th percentile	75th percentile
OECD countries	61	$3.0	$5.5	$8.8
New Zealand, pre-2022	25	$7.6	$8.6	$14.3
New Zealand, proposed as of 2025	12	$32.3	$45.3	$98.9

[72] https://nzta.govt.nz/planning-and-investment/major-projects/roads-of-national-significance
[73] https://www.stats.govt.nz/topics/price-indexes/
[74] https://data.worldbank.org/indicator/PA.NUS.PPP

Source: Data on international projects is from New Zealand Infrastructure Commission (2022) updated to 2025 NZD using Stats NZ Capital Goods Price Index for Civil Construction. Data on New Zealand projects is summarised in Table 29 and Table 30. Data only includes new road projects, excluding widening projects. We exclude Wellington SH1 improvements and East West Link from the 2025 proposed roads data, as these projects have unusual scope relative to other roads in the dataset.

Table 29: Unit cost estimates for pre-2022 motorway and expressway projects

Project	Region	Date of completion/cost estimate	Project cost updated to 2025 NZD per m	Project type	Estimated lane km	Estimated unit cost (2025 NZD m per lane-km)
SH1 Albany-Silverdale (2000)	Auckland	2000	$287	New road	56	**$5.1**
SH16 Upper Harbour-Greenhithe (2007)	Auckland	2007	$198	New road	26	**$7.6**
SH1 Northcote-Sunnynook widening (2008)	Auckland	2008	$17	Widening	4.4	**$3.8**
SH1 Northern Gateway (2009)	Auckland	2009	$570	New road	30	**$19.0**
SH20 Mt Roskill Extension (2009)	Auckland	2009	$328	New road	16	**$20.5**
SH16 NW Widening (2011)	Auckland	2011	$152	Widening	29	**$5.2**
SH20 Manukau Extension (2011)	Auckland	2011	$319	New road	27	**$11.8**
SH1 Newmarket to Greenlane (2011)	Auckland	2011	$21	Widening	2.3	**$9.0**
SH16 Upper Harbour-Hobsonville (2012)	Auckland	2012	$322	New road	33.6	**$9.6**
SH16 Lincoln to Westgate widening (2019)	Auckland	2019	$142	Widening	9	**$15.8**
SH1 Manukau to Papakura widening	Auckland	2021	$440	Widening	18.4	**$23.9**
SH1 Puhoi to Warkworth	Auckland	2020	$1,132	New road	74	**$15.3**
SH1 Papakura to Drury South Stage 1	Auckland	2021	$810	Widening	9	**$90.0**
Penlink	Auckland	2021	$915	New road	14	**$65.4**
Waikato Expressway: Te Rapa	Waikato	2012	$252	New road	30.4	**$8.3**
Waikato Expressway: Ngaruawahia	Waikato	2015	$234	New road	49.2	**$4.8**
Waikato Expressway: Cambridge	Waikato	2015	$257	New road	64	**$4.0**
Waikato Expressway: Rangiriri	Waikato	2017	$167	New road	19.2	**$8.7**
Waikato Expressway: Longswamp	Waikato	2020	$119	New road	23.6	**$5.0**
Waikato Expressway: Huntly	Waikato	2020	$494	New road	60.8	**$8.1**
Waikato Expressway: Hamilton bypass	Waikato	2021	$751	New road	87.2	**$8.6**
Tauranga Eastern Link	Bay of Plenty	2015	$641	New road	84	**$7.6**
Takitumu North Link Stage 1	Bay of Plenty	2021	$810	New road	27.2	**$29.8**
Manawatū Tararua Highway	Manawatū	2021	$767	New road	46	**$16.7**
Kapiti Expressway: Mackays to Peka Peka	Wellington	2017	$857	New road	72	**$11.9**
Kapiti Expressway: Peka Peka to Otaki	Wellington	2021	$501	New road	52	**$9.6**
Transmission Gully	Wellington	2021	$1,546	New road	108	**$14.3**
Christchurch Northern Motorway	Canterbury	2020	$374	New road	56	**$6.7**
Christchurch Western Belfast Bypass	Canterbury	2017	$166	New road	20	**$8.3**
Christchurch Southern Motorway Stage 1	Canterbury	2012	$205	New road	26	**$7.9**
Christchurch Southern Motorway Stage 2	Canterbury	2020	$251	New road	30	**$8.4**

Source: Data from New Zealand Infrastructure Commission (2022), updated to 2025 NZD using Stats NZ Capital Goods Price Index for Civil Construction. Data sources are as described in that report. This table excludes two roads that were in planning in 2021 (with published cost estimates) that have subsequently been included in the subsequent RoNS programme.

Table 30: Unit cost estimates for proposed motorway and expressway ('RoNS') projects proposed as of 2025

Project	Region	Date of cost estimate	Lower-end cost estimate (2025 NZD per m)	Higher-end cost estimate (2025 NZD per m)	Project type	Estimated lane km	Basis of lane km estimate	Estimated unit cost (lower end estimate, 2025 NZD m per lane km)
Ara Tūhono – Warkworth to Te Hana	Auckland	2023	$2,981	$3,907	New road	104	(1)	**$28.7**
Northland Corridor – Te Hana to Whangārei	Northland	2025	$15,300	$18,300	New road	296	(1)	**$51.7**
Mill Road Stage 1	Auckland	2025	$1,750	$2,050	New road	28	(1)	**$62.5**
East West Link	Auckland	2025	$3,700	$4,100	New road / widening	20.2	(2)	**$183.2**
Hamilton Southern Links	Waikato	2025	$2,320	$2,720	New road	57	(3)	**$40.7**
Cambridge to Piarere	Waikato	2023	$1,336	$1,748	New road	64	(1)	**$20.9**
Tauriko West	Bay of Plenty	2025	$2,800	$3,300	New road	30	(3)	**$93.3**
Takitimu North Stage 2	Bay of Plenty	2025	$900	$1,400	New road	28	(1)	**$32.1**
Hawke's Bay Expressway	Hawke's Bay	2025	$600	$700	New road	14	(1)	**$42.9**
Ōtaki to North of Levin	Wellington	2025	$2,100	$2,100	New road	90	(1)	**$23.3**
Petone to Grenada	Wellington	2025	$2,100	$2,600	New road	24	(3)	**$87.5**
SH1 Wellington improvements	Wellington	2025	$2,900	$3,800	Road tunnels	7	(2)	**$414.3**
Hope Bypass	Tasman	2025	$1,100	$1,400	New road	8	(2)	**$137.5**
Belfast to Pegasus and Woodend Bypass	Canterbury	2025	$800	$1,000	New road	30	(1)	**$26.7**

Source: New Zealand Infrastructure Commission analysis of project information published by NZTA. This table excludes the Alternative SH16 project, where we could not find a published cost estimate. It also combines the Te Hana to Port Marsden and Port Marsden to Whangārei segments of the Northland Corridor, as published information did not break these two segments of the project apart. Notes: (1) Lane-kilometres estimated based on NZTA published information on project length and number of added lanes. (2) Lane-kilometres estimated based on indicative scope diagrams/maps published in Investment Cases should be considered less reliable. (3) Lane-kilometres estimated based on NZTA published information on number of added lanes and estimated project length based on indicative scope diagrams/maps published in Investment Cases.

Appendix B: Urban rapid transit projects

Alternative estimates of public transport infrastructure capacity

As a cross-check on Auckland Transport and NZTA (2025) indicative estimates of public transport infrastructure capacity, we produce alternative estimates using information from the US *Transit Capacity and Quality of Service Manual*, a standard engineering source (National Academies of Sciences, Engineering, and Medicine, 2013).

Passenger capacity of different public transport vehicles

Table 31 summarises information on seated and total capacity of selected public transport vehicles. For calculating hourly passenger capacity of a public transport corridor, we use a ‘comfortable’ capacity figure, reflecting all seats fully occupied plus half of standing capacity occupied. This allows for high capacity utilisation while allowing for some variation in occupancy from vehicle to vehicle.

Table 31: Indicative estimates of public transport vehicle capacity

Vehicle type	Representative make/model	Seated capacity	Total capacity	‘Comfortable’ capacity (all seats and half standing)
Low-capacity bus	Yutong ZK6890HG	22	60	41
Standard single-decker bus	Yutong E13	36	78	57
Articulated bus	Volvo 7800	52	200	126
Light rail vehicle	Bombardier Flexity 2	80	308	194
Double-capacity light rail vehicle	2x Bombardier Flexity 2	160	616	388

Source: New Zealand Infrastructure Commission summary of information from vehicle manufacturers.

Hourly vehicle capacity of different infrastructure options

Table 32 provides a range of estimates for hourly vehicle capacity of different infrastructure options, based on varying assumptions about infrastructure configuration and operation. These calculations are based on methods and parameters outlined in the TCQSM, with judgments about a range of plausible values to use.

For each type of infrastructure, we consider varying scenarios for dwell time in stops, signal delay at nearby intersections, clearance time from stops, and re-entry delay if there are adjacent traffic lanes. These combine to influence the amount of time it takes each vehicle to pass through a stop, which in turn drives hourly vehicle capacity.

Table 32: Indicative estimates of hourly vehicle capacity of different infrastructure configurations

System description	Scenario	Environment assumption	Number of loading areas	Dwell time (seconds)	Signal delay (seconds)	Clearance + headway time (seconds)	Re-entry delay (seconds)	Hourly stop capacity (veh/hr)
Bus in general traffic lane	Low capacity	Urban arterial, traffic signals, on board ticketing /high dwell time, 1 berth, typical single decker bus	1	60	30	12	75	20
Bus in general traffic lane	High capacity	Urban arterial, traffic signals, on board ticketing /high dwell time, 1 berth, large single decker bus	1	60	30	12	50	24
Bus lane - in road	Low capacity	Urban arterial, traffic signals, high dwell time, 1 berths (turning vehicles)	1	60	30	12	30	27
Bus lane - in road	High capacity	Urban arterial, traffic signals, moderate dwell time, 1 berths (no turning vehicles)	1	30	30	12	15	41
Busway - segregated corridor	Low capacity	Urban arterial, No signal priority, onboard ticketing / low dwell time, standard bus	1	60	30	12	0	35
Busway - segregated corridor	High capacity	Urban arterial, Signal priority, offline ticketing / low dwell time, articulated vehicle	1	30	10	24	0	56
Light rail - in road	Low capacity	Urban arterial, no signal priority, on board ticketing,	1	60	30	24	0	32
Light rail - in road	High capacity	Urban arterial, signal priority, off board ticketing,	1	30	10	24	0	56
Rail - segregated corridor	Low capacity	Urban arterial, segregated corridor, on board ticketing,	1	60	0	24	0	43
Rail - segregated corridor	High capacity	Urban arterial, segregated corridor, off board ticketing,	1	30	0	24	0	67

Source: New Zealand Infrastructure Commission estimates based on parameters outlined in TCQSM Chapters 6 and 7 (National Academies of Sciences, Engineering, and Medicine, 2013). We drew upon Exhibits 6-14, 6-17, 6-59, and 6-61, plus judgments about which range of parameter values might be relevant for different contexts. Hourly stop capacity is estimated by dividing the number of seconds in an hour (3600) by the number of seconds of dwell time, signal delay, clearance and headway time, and re-entry delay that each vehicle incurs, on average.

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Hourly passenger capacity

Finally, we estimate hourly passenger capacity of different public transport infrastructure options by multiplying passenger capacity of relevant vehicle types by vehicle capacity of different infrastructure options. Table 33 summarises these calculations.

Table 33: Indicative estimates for public transport infrastructure capacity

System description	Scenario	Example vehicle	Passengers per vehicle	Vehicles per hour	Hourly passenger capacity
Bus in general traffic lane	Low capacity	Yutong ZK6890HG	41	20	800
	High capacity	Yutong E13	57	24	1,400
Bus lane - in road	Low capacity	Yutong E13	57	27	1,600
	High capacity	Yutong E13	57	41	2,400
Busway - segregated corridor	Low capacity	Yutong E13	57	35	2,000
	High capacity	Volvo 7800	126	56	7,100
Light rail - in road	Low capacity	Bombardier Flexity 2	194	32	6,100
	High capacity	Bombardier Flexity 2	194	56	10,900
Rail - segregated corridor	Low capacity	Bombardier Flexity 2	194	43	8,300
	High capacity	2x Bombardier Flexity 2	388	67	25,900

Source: New Zealand Infrastructure Commission estimates based on information summarised in Table 31 and Table 32.

Public transport patronage scenarios

For each public transport corridor, we consider a range of scenarios for future patronage growth. As the basis for these scenarios, we draw upon project modelling from business cases and published modelling reports from relevant regional forecasting centres.

We use this for our baseline estimates of peak-hour demand growth, with an adjustment for post-Covid changes in public transport patronage. We then construct a sensitivity range around baseline patronage projections based on regional population growth scenarios, scenarios for faster or slower per-capita travel demand growth, and over- or under-estimation in public transport demand.

Baseline patronage growth

Our review of rapid transport project business cases and related modelling published by the Auckland Forecasting Centre[75] found that business cases do not typically present demand modelling in a consistent format. As a result, it was necessary to adjust published figures to provide a reasonably comparable set of demand forecasts.

Where possible, public transport patronage forecasts are for hourly demand in the inbound direction at the peak-load point. Given the peakiness of public transport patronage, this is a key figure for transport agency capacity planning. However, we note that this approach may be overly

[75] https://mahere.at.govt.nz/AFCDemandForecasts/

conservative as high occupancy at peak times may be desirable if it is associated with better capacity utilisation in off-peak times.

An important note is that business case forecasts generally relate to scenarios where infrastructure and services are improved, rather than a 'do-minimum' scenario where infrastructure is not improved. Improvements to speed, reliability, and capacity are generally expected to boost patronage, for instance by attracting more users from congested roadways. In some cases, like the City Centre to Māngere corridor, multiple infrastructure scenarios have been modelled. In this case, we take a more 'conservative' set of infrastructure upgrade assumptions, which results in lower patronage forecasts. A full analysis of the costs and benefits of competing upgrade options is out of scope for this high-level timing analysis.

Table 34 summarises the available forecasts for the projects that we reviewed.

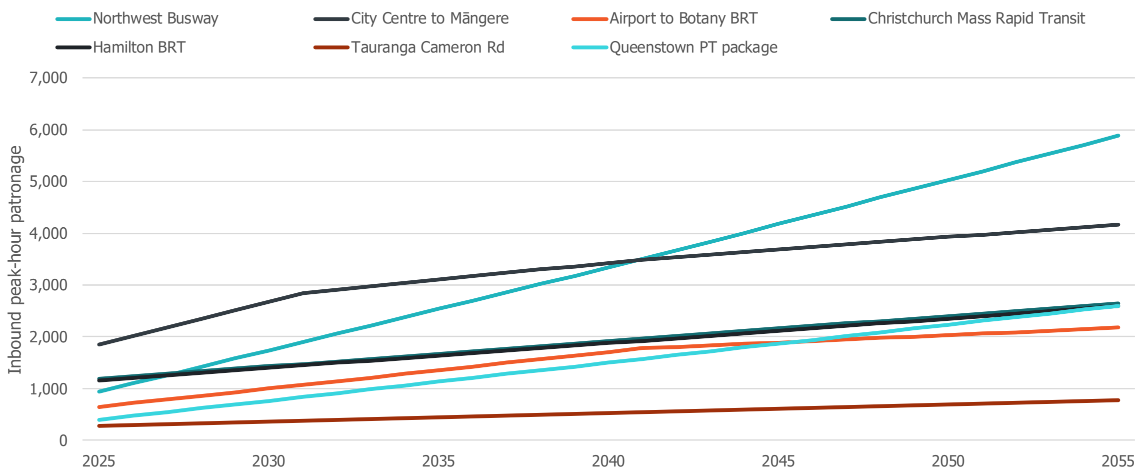
Table 34: Availability of business case or forecasting centre patronage modelling

Project	Measure	Model years	Adjustments
Northwest Busway (Auckland)	Inbound peak hour patronage at peak load point	2031, 2041, 2051	None
City Centre to Māngere (Auckland)	Inbound peak hour patronage at peak load point	2031, 2041, 2051	None
Airport to Botany (Auckland)	Inbound peak hour patronage at peak load point	2030, 2051 [plus 2041 from other AFC modelling]	None
Christchurch rapid transit	Daily network patronage	2021, 2051	Converted daily to inbound peak hour patronage using ratio from NW Busway modelling
Hamilton bus rapid transit	Inbound peak hour patronage (total)	2051	2025 value estimated based on forecast growth over same period on most comparable system (Christchurch)
Tauranga Cameron Rd bus improvements	Daily patronage	2018, 2048	Converted daily to inbound peak hour patronage using ratio from NW Busway modelling
Queenstown PT improvements	Inbound peak hour patronage	2025, 2040	None

Source: New Zealand Infrastructure Commission analysis of business case and published forecasts.

As forecasts were generally provided only for selected dates, we used straight-line interpolation or extrapolation to fill in intermediate dates. Figure 36 summarises these baseline patronage projections, which have not been adjusted for post-Covid changes in public transport patronage.

Figure 36: Summary of peak-hour PT patronage projections (non-Covid adjusted)



Source: New Zealand Infrastructure Commission analysis of business case and forecasting centre information.

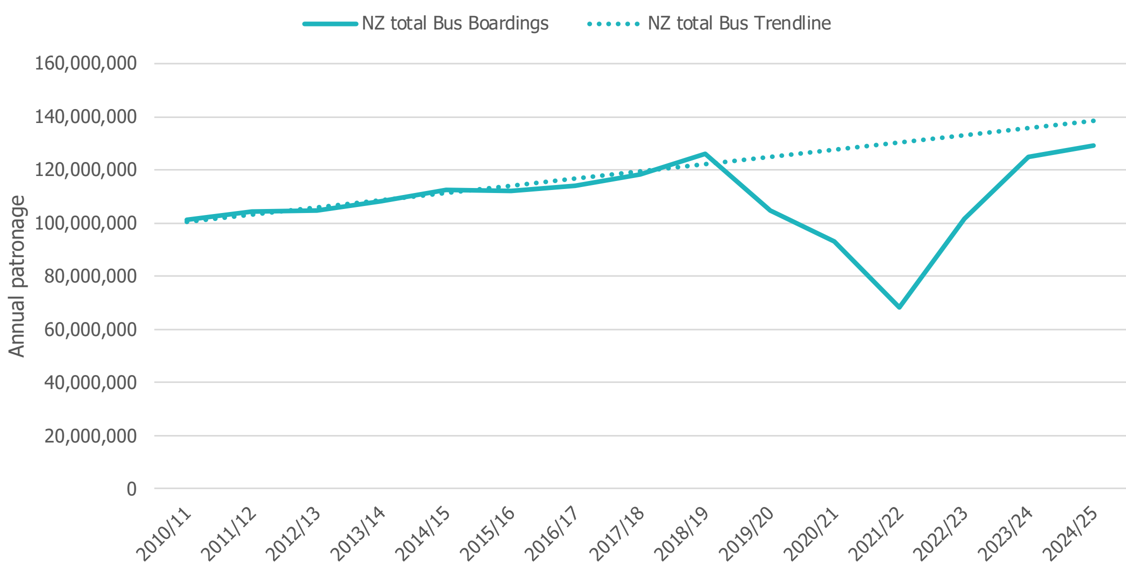
Adjustments for post-Covid changes in public transport demand

The Covid-19 pandemic caused 'shocks' to public transport patronage, some of which have been slow to unwind. As the transport forecasting models used for business case analysis are (currently) calibrated based on pre-Covid data, this means that they may mis-estimate current travel demands and hence future growth scenarios.

Prior to Covid-19, public transport patronage was growing about twice as fast as population growth, with fastest growth in the Auckland and Otago regions. Patronage declined significantly from 2019 to 2022, but recovered to pre-Covid levels by 2025. Figure 37 shows annual bus patronage for New Zealand as a whole, relative to the pre-Covid trendline. As of 2024/25, bus patronage was 3% above the pre-Covid (2018/19) value, but 7% below the pre-Covid trendline.

Rail patronage in Auckland and Wellington remains significantly below the pre-Covid trend. This is due in part to track maintenance and upgrades that have reduced services, and hence may not partly reflect supply constraints rather than demand shifts.

Figure 37: National trends in New Zealand's bus patronage, 2011–2025



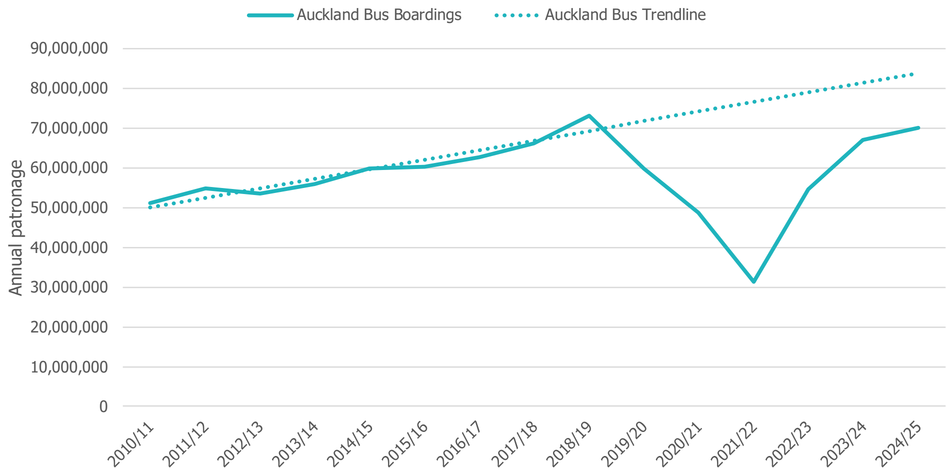
Source: New Zealand Infrastructure Commission analysis of NZTA transport volume data.[76]

However, regional trends vary significantly. Figure 38 shows bus patronage trends for Auckland (54% of national bus boardings), Canterbury (12%), and Otago (4%). Auckland patronage remains below the pre-Covid trend; Canterbury has caught back up to the pre-Covid trend; and Otago has exceeded the pre-Covid trend.

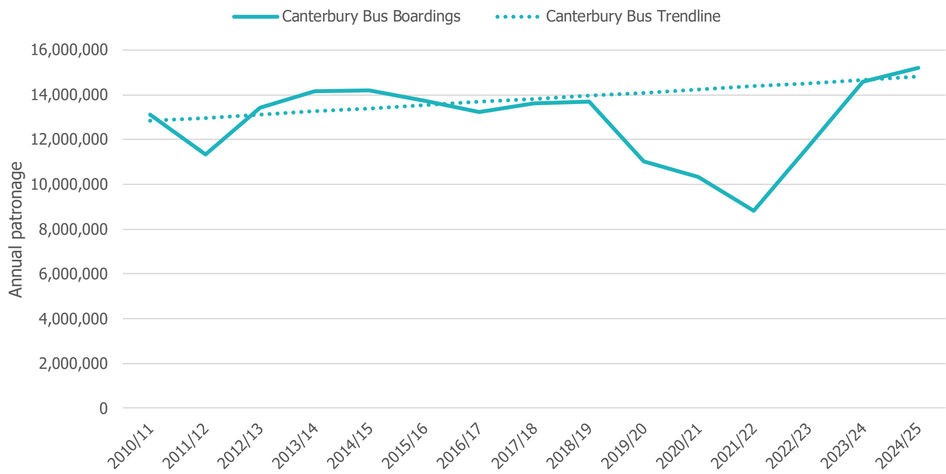
[76] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools

Figure 38: Trends in bus patronage for selected regions, 2011–2025

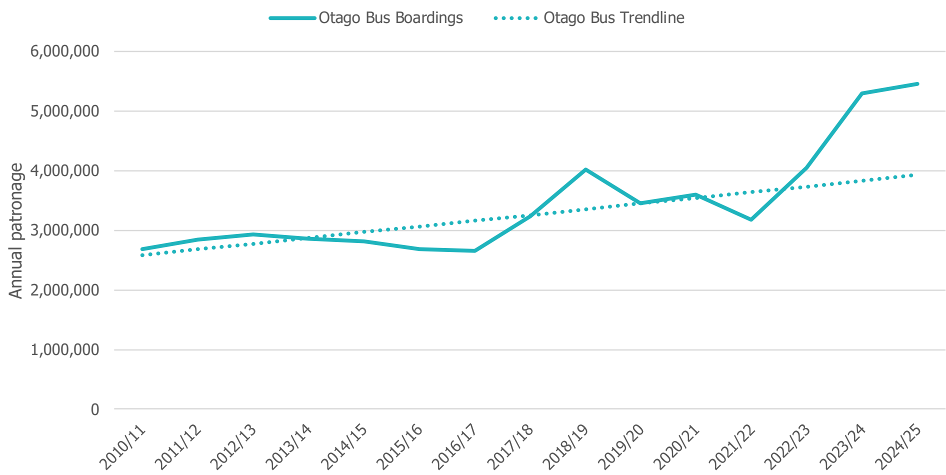
Panel A: Auckland



Panel B: Canterbury



Panel C: Otago



Source: New Zealand Infrastructure Commission analysis of NZTA transport volume data.[77]

As a result, we apply regional adjustments reflecting what's changed since the Covid-19 pandemic. Table 35 summarises 2024/25 patronage as a share of 2018/19 (pre-Covid) patronage and as a share of the extrapolated pre-Covid trend. It then outlines regional-level adjustments to

[77] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools

public transport patronage modelling based on either the lower of the two values or, if both values are below 100%, the average of the two values.

This results in upward adjustments to modelled demand paths in some regions, principally the Otago region (containing Queenstown), and downward adjustments in others.

Table 35: Summary of post-Covid changes to bus patronage, by regions

Region name	2024/25 patronage as % of 2018/19 patronage	2024/25 patronage as % of extrapolated pre-Covid trend	Adjustment to pre-Covid forecasts
Auckland *	96%	84%	90%
Bay of Plenty region *	136%	113%	113%
Canterbury region *	111%	103%	103%
Gisborne region	98%	107%	98%
Hawkes Bay region	88%	81%	84%
Manawatū-Whanganui region	105%	136%	105%
Marlborough-Nelson-Tasman	213%	123%	123%
Northland region	121%	119%	119%
Otago region *	136%	139%	136%
Southland region	91%	[no sensible pre-trend]	91%
Taranaki region	119%	103%	103%
Waikato region *	104%	117%	104%
Wellington region	106%	103%	103%

Source: New Zealand Infrastructure Commission analysis of NZTA transport volume data.[78] *Note: * indicates regions with major rapid transit projects.*

Upside and downside scenarios for patronage growth

Public transport patronage growth is uncertain. Faster or slower regional population growth, per-capita travel demand growth, or uptake of service improvements may affect patronage.

We therefore fit a range around Covid-adjusted baseline patronage projections based on a combination of regional population scenarios, per-capita travel demand growth, and scenarios for over- or under-estimation of patronage.

Regional population scenarios

We use Stats New Zealand's latest regional population projections to understand how rapidly travel demands may grow in different regions. In doing so, we assume that a larger regional population will flow through directly to increased travel demand for major public transport routes in that region.

Stats NZ's subnational population projections cover the 2023–2053 period, and provide low, medium, and high scenarios that reflect different assumptions about migration and fertility.

[78] https://nzta.govt.nz/planning-and-investment/learning-and-resources/transport-data/data-and-tools

Because our analysis period extends beyond 2053, we extrapolate growth trends forward from 2053.

Table 23 in Appendix A summarises average annual population growth rates projected for each region for the 2025–2055 period. Regions with major rapid transit projects tend to have higher-than-average projected population growth. However, the range between low and high population projections can be quite wide even in high-growth regions.

Scenarios for per-capita travel

Table 36 summarises the three scenarios that we use for per-capita public transport patronage growth. We align these scenarios with the scenarios for state highway traffic volume growth, outlined above In addition to the central scenario, we consider a low scenario where per-capita patronage does not grow and a high scenario where per-capita patronage grows three times as rapidly the central scenario (consistent with a specific location experiencing very rapid and sustained demand growth).

Table 36: Scenarios used for future changes in per-capita public transport volumes

Scenarios	Average annual change, 2025–onward	Notes
Central	0.25%	Consistent with shorter-term trend for state highway VKT to grow more rapidly than local road VKT
Low	0.00%	Aligns with network-wide projections for VKT per capita
High	0.75%	Upside scenario that matches shorter-term state highway VKT trend in some regions with unusually high growth

Source: New Zealand Infrastructure Commission analysis.

Scenarios for over- or under-estimation of public transport patronage

Errors in transport demand forecasts are common. Statistical reviews show that it's common for benefit and demand forecasts to be more than 20% higher or lower than what actually happens (Bezdek & Wendling, 2002; Dodge, 2019; Flyvbjerg & Bester, 2021; Hartgen, 2013; Hoque et al., 2021; Wignall, 2017). On average, infrastructure demand and benefit forecasts tend to be over-optimistic, reflecting the fact that over-estimates are more common than under-estimates and that over-estimates tend to be larger, on average, than under-estimates.

There are no firm guidelines for adjusting public transport demand forecasts to provide a range of possible demand scenarios. We note that by considering the possibility for faster or slower growth in population and per-capita travel demand, we have already partly adjusted for the potential for forecasting errors.

Table 37 summarises the adjustments that we use in this analysis. We note that these are likely to be conservative.

Table 37: Scenarios for over- or under-estimation of travel demand

Scenarios	Percentage adjustment to base demand	Notes

Central	0%	Central scenario is not adjusted relative to baseline.
Low	-10%	Wignall (2017) finds that New Zealand transport (road) projects with benefit over-estimates have a -32% error, on average. We use one-third of this value, as this reflects a combination of traffic over-estimation and benefit over-estimation.
High	+5%	Wignall (2017) finds that New Zealand transport (road) projects with benefit under-estimates have a +16% error, on average. We use one-third of this value, as this reflects a combination of traffic under-estimation and benefit under-estimation.

Source: New Zealand Infrastructure Commission analysis.

Combined scenarios for high or low growth in public transport demand

We then combine regional population scenarios with scenarios for per-capita VKT growth to obtain an overall scenario range for public transport patronage for rapid transit projects in different regions.

As noted above, we use Covid-adjusted business case projections as central scenarios, and construct low and high scenarios that adjust the central scenario.

The low end of the scenario range combines low scenarios for regional population growth, growth in per-capita public transport patronage, and transport demand over-estimation. The high scenario combines high scenarios for regional population growth, per-capita public transport patronage growth, and transport demand over-estimation. Table 38 summarises the impact of these combined scenarios for 2030 and 2050. Interestingly, the scenario range does not vary greatly by region, although it does expand over a longer time horizon.

Table 38: Scenario range around central public transport patronage forecasts

	2030 patronage as share of central forecast		2050 patronage as share of central forecast	
Regional population scenario	**Low**	**High**	**Low**	**High**
Per-capita patronage scenario	**Low**	**High**	**Low**	**High**
Travel demand over-estimation scenario	**Low**	**High**	**Low**	**High**
Region				
Northland region	-14%	11%	-25%	32%
Auckland *	-14%	11%	-24%	31%
Waikato region *	-14%	11%	-25%	32%
Bay of Plenty region *	-14%	11%	-24%	31%
Gisborne region	-14%	11%	-26%	34%
Hawke's Bay region	-14%	11%	-26%	33%
Taranaki region	-14%	11%	-25%	33%
Manawatū-Whanganui region	-14%	11%	-26%	34%
Wellington region	-14%	11%	-25%	33%
Tasman region	-14%	11%	-24%	31%
Nelson region	-14%	11%	-26%	33%
Marlborough region	-14%	11%	-26%	33%
West Coast region	-14%	11%	-27%	35%
Canterbury region *	-14%	11%	-25%	32%
Otago region *	-14%	11%	-25%	33%
Southland region	-14%	11%	-26%	34%

*Source: New Zealand Infrastructure Commission analysis. Note: * indicates regions with major rapid transit projects.*

Unit cost estimates for rapid transit projects

Our unit cost estimates for rapid transit projects build upon the Commission's previous research on high-level international cost benchmarking for infrastructure projects.[79] In that research, we analysed international data on underground rail project costs (including one New Zealand project, the City Rail Link) and reviewed several international datasets of rail-based rapid transit project costs. However, we did not compile data on other types of rapid transit projects, in particular busway projects.

We build upon our previous analysis in two ways.

First, to understand international trends in rapid transit infrastructure costs, we re-analyse a dataset on light and heavy rail project costs published by the Eno Center for Transportation (Aevaz et al., 2021) to understand unit cost ranges for light and heavy rail projects with varying levels of grade-separation (achieved through tunnelled or elevated alignments).[80] This dataset includes data on almost 200 projects in 13 OECD countries, excluding New Zealand. To normalise costs to 2025 NZD values, we convert costs for international projects to New Zealand dollar

[79] https://tewaihanga.govt.nz/our-work/research-insights/the-lay-of-the-land-benchmarking-new-zealand-infrastructure-delivery-costs
[80] https://projectdelivery.enotrans.org/

equivalents using the World Bank's purchasing power parity exchange rates,[81] which control for differences in price levels for tradeable and non-tradeable goods between countries, and then inflate them to 2025 NZD using Stats New Zealand's Capital Goods Price Index for Civil Construction.[82]

Table 39: Unit cost estimates for light and heavy rail projects in OECD countries

Project category	Notes	Number of projects	Unit cost (2025 NZD m/km)				
			5th percentile	25th percentile	50th percentile	75th percentile	95th percentile
At-grade light rail	75%+ at-grade	82	$35	$64	$82	$102	$249
Partially tunnelled/elevated light rail	25% to 75% at-grade	11	$94	$123	$175	$251	$351
Tunnelled/elevated light rail	<25% at-grade	11	$175	$221	$274	$506	$630
Tunnelled/elevated heavy rail	<25% at-grade	49	$161	$230	$308	$493	$1,078

Source: New Zealand Infrastructure Commission analysis of data published by the Eno Center for Transportation (Aevaz et al., 2021).

New Zealand has not completed any light rail projects, but it has completed and proposed several busway projects, primarily in Auckland. To understand local cost trends, we gather high-level information on completed and proposed busway projects in Auckland from information published by the NZ TA as of late 2025, as well as other publicly available information.[83] Published cost estimates for proposed projects were assumed to be based on current New Zealand dollars, although this was not clearly specified in documentation. As above, we normalise costs to 2025 NZD values using Stats New Zealand's Capital Goods Price Index for Civil Construction.[84] Table 40 presents these estimates.

Table 40: Unit cost estimates for completed and proposed busway projects in New Zealand

Project	Region	Date of actual cost / cost estimate	Total cost (2025 NZD per m)	Project length (km, 2-way equivalent)	Number of stations	Estimated unit cost (2025 NZD per km)
Northern Busway	Auckland	2008	$504	7.45	5	$68
Eastern Busway Panmure to Pakūranga	Auckland	2021	$340	2.6	1	$131
Northern Busway extension	Auckland	2022	$341	5.0	1	$68
Eastern Busway Pakūranga to Botany	Auckland	2025 (estimate)	$856	5.0	5	$171
Airport to Botany Busway	Auckland	2021 (estimate)	$2,227	18.0	12	$124
Northwestern Busway	Auckland	2025 (estimate)	$4,100	10.0	3	$410

Source: New Zealand Infrastructure Commission analysis of publicly available project information. When calculating project length, we adjust for segments that only offer a busway in one direction. Note that project scope varies, and some projects include non-busway elements such as the Reeves Road flyover included in the Pakūranga to Botany section of the Eastern Busway. We have not attempted to adjust for this. For the Northwestern Busway, we used the lower end of the published cost estimate range ($4.1bn-$4.6bn).

[81] https://data.worldbank.org/indicator/PA.NUS.PPP
[82] https://www.stats.govt.nz/topics/price-indexes/
[83] For instance: https://nzta.govt.nz/projects/northwest-busway/publications
[84] https://www.stats.govt.nz/topics/price-indexes/

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