Rail freight public value project – RAIL 2045
Estimated State highway impacts arising from any mode shift of rail freight

5 December 2014 – V.6.2 FINAL

Summary

1. This report has taken a high level assessment of the possible State highway network impacts of significant rail freight movement onto road. This is done to assist the development of a public value assessment, being led by The Treasury with the Ministry of Transport, to establish the extent of the transport benefits that the rail network provides New Zealand.

2. The initial analysis has shown that on the majority of the national State highway network (recognising that some of this freight may be moved by coastal shipping instead) appears to have sufficient capacity to handle most of this freight, if this freight was moved to road. On the open State highways there would be instances where some additional construction projects would be required (additional passing lanes) or more substantive projects would be brought forward (bridge replacements, four-laning). Much more substantial analysis is needed to identify and itemise what the full impacts may be over a thirty year period, recognising there will also be an increase in current road freight volumes of around 2% per annum as well as increasing rail freight volumes (estimated at 2% per annum also).

3. The analysis does show, however, that there are significant pinch-points on the State highway network where additional truck movements would create significant adverse network effects notably additional congestion. This was mainly within major urban areas: Auckland (to/from the Ports of Auckland, SH1, SH16 and Grafton Gully), Tauranga (to/from Port of Tauranga, specifically SH29), access to Wellington (SH1, Petone to Grenada, access to inter-island ferry terminals), within Christchurch (to/from Port of Lyttelton, SH1, SH74, SH76) and to a lesser degree through Dunedin (SH1-88 and access to Port of Otago). We have not undertaken a detailed evaluation, but the mitigations for these impacts are estimated as likely to be significant. It is important to note that these mitigations would be 'triggered' earlier by an increase in truck trips, rather than entirely caused by them. Despite this they would still require investment earlier than otherwise planned and some 'ball park' figures have been developed, recognising the high cost of providing additional road capacity within an urban environment.

4. There would be some negative road externalities around an increased crash risk, particularly where the road has an existing crash risk due to road and road-sides risk factors. Some of this risk is off-set by a reduction in crash risk on rail level crossings (where freight-related movements have been discontinued). Other externalities such as loss of amenity value, driver frustration, and community severance will be created on each line but in low levels in most places. The rationale for this finding was that in most cases existing problems with truck movements will be exacerbated to some degree, but in most cases not qualitatively.

5. In Table 1. below, is a summary of the estimated annualised costs to the road network alternative by rail line if all rail freight was shifted to road (see

Methodology for why this assumption was adopted). Table 2. Provides the same analysis with an 8% discount rate.

Table 3. is a summary of the estimated annualised costs to the road network alternative if rail freight was shifted to road except for the upper North Island- Auckland to Tauranga (with the exception of the Northland line), noting that while this line is commercially viable – a reduction in services across the remainder of the network will move some volumes within this area onto road.

Table 1. Summary of the estimated annualised costs to the road network if rail freight is closed down (based on 6% discount rate)

Line	Length (km)	% tonne-km	Maint. & Ops ($M)	Small improve. ($M)	Major pinch points ($M)	Total Impact ($M)
North Auckland	228	1	0.5	0.3	0	1
Auckland – Christchurch	1099	45	25	12	16.5	45-65
Auckland – Tauranga	195	10	5	3	10.5	15-25
New Plymouth – Palmerston North	230	4	2	1	0	3
Palmerston North – Napier	180	3	1.5	0.9	0	2.5
Wairarapa	140	1	0.5	0.3	0.5	1.5
West Coast	243	17	9.5	4.5	0	12-20
Christchurch South	561	19	11	5.5	5.5	20-26
TOTAL	2876	100	55	27.5	33	100-144

Notes: across the network there is a net crash cost of $20M per year and of emissions of $10M per year. We have incorporated the cost of mitigation into Maintenance & Operations, small improvements, and major pinch points.

Table 2. Summary of the estimated annualised costs to the road network if rail freight is closed down, based on 8% discount rate (5-8% increase on major pinch points).

Line	Length (km)	% tonne-km	Maint. & Ops ($M)	Small improve. ($M)	Major pinch points ($M)	Total Impact ($M)
North Auckland	228	1	0.5	0.3	0	1
Auckland – Christchurch	1099	45	23	11	16	46-66
Auckland – Tauranga	195	10	5	2.5	11	16-26
New Plymouth – Palmerston North	230	4	2	1	0	3
Palmerston North – Napier	180	3	1.5	0.8	0	2.5
Wairarapa	140	1	0.5	0.3	0.5	1.5
West Coast	243	17	8.5	4	0	12-20
Christchurch South	561	19	10	5	5.3	21-26
TOTAL	2876	100	50	25	30.5	103-146

Table 3. Summary of the estimated annualised costs to the road network for Upper North Island "Golden Triangle", based on 8% discount rate

Line	Length (km)	% tonne-km	Maint. & Ops ($M)	Small improve. ($M)	Major pinch points ($M)	Total Impact ($M)
North Auckland	228	1	0.5	0.3	0	1
Auckland – Christchurch	1099	45	20	8.5	7.5	30-45
Auckland – Tauranga	195	10	0	0	0	0
New Plymouth – Palmerston North	230	4	2	1	0	3
Palmerston North – Napier	180	3	1.5	0.8	0	2.5
Wairarapa	140	1	0.5	0.3	0.5	1.5
West Coast	243	17	8.5	4	0	12-20
Christchurch South	561	19	10	5	5.3	21-26
TOTAL	2876	100	50	25	30.5	71-99

Introduction

6. The KiwiRail freight task is approximately 4.9 billion NTK (net tonne kilometres) or around 1.4 million truck trips per year. This is up from 3.9 billion NTK in the original Turnaround Plan in 2009.[1] KiwiRail forecast this to grow to over 6.7 billion NTK by 2045 while the NFDS forecasts 6.0 billion NTK. Nationally rail accounts for around 16% of freight movements by tonne-kilometre (volume multiplied by distance), road represents 70% (carried by all trucks over 3.5 tonnes) and coastal shipping 14%.

7. The volume moved by rail represents around 25% of the freight task serviced by 'big/heavy' trucks combinations (HCV2s being truck combinations with six or more axles), which is in the order of 16 billion tonne kilometres per year.[2] The freight moved by rail tends to be heavy and bulk goods moved over medium to long distances, or where large single movements add value to the greater supply chain (such as container moves to and from ports).

Methodology

8. This report was prepared to help inform the public policy process working to evaluate the benefits of rail. To assist the process the Transport Agency was asked to put together a high-level assessment of the road impacts of any freight transfer from rail. In doing this it was assumed that any difference in travel would be experienced mostly on the State highway network, as rail provides for primarily longer movements of freight with local road trips already undertaken when moving freight to and from rail.

9. This paper outlines the indicative impacts and estimated costs of a scenario where the rail freight task shifts substantially to road, increasing HCV2 traffic on existing highway routes by around 30%.[3] This scenario presented is a 'caricature' scenario that assumes the transfer of 100% of rail freight to road. It is recognised that a range of other finer grained scenarios, not discussed in this report, exist involving various modal permutations of rail, road and coastal (including international ships moving containerised goods).[4] This report provides some limited discussion of these, but substantive discussion of possible modal outcomes and contestability of the current freight task is out of scope.

10. Rail commuter lines for urban passenger services are assumed to remain as they currently are. No analysis has been done on the impacts of any movement of passenger movements onto road. It should be noted that the cost of the built infrastructure used by passenger and rail freight is shared between these two uses, so any reduction in rail freight activity may increase the operating costs of

[1] KiwiRail Turnaround Plan 2009/10
[2] Based on 1.6 billion VKTs per year from road user charges purchase data x55% loading x average payload of 18 tonnes.
[3] This is based on, a modelled estimate of an additional 236 million VKTs per year on the State Highway and Local Road network. This includes both outhaul and backhaul travel serviced by 50 tonne HPMVs (50MAX). Current HCV2 VKTs on the State Highway segments of the rail to road routes totals 709 million out of a total of around 1.6 billion annual HCV2 VKTs. Adding say a further 15% VKTs to include the local road segment of the rail to road routes indicates a current baseline of 815 million annual HCV2 VKTs. (236/815 = 29%).
[4] Previous reports commissioned estimate that while rail and coastal shipping do compete on inter-island freight, coastal shipping currently dominates the market for non-time sensitive goods. See http://nzta.govt.nz/resources/domestic-sea-freight-development-fund/coastal-shipping-and-modal-freight-choice/index.html

public transport services, which would require additional funds from fare revenue, regional rates and the National Land Transport Fund (NLTF).[5]

11. The scenario further assumes current freight volumes with a nation-wide average annual increase of 2%. There is no finer grained analysis of area specific increases, or potential future increases, in freight volumes arising for freight types that are largely or significantly moved by rail (see Table below). In some areas, this future volume may be above the assumed base-line. So this reports looks at rail freight movements as a 2014 ‘snapshot’ with assumed average growth.

Table 4. Major rail freight commodity segments 2012 and forecast growth by 2042.[6]

Commodity	Million tonnes	modal share	estimated growth by 2042
Milk	.08	4%	59%
Dairy	2.6	49%	65%
Export logs	2.3	16%	-38% (declining after years of growth)
Processed wood (panel)	0.2	13%	91%
Pulp & paper	1.1	41%	17%
Meat	0.4	36%	8%
Grain	0.1	5%	107%
Fish	0.1	7%	26%
Wool	0.0	15%	-4%
Coal	5.0	60%	47%
Minerals (other)	0.1	15%	103%
Iron & Steel	0.5	14%	25% (steel & aluminium)
Retail & manufacturing	4.0	10%	134%, 31%
General freight	N/A	N/A	54%

12. Also not analysed are potential shifts in time of day freight travels, with a great deal of the current rail freight task moved at night or in the weekends. As this freight tends to be less time sensitive it has been assumed that most of this freight would be moved during the current longer working day and week that is typical of the road freight industry.

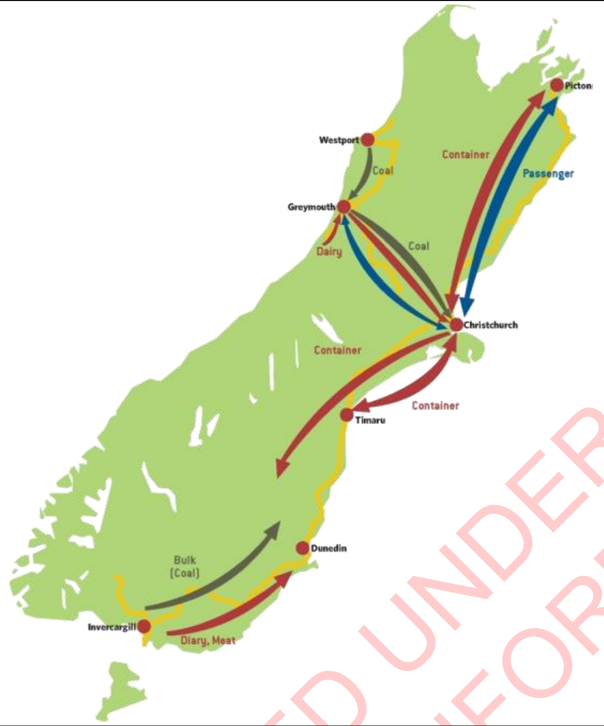
13. This report discusses the significant impacts on the State highway and local road network (where relevant as most transferred freight travel is likely to run predominantly on State highway routes) in terms of:

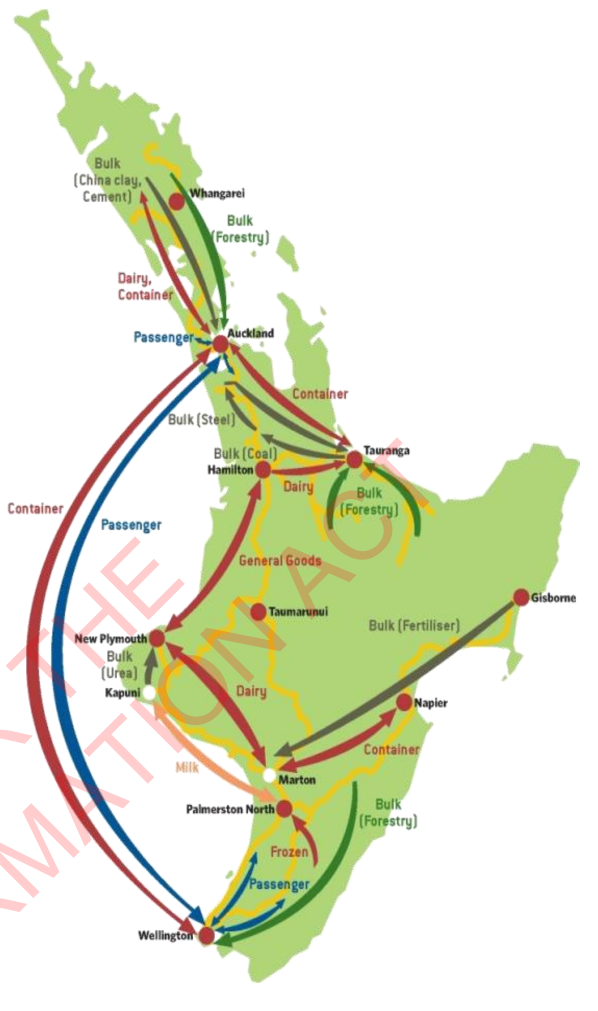
- Demand (daily traffic volumes, HCV2s, additional HCV2s)
- Route congestion impacts
- Congestion and resilience pinch points
- Crash black spots
- Road network safety impacts net of a decrease in rail crossing crashes
- Urban impacts
- Effect on network resilience values
- Reduced amenity values
- Need for increased or accelerated capital works
- Maintenance and renewal impacts

[5] This amount has not been assessed but it is estimated between $5-10 million annually.
[6] Interpreted from National Freight Demand Study, 2014, pp. 270, 280

Table 5. Road segments based on rail route segments

1. Northland (North Auckland) line
2. Auckland-Christchurch
3. Auckland-Tauranga
4. New Plymouth-Palmerston North
5. Palmerston North-Napier
6. Wairarapa
7. West Coast
8. Christchurch-south





14. The focus is upon impacts on the road infrastructure and direct externalities. Supply issues such as truck driver availability, truck purchases including capital and maintenance costs are not within scope. Also outside the scope of this discussion is the extent to which the cost allocation model / road user charges (RUC) system recovers the full additional resource costs of road maintenance and construction.[7]

15. The eight road route segments set out in Tables 1 and 2, total almost 4000kms of State highway, and are based on KiwiRail Limited's freight origin and destination data provided. The alternative State highway routes was determined on the assumption that trucks would travel in roughly parallel routes to the current rail lines, with preferences to routes that provided a level of service best suited to trucks. As such most of the routes identified already carry significant numbers of truck trips (HCV2s) undertaking journeys to and from similar origins/destinations. Without detailed freight origin/destination data the railhead was used as the default journey point.

16. Appendix Two provides line-by-line discussion of potential road network impacts of the rail freight task. These regional results are summarised in a single table in Appendix One.

[7] See Ministry of Transport paper, *What do Heavy Vehicles Pay For?*, 2014

Congestion

17. Appendix One shows that most of the strategic State highway network, with existing planned improvements in the form of Roads of National Significance (RoNS) and other works, is generally capable of receiving the additional rail freight volumes. Appendix five provides maps showing current total and HCV daily traffic (AADT)[8], as well as increased HCV daily traffic by route.

18. Four-laning to relieve route congestion (and also safety issues) is initially considered at around 12-14,000 AADT (annual average daily travel – all vehicles), although typically undertaken at around 20,000 AADT once considered against other investment priorities. There are number of routes that are likely to exceed 14,000 AADT, caused at least in part by the additional rail freight task. All routes likely to exceed 14,000 AADT have adequate planned 4-laning projects, largely in the form of RoNS projects.

19. Heavy vehicles are on average around 10% of the general traffic flow on the major national routes (over 800 HCVs a day) or high-volume national routes (over 1200 HCVs a day).[9] Taking an existing busy route as an example, such as over the Kaimai range (SH29), a 6% increase of HCV2s on top of the existing 1,400 heavy vehicles can be accommodated in the short term. The network capacity issues relate more to pinch points, mostly at either end of the journey, rather than route segments.

Pinch points

20. The following significant pinch points are identified for which there are imminent or readily available mitigations:
    - Auckland's Central Motorway Junction (western ring route complete within the next few years).
    - Wellington's Ngauranga Gorge and SH1/2 interchange (New Petone - Grenada route, and Cross Valley Link)
    - Rimutaka (realignments).

21. Pinch points with the highest technical and cost challenge are:
    - Brynderwyns, north of Auckland (SH1)
    - Kaimai summit (SH29) and flanks where a summit tunnel could be required in addition to further passing lanes and medians (Rough order cost of $1-2B+ for the tunnel and circa $0.5B for the approaches).
    - West Coast passes (SH73) - few options for further upgrades.
    - Maintenance of route resilience at Manawatu Gorge (SH3) in the absence of rail
    - Kaikoura Coast (SH1)

22. The above are already issues that would be exacerbated by the additional demand.

Crash black spots

23. Additional to the higher crash risk from additional trucks on the network (see below), there are a number of areas with concentrations of fatal and serious HCV2 crashes shown in Appendix four comprising the Waikato, North of Tokoroa, Desert Road, Kaikoura Coast and South of Christchurch. Significant increases of

[8] Annual Average Daily Travel (AADT), HCV being heavy vehicles over 3.5 tonnes
[9] See the one network road classification: http://www.nzta.govt.nz/projects/road-efficiency-group/onrc.html

heavy vehicles on these routes could increase severe crashes by more than the all trucks / all routes average exposure. Mitigation works could be required.

Road safety impacts

a) *Increased crash exposure*

24. Specific safety impacts are discussed in Appendix Two. The network-wide crash risk impacts are set out in Appendix Three. These are in the order of $20 million after allowing for reduction in rail crossing injuries. Current HCV2 fatal crashes total around 22 per year. The safety analysis suggests an increase in probability of around 4 fatal crashes (18%) per year (before rail crossing safety benefits are considered). The increase in heavy traffic will also increase the potential for an increase in the number of non-serious crashes that disrupt the network (due to damaged trucks and freight blocking the network).

b) *Increased driver frustration (other road users and truck drivers)*

25. Heavy truck combinations are expected in the scenario to increase by around 30% on the State highway over all. Public comment from other road users of their perception, or experience, of safety risks due to the presence a heavy truck is common in the media, anecdotally and in formal complaints received by the Transport Agency from time to time.[10] Likewise is comment around the frustration of other road users having their trips disrupted by slower moving trucks, with the open road speed limit for a truck being 90kph (and uphill climbs slowing trucks further). As an example, currently a trip from Hamilton to Tauranga could require the number of trucks overtaken by motorists to increase by around 10 from a current level of 20 to 30 trucks. This increase may or may not be noticeable. In either case the value of this impact, including potential safety impacts additional to this frustration, is difficult to measure.

26. Gradients are the main cause of slow moving heavy vehicles, and most steep routes already have passing lanes. New trucks, including high productivity motor vehicles (HPMVs)[11], tend to have higher power to weight ratios than most heavy vehicles. Servicing the rail freight task with these newer vehicles would improve the alignment of truck speeds with the general traffic flow. But this would mitigate not solve the problem entirely. Some routes could also have additional passing lanes added to substantially mitigate the impact.

Urban impacts

27. Routes with high additional flows under a rail-to-road scenario already have high traffic volumes and impacts. The marginal increase in noise, vibration and community severance (also known as loss of amity value) may not be significant on these routes. Proposed and underway Roads of National Significance (RoNS) and other works will mitigate some of these effects. Increased pressure for noise barriers and bypasses could arise however in some small towns including Tirau, Tokoroa, Turangi, Waiouru, Taihape, Hunterville, Bulls, Sanson, Foxton, Levin Picton, Blenheim Kaikoura and Amberley. But the additional volumes are likely to add to the existing negative truck-related externalities, rather than qualitatively changing them.

[10] As an example increases in heavy vehicle numbers in Timaru this year triggered negative media comment: See http://www.stuff.co.nz/timaru-herald/news/9605965

[11] Being heavier and/or longer truck combinations that operate under permit from the NZ Transport Agency and/or local councils and can move more freight on fewer trips.

Maintenance & Operations

28. A marginal analysis of the impacts of additional loadings on the State Highway network indicates an increase in costs of $40-45M per year plus some rebuilding of roads in the short to medium term. Hence we have adopted a figure of $50M per year with a range of $45M to $60M per year. This does not include:
    a. Increased HCV2s and passing issues could increase road edge breaking and maintenance costs
    b. Increased HCV2s could accelerate bridge replacement costs.

Option Values

29. Option values have been uncosted with a paper being developed by the Ministry of Transport. In terms of option value rail may play a greater, or lesser role, in the overall movement of freight depending on a number of future scenarios. These were deemed out-of-scope of the current project so have not been explored.

Conclusion

30. In conclusion, there would be a range of significant pinch-points within the main urban areas and on specific areas of the network. There would also be additional or heightened community and road user perceptions of dis-benefits that would need to be addressed or accepted by those affected. There would also be additional safety risk that may result in serious and fatal crashes (potentially also more non-serious crashes that disrupt the network). These factors aside the road network could feasibly accommodate the 30% increase in HCV2 traffic under existing investment plans.

Appendix One

Summary assessment of the potential region by region impacts on the strategic state highway network detailed in Appendix Two

Table 1. Assessment of potential congestion areas on the strategic State highway network

Line / Route	Sections	Average vehicles per day (AADT) 2014	Forecast AADT 2025	Average HCVs per day (%) 2014	Forecast HCVs per day 2025	Additional HCVs per day 2014		Impacts (L - M - H) and mitigation required				Mitigation (Easy- difficult)
						#	% Inc	Route congestion & resilience	Congestion Pinch points	Safety & frustration	Communities	
Northland	Whangarei - Warkworth	8-9,000	8-9,000	900 (12%)	1,100	40-50	L		-	-	Generally not noticeable	Adequate projects in place or planned
	Warkworth – Auckland	9,000+	9,000+	900-1,200 (7-10%)	1,100-1,500	40-50	L	4 laning from Puhoi to Warkworth in North and Hamilton bypass in south	POA	-	-	RONS
Auckland to Christchurch	Auckland - Cambridge	14,500+	17,000+	1,600+	2,150+	100-400	M		POA	-	-	RONS (Waikato expressway)
	Cambridge - Taupo	6-14,500	7-17,000	600-1400 (10%)	800-1,900	100-400	H	4L in longer term		Some black spots Passing lanes & medians	HCV increases generally not noticeable. Some increased pressure for bypasses at Taihape, Bulls, Sanson, Foxton, Blenheim & Kaikoura	Passing lanes & medians
	Taupo - Levin	3-8,000	3,200-8,500	600-900 (12-22%)	750-1,100	100-400	H					
	Wellington - Levin	12,000+	13,000	1,100+	1,350+	200-400	M	4L required	Ngauranga			
	Picton - ChCh	1,500	1,500	300 (20%)	350	100 - 400	L	-	-			RONs + Woodend bypass
Auckland to Tauranga	Kaimais (SH29)	8,000	9,300	1600 (20%)	2,150	300-600	L	-	-	Passing lanes & medians Summit & Tga. Some spreading onto unsuitable routes		Summit tunnel Passing lanes & medians.
	Urban Tauranga	14,500+	17,000+	1,400+ (10%)	1,900+	300-600	H	4L required	-	-		RONS
N. Plymouth to P. North		6-10,000	6,600-11,000	600-1200 (10%)	750-1,500	50-140	M	-	-	-		-
P. North to Napier		6-10,000	6,600-11,000	600-1200 (10%)	750-1,500	50-140	H	Gorge resilience -	-	-		Gorge resilience costs
Wairarapa		4-20,000	4,200-21,000	300-900	400-1,100	10-30	M	-	Rimutaka Hill	-		-
West Coast		1-2000	1-2,000	200-400	220-440	300-400	H	-	Passes -	-		Difficult terrain for Passing lanes
Christchurch south		2.5-10,000	3,200-13,000	100-1500 (10-15%)	150-2,200	50-250	M	-	-	Some black spots		-

L<10%, M= 10-25%, H >25%

L<10%, M= 10-25%, H >25%

Appendix One (continued)

Table 3 continued. Telemetry data for precise location examples

Route	Route sub segments	AADT all vehicles.	HCV % / #	Additional HCVs	
				#	%
Northland line	Whangarei - Warkworth	9000$_{(1)}$	*11%* 1,000	40-50	3%
	Warkworth - Akld	12,000$_{(2)}$	*9%* 1,100	40-50	*5%*
Auckland to Christchurch	Auckland (Drury)	42,000$_{(3)}$	*11%* 4,500	380-580	13%
	- Karapiro	14,500$_{(3)}$	*11%* 1,600	380 - 580	*36%*
	Cambridge - Taupo	8,500$_{(4)}$	*18%* 1,500	130- 580	Up to 40%
	Taupo - Levin	3,000$_{(5)}$	*20%* 700	130-260	Up to 37%
	Wellington - Levin	23,000$_{(6)}$	*8%* 1,800	190-260	*15%*
	Picton - ChCh	2,500$_{(7)}$	*20%* 500	130 - (580 from Waipara)	5% (Kaiik)
Auckland to Tauranga	Kaimais (SH29)	9,000$_{(8)}$	*15%* 1,400	130-580	6%
	Tga Eastern Link	18,000$_{(9)}$	*11%* 1,900	130-580	*3%*
N.Plymouth to P. North	Waitotara	3,500$_{(10)}$	*18%* 650	50-130	20%
P.North to Napier	Manawatu Gorge	6,500$_{(11)}$)	*12%* 750	80-190	25%
Wairarapa	Rimutaka	5,500$_{(12)}$	*6%* 350	30-50	14%
West Coast	Arthurs & Lewis passes	1,300$_{(13)}$)	*15%* 200	50(AP) - 580-(LP)	290% (LP)
Christchurch south	Dunsandel	11,000$_{(14)}$	*15%* 1,600	80-190	12%

Telemetry sites: (1). Wellsford 336, (2.) Kaipara Flats 363, (3.) Drury WIM & Karapiro 20, (4.) Tokoroa WIM5, (5.) Desert Road 795, (6) Paekakariki Tele47, (7) Kaikoura, (8.) Kaimai, (9) Te Puke (10) Waitotara, (11.) Manawatu Gorge, (12) Rimukata, (13) Average of Arthurs & Lewis, (14.) Dunsandel Tele6

Appendix one (continued)

Table 1 shows that -

a) Routes receiving the rail freight task have AADT (all vehicles both ways) in a wide range from 42,000 at Drury south of Auckland to 1,300 on the Lewis and Arthurs Passes.

b) Heavy vehicles (HCV = vehicles >3.5 Tonnes) make up from 6-20-% of the traffic flow on these routes but typically around 12%. This represents daily flows of heavy vehicles in range from 4,500 at Drury to approximately 200 on the West Coast passes.

c) 'Big heavies' (HCV2s being vehicle combinations with 6 or more axles) are what the general public might more typically think of as a big/heavy truck. These would represent a significantly smaller percentage of the daily flow.

d) The bottom end of the range of additional heavy vehicles is a largely inconsequential volume increase of up to 50 HCV2s (2/hour) on the Northland and Rimutaka lines. The high end of the range of additional heavy vehicles is 580 per day (24 / hour) in the Auckland / Waikato/ BOP triangle.[12]

e) The data field best expressing the likely nature of change impacts on other drivers and communities is the percentage increase in heavy vehicles. On many route segments an increase of 500 HVCs per day is on top of already significant heavy vehicle flows. The routes and nodes with large percentage increase in heavy vehicle volumes are the Waikato-Taupo segment of SH1 and the coal route over Lewis Pass. Tripling of heavy vehicle volumes on Lewis Pass probably presents the biggest challenge (if this was actually to happen).

f) Some regionally significant increases are at Waitotara and Manawatu gorges, but the absolute volumes are unlikely to be concerning.

Appendix Two

Rail freight value project road route assessments

1. Northland line

Demand

- 7000 to 14,000 vehicles per day
- 600 to 1400 HCVs per day (circa 10%)
- Additional 40-50 HCVs per day (+4 to 6%), representing one train per day
- Indicative additional highway cost $1M to $2M per year.

Congestion impacts

- At an additional 40-50 HCVs per day the impacts are considered relatively minimal.

Pinch points

- Brynderwyn Hills, north of Wellsford (SH1)

Crash black spots

Urban impacts

- Warkworth amenity impacts, but mitigated by RoNS
- Currently some capacity issues on SH1 in Whangarei, but programmed activities will mitigate.

Effect on network resilience values

- Potential option value for route resilience issues at Brynderwyn Hills.
- Prospect of connection to North Port as an alternative to an increasingly growth restrained Ports of Auckland, Northland line would need to be upgraded at a cost of $150M+ (rail connection into North Port at Marsden Point and raising tunnel ceilings to take high cube containers – which are becoming more commonly used. Lack of high-cube capability limits the ability of some freight to be moved on this line.)
- Possible serving of growth in Marsden Point - Auckland fuel line demand that is currently at capacity.

Need for increased or accelerated capital works.

Advice provided was that the "future maintenance and capital cost implications for the Northland State highway network would be insignificant." Stephen Town, Auckland and Northland Regional Director - memo November 2012.

Conclusion: Given the low demand the shift to road would have a minimal impact on the direct and indirect costs of the North Auckland road network.

2. Auckland to Christchurch

Demand

- 1500 to 14,000 vehicles per day
- 400 to 1500 HCVs per day (circa 10%)
- Additional 100-400 HCVs per day (+25 to 30%),
- Note the Ports of Auckland and KiwiRail recent deal to move more containers to/from the inter-modal terminal at Wiri.
- Indicative additional highway cost $50-70M per year

Congestion impacts

- Ports of Auckland (POA) to Penrose have highest volumes on rail network. Potential POA connection issues.
- An increased cost of road bridging could lead to two port calls with imports to Auckland and exports through Tauranga.

Pinch points

- Some constraint between Grafton Gully and the Port gates, and in the longer term Waiouru to Bulls. To mitigate this would mean bringing forward some very large projects including Grafton Gully, Auckland motorway, Piarere to Taupo, and Waiouru to Bulls projects (circa $4000M) by 5-10 years at an NPV cost of circa $400M to $600M or annualised cost of $15-$20M per year.
- Narrow shoulder limit pull over opportunities
- Number of slow spots

Crash black spots

- North of Tokoroa
- Desert Road
- Kaikoura coast rollovers.

Urban impacts

- Generally within small towns including the likes of Tirau, Tokoroa, Turangi, Waiouru, Taihape, Hunterville, Bulls, Sanson, Foxton, Levin, Picton, Blenheim, Kaikoura.
- Conflict with urban flows in Wellington

Effect on network resilience values

- Desert Road winter closures would create pressure on alternative routes.

Reduced amenity values

- Social severance impacts likely in rural town such as Amberley and Kaikoura

Need for increased or accelerated capital works.

- Woodend, north of Christchurch bypass currently on 15 and 10 year plans respectively likely to need acceleration.

Conclusion: There is a high demand on the Auckland to Christchurch route, hence there would be a considerable direct and indirect cost impact of shifting freight to road.

3. Auckland to Tauranga

Demand

- 8000 to 14,000 vehicles per day
- 1200 to 2200 HCVs per day (15 to 20%)
- Additional 300-600 HCVs per day (+25 to 30%)
- Indicative additional highway cost $15-25M per year

Congestion impacts

- Kotahi initiative of Fonterra, Silverdale Farms and others with Port of Tauranga an important consideration, focused on Waikato.
- Changes in container flows, such as due to larger ships (7000+ TEUs) or possible port mergers or changes in operation need to be considered.
- The Waikato is a common conduit / marshalling point for freight to Port of Tauranga (POT) from many origins. The network effects are experienced here in contrast to the simple origin - destination analysis of the Napier - Gisborne line.
- Eastern link likely to provide sufficient capacity.

Pinch points

- East from Tauranga likely to be congestion impact on Rotorua eastern corridor where already capacity constrained.
- Kaimai Ranges (SH29)
- To mitigate these would mean would mean bringing forward a series of some very large projects between Piarere and Tauranga (circa $1000M to $3000M depending on options selected) by 5 years at an NPV cost of circa $150M to $400M or annualised cost of $10-$20M per year.

Urban impacts

- Significant increases in settlement expected, particularly in urban areas such as Hamilton and Tauranga.

Need for increased or accelerated capital works.

- Waikato Expressway and Hamilton Bypass likely to provide significant capacity to service rail volumes.
- Kaimai road tunnel costed at $2-3B+

Conclusion: There is a high demand on the Auckland to Tauranga route, hence there would be a considerable direct and indirect cost impact of shifting freight to road.

4. New Plymouth to Palmerston North

Demand

- 6000 to 10,000 vehicles per day
- 600 to 1200 HCVs per day (circa 10%)
- Additional 50-140 HCVs per day (+10%),
- Note. A new dairy dryer in Pahiatua may reduce / remove the current need for the Tararua - Whareroa milk train. Coastal shipping alternatives to rail for containerised cargo from Taranaki, potentially sailing around to Tauranga or to other hub port. Would increase transit times.
- Indicative additional highway cost $4-6M per year

Congestion impacts

- Karioi to Napier may shift from Manawatu Gorge route to Napier Taupo road.

Pinch points

- Generally good capacity.

Urban impacts

- Some conflict with rural schools

Conclusion: Given the relatively low demand the shift to road would have a small impact on the direct and indirect costs of the central North Island roading network.

5. Palmerston North to Napier

Demand

- 4000 to 10,000 vehicles per day
- 600 to 1200 HCVs per day (circa 10%)
- Additional 100-400 HCVs per day (+15 to 30%)
- Indicative additional highway cost $3-4M per year

Congestion impacts

- Prospect of increased volumes by road directly to Port of Napier.
- Seasonal peaks in agricultural production and forestry harvesting
- Average travel speeds could be impacted during high loading seasons - summer, late spring and early autumn.
- Narrow shoulder limit pull over opportunities

Pinch points

- Countervailing benefits of removal of rail causation of road congestion needs to be considered – such as: trains to the Port of Napier can block five intersections in Napier
- Local route to port is unclear
- High productivity motor vehicle (HPMV) capacity, likely to be a focus of NLTP 2015/18 investment.

Effect on network resilience values

- The road through the Manawatu Gorge has significant resilience issues compared with rail.

Need for increased or accelerated capital works.

- Mitigating the resilience issues on the Manawatu Gorge circa $100m+ on a longer term basis

Conclusion: Given the relatively low demand the shift to road would have a small impact on the direct and indirect costs of the central North Island road network.

6. Wairarapa

Demand

- 4000 to 20,000 vehicles per day
- 300 to 900 HCVs per day (circa 5 to10%)
- Additional 10-30 HCVs per day (+3%),
- Note: There is a prospect that road only might see these re-routed from a Wellington to a Napier destination.
- Indicative additional highway cost $1.5-2M per year

Pinch points

- Rimutaka Hill road is a very sensitive route with issues already.
- HPMV capacity constrained due to fit-to-network concerns on hill road.

Crash black spots

- Already safety issues on Rimutaka Hill Road where there are curvature issues.
- Tracking issues on Hill Road.
- Safety risks on SH2 due to road and road sides.

Need for increased or accelerated capital works.

- Cost to mitigate Rimutaka's certainly in the region of $100+, already only a small proportion could be ascribed to the shifting demand.

Conclusion: Given the relatively low demand the shift to road would have a minimal impact on the direct and indirect costs of the Wellington and Wairarapa road network.

7. West Coast

Demand (SH73 Arthur's Pass and SH7 Lewis Pass)

- 1000 to 2000 vehicles per day
- 50 to 250 HCVs per day (circa 10%)
- Additional 50 to 100 HCVs per day on SH73 (+50 to 100%) and 300 to 400 on SH7 (+200 to 400%)
- NB. The Alpine route is predominantly coal with 8 x 30 wagon trains per day = more than 50MAX HPMVs onto SH73. There is one general freight / dairy train per day. Coal will continue to be variable and the contractual commitments to Solid energy are a consideration.
- Indicative additional highway cost $16-25M per year

Congestion impacts

- Reefton to Greymouth likely to see increased volumes.
- The Alpine route is predominantly coal with 8 x 30 wagon trains per day = more than 50MAX HPMVs onto SH73.
- There is one general freight / dairy train per day. Price of coal may determine value of moving it, similar to situation in the forestry sector where production (and transport) reduces in times of low export prices.

Pinch points

- The impacts through both passes given the additional volumes could be significant. Arthurs and Lewis passes are key likely pinch points along with one lane bridges where current queuing is light, but level of service (LOS) likely to deteriorate considerably with rail volumes. Also, additional slow vehicles could lead to overtaking crashes. These impacts are likely to be experienced equally on Arthurs and Lewis Passes. Mitigation could include further slow vehicle bays, but a very difficult to achieve to cater for a three-fold increase in HCVs.

Conclusion: There is a high demand on the West Coast route, hence there would be a considerable direct and indirect cost impact of shifting freight to road.

8. Christchurch south

Demand

- 2500 to 10,000 vehicles per day
- 200 to 2000 HCVs per day (circa 10 to 20%)
- Additional 50-250 HCVs per day (+10 to 25%)
- Indicative additional highway cost $24-30M per year

Congestion impacts

- Transfer of rail freight would be on top of existing plans/ expectations for a 20% increase in rail freight.
- Rail freight currently aggregating at Darfield and Rolleston with Port of Lyttelton destination.
- The Port of Lyttelton currently has a 20% rail mode share and is targeting 40% with growth from 350,000 TEU to between 800,000 and 1,500,000 TEU. Lyttelton Road Tunnel can only cater for 1,000,000 TEU p.a. and therefore tunnel duplication could be required in 30-year period.

Pinch points

- In Christchurch Brougham St would need major work to cater for significant increases in truck volumes. Road access to/from Lyttelton. Some constraints on SH1 (north and south).

Crash black spots

- Immediately south of Christchurch (SH1)
- North of Oamaru (SH1)

Urban impacts

- Some increase in urban congestion is likely, resulting in some additional driver frustration. Some additional conflicts between trucks and other road users.

Need for increased or accelerated capital works.

- Rolleston bypass currently on 15 and 10 year plans respectively likely to need acceleration.
- Two plus one lanes and four-laning strategies likely to be required.
- Increased edge breaking due to driver pullovers is likely with Opex impacts.

Conclusion: There is a high demand on the Christchurch south route, hence there would be a considerable direct and indirect cost impact of shifting freight to road.

Appendix Three
Safety impact analysis

Table 2. Annual crash costs if rail freight transferred to 50 tonne HPMVs (50Max)

Crash costs - based on average social cost per crash for both State Highway and local road segments	
Crash severity	**Method 1.** Single nationwide assessment of crash risk based on HPMV crash risks 2010-13 ***($M)***
Fatal crash - annual	-18
Serious crash - annual	-9
Minor crash - annual	-2
Total annual cost of additional crashes	-29
Less decrease in fatal, serious & minor rail crossing crashes	11
Net increase in annual cost of additional road crashes	**-18**
30Y NPV of net costs @ 8% discount rate and 2% annual compounding traffic growth	**-247**

Method

- A simple nationwide estimate of crash risk has been used in this analysis. A more complex alternative methodology that calculates a specific crash rate for each route is in the process of being evaluated.

Assumptions

- The increase in vehicle kilometres of travel (VKT) on each route is calculated from the combined State Highway and local road route length and annual increase in truck volume estimated through a separate analysis by KiwiRail and NZTA staff.

Nationwide estimate of crash risk assumed

The vehicle kilometres travelled (VKT) per crash ratio shown in

- Table 2 is a nationwide estimate of crash risk. It is assumed crash rates for each heavy vehicle; HPMV and 50 Max vehicles are uniform nationally.

Crash risk assumption

- The crash risk is based on research for the 2013 Monitoring evaluation and review (MER) of the HPMV rule.[13] This research provided a crash risk exposure measure in terms of *million VKTs per crash* for both HPMVs and a comparative standard heavy vehicle combination operating up to 44 tonnes GMV. For HPMVs, this data was accessed by matching HPMV plate numbers with RUC distances purchased and crash matches within CAS. For standard heavy vehicles CAS and RUC data were queried for heavy vehicle combinations with six or more axles.

- This analysis assumes a crash risk exposure in Table 3 based on analysis of all HPMVs and 50MAX vehicles such as 61, 21 and 9 million VKT per fatal, serious and minor crash respectively. This HPMV data is of a similar order to the crash risks for Class one heavy vehicles.

- The application of this crash risk ratio to the increase in VKT predicts the increased crashes.

Table 3. Crash risk estimates

Crash Type	Class One Heavy vehicles (RUC class 6 or greater)	HPMV Trucks (over length + higher mass & both higher mass & over length	50MAX
Fatal crashes	1 per 59 million VKT	1 per 61 million VKT	
Serious crashes	1 per 26 million VKT	1 per 21 million VKT	
Minor crashes	1 per 8 million VKT	1 per 9 million VKT	

Cost of crashes

- Table 4 lists the assumed costs per crash. On average there is more than one injury per crash and a single crash can have a range of injury types. The crash injury type is based on the worst injury incurred by the crash.

Table 4. Crash costs

	Average injury cost per crash
Fatal	4,536,300
Serious	826,000
Minor	85,000

Assumed that rail freight moves to vehicles with minimum 50MAX capacity

- Allocation of the rail freight task has been completed for both standard 44 tonne and 50MAX vehicle combinations. This analysis assumes that the rail freight task

[13] D Stimpson 2014 *Monitoring, Evaluation and Review of the Vehicle Dimensions and Mass Rule Implementation May 2011 to April 2013* V 5.0 Final 6 May 2014

transfers completely to 50MAX vehicles on the basis that this is likely to become the standard vehicle type for general freight tasks. This is a conservative assumption with respect to increase in vehicle numbers because some of the freight task would be taken up by full HPMV vehicles operating up to 62 tonnes. Vehicle numbers and safety impacts would therefore be lower in this situation.

No difference in crash rate assumed between full HPMVs and 50MAX vehicles

- It is assumed there is no difference in crash rate between full HPMVs and 50MAX HPMVs. The crash risk exposure measure applied in this analysis is that calculated across both full HPMVs and 50MAX for the 2013 MER. This measure, while readily available, is now becoming out-dated as total HPMV numbers grow and 50Max vehicles become an increasingly prevalent subset of HPMVs. Update of this data could provide more accuracy if the safety aspect of this overall project is considered a critical influencing factor.

2013 MER assumed HPMV plated vehicles were not in 44T combinations at the time of a crash

- It is assumed that HPMV vehicles only operate as HPMV vehicles. HPMV plated trailers could be involved in crashes while combined with standard 44 tonne trucks. This could influence the crash risk exposure data for HPMVs if standard 44 tonne vehicles had a materially different crash risk. There is no evidence that this is the case however.

Heavy vehicle density

- It is assumed the crash rate per vehicle kilometre of travel does not vary with density of heavy vehicles.

Time of day and day of week

- It is possible that an increased propensity for the rail sourced freight to move during daylight hours and on weekdays could change the crash risk. While analysis of truck crashes in New Zealand (Colin Morrison 2013) indicates distinct time of day and day of week patterns - it is not clear whether this simply reflects changes in heavy vehicle volumes at these times and days. Further work would be required to assess whether there is a real change in crash risk per VKT across time of day and days of week.

Level crossing risk reduction

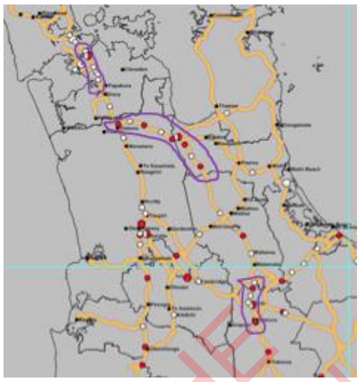
- Any increase in road crashes is likely to be partially offset by a decrease in level crossing incidents.

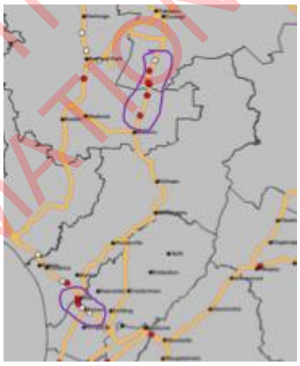
- Each collision with a train recorded in the 2009 - 2013 period has been reviewed to identify whether the collision was with a freight train in order to exclude commuter service or other service such as the MOTAT or Christchurch tram. We assume an 100% reduction in the following annual average level crossing crashes over the last five years:

    - Fatal. 1.6 average crashes per year
    - Serious. 4.0 average crashes per year
    - Minor. 5 6 average crashes per year

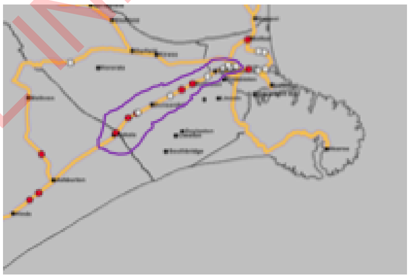
Appendix four

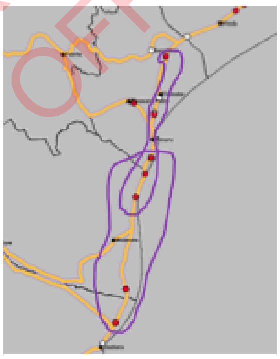
Identification of potential heavy vehicle crash black spots. Expert visual selection by *Fergus Tait, National Manager Traffic and Safety, Highways and Network Operations, NZTA of* potential risk sites based on crash incidence with no adjustment for traffic density.





Key:
Red dot = fatal 2009 - 14
White dot = Serious 2009-14



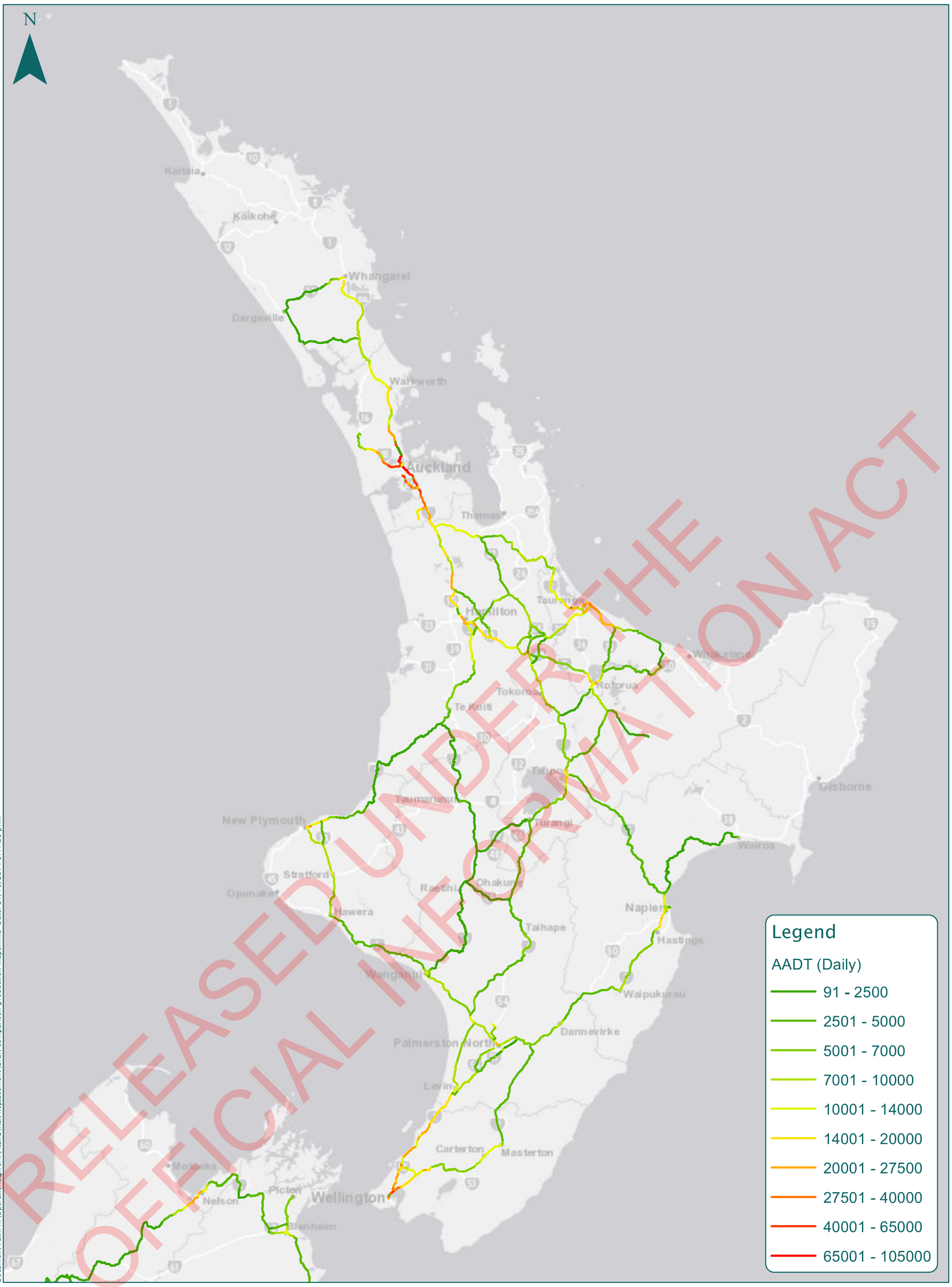


Appendix five

Current AADT - all vehicles. North and South Islands

Current AADT - heavy trucks - North and South Islands

Additional trucks - North and South Islands

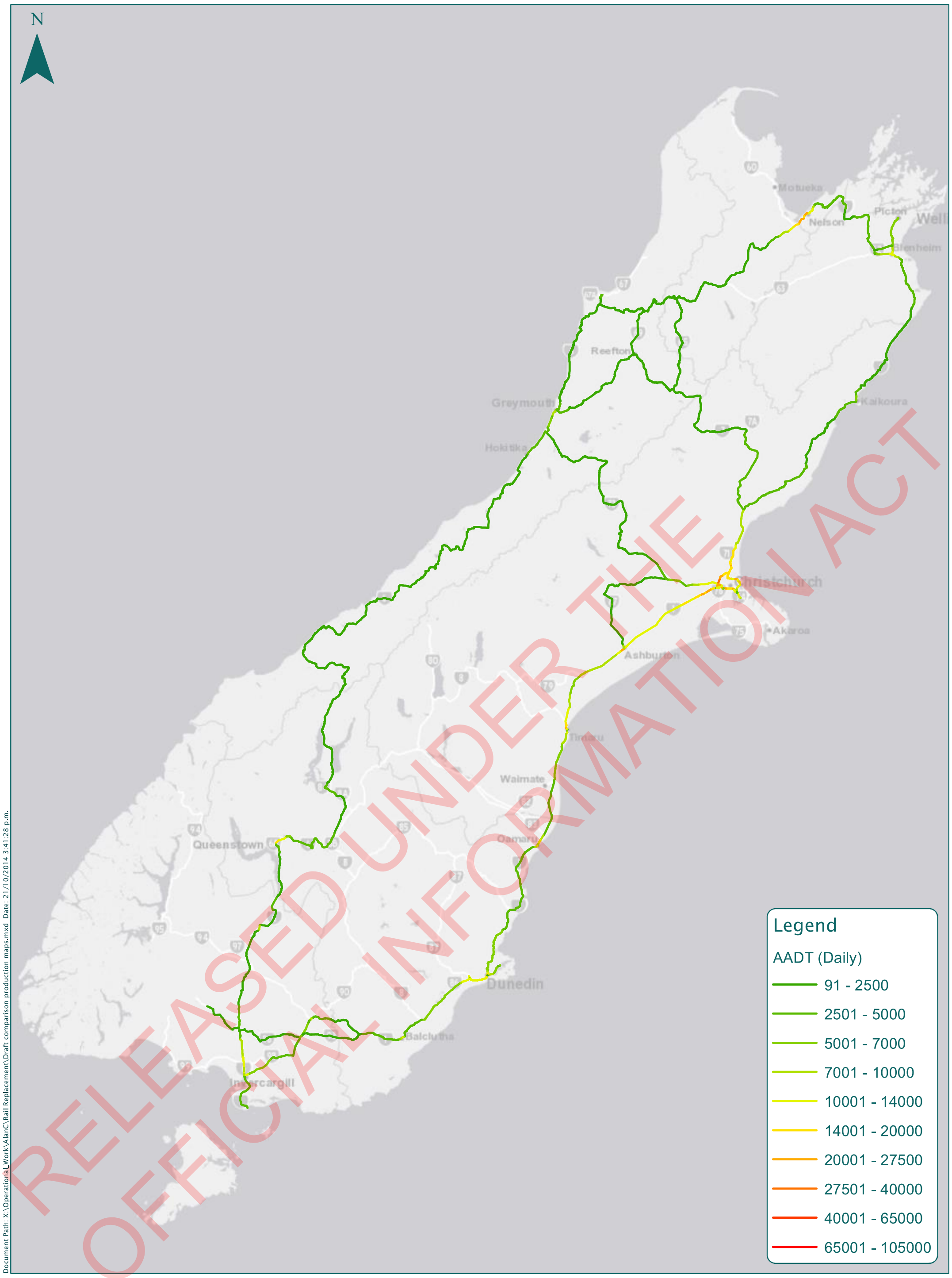


NZ TRANSPORT AGENCY WAKA KOTAHI

AADT

North Island

0 50 100 km

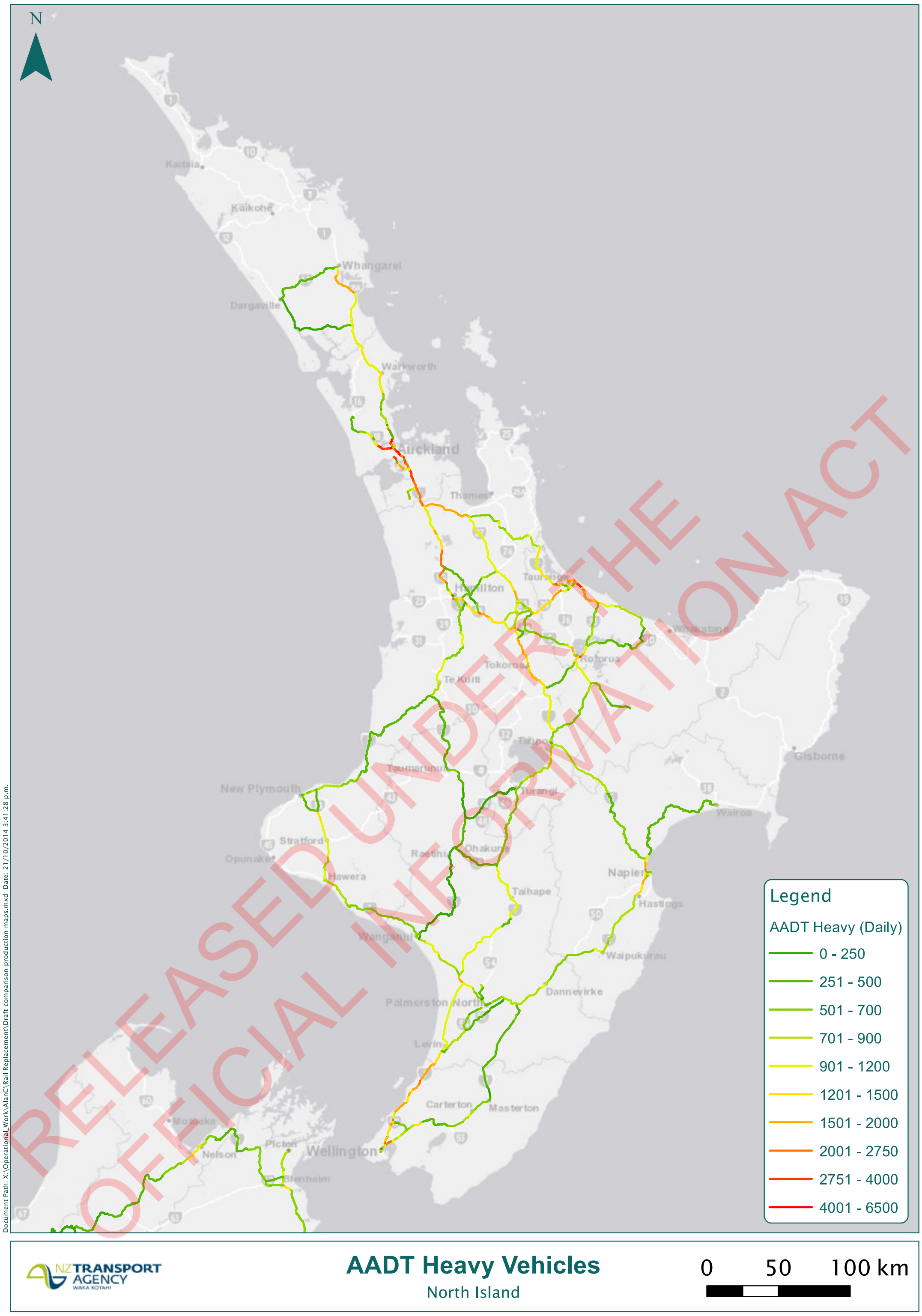


NZ TRANSPORT AGENCY

AADT

South Island

0 50 100 km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Whangarei
Dargaville
Warkworth
Auckland
Thames
Hamilton
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Whakatane
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Tokoroa
Te Kuiti
Taupo
Taumarunui
Turangi
New Plymouth
Stratford
Opunake
Hawera
Raetihi
Ohakune
Taihape
Napier
Hastings
Waipukurau
Dannevirke
Wanganui
Palmerston North
Levin
Carterton
Masterton
Wellington
Wairoa
Gisborne
Motueka
Nelson
Picton
Blenheim
Legend
AADT Heavy (Daily)
0 - 250
251 - 500
501 - 700
701 - 900
901 - 1200
1201 - 1500
1501 - 2000
2001 - 2750
2751 - 4000
4001 - 6500
NZ TRANSPORT AGENCY
WAKA KOTAHI
AADT Heavy Vehicles
North Island
0 50 100 km
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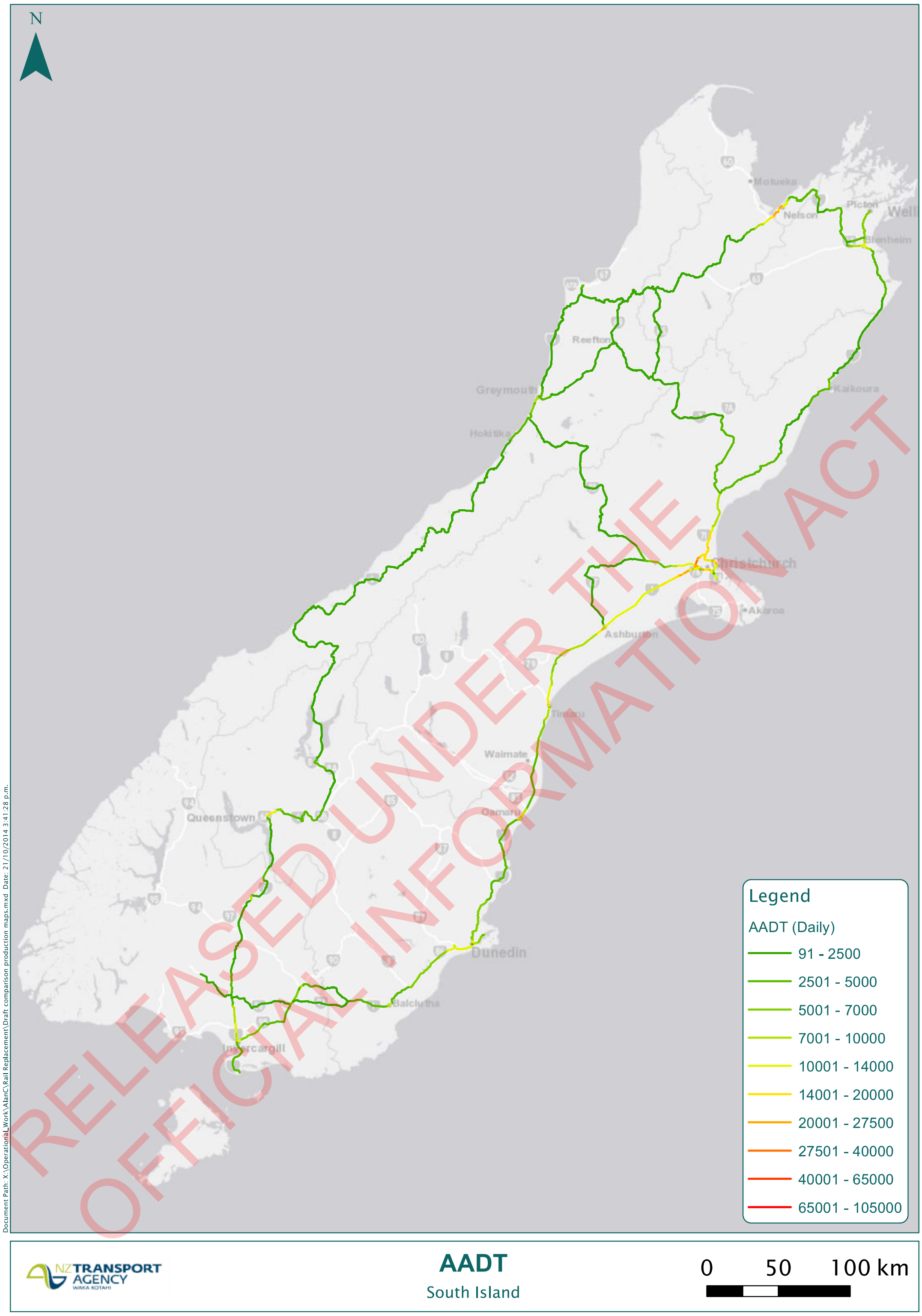
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Kaikoura
Christchurch
Akaroa
Ashburton
Timaru
Waimate
Oamaru
Queenstown
Dunedin
Balclutha
Invercargill
Legend
AADT (Daily)
91 - 2500
2501 - 5000
5001 - 7000
7001 - 10000
10001 - 14000
14001 - 20000
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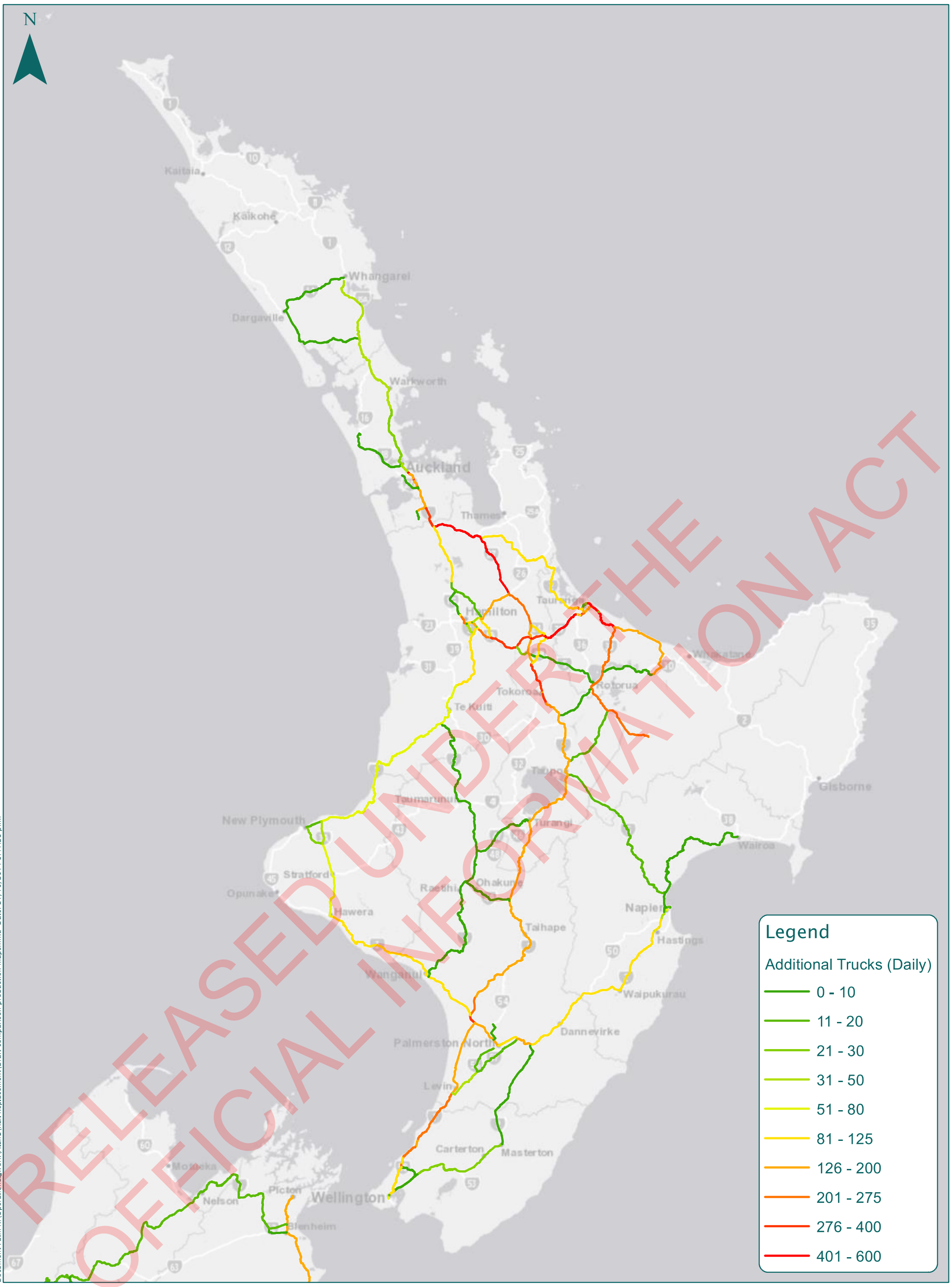
40001 - 65000
65001 - 105000
RELEASED UNDER THE OFFICIAL INFORMATION ACT
AADT
South Island
0 50 100 km

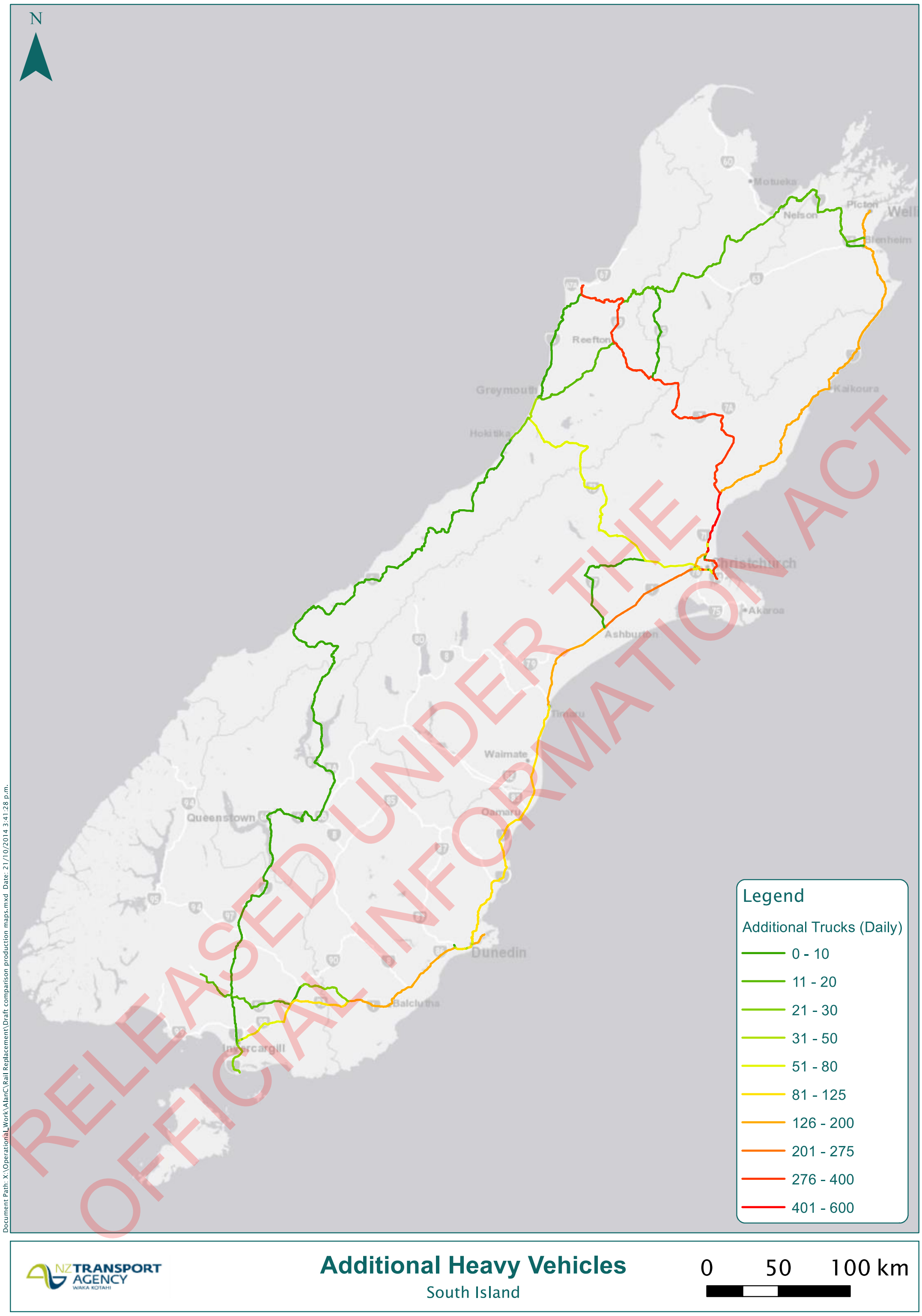


NZ TRANSPORT AGENCY

Additional Heavy Vehicles

North Island

0 50 100 km



Additional Heavy Vehicles
South Island