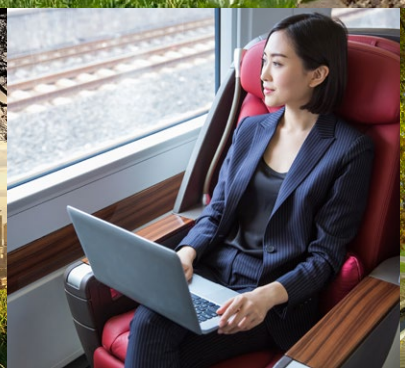
REGIONAL RAPID RAIL

Upper North Island Passenger Network



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Written and developed by Greater Auckland with grateful assistance from many others
Principal authors: Harriet Gale and Nicolas Reid
Layout and document design: Cornelius Blank

EXECUTIVE SUMMARY

Greater Auckland is proud to present our proposal for Regional Rapid Rail – an Upper North Island Passenger Network.

The "Golden Triangle" of Auckland, Waikato and the Bay of Plenty now make up over 50% of New Zealand's population, and are expected to account for over 70% of New Zealand's growth in the future. If we fail to provide the necessary infrastructure, we will miss out on many of the benefits from this coming growth.

We need to provide a step change in intercity transit to leverage this growth proactively, rather than reactively waiting for it to congest the Waikato Expressway and Auckland's Southern Motorway. With the Waikato Expressway almost complete, what is missing is the maximisation of the complementary rail corridors. Regional Rapid Rail is a three-stage proposal to upgrade the existing trunk rail corridors for higher speed intercity trains.

The strategic goals of Regional Rapid Rail are to:

- Connect major employment and population centres
- Deliver a fast and competitive rail service
- Provide a regular and frequent rail service
- Make complementary improvements to the rail freight network
- Assist the creation of affordable housing supply
- Link regional transportation to well-planned communities with good urban outcomes
- Integrate directly with local public transport, walking and cycling networks
- Reduce road traffic injury and deaths
- Ensure value for money for taxpayer investment

Regional Rapid Rail will revitalise the existing rail network using modern technology tilting trains travelling up to 160km/h on upgraded tracks. This will allow for much faster trains, providing quick and reliable journeys that are faster than driving and skip the traffic completely. This revitalised network will stitch together the economy of Auckland, Hamilton and Tauranga, and extend the benefits of growth and development of the main centres to their nearby towns and villages. This will provide fast and reliable travel options to regular commuters, business travellers, shoppers, students, local visitors and international tourists alike.

However, Regional Rapid Rail isn't just a scheme for commuter trains on the trunk line. It is an integrated regional economic development plan for the Upper North Island, based on fast and regular intercity train connections between the cities and towns of Auckland, the Waikato and the Bay of Plenty.

The proposal has four pillars for success:

- Using the right technology to achieve speed and performance affordably
- Leveraging existing infrastructure
- Providing a frequent, reliable and regular service for all trip types
- Integration with land use and development plans

Three stages are proposed for Regional Rapid Rail, for successive investment and development over time.

The first stage is an interim, to be set up quickly and inexpensively using existing trains running on the current network. It is intended to build patronage and show the viability of regional intercity rail in the short term while subsequent stages are being procured.

The second stage represents an investment in new higher speed tilting trains and network upgrades to create a truly regional network of rapid trains on three lines between Auckland and Hamilton, Tauranga and Te Kuiti respectively.

The third stage expands this network, extending the lines across the Waikato and Bay of Plenty to Rotorua, Cambridge and Te Puke. This stage further improves train speeds and journey times through infrastructure developments and upgrades, creating a true higher speed network for the Upper North Island.

STAGE 1 Interim network

Three trains, existing 96-seater Silver Fern units.

Two peak and three interpeak services each way on weekdays, reduced weekend service.

One return service per day to Tauranga.

Hamilton to Auckland in approximately 2 hours 15 minutes

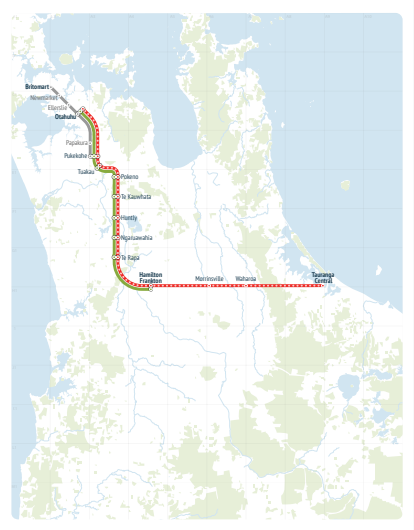
Auckland to Tauranga in approximately 3 hours 30 minutes

Eight new stations – basic but fit for purpose

Potentially **350,000 passengers** / year

Estimated Capital cost: **$10m**

Estimated Subsidy: **$2m / year for five years**



STAGE 2 Investment in Efficiency and Performance

Seventeen higher speed dual mode diesel and electric tilt trains, 300 seated passengers per train.

Three lines with regular service between Auckland and Hamilton, Tauranga and Te Kuiti.

Hamilton to Auckland in approximately 1 hour 30 minutes

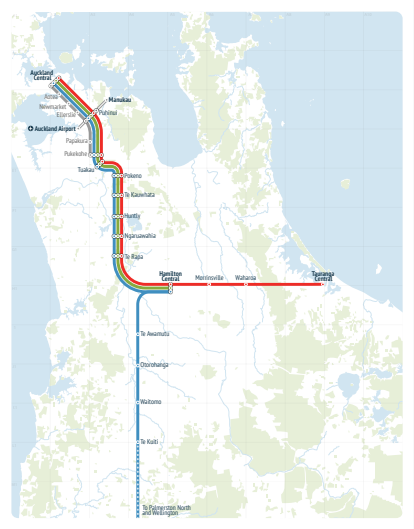
Auckland to Tauranga in approximately **2 hours 30 minutes**

New stations and network-wide track improvements

Potentially **3.5m passengers** per year

Estimated Capital cost: **$400m**

Estimated Operating Subsidy: **$0**



STAGE 3 Future Expansion and Extension

Thirty-two higher speed dual mode diesel and electric tilt trains, 300 seated passengers per train.

Four lines with a regular, frequent service between Auckland and Cambridge, Rotorua, Te Puke and Te Kuiti, via Hamilton and Auckland.

Hamilton to Auckland approximately 1 hour 10 minutes

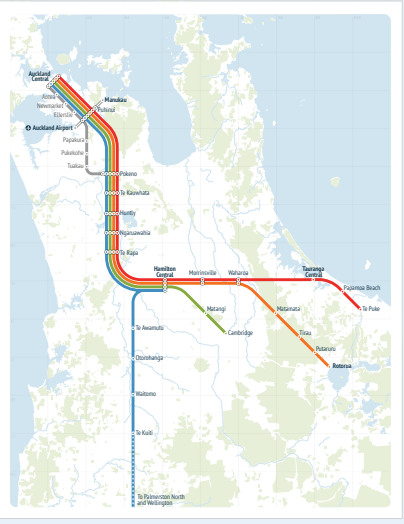
Auckland to Tauranga in approximately 2 hours

Regional signalling upgrade and Bombay deviation tunnel

Potentially **6m passengers** per year

Estimated Capital cost: **$1.45b**

Estimated Operating profit: **$10m+ per year**



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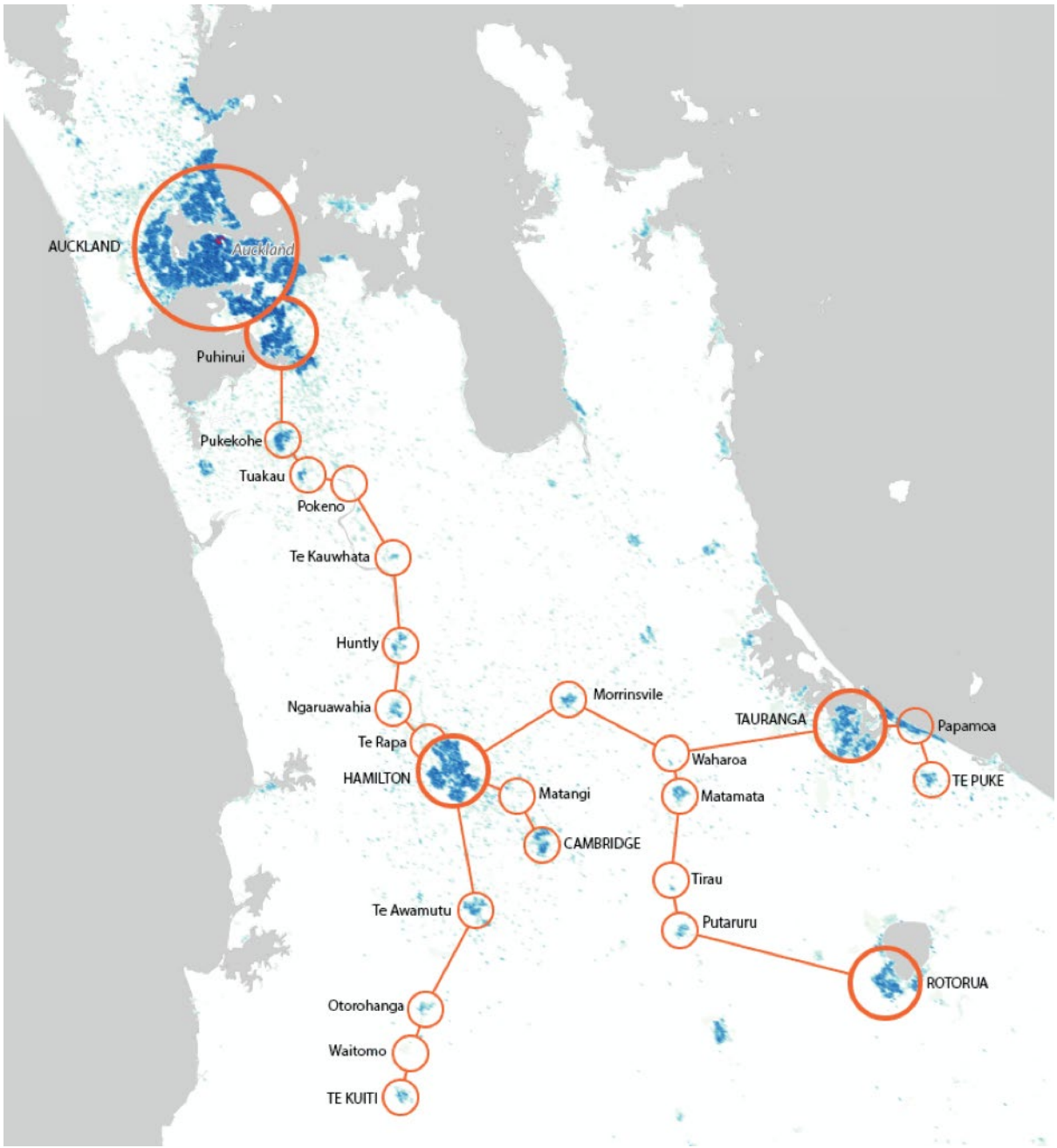
THE "GOLDEN TRIANGLE"

The following is a schematic showing the Stage 3 network overlaid on a population density map of the Upper North Island. At this stage, more than half of the population and economy of New Zealand would be served by the Regional Rapid Rail Network.



NEXT STEPS

Government, NZTA and KiwiRail

Identify NZTA or KiwiRail as the lead entity for developing Regional Rapid Rail (RRR)

Provide sufficient funding for the Government Policy Statement and/or Crown grant to the relevant entity

Create an Urban Development Authority to work with councils in progressing re-development plans near planned stations and in proximity to the corridor

Start route protection on the identified realignments so available for the future stages

Auckland Council, Auckland Transport & CRL Limited

Ensure planned re-development of Britomart, Otahuhu, and Puhinui stations are suitable for frequent, long distance passenger services

Contribute where required to funding and delivery of the ATAP Rail Development Programme initiatives (e.g. level crossing removals, station upgrades, etc.)

Waikato & Bay of Plenty Councils

Work with the relevant entity and new Urban Development Authority to progress land use planning and re-development potential near future stations.

Provide local infrastructure and service upgrades to maximise access to stations (e.g. feeder buses, walking/cycling connections, integrated ticketing, park/kiss & ride)

INTRODUCTION

Greater Auckland is proud to present our proposal for Regional Rapid Rail – an Upper North Island Passenger Network.

In July 2013, we launched the original Congestion Free Network to much success. The core of that original proposal now makes up most of the strategic public transport network proposed in the Auckland Transport Alignment Project. The debate is now not if to build a Congestion Free Network in Auckland, but when.

In April 2017 we released the Congestion Free Network 2.0. This reflects the great changes since 2013, such as the funding of the City Rail Link (CRL), the Urban Cycleways Fund, the beginning of the New Network, the passing of the Auckland Unitary Plan, the Auckland Transport Alignment Project (ATAP), and Auckland Transport's investigations into Light Rail. The focus was to update the Congestion Free Network to reflect these advances, as well as well push for an even better network faster than the current plans. The Congestion Free Network 2.0 was future-proofed in anticipation of future regional rail links between the Waikato and Auckland.

The "Golden Triangle" of Auckland, Waikato and the Bay of Plenty now make up over 50% of New Zealand's population, and are expected to account for over 70% of New Zealand's growth in the future. We need to provide a step change in intercity transit to leverage this growth proactively, rather than reactively waiting for it to congest the Waikato Expressway and Auckland's Southern Motorway. If we fail to provide the necessary infrastructure, we will miss out on many of the benefits from this coming growth.

We have the opportunity to create a well-planned, integrated Upper North Island transport system– one that is able to deliver strong economic and social outcomes, including regional development, not just for the area but for New Zealand as a whole.

OBJECTIVES: WHY RAPID RAIL, WHY NOW?

The following ten principles are the main objectives and design goals of the Regional Rapid Rail network:

1. **Connect major employment and population centres,** including central business districts, growing metropolitan areas, employment areas and satellite towns in the Upper North Island.

2. **Deliver a fast and competitive rail service** with a target travel time of 90 minutes from Hamilton to Auckland and under 2 ½ hours from Tauranga to Auckland. The emphasis is on quality of time and maintaining consistent and reliable speeds.

3. **Provide a regular and frequent rail service**, scheduled to suit a range of travel times and trip purposes, serving commuters, tourists, students and residents alike.

4. **Make complementary improvements to the rail freight network**. All upgrades should, at the least, not disturb KiwiRail's ability to move freight now or in the future. Passenger rail network upgrades should also seek complementary improvments that also enhance the efficiency and capacity of the Kiwirail rail freight network.

5. **Assist the creation of affordable housing supply** that is well connected by congestion-free transit. Use transit focussed residential development to catalyse the local economies of northern Waikato towns, which face potential economic decline by being bypassed by the new Waikato Expressway.

6. **Link regional transportation to well-planned communities with good urban outcomes**. This should not just be a rapid train network but the means to create vibrant, livable towns and cities that are economically and socially sustainable.

7. **Integrate directly with local public transport, walking and cycling networks,** such as the Congestion Free Network 2.0, to maximise coverage and usefulness.

8. **Deliver environmental benefits** by limiting growth of long range traffic and reducing pollution and CO^2 emissions, assisting New Zealand to meet its commitments under the Paris Agreement.

9. **Reduce road traffic injury and deaths**, to assist New Zealand in reaching Vision Zero.

10. **Ensure value for money for taxpayer investment** by optimising investment in infrastructure where it is most effective, regardless of mode.

THE UPPER NORTH ISLAND OPPORTUNITY

The Upper North Island is made up of the Northland, Auckland, Waikato, and Bay of Plenty regions. The focus of this report, however, is mainly around the Golden Triangle of Auckland – Hamilton – Tauranga.

Half of all New Zealanders live in the Auckland, Waikato, or Bay of Plenty regions, and in the last 20 years, 68% of New Zealand's growth has been in these three regions.[1] These trends are expected to continue. In the next 30 years 70% of total population growth and 72% of working age population growth will be in Auckland, Waikato, or the Bay of Plenty.

By 2043 the Golden Triangle regions will be home to 3.2 million people, 55% of New Zealand's population. Auckland's population will be three times that of Canterbury, the second largest region. Auckland will be five times larger than the Christchurch or Wellington urban areas, and Hamilton and Tauranga (which are already the fourth and fifth largest cities in New Zealand) will continue to grow.

Increasingly, New Zealand's success will depend on the Golden Triangle regions.

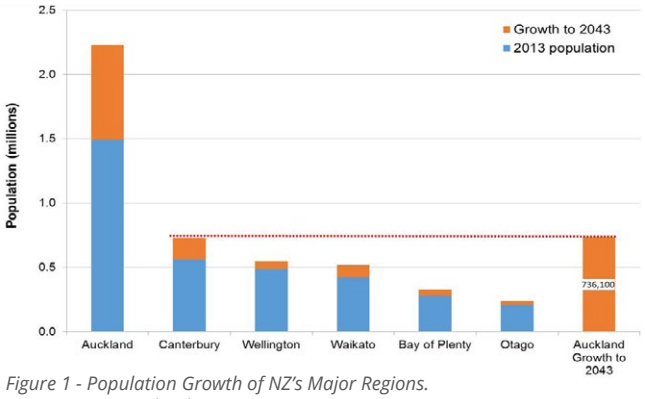


Figure 1 - Population Growth of NZ's Major Regions. Statistics New Zealand, May 2015

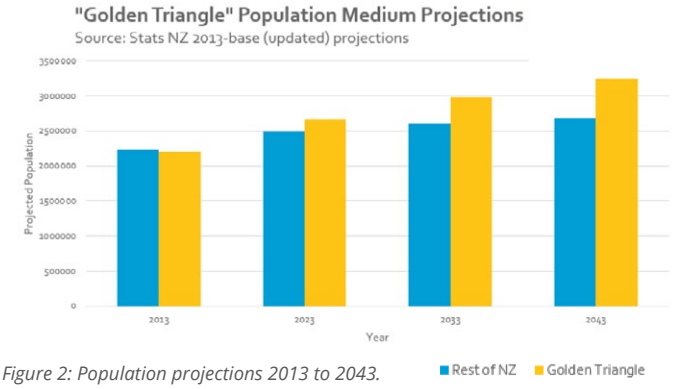


Figure 2: Population projections 2013 to 2043.

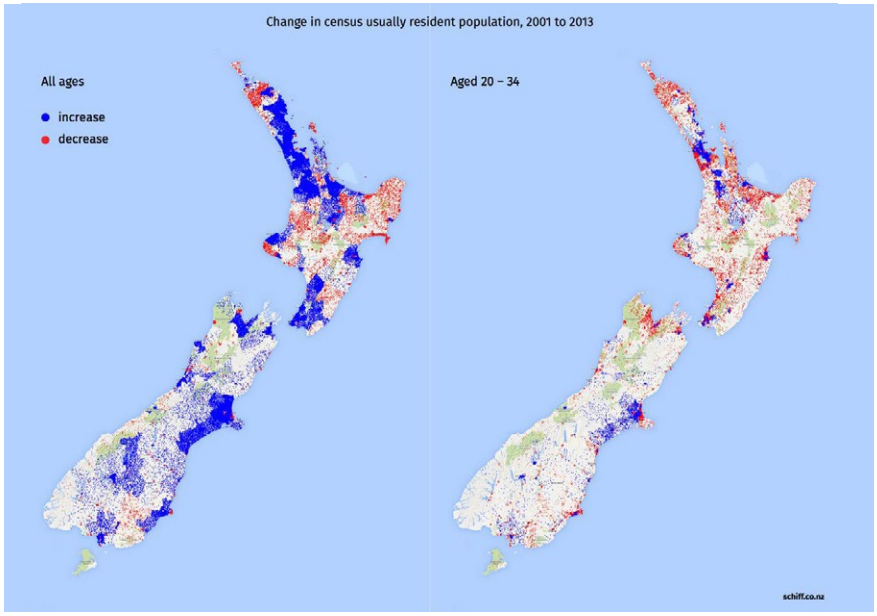


Figure 3 - Change in 20-34-Year-Olds in NZ by Area (2001-2013)

Large cities are already the engine room of the New Zealand economy, and will continue to do so in the future. Major cities like Auckland, Hamilton and Tauranga tend to attract a younger population than other parts of New Zealand, with young people moving there for education and employment.[2] Although cities are not immune from an "ageing population", they will be insulated from its effects due to higher birth rates and migration. The housing crisis in Auckland has created spillover pressure on the Bay of Plenty and Waikato regions, as some Aucklanders locked out of affordable housing seek housing options in Hamilton, Tauranga and towns in the northern Waikato.

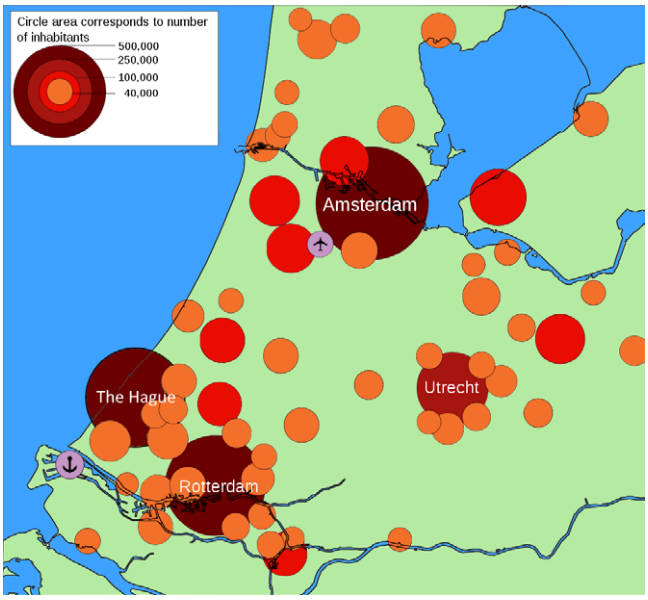
1. 2016 subnational population estimates, Stats NZ
2. Mapping the young(ish) adults, Aaron Schiff - http://schiff.co.nz/2014/10/mapping-the-youngish-adults/

In short, the Golden Triangle regions are the fastest growing in the country, making up most of New Zealand's future working age population growth, as well as total population growth. They are already home to half of all New Zealanders, with growth especially high in the cities of Auckland, Hamilton and Tauranga. The housing crisis, as well as job opportunities in Auckland, means it is vital to better link these regions: connecting people to opportunities such as jobs and education, as well as opening up further housing options.

We need to provide a step change for passenger transportation between Tauranga – Hamilton – Auckland.

NEW ZEALAND'S RANDSTAD?

The Randstad is an area in the Netherlands made up of multiple major cities including Amsterdam, Rotterdam and Utrecht, as well as smaller towns and villages, all interconnected by a network of rapid and frequent train lines. The Randstad is remarkable in that it functions as a single metropolis rather than a collection of nearby cities. Because of the fast transit connectivity linking the urban areas of the Randstad, people can live, work and play almost anywhere across south Holland.



Could the Golden Triangle be New Zealand's Randstad? Regional Rapid Rail would create a similar model for the Golden Triangle, enabling an interconnected network of highly livable and economically prosperous cities and towns. Each would retain its own character and charms, yet be highly accessible to each to other due strong rapid transport connections.

The Golden Triangle covers a slightly larger area than the Randstad, and it has only one-third the population. Nonetheless, the model of an interconnected network of similar sized cities functioning together as a regional economy holds true. The Randstad's condition is one of a number of towns and cities of similar scale; not England or France's model of a primary city with satellites. While Auckland is still highly likely to be dominant in the Upper North Island, the centres of Hamilton and Tauranga and the smaller towns provide a counterweight.

The aspiration of Regional Rapid Rail is not for the cities and towns of the Waikato and Bay of Plenty, to simply become satellites of Auckland, but for all urban areas to contribute to one integrated economy, and be great liveable places as well.

RAPID INTERCITY RAIL – THE MISSING MODE

The Expressway is almost complete, now what?

The Waikato Expressway Road of National Significance is well underway, with some sections already complete and with the remaining sections all due to be completed by 2020. Once finished, the Expressway will form a continuous four-lane dual carriageway, stretching 101 kilometres from the Bombay Hills to beyond Cambridge, bypassing many towns such as Huntly, Ngaruawahia and Cambridge.[3]

NZTA says that the Waikato Expressway will:

- Reduce travel times between Auckland and Tirau by 35 minutes.
- Significantly reduce the number of fatal and serious injury crashes.
- Increase the highway's capacity and passing opportunities.
- Reduce traffic congestion within smaller communities like Huntly, Ngaruawahia and Cambridge.
- Reduce fuel costs route and contribute to economic growth.

However, it is clear that most of these benefits will only exist as long as the expressway remains free flowing and uncongested by commuter traffic. Given the spill over housing pressures of the main centres and demand for suburban development in the north Waikato, additional traffic and congestion is a certainty unless something else is done too.

With the Waikato Expressway almost complete, what is missing is the maximisation of the complementary rail corridors: the North Island Main Trunk (NIMT) and East Coast Main Trunk (ECMT).

At present, KiwiRail runs multiple freight trains per day and intends to grow this network. In addition to this, a tourist-focused passenger service runs between Auckland and Wellington, with the train running to Wellington one day and returning the next. Both of these current uses of the trunk lines would be improved by Regional Rapid Rail.

The NIMT is mostly double tracked, partially electrified and in reasonable condition as a main line. The ECMT is generally single track, however recent upgrades, including two new passing loops as well as the extension of three other passing loops in 2012, have increased capacity significantly.[4] This corridor is not being used to its full potential, and further improvements are an obvious means to leverage value from the existing infrastructure.

3. Waikato Expressway, http://www.nzta.govt.nz/projects/waikato-expressway/
4. Further investment in busy rail line between Hamilton and Tauranga, http://www.kiwirail.co.nz/news/140/129/Further-investment-in-busy-rail-line-between-Hamilton-and-Tauranga.html

Other Modes Considered

Bus- and coach-based options were considered. At present, many intercity bus services operate across the Upper North Island, but we have not considered them for significant father investment. This is because they do not provide a step change to passenger travel times, as any service would be caught on the congested road network in Auckland, and increasingly in the Waikato and Bay of Plenty. Without fast and reliable travel, bus based system are unlikely to deliver the integrated development of the Waikato towns between Hamilton and Auckland.

The provision of a step change in bus performance would require an Auckland Southern Busway, and bus priority lanes on the Waikato Expressway. We consider this significant investment and impact on traffic operations to be uneconomical, compared to utilising the existing NIMT rail line which already runs through the corridor and has capacity available. Also, as demonstrated by the recent SH16 upgrade within Auckland, bus shoulder lanes on highways do not deliver espeically high quality outcomes due to their conflict with traffic at on and off ramps. Furthermore this would not provide the same close interface with existing communities and future development as could be done using the rail network and town centre railway stations.

True High-Speed Rail was also considered, of the kind used in Europe and Asia with speeds in excess of 300km/h. This was considered infeasible in the near future and was not taken forward as an option for the following reasons:

- The extreme cost would be prohibitive, requiring new tracks and a corridor built mostly in tunnel or viaduct, due to the need for very broad curves and shallow grades to achieve true high-speed running.
- The benefits would only accrue to passenger services and would not result in a step change for KiwiRail's freight business.
- A rapid regional rail system serving towns and villages is a better fit with the project objectives, as a high-speed rail network that would bypass local areas and only serve the main centres.

While inter-regional rail services existed for much of the 20th century, nearly all of these services were either cancelled, tied in with the suburban networks, or replaced with tourist-focused services in the 1990s and early 2000s. The Hamilton to Auckland service was cancelled in 2001, as Tranz Rail could not raise the $400,000 subsidy required to maintain operations of the basic network that was running at that time.

LEARNINGS FROM RECENT PROPOSALS FOR WAIKATO INTER-CITY RAIL

The Paling Report (2006)

The Hamilton – Auckland Rail Feasibility Study[5], known as the Paling Report, was completed in 2006.

This proposed a single weekday return service that would stop at Hamilton South, Hamilton North, Huntly, Ngaruawahia, Te Kauwhata, Pukekohe, Papakura, Manurewa, Newmarket and Britomart; with a service from Hamilton to Auckland at 6:30am and returning from Auckland at 5:30pm.

The report postulated that the service would cost $18.6m in capital expenditure, with annual operating costs of $2.3m and a Benefit Cost Ratio (BCR) of approximately 1.0. Due to all suitable trains being leased at the time[6], the report had a cost of $12.6m for new carriages and locomotives. The report also budgeted for two locomotives per train as Britomart does not allow the changing of ends.

The report also noted that ARTA said they could not provide peak paths on the Auckland network until 2009.

The report recommended that further discussions with stakeholders should take place, and if successful move onto the next stage of the business case.

Waikato – Auckland Passenger Rail Service Preliminary Business Case (2009)

The Waikato – Auckland Passenger Rail Service Preliminary Business Case[7] built on the Paling Report of 2006, however it proposed using the Silver Ferns as opposed to new rolling stock as these had become available by that point. The operating cost of service was estimated at $1.87m pa with a BCR of 1.9.

The report recommended prompt action due to the ability to secure the Silver Fern train sets. The authors noted, however, that ARTA could not provide peak access to Britomart due to the desire to implement improved frequencies on the Auckland network.

Hamilton – Auckland Passenger Rail Service Scoping Report (2011)

The Hamilton – Auckland Passenger Rail Service Report was commissioned by Environment Waikato and was completed in 2011.[8] This was complemented by other reports such as the Hamilton – *Auckland Passenger Rail Service Scoping Report*[9] and *Passenger Rail Service Market Research Results*[10].

The service was proposed to be trialled for two years and would have cost $2.99m including capital expenditure and operating subsidy. The service would use a single Silver Fern DMU train stopping at Frankton, The Base, Huntly, Te Kauwhata, Tuakau, Papatoetoe, The Strand and Newmarket, with the train making one peak and one off-peak return service per day.

In summary, this series of reports found a Waikato – Auckland passenger service had high strategic fit, being consistent with national transportation policy goals, and was economically viable, with benefit-cost ratio of 1.5 under the NZTA *Economic Evaluation Manual*, and 2.5 under the KiwiRail manual.

Furthermore, the market survey showed 91% support among the general public and almost as high support among Waikato ratepayers. It also identified that the primary intention for passengers was to use it for social purposes, such as visiting friends, going to events or shopping, as opposed to commuting for work. This research also identified that the average acceptable fare would be around $36 return for the full trip.

While worthwhile, two major challenges were identified:

1. planning the service across many local and central government authorities and having those authorities agree;

2. Not being able to use Britomart or Newmarket as a terminal, and concerns for operations north of Homai without a third main track, due to objections from Auckland Transport. This was owing to anticipated capacity constraints on the network and the lack of expansion plans at that time.

Nonetheless, the report reiterated the positive economic evaluation and concluded with a recommendation to move forward to next stage.

5. Paling Report 2006, http://s3.amazonaws.com/zanran_storage/www.ew.govt.nz/ContentPages/2493312.pdf
6. the Silver Ferns, all other DMUs and all SA carriages were being used in Auckland suburban operations at the time. They have since been replaced by new EMUs and are now largely unused, being in charter service or storage.
7. Waikato – Auckland Passenger Rail Service Preliminary Business Case 2009, http://www.bettertransport.org.nz/wp-content/uploads/2010/04/WaikatoRailBusinessCase.pdf
8. Hamilton – Auckland Passenger Rail Service Report 2011, https://www.waikatoregion.govt.nz/assets/PageFiles/18093/Final%20recommendations%20report.pdf
9. Hamilton – Auckland Passenger Rail Service Scoping Report 2011, https://www.waikatoregion.govt.nz/assets/PageFiles/18093/hamilton-auckland%20report%2012%20jan%2011.pdf
10. Passenger Rail Service Market Research Results 2010, Page 7, https://www.waikatoregion.govt.nz/assets/PageFiles/18093/1794762RailSurvey.PDF

Usage Occasions

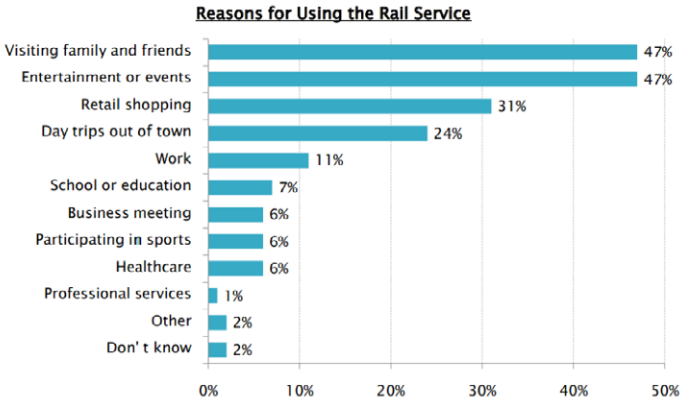


Figure 4 - Usage Occasions, Page 16, https://www.waikatoregion.govt.nz/assets/PageFiles/18093/1794762RailSurvey.PDF

Peak services (2 peak services or 1 peak return service)–

Depart Hamilton	06:00
Arrive Strand, Auckland	08:20
Arrive Newmarket, Auckland	08:27
Depart Strand, Auckland	17:30
Arrive Hamilton	19:45

Off peak services (2 off peak services; one departing Auckland and one departing Hamilton) –

Depart Auckland (Britomart)	09:30
Arrive Hamilton	11:45
Depart Hamilton	14:30
Arrive Auckland (Britomart)	16:45
Depart Auckland (Strand)	17:30 (return peak service noted above)

Figure 5 - Timetable, Auckland Passenger Rail Service Report 2011 Page 17

SUMMARY OF LESSONS LEARNED FROM PREVIOUS STUDIES

The main lessons learned from the previous reports are:

- A Hamilton – Auckland rail service has been found feasible on multiple occasions over the last decade, with positive economic evaluations showing benefit-cost raitios greater than 1.0. The economic case would likely be stronger now, with greater population and greater traffic congestion issues.
- Fares in the range of $15-$20 between Hamilton and Auckland, or vice versa, would be acceptable, allowing for a commercially viable service.
- Progressing this project at a local government level will be difficult due to the many councils involved, each with different expectations and priorities. Therefore, any Regional Rapid Rail Proposal should be led by central government.
- Capacity constraints on the Auckland network and impacts on suburban rail services are a concern, any new service would need to work around this constraint.
- The use of at least two of the Silver Ferns is feasible and affordable;
- Market research shows that only a small proportion of potential users would use the service for regular commuting. While work commuters would travel more regularly, many more people would use the service occasionally for shopping, entertainment and family reasons.[11] Therefore, the service plan needs to provide a range of departures across the day and the week to suit a wide variety of trips, as well as serving commuters well.

11. This is not to ignore the importance of regular commuters to the customer base: one daily commuter would use the service ten times a week, every week, providing a regular stream of patronage and revenue.

WHAT IS REGIONAL RAPID RAIL?

Regional Rapid Rail isn't just a scheme for commuter trains on the trunk line. It is an integrated regional economic development plan for the Upper North Island, based on fast and regular intercity train connections between the cities and towns of Auckland, the Waikato and the Bay of Plenty.

Regional Rapid Rail will revitalise the existing rail network using modern technology trains and upgraded tracks. This will allow for much faster trains, providing quick and reliable journeys that are faster than driving and skip the traffic completely. This revitalised network will stitch together the economy of Auckland, Hamilton and Tauranga, and extend the benefits of growth and development of the main centres to their nearby towns and villages. This will provide fast and reliable travel options to regular commuters, business travellers, shoppers, students, local visitors and international tourists alike.

The Regional Rapid Rail project has four pillars for success:

1

—

Using the right technology for affordable speed and performance: Tilting trains run fast on the straights and keep the speed up through curves for much shorter journey times. Dual-mode power systems run on cheap, clean electricity where overhead lines exist, but use onboard diesel power to carry on where there aren't any.

2

—

Leveraging existing infrastructure: The project uses existing rail corridors and infrastructure rather than building new and expensive routes. The existing rail network has some capacity left, and proposed upgrades and extensions will provide plenty more.

3

—

Providing a frequent, reliable and regular service for all trip types: For each trip taken to get to work, two more trips are taken for other reasons like, school, shopping, healthcare, family, friends and fun. The plan acknowledges this by proposing a wide network of regular departures, all day, seven day a week to support a robust and varied economy.

4

—

Integration with land use and development plans: Transport, housing and business development are inextricably linked. Town centre train stations will be a hub of activity and development, revitalising the towns of the Waikato and Bay of Plenty, and allowing people wanting the small-town lifestyle to still access the jobs and services of the big cities.

TECHNOLOGY FOR AFFORDABLE HIGHER SPEED RAIL IN NEW ZEALAND

Investment in the right rail technologies is fundamental to unlocking the latent capacity in the existing network, and is key to delivering higher speed Regional Rapid Rail without incurring excessive costs.

Tilt Train Technology

A tilting train is a train that is designed to tilt into a curve to allow it to corner better at higher speeds. The main reason that conventional trains are required to slow down for curves is for the comfort of passengers, the safety of crew onboard, and the stability of luggage, objects and equipment. The limit at which a speeding train would derail on a tight corner is far beyond the level where people inside the cabin would experience uncomfortably strong lateral forces.

New high-speed railways are built with very long curves with highly banked corners to avoid this problem and allow cornering at high speeds. However, to achieve the right geometry, dedicated high-speed train lines must be built at enormous expense, and such lines cannot be used shared conventional freight trains.

Tilting trains are an alternative way to overcome this limitation, and allow considerably improved cornering speeds on existing mainline tracks. They use electromechanical systems to tilt the cabin of the train against the cornering forces. Much like aircraft or motorcycles, they lean into the turns to compensate for the lateral forces created by cornering at higher speeds.

This allows tilting trains to corner at considerably higher speeds on winding mainline tracks, like the main lines of Auckland, the Waikato and Bay of Plenty. While the maximum speed may not be exceptionally high, experience overseas indicates that maintaining higher speeds through curves can have a very significant impact on total travel times. A 20% reduction in overall journey time is the typical difference between using tilting and conventional passenger trains on the same railway.

Bundaberg to Brisbane (Southbound)

Departing	Monday	Tuesday	Thursday	Friday	Saturday
		Tilt Train		Tilt Train	
Bundaberg	5:15am	5:15am	5:15am	5:15am	5:15am
Howard	6:02am	5:46am	6:02am	5:46am	6:02am
Maryborough West	6:23am	6:01am	6:23am	6:01am	6:23am
Gympie North	7:48am	7:01am	7:48am	7:01am	7:48am
Cooroy	8:37am	7:37am	8:37am	7:37am	8:37am
Nambour	9:18am	7:57am	9:18am	7:57am	9:18am
Landsborough	9:52am	8:32am	9:52am	8:32am	9:52am
Caboolture	10:26am	8:57am	10:26am	8:57am	10:26am
Brisbane (Roma Street)	11:40am	9:50am	11:40am	9:50am	11:40am

Tilting train technology can achieve considerable travel time savings. For example, tilt trains between Bundaberg and Brisbane in Queensland achieve almost two hours in time savings compared to conventional trains. The blue boxes are the tilt train times, while the yellow is the conventional train.[12] The Queensland example is very relevant to the New Zealand situation, as it operates on the same 1067mm narrow gauge track, achieving speeds of 160km/h in regular service and up to 210km/h[13] in test runs. Similar trains are also operated on the same track gauge in Japan. These examples demonstrate that tilt train technology is viable for the existing New Zealand network.

The manufacturer of the Auckland EMUs CAF (Construcciones y Auxiliar de Ferrocarrilles) can deliver tilt train technology with their proven SIBI Active Tilt system, which they estimate can reduce travel times by 30%.[14] Most other train manufacturers also offer tilt train technologies with decades of successful revenue service.

By tilting, the train also evens out the force on its wheels when cornering, and does far less damage to track at higher speeds than conventional trains.

Apart from the tilting cabin mechanism, tilt trains are no different to conventional trains and can run on the same tracks as freight trains, tourist trains and suburban passenger services

Dual Mode Rolling Stock

The upper North Island rail network is currently electrified in suburban Auckland and between Hamilton and Palmerston North, but is suitable only for diesel trains between south Auckland and Hamilton, and between Hamilton and Tauranga. A further complication is that diesel powered trains can no longer operate in Britomart station in central Auckland.[15]

To complete electrification of the network between Auckland and Tauranga would cost over $700m.[16] However, this cost can be avoided with technology to allow dual-mode train operations. Regional Rapid Rail proposes rolling stock that allows operations under both 25kV AC electric power where the overhead wires exist, and via onboard diesel generators where it does not. These systems are commonplace in Europe and Asia where train services extend from electric mainlines into less used branch lines where electrification would be uneconomic.

Once again CAF and most other manufacturers can deliver this technology, allowing dual mode diesel and electric with many different power supplies such as 1500V DC or 25kV AC.[17]

12. Queensland Rail – Tilt Train Timetable, https://www.queenslandrailtravel.com.au/Planyourtrip/timetable
13. World's fastest on narrow tracks, http://www.smh.com.au/news/National/Worlds-fastest-on-narrow-tracks/2004/11/16/1100574468966.html
14. SIBI – Active Tilt System, http://www.caf.net/en/innovacion-tecnologia/productos-tecnologicos/sibi.php
15. KiwiRail denies ultimatum, http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1andobjectid=11566906
16. Extension of Electrification Benefits and Costs Report to ONTRACK, Murray King and Francis Small, Page 47
17. Civity, http://www.caf.net/en/productos-servicios/familia/civity/

REGIONAL RAPID RAIL STAGES

Three stages are proposed for Regional Rapid Rail,
for successive investment and development over time.

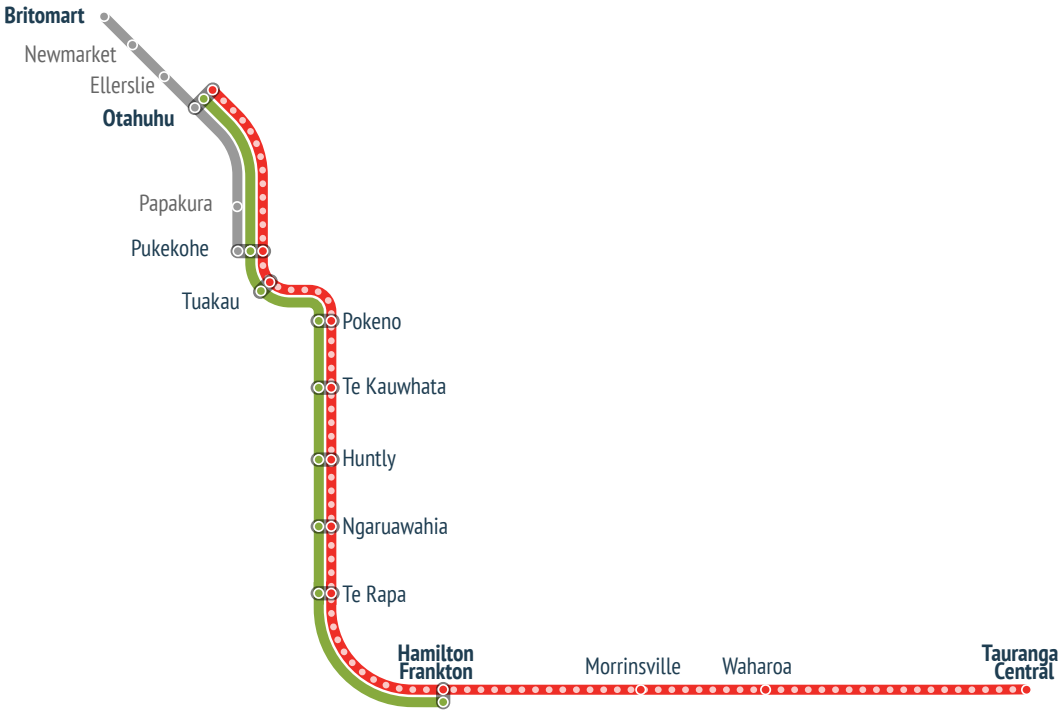
The first stage is an interim, to be set up quickly and inexpensively using existing trains running on the current network. It is intended to build patronage and show the viability of regional intercity rail in the short term while subsequent stages are being procured.

The second stage represents an investment in new higher speed tilting trains and network upgrades to create a truly regional network of rapid trains.

The third stage expands this network, extending the lines across the Waikato and Bay of Plenty, and further improving train speeds and journey times.

STAGE 1

Interim network: getting started quickly and affordably



CONCEPT

The concept for Stage 1 is to quickly deliver an affordable 'start up' intercity service between Auckland, Hamilton and Tauranga using existing trains from the current fleet, running on the existing network.

Stage 1 is a short term interim step, with an intended operating life of five years. The main purpose is to build ridership and confirm the viability of the regional rail concept, in advance of significant investment in new fleet and infrastructure upgrades (Stage 2).

Stage 1 is based around maximising the usage of three existing Silver Fern train sets that are currently available, running them from the existing Hamilton station in Frankton to the spare terminal space at Otahuhu in Auckland, for onward connections to Central Auckland. Apart from constructing basic rail station platforms at eight locations in the Waikato and Bay of Plenty, no major capital works or network improvements are proposed for Stage 1.

NETWORK AND OPERATING PLAN

While an all-day, seven-days-a-week timetable is proposed, the focus of Stage 1 is peak-time trips for Hamilton and Waikato residents to access Auckland.

The main route is the Waikato Line, which would run between Hamilton and Auckland, serving Hamilton-Frankton, Te Rapa, Ngaruawahia, Huntly, Te Kauwhata, Pokeno, Tuakau, and Otahuhu with peak service and regular, if somewhat infrequent, service both ways across the day.

Once a day the Bay of Plenty Line would run, with one Waikato service extended to run from Auckland to Tauranga and return, stopping at Morrinsville and Waharoa (near Matamata) on the way.

The number of towns served is a trade-off between providing good access to a number of communities and providing relatively fast journeys without too many stops. In stage 1, the focus is on providing regular service to all towns likely to generate significant activity.

Timetable

Two peak time departures are proposed from Hamilton up to Auckland on weekday mornings, timed to arrive at Otahuhu at 7:25 am and 8:25 am, to allow arrivals in the Auckland City Centre just prior to 8 am and 9 am respectively. This is intended to align with the start of the working day, university schedules and the opening of shops.

After the morning peak, both trains would return through the Waikato to Hamilton, with the earlier departure from Auckland continuing to Tauranga and back, during which time the latter departure would undertake an additional middle of the day return trip from Hamilton to Auckland, and back again.

Both trains would then arrive back at Otahuhu in time to provide two evening peak runs from Auckland back to Hamilton, departing at 5:35 pm and 6:35 pm respectively.

Stage 1 will include five return trips per day between Hamilton – Auckland, comprised of:

- Two peak commuter trips from Hamilton to Auckland in the morning, and from Auckland to Hamilton in the evening
- Three departures through the middle of the day from Auckland to Hamilton and return, including one that continues to Tauranga and back.

On weekends, a reduced service would operate using only two trains, to reduce operating costs and allow one train set to be taken out of service each weekend for maintenance and repairs. The weekday timetable would be the same as the weekday, except with one fewer peak service each way and one less return trip during the middle of the day.

Travel times

WAIKATO LINE:

- Hamilton to Auckland-Otahuhu and vice versa (five each way per day, including one continuing as a Bay of Plenty Line service)
- 1 hour 51 minutes each way
- + 25 minutes Otahuhu to Britomart using AT Metro urban trains

BAY OF PLENTY LINE:

- Auckland-Otahuhu to Tauranga (one return trip per day, via Hamilton)
- 3 hours 25 minutes each way
- + 25 minutes Otahuhu to Britomart using AT Metro urban trains

Train fleet

The train fleet would comprise of three existing RM class "Silver Fern" diesel multiple unit railcars, each with capacity for 96 seated passengers.

These trains were purpose built for intercity operations and have toilets and airline style on board passenger facilities. They are capable of speeds of over 120km/h. However, they are not permitted to reach this speed on the current network. They have already had interior refurbishment to a high standard for the charter and tourism market. The mechanical refurbishment is proposed to extend their operating life for five years of regular service, including a more extensive overhaul of the third unit to return it to operational condition.

Figure 6 - NZR RM class (Silver Fern)

Two units would be operated in-service each weekday, with the third kept as a 'hot spare' to be put into service in case either of the other trains had to be taken out of service due to maintenance issues. Keeping one of the three trains in reserve recognises the fact that the vehicles in question are over forty years old and are likely to experience reliability issues. On the weekends only one train would operate each day, allowing the other two to undertake routine serving and maintenance.

If the Silver Ferns were not feasible, then investigations could be done into upgrading ADL Class DMU's, or SA set carriages for intercity travel. The latter would also require the leasing of a locomotive.

The other option is to procure new rolling stock such as what is proposed for Stage 2 straight away running the Stage 1 pattern.

Stations

Within Auckland, the choice of rail terminal is limited in the immediate future by congestion on the core parts of the city's suburban train system. While Britomart station in downtown central Auckland is the logical terminal point, it is already operating at maximum capacity, and no additional trains can run there until the City Rail Link extension is opened (circa 2023). Furthermore, since the station was electrified Britomart no longer supports diesel powered trains.

Instead, Otahuhu was selected as the next best terminus for Stage 1. Otahuhu has a spare platform available for intercity trains, and it is the station closest to Central Auckland that is served by both the Southern and Eastern Lines of the suburban train network. Both suburban lines calling at this station means there is a departure every five minutes for onward trips to Britomart Station in Central Auckland, with a travel time of 25 minutes. Otahuhu also provides direct connections to other key destinations on the rail network such as Newmarket, Ellerslie, Manukau and Middlemore Hospital. It is close to the proposed stabling area and has connections to the southern new network.

The Strand (old Auckland Station) was considered, as this is the current terminal for tourist trains in Auckland. However, this station is not currently suitable for an intercity commuter service, as it is somewhat remote and inaccessible from the city centre, and it does not connect to any of the suburban passenger lines or bus routes for onward connection. Newmarket station was also discounted due to capacity constraints at the platforms and junction.

In Hamilton, the existing Frankton rail station would be used for Stage 1. While this has a less than ideal location approximately 1.5km west of central Hamilton, it is a currently operational train station with all the infrastructure and passenger facilities required to support the initial service. Frankton has nearby bus connections, parking, and a large amount of land where temporary Park & Ride could be developed cheaply.

Outside Auckland and Hamilton, some new and upgraded stations are required to implement the Stage 1 service. For Stage 1 a very basic level of station development is proposed to provide the bare minimum required for a functional train stop. In each case, only a single short platform, a simple bus-stop style canopy shelter with bench seats, and a light pole would be delivered. In most cases, this involves building new platforms at former station sites. However, some places would require an entirely new station location.

- Existing stations utilised without change: Auckland-Otahuhu, Pukekohe, Huntly, Hamilton-Frankton;
- New platforms required at former station sites: Tuakau, Pokeno, Te Kauwhata, Ngaruawahia, Morrinsville;
- Entirely new stations required: Te Rapa, Waharoa, Tauranga Waterfront;

Infrastructure Development

Stage 1 uses existing railway track and signal infrastructure only, with no changes or improvements proposed. Nonetheless, it is assumed that the first section of the third main in South Auckland is operational to allow the Stage 1 intercity trains to access Otahuhu station without delaying local passenger and freight trains. The Government has recently announced the funding of the third main as well as an extension of the electrification to Pukekohe as part of a recent Commuter Rail Package.[18]

Depot and operations

The trains would be based at the rail yards at Te Rapa, Hamilton. They would receive basic fuelling, cleaning and servicing there, primarily overnight.

While the facilities at Otahuhu are well equipped to service the trains, basing them in Auckland would require very early morning delivery runs to collect the first passengers in Hamilton for the morning peak, and require returning the trains from Hamilton back to Auckland after the evening peak. Avoiding this 'dead running' by basing the trains in Hamilton greatly improves the operational performance and cost recovery. A Hamilton base also contributes to the regional development aspect of the RRR proposal, by supporting maintenance and servicing jobs for the rail hub outside of Auckland.

More significant servicing and maintenance tasks would be undertaken over the weekend. Each weekend two units could be rotated out of service while the remaining one continues to provide the reduced weekend timetable. Periodic heavy engineering work may be undertaken in Auckland at this time.

18. $267 million investment in commuter rail, https://www.national.org.nz/_267_million_investment_in_commuter_rail

COSTS, REVENUE, RIDERSHIP AND SUBSIDY

The capital development budget for Stage 1 is estimated at $9.6m, primarily to construct or rebuild basic platforms and shelters at former and railway station sites, and refurbishing the trains.

Net operating subsidy (operating costs less fare revenue) is estimated as $1.95m per annum, for five years.

Given the proposed five-year lifespan of the Stage 1 proof-of-concept network, this indicates a total fiscal package of an estimated $20m for the five year trial period.

Capex costs

A capital investment of approx. $3.5m has been allocated to refurbishing the three Silver Fern rail cars. This includes mechanical refurbishment of all three units at around $1m each and interior overhaul of one un-refurbished unit at an estimated $0.5m.

Stage 1 includes basic platform infrastructure at eight new re-instated stations, and minor refurbishment of the existing Huntly station, with a total estimated cost of $6.5m for station, works.

No other significant capital development of network infrastructure is proposed for stage 1.

Operating costs

The total cost to operate the stage 1 network is estimated at approximately $6m per year.

The Stage 1 schedule requires the operation of approximately 484,000 service-kilometres and 7,260 service-hours per annum. This level of service requires four full-time crews to operate, allowing for annual leave, sick leave and other entitlements. Each crew would comprise one train driver in the cab, and one customer services manager in the passenger cabin.

Network access charges have been estimated at $4.50 per service-kilometre, and vehicle operating costs at $6.00 per service-kilometre.

The following annual estimated operating costs have been included in the total figure:

- Train crew: $680,000
- Management and marketing: $168,000
- Fuel and vehicle and operating expenses: $2,900,000
- Network access charges: $2,180,000
- Depot operations: $200,000

Ridership

Stage 1 could generate potentially 350,000 boardings per annum if implemented in the near future.

This would represent around 500 return passengers per weekday, with an average trip length of 75km, and an average train occupancy of 60% across the day. This high level of occupancy is due to the relatively large proportion of peak service, in combination with the expected attractiveness of the one Tauranga service.

These estimates would translate into around 28 million passenger-kilometres per annum.

Revenue and Subsidy

Given the above scenario, predicted stage 1 fare revenue would amount to around $4m per year, assuming an average revenue figure of $0.15 per passenger-kilometre. This is equivalent to a nominal fare of $20 for a one-way trip between Hamilton and Auckland, and $35 between Tauranga and Auckland.

Comparing predicted operating costs to estimate revenue shows a net subsidy for stage 1 of approx. $2m per annum, with a potential farebox recovery ratio of 68%. This ratio is above the 50% recommended by NZTA as part of its National Farebox Recovery Policy.[19] This equates to a net subsidy of around $5.20 per passenger, or 7c per passenger-kilometre.

CONCLUSION

Stage 1 is a short-term proof of concept for Regional Rapid Rail using a small number of existing trains running on existing tracks. It requires an estimated $10m of capital funding up front and $2m subsidy per year, for five years, to deliver a basic but functional intercity rail service to ten towns and cities across the Waikato and Bay of Plenty.

This low-capital approach permits a service to be put into action quickly and inexpensively, building up patronage and allowing the development of Waikato towns to be accelerated and the confidence to prepare urban planning strategies that take both rail and road transport into account. The five-year trial period allows sufficient time for people to respond to changes in where and how they live and work, without committing the government to high levels of expenditure or a long-term development programme in advance.

The trial period should demonstrate the viability of intercity rail between Auckland, the Waikato and the Bay of Plenty, and justify the further capital expenditure to improve service levels, capacity, operational efficiency and cost recovery.

19. National Farebox Recovery Policy, https://www.nzta.govt.nz/assets/resources/national-farebox-recovery-policy/docs/national-farebox-recovery-policy.pdf

STAGE 1 MAP


Britomart
Newmarket
Ellerslie
Otahuhu
Papakura
Pukekohe
Tuakau
Pokeno
Te Kauwhata
Huntly
Ngaruawahia
Te Rapa
Hamilton
Frankton
Morrinsville
Waharoa
Tauranga
Central
GREATER AUCKLAND
Waikato line
Bay of Plenty line
King Country line
Geyserland line
Southern line (Auckland suburban)
Other rapid transit connections
Daily or twice-daily serivce only
International airport
Regional Rapid Rail
RRR

STAGE 2

Building a True Rapid Rail Network: Investment in Efficiency and Performance

CONCEPT

The strategic concept for Regional Rapid Rail Stage 2 is to invest in new higher-speed tilting trains and supporting track upgrades to achieve the maximum utilisation of the existing upper North Island rail network for intercity passenger services.

Building off the Stage 1 proof-of-concept trial, Stage 2 represents a significant investment programme to significantly improve train speeds, capacity and operational performance and achieve a step-change in ridership. Many of these improvements for higher speed passenger trains would also benefit freight operations.

NETWORK AND OPERATING PLAN

A network of three integrated lines is proposed for Stage 2, providing fast and regular bi-directional services all-day, seven days a week. In addition to providing significant commuter capacity at peak times, the focus of Stage 2 is to provide a regular and reliable timetable across the network, all day, seven days a week. This is to allow the network to be used for a range of purposes and trip types and to give customers the flexibility to travel where and when they choose.

Two regular all-day intercity rail lines and one peak-only service form the core of the Stage 2 network:

- **The Bay of Plenty Line**, running a regular timetable both ways all-day between Tauranga and Auckland via Waharoa, Morrinsville, Hamilton and the towns of the northern Waikato.
- **The King Country Line**, running a regular timetable both ways all-day between Te Kuiti and Auckland via Waitomo (Hangatiki junction), Otorohanga and Te Awamutu, then calling at Hamilton and the towns of the northern Waikato.
- **The Waikato line** becomes a peak-only service under Stage 2. This provides additional peak capacity between Hamilton and Auckland at weekday commuter times but is not required across the day or on weekends as the north Waikato section is well served by the combination of the two main lines.

The Stage 2 network services a range of trip types and customer markets.

As well as providing rapid connections between the main centres of Auckland, Hamilton and Tauranga; the network provides regular service from the towns of the Waikato, Bay of Plenty and King Country to the Auckland metropolis. In addition, the two main routes would also function as local commuter rail services to Hamilton and Tauranga, providing for quick commutes from Te Awamutu to Hamilton or Morrinsville to Tauranga, for example.

Furthermore, as the lines double up between Hamilton and Auckland, the network provides double the capacity and service frequency in that section. This provides fast trips, short waiting times and abundant connectivity at all times to Auckland from its southern hinterland, where the network would function similar to a suburban rail service

Timetable

Each station on the RRR network would have a minimum service of one train per hour each way, all day, seven days a week, and two trains an hour in the peak direction during the morning and evening peak periods on weekdays. For ease of use, departures under the all-day network would be 'clock face', leaving on a regular schedule at the same time each hour.

Between Hamilton and Auckland and at all stops in between, the combination of lines would result in two trains per hour all day, with the lines timetabled to provide an even 30-minute headway. Furthermore, at peak times the combined frequency of all lines would be four trains an hour in the peak direction, with 15-minute headways between Hamilton and Auckland for two hours on weekday mornings, and the same from Auckland to Hamilton on weekday evenings.

The network would operate seven days a week, for fifteen hours per day, from first departures at approximately 6:00 am to the last arrivals around 9:00 pm.

Additional late-night services could also be operated on Friday and Saturday nights, for example through midnight or later; or to serve special events, concerts or sporting fixtures. However, these extra services have not been included in the Stage 2 OPEX costing, as they would likely be funded separately.

Travel times

WAIKATO LINE:

- New Hamilton Central Station to Downtown Auckland (Britomart)
- 1 hour 30 minutes each way
- Two peak direction departures per hour at peak times on weekdays, as overlay capacity for the Bay of Plenty and King Country Lines.

BAY OF PLENTY LINE:

- Tauranga Central Station to Downtown Auckland (Britomart), via Hamilton
- 2 hours 30 minutes each way
- One departure per hour all day, each way

KING COUNTRY LINE:

- Te Kuiti to Downtown Auckland (Britomart), via Hamilton
- 2 hours 15 minutes each way
- One departure per hour all day, each way

Train fleet

Stage 2 includes the purchase of a new fleet of purpose built intercity trains. These trains would be procured with a series of design specifications that together would allow comfortable, higher speed operation on the existing corridors of the New Zealand rail network.

The main characteristics of this new fleet would be:

- Higher speed operation, with a maximum speed of 160km/h.
- Active tilting train bodies to allow higher speeds to be maintained through curves.
- Narrow gauge (1067mm) wheel gauge and standard loading gauge, to allow operation anywhere on the New Zealand rail network.
- Dual mode power, with a combination of 25KvAC electric motive power and onboard diesel generators located under the floor.
- Multiple-Unit configuration, using self-powered trains rather than locomotives pulling separate carriages.
- Double ended, allowing trains to arrive and depart at any terminal station without having to turn around.
- Four-car units, approximately 100m in length, with seating capacity for 300 passengers. These could be coupled together into double units of 200m length to seat 600 passengers, doubling capacity and aligning with the approximate maximum length of existing terminal platforms in Auckland.

By being higher speed tilt trains, considerably faster journey times can be achieved on existing low-radius curvilinear track, without the need to spend many billions of dollars building true high-speed rail alignments.

With dual mode power, these trains can operate on cheap, quiet and emission free electricity where the overhead line exists, and under independent diesel power where it does not. This allows a single train set to carry passengers on routes using parts of both the partially-electrified North Island Main Trunk and non-electrified East Coast Main Trunk, and to operate in Britomart station and other underground areas easily.

The trains would have the range of passenger conveniences expected for longer distance intercity trips, including comfortable high-backed seats, tray tables, USB charging, tray tables and onboard Wi-Fi. Other facilities would include wheelchair accessible toilets, drinking fountains and luggage racks.

A café and bar service would also be provided, with the Train Manager serving from a trolley between stops, in the style of Japanese bullet trains. However, a separate servery bar or restaurant car is not proposed. These occupy a large floor area that displaces a large amount of passenger seating, which negatively affects the capacity and efficiency of the trains.

A single seating class is proposed. However, this would be more accommodating that suburban trains in terms of seat size and leg room and would be similar to a traditional business class seat on an airline. Each pair of seats would be rotatable allowing all seats to be turned to face in the direction of travel at the start of each trip. However, this also allows families or groups of people travelling together to rotate one pair towards the rear of the trains, creating a booth of four seats facing each other.

To operate Stage 2 a fleet of 17 four-car train sets is required. This is comprised of 15 units for peak service delivery, one unit for a hot spare, and one for rotation for maintenance.

Infrastructure Development

The aim of Stage 2 is to create an efficient higher speed intercity network, as such some investment in track upgrades infrastructure development is required to gain the full speed benefits of the new higher speed tilt train fleet.

Track improvements: Operation at speeds of up to 160km/h requires tighter tolerances on track maintenance and geometry. The Stage 2 budget includes a funding allocation for track renewals and localised upgrades across the network to support high speed running. This allocation also includes an extension of passing loops on the mostly single-track sections of the ECMT between Hamilton and Tauranga, and the NIMT between Hamilton and Te Kuiti.

Level crossing upgrades: In addition, Stage 2 includes the upgrade of 32 level crossings with additional barrier arms, warning lights, detection systems and signal improvements to allow trains to cross them at high speed safely.

Whangamarino realignment: One major track development is included in Stage 2. The North Island Main Trunk Line is mostly double track between Auckland and Hamilton, with the major exception being a single-track section between Mercer and Te Kauwhata which winds along an old alignment skirting the edge of the Whangamarino swamp. It is currently slow to traverse this section for all trains, while the single track creates a pinch point and the swampy soil conditions make maintaining precise track geometry difficult.

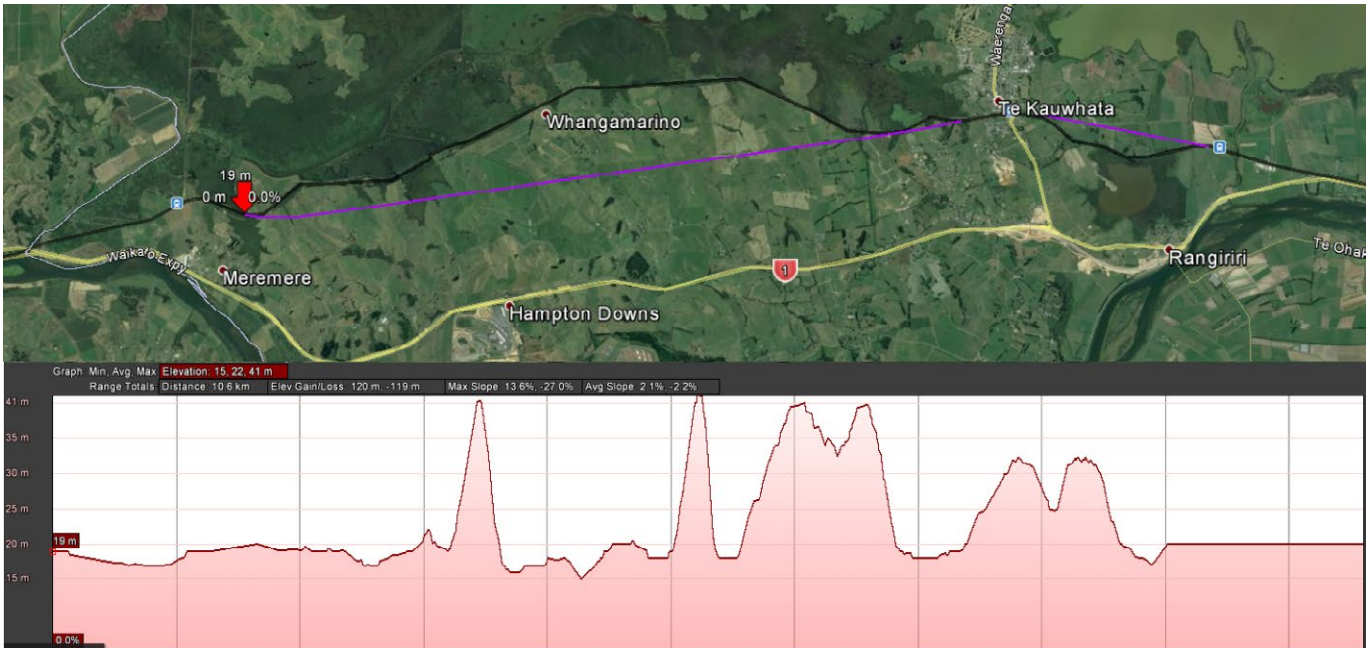


Figure 8 - Te Kauwhata – Amokura Realignment

A realignment is proposed for the swamp section to make it more suitable for Regional Rapid Rail. This is comprised of a new twin-track alignment on a generally straight line between Amokura (near Meremere village) and Te Kauwhata station, running across the rolling farmland approximately 1km west of the existing line along the swamp edge. This land is generally flat and undeveloped, except for a series of five ridges that would need to be treated with cuttings of 10m to 20m, as can be seen in the diagram below.

This would be paired with a smaller deviation to the south, removing a series of reverse curves between Te Kauwhata and Rangairiri, and avoiding a similar alignment along marshy land at the edge of Lake Kopuera.

In total, this realignment includes 14.5km of new higher speed double track railway, with significant earthworks to provide a generally straight and level alignment. With both deviations, the existing main trunk line would be retained as a passing loop for slower freight trains, in addition to the new double track line, linking into the existing triple track section through Te Kauwhata station. In effect, this would triple track the whole NIMT between Meremere and Rangiriri and allow high-speed passenger trains and slower freight trains to occupy the section at the same time.

Auckland Third Main: It is assumed that the third and possibly the fourth main track is implemented in South Auckland by the time Stage 2 is operational. At a minimum, the third main between Westfield Junction and Puhinui Junction would be required to operate Stage 2 RRR. The cost of this has not been included in the Stage 2 budget as it is likely that this project will proceed shortly regardless. As noted before the Government has recently announced funding for the Third Main between Westfield-Wiri.

Electrification: The new dual mode train sets specified for this stage can run under both electric and diesel power and therefore do not require any extension of electrification to operate. Nonetheless, they would benefit from cheaper and cleaner motive power if electrification were extended for suburban or rail freight operations.

Due to the existing NIMT Electrification between Te Rapa and Palmerston North, an opportunity exists to easily extend the electrification from Te Rapa yard to the site of the Te Rapa station in the North (approx. 3km), and from Frankton Junction to Claudelands in the east (approx. 4km). This would allow RRR trains to operate entirely under quiet and emission-free electric power within the suburbs of Hamilton city, including the tunnel section under the city centre. However, as this is not required to run the network, we have not considered this in scope for the Stage 2 budget.

Stations

Auckland stations: Stage 2 utilises Britomart station on the downtown Auckland water-front as the Auckland Central station, providing direct access to the city centre and removing the need for a transfer to suburban trains. The electric-capable double ended train units specified for Stage 2 will be able to efficiently operate in and out of the Britomart underground terminal platforms from the NIMT (Eastern Line).

While Britomart is currently operating at maximum capacity as the suburban rail terminal for Auckland, the completion of the City Rail Link extension (circa 2023) will convert Britomart to a through the station for suburban trains. Initially, this will reduce the number of suburban trains operating through the existing eastern approach tunnel, and it will free up two terminal platforms that will no longer be required for suburban train operations. RRR Stage 2 includes up to four trains per hour terminating at Britomart at peak times; this is approximately the maximum number of intercity trains that could terminate at Britomart in the 2020s, without disrupting the operation of the City Rail Link system and the Auckland suburban network.

For Stage 2, the main interchange station in south Auckland would shift to Puhinui. This station is located at an ideal point on the network at the first point where the two main suburban lines converge. Puhinui allows easy connection to local trains and buses, and a direct one-station train link to Manukau Central. Furthermore, Puhinui provides a direct connection to Auckland International Airport, 6km to the west via Stage Highway 20B. Plans are underway to implement and express bus shuttle from Puhinui station to the airport in the immediate future, to be replaced by a dedicated light rail link in the future.

Hamilton Central Station: The existing Hamilton main station at Frankton is poorly located outside of the city centre, and its configuration is unsuitable for supporting the high frequency of through and terminal trains required by Stage 2. A new Hamilton Central station is required, for which two options exist.

The first option would be to construct a new Hamilton Central station in an open cutting in the park land alongside Bryce Street, between the Seddon Road overbridge and the ECMT portal under Tristram Street. This would locate the new central station one block west of the existing bus interchange, and two blocks away from the core of downtown Hamilton. It would also be within walking distance of the cricket and rugby stadiums, and the Founders Theatre.

This would include one island platform with two through tracks linking to the main line to the east for the Bay of Plenty Line (and freight on the ECMT), and a second island with two terminal tracks from the west for the Waikato and King Country Lines, which would terminate or change direction at this station.

This would require rebuilding Seddon Road over bridge with a broader span to clear multiple tracks. However, the rest of the station would be relatively cheap and simple to construct at this location, provided a strip of parkland could be acquired. The location in a cutting would allow easy concourse access from street level, with the main entrance at the corner of Bryce Street and Tristram Street. This would also require approximately 600m of double tracking from Frankton to the new station site, and the construction of the currently missing third leg of Frankton Junction. This simple first option has been included in the capital development budget for Stage 2.

The second option would be to reconstruct the former Hamilton underground station. The former station is derelict and has only a single track and platform which must also accommodate all ECMT freight. Furthermore, its entrances have since been built over by the K-Mart building on the block fronting Bryce Street between Tristram Street and Anglesea Street. This option would provide an excellently located central station within the city centre proper, linked directly to the bus interchange. However, it would be infeasible to expand the former station to the required configuration of four tracks and two island platforms without demolishing the buildings above. Therefore, this represents the option for a comprehensive

Figure 9 – Options for development of a new Hamilton Central Station

Figure 10 – Single-track former Hamilton Underground Station (Circa 2001

urban redevelopment, which would include demolishing the K-Mart building, constructing the new station and tracks in a trench below the site, then redeveloping the land above. Therefore, this option represents a high cost, but high return urban redevelopment plan, analogous to a "mini-Britomart" for central Hamilton.

Regional stations: This stage includes upgrades to the nine basic stations from Stage 1, to convert them to double platform stations with a higher standard of passenger facilities. This includes a second track and platform at Tauranga to allow regional trains to stop without blocking the main line. In addition, four new regional stations are proposed for the King Country Line. This includes upgrades to the existing stations at Otorohanga and Te Kuiti, constructing passenger facilities at the old Te Awamutu platform, and building an entirely new station at Hangatiki to serve Waitomo.

Depot and operations

Stage 2 requires a dedicated depot facility and stabling yard for intercity units; the budget has been allocated to construct a purpose-built depot and supporting facilities at either Frankton or Te Rapa. This depot would be capable of undertaking all regular servicing, maintenance and engineering works.

As in Stage 1, it is proposed to site this depot in the Hamilton area to provide a centralised base of operations for the RRR network, in a location that minimises dead running and allows for convenient vehicle and crew rotations for cost effective operations. As a base for train crew and associated depot and support staff, this also represents a significant regional employment anchor.

COSTS, REVENUE, RIDERSHIP AND SUBSIDY

The capital development budget for Stage 2 is estimated at $397m, with approximately half this figure going to a fleet of 17 new higher speed tilting trains, and the remainder on network improvements and station upgrades.

Net operating profit (fare revenue less operating cost) is estimated at $6.3m per annum. This indicates that, after the initial capital injection to purchase fleet and network improvements, the daily operations of the Stage 2 network would be profitable and self-sustaining without the need for ongoing operational subsidy.

Capex costs

A capital investment of $187m is estimated for the purchase of the new higher speed tilt train fleet.

This is paired with $78m for network-wide track improvements to allow higher speeds, $16m for upgrading level crossings to high-speed standard, and $73m for the triplication and realignment of the NIMT from Meremere to Whangamarino.

Stage 2 also includes $18m for new and upgraded stations and $25m for a dedicated Regional Rapid Rail depot and stabling yard in Hamilton.

Operating costs

The total cost to operate the stage 2 network is estimated at approximately $50m per year.

The Stage 2 schedule requires the operation of approximately 4.2 million service-kilometres and 47 thousand service-hours per annum. This level of service requires twenty-six full-time crews to operate, allowing for annual leave, sick leave and other entitlements. Each crew would comprise one train driver in the cab, and one customer services manager in the passenger cabin.

Network access charges have been estimated at $4.50 per service-kilometre, and vehicle operating costs at $6.00 per service-kilometre.

The following approx. annual operating costs have been included in the total figure:

- Train crew: $4.5m
- Management and marketing: $1m
- Fuel and vehicle and operating expenses: $25m
- Network access charges: $19m
- Depot operations: $1m

Ridership

Stage 2 is estimated to generate approximately 3.5m boardings per annum circa 2025 if implemented in the early 2020s. Given the relative size of the network, this is a broadly equivalent outcome to the regional rail networks in Victoria and New South Wales serving regional towns and cities around Melbourne and Sydney respectively.

This represents approximately 4,800 return passengers per weekday, with an average trip length of 109km, and an average train occupancy of 30% across the day. This lower level of occupancy reflects the consistent bi-directional

service delivery across the day and week and the fact that the new train fleet would have high passenger capacities and do not necessarily need to be full to operate profitably.

These figures translate into 380m passenger-kilometres per annum.

Revenue and Subsidy

The predicted Stage 2 fare revenue amounts to around $50m per year, assuming an average revenue figure of $0.15 per passenger-kilometre. This is equivalent to a nominal fare of $20 for a one-way trip between Hamilton and Auckland, and $35 between Tauranga and Auckland.

Comparing predicted operating costs to estimate revenue shows a net operating profit for Stage 2 of around $6m per annum, with a farebox recovery ratio of 112%. This equates to a net operating profit of $1.80 per passenger, or 2c per passenger-kilometre.

CONCLUSION

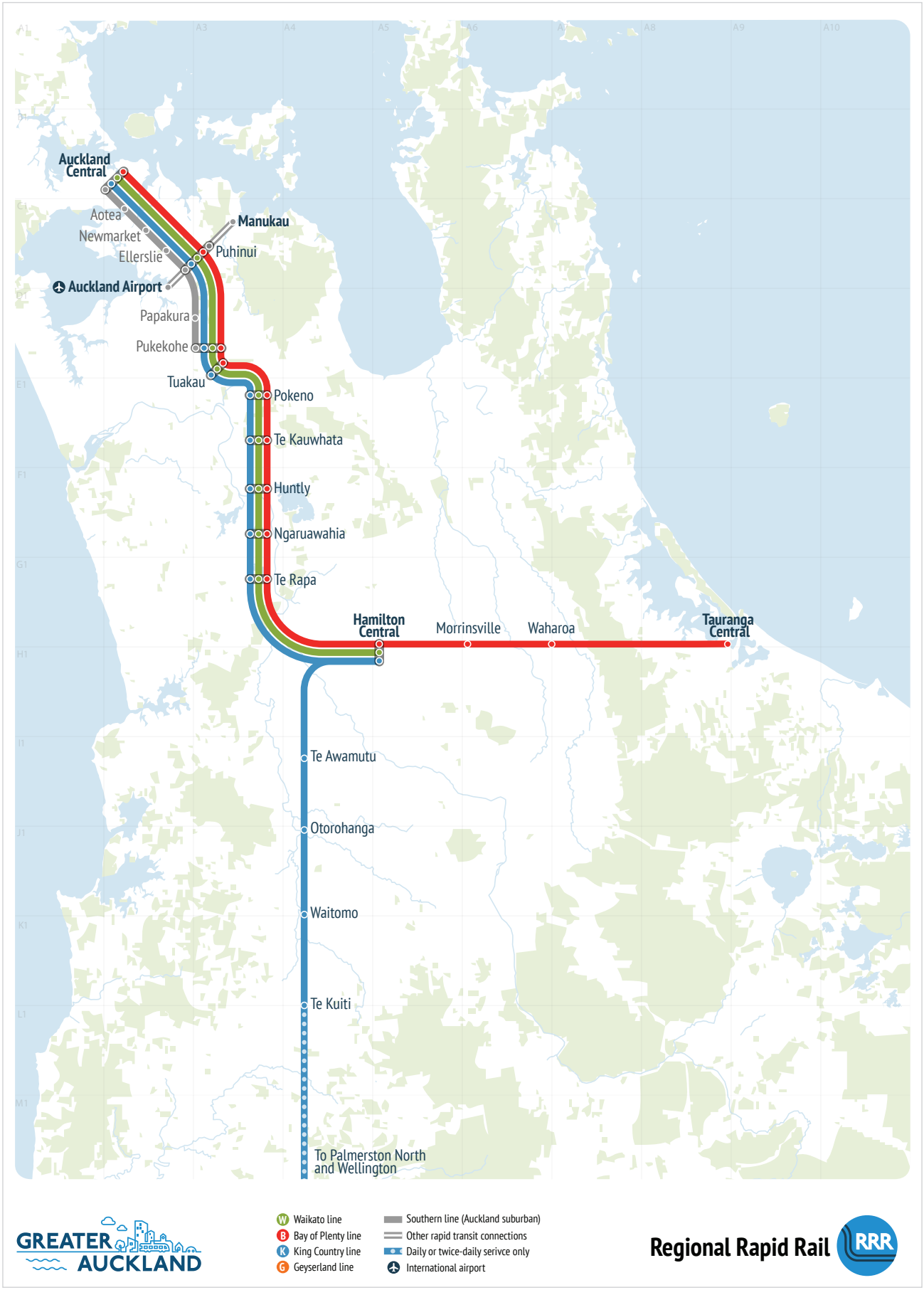
Stage 2 of Regional Rapid Rail represents the maximum utilisation of the existing upper North Island rail network for intercity passenger services. A significant investment is required in new tilting trains and network improvements to allow speeds of up to 160km/h. However, the outcome of this investment is a profitable and subsidy-free network of rapid, reliable, regular service seven days a week, linking regional towns and villages to the main centres, and linking the main centres to each other.

This stage offers a high level of transport capacity independent of the highway network, which combined with fast journeys and frequent schedules will allow many people to travel around the upper North Island without contributing to traffic congestion. Meeting some of the growth in transport demand with higher speed rapid rail will keep the state highways flowing freer for the freight and traffic that does remain. This supports the further integration of the regional economies and allows people to make new choices on where they live and work.

With trips between the city centres of Auckland and Hamilton in an hour and a half and between Tauranga and Auckland in less than two and half hours regardless of traffic or time of day, Stage 2 Regional Rapid Rail would be the mode of choice for many travellers. Intercity rail travel would often be faster and consistently more reliable than driving, and usually faster than a journey by regional aircraft once irregular schedules and airport access issues are considered.

Indeed, given the fast, regular and reliable service offered, Regional Rapid Rail stage 2 would greatly improve domestic access from the Waikato and Bay of Plenty to Auckland International Airport, by way of the shuttle connection at Puhinui Station in south Auckland. Regional Rapid Rail could be trains to the planes.

STAGE 2 MAP


Auckland Central
Aotea
Newmarket
Ellerslie
Auckland Airport
Manukau
Puhinui
Papakura
Pukekohe
Tuakau
Pokeno
Te Kauwhata
Huntly
Ngaruawahia
Te Rapa
Hamilton Central
Morrinsville
Waharoa
Tauranga Central
Te Awamutu
Otorohanga
Waitomo
Te Kuiti
To Palmerston North and Wellington
GREATER AUCKLAND
Waikato line
Bay of Plenty line
King Country line
Geyserland line
Southern line (Auckland suburban)
Other rapid transit connections
Daily or twice-daily serivce only
International airport
Regional Rapid Rail
RRR

STAGE 3
Future Expansion and Extension

CONCEPT

The strategic concept for Stage 3 is to improve journey times, improve service levels, and to extend the reach of the network to new towns and cities in the upper North Island.

This has three main components. Firstly, doubling the size of the intercity train fleet to double capacity and halve headways, and implementing a new signalling system to allow close running at high speed. Secondly, constructing an express bypass line at the core of the network in Bombay, doubling network capacity and saving twenty minutes off all trips to or from Auckland. And thirdly, reinstating rail to formerly abandoned rights of way to extend the network Cambridge and Rotorua, and reintroducing passenger rail to the freight network east of Tauranga.

By creating a true multi line network of integrated, frequent and fast train services, Stage 3 will combine the separate economies, housing markets, and job markets of the upper North Island into a single highly-productive powerhouse for the New Zealand economy.

NETWORK AND OPERATING PLAN

A network of four passenger lines is proposed for Stage 3, providing fast and regular bi-directional services all-day, seven days a week. Building from Stage 2, this stage provides a very high level of service and fast journeys to provide for a wide variety of intercity trips for work, education, shopping and entertainment.

Four regular all-day intercity rail lines form the Stage 3 network, two are extensions of the main lines from Stage 2, one line remains the same, and the fourth is new line serving three new towns and one city in the south-eastern Waikato.

- **The Bay of Plenty Line**, running a regular timetable both ways all-day between Tauranga and Hamilton and Auckland. In Stage 3 this line is extended past Tauranga Central via a new east Tauranga station at Papamoa Beach, to a new terminus at Te Puke.
- **The Waikato line** is extended through Hamilton to Cambridge, via Matangi, operating a regular all-day service from Cambridge to Auckland.
- **The King Country Line,** running a regular timetable both ways all-day between Te Kuiti and Auckland via Hamilton. This service remains unchanged from Stage 2, except travel times to Auckland are reduced.
- **The Geyserland Line**, a new line running from Rotorua to Auckland via Putaruru, Tirau and Matamata, then following the route of the Bay of Plenty Line from Waharoa to Hamilton and Auckland.

As well as providing rapid connections between the main centres of Auckland, Hamilton and Tauranga; the stage 3 network extends to Rotorua and the south Waikato, providing excellent connectivity across the four largest cities and twenty smaller towns across Auckland, the Waikato and Bay of Plenty.

This integrated network provides for fast links between the main centres, from satellite towns to the main centres, and it also provides the opportunity to connect between lines to travel rapidly between smaller towns across the regions.

Furthermore, as the four lines overlap between Hamilton and Auckland, the network provides a very high level of capacity and service frequency on that section, bringing the northern Waikato comfortably within the commuter belt of both Auckland and Hamilton.

In the south of Auckland, an express bypass of Pukekohe is proposed via a Bombay deviation and tunnel, allowing trains to operate at high speed directly between Pokeno and Puhinui in fifteen minutes and avoiding the busy Southern Line south of Drury. This would be paired with an extension of the Southern Line suburban trains through Pukekohe and Tuakau to connect to the RRR network at Pokeno.

Timetable

EEach station on the expanded RRR network would have a minimum service of one train per hour each way, all day, seven days a week, and two trains an hour at peak. For ease of use, departures under the all-day network would be 'clock face', leaving on a regular schedule at the same time each hour.

Between Hamilton and Auckland, and at all stops in between, the combination of lines would result in four trains per hour all day, with the lines timetabled to provide an even 15-minute headway. Furthermore, at peak times the combined frequency of all lines would be eight trains an hour in the peak direction, with trains every seven to eight minutes between Hamilton and Auckland during the weekday peaks.

The network would operate seven days a week, for fifteen hours per day, from first departures at approximately 6:00 am to the last arrivals around 9:00 pm. Additional late-night and special event services could also be operated. However, these have not been included in the Stage 3 costing.

Travel times

WAIKATO LINE:

- Hamilton Central Station to Downtown Auckland (Britomart): 1 hour 13 minutes.
- Cambridge to Auckland: 1 hour 31 minutes.
- Cambridge to Hamilton: 18 minutes.
- One departure per hour, each way all-day, two per hour at peak times.

BAY OF PLENTY LINE:

- Tauranga Central Station to Downtown Auckland (Britomart): 2 hours 5 minutes.
- Tauranga to Hamilton: 52 minutes.
- Te Puke to Auckland: 2 hours 22 minutes.
- Te Puke to Tauranga: 17 minutes.
- One departure per hour, each way all-day, two per hour at peak times.

KING COUNTRY LINE:
- Te Kuiti to Downtown Auckland (Britomart): 1 hour 55 minutes.
- Te Kuiti to Hamilton: 43 minutes.
- Te Awamutu to Hamilton: 12 minutes.
- One departure per hour, each way all-day, two per hour at peak times.

GEYSERLAND LINE:
- Rotorua to Downtown Auckland (Britomart): 2 hours 30 minutes.
- Rotorua to Hamilton: 1 hour 17 minutes.
- One departure per hour, each way all-day, two per hour at peak times.

Train fleet

For Stage 3 the Regional Rapid Rail train fleet would be expanded with a second tranche of 15 additional trains, bringing the total fleet size to 32 units. For efficiency and full interoperability, this second order of trains would be of an identical specification to that of Stage 2. If strong patronage growth is expected, additional trains could be procured to allow the use of coupled double-length trains at peak times.

Infrastructure

Network-wide signalling upgrade: To allow for safe operation at higher speeds with close headway, implementation of an improved signalling system is a core component of Stage 3. A signalling upgrade of the entire RRR network area to European Train Control System Level 1 (ETCS1) is proposed, consistent with the system already in use on the suburban Auckland network.

This system automatically slows trains exceeding speed limits on curves and other limited speed sections and will automatically halt a train passing a stop signal, preventing the potential for most derailment or collision incidents. This will dramatically increase safety for the service by reduced risk of overspeed and signals passed at danger (SPADs). The increased safety, while being a benefit in its own right, also allows services to operate at higher speeds through existing signal blocks.

While this signalling upgrade is a significant capital investment, the safety, speed and network efficiency benefits are likewise very significant, and accrue to passenger trains and freight alike as the Auckland Rail Development Programme between KiwiRail and Auckland Transport already proposes that Auckland freight trains should move to be ETCS1 compliant.

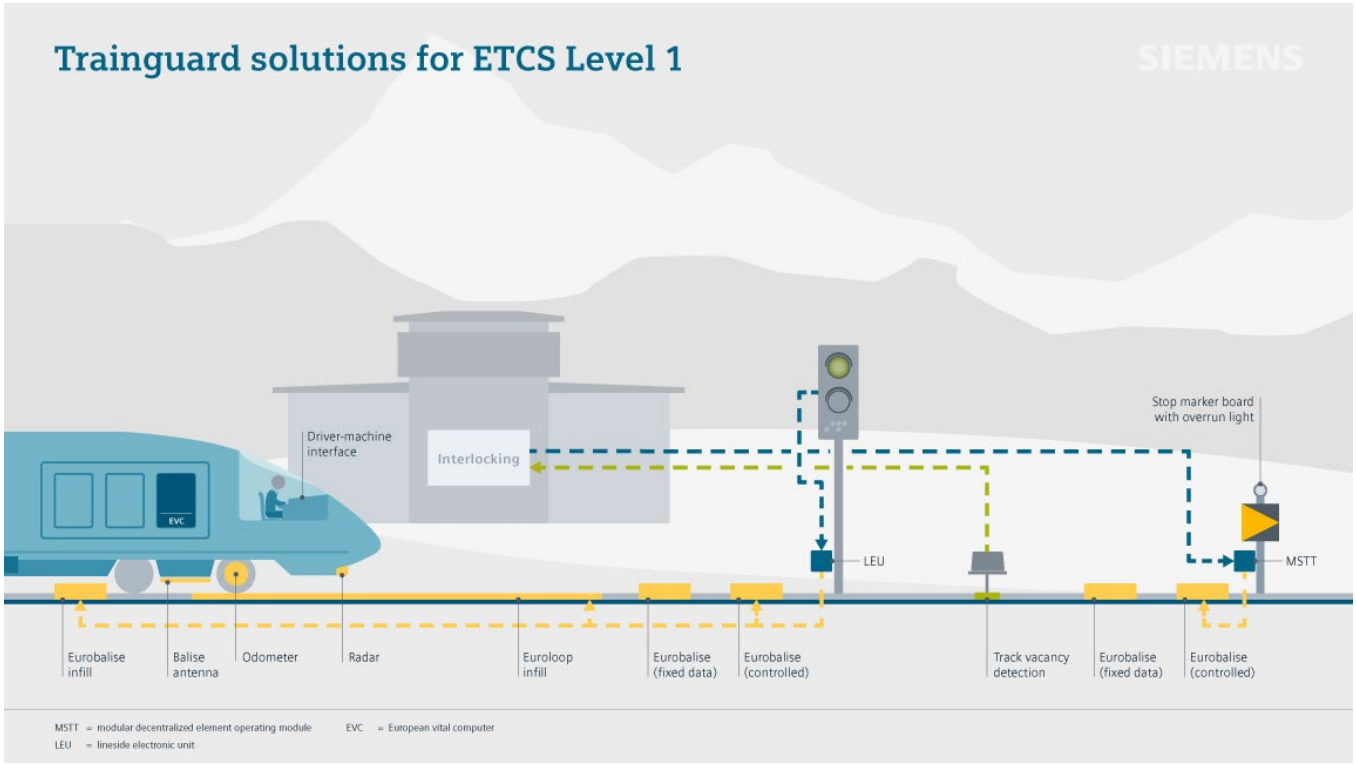


Figure 11 - SIEMENS Trainguard 100

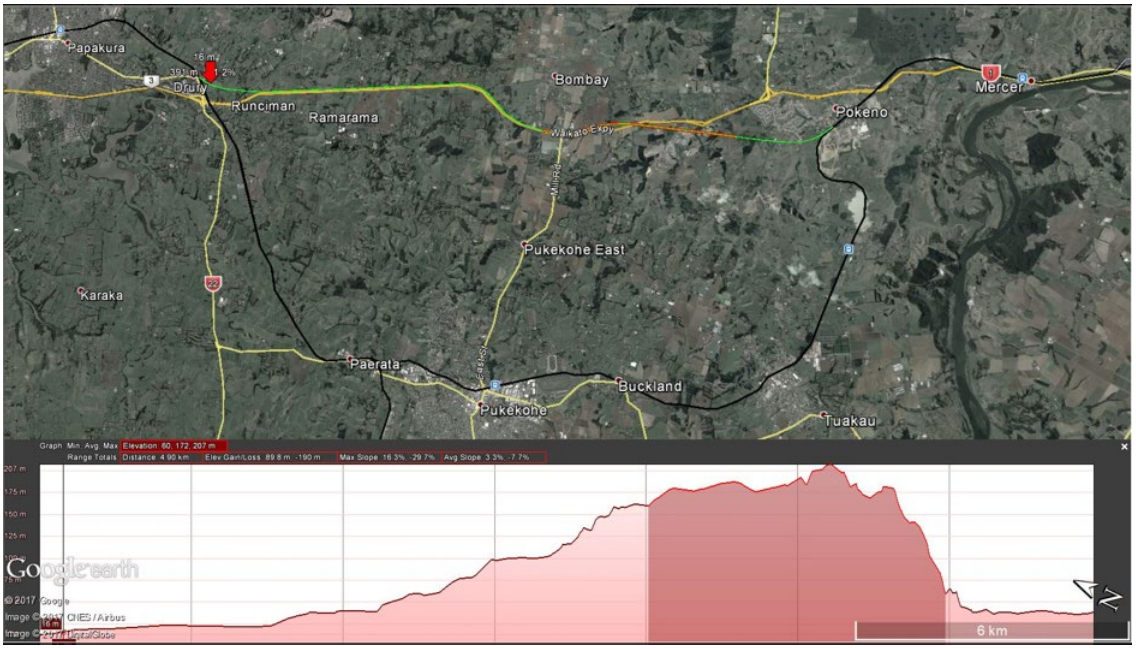


Figure 14 - Bombay Deviation (Red = Tunnel, Green = Surface, Black = Existing)

Bombay deviation bypass line: The existing NIMT line between Drury and Pokeno avoids the Bombay Hills with a circuitous route running 7km to the west via Pukekohe. Current Auckland Council plans are for significant suburban development along this line between Drury and Pukekohe, intended to be supported by an extension of Southern Line suburban train services to Pukekohe, and beyond. By the time RRR Stage 3 could be implemented the tracks through Pukekohe will be very busy, and current plans are in progress for a third and possibly fourth track along this section.

Instead of track amplification on the existing line through Pukekohe, Stage 3 includes a new bypass line on a direct alignment following the motorway corridor between Drury and Pokeno, a total of 17km of new track of which 5.5km would be in a tunnel between Mill Road and the north of Pokeno. This alignment is shown below, with the existing line in black and the new deviation in green (surface route) and red (tunnel). We recommend that steps are taken as soon as possible to protect the potential corridor alongside the motorway and through Pokeno.

The benefits of this bypass are fourfold. Firstly, the direct 17km route avoids the 31km long route via Pukekohe, a saving of 14km. Secondly, the new deviation would be largely straight with a few high-radius curves, allowing 160km/h speeds to be maintained along its full length. Thirdly, the route would allow a direct run from Pokeno to Drury, without suburban trains on the line or passing through the suburban stations at Tuakau, Pukekohe, Paerata or Drury West. Fourthly, the new twin tracked tunnel route would result in a total of four tracks between Drury and Pokeno.

Under this scenario, regional intercity trains and fast electric freight trains would use the Bombay bypass, while suburban trains and slower freights would use the existing line via Pukekohe.

In combination with the planned third and fourth mains in suburban south Auckland, and the proposed Whangamarino swamp deviation of Stage 2, the Bombay deviation would effectively provide three or four tracks on the NIMT for over half of the route between Auckland and Hamilton.

Overall, this deviation would reduce RRR travel times between the Waikato and Auckland by an estimated 20 minutes (and a similar benefit for freight), bringing the travel time between Hamilton and Auckland down to just 1 hour and 13 minutes.

It is integral, however, that steps be taken to protect this corridor.

Regional rail network extensions: Expansion of the Waikato Line services to Cambridge requires refurbishment of existing single track to the current terminus at Hautapu, and the construction of new twin track line from Hautapu along the former right of way to central Cambridge, with a new terminal station proposed in the vicinity of Whitaker Street. This will include a number of new level crossings. However, a general single-track alignment with standard speed limits is proposed between Cambridge and the ECMT.

A more extensive reconstruction is required to reintroduce services to Rotorua. Stage 3 includes a budget allocation to refurbish the existing active freight line between Waharoa

and Putaruru to higher speed standard, including stations serving Matamata and Tirau, and a more substantial allocation to reconstruct the mothballed 20km branch line between Putaruru and the Rotorua suburbs. Also included is the construction of a 1.7km line extension from the former Lake Road terminus to a new central Rotorua station, proposed for the corner of Ranolf Street and Pukuatua Street, two blocks west of the city centre core. This would require some land acquisition and the reconfiguration of the edge of the Kuirau Park playing fields and access road but would locate the station within walking distance of most of the Rotorua CBD, including many hotels and tourist attractions.

On the Bay of Plenty Line, an extension of services along the existing ECMT freight line from Tauranga to Te Puke is proposed, with a new station at Papamoa Beach included serving the suburban expansion of eastern Tauranga directly. As this track already exists no new line is required. However, the budget is allocated to improve the line to a higher speed standard.

Other Network improvements: It is assumed that by the time of implementing the major components of Stage 3 RRR, most or all a third and fourth main will have been constructed in south Auckland between Westfield junction and the start of the Bombay deviation at Drury. This would be required to express RRR trains past frequent suburban services. however it is assumed that this project is required for freight and suburban train operations regardless, and no additional budget has been allocated.

Stage 3 also includes additional upgrades of level crossings to a high-speed standard.

Stations

New Auckland Terminal provision: Under Stage 3 there would be eight trains arriving and departing at Britomart per hour at peak times, occupying sixteen slots through the eastern throat tunnel accessing the station. As this tunnel is also one of the two accesses to the City Rail Link, this level of regional train activity would most likely generate unacceptable train congestion for the suburban network in the future. To remedy this, Stage 3 includes an allocation of funding to improve terminal capacity in Auckland. There are two options for this.

The simplest and most cost effective option would be to construct a new regional terminal station at Quay Park, in the vicinity of the current Strand terminal, and to no longer operating RRR trains to Britomart. This new terminal station would also include platforms for the Eastern Line suburban service, to provide cross-platform connections to Britomart and the other City Rail Link stations. While affordable and effective, this option does have the main downside of moving the Auckland terminal outside of the core of the city centre and requiring onward connections for almost all trips to Auckland. This downside may be offset somewhat if the Quay Park area develops intensively in the future.

The alternative option would be to construct additional tracks between Quay Park junction and Britomart, to increase network capacity in the eastern throat and separate suburban and intercity trains. This could take the form of a 900m long tunnel under Quay Street, with a delicate connection back to the head of the platform access crossovers underneath Britomart Place. This would allow RRR trains to operate at a high frequency directly into downtown Auckland. However, this new tunnel link would come at considerable cost and construction risk and may necessitate track and platform layout changes within Britomart station itself.

Hamilton Station area enhancements: With three RRR lines running through Hamilton Central, in addition to all freight using the ECMT, the current single-track section of line in the tunnel under central Hamilton will be inadequate. Stage 3 includes duplication of the city centre tunnel, the river crossing and the line as far as the Cambridge branch junction. This is expected to require a new tunnel of a 630m length under Bryce Street, and one new platform at the Hamilton Central station. Future proofing for this would be included in the design of the new station in Stage 2.

Regional Stations: In addition to new terminal stations in central Cambridge and Rotorua, new standard quality stations are included for Matangi, Matamata, Tirau, Putaruru, Papamoa Beach, and Te Puke.

Depot and operations

Stage 3 would continue to use the depot and base of operations established in Hamilton in Stage 2, with an extension of the stabling yard to suit the larger fleet. To potentially improve operating efficiency further, additional stabling yards and minor depot facilities could be established in Tauranga and co-located at suburban train facilities in Auckland.

COSTS, REVENUE, RIDERSHIP AND SUBSIDY

The capital development budget for Stage 2 is estimated at $1.45 billion, with approximately one-third of this being spent on the Bombay deviation and tunnel, one-third on a network wide signalling upgrade, and the remainder of an expanded fleet and extending the network to Cambridge, Rotorua and Te Puke.

Net operating profit (fare revenue less operating cost) is estimated at $13.4m per annum. This indicates that, after further capital investment for further fleet and network upgrades, the daily operations of the Stage 3 network would remain profitable and subsidy-free.

Capex costs

A capital investment of $165m is estimated to double the size of the higher speed tilt train fleet.

This is paired with an estimated $480m for a network-wide signalling system upgrade, and $560m to construct a Bombay tunnel and realignment of the NIMT for a direct route bypassing Pukekohe, to substantially improve journey times by rail and create a true high-speed trunk line.

In combination with this; network extensions, stations and crossing upgrades are planned for Cambridge ($30m), Rotorua ($80m) and Te Puke ($10m).

Stage 2 also includes $68m for network capacity upgrades around the main stations at Auckland, Hamilton and Tauranga.

Operating costs

The total cost to operate the Stage 3 network is estimated at approximately $100m per year.

The Stage 3 schedule requires the operation of approximately 8.3 million service-kilometres and 88 thousand service-hours per annum, being approximately double the service delivery of Stage 2.

This level of service requires 49 full-time crews to operate, allowing for annual leave, sick leave and other entitlements. Each crew would comprise one train driver in the cab, and one customer services manager in the passenger cabin.

Network access charges have been estimated at $4.50 per service-kilometre, and vehicle operating costs at $6.00 per service-kilometre.

The following approx. annual operating costs have been included in the total figure:

- Train crew: $8m
- Management and marketing: $1.5m
- Fuel and vehicle and operating expenses: $50m
- Network access charges: $37m
- Depot operations: $1.50m

Ridership

Stage 3 is estimated to generate approximately 6.9m boardings per annum circa 2035. This is equivalent to approximately half the current Victorian V-Line system, a network of five regional lines centred on Melbourne.[20]

This represents approximately 9,500 return passengers per weekday, with an average trip length of 108km, and an average train occupancy of 30% across the day. This relatively low level of occupancy reflects the consistent bi-directional service delivery across the day and week and the fact that the train fleet would have high passenger capacities that do not necessarily need to be full to operate profitably.

These figures translate into 746m passenger-kilometres per annum.

Revenue and Subsidy

The predicted Stage 2 fare revenue amounts to around $110m per year, assuming an average revenue figure of $0.15 per passenger-kilometre. This is equivalent to a nominal fare of $20 for a one-way trip between Hamilton and Auckland, and $35 between Tauranga and Auckland.

Comparing predicted operating costs to estimate revenue shows a net operating profit for Stage 2 of $13.4m per annum, with a farebox recovery ratio of 114%. This equates to a net operating profit of $1.94 per passenger, or 2c per passenger-kilometre.

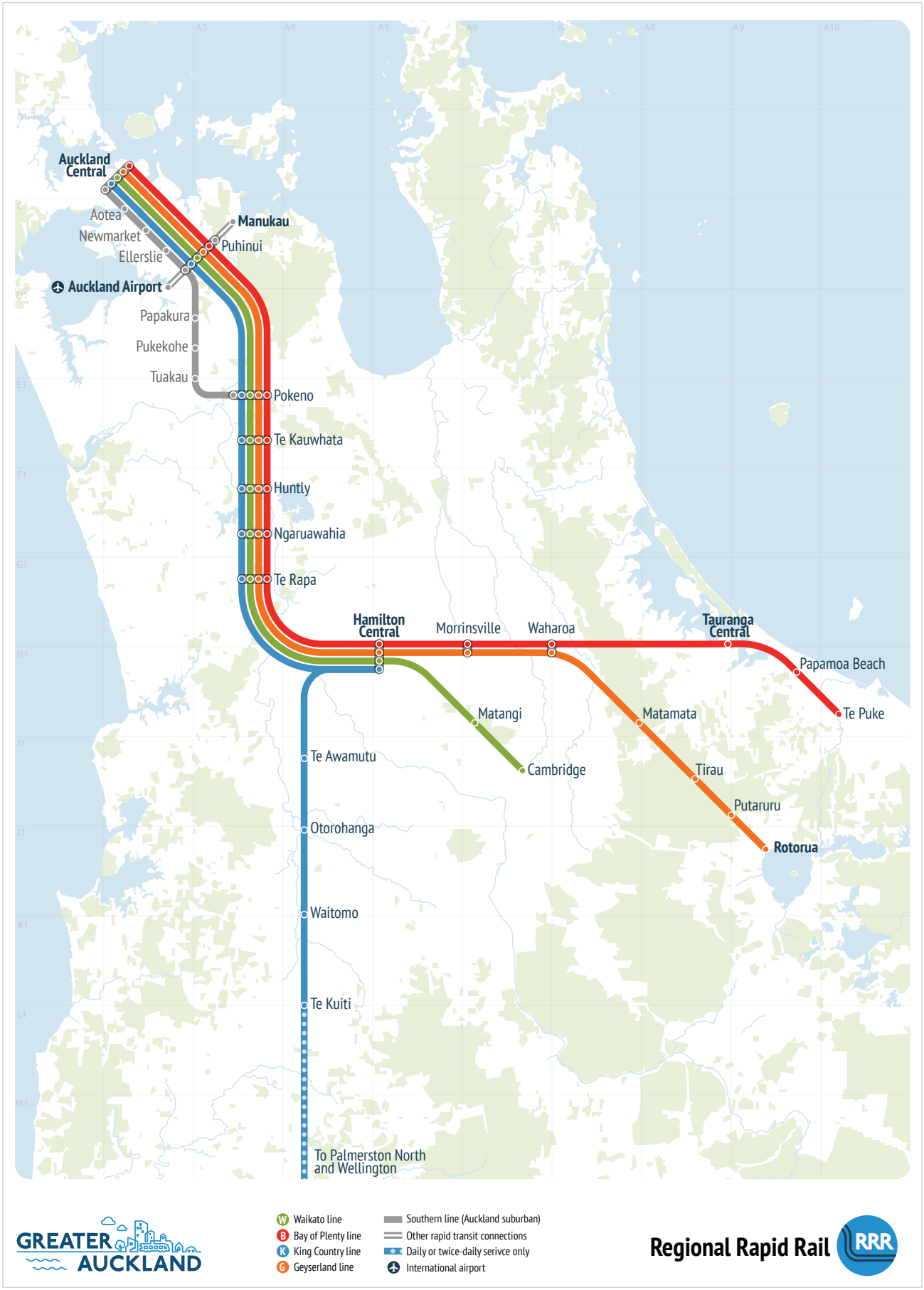
CONCLUSION

Stage 3 of Regional Rapid Rail takes the higher speed network of Stage 2 and extends it to more towns and cities across the Waikato and Bay of Plenty, while also cutting the travel time to Auckland by a further 20 minutes. Stage three would reduce travel times between Hamilton and Auckland to just 1 hour 13 minutes and would like Tauranga and Auckland in 2 hours 5 minutes.

While this stage does include a significant package of capital investments totalling $1.45 billion, the resulting network is one of very high capacity, excellent connectivity and very rapid trains, running frequent intensive service on a network of four lines serving twenty-three towns and cities across the upper North Island. Overall, this network would directly integrate over half the population and economic production of New Zealand into a single regional economy.

20. 16.2m rail passengers in 2015/2016.
https://corporate.vline.com.au/getattachment/6ad41cbe-17f6-489c-9fac-d65a1a627131/Annual-Report-2015-16

STAGE 3 MAP


Auckland Central
Aotea
Newmarket
Ellerslie
Manukau
Puhinui
Auckland Airport
Papakura
Pukekohe
Tuakau
Pokeno
Te Kauwhata
Huntly
Ngaruawahia
Te Rapa
Hamilton Central
Morrinsville
Waharoa
Tauranga Central
Papamoa Beach
Te Puke
Matangi
Cambridge
Matamata
Tirau
Putaruru
Rotorua
Te Awamutu
Otorohanga
Waitomo
Te Kuiti
To Palmerston North and Wellington
GREATER AUCKLAND
Waikato line
Bay of Plenty line
King Country line
Geyserland line
Southern line (Auckland suburban)
Other rapid transit connections
Daily or twice-daily serivce only
International airport
Regional Rapid Rail
RRR

INTEGRATION WITH FREIGHT AND URBAN PUBLIC TRANSPORT NETWORKS

BENEFITS OF REGIONAL RAPID RAIL TO KIWIRAIL

Many of the Regional Rail upgrades would directly benefit KiwiRail's freight business through allowing decreased travel times for freight services, more efficient operations or allowing more services a day to be feasibly run. Some of the upgrades proposed in this report are already anticipated to be done in the short (0 – 5 Years), medium (5-10 years) or long (10+ years) term as part of the KiwiRail *Upper North Island Freight Story* (2013)[21]. These timeframes are broadly equivalent to our Stage 1,2 and 3 respectively.

The upgrades from the Upper North Island Freight Story were:

- Third Track Westfield to Wiri (Short term)
- Enhancement works to 12km section NIMT (Short term)
- Construction of sections of double tracking NIMT (Medium term)
- East Coast Main Trunk crossing loops and double tracking to Kaimai tunnel portal (Medium term)
- Reverse sensitivities and Tauranga CBD level crossings (Medium term)
- Third Track Port of Auckland to Papakura (Long term)

Furthermore, many upgrades were scheduled for funding as part of the Auckland Transport Alignment Project (ATA), through the inclusion of Auckland Rail Development Programme in Decade 1 (2018-2028), Decade 2 (2028-2038), or Decade 3 (2038-2048)[22]

- Third track Westfield – Wiri and Westfield junction improvements (Decade 1)[23]
- Southern Line Level crossing removals (Decade 1)
- Papakura to Pukekohe electrification (Decade 1)[24]
- Fourth track Westfield-Wiri (Decade 2)
- Third and fourth track Wiri – Papakura (Decade 3)
- Third track Papakura – Pukekohe (Decade 3)
- Upgrade of freight services to be ETCS1 compliant (Decade 1)

While some of these would need to be accelerated for Regional Rapid Rail, they do not entirely fall on Regional Rapid Rail to fund due to also providing significant benefits to rail freight or already being budgeted in the future. In this case RRR investment would increase the potential benefits in any business case for the above upgrades.

21. Upper North Island Freight Story, Pages 16-21, https://www.nzta.govt.nz/assets/Planning-and-investment/docs/upper-ni-freight-story-shared-evidence-base.pdf
22. ATAP Indicative Project Costings, https://www.greaterauckland.org.nz/2016/12/20/atap-indicative-projects-costings/
23. Recently announced by the central government for imminent funding and construction.
24. Recently announced by the central government for imminent funding and construction.

INTEGRATING WITH PUBLIC TRANSPORT AND CYCLING NETWORKS

It is integral that Regional Rapid Rail links well with local public transport and cycling networks to fully maximise coverage and achieve maximum accessibility.

Stations should be equipped with secure bike parking and future proofed for bike share schemes, while the new rolling stock should include dedicated bike racks. The authority administering Regional Rapid Rail should work with local councils to make sure cycling links are provided to and around station. Taking advantage of the electric bicycle revolution currently taking place in the world would be a wise move for any Regional Rapid Rail proposal.

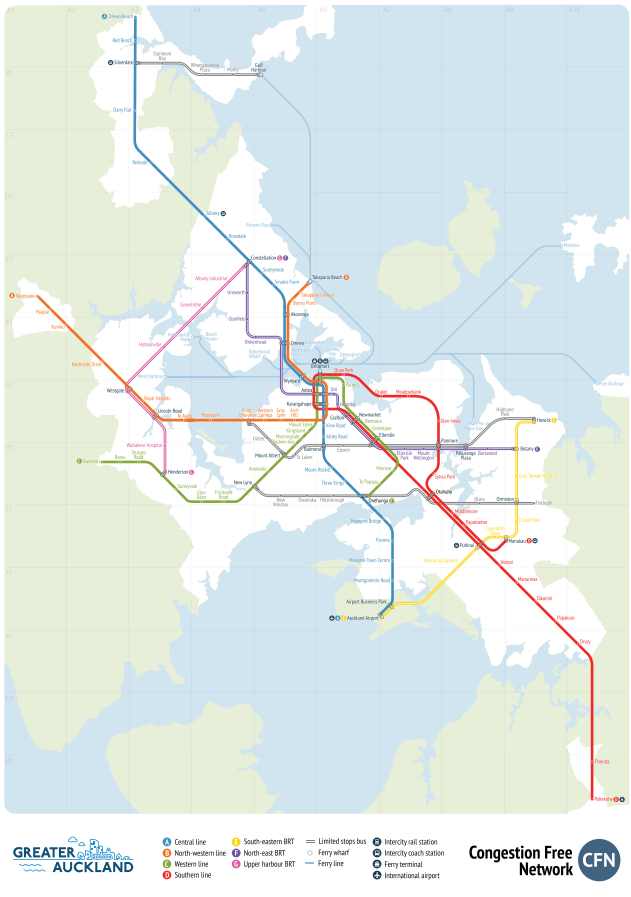


Figure 15 - Congestion Free Network 2

At Auckland, RRR stops should link well with the suburban train network, with the stop proposed at Puhinui to allowing easy connection to the airport and nearby employment area, and for transfer to Southern Line services to Newmarket, and Eastern Line services to Manukau.

Once the City Rail Link is open the RRR terminal at Britomart will allow connection to the whole heavy rail and busway network, and the proposed light rail network. Before the City Rail Link, terminating at Otahuhu allows easy connection to the suburban train lines and the South Auckland bus network. Ideally Regional Rapid Rail should operate under the AT Hop integrated ticketing system, allowing convenient ticket payment options and seamless transfers within Auckland.

The train station in Hamilton shall be located as close as possible to the Hamilton Transport Centre in central Hamilton, to best align with Hamilton's radial bus network. This will connect the rail lines to nearly all the major bus routes. The one exception to this is the Orbiter loop bus service, which best connects to Regional Rapid Rail at the proposed Te Rapa Station near The Base shopping centre.

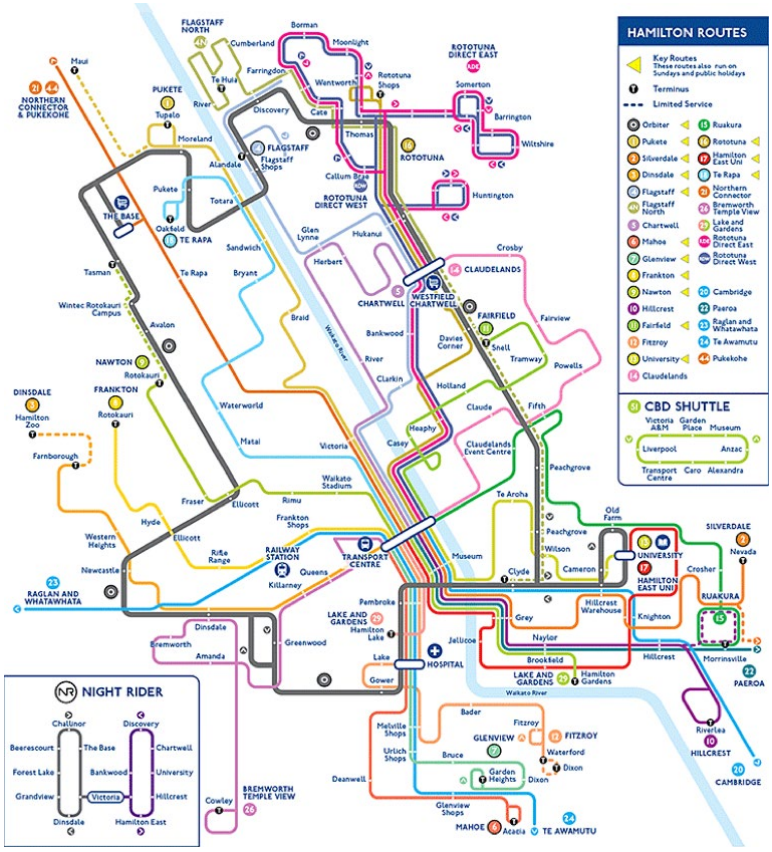


Figure 16 - Hamilton Bus Network

At Tauranga, the central station would be located on The Strand, one block away from current major bus terminus at Willow Street, where all Tauranga urban bus routes currently terminate. This will allow easy access to Regional Rapid Rail from the local public transport network, increasing coverage to the greater Tauranga area, and to the eastern Bay of Plenty via connections to coaches. A timed ferry link from Fisherman's Wharf (next to the proposed RRR station) to the pier at Mount Maunganui could be an effective connection, particularly for tourist travellers.

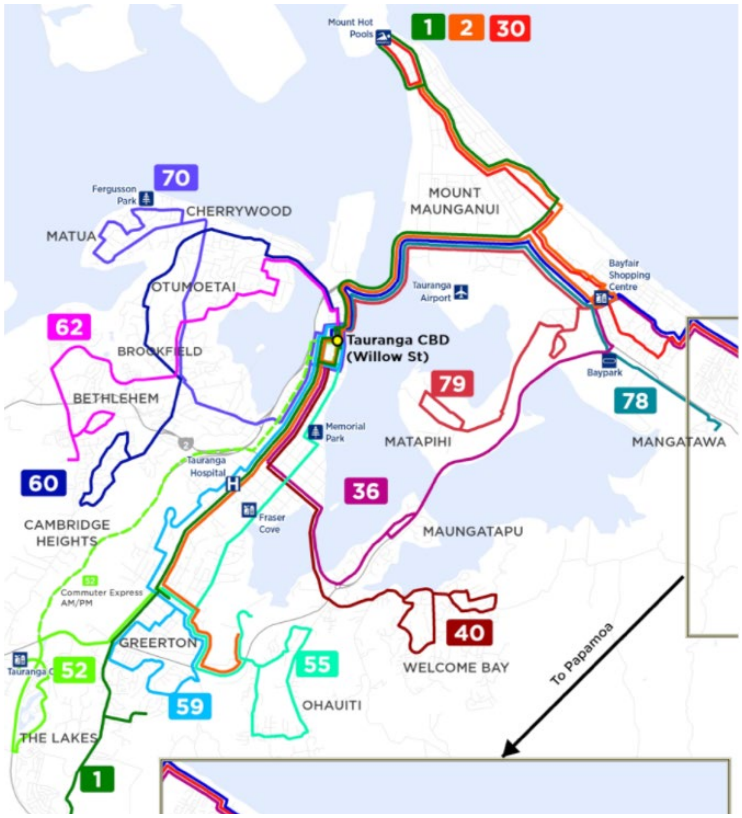


Figure 17 - Tauranga Bus Network

REGIONAL RAPID RAIL ELSEWHERE IN NEW ZEALAND?

Consideration was given to applying the Regional Rapid Rail concept to lines from Auckland to Whangarei, and to networks focussed on Wellington and Christchurch.

Auckland to Whangarei-Northland

A passenger service between Whangarei and Auckland, was dismissed due to several factors, including that the current line to northland takes a route through West Auckland that follows a very winding and indirect alignment. Furthermore, the route is very long, with the distance being almost 200km by rail with only one town of significant size in between. Even with significant upgrades it is likely that the route north would not be time competitive with driving.

The quality of the track is currently very poor, requiring a large investment to bring it up to standard. KiwiRail reports it would cost $240 million just to bring the railway from Waitakere to Whangarei up to the standard as the line between Hamilton and Port of Tauranga. In addition, due to low freight volumes combined with constraints at the New Lynn trench as well as other corridor issues, there are no plans for a third track on the line north of Auckland. This would result in passenger services being stuck behind all stops Western Line services.

Greater Auckland would support the introduction tourist trains to Whangarei, or upgrades of the North Auckland line for freight, if either could be justified in economic terms bearing in mind the slow and circuitous nature of the line. However, unlike the regions to the south of Auckland, the low population and low growth for the areas to the north of Auckland do not present a convincing case for Regional Rapid Rail investment.

Wellington and the Lower North Island

While the Wellington to Palmerston North axis has somewhat less population and growth than the Golden Triangle of the Upper North Island, a Regional Rapid Rail model could be effective on a smaller scale. Higher speed trains and track improvements could greatly improve capacity, speed, amenity, and environmental outcomes for regional trains between Wellington and towns and cities of the Lower North Island.

The same dual mode diesel - electric tilting train stock could be procured for an expanded network based around improved speeds and frequencies on the Capital Connection between Palmerston North and Wellington, while extensions of the service to Whanganui and Dannevirke could be feasible. There is the potential for such vehicles to have a 1600v DC traction system instead of 25kvAC to work with the current Wellington electrification.

In addition, longer distance lines using faster tilt trains could be operated between Wellington and Napier (similar to the recent “Ruahine Runner” proposal[25]) or Wellington and New Plymouth. One or both of these services could effectively be extensions of the Capital Connection from Palmerston North, expanding both the coverage and frequency of the current Capital Connection at the same time.

Christchurch and Canterbury

A higher speed train link from Christchurch to Dunedin, via Oamaru and Timaru, could be implemented on an upgraded South Island Main Trunk. The rolling stock would need only be diesel powered unless future proofed for electrification. The service could also simply be Timaru or Ashburton to Christchurch, if found to be more feasible.

Nonetheless, the Canterbury region has generally sparse patterns of rural development and low population outside of Christchurch itself. Other potential lines for include to Springfield in the west, and to Kaikoura in the north, however the lack of intermediate towns and cities indicate these would be unlikely to generate sufficient patronage to justify more than a few train services per day.

25. Greens propose 'Ruahine Runner' train service through Manawatu Gorge,

REGIONAL DEVELOPMENT AND LIVEABLE TOWNS – NOT JUST A RAPID TRAIN

Improved transport is a means to an end, not the end goal itself. The real goals to achieve better outcomes whether this be more housing supply, greater connection to jobs, or better environmental and placemaking outcomes. It is important that any Regional Rapid Rail project aligns well with integrated urban planning, rather than vice versa. The Regional Rapid Rail should seek to facilitate vibrant, liveable towns along its path rather than forcefully pushing its way through. They should be liveable places, because liveable places are economically productive and socially sustainable.

We need to create livable towns, not just a rapid train

For Regional Rapid Rail to be a real success, the towns along it cannot be ignored or badly planned. It is imperative that urban plans do not follow the traditional Anglosphere approach with regional rail projects, where urban planning is side-lined or ignored, creating poorly functioning communities without proper services.

Towns connected to Regional Rapid Rail should have well-planned town centres which the station integrates with directly. Where possible the station should serve the town, rather than the town the station. Zoning for mixed use will allow for combining transport, jobs and shopping, while the ability for higher density residential development (such as town houses and flats) around the station will increase the ridership on the service.

New greenfields suburbs around the station should have grid-based streets with direct and accessible routes for active modes, rather than circuitous car-based cul-de-sac streets that make walking and cycling to the station difficult. This should be backed up with main roads incorporating modern cycle design and green infrastructure allowing for a vibrant, walkable, and bikeable town.

For larger towns, feeder bus services linking the suburbs to the centre and the station will be very useful, while connecting buses can serve nearby villages without stations (such as Meremere, Taupiri and Bombay), allowing access to larger towns both for shopping and services, and onward rail trips.

TRANSIT ORIENTED DEVELOPMENT

Transit orientated development can have a double benefit for small towns, it can serve to maximise transit use, as well as creating a livable, vibrant and economically sustainable community.

However, to succeed it needs to work alongside best-practice urban planning. Generally, this means following three core principles:

1. **Allowing mixed density** – Resulting in a vibrant, diverse community with options for differing household sizes and make ups, including options affordable to young families, singles, retirees and poorer people.

2. **Allowing mixed use** – Creating walkable, connected communities that are economically robust at the local scale. Strict zoning areas for different uses was created to due to public health concerns over urban factories in the industrial revolution, an issue that largely no longer exists. While it is important to make sure heavy industrial is not located in residential areas, there is no reason why most residential, retail and commercial uses cannot be intermixed.

3. **Creating walkable and bikeable streets** – Using best practice street design will build a safe, connected community as well dramatically expanding the walking catchment of the rail service. Streets should connect communities, not sever them from each other. As the image below demonstrates, the street pattern can make a significant difference to your station catchment, as it greatly influences the area that a given amount of time walking from the station covers. In this image from different neighbourhoods in Seattle the two examples are at the same scale. The station is the red dot, the theoretical ten-minute walk radius is the red circle, while the actual ten-minute walk possible under each street network is shown in blue. The fine-grained grid network on the right has several times more homes within walking distance than the cul-de-sac form on the left.

IMAGES AND MAPPING COURTESY OF URBAN DESIGN 4 HEALTH

Figure 18 - Seattle Street Pattern/Station Catchment Comparison, https://www.greaterauckland.org.nz/2010/05/14/street-patterns-matter/

CASE STUDY
SPRINGFIELD QUEENSLAND

Springfield in Brisbane is often used as a case example for future greenfield transit orientated development.

However, far from being revolutionary, it falls into the same traps as many conventional Anglosphere greenfield developments.

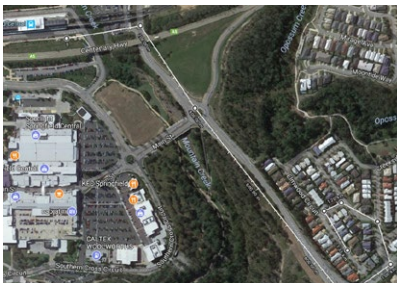
Some examples of these pitfalls are:

- Different land-uses and activities (retail, education, residential, healthcare) are highly separated, rather than an integrated walkable mixed use. Because of the distance between them people will drive from the residential area to the station, university or mall due to safety and travel time concerns with long walks.

- The road network acts as a wall to walkability, with expressway-like arterials severing the differing uses and making crossing the road difficult.

- The cycle network is far from best practice. Narrow unprotected lanes exist on these large high-speed arterial roads when best-practice recommends protected cycle lanes on any street with a speed limit above 30km/h. On the local residential streets, minimal cycle infrastructure exists despite 50km/h speed limits. As a result, the station does not have a functional cycle catchment in practice.

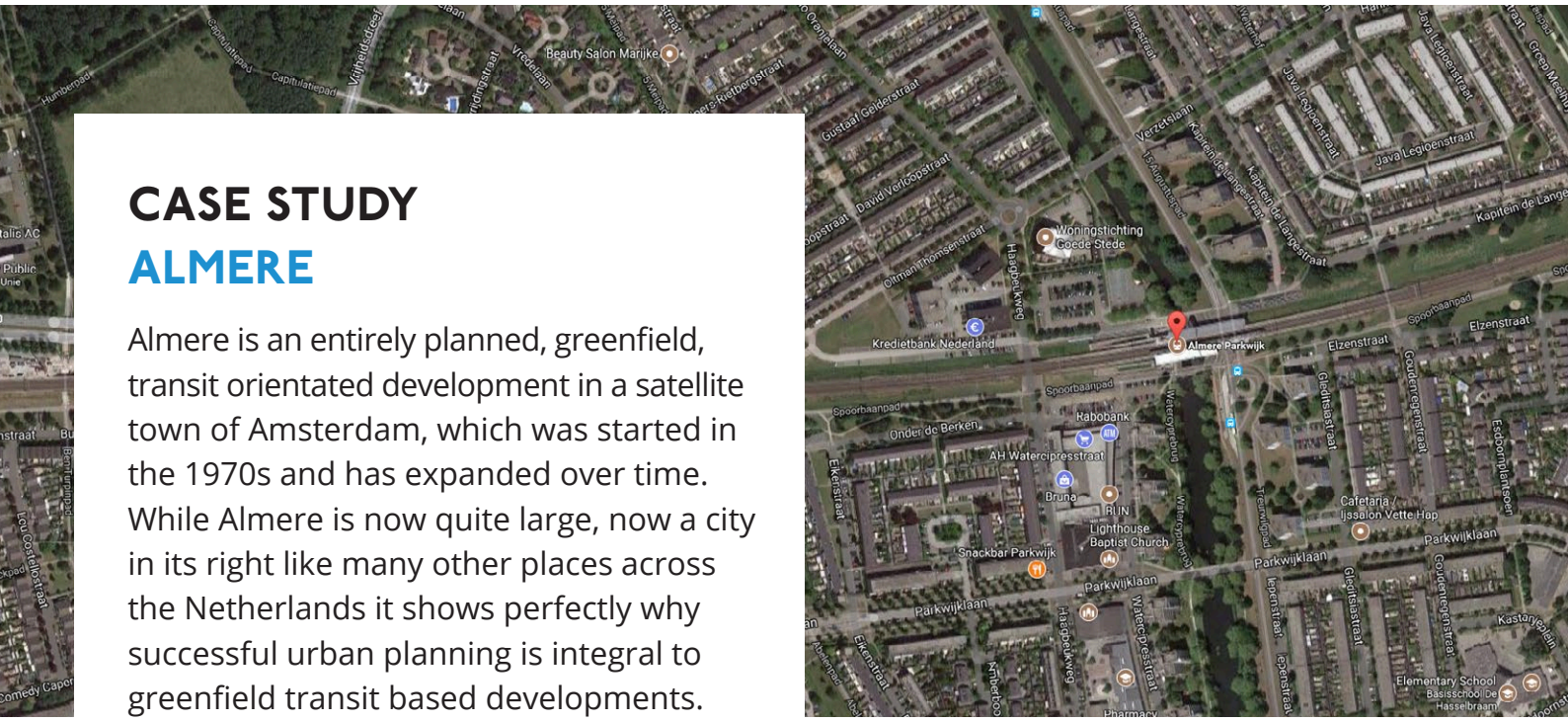
- The residential street pattern is not designed as a walking grid, resulting in significantly increased walking distances via roundabout paths instead of direct routes. As a result, the station does not have any significant walk-up catchment in practice, with the nearest houses being over a kilometre away on foot. Realistically, people will try to drive to the station.



- While the supposed focus of the master-plan is transit, the development uses the majority of its area for parking and circulation roads for traffic, creating auto-dependency in areas close to the station.

- The residential does not have a range of sizes and forms, but is focussed almost entirely around detached dwellings. This will create a less diverse community in terms of age and family size, provides fewer market options for affordability, and does not maximise potential walk up catchment to the station. Furthermore, the lack of mixed density in and near the town centre will create a mall atmosphere, rather than a lively all-day family-friendly town centre with the potential for thriving nightlife.

Springfield shows that success with transit oriented development is not as simple as providing a fast train service. While you may have a quick train to the city, you will still require a car trip to get to the train, and for anything else.



CASE STUDY
ALMERE

Almere is an entirely planned, greenfield, transit orientated development in a satellite town of Amsterdam, which was started in the 1970s and has expanded over time. While Almere is now quite large, now a city in its right like many other places across the Netherlands it shows perfectly why successful urban planning is integral to greenfield transit based developments.

The Google Maps picture above does not show the central station in Almere, but rather the next station along Almere-Parkwijk. You can see many fundamental differences from the Springfield case study, such as:

- The street pattern is designed for walkability and bikeability, both to the station as well as across the community as a whole. The realistic catchment of the station is thus much higher than at Springfield.

- The mixed density layout creates a vibrant diverse community serving different household sizes and types. While in New Zealand the density would likely be lower with a larger share of detached houses than Almere, it shows how different housing types can be mixed without problems.

- The streets are designed to interconnect with excellent walking and cycling infrastructure, and arterial roads do not sever the community. The local residential streets are calmed with low-speed limits lined with trees, narrow traffic lanes, and permeable non-asphalt surfacing all create a low-speed environment. On major streets, cycling is protected from traffic.

- Feeder buses also serve the local area with a simple but well-located interchange next to the station.

- The design of Almere shows the power of good urban planning: the station has maximised catchment making the service more viable, but the community is also a livable one with a mix of affordable housing types not requiring a car to drive to work or shop. Residents can easily walk and cycle to a local town centre, local schools and community facilities, rather than requiring a car trip to do anything. It is a community designed so people of all ages and backgrounds can live, work and play locally, as well as easily catch a fast train to work in the big city.

FRAMEWORKS FOR IMPLEMENTATION

GOVERNANCE AND OWNERSHIP

In New Zealand, the governance of transport is currently the domain of several levels and agencies of government.

- Public Transport operations are the general responsibility of regional councils, funded jointly through local rates and government grants.
- However, the construction of public transport infrastructure such as stations and stops falls to local and city councils.
- Railway maintenance, construction and operations is the responsibility of KiwiRail. They are the track owner and sole rail operator outside of the Auckland and Wellington suburban networks, and some tourist and heritage routes. KiwiRail is primarily tasked and concerned with maintaining a profitable freight operation, however it does also operate some long-distance tourist services. Nonetheless KiwiRail does not have a regular funding mechanism for capital investment, relying on crown grants, and is nominally expected to fund network improvements from operating profit. In practice, KiwiRail does not have the means to fund or operate Regional Rapid Rail.
- The New Zealand Transport Agency is tasked with planning and delivering strategic national transport corridors, primarily state highways. The NZTA is currently forbidden to fund or plan rail infrastructure, as this falls to KiwiRail, however it does in effect subsidise urban passenger rail operations.
- Overall, the funding of major national projects falls to the Treasury and Ministry of Transport, via the NZTA, from the Land Transport Fund and crown grants.

It is clear that intercity rail is not well catered for with the current structure of transport governance, it is a particular case that slips through the cracks of the governance structure. Previous proposals have faltered due to the indistinct and overlapping jurisdictions of the various arms of government, and the lack of one primary agency controlling the project.

Therefore, we propose that Regional Rapid Rail be governed and owned by a single authority, administered at the central government level in partnership with the affected councils and agencies.

We suggest that Regional Rapid Rail be set up as a separate authority with funders and stakeholders acting as shareholders, using what the Government and Auckland Council has done with City Rail Link Limited as an example. However, alternate structures could be to establish RRR as a unit of the NZTA, or as a division of KiwiRail. In either case this would require a change of policy, and potentially a change of legislation.

Above all however, Regional Rapid Rail is strategic inter-regional transport of national significance, should be led from the central government level with a corresponding commitment in policy and a funding.

ORGANISATIONAL RESPONSIBILITIES

Whether the organisation is established as a new entity, or as an arm of an existing agency, it will need to have much the same responsibilities. These include:

- Designating and protecting future corridors, potentially in conjunction with KiwiRail and local councils.
- Working collaboratively with both central government and local government on the creation and implementation of high level plans.
- Network planning and strategic oversight of the Regional Rapid Rail services.
- The actual operation of Regional Rapid Rail services, or alternately the administration of contracts to operate the services under tender.

ROLE OF COUNCILS

The role of councils would be to support and enable Regional Rapid Rail, which they could do by:

- Working collaboratively with the RRR Authority on the creation and implementation of the high-level plans.
- Aligning local land use and zoning plans to maximise the benefit of RRR.
- Assisting with funding for additional station upgrades, and enhancements to town centres around station sites.
- Linking public transport and cycling networks to Regional Rapid Rail stations, this could be via infrastructure or service changes, and integrated ticketing.

FUNDING AND REVENUE

In addition to traditional government funding methods, Regional Rapid Rail could finance itself through potential mechanisms including:

- Directly developing land along the corridor, including redundant railway land at former depot and yard sites.
- Implementing land value capture mechanisms such as those mentioned in the recent Productivity Commission's Better Urban Planning Report.
- Targeted rates.
- Regional fuel tax, regional GST or similar geographically targeted taxes or levies.
- Public Private Partnerships.
- Re-investment of any operating profit back into capital development.

APPLYING URBAN PLANNING TO REGIONAL RAPID RAIL

We have seen how good urban planning is integral to the success of transit orientated development, but how do we apply it to Regional Rapid Rail?

The following are some concepts for implementing coordinated urban planning and inter-regional rail transport in New Zealand:

The Regional Rapid Rail Authority could be give a mandate of both urban development and transport. The development arm could function in a comparable way to Panuku Development Auckland. This would involve the RRR Authority:

- Working collaboratively with regional councils, local councils, and residents to help shape and unlock development in towns along the proposed routes.
- Creating high level project plans similar to Panuku's Transform Manukau[26] or Unlock Henderson[27], creating the platform for thriving towns by following best practice urban planning. A near-term test case would be transit-oriented planning of the next stage of greenfield development in Pokeno.
- Bringing together local and central government land holdings, in partnership with major private and institutional land holders, to allow full advantage of government land to be utilised for development. This may include the disposal of unneeded land and the purchase of new land.
- Working with and engaging local Iwi jointly as Mana Whenua, stakeholders and land owners.

Potential mechanisms to enable the RRR Authority to action these competencies could include:

- Giving the Authority Urban Development Authority power, allowing Regional Rapid Rail the ability to fast track coordinate development.
- Allowing RRR the ability to levy or receive targeted rates, or use land value capture to help pay for both the rail network improvements and the related urban development.
- Allow Regional Rapid Rail to raise credit to fast track development.

For Regional Rapid Rail to be a true success transport must be linked to good urban planning, without doing so will mean New Zealand will be unable to unlock the transformative effects Regional Rapid Rail could provide.

26. Transform Manukau, https://www.panuku.co.nz/manukau
27. Unlock Henderson, https://www.panuku.co.nz/henderson

CONCLUSION

The time for Regional Rapid Rail is now.

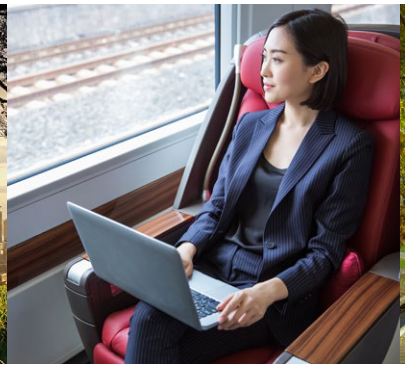
A step change in fast, sustainable inter-city land transport is required to integrate the economies of the cities and towns of the Upper North Island. Consistent travel times of less than 90 minutes between Hamilton and Auckland, and less than 60 minutes between Hamilton and Tauranga, will result in over half the population of New Zealand being linked together into a single economic entity. The regular and frequent service schedule running all-day, seven days a week would support a robust and sustainable economy, providing for a range of trip purposes and serving commuters, tourists, students and residents alike.

Regional Rapid Rail is not just a plan for fast trains, it is a regional development proposal that will help structure population growth and development at a national scale.

Investments in new rapid trains and track upgrades will leverage the existing rail network infrastructure, allowing it to provide a fast and high capacity passenger system to complement the state highway network. Without rapid passenger rail, the Waikato Expressway and connecting highways risk being overwhelmed by commuter traffic, as suburban development continues to spill over from the main centres to the towns of the Waikato and Bay of Plenty. At the same time, without Regional Rapid Rail to catalyse new development and reinvigorate local economies, the newly bypassed towns of the Waikato face economic decline as traffic-dependent dormitory suburbs.

Regional Rapid Rail is an affordable proposition for infrastructure of national significance, giving complementary benefits to both the movement of people and the efficiency and performance of freight.

The Stage 2 investment of $400 million dollars, comparable to one section of an expressway bypass, buys a comprehensive three-line rapid rail network linking Auckland, Hamilton and Tauranga to each other, and to their satellite towns and villages. The Stage 3 network of $1.5 billion would revolutionise transport in the Golden Triangle area, for the price of one rural motorway. With remarkably fast train services linking almost all towns and cities of the growth regions of Auckland, Waikato and Bay of Plenty to each other, Regional Rapid Rail will place more than half of the New Zealand population and economy on one efficient and effective transit system.


FREQUENTLY ASKED QUESTIONS

What is a tilt train?

A tilting train is a train that is designed to tilt into a curve to allow it to corner better at higher speeds. The main reason that conventional trains are required to slow down for curves is for the comfort of passengers. The limit at which a speeding train would derail on a tight corner is far beyond the level where people inside the cabin would experience uncomfortably strong lateral forces. Tilting trains are a cost-effective way to considerably improve cornering speeds on existing mainline tracks, for this reason tilt trains can be found across the world including in Queensland as well as Japan.

How fast could trains actually go in New Zealand?

160 kilometres per hour is the feasible maximum service speed for tilt trains running on New Zealand's narrow (1067mm) track gauge. Trains running on the same gauge achieve this speed in passenger service in Australia and Japan. This would require new purpose-built trains and track upgrades.

Don't tilt trains cause motion sickness?

Motion sickness was an issue on first generation tilt trains designed in the 1960s and 1970s, these used passive mechanical tilting systems that suffered from lag and jerkiness. This problem has been solved by modern computer controlled active tilt systems that predict curves using GPS and have smooth electric or hydraulic control.

What is a dual mode train?

A dual mode train is one that can work on multiple propulsion systems. In this case, the rolling stock would be able to run on 25kvAC electrification of the NIMT and Auckland network as well as have a diesel-electric engine when the train is not under the wires. This means that electrification of the whole network is not mandatory making the programme much more affordable and feasible.

I thought Dual Mode Trains were not allowed on KiwiRail network?

This restriction only applies to the freight locomotives which are much heavier and whose weight is spread over fewer axles. KiwiRail has confirmed to us that Dual mode multiple unit passenger trains are ok for the current network.

What if the Silver Ferns do not work, aren't they too old?

The Silver Ferns are old, but serviceable. If the Silver Ferns are not feasible in practice, then investigations could be done into upgrading ADL Class DMUs, or SA set carriages for intercity travel. The latter would also require the leasing of locomotives. Another option would be to procure a small tranche of new rolling stock as proposed for Stage 2, but using it to run the Stage 1 pattern.

FREQUENTLY ASKED QUESTIONS CONTINUED

Wouldn't it be better to procure the new rolling stock straight away compared to older trains?

Potentially, that would be a discussion for Central and Local Government. We would have no objection to this. However, there would be approximately five years lead time to fund, contract, build, deliver and commission a new train fleet. Stage 1 as proposed was intended as a demonstration network, to start operations in the interim while this procurement process is underway.

Won't this negatively affect KiwiRail's freight movement?

We have been conscious and respectful of KiwiRail's freight movements in this proposal. Objective number three of Regional Rapid Rail is that any upgrades should not cause any long-run problems to KiwiRail's ability to move freight and meet New Zealand's freight growth. Where possible, any rail upgrade should also seek to enhance KiwiRail's rail freight potential.

Is a Bombay tunnel really necessary?

Not necessarily, however, we have proposed these ideas so that Government can consider protecting the corridor now for so the option is not taken away in the future. The need for expanded transport corridors often comes just after the corridor has been built out by the very development that has caused the need for additional transportation capacity. Too many times we have seen a lack of corridor protection resulting in increased cost or making a project unviable.

Is this proposal all about Auckland?

We don't see this as just about Auckland but enabling regional development across the Golden Triangle of Auckland, Waikato and Bay of Plenty. The proposal provides as much capacity to leave Auckland and access regional areas as it does the other way around. While Auckland is still highly likely to be dominant, Hamilton is perhaps the greatest beneficiary of this network. The aspiration is not the Golden Triangle cities and towns simply become a periphery of Auckland but great liveable places as well all connected to each other.

Could Regional Rapid Rail be applied to other parts of the country?

Regional Rapid Rail could also be expanded to other parts of New Zealand. Networks focussed on Wellington and Christchurch are the obvious candidates.

For an expanded network based around the Capital Connection between Palmerston North and Wellington, the same dual mode diesel - electric tilting train stock could be procured. However, would simply have a 1600v DC traction system instead of 25kvAC to work with the current Wellington electrification. The rolling stock could improve capacity, speed, amenity, and environment for this existing route.

A higher speed train link from Christchurch to Dunedin, via Oamaru and Timaru, could be implemented on an upgraded South Island Main Trunk. The rolling stock would only need to be diesel powered unless future proofed for electrification. The service could also simply be Timaru or Ashburton to Christchurch if found to be more feasible.

APPENDIX – STAGE 1
Operating Plan and Cost Data

STAGE 1 OPERATING METRICS

Line	Waikato Line	Bay of Plenty Line	Network total
From	**Auckland-Otahuhu**	**Auckland-Otahuhu**	
To	**Hamilton-Frankton**	**Tauranga**	
Route Length one-way (kilometres)	130	225	
Running time one-way (minutes)	111	145	
Layover rate (% of running time)	15%	15%	
Return trip cycle time (minutes)	255	333	
Trips per hour at peak (one way - peak direction)	1 (two departures per peak)	No peak service	1 (two departures per peak)
Trips per hour base timetable (both ways all-day)	Approx. two-hourly	One return per day	Approx. two-hourly
Total return trips per weekday	4	1	5
Total return trips per weekend	2	1	3
Peak fleet requirement (trains)	2	-	2
Spares and rotation	-	-	1
Total fleet size			3
Service-km per weekday	1,040	449	1,489
Service-km per weekend day	520	449	969
Service-km per year	319,655	163,954	483,609
Service-hours per weekday	17	6	23
Service-hours per weekend day	9	6	14
Service-hours per year	**5,234.43**	**2,027**	**7,262**

STAGE 1 RUNNING SCHEDULE

WAIKATO LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Otahuhu	Tuakau	48.0	80	76	38	0:37
Tuakau	Pokeno	9.0	80	62	9	0:46
Pokeno	Te Kauwhata	22.2	80	72	19	1:05
Te Kauwhata	Huntly	17.2	80	70	15	1:20
Huntly	Ngaruawahia	14.8	80	68	13	1:33
Ngaruawahia	Te Rapa	13.7	80	67	12	1:45
Te Rapa	Hamilton-Frankton	5.0	80	53	6	1:51
	Line Total:	**129.9**	**80**	**70**	**111**	**1:51**

BAY OF PLENTY LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Otahuhu	Tuakau	48.0	80	76	38	0:37
Tuakau	Pokeno	9.0	80	62	9	0:46
Pokeno	Te Kauwhata	22.2	80	72	19	1:05
Te Kauwhata	Huntly	17.2	80	70	15	1:20
Huntly	Ngaruawahia	14.8	80	68	13	1:33
Ngaruawahia	Te Rapa	13.7	80	67	12	1:45
Te Rapa	Hamilton-Frankton	5.0	80	53	6	1:51
Hamilton-Frankton	Morrinsville	26.9	80	73	22	2:13
Morrinsville	Waharoa	23.2	80	72	19	2:32
Waharoa	Tauranga	44.6	80	76	35	3:07
	Line Total:	**224.6**	**80**	**72**	**188**	**3:07**

STAGE 1 ESTIMATED OPERATING EXPENDITURE, REVENUE AND SUBSIDY SCENARIO

OPERATING EXPENDITURE	
Service-hours per annum	7,262
Service hours per annum per crew	1,800
Number of crews on payroll	4
Number of drivers per crew	1
Number of train managers per crew	1
Driver Salary	$110,000
Train Manager Salary	$60,000
Total Crew Salary per annum:	$680,000
Management staff and company overheads	10.0%
Management staff and company overheads	$68,000
Marketing and customer service budget	$100,000
Total management and marketing per annum:	$168,000
Service-km per annum	483,609
Vehicle opex per service-km	$6
Total vehicle opex cost per annum:	$2,901,655
Network access charges per service-km	$4.50
Network access per annum:	$2,176,241
Depot operations per annum:	$200,000
Total operation cost per annum:	**$6,125,897**

REVENUE	
Service-km per annum	483,609
Fare revenue per passenger km (@ $20 Hamilton to Auckland)	$0.15
Maximum passengers per train	96
Average all-day passenger occupancy per train	60%
Passenger-km per annum	27,855,890
Average passenger trip length (km)	74.5
Passenger boardings per annum	373,905
Return trips per weekday	512
Fare revenue per annum	**$4,178,384**

SUBSIDY	
Subsidy/profit per passenger boarding	-$5.21
Subsidy/profit per passenger-km	-$0.07
Farebox recovery ratio	68%
Net subsidy	**-$1,947,513**

STAGE 1 ESTIMATED CAPITAL DEVELOPMENT COSTS

Component	Unit	Number of units	Unit cost ($m)	Estimate ($m)	Notes
Silver Ferns interior refurbishment	Per train (2 car)	1	$500,000	$500,000	3 Refurbished units total
Silver Ferns mechanical refurbishment	Per train (2 car)	3	$1,000,000	$3,000,000	
Track Upgrades	Per km			$0	None in Stage 1.
New Basic stations	Per station	8	$750,000	$6,000,000	New stations with single platforms and basic shelters at Tuakau, Pokeno, Te Kauwhata, Ngaruawahia, Te Rapa, Morrinsville, Waharoa, Tauranga.
Refurbished station	Per station	1	$100,000	$100,000	Huntly
STAGE 1 TOTAL	**-**	**-**	**-**	**$9,600,000**	

APPENDIX – STAGE 2
Operating Plan and Cost Data

STAGE 2 OPERATING METRICS

Line	Waikato Line	Bay of Plenty Line	Network total	
From	**Auckland-Britomart**	**Auckland-Britomart**	**Auckland-Britomart**	
To	**Hamilton Central**	**Tauranga**	**Te Kuiti**	
Route Length one-way (kilometres)	144	246	211	
Running time one-way (minutes)	93	142	135	
Layover rate (% of running time)	10%	10%	10%	
Return trip cycle time (minutes)	204	312	298	
Trips per hour at peak (one way - peak direction)	2	1	1	4
Trips per hour base timetable (both ways all-day)	-	1	1	2
Total return trips per weekday	4	14	14	32
Total return trips per weekend	0	7	7	14
Peak fleet requirement (trains)	4	6	5	15
Spares and rotation	-	-	-	2
Total fleet size				17
Service-km per weekday	1,152	6,894	5,907	13,952
Service-km per weekend day	-	3,447	2,953	6,400
Service-km per year	287,882	2,119,825	1,816,374	4,224,081
Service-hours per weekday	14	73	70	156
Service-hours per weekend day	-	36	35	71
Service-hours per year	**3,407**	**22,421**	**21,385**	**47,213**

STAGE 2 RUNNING SCHEDULE

WAIKATO LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puhinui	22.8	100	87	16	0:15
Puhinui	Pukekohe	31.2	100	91	21	0:36
Pukekohe	Tuakau	8.0	100	71	7	0:43
Tuakau	Pokeno	9.0	100	73	7	0:50
Pokeno	Te Kauwhata	22.2	160	126	11	1:01
Te Kauwhata	Huntly	17.2	160	119	9	1:09
Huntly	Ngaruawahia	14.8	100	82	11	1:20
Ngaruawahia	Te Rapa	13.7	160	111	7	1:27
Te Rapa	Hamilton Central	5.0	100	61	5	1:32
	Line Total:	**143.9**	**160**	**93**	**93**	**1:32**

BAY OF PLENTY LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puhinui	22.8	100	87	16	0:15
Puhinui	Pukekohe	31.2	100	91	21	0:36
Pukekohe	Tuakau	8.0	100	71	7	0:43
Tuakau	Pokeno	9.0	100	73	7	0:50
Pokeno	Te Kauwhata	22.2	160	126	11	1:01
Te Kauwhata	Huntly	17.2	160	119	9	1:09
Huntly	Ngaruawahia	14.8	100	82	11	1:20
Ngaruawahia	Te Rapa	13.7	160	111	7	1:27
Te Rapa	Hamilton Central	5.0	100	61	5	1:32
Hamilton Central	Morrinsville	26.9	160	131	12	1:45
Morrinsville	Waharoa	23.2	160	127	11	1:56
Waharoa	Tauranga	44.6	100	93	29	2:24
	Line Total:	**238.6**	**160**	**99**	**145**	**2:24**

STAGE 2 RUNNING SCHEDULE – CONTINUED

KING COUNTRY LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puhinui	22.8	100	87	16	0:15
Puhinui	Pukekohe	31.2	100	91	21	0:36
Pukekohe	Tuakau	8.0	100	71	7	0:43
Tuakau	Pokeno	9.0	100	73	7	0:50
Pokeno	Te Kauwhata	22.2	160	126	11	1:01
Te Kauwhata	Huntly	17.2	160	119	9	1:09
Huntly	Ngaruawahia	14.8	100	82	11	1:20
Ngaruawahia	Te Rapa	13.7	160	111	7	1:27
Te Rapa	Hamilton Central	5.0	100	61	5	1:32
Hamilton Central	Te Awamutu	25.7	160	130	12	1:44
Te Awamutu	Otorohanga	23.4	100	88	16	2:00
Otorohanga	Waitomo	7.9	100	71	7	2:07
Waitomo	Te Kuiti	10.1	100	76	8	2:15
	Line Total:	**211.0**	**160**	**93**	**135**	**2:15**

STAGE 2 ESTIMATED OPERATING EXPENDITURE, REVENUE AND SUBSIDY SCENARIO

OPERATING EXPENDITURE	
Service-hours per annum	47,213
Service hours per annum per crew	1,800
Number of crews on payroll	26
Number of drivers per crew	1
Number of train managers per crew	1
Driver Salary	$110,000
Train Manager Salary	$60,000
Total Crew Salary per annum:	$4,420,000
Management staff and company overheads	10.0%
Management staff and company overheads	$442,000
Marketing and customer service budget	$500,000
Total management and marketing per annum:	$942,000
Service-km per annum	4,224,081
Vehicle OPEX per service-km	$6
Total vehicle opex cost per annum:	$25,344,488
Network access charges per service-km	$4.50
Network access per annum:	$19,008,366
Depot operations per annum:	$1,000,000
Total operating cost per annum:	**$50,714,853**

REVENUE	
Service-km per annum	4,224,081
Fare revenue per passenger km (@ $20 Hamilton to Auckland)	$0.15
Maximum passengers per train	300
Average all-day passenger occupancy per train	30%
Passenger-km per annum	380,167,313
Average passenger trip length (km)	109.0
Passenger boardings per annum	3,488,774
Return trips per weekday	4,779
Fare revenue per annum	**$57,025,097**

SUBSIDY	
Subsidy/profit per passenger boarding	$1.81
Subsidy/profit per passenger-km	$0.02
Farebox recovery ratio	112%
Net profit per annum	**$6,310,244**

STAGE 2 ESTIMATED CAPITAL DEVELOPMENT COSTS

Component	Unit	Number of units	Unit cost ($m)	Estimate ($m)	Notes
New Tilt Train rolling Stock	Per train (3 car)	17	$11,000,000	$187,000,000	
Upgrade Basic stations to Standard quality	Per station	9	$750,000	$6,750,000	Stations as above
New Standard quality stations	Per station	4	$1,500,000	$6,000,000	King Country Line stations: Te Awamutu, Otorohanga, Waitomo, Te Kuiti.
New Hamilton Central Station	Per station	1	$5,000,000	$5,000,000	
General track, passing loop and signalling improvements (network wide)	Per network km	313	$250,000	$78,250,000	
Realignment of NIMT - triple tracking	Per km double track	14.5	$5,000,000	$72,500,000	Te Kauwhata – Amokura (swamp deviation)
High-speed level crossing upgrades	Per crossing	32	$500,000	$16,000,000	NIMT Pukekohe to Te Kuiti, ECMT Frankton Junction to Tauranga Central
New Hamilton Depot	Per depot	1	$25,000,000	$25,000,000	
STAGE 2 TOTAL				**$396,500,000**	

APPENDIX – STAGE 3
Operating Plan and Cost Data

STAGE 3 OPERATING METRICS

Line	Waikato Line	Bay of Plenty Line	King Country Line	Geyserland Line	Network total
From	**Auckland-Britomart**	**Auckland-Britomart**	**Auckland-Britomart**	**Auckland-Britomart**	
To	**Cambridge**	**Te Puke**	**Te Kuiti**	**Rotorua**	
Route Length one-way (kilometres)	154	246	197	266	
Running time one-way (minutes)	92	142	116	150	
Layover rate (% of running time)	10%	10%	10%	10%	
Return trip cycle time (minutes)	201	312	255	330	
Trips per hour at peak (one way - peak direction)	2	2	2	2	8
Trips per hour base timetable (both ways all-day)	1	1	1	1	4
Total return trips per weekday	16	16	16	16	64
Total return trips per weekend	7	7	7	7	28
Peak fleet requirement (trains)	6	8	7	8	29
Spares and rotation	-	-	-	-	3
Total fleet size					32
Service-km per weekday	4,926	7,879	6,302	8,499	27,606
Service-km per weekend day	2,155	3,447	2,757	3,719	12,078
Service-km per year	1,479,373	2,366,030	1,892,603	2,552,502	8,290,509
Service-hours per weekday	54	83	68	88	293
Service-hours per weekend day	23	36	30	39	128
Service-hours per year	**16,121**	**25,025**	**20,390**	**26,452**	**87,988**

STAGE 3 RUNNING SCHEDULE

WAIKATO LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puhinui	22.8	100	87	16	0:15
Puhinui	Pokeno	34.2	160	136	15	0:30
Pokeno	Te Kauwhata	22.2	160	126	11	0:41
Te Kauwhata	Huntly	17.2	160	119	9	0:49
Huntly	Ngaruawahia	14.8	100	82	11	1:00
Ngaruawahia	Te Rapa	13.7	160	111	7	1:08
Te Rapa	Hamilton Central	5.0	100	61	5	1:13
Hamilton Central	Matangi	12.2	100	79	9	1:22
Matangi	Cambridge	11.8	100	78	9	1:31
	Line Total:	**153.9**	**160**	**101**	**92**	**1:31**

BAY OF PLENTY LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puhinui	22.8	100	87	16	0:15
Puhinui	Pokeno	34.2	100	136	15	0:30
Pokeno	Te Kauwhata	22.2	100	126	11	0:41
Te Kauwhata	Huntly	17.2	100	119	9	0:49
Huntly	Ngaruawahia	14.8	160	82	11	1:00
Ngaruawahia	Te Rapa	13.7	160	111	7	1:08
Te Rapa	Hamilton Central	5.0	100	61	5	1:13
Hamilton Central	Morrinsville	26.9	160	131	12	1:25
Morrinsville	Waharoa	23.2	100	127	11	1:36
Waharoa	Tauranga	44.6	160	93	29	2:05
Tauranga	Papamoa Beach	12.6	160	79	10	2:14
Papamoa Beach	Te Puke	9.1	100	73	7	2:22
	Line Total:	**246.2**	**160**	**104**	**142**	**2:22**

STAGE 3 RUNNING SCHEDULE – CONTINUED

KING COUNTRY LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puninui	22.8	100	87	16	0:15
Puninui	Pokeno	34.2	160	136	15	0:30
Pokeno	Te Kauwhata	22.2	160	126	11	0:41
Te Kauwhata	Huntly	17.2	160	119	9	0:49
Huntly	Ngaruwahia	14.8	100	82	11	1:00
Ngaruwahia	Te Rapa	13.7	160	111	7	1:08
Te Rapa	Hamilton Central	5.0	100	61	5	1:13
Hamilton Central	Te Awamutu	25.7	160	130	12	1:25
Te Awamutu	Otorohanga	23.4	100	88	16	1:41
Otorohanga	Waitomo	7.9	100	71	7	1:47
Waitomo	Te Kuiti	10.1	100	76	8	1:55
	Line Total:	**196.9**	**160**	**102**	**116**	**1:55**

GEYSERLAND LINE

From	To	Distance (km)	Top speed (km/h)	Average speed (km/h)	Section running time (mins)	Cumulative running time
Auckland-Britomart	Puninui	22.8	100	87	16	0:15
Puninui	Pokeno	34.2	160	136	15	0:30
Pokeno	Te Kauwhata	22.2	160	126	11	0:41
Te Kauwhata	Huntly	17.2	160	119	9	0:49
Huntly	Ngaruawahia	14.8	100	82	11	1:00
Ngaruawahia	Te Rapa	13.7	160	111	7	1:08
Te Rapa	Hamilton Central	5.0	100	61	5	1:13
Hamilton Central	Morrinsville	26.9	160	131	12	1:25
Morrinsville	Waharoa	23.2	160	127	11	1:36
Waharoa	Matamata	8.1	160	92	5	1:41
Matamata	Tirau	18.9	160	122	9	1:51
Tirau	Putaruru	9.2	100	74	7	1:58
Putaruru	Rotorua	49.5	100	94	32	2:30
	Line Total:	**265.6**	**160**	**106**	**150**	**2:30**

STAGE 3 ESTIMATED OPERATING EXPENDITURE, REVENUE AND SUBSIDY SCENARIO

OPERATING EXPENDITURE	
Service-hours per annum	87,988
Service hours per annum per crew	1,800
Number of crews on payroll	49
Number of drivers per crew	1
Number of train managers per crew	1
Driver Salary	$110,000
Train Manager Salary	$60,000
Total Crew Salary per annum:	$8,330,000
Management staff and company overheads	7.5%
Management staff and company overheads	$624,750
Marketing and customer service budget	$1,000,000
Total management and marketing per annum:	$1,624,750
Service-km per annum	8,290,509
Vehicle opex per service-km	$6
Total vehicle opex cost per annum:	$49,743,051
Network access charges per service-km	$4.50
Network access per annum:	$37,307,289
Depot operations per annum:	$1,500,000
Total operation cost per annum:	**$98,505,090**

REVENUE	
Service-km per annum	8,290,509
Fare revenue per passenger km (@ $20 Hamilton to Auckland)	$0.15
Maximum passengers per train	300
Average all-day passenger occupancy per train	30%
Passenger-km per annum	746,145,770
Average passenger trip length (km)	107.9
Passenger boardings per annum	6,916,763
Return trips per weekday	9,475
Fare revenue per annum	**$111,921,866**

SUBSIDY	
Subsidy/profit per passenger boarding	$1.94
Subsidy/profit per passenger-km	$0.02
Farebox recovery ratio	114%
Net subsidy	**$13,416,776**

STAGE 3 ESTIMATED CAPITAL DEVELOPMENT COSTS

Component	Unit	Number of units	Unit cost ($m)	Estimate ($m)	Notes
Additional Tilt Train rolling stock	Per train (3 car)	15	$11,000,000	$165,000,000	
Upgrade signalling system to ETCS L1	Per network km	444	$1,100,000	$488,400,000	NIMT Pukekohe to Te Kuiti, ECMT Frankton Junction to Te Puke, Cambridge and Rotorua branches
Auckland Central Station project	Per station	1	$50,000,000	$50,000,000	Either Britomart eastern tunnel third track or Quay Park Station development
Twin-track central Hamilton section	Per km double track	6.3	$10,000,000	$63,000,000	ECMT Lake Road to Cambridge Branch Junction
Expand Hamilton Central Station	Per station	1	$5,000,000	$5,000,000	
Upgrade Tauranga Central Station	Per station	1	$3,000,000	$3,000,000	
Bombay deviation (new high speed surface alignment)	Per km double track	12	$10,000,000	$120,000,000	Drury to Mill Road
Bombay deviation (tunnel section)	Per km double track	5.5	$80,000,000	$440,000,000	Mill Road to Pokeno
Cambridge Extension: New Standard Quality stations	Per station	2	$1,500,000	$3,000,000	Matangi, Cambridge
Cambridge Extension: upgrade existing track	Per network km	20.5	$250,000	$5,125,000	ECMT to Hautapu
Cambridge Extension: New track	Per km double track	3.5	$5,000,000	$17,500,000	Hautapu to Cambridge Central (Whittaker Street)
Cambridge Extension: High speed level crossings	Per crossing	10	$500,000	$5,000,000	
Cambridge extension subtotal				**$30,625,000**	
Rotorua extension: New Standard Quality stations	Per station	4	$1,500,000	$6,000,000	Matamata, Tirau, Putaruru, Rotorua
Rotorua extension: upgrade existing track	Per network km	36.1	$250,000	$9,025,000	Waharoa to Putaruru
Rotorua extension: reconstruct former rail line	Per network km	49.5	$1,000,000	$49,500,000	Putaruru to Rotorua (Lake Road)
Rotorua extension: New track	Per km double track	1.7	$5,000,000	$8,500,000	Lake Road to Rotorua Central (Randolf Street)
Rotorua extension: High speed level crossings	Per crossing	14	$500,000	$7,000,000	
Rotorua extension subtotal				**$80,025,000**	
Te Puke extension: New Standard Quality stations	Per station	2	$1,500,000	$3,000,000	Papamoa Beach, Te Puke
Te Puke extension: upgrade existing track	Per network km	21.6	$250,000	$5,400,000	
Te Puke extension: High speed level crossings	Per crossing	3	$500,000	$1,500,000	
Te Puke extension subtotal				**$9,900,000**	
STAGE 3 TOTAL				**$1,454,950,000**	