Pavement IAP Section 2 01 Pavement Lifecycle Plan final

Draft version February 2015

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If you have further queries, call our contact centre on 0800 699 000 or write to us:

NZ Transport Agency
Private Bag 6995
Wellington 6141

This document is available on the NZ Transport Agency’s website at www.nzta.govt.nz

Contents

1. SCOPE AND STATUS OF THIS PLAN

This plan reflects the management of current and future infrastructure to provide the targeted customer levels of service. It does not reflect the acquisition or disposal or improvement of infrastructure initiated to change throughput, effective speed or mid-term safety.

This is a draft plan. It supports the draft SHAMP 2015.

It will be revised as the SHAMP is finalised and over 2015 – 2017 in preparation for the SHAMP 2018.

2. OVERALL BUSINESS CASE

The need for road pavements

Road pavements are primarily built and maintained to provide effective access for vehicles at the least cost.

They are built so that they also support safe and comfortable travel at the operating speed of the road.

Road pavements play a key role in the movement of people and goods and contribute to New Zealand's economic and social environment. These roles are indicated below:

Movement of people & goods	Daily traffic
	Heavy commercial vehicles
	Pedestrians and cyclists
	Buses
Economic and social	Linking places
	Connectivity
	Freight –coastal and inland ports
	Airport passengers
	Tourists
	Hospitals and essential services

By providing road pavements that are fit for purpose for each of the One Network Road Classifications we support delivery of the following customer levels of service, for each classification at the effective travel speed:

- Effective access
- Safety
- Amenity – comfort
- Cost effectiveness

And so contribute to making the transport system:

- Effective – by assisting people and freight go where they need to go in a timely manner
- Efficient – by targeting the ONRC levels of service, more efficiently each year
- Safe – by supporting safe travel at the effective speed for each classification
- Resilient – by having sufficient strength and capacity to carry the freight of today and tomorrow.

The state highway network

The state highway network is a significant national asset, made up of 11,373 kilometres of roads. While the state highways make up only 10% of New Zealand roads, they transport 50% of the country's general traffic and 70% of freight.

Road pavements make up approximately $12 billion (41%) of the total depreciated replacement value of all state highway assets ($29 billion, figures exclude land under roads $9 billion).

Effective and efficient management of road pavements

2.1.1 Approach

Annual expenditure on the repair and renewal of road pavements is about 50% of total maintenance and renewal spend. Therefore an advanced strategy for optimising expenditure in pavement renewals is critical, but this must be balanced against providing the fit for purpose customer levels of service.

The New Zealand Transport Agency has implemented a significant change to the way it asset manages pavements.

This is built around three principles:

1. Only intervene
    - when there is a performance failure (or too great a risk of one)
        - eg skid resistance treatments, unsafe potholes
    - or earlier when this is the least-cost option long term
        - eg resurfacing before cracks propagate leading to significant maintenance after water ingress into the pavement.
2. Adopt an aggressive approach, taking risks in proportion to the purpose and classification of the road, generally
    - Take few risks on higher classification roads
    - Take greater risks on lower classification roads
    - Only take managed risks.
3. Adopt a continual improvement approach, learning from experience
    - Evidence based decisions
    - Review the success of decisions
    - Sector experience and research
    - Adjust practice.

The key elements of this approach used in the development of the proposed 2015-18 programme include:

- Using a standard nationwide approach to analysing and proposing pavement works at the minimum sustainable level, and using this as the basis for regional planning
- Introducing and developing decision support analytics
- Introducing and using enhanced decision support tools, eg Juno viewer, to provide suitable information to decision makers in the field
- Adopting a more robust ‘macro’ treatment selection process than that required by the *Economic evaluation manual*, using enhanced net present value and cash flow analysis
- Reviewing and adjusting proposed renewal programmes on a consistent basis nationwide, using the RAPT process
- Being clear about the root cause of defects and treating those, eg through enhanced drainage programmes
- Initiating a monitoring framework that will measure the success of deferring works.

The key elements that are being progressively introduced over 2014-2018 include:

- Accepting ownership for the risk associated with the scope and treatments of the renewals programme implemented inside the NOC procurement model
- Procuring and undertaking activities at efficient costs within the NOC model
- Requiring that NOC contracts deliver quality works through the quality assurance elements of the NOC contract
- Introducing the Traffic Speed Deflectometer to increase understanding of the strength of state highway pavements, and indicate remaining pavement lives and hence the scale of forward programmes
- Trialling laser and image scanning techniques that will provide effective assessment of surface condition by measuring cracks, scabbing, etc, and potentially implementing these to provide 100% objective measurement of all faults currently assessed through visual rating
- Working through the NZTA research programme to develop a feasible means of determining pavement moisture content on a network wide and site specific basis to improve the timing of resurfacing, understanding failure mechanisms to improve treatment selection and scoping, and the targeting of drainage maintenance and renewal works.

These initiatives are part of our approach to increasing the effectiveness and efficiency of pavement management required to deliver the customer levels of service with increasing efficiency.

An efficiency programme was initiated about three years ago with the M&O review and has resulted in 4% savings in 2014/15. Further details of this approach are in the *Infrastructure asset management plan*.

2.1.2 Recent efficiency gains

An efficiency programme was initiated about three years ago with the M&O review and has resulted in 4% savings in 2014/15. This result also reflects a big effort to lower costs.

The Agency has only recently seen the benefits of these changes. Over the last three years, about $120 million of savings have been achieved compared to prior expenditure trends, despite input price increases and increases in the scale and complexity of the network.

The base preservation levels for resurfacing are now 840 km/yr, about 150 km/yr less than previous programmes. This is an indicator of the efficiency gains from the Transport Agency’s approach.

The forward budget challenge is expected to require 4% saving each year over the next 10 years. For pavements, about half of this may be achieved through effectiveness gains in the renewals programme.

2.1.3 Infrastructure performance

The Transport Agency has analysed historical pavement trend performance over the last 5 years. The main indicators for typical levels of service on the state highways are:

- Access
  - Route availability
- Safety correlated
  - Rutting
  - Skid resistance performance
- Amenity - comfort correlated
  - Roughness

Section performance provides performance outcomes for the entire state highway network. In summary, the main results are that performance metrics meet targeted levels. This means that when applying its intervention strategy, the agency is able to reduce maintenance and renewal programmes targeting lower long term sustainable costs.

However, skid resistance targets are not met everywhere yet, and until recently treatments were inefficient as indicated by short lives of road surfaces in high stress areas. In response we have established a dedicated fund within the pavement work categories to address skid resistance, and are selecting more durable treatments using high friction aggregates or specialist products eg melter slag, in areas of greatest demand. These treatments provide better performance and longer service lives at a higher cost. We expect that as a result, the skid resistance deficit will be eliminated, and there will be a significant reduction in the length of network with skid resistance issues over the next ten years as existing road surfaces are replaced, resulting in improved performance at reduced long term cost.

2.1.4 Infrastructure condition

The state highway network is in reasonable condition. Because of this the short term base preservation levels for resurfacing and pavement rehabilitation are below long term sustainable levels.

Figure 1: Proposed works vs base preservation quantities (chip seal)

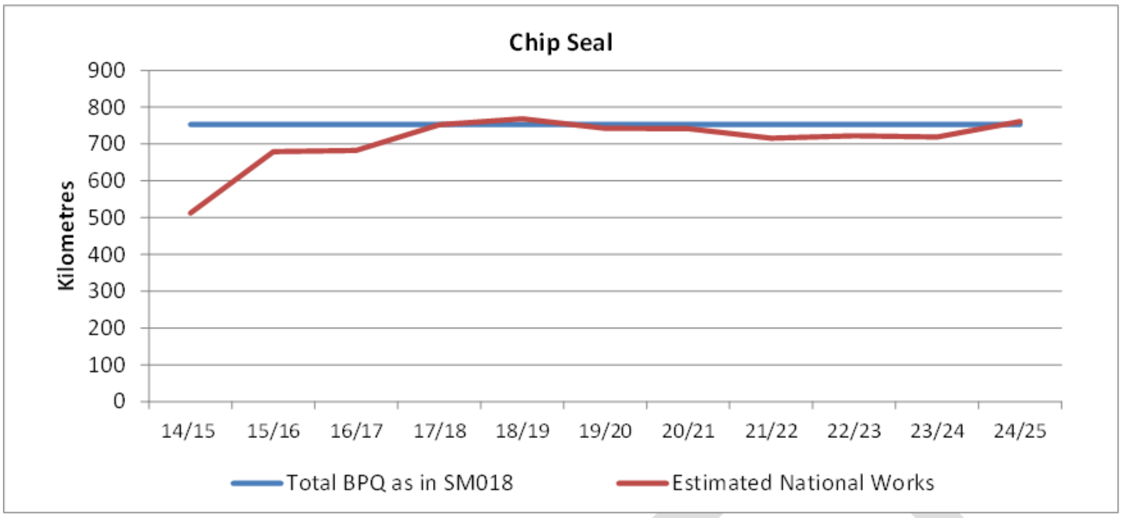


Figure 2: Proposed works vs base preservation quantities (TAC)

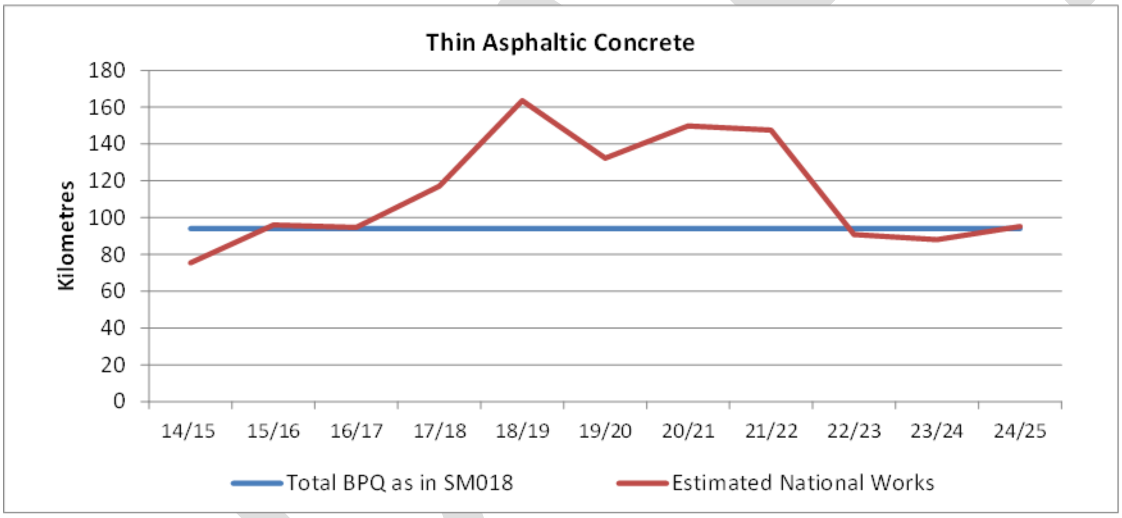
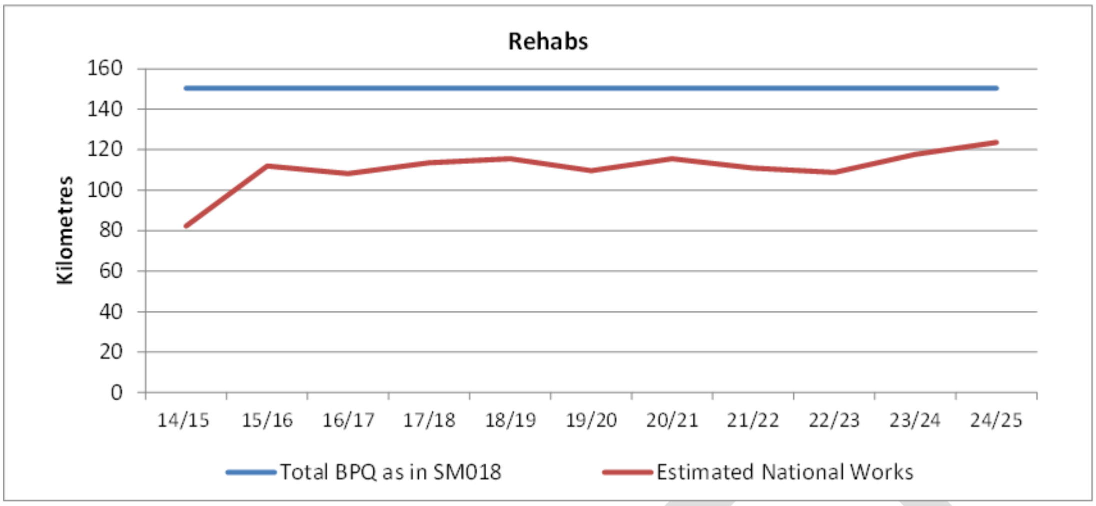


Figure 3: Proposed works vs base preservation quantities (rehabs)



The general reduction in renewal works is allowing the condition of the network to adjust to a new stable state, whereby about 10% of surfaces that are serviced a year later than usual will generally be more deteriorated before they are replaced. This will cause a small drop in the average condition of the network.

Figure 4: Example of a low classification road deferred by the RAPT

Figure 5: Typical condition of a deteriorated road surface deferred by the RAPT

2.1.5 Programme development

The proposed programme for 2015-18 describes the pavement repair and renewal works expected to be implemented in order to deliver the targeted levels of service with the forecast change in network asset condition.

The proposed programme for 2015-18 was developed in conjunction with preparation of the 2014/15 annual plan.

The robust process used involved:

- Developing and issuing ‘Annual Plan Instructions’, which
  - Described the process to be used
  - Set out the base preservation quantities for each network
  - Set out the net present value process.
- Regions developing proposed programmes with their supply chain partners
  - Develop and review optional treatment strategies
  - Evaluate options and recommend best option
  - Document decision, target performance, evidence and analysis used
  - Collaborating with the National Office in monitoring all the sites that have been deferred.

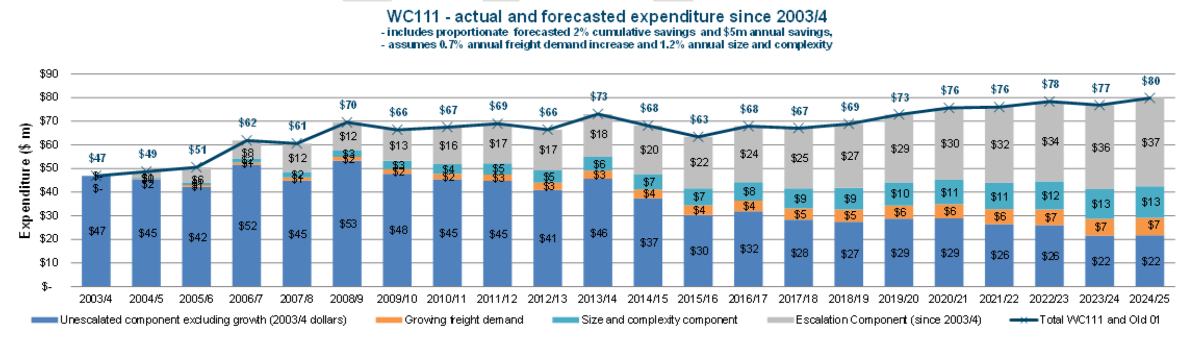
- Nationwide review and moderation of proposals through
    - RAPT reviews – and subsequent programme adjustment
    - Challenge sessions
    - Nationwide moderation of proposals.

The inputs used are:

- Past network expenditure, and works for maintenance, resurfacing and rehabilitation
- Trends in network condition
- Draft GPS funding ranges
- Visual inspection
- Efficiency targets of 4% indicative
- The revised intervention and risk strategy
- Level of service targets for the SH classification
- Forecast changes in demand using the Treasury's forecasts of freight growth
- Forecast impacts on the programme from completed capital projects, and state highway revocations
- Forecast input price changes
- Contractual obligations
- The current forward works programme as base of developing the 10 year plan
- Forecast impacts of the Network Outcomes Contract rollout
- Nationwide costs applicable to the pavement programme.

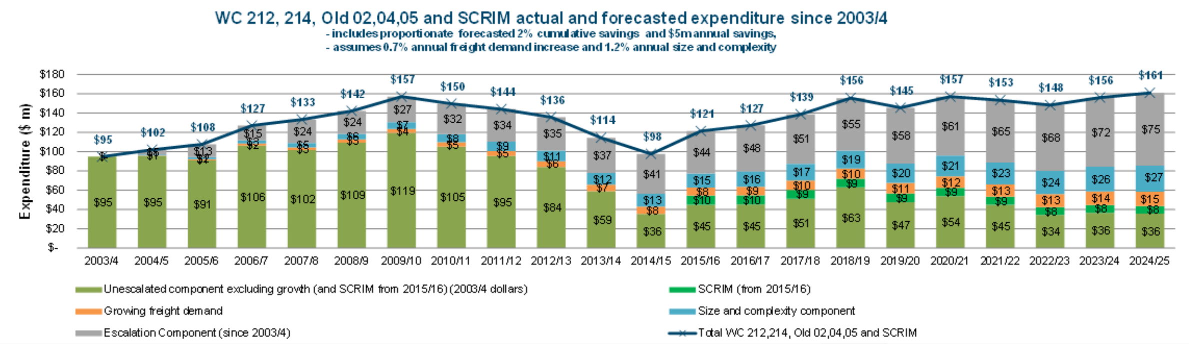
The resulting network programmes were apportioned to each relevant regional council and entered in TIO.

Figure 6: Pavement maintenance: past and forecast expenditure in real and nominal terms



This figure indicates reductions in forecasted real pavement maintenance expenditure, showing efficiency and effectiveness improvements in comparison to past expenditure versus all the extra components due to growth in freight, escalation cost increases and extra maintenance due to the growing size of the state highway network as a result of the capital improvement programme.

Figure 7: Pavement renewals: past and forecast expenditure in real and nominal terms



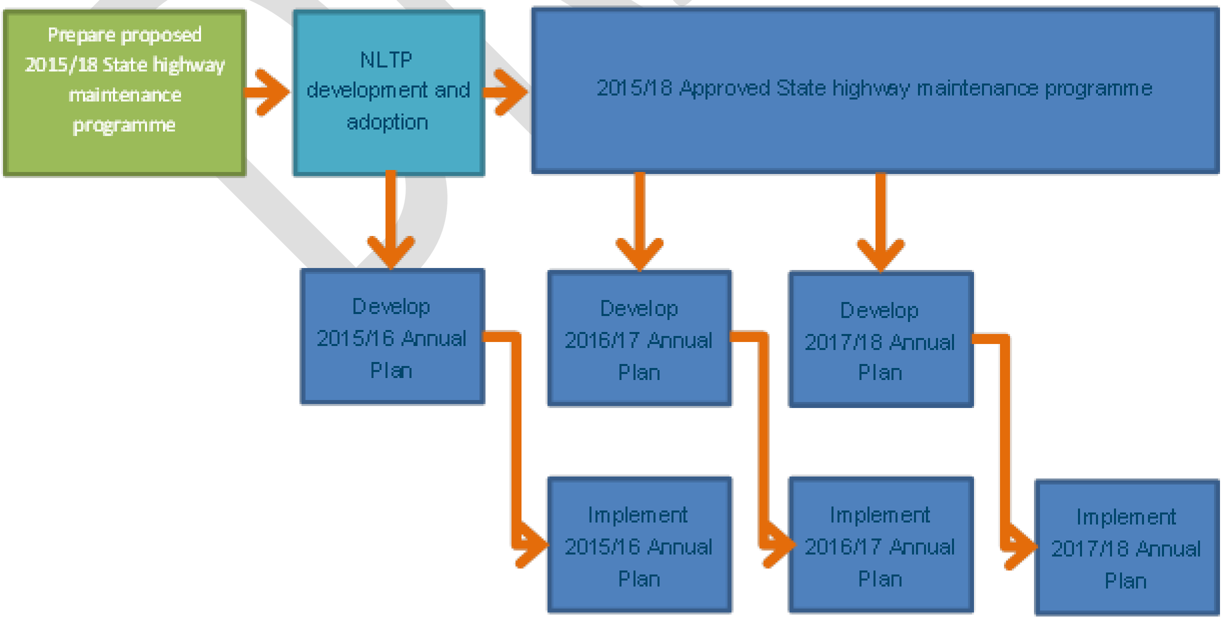
This figure indicates reductions in forecasted real pavement maintenance expenditure, showing efficiency and effectiveness improvements in comparison to past expenditure versus all the extra components due to growth in freight, escalation cost increases and extra maintenance due to the growing size of the state highway network as a consequence of the ongoing capital improvement programme.

The above figures represent the pavement activities (reactive and renewal) of this aggressive programme. The intention is to continue with a ‘flat line’ budget for the continuing programme, where the Agency will continue to save on average $20m/year (approximate). This strategy takes into account the increased risk of distressed pavements and premature pavement failures.

2.1.6 Programme implementation

The programme approved in the 2015-18 NLTP will be implemented through three annual plans as indicated in the diagram below.

Figure 8: The relationship between the 2015-18 NLTP programme and annual plans



2.1.7 Developing each annual plan

Each annual plan is developed using a similar process to that used for the development of the three year programme. The process involves:

- Developing and issuing 'Annual Plan Instructions', which
  - Described the process to be used
  - Confirming the base preservation quantities for each network supported by a detailed drive through the network
  - Set out the treatment selection and prioritisation process.
- Regions developing proposed programmes with their supply chain partners
  - Develop and review optional treatment strategies, eg drainage works to reduce deteriorations work, local AWT and resurfacing, pavement rehabilitation
  - Evaluate options and recommend best option
  - Document decision, evidence and analysis used.
- Nationwide review and moderation of proposals through
  - RAPT reviews – and subsequent programme adjustment
  - Challenge sessions
  - Nationwide moderation of proposals.

The inputs to be used:

- Past network expenditure, and works for maintenance, resurfacing and rehabilitation
- Trends in network condition
- Approved funding for state highway maintenance, related levels of service targets and risk
- Visual inspection
- Efficiency targets
- The revised intervention and risk strategy
- Level of service targets for the SH classification
- Forecast changes in demand using the Treasury's forecasts of freight growth
- Forecast impacts on the programme from completed capital projects, and state highway revocations
- Forecast input price changes
- Contractual obligations
- The current forward works programme
- Forecast impacts of the Network Outcomes Contract rollout
- Nationwide costs applicable to the pavement programme

Each annual plan will be adopted and published in April before the year starts to give network managers and suppliers sufficient confidence to proceed with preparatory planning and work.

2.1.8 Delivering and developing the annual plans in each network

The Transport Agency has changed its contract model for procuring maintenance and operations for the state highway network. The new NOCs wrap the previous traditional, hybrid and PSMC contract models into a new procurement approach that contains the best elements of all three.

Smarter asset management and expectations to deliver efficiency savings are embedded within the NOC, including the right outcomes, tensions, investment level and the right behaviours. These approaches are adopted by the suppliers in their Maintenance Management Plans and in their Quality Assurance Plans.

The contracts are targeting an efficiency gain as distinct from a cost cut. This will be delivered through:

- New Levels of Service that are reflected inside the Operational Measurements (OPMS), delivering a similar level of service to customers with a reduced level of input
- Ownership of the asset and taking a greater risk of potential failure.

This will provide the flexibility to vary renewals quantities based on robust NPV analysis and take more risk in deferring treatments via the RAPT process.

Suppliers report their progress to plan, standard and performance target. Audits confirm the validity of reports.

The Network Outcomes Contracts reward suppliers for continued good performance through potential extension of term, and respond to performance below target through reduction in payment, or in the case of extreme poor performance through reduction in term.

The achievement of works implemented and decisions to defer works are both monitored and inform process improvement and future programme development.

The NOCs will provide better condition and maintenance cost information in order to more effectively target maintenance and renewals.

Assessment of the pavement repair and renewal programme

2.1.9 Strategic fit

Table 1: Indicative assessment of strategic fit

Links to planning	The lifecycle management plan for pavements supports and is in keeping with the 2015-18 State Highway Activity Management Plan. The Strategic Case has been endorsed.	H
Customer levels of service	The customer levels of services target by this plan are transitioning from those adopted for the state highway classification framework, and those similar service levels of the One Network Road Classification. Other elements of the state highway programme are targeting the gaps in service. This plan targets the challenge to maintain service levels increasingly efficiently. It is targeting both effective ongoing achievement of service targets, and reducing cost. The skid resistance aspect of the programme represents an exemplary approach. The ring fencing of a skid resistance fund, the innovative use of imported chip and melted slag to improve the cost effectiveness demonstrate improvement made to practices to close the efficiency gaps. This will clearly demonstrate an extension of the life of surfacing without compromising the safety of the roads. Both the extension of the default NPV calculations of the EEM to recognize the travel time impacts of alternative intervention strategies, and the trialling of long life OGPA demonstrate by example closing the efficiency gap in the travel time impacts of pavement asset management. The enhancement of quality assurance processes through the Network Outcomes Contracts will reduce the frequency of early failures and increase the service lives of pavement renewals both of which reduce the impact of the programme on our customers. The different approaches to higher and lower classification state highways demonstrates the targeting of effort in favour of the most important routes that carry freight, tourists.	H

We believe that the initiatives include in the programme that improve its effectiveness and efficiency through initiatives addressing long term planning goals and customer service levels indicate that its rating should be above the 'default' medium rating at High.

2.1.10 Benefit and cost appraisal

The state highway network, and networks is and are nearly unique in the country making cost appraisal challenging. The considerations we have made in this area are shown in the following table.

Table 2: Indicative appraisal of benefit and cost

Present value method	The dtims modelling, and review of past treatment and condition trends used to develop the base preservation quantities that are the foundation of the surface and renewals programmes in the Network Outcome Contracts have in essence been derived using a PV style method. Treatment selection for pavement rehabilitation requires use of the enhanced Net present value method that HNO has adopted that enhances the default EEM method.	H
Benchmarking method	When developing base preservation quantities per network we considered the past trends in renewal work quantities and the trend in condition, reducing the target quantities when there has been previous periods of significant work, and positive condition trends, eg Taranaki. Similarly, networks such as Wellington it reduced programmes and worsening condition have higher than non-renewals programmes. The performance management framework that is inherent in the Network Outcomes Contracts, and the increased focus we are applying to benchmarking by the newly established HNO Performance Management Scheme all demonstrate a commitment to measure network performance and embed the learnings in changed practice. The total network costs are reducing in line with the reduced quantities.	H

In theory the cost appraisal should compare costs to the norm, but there is no natural norm for state highways. While it might be tempting to consider each network against the norm for state highways that is in fact meaningless because if they were all perfectly efficient then the costs in each network would still be different because of the external factors, and these alone would be the cause of any difference.

What we can say is that the significant costs have been addressed using a PV method, and each network's benchmark trends in programme and condition have been considered, so the processes used meet the test for a high rating.

2.1.11 Effectiveness

Table 3: Indicative assessment of effectiveness

Outcomes focused	The current level of service framework used is similar to that of the ONRC. This SHAMP gives the commitment to full adoption by 2018-21.	M
Integrated	The pavement asset management approach embedded in the Network Outcome Contract has been agreed and adopted in the networks where there are shared service arrangement, eg Marlborough Roads, Tairawhiti Roads, WBOP. The pavement rehabilitation programme is coordinated with the minor safety programme by improving road geometry during the renewal works. Treatment designs are sensitive to context. In peri-urban areas noise mitigating surfaces are commonly used. In provincial towns special surfaces are used to meet the needs of state highway users and also pedestrian and other modes, and shop keepers and their customers and similar place based considerations.	H
Correctly scoped	The net present value method used and the RAPT process, plus the consideration of other programmes such as drainage all indicate significant effort is being made to correctly scope works, the reduced programme in part demonstrates the success of this. The Net present value method adopted test do-maintenance as a required alternative to a do-renewal treatment. The preparedness to reduce scope of area wide treatments on lower classification roads demonstrates targeting works to the correct scope for the circumstances.	H
Affordable	The development of the base preservation quantities and the use of an enhanced net present value methodology, plus the RAPT process have reduced costs. The fit of the total programme within the GPS funding ranges demonstrates affordability.	H
Timely	The willingness to take risks by deferring works on lower classification roads indicates progress to more timely interventions. The NPV and RAPT processes challenge the timing of works. The outcome is often a deferral of works where the risk of failure is low. While improvement is being made, no ideal framework has	M

	yet been developed.	
Confidence	Greater risks are being taken on lower classification roads by deferring works. A measuring regime is in pace to assess the outcomes of this approach and to inform process improvement. The development of objectives crack, heave shove and moisture content measurement will aid confidence. The use of both deterministic and stochastic approaches to renewal programme development demonstrates intent to manage uncertainty in forecasting, and therefore manage risk.	H

Summary

The proposed programme represents an aggressive approach to delivering access safely and comfortably along the state highway network. The proposals were formulated both by a nationwide top-down approach and by a detailed bottom up approach. The proposals target reduced unit costs compared to the 2015-18 period. The targeted reduction requires the ongoing continual improvement processes of this plan to identify and deliver further gains in the effectiveness and efficiency of pavement management to achieve the overall 4% gains sought.

3. ASSET OVERVIEW

Asset type and sub-types

The pavement asset group is divided into the following asset types and sub-types:

- Formation (subgrade and stabilisation)
- Pavement (sub-base, basecourse and shoulder basecourse)
- Surfacing (chip seal, asphaltic concrete)

Diagrams of the road pavement layers as referred to in this document are provided in the figure below for typical rural and urban roads:

Figure 9: Typical rural road cross section

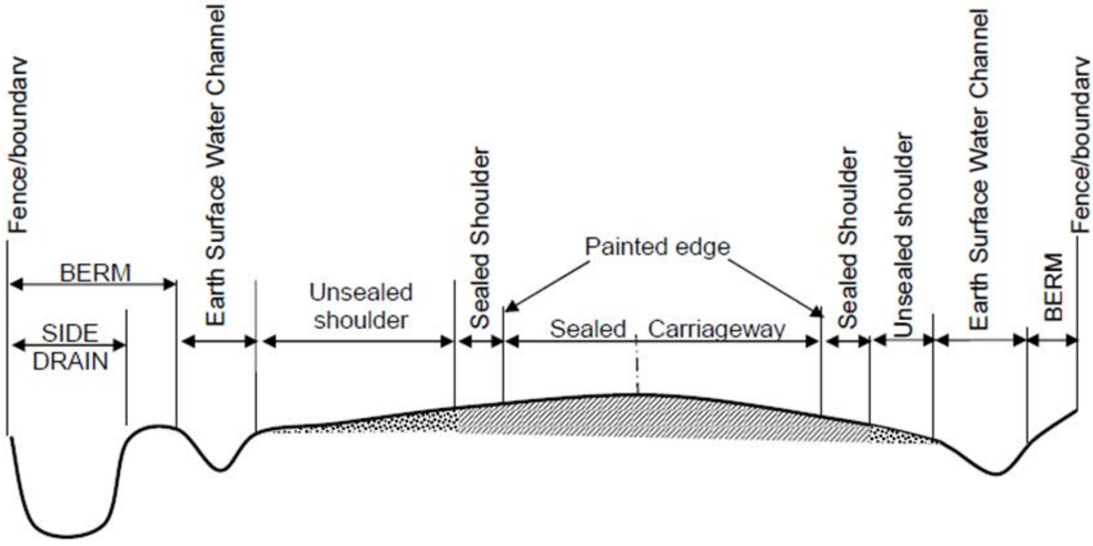
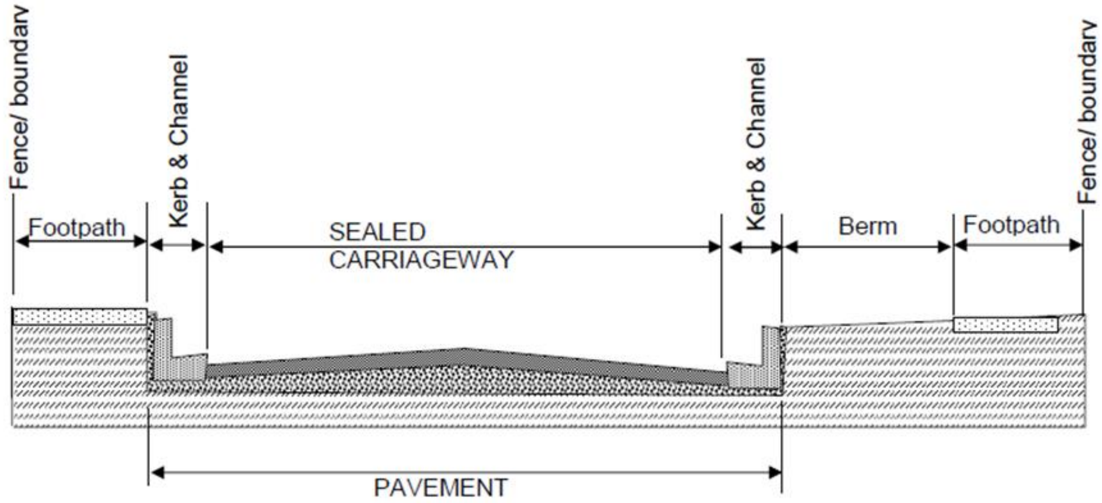


Figure 10: Typical urban road cross section



Tables of quantities by network and by classification showing:

- Lane km
- Pavement type (unbound, unbound modified, bound
- Surface type

Table 4: State highway pavement quantities

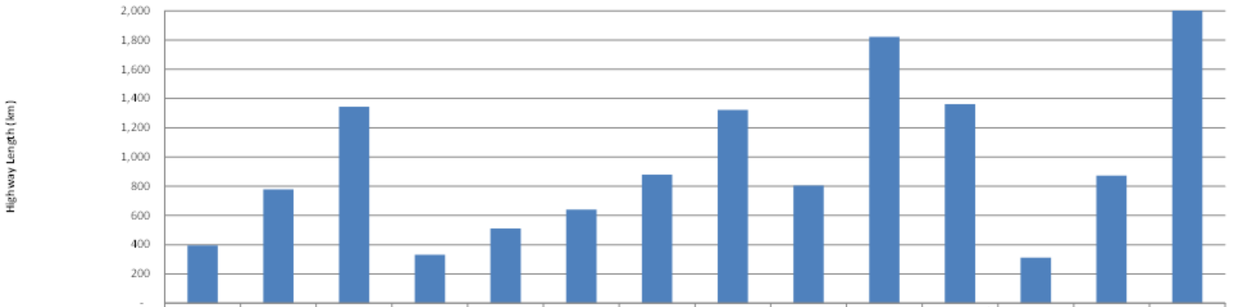
	High Volume		National Strategic		Regional Strategic		Regional Connector		Regional Distributor		Total Length	
	Network length	Lane length	Network length	Lane length	Network length	Lane length	Network length	Lane length	Network length	Lane length	Network length	Lane length
												(km)
Pavement Type												
Unbound	315.4	1,024.8	713.4	1,535.0	1,415.2	2,989.1	1,147.8	2,317.9	2,433.5	4,889.1	6,025.2	12,755.9
Unbound modified	83.7	222.0	144.5	313.7	301.6	637.4	167.8	335.7	512.3	1,029.8	1,209.8	2,538.5
Bound	28.4	116.3	6.6	14.8	14.8	35.7	0.4	1.1	8.1	16.9	58.2	184.8
Unknowns*	581.1	887.6	472.7	997.6	642.3	1,281.9	962.3	1,911.6	1,319.0	2,637.9	3,977.4	7,716.6
With ramp and roundabout												
Unbound	364.6	1,091.5	714.0	1,535.6	1,421.5	2,996.4	1,148.3	2,318.6	2,433.5	4,889.1	6,081.9	12,831.3
Unbound modified	87.9	227.5	144.5	313.7	302.0	637.8	167.8	335.7	512.3	1,029.8	1,214.4	2,544.4
Bound	51.4	153.5	6.6	14.8	15.2	36.3	0.4	1.1	8.1	16.9	81.6	222.7
Unknowns*	647.5	981.8	477.1	1,003.3	651.0	1,293.6	964.6	1,914.8	1,319.9	2,639.3	4,060.0	7,832.8
Surface Type												
Chipseal	373.7	772.2	1,191.2	2,501.1	2,161.4	4,453.9	2,164.3	4,331.1	4,087.5	8,191.2	9,978.0	20,249.5
Asphaltic concrete	621.9	1,425.7	123.4	249.1	184.2	378.3	87.1	179.5	110.0	220.7	1,126.5	2,453.3
Others	12.4	26.1	22.4	46.8	28.6	60.2	26.9	50.7	43.4	86.8	133.7	270.6
Unsealed	-	-	-	-	-	-	-	-	32.0	64.0	32.0	64.0
With ramp and roundabout												
Chipseal	387.3	787.2	1,191.2	2,501.1	2,169.9	4,464.2	2,165.2	4,332.6	4,088.1	8,192.2	10,001.7	20,277.2
Asphaltic concrete	737.7	1,591.0	126.8	254.0	190.0	387.0	87.4	180.0	110.2	221.0	1,252.1	2,633.0
Others	25.2	44.7	23.8	48.3	30.1	61.8	28.4	52.7	43.4	86.8	151.0	294.2
Unsealed	-	-	-	-	-	-	-	-	32.0	64.0	32.0	64.0
Total												
Without ramp and roundabout	1,008.6	2,250.6	1,337.2	2,861.1	2,373.8	4,944.1	2,278.2	4,566.3	4,272.9	8,573.6	11,270.6	23,195.7
With ramp and roundabout	1,151.3	2,454.4	1,342.1	2,867.5	2,389.7	4,964.2	2,281.0	4,570.1	4,273.8	8,575.1	11,437.9	23,431.2

Note this table reflects the information in RAMM, missing information causes an under-reporting of quantities. Network length by surface type is calculated using the predominant surface type in its lanes.

The NZ Transport Agency owns and operates 11,438 km of state highways (including roundabouts and ramps) with the longest lengths located in Waikato, Otago and Canterbury. The figure below provides a breakdown of the total highway lengths for each region.

Figure 11: Highway lengths per region (km)

Source: RAMM information June 2014



	Auckland	Bay of Plenty	Canterbury	Gisborne	Hawkes Bay	Nelson/ Marlborough	Northland PSMC	Otago	Southland	Waikato	Wanganui/ Manawatu/ Taranaki	Wellington	West Coast	Total
2014 Highway Length (km)	394	778	1,344	331	512	641	878	1,322	805	1,821	1,363	312	872	11,373
% of Total	3%	7%	12%	3%	4%	6%	8%	12%	7%	16%	12%	3%	8%	100%

Land and formation

Land and formation are defined as follows:

- Land area - this is the area of the road corridor.

Land under roads is valued at $8.8 billion and does not depreciate.

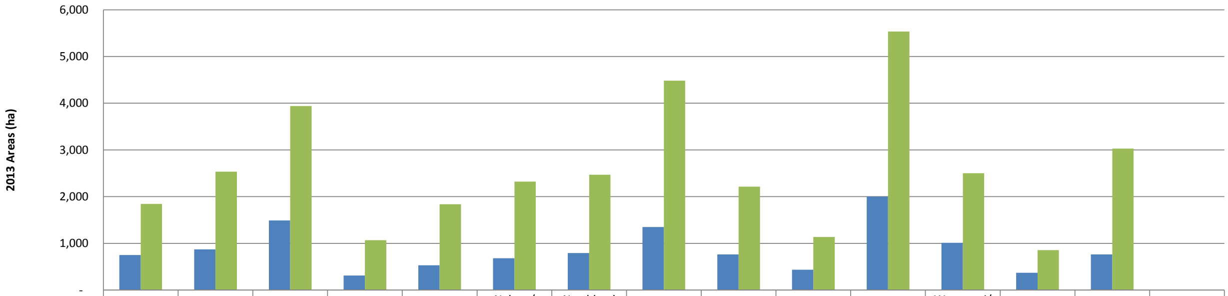
- Formation - the carriageway formation includes all earthworks necessary to prepare the cut and fill batters and bring the road foundation up to the underside of the sub-base, including the construction of earth surface, water channels and berms.

Formation under roads is valued at $7.8 billion and does not depreciate.

The land and formation per region is summarised in the figure below:

Figure 12: Land and formation by location (2013

Source: RAMM information June 2014



	Auckland	Bay of Plenty	Canterbury	Gisborne	Hawkes Bay	Nelson/ Marlborough	Northland PSMC	Otago	Southland	Taranaki	Waikato	Wanganui/ Manawatu	Wellington	West Coast	Total
Formation (ha)	749	870	1,491	310	530	680	792	1,348	762	435	2,001	1,011	371	763	12,114
Land Area (ha)	1,845	2,534	3,939	1,066	1,836	2,322	2,468	4,481	2,215	1,137	5,532	2,501	854	3,030	35,760
Formation % of Total	6%	7%	12%	3%	4%	6%	7%	11%	6%	4%	17%	8%	3%	6%	

Pavement base

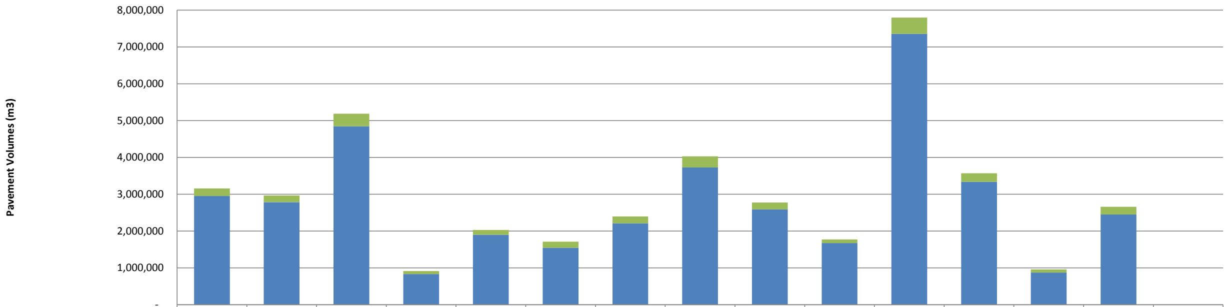
State highway pavements are defined as follows:

- Base course - the base course is the layer of material that is located directly under the surface layer.
- Structural asphaltic concrete - structural asphaltic concrete is an asphaltic concrete layer greater than 80mm thick that provides structural support and is not a surfacing layer.
- Sub-base - the sub-base is the layer above the formation and below the basecourse.

The pavements per region is summarised in the figure below:

Figure 13: Pavement quantities by location (2013)

Source: RAMM information June 2014



	Auckland	Bay of Plenty	Canterbury	Gisborne	Hawkes Bay	Nelson/ Marlborough	Northland PSMC	Otago	Southland	Taranaki	Waikato	Wanganui/ Manawatu	Wellington	West Coast	Total
Shoulder Basecourse (m3)	205,936	185,066	340,660	82,634	133,483	164,818	186,790	301,257	185,567	99,109	442,213	232,123	84,379	210,397	2,854,432
Other Pavement Quantities (m3)	2,949,173	2,781,803	4,844,468	831,033	1,897,460	1,545,654	2,209,794	3,726,254	2,587,514	1,671,918	7,352,467	3,336,837	872,287	2,448,344	39,055,006
Total (m3)	3,155,109	2,966,869	5,185,128	913,667	2,030,943	1,710,472	2,396,584	4,027,511	2,773,081	1,771,027	7,794,680	3,568,960	956,666	2,658,741	41,909,438
Pavement % of Total	8%	7%	12%	2%	5%	4%	6%	10%	7%	4%	19%	9%	2%	6%	

Pavement surfacing

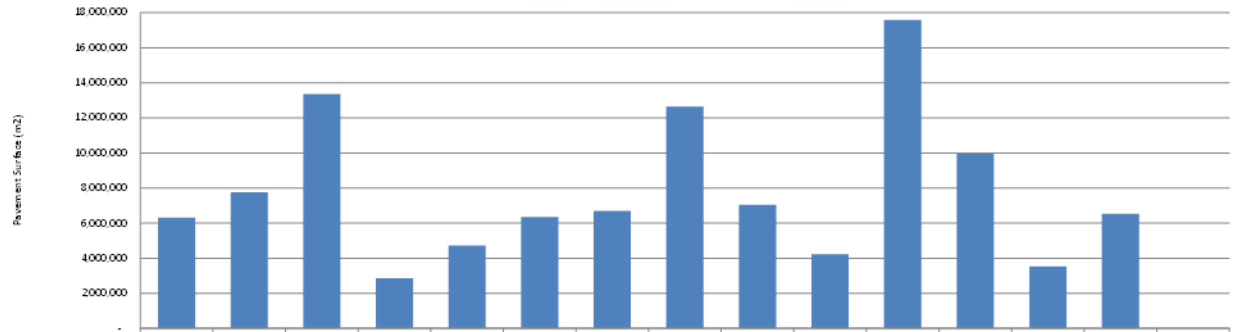
State highway pavement surfacing includes the following types:

- Unsealed - no bound surface.
- Asphaltic concrete - a mixture of bituminous binder and aggregate with or without **mineral filler produced in a mixing plant. It is delivered, spread and compacted** while hot, also referred to as hot mix asphalt. Asphaltic concrete is used on high traffic volume roads and sections of road with higher surface stress (for example intersections).
- Chipseal - a pavement surfacing type consisting of a layer or layers of uniformly sized aggregate or sealing chip, spread over a film of freshly sprayed binder and subsequently rolled into place. Called Surface dressing in UK and Sprayed seal in Australia. Chipseal is typically used on roads with lower traffic volumes. It has a lower installation cost than asphaltic concrete, but has a shorter life expectancy.
- Open graded porous asphalt - a gap graded hot mixed asphalt containing a mix of binder and larger sized aggregates with only small amounts of fine material, with relatively high void content, and depending largely on mechanical interlock for stability. It has interconnected voids, which aid drainage of road surface water. It is installed in sections of road where improved skid resistance is required.

The pavement surfacing per region is summarised in the figure below:

Figure 14: Area of pavement surfacing by location (2014)

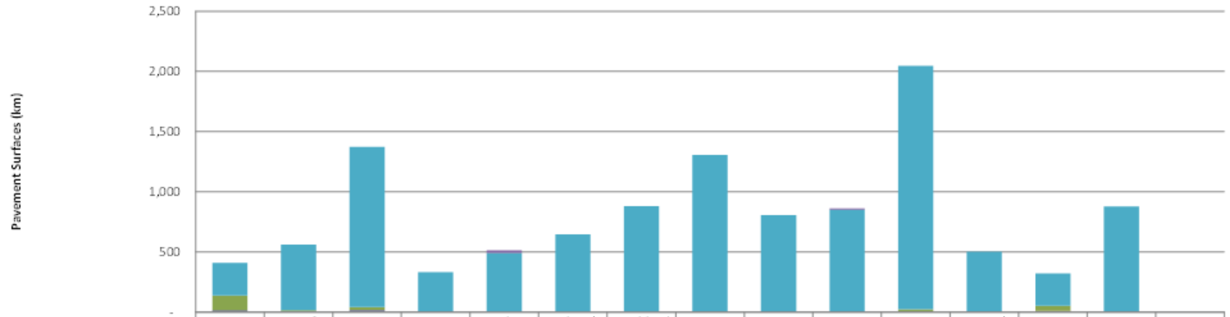
Source: RAMM information June 2014



	Auckland	Bay of Plenty	Canterbury	Gisborne	Hawkes Bay	Nelson/ Marlborough	Northland PSMC	Otago	Southland	Taranaki	Waikato	Wanganui/ Manawatu	Wellington	West Coast	Total
Pavement Surface (m2)	6,324,587	7,760,103	13,353,186	2,865,420	4,718,732	6,344,046	6,697,800	12,636,721	7,037,647	4,224,391	17,576,640	9,958,133	3,531,486	6,539,697	109,568,588
% of Total	6%	7%	12%	3%	4%	6%	6%	12%	6%	4%	16%	9%	3%	6%	

Figure 15: Length of pavement surfacing by type and location (2014)

Source: RAMM information June 2014



	Auckland	Bay of Plenty	Canterbury	Gisborne	Hawkes Bay	Nelson/ Marlb.	Northland PSMC	Otago	Southland	Taranaki	Waikato	Wang./ Manaw.	Wellington	West Coast	Total
Unsealed	-	-	-	-	20	-	-	-	-	12	-	-	-	-	32
Thin Surfaced Flexible	272	545	1,333	331	491	641	878	1,304	805	849	2,024	500	267	874	11,114
Structural Asphaltic Concrete	121	11	24	-	-	-	-	4	-	-	19	-	45	1	224
Concrete	1	-	1	0	-	-	-	-	-	-	-	2	1	2	7
Bridge	16	5	16	-	0	5	3	-	-	0	5	-	7	0	57
Total	409	560	1,373	331	512	646	881	1,308	805	861	2,048	501	320	878	11,434
% of Total	4%	5%	12%	3%	4%	6%	8%	11%	7%	8%	18%	4%	3%	8%	

4. DEMAND, VOLUME AND INPUT PRICE DRIVERS

Demand

Freight demand is expected to grow, as described in the *Infrastructure asset management plan*.

Freight demand is expected to grow at about 1.2% pa, as forecast by Treasury. Freight growth predominantly affects pavements by reducing their life, and therefore increasing the rate at which they are maintained and renewed, and thus increases annual expenditure in line with increased traffic and therefore with increased Road User Charges.

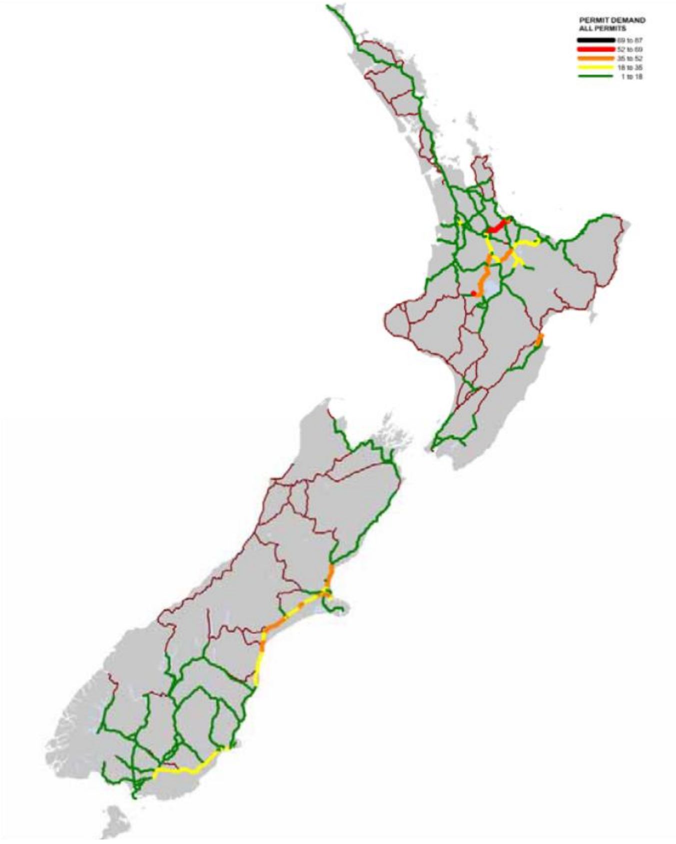
Pavement programmes have been increased in proportion to the increase of forecast freight demand.

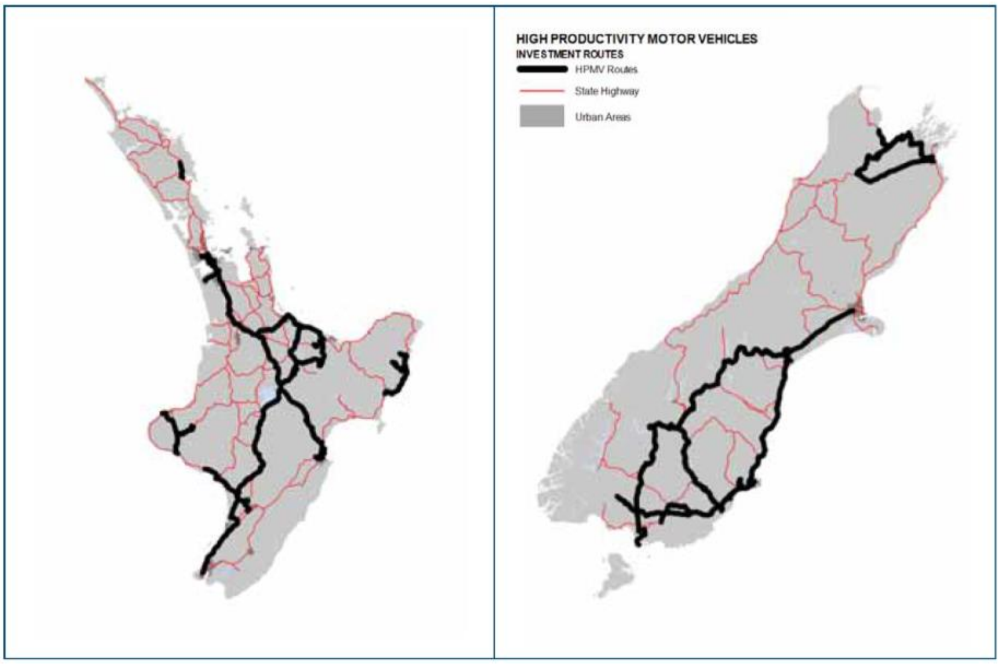
4.1.1 High productivity motor vehicles

The NZ Transport Agency has targeted reduced freight costs by giving high productivity motor vehicles access to routes where there is demand and high uptake. This recent legislative change will allow larger and heavier trucks on the network, increasing wear and resulting in shorter asset lives and increased replacement costs.

The NZ Transport Agency has identified the following high productivity investment routes:

Figure 16: Demand for high productivity motor vehicle permits (based on applications received)





Volume

Past and ongoing construction of new state highways, and revocation of state highways all contribute to a change in the amount, or volume, of state highway pavements that must be maintained and renewed.

Allowances have been made for:

- resurfacing works 7 years after projects are compete when resurfacing is expected to be required for the first time
- maintenance of surfaces and pavements 2 years after completion when defects liabilities periods end, and responsibility transfers to the Transport Agency from the contractor
- The maintenance portion of financing costs for PPP style contracts when these are first brought to charge.

Table 5: Forecast changes in pavement quantities to be maintained and renewed.

NOC Area	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km	Centreline_km
Auckland	410.7	410.7	412.7	427.9	432.3	432.3	436.2	436.2	436.2	436.2	472.3
Bop East	567.1	567.1	567.1	567.1	567.1	567.1	567.1	567.1	567.1	567.1	567.1
Bop West	223.8	223.8	223.8	223.8	223.8	223.8	223.8	223.8	223.8	223.8	223.8
Central Waikato	743.5	743.5	743.5	743.5	743.5	743.5	743.5	743.5	743.5	743.5	743.5
Christchurch	211.5	211.5	213.7	230.9	255.3	269.3	273.1	273.1	273.1	273.1	273.1
Coastal Otago	771.9	771.9	771.9	771.9	771.9	771.9	771.9	771.9	771.9	771.9	771.9
East Waikato	532.7	532.7	532.7	532.7	532.7	532.7	538.6	538.6	538.6	538.6	538.6
Gisborne	330.9	330.9	330.9	330.9	330.9	330.9	330.9	330.9	330.9	330.9	330.9
Hawkes Bay	512.1	512.1	512.1	512.1	512.1	512.1	512.1	512.1	512.1	512.1	512.1
Manwatu	631.3	631.3	631.3	631.3	631.3	631.3	631.3	631.3	631.3	631.3	631.3
Marlborough	259.5	259.5	259.5	259.5	259.5	259.5	259.5	259.5	259.5	259.5	259.5
Milford Sound	196.8	196.8	196.8	196.8	196.8	196.8	196.8	196.8	196.8	196.8	196.8
Nelson Tasman	386.4	386.4	386.4	386.4	386.4	386.4	386.4	386.4	386.4	386.4	386.4
Northland	880.8	880.8	880.8	880.8	880.8	880.8	880.8	880.8	880.8	880.8	880.8
Nth Canterbury	590.6	590.6	590.6	590.6	590.6	590.6	590.6	590.6	590.6	590.6	590.6
Otago Central	536.5	536.5	536.5	536.5	536.5	536.5	536.5	536.5	536.5	536.5	536.5
West Waikato PSMC006	348.4	348.4	348.4	348.4	348.4	348.4	348.4	348.4	352.3	352.3	352.3
West Waikato iPSMC007	389.6	389.6	429.4	429.4	432.3	504.5	504.5	504.5	504.5	504.5	504.5
Southland	608.2	608.2	608.2	608.2	608.2	608.2	608.2	608.2	608.2	608.2	608.2
Sth Canterbury	570.7	570.7	570.7	570.7	570.7	570.7	570.7	570.7	570.7	570.7	570.7
Taranaki	530.6	530.6	530.6	530.6	530.6	530.6	530.6	530.6	530.6	530.6	530.6
Wellington	331.0	331.0	332.0	332.0	371.0	371.0	400.3	400.3	480.7	480.7	480.7
West Coast North	440.0	440.0	440.0	440.0	440.0	440.0	440.0	440.0	440.0	440.0	440.0
West Coast South	437.7	437.7	437.7	437.7	437.7	437.7	437.7	437.7	437.7	437.7	437.7
Totals	11442.5	11442.5	11487.5	11519.9	11590.5	11676.8	11719.5	11719.5	11803.8	11803.8	11839.9

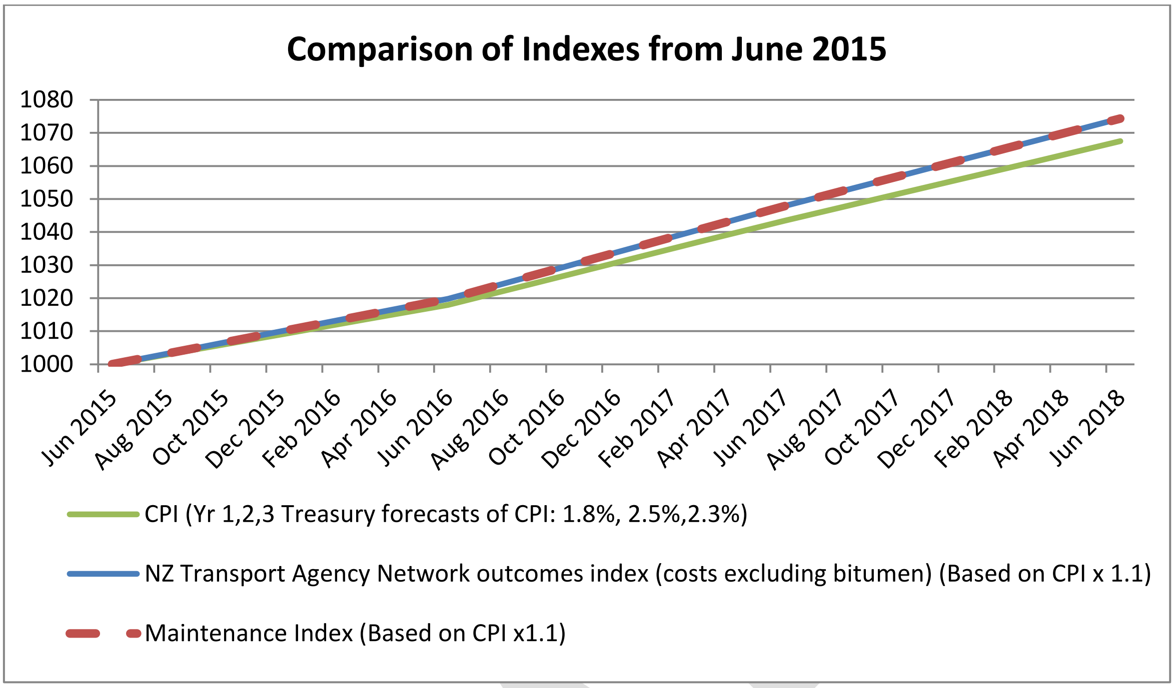
This table shows that an indicative 0.5% pa increase in volume must be maintained.

Input price

Input prices are expected to grow, as described in the *Infrastructure asset management plan*, 10% faster than the consumer price index.

We have assumed that bitumen prices grow at the same rate as the Network Outcome Maintenance Index, and not at a higher rate as occurred in the past 15 years.

Figure 17: Treasury forecast CPI, Network Outcome Maintenance Index and Maintenance Index



5. ASSET CAPACITY AND PERFORMANCE

Performance

5.1.1 Effective access

Description

The primary service level of roads is the ability to travel along the preferred route to the destination.

Access is potentially affected by:

- pavement condition
- loss of support for the carriageway, eg by scour from and adjacent river, or a slip on the downhill side of the road
- blockage of the road, eg by slip material from the uphill side of the road, or by broken down vehicles
- Road works.

Target/limit

The LOS for all road types is contained within the Performance Targets for Operational Performance Measures, the One Network Road Classification's service framework significantly enhances and extends to past performance framework.

Performance

No state highway has been closed or become impossible because of the pavement condition, and none are expected to be because they are maintained in sufficiently good condition.

Current measures are presented below.

Table 6: Measures from SOI

Operational Performance Measures	SOI Output Class	SOI Service Delivery Performance	Target			
			2014/15	2015/16	2016/17	2017/18
Access	Availability					
Smooth travel exposure	Maintenance and operation of state highways	Smooth ride: % of travel on network classed	≥97%			
Texture		Safe stopping: % of network meeting surface texture standards	≥97%			
Good skid exposure – threshold level	Renewals of state highways	Safe stopping: % of travel on network above skid threshold	≥98%			
Rutting >20mm		Network resilience: % of rutting >20mm over state highway network	<2.5 %	<3%	<3%	<3%

Table 7: Summary of state highway availability (provisional)

Source: NZ Transport Agency Annual Report (for the year ended 30 June 2014)

	Financial Year	
	2012/13	2013/14
% of availability of state highway network*	94.0%	85.0%

*Availability of state highway network is the percentage of unplanned road closures resolved within 12 hours.

5.1.2 Safety - skid resistance

Description

Skid resistance is an indication of the safety of the network, particularly in the wet. Skid resistance targets are set higher where there is greater risk, eg on tight corners, or approaches to intersections, and lower whether there is good geometry or other factors have contributed to a lower crash risk.

It is reported as both:

- the proportion of travel on roads with good skid resistance to indicate how safe travel is, and
- the proportion of roads meeting the 'warning' or inspection level, and those meeting the 'targeted' or threshold level, to indicate the success of prior interventions and the requirement for future interventions.

Skid resistance is primarily a function of the surfacing aggregate microtexture and macrotexture. It is lower when the road surface is wet. For wet road surfaces the loss of skid resistance progressively increases with increasing speed, at higher speeds and thicker water films a limit state of aquaplaning may occur.

The skid resistance policy was changed in 2013, requiring greater skid resistance on tight bends, approaches to intersections and similar higher risk areas. The skid resistance of the state highway was similar in 2013 to 2012, but because the new targets were more stringent the deficiency in skid resistance reported increased.

Target/limit

The LOS for all road types is contained within the Performance Targets for Operational Performance Measures.

The policy governing skid resistance changed recently meaning that performance reported for 2013/14 onwards is against a more stringent and better targeted standard than before.

Table 8: Skid resistance performance targets for operational performance measures

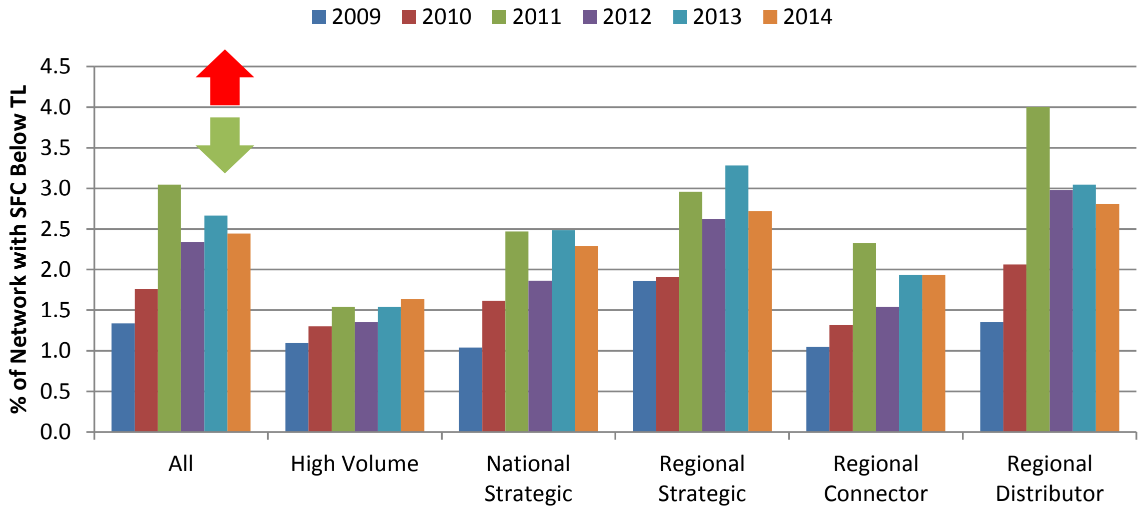
Source: NZTA LOS Measures - 2013-12-09

Operational Performance Measures	SH Classification Performance Targets				
	National Strategic (High Volume)	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
Skid resistance management - evidence that NZTA T/10 process has been adhered to for X% of exception reported sites	100%	100%	100%	100%	100%
Skid resistance management - evidence that X% of Priority A sites have been addressed in accordance with NZTA T/10 within 3 months of receiving Annual Exception Report	100%	100%	100%	100%	100%
Skid resistance - the number of identified SCRIM exceptions shall decrease over time	annual reduction	annual reduction	annual reduction	annual reduction	annual reduction
Skid resistance - there shall be an X% increase year on year in the number of sites with a SCRIM coefficient between TL and IL	0%	0%	0%	0%	0%

Performance

Figure 18: Skid resistance historic performance against threshold level

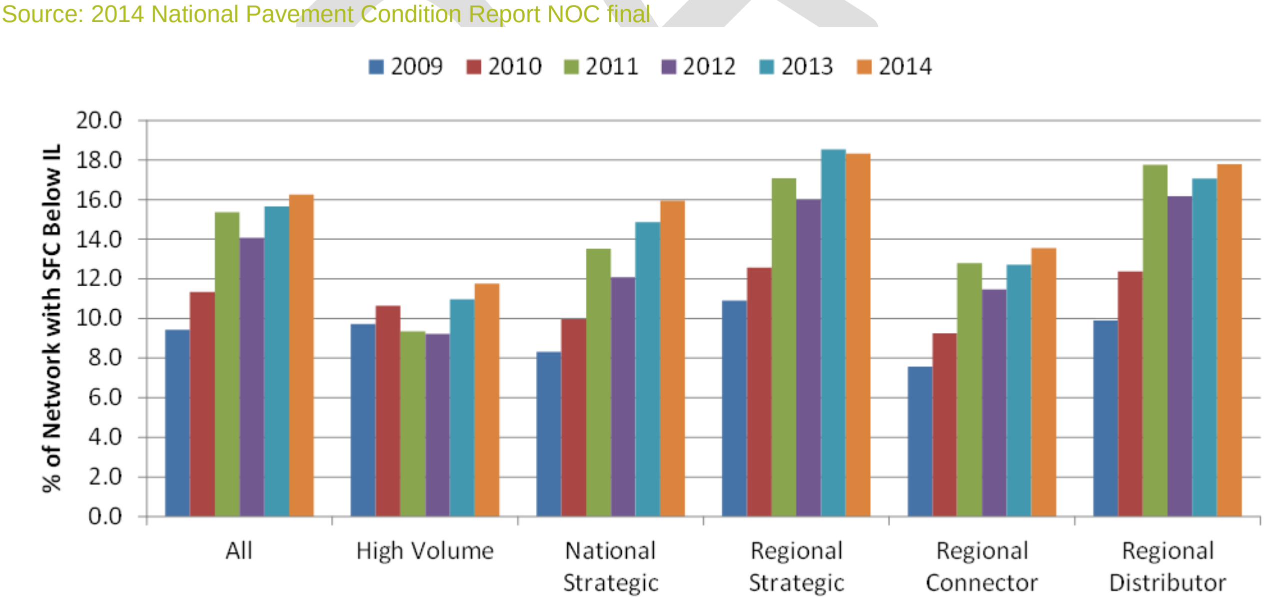
Source: 2014 National Pavement Condition Report NOC final



The figure above shows a worsening trend. High volume national strategic roads perform the best in terms of skid resistance below the threshold level.

Figure 19: Skid resistance historic performance against investigatory level

Source: 2014 National Pavement Condition Report NOC final

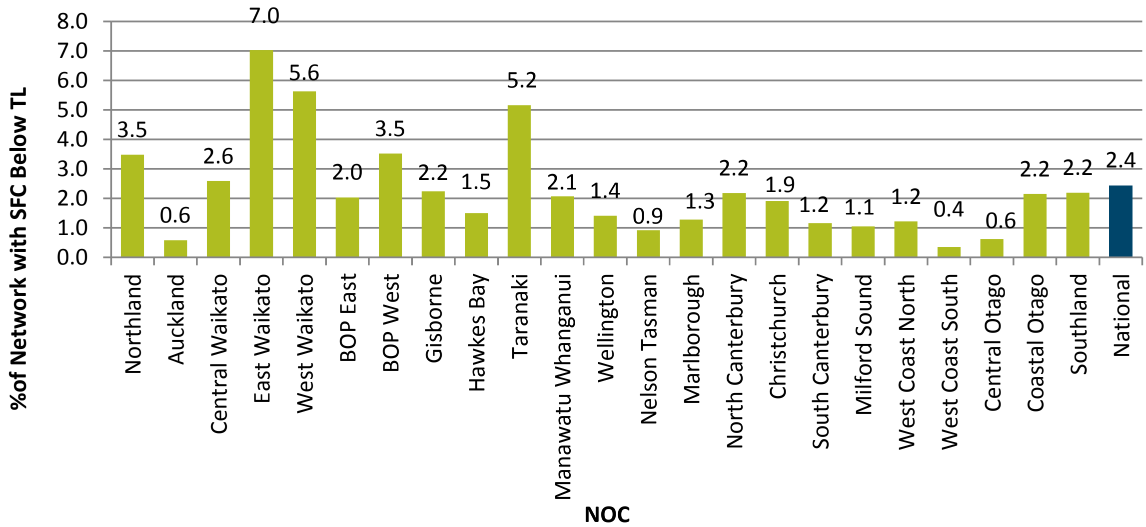


The table below indicates that the year on year increase target of 0% based on the average for all roads are not achieved.

Table 9: Year on year increase in the number of sites with SFC between IL and TL

Year	% of network with SFC below Threshold Level TL	% of network with SFC below Investigation Level IL	Difference	Year on Year increase
2009	1.34	9.43	8.09	
2010	1.76	11.35	9.59	19%
2011	3.05	15.37	12.32	28%
2012	2.34	14.08	11.74	-5%
2013	2.66	15.67	13.01	11%
2014	2.44	16.27	13.83	6%

Figure 20: Skid resistance per region for 2014
Source: 2014 National Pavement Condition Report NOC final



The percentage of the network with skid resistance below the threshold level is the highest for East and West Waikato and Taranaki.

Skid resistance trend summary

There is a worsening trend on all SH classification in terms of skid resistance. Therefore a performance issue is developing and more investment needs to be made towards skid improvement.

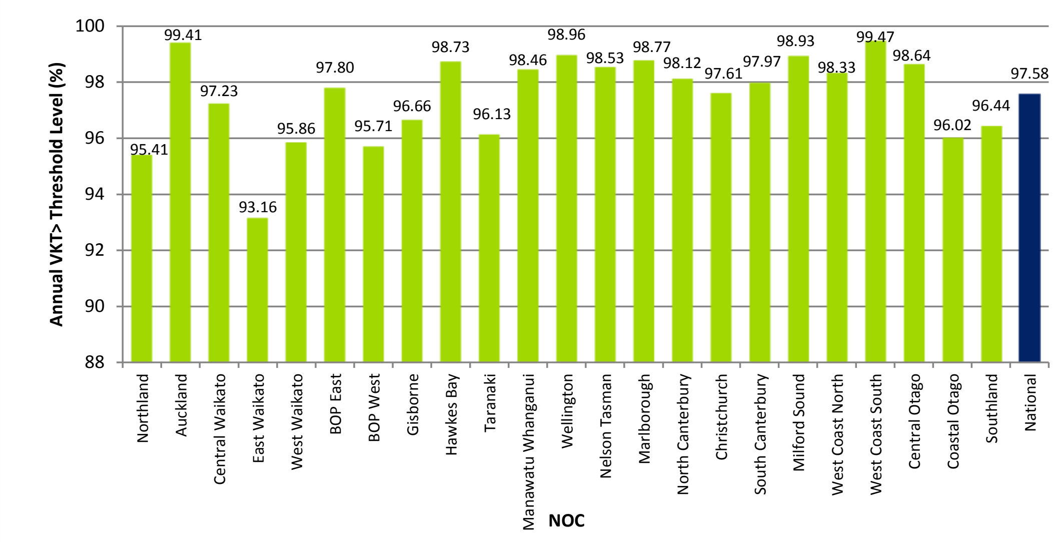
Good skid exposure

Good skid exposure is an indication of the volume of traffic exposed to highway lengths that are currently above the threshold value for providing good skid resistant road surfaces.

The skid resistance performance of the state highway network is shown in the following figures.

Figure 21: Good skid exposure - threshold level by network

Source: 2014 National Pavement Condition Report NOC final



Refer to appendix A for detailed skid exposure information in each region.

5.1.3 Safety – rutting

Description

Pavement rutting, and other surface faults such as heaves, shoves and depressions may reduce road safety by:

- adversely affecting tracking by vehicles, particularly motorcycles
- holding water, making aquaplaning more likely.

Target/limit

The LOS for all road types is contained within the Performance Targets for Operational Performance Measures.

Table 10: Rutting performance targets for operational performance measures
Source: NZTA LOS Measures - 2013-12-09

Operational Performance Measures	SH Classification Performance Targets				
	National Strategic (High Volume)	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
Rutting - no more than X% of wheel path length shall have rutting more than 20mm in depth, or constitutes a safety hazard	1%	1%	1.5%	2%	2%
Rutting - based on rut progression over network length with no more than Xmm / yr	1	1	1	1	1

Performance

The figure below indicates that the targets for the different SH classifications are met on a national average level. Notably, all classifications of SH roads are performing well with respect to the performance targets. All classifications indicate a slightly reducing trend in pavement rutting and therefore a slightly improving trend in pavement base condition.

Figure 22: Percentage of network with rutting >20mm (historic performance)
Source: 2014 National Pavement Condition Report NOC final

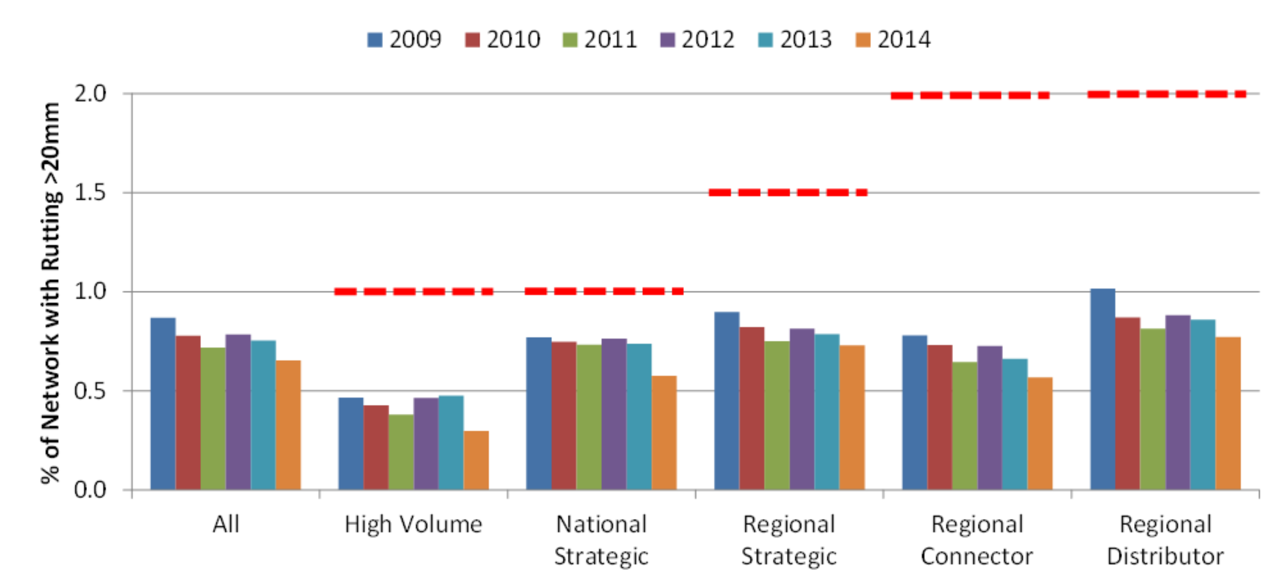
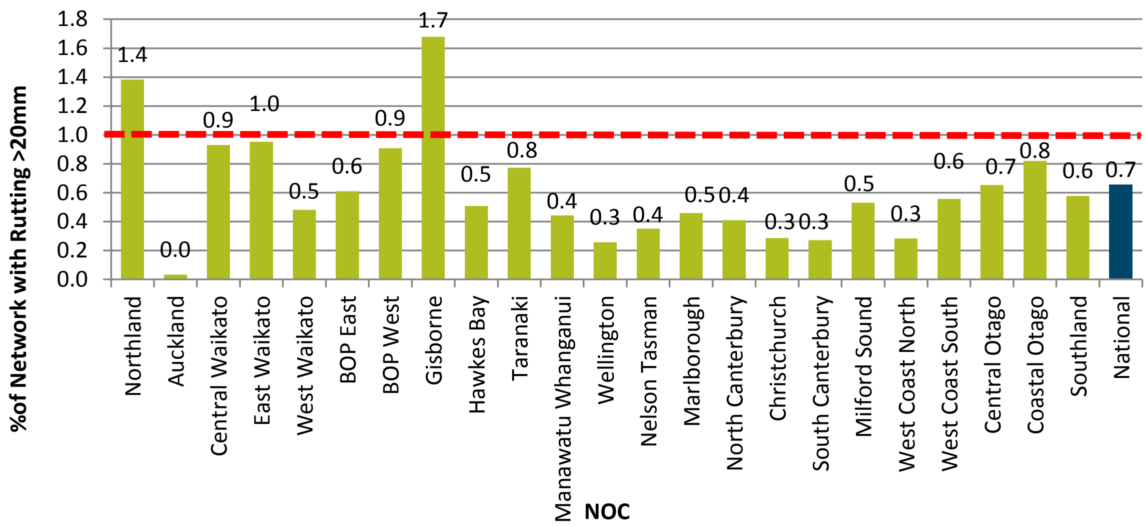


Figure 23: Percentage of network with rutting >20mm by region (2014)

Source: 2014 National Pavement Condition Report NOC final



The figure above shows that the only regions that do not meet the higher 1% performance target on average are Northland and Gisborne. Further analysis below indicates that the National Strategic roads in Northland and the Regional Strategic roads in Gisborne do not meet the LOS targets. However, Northland shows an improving trend over recent years.

Further discussion on Gisborne's suddenly worsening trend in rutting values on Regional Strategic roads over the last two years is to be developed.

Figure 24: Percentage of Northland with rutting >20mm per SH classification (historic performance)

Source: 2014 National Pavement Condition Report NOC_final

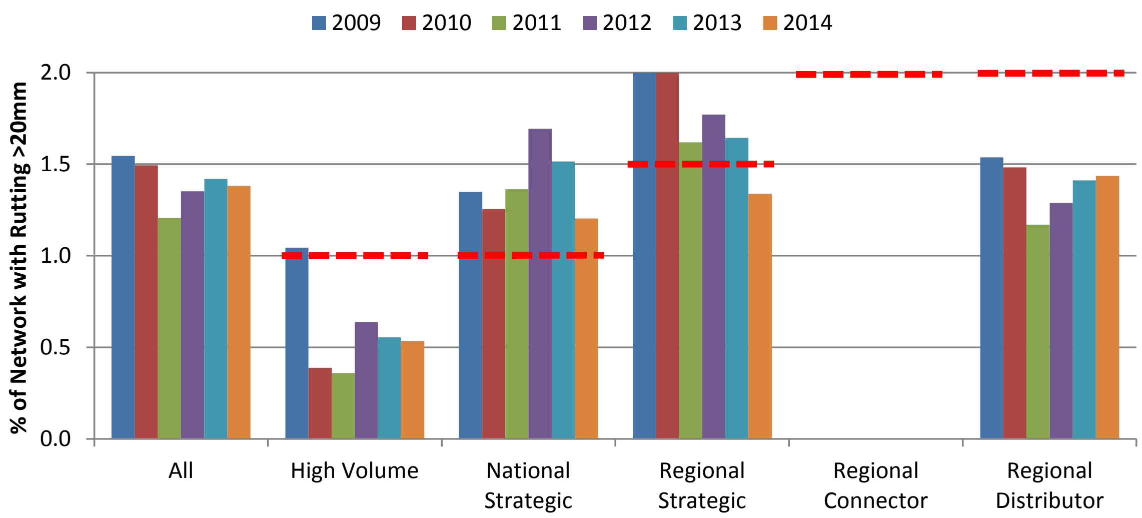
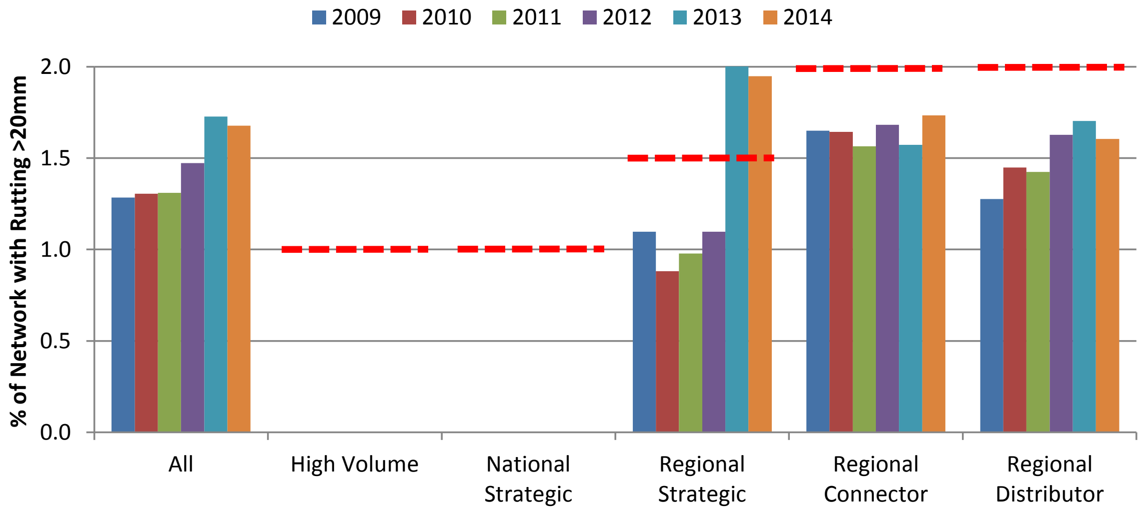


Figure 25: Percentage of Gisborne with rutting >20mm per SH classification (historic performance)
Source: 2014 National Pavement Condition Report NOC_final



Rutting trend summary

Nationally, there is a slightly reducing trend in pavement rutting.

5.1.4 Amenity - comfort - roughness

Description

Travel is uncomfortable where the road surface is too rough for the travel speed. When roughness becomes excessive it may adversely affect safety.

Target/limit

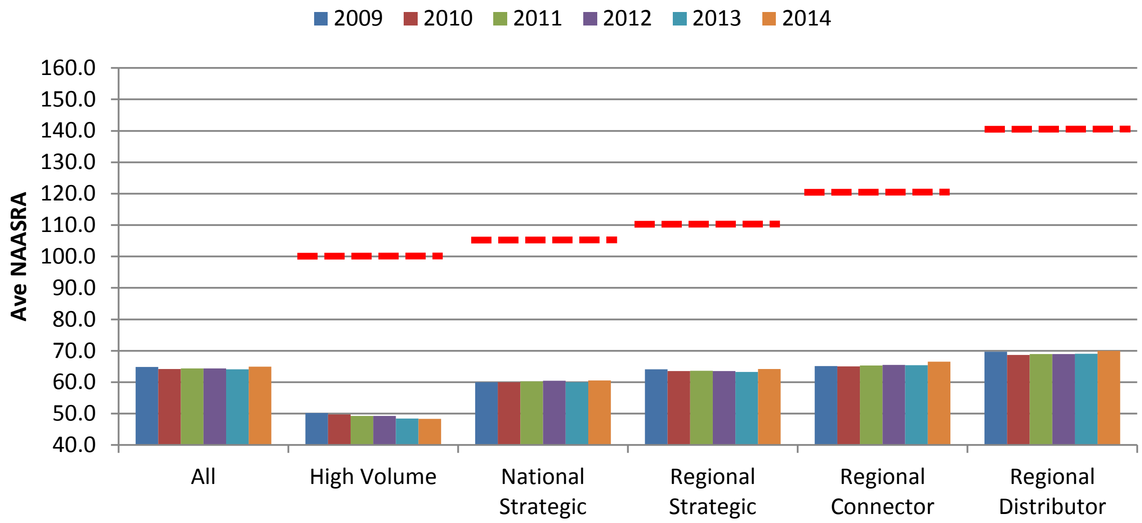
The LOS for all road types is contained within the Performance Targets for Operational Performance Measures.

Table 11: Roughness performance targets for operational performance measures
Source: NZTA LOS Measures - 2013-12-09

Operational Performance Measures	SH Classification Performance Targets				
	National Strategic (High Volume)	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
Rural smoothness (excluding urban sections) - more than 98% of the SH classification type shall be smoother than X lane IRIqc (Y NAASRA), when measured at 100m intervals.	98% > 3.8 lane IRIqc (100 NAASRA)	98% > 4.4 lane IRIqc (115 NAASRA)	98% > 4.6 lane IRIqc (120 NAASRA)	98% > 5.0 lane IRIqc (130 NAASRA)	98% > 5.7 lane IRIqc (150 NAASRA)
Urban smoothness - more than 98% of all urban sections in SH classification type shall be smoother than 5.7 lane IRIqc (150 NAASRA), when measured at 100m intervals.	98% > 5.7 lane IRIqc (150 NAASRA)	98% > 5.7 lane IRIqc (150 NAASRA)	98% > 5.7 lane IRIqc (150 NAASRA)	98% > 5.7 lane IRIqc (150 NAASRA)	98% > 5.7 lane IRIqc (150 NAASRA)

Performance

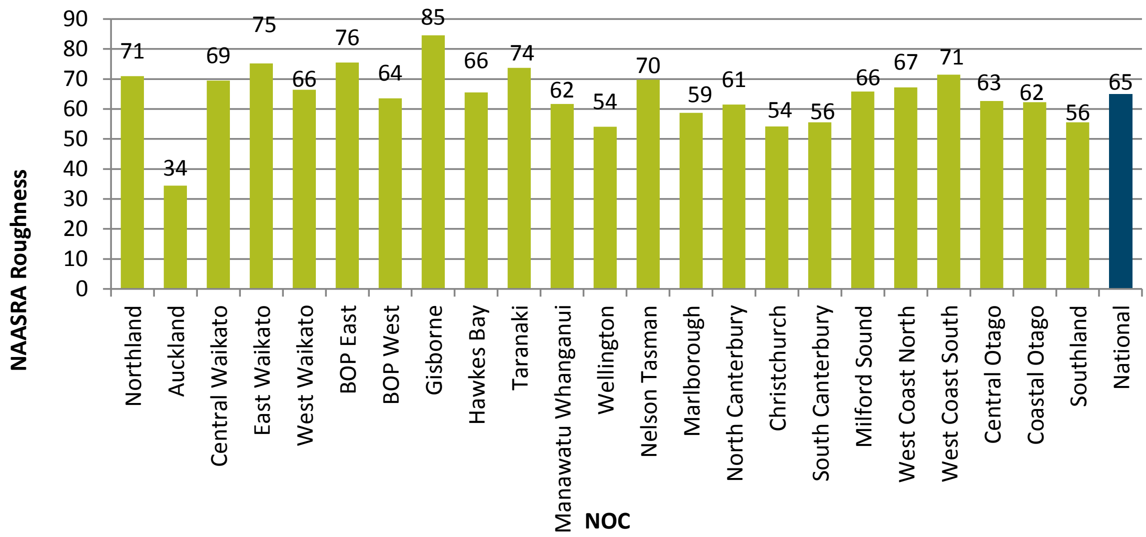
Figure 26: Average NAASRA roughness (historic performance) for each SH classification
Source: 2014 National Pavement Condition Report NOC_final



This graphs shows the average NAASRA and is not an indication of whether or not the smoothness target of >98% (roughness target ≤2%) is met. As to be expected, the higher the classification of the road the better the average condition with respect to roughness. Notably, high volume roads have much lower roughness than other roads.

Figure 27: Average NAASRA roughness per NOC for 2014

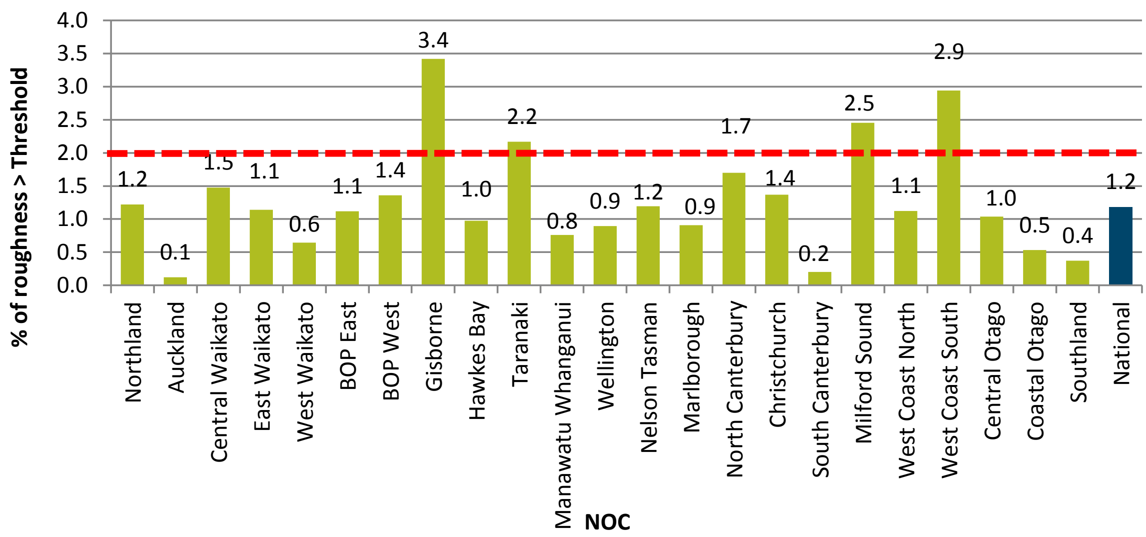
Source: 2014 National Pavement Condition Report NOC_final



As with the previous graph, this shows the average NAASRA and is not an indication of whether or not the smoothness target of >98% (roughness target ≤2%) is met.

Figure 28: Percentage roughness > threshold (100mm) per NOC region for 2014

Source: 2014 National Pavement Condition Report NOC_final



Note: the smoothness target is 98% > 150 NAASRA, therefore the roughness target is no more than 2% > 150 NAASRA. Therefore anything above the red line does not meet the target.

Neither Gisborne, Taranaki, Milford Sound nor West Coast South, which currently do not meet the roughness performance target, have any high volume or National Strategic roads. No significant changes in average roughness (worse or improvement) have been achieved in smoothness for these NOCs as indicated in the table below.

Click here to enter text.

Table 12: Average NAASRA for Gisborne, Taranaki, Milford Sound and West Coast South (historic)
Source: 2014 National Pavement Condition Report NOC_final

Gisborne

	All	High Volume	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
2009	85.28	0.00	0.00	80.23	78.08	89.03
2010	83.79	0.00	0.00	78.20	78.99	86.73
2011	80.07	0.00	0.00	71.86	78.78	85.37
2012	84.12	0.00	0.00	79.80	79.08	86.91
2013	84.00	0.00	0.00	80.00	78.00	87.00
2014	84.54	0.00	0.00	77.25	79.35	87.93

Taranaki

	All	High Volume	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
2009	74.77	0.00	0.00	64.37	65.05	84.70
2010	73.40	0.00	0.00	63.78	62.61	82.58
2011	73.43	0.00	0.00	63.95	63.32	81.97
2012	73.45	0.00	0.00	63.47	64.47	82.94
2013	73.00	0.00	0.00	63.00	64.00	82.00
2014	73.67	0.00	0.00	64.17	65.35	82.67

West Coast South

	All	High Volume	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
2009	72.38	0.00	0.00	73.65	72.10	0.00
2010	71.70	0.00	0.00	70.82	71.90	0.00
2011	70.53	0.00	0.00	70.77	70.48	0.00
2012	71.26	0.00	0.00	70.88	71.34	0.00
2013	70.00	0.00	0.00	69.00	71.00	0.00
2014	71.40	0.00	0.00	71.80	71.31	0.00

Milford Sound

	All	High Volume	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
2009	65.24	0.00	0.00	66.12	0.00	57.74
2010	63.29	0.00	0.00	64.00	0.00	57.20
2011	64.43	0.00	0.00	65.22	0.00	57.70
2012	64.49	0.00	0.00	65.32	0.00	57.42
2013	64.00	0.00	0.00	65.00	0.00	57.00
2014	65.77	0.00	0.00	66.62	0.00	58.54

Trend summary

For high volume National Strategic roads the roughness (average NAASRA) has improved slightly over the past 5 years. For all other SH classifications there have been a consistent, level trend. All regions meet the operational performance measure targets except for Gisborne, Taranaki, Milford Sound and West Coast South, where the 98% > threshold smoothness (which varies between 100 NAASRA and 150 NAASRA depending on SH classification or urban/rural) are not achieved.

5.1.5 Efficiency

Description

The cost of delivering access safely and comfortably over pavements should be minimised on a long term basis. In conjunction with service level targets this aspect of service provides an indication of the 'value for money' of pavement provision.

The long term costs depend on:

- The effectiveness of treatments, and the quality assurance of construction, which together deliver durable works and longer service lives
- An optimised balance between maintenance and renewals which delivers the least long term cost
- An optimised balance between intervention timing and risk for each classification that balances the possibility of increased repairs if intervention is too late, with the opportunity to benefit from an extended service life
- Ideal treatment selection, scope, and timing which ensures only the right works are undertaken in the right place at the right time
- The procurement framework used to engage suppliers to deliver external suppliers

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- The price for services provided by external suppliers
- The cost of inputs to our suppliers
- The effectiveness of the Transport Agency in asset management and procurement.

Target/limit

The aspirational target for efficiency is to reduce unit pavement costs to become 2/3 of the 2012 expenditure in ten years on a sustainable per unit basis. This requires an efficiency gain of 3% pa for ten years.

Each network has unique characteristics, circumstances and history, which mean that unit costs are not, and likely will not be, equal everywhere. Each network has service contracts with some years to run so efficiency initiatives are adopted at different times across the entire state highway network. Past attempt to determine a reliable relationship between network characteristics and unit costs have failed, we don't have confidence in the extent that the controllable and uncontrollable characteristics have on cost in each network.

This means it is more efficient to target:

- Exceeding the current efficiency horizon, and
- Continual improvement

than to attempt to determine an ideal operating framework.

Continual improvement

The Transport Agency has adopted a process of continual improvement, as described in the *Infrastructure asset management plan*.

The approach is to continually seek efficiency improvement.

Key elements of this are:

- Enhanced quality assurance of works by suppliers, and independent audit to improve works quality, and durability and thus extend service lives, delay the onset of maintenance and reduce costs
- Enhance treatment selection and timing to extract the maximum service lives from prior treatments, select and scope the correct interventions for the situation
- Measurement of the performance of treatments against target
- Measurement of the success of do-maintenance treatments on marginal sites
- Enhanced condition measurement through the introduction of the TSD and laser crack measurement devices, and the potential introduction of direct measurement of pavement moisture
- Improved understanding of the relationship between condition, moisture and the growth in reactive maintenance as inputs to renewal timing decisions
- Enhanced use of drainage treatments to delay and mitigate pavement and surface deterioration
- Annual review of achievement vs target

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- Review of the pavement LAMP over 2015-18.

Performance

Figure 29: Reactive maintenance for 2015-18 vs. VKT/lane km

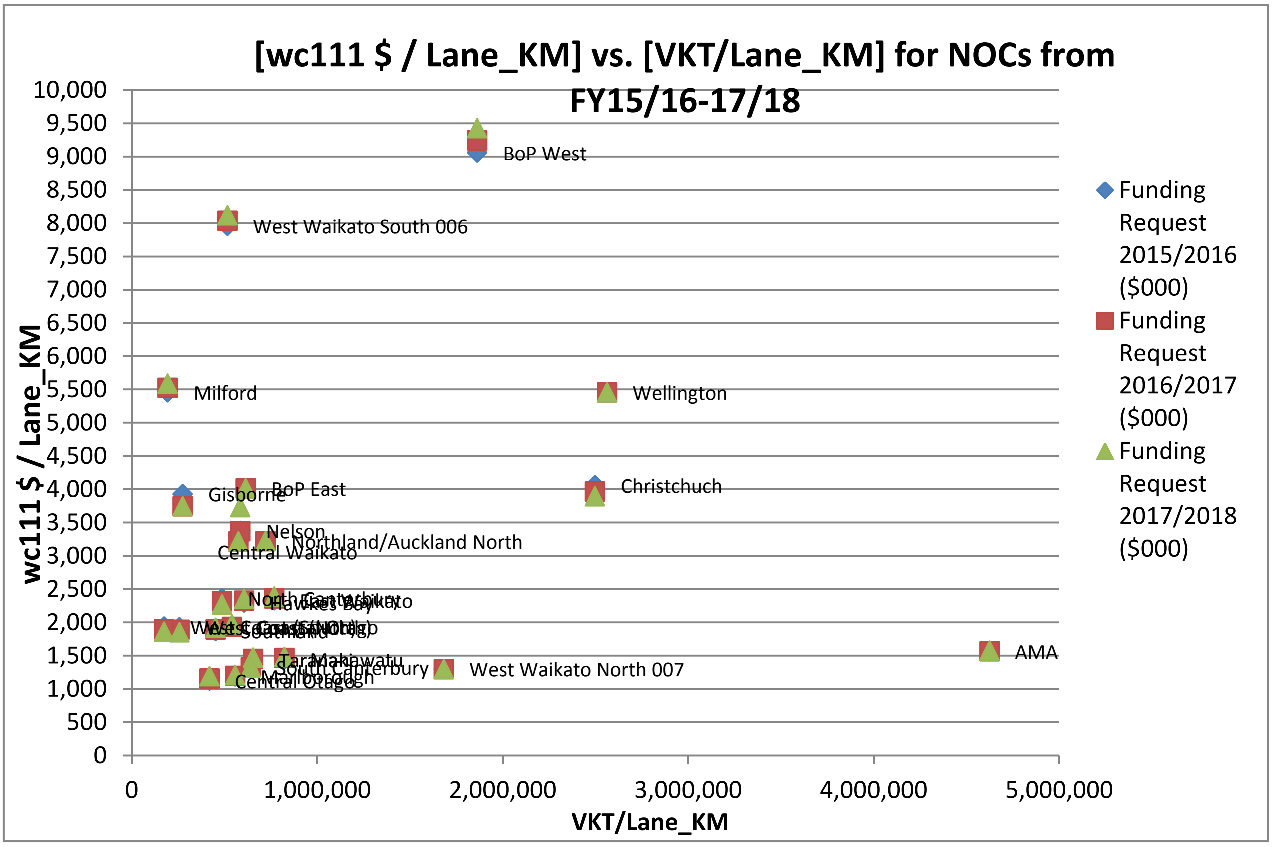

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Figure 30: Reactive maintenance for 2015-18 vs. ESA/lane km

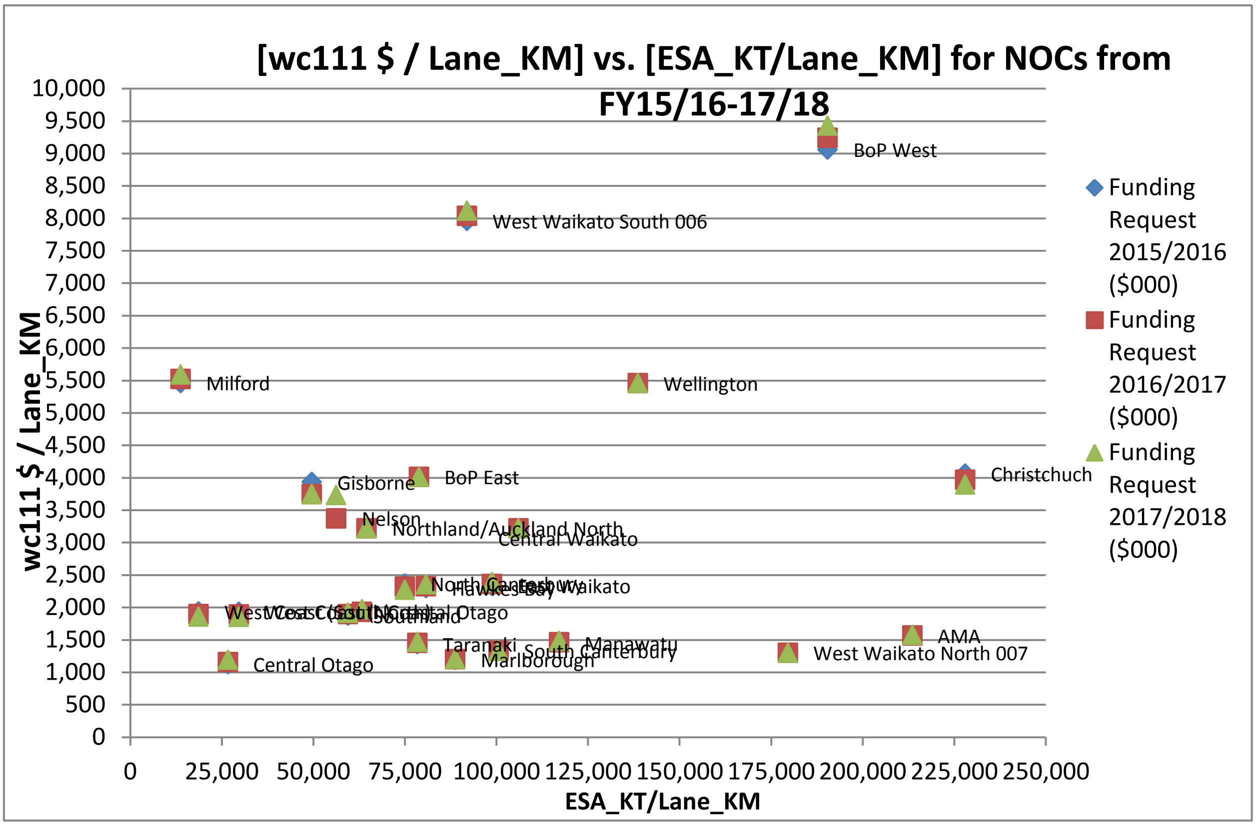

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Figure 31: Renewals from 2015-18 vs. VKT/lane km

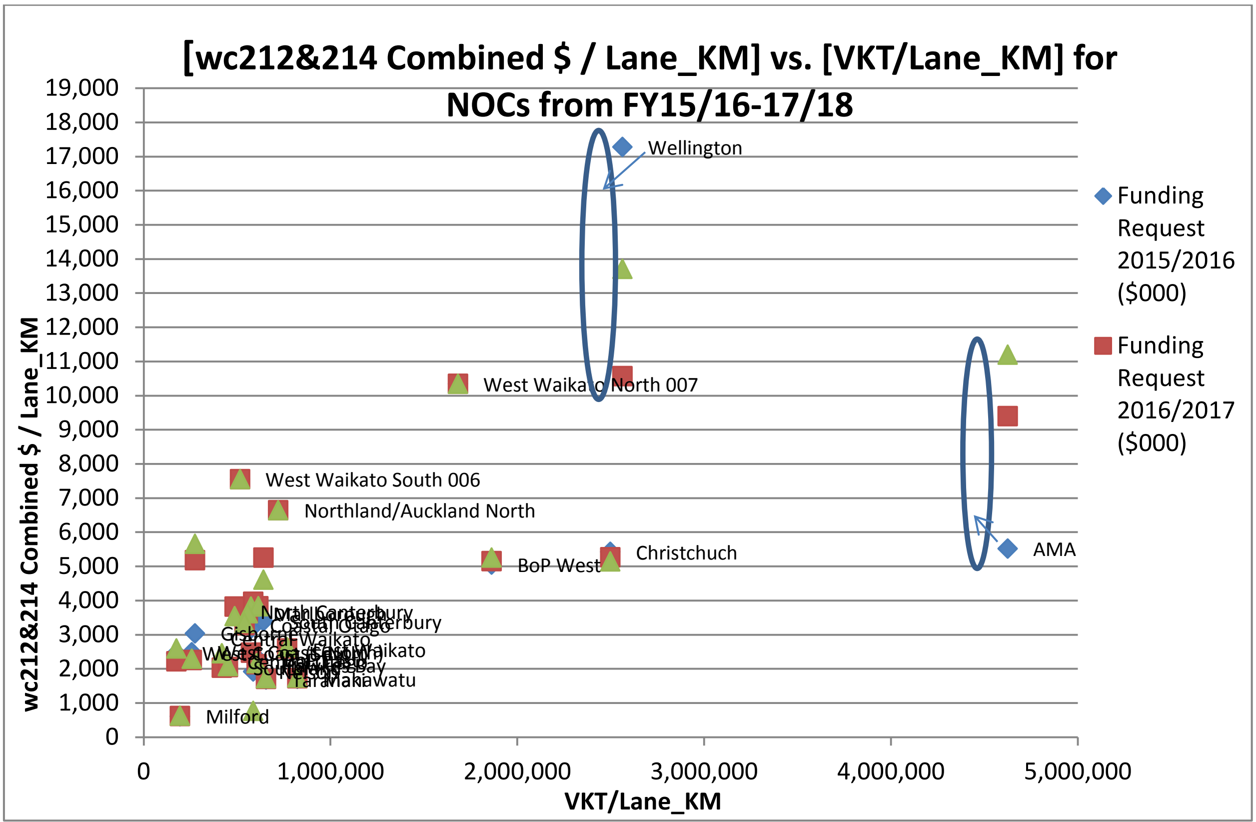

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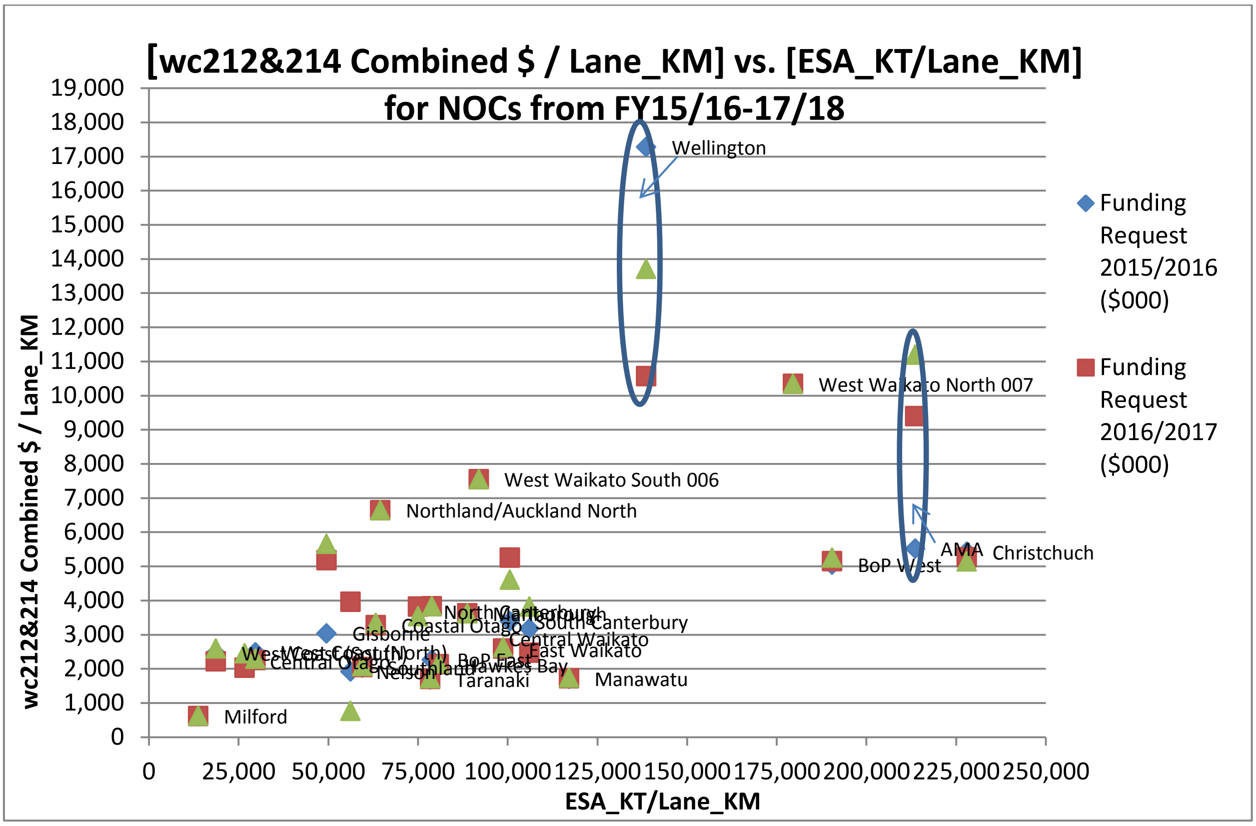
Figure 32: Renewals from 2015-18 vs. ESA/lane km



The effort of the Agency to push the overall budget over the next 3 years is evident in the reduction of renewal works along the network. On the other hand, this generates an increase in reactive maintenance, which in the NOC procurement model comes under the contractors' risk. The base preservation quantities developed by the Agency confirm this trend with a high emphasis on reactive maintenance in recently awarded networks like Taranaki, Manawatu and Central Waikato.

We expect that networks like West Waikato South (PSMC006) and West Waikato North (PSMC007) will drop the general cost of renewals and reactive works, aligning the other NOC regions when the contract periods end and they are combined as a single NOC contract.

Interestingly, the Wellington network seems to have a high cost per ESA or VKT for renewal works. This is due to an increase in asphaltic concrete surfacing and structural repairs that the network needs to address due to the recent finalisation of capital schemes, but at the end of 17/18 the overall cost should drop significantly.

The performance of the Wellington and Auckland networks is similar, but surface condition is different, and treatment strategies have been different. We are reviewing the implications and expect there may be a change in intervention strategy in either network. This may include the use of preventive treatments to extend OGPA service life, the use of Epoxy OGPA, which has a slower environmental decay rate, and an adjustment of the balance of repairs and renewals.

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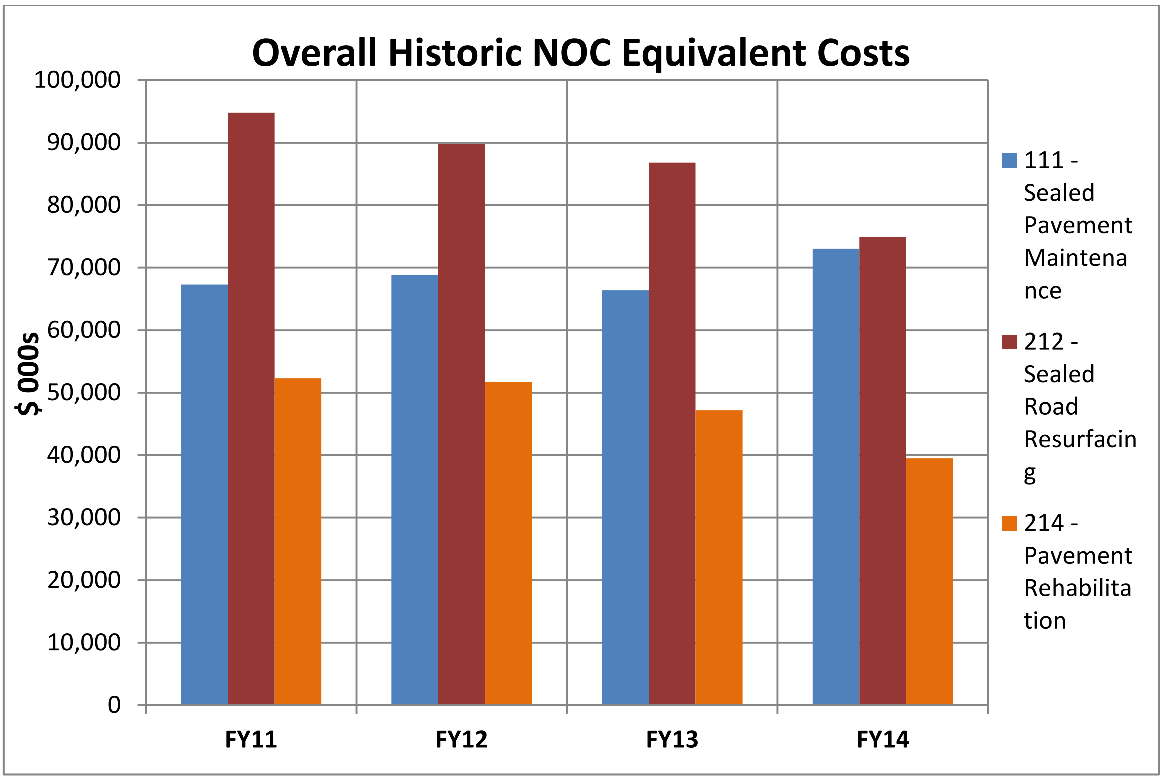
Figure 33: Trend in pavement cost
Source: 2014 National Pavement Condition Report NOC_final



The proposed programme represents an increase in value for money because:

- Performance standards are forecast to be achieved
- Real unit costs are decreasing
- Condition is forecast drop decline towards, but not falls below the sustainable level.

Capacity

5.1.6 Dimension

All state highway pavements have the capacity to carry conventional freight without significant damage.

The map below indicate those sections of SH that are able to carry conventional freight in lane, and those where the geometry and lane widths are not sufficient to allow all conventional vehicles to track in lane.

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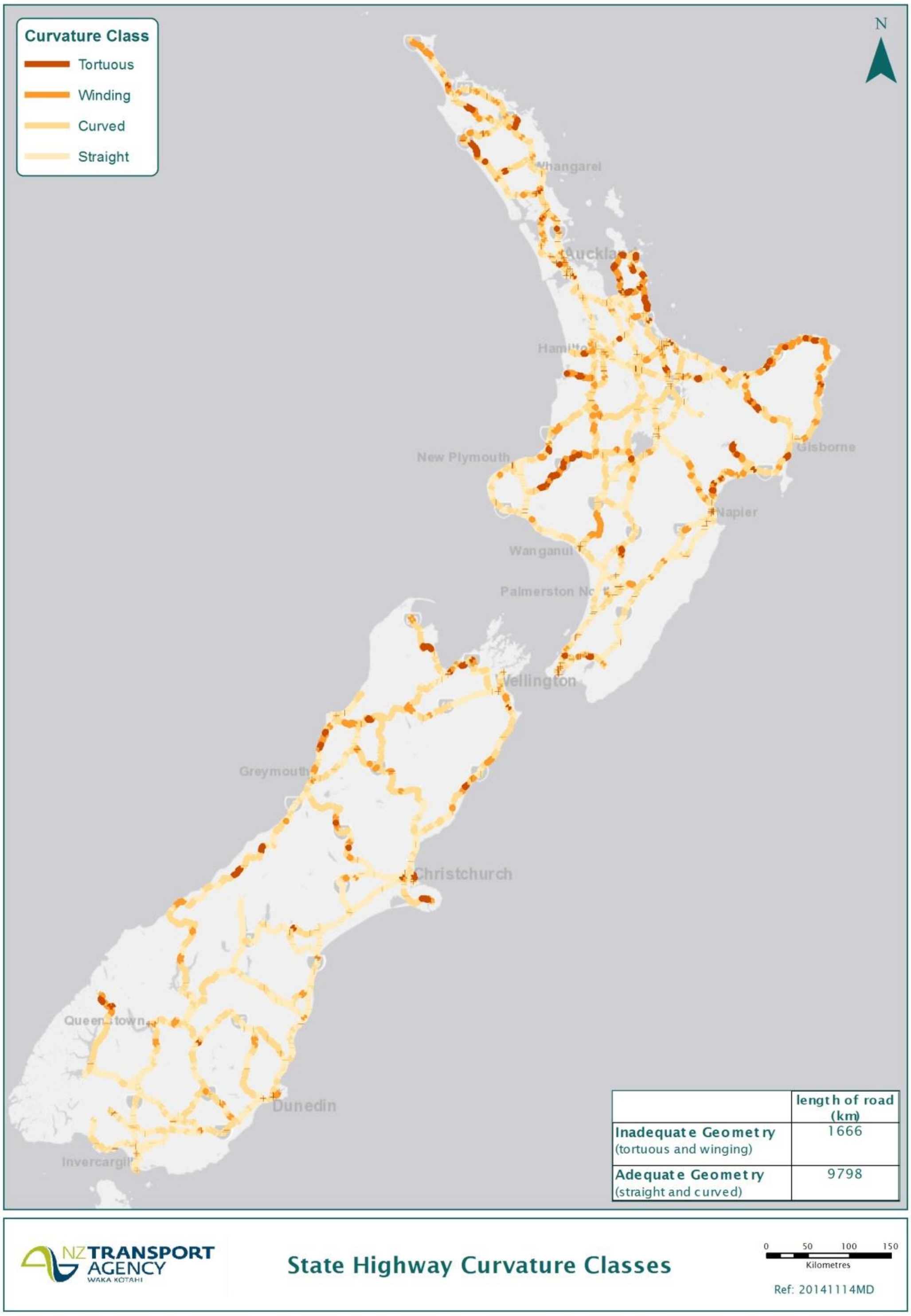
Figure 34: Indicative capacity of the state highway network
Source: 2014 National Pavement Condition Report NOC final



5.1.7 Volume

The scope of this LAMP excludes management and response to volume capacity issues.

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It does, however, reflect the works and costs required to deliver service on the operative network so it does reflect the net impact of growth of the network from capital projects.

6. ASSET CONDITION

Summary of condition

The condition of pavements is indicated by:

- The surface condition index which indicates the number of surface faults and repairs that are present
- The pavement condition index which indicates the deterioration of pavements under load or environmental conditions
- Texture, which indicates whether a road surface is near the end of its effective service life
- The growth of rutting, which indicates whether the strength of a pavement has been consumed by traffic.

Condition

Surface and pavement condition indexes are presented here for past trend analysis. They will be discontinued when automatic measurement of surface cracking and other faults is introduced and the coverage of the Traffic Speed Deflectometer is extensive. This will lead to a more reliable determination of pavement condition. It will incorporate a GPR (Ground penetrating radar) that will detect the pavement and surface layer thickness, as well as moisture.

The Agency expects to use this data, overseas experience and research findings to build a more robust framework describing the condition of the network. This framework will be used to estimate remaining service lives, better describe failure modes and target treatments to need to support a more effective and efficient programme.

We have presented the traditional surface and pavement condition indexes in two figures below as they provide useful trend information. However, we expect the new framework to replace these as it will be based on more extensive and meaningful condition data. One of the shortcomings of these traditional indexes has been a poor understanding of the relationship between customer service levels, the indexes and the optimal lifecycle cost. We expect these indexes to deteriorate as a result of the reduced pavement and surface renewals programme, but that this will not have a significant impact on customer service levels.

Description

The surface condition index (SCI) is a single index summarising surface condition based on visually measured condition defects (from RAMM rating) and also accounts for the age of the surfacing in comparison with design lives.

The index can be summarised as: SCI = Condition Index (CI) + Age Index (AI)

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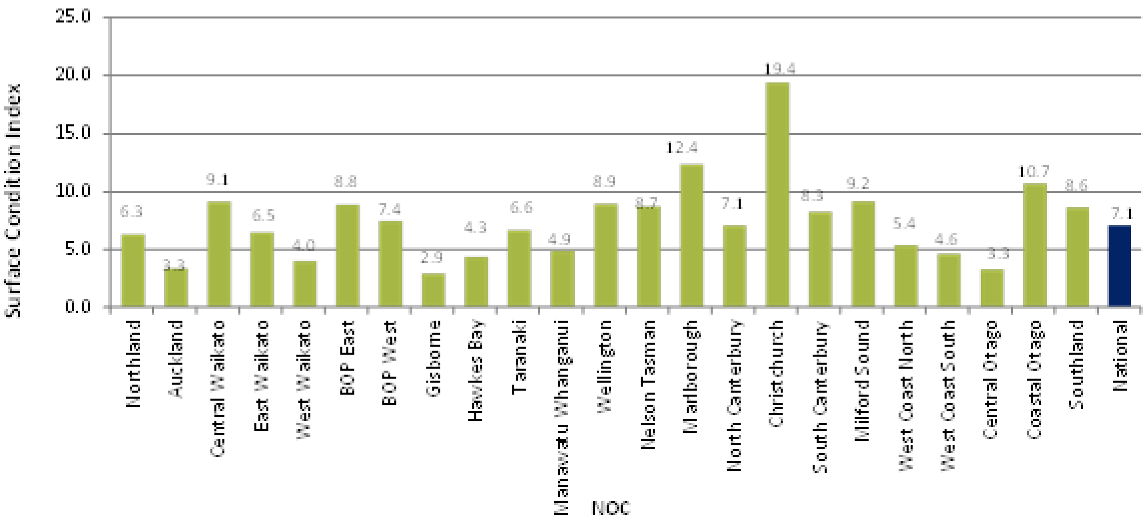
Figure 35: Surface condition index

Source: 2014 National Pavement Condition Report NOC_final



As discussed in the introduction above, this could be the last time the surface condition index is considered. The reason being the lack of a robust methodology for reporting faults ie surface cracking, can result in a very misleading interpretation of surface condition data.

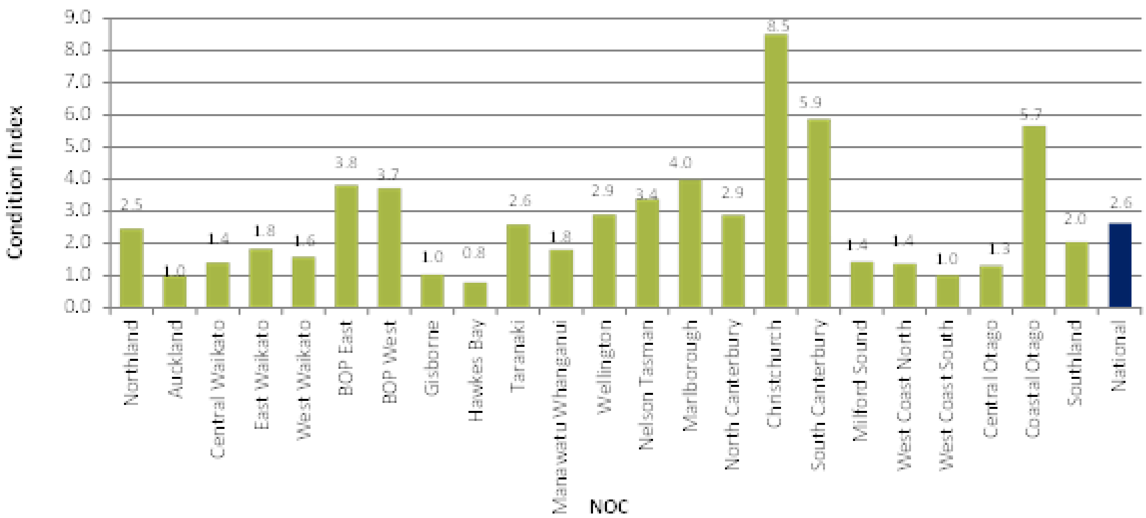
6.1.1 Pavement condition index

Description

The pavement condition index (PCI) is a single index summarising pavement condition based on a structural number from the FWD (Falling Weight Deflectometer) deflection and visual parameters, such as cracking, of measured condition defects (from RAMM rating) and also accounting for the age of surfacing in comparison with design lives.

Figure 36: Pavement condition index

Source: 2014 National Pavement Condition Report NOC_final



As for the surface condition index, there is a belief that these results don't reflect the real situation of the network. We don't have enough confidence in visual reporting and measurement, and currently deflection data from the FWD is not sufficient enough to support the above. This situation will change

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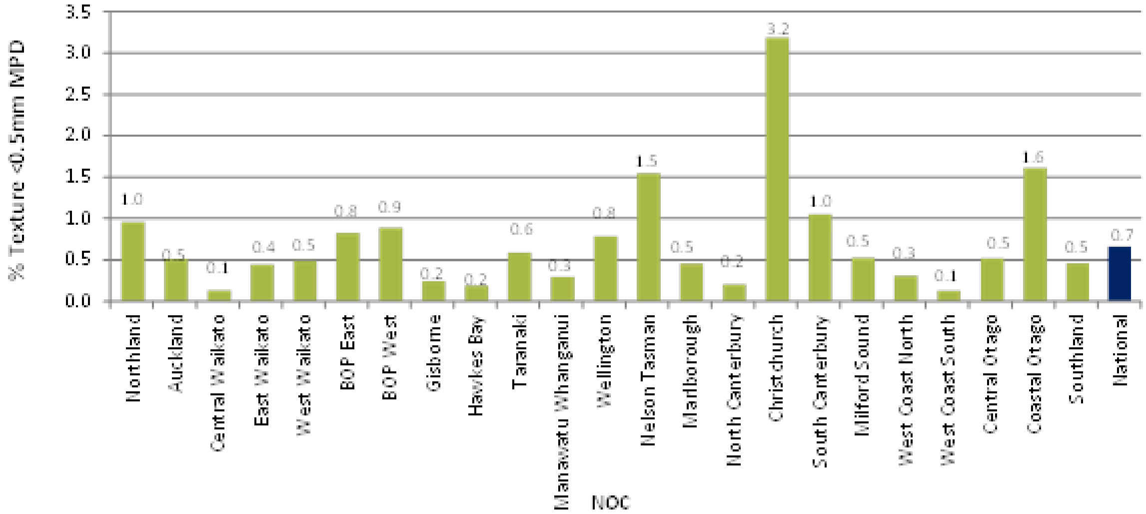
with the TSD. This will give more reliability in building an index and understanding the real condition of the pavement.

6.1.2 Texture depth index

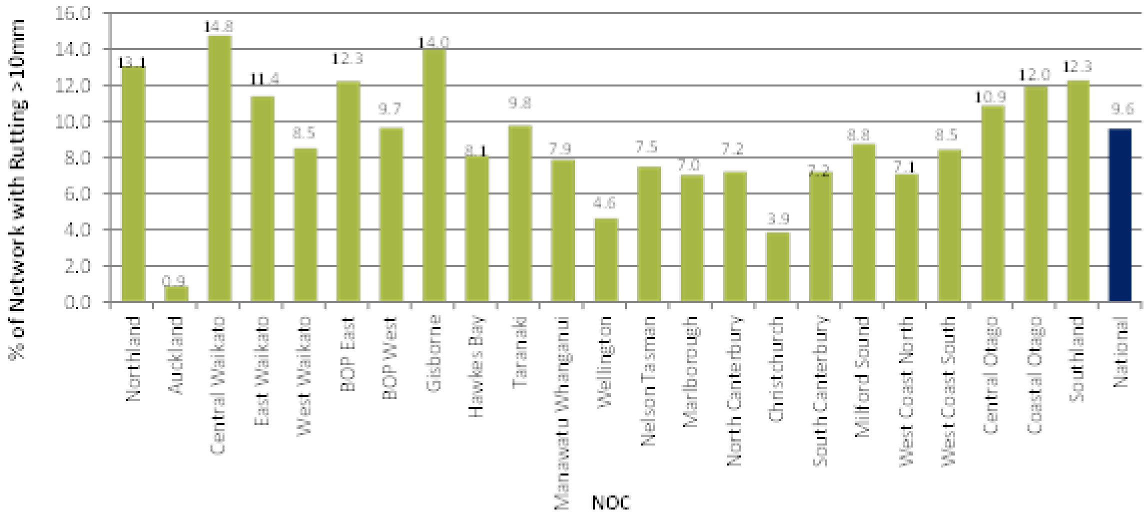
Figure 37: Texture depth index



The texture depth from the High Speed Data confirms low texture depths in high traffic environments with the presence of low radius bends and inadequate geometry as well as a flushed surface ie Central Waikato.

6.1.3 Rutting progression

Figure 38: Rutting >10mm
Source: 2014 National Pavement Condition Report NOC_final



Rutting progression confirms the philosophy of the Agency to push for more risk on the network. Noticeably the tendency of the last RAPT/NPV/Challenge session was to defer more sites with significant rutting ie Gisborne and Central Waikato. This affirms the method of taking more risk in accordance with the Network Outcomes Contract.

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Asset Age Analysis

Description

Asset age is one of the factors influencing the renewal of pavement bases and surfacing. Asset useful life (life expectancy) is the period over which an asset is expected to be available for use and remaining useful life is the time remaining until the asset ceases to provide the required service level or economic useful life.

Life expectancy

Typical pavement life expectancies from NAMS with information from the NZTA RAMM database are summarised in the table below:

Table 13: Pavement average age and life expectancy
Source: NZ infrastructure Asset Valuation and Depreciation Guidelines – version1.2 (NAMS)

Asset Type	Asset Type	Average Age	Life Expectancy (NAMS)	Life Expectancy (NZTA)
Land and Formation	Land Area	n/a	Not applicable	Not applicable
	Formation	n/a	Not applicable unless unstable sub-grades and linear subsidence is expected	Not applicable
Pavement Base	Base Course	TBC	35 - 100	50
	Subbase	TBC	35 – 100 (or not depreciated)	Not applicable
Surfacing	Chipseal	TBC	7 - 20	Average 9.2 years Range TBC
	Asphaltic Concrete	TBC		
	Unsealed	TBC		

Performance

Overall the Average Seal Age (ASA) and Average Remaining Seal Life (ARSL) show a worsening trend over the last 5 years (refer to

The national Average Seal Age in 2014 was 5.92 years, which is approximately 64% of the average expected life. Conversely, the national Average Remaining Seal Life in 2014 was 3.27 years, which is approximately 36% of the average expected life.

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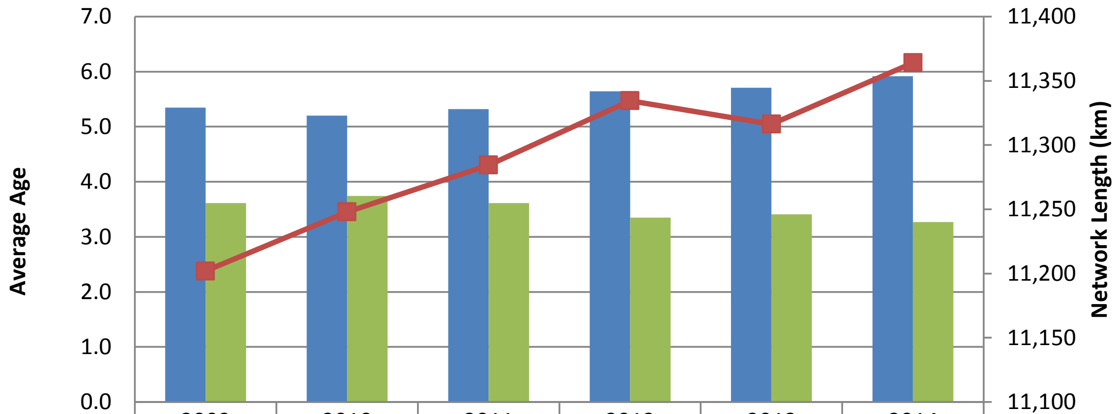
Figure 39: Average age and remaining life for seals for the network by year

Source: 2014 National Pavement Condition Report NOC September 2014

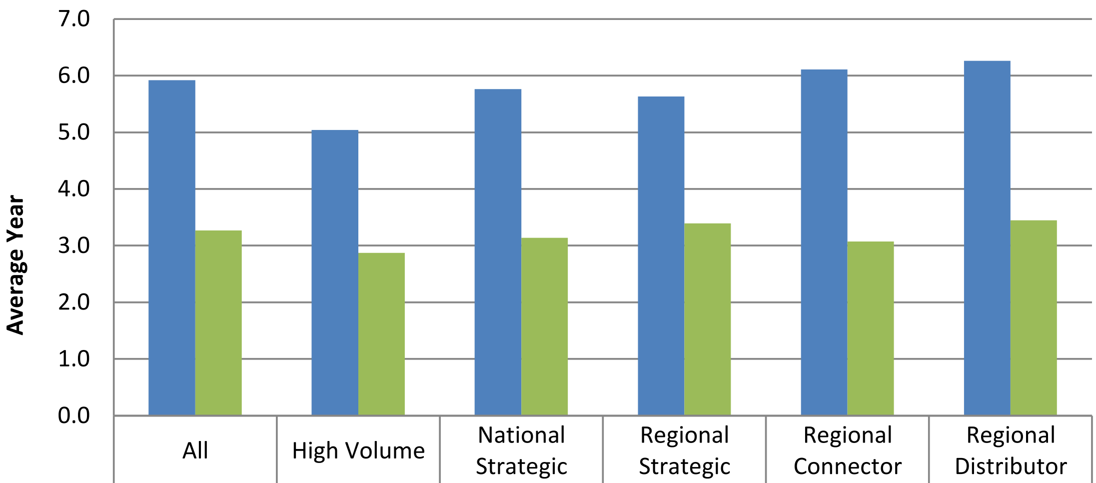


	2009	2010	2011	2012	2013	2014
ASA	5.35	5.20	5.32	5.64	5.71	5.92
ARSL	3.61	3.74	3.61	3.35	3.41	3.27
Length	11,201.96	11,247.92	11,284.47	11,334.53	11,316.24	11,364.02

The figure below shows that the life expectancy (ASA + RSL) for high volume (7.9 years) and National Strategic roads (8.9 years) are, on average, less than for the regional roads (9 to 9.7 years). This is consistent with the road classifications and expectations of these roads.

Figure 40: Average remaining seal life by road type for 2014

Source: 2014 National Pavement Condition Report NOC September 2014



	All	High Volume	National Strategic	Regional Strategic	Regional Connector	Regional Distributor
ASA	5.92	5.04	5.76	5.63	6.11	6.26
RSL	3.27	2.87	3.14	3.39	3.07	3.45

The regional variation in ASA in 2014 in the figure below varies widely from 3.3 in Gisborne to 8.2 years in Christchurch. It may be that Christchurch ASA has increased in the last few years due to the earthquake crisis and consequent inability to undertake normal resurfacing.

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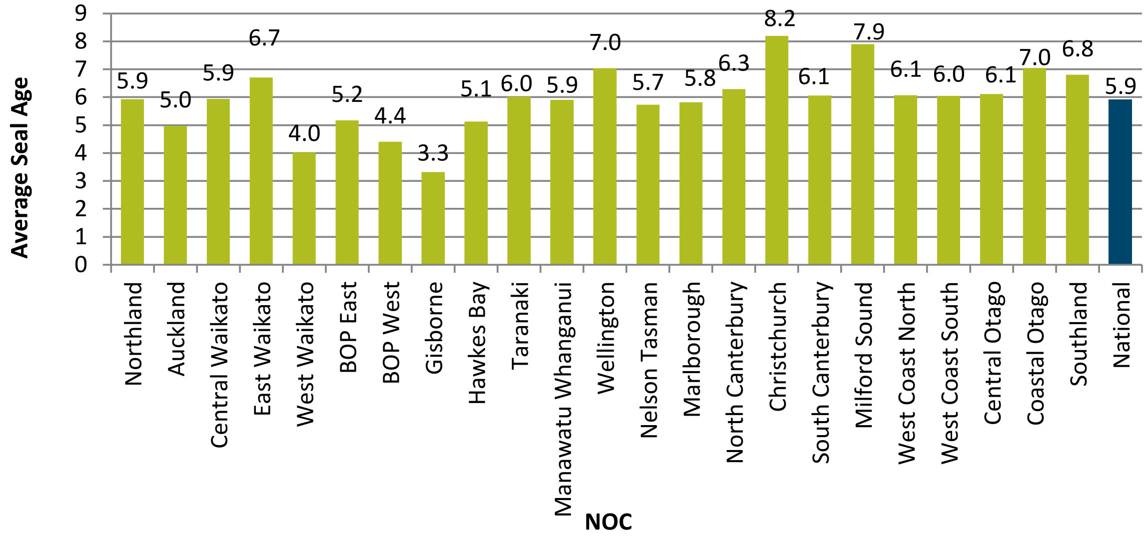
Figure 41: Seal age (average per region) for 2014

Source: 2014 National Pavement Condition Report NOC September 2014



Age trend summary

The decreasing trend in Average Remaining Seal Life is consistent with the Agency's approach of 'working the pavement asset harder' to replace assets only at the very end of their useful service life.

Further discussion on the decreasing trend in average seal life age and corresponding remaining useful lives and worsening trend in skid resistance is to be developed.

Further discussion on seal life age for roads in Christchurch in 2014 is to be developed.

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7. ASSET VALUATION

The total replacement cost of the pavement assets is $12 billion. A detailed valuation of the assets was undertaken in 2013 - the pavement data is shown below.

Table 14: Asset valuation (excluding land)
Source: 2014 Valuation

Asset Type	Unit Measured	Asset Expected Life (Years average)	Overall Quantity	Replacement Cost ($)	Depreciated Replacement Cost ($)	Annual Depreciation ($)	Renewal expenditure ($)
Formation	m^2	NA	22422	6,970,512,506	6,970,512,506	-	
Base course	M3	50	18291	2,009,874,368	1,004,937,183	40,197,486	
Sub base	M^3	NA	9141	1,825,974,074	1,825,974,074	-	
Surfacing	m^2	7	109,783,606	1,120,483,510	424,734,555	130,405,091	
TOTAL				11,926,844,458	10,226,158,318	170,602,577	

Note:

1. The figures above do not include land under roads, which is valued at $9 billion and is assumed to be non-depreciating
2. Asset average expected life for the network is indicated in the above table by replacement cost divided by annual depreciation.

7.1.1 Key valuation parameters

The valuation for pavement surfacing is as per the table below.

Table 15: Asset valuation summary for pavement surfacing
Source: RAMM information June 2014

Sub-Type	Replacement Cost ($)	Depreciated Replacement Cost	Average Life Expectancy	Average Age	Average Remaining Life	Annual Depreciation
Pavement Surface	1,120,483,510	424,734,555	7	4.3	2.7	130,405,091

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Table 16: Asset valuation summary for formation and land area

Source: 2014 Draft Valuation which includes all assets up to 30 June 2013 received 9 June 2014 and email 10 June 2014

Sub-Type	Replacement Cost ($)	Depreciated Replacement Cost ($)	Average Life Expectancy	Average Age	Average Remaining Life	Annual Depreciation
Land under roads	8,003,000,000	8,003,000,000	indefinite	n/a	indefinite	nil
Formation	5,568,110,783	5,568,110,783	indefinite	n/a	indefinite	nil
TOTAL	13,571,110,783	13,571,110,783	indefinite	n/a	indefinite	nil

8.

The valuation for pavement base is as per the table below:

Table 17: Asset valuation summary for pavements

Source: 2014 Draft Valuation which includes all assets up to 30 June 2013 received 9 June 2014 and email 10 June 2014

Sub-Type	Replacement Cost ($)	Depreciated Replacement Cost ($)	Average Life Expectancy	Average Age	Average Remaining Life	Annual Depreciation
Base Course	2,009,874,368	1,004,937,184	50	25	25	40,197,487
Sub base	1,825,974,075	1,825,974,075	N/A	N/A	N/A	N/A
TOTAL	3,835,848,443	2,830,911,258	-	-	-	40,197,487

Changes from previous valuations

The current spend to date is approximately $74.9 million on pavement surfacing and $39.7 million on pavement construction. This indicates that the valuation is aligned with the current investment framework of driving infrastructure harder in service. Depreciation is greater than renewal expenditure ie we are consuming part of the good condition of the asset in order to establish a new balanced situation.

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8. RISK MANAGEMENT PLAN

Risk Context

8.1.1 Service level risks

The greatest risks to access are:

- Loss of integrity of the road formation arising from, for example:
    - Scour by nearby rivers
    - Coastal erosion
    - Underslips on the downhill side of the road.
- Blockage of the carriageway by, for example:
    - Events or incidents, eg crashes, broken down vehicles, lost cargo
    - Over slips depositing material on the road
    - Floods making the road impassable.

The risks to the serviceability and integrity of road surfaces, pavements and formation from deterioration are generally very low due to the sophisticated maintenance and renewal processes employed.

8.1.2 Value for money risks

The greatest risks to the value for money of service levels arise from:

- The potential to defer renewal works beyond the optimum intervention point
- The potential to inadequately address the causes of failure or deterioration, in part, when maintaining or renewing road surfaces and pavements.

Any such event would lead to a greater amount of maintenance works than normal to restore and maintain service

- A prolonged reduction in road resurfacing and pavement renewal works, below the long term sustainable level, that requires abnormal amounts of maintenance to maintain service, and allows the condition of surfaces and pavements to deteriorate to such an extent that they require rebuilding rather than the cheaper renewal to maintain service levels.

This risk arises either by prolonged under-investment, or an underestimate of pavement and surface deterioration.

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Risk management strategies

Table 18: Asset valuation summary for pavements

Source: 2014 Draft Valuation which includes all assets up to 30 June 2013 received 9 June 2014 and email 10 June 2014

2.3.1 Risk category	2.3.2 Management strategy
Scour and coastal erosion	Monitor threats, take preventive action before forecast adverse weather
Underslips	Develop, prioritise and implement preventive maintenance works
Overslips and floods	
	Prepare emergency response plans
	Implement emergency works to restore service
	Implement resilience programme business case to assess risk over the state highway network, asses risk, propose, develop, prioritise and implement responses
	Communicate threats, impacts, response and restoration of service
	Utilise parallel routes
Skid resistance	Measure performance
Texture	Inspect network
Roughness	Make defects safe: barricade, temporary repair, etc
Rutting	
	Prioritise and treat defects by optimised repair or renewal, eg replace skid deficient surface, remove excess bitumen by water cutting
Incidents	Prepare response plans
	Implement response plans
	Communicate threats, impacts, response and restoration of service
	Utilise parallel routes
Value for money	Benchmark efficiency and effectiveness
	Monitor network condition
	Repair defects, restore service
	Select optimised intervention strategies
	Measure effectiveness and efficiency of strategies

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Modify strategies

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Specific risks and management strategies

There are many site specific risks associated with pavement management. Examples and their treatment are outlined in the following table.

Table 19: Asset valuation summary for pavements
Source: 2014 Draft Valuation which includes all assets up to 30 June 2013 received 9 June 2014 and email 10 June 2014

2.3.3 Risk	2.3.4 Management Strategy
Milford access road	Proactive Rockall, avalanche hazard mitigation
	Access management
Nevis Bluffs	Proactive Rockall hazard mitigation
	Removal of hazardous material
SH 3 rockfall	Barricades
	Removal of hazardous material
Waioeka Gorge	Monitor incipient slips
Diana Falls	Removal of hazardous material
	Barricades

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9. NETWORK OPERATION PLAN

Access to the network by unconventional vehicles

Individual over dimension or over weight trips are enabled whenever and where ever possible without significant adverse impact on other customer's trips. The process for this is described:

The NZ Transport Agency has a number of ways of achieving its purpose and objectives through managing and controlling the state highway network. These methods are detailed in the state highway Control Manual (December 2013) and include:

- The promotion of policies in district plans consistent with roading and community needs
- Designation and purchase of land to enable alignment improvements or capacity expansion
- Statutory provisions of limited access control
- Bylaw provisions to manage the activities of some highway users
- Other statutory control measures such as temporary speed restrictions, road closures, etc.

Access to adjoining property

The Roading Powers Act is the principal act used to exercise powers and controls on state highways. The act includes many provisions for access management, including:

- Restrictions to land entry without the owner's consent
- Giving notice before entering land
- Creating and revoking state highways
- Creating and revoking limited access roads
- Permitting vehicle parking spaces, buildings or other facilities on or adjacent to a state highway
- Controlling encroachment, obstruction, damage, etc to state highways including exercising powers to prosecute
- Imposing conditions on territorial local authority (TLA) and utility work on state highways.

The NZ Transport Agency manages the number of access points across the network appropriate to classification, and ensures all points meet high standards for location and design. About 60% of the network is gazetted as a limited access road, the legislation for which requires the NZ Transport Agency to license all access points (eg driveways) and to set appropriate conditions for their use. A robust process is in place for approving any new accesses to the network. When considering developments, the NZ Transport Agency works with developers to ensure that accesses are in the safest possible locations and that the development will not have undue effects on the network.

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Consent management

The NZ Transport Agency issues and monitors consents/agreements for activities affecting state highways. These include:

Table 20: Consent/agreements for activities affecting state highways
Source: State highway control manual December 2013

Consent/Agreement	Description
Schedule of Reasonable Conditions	Consent for services that belong to recognised Utility Operators (where the utility operator is a local authority or authorised in legislation)
Works access permit	Consent for utility services works
Deed of Grant	Consent for other services where the applicant is not a recognised service authority.
Licence to Occupy Road	Consent for the use of part of the road reserve (e.g. for mobile phone cell sites or stock fencing)
Agreement as to Work on State Highway	Any works on non-motorway state highways, where the principal requires the Agency's consent for undertaking utility works within state highway road reserve and the Principal has no legislative or other authority for requesting consent.

Under the Resource Management Act 1991 resource consents are required for discharges and works including but not limited to earthworks and discharge of contaminants into the environment. More information is provided in ss72-77 of the Resource Management Act.

The Transport Agency response to spill incidents to address any consenting issues arising from provisions of regional and district plan rules are discussed in the 'Operation and Environmental Response' section of this plan.

Collaborative working arrangements

The NZ Transport Agency works together with other network operators and transport agencies to coordinate activities. The following mechanisms are in place for building and maintaining collaborative working arrangements:

- TLA liaison meetings
- To optimise the networks, the NZ Transport Agency has adopted a network operating framework, which is an integrated process that helps the Transport Agency and other network providers to better manage and plan the use of the transport network. More information is provided in the SHAMP section 8.1.1.
- The Permitting Project plus Opermit phase 4, undertaken during 2013/14, provided the road transport industry with a single customer interface to both the NZTA and other Road Controlling Authorities.

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- Together with Auckland Transport, the NZ Transport Agency has established the Joint Traffic Operations Centre, which enables us to take a ‘one network’ approach to managing traffic on the entire Auckland network, not just the state highways.

Collaborative service delivery arrangements are in place, or being implemented for:

- Marlborough Roads
- Tairawhiti Roads
- Western Bay of Plenty

Other relevant operational issues

The NZ Transport Agency also has expectations that it will work with various agencies and organisations to provide services to allow access to the state highway network and support a number of activities that meet obligations under legislation.

9.1.1 Incident management

The NZ Transport Agency has a signed protocol with the emergency services for the provision of services to support emergency services on site due to on-road events such as road crashes, spills, etc. When called upon, the Agency will make resources available at the site of the event within a set level of service and will manage the traffic and any detours required to free the emergency services for other duties. The Agency will also provide resources and materials to manage any resultant spills.

9.1.2 Emergency works

The NZ Transport Agency provides for resources through its maintenance contracts to ensure immediate initial response to restore access after an emergency event, and for appropriate follow-up works to restore the level of service requirement for the network.

9.1.3 Utilities

The NZ Transport Agency has responsibilities under the Government Roading Powers Act, the various utilities Acts and the national utilities code to manage the utilities’ legislated right of access to the state highway network. The right of access is not unfettered and the Agency, as with any other road controlling authority, has a right to reasonably set conditions and safeguards to protect the network. There are a number of duties set including sharing its programmes and holding liaison meetings with the utility operators.

9.1.4 Community events

The Land Transport Management Act sets expectations that the NZ Transport Agency will assist communities including providing resources to make the reasonable use of highways available as community space to support community initiatives. The Agency has processes in place to ensure that correct procedures are followed to allow customer interactions to happen safely and to provide continuity of access during community events.

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9.1.5 Rail level crossings and Deeds of Grant

Railway level crossings on the state highway network are a joint responsibility to manage between KiwiRail and the NZ Transport Agency and these responsibilities are divided as set out in the Railways Act. These responsibilities may be varied according to the conditions of any Deeds of Grant that have been agreed between the parties for specific works that have been conducted on rail land. In general KiwiRail will maintain between and either side of the rail lines and the Agency will maintain the approaches.

9.1.6 Risk register

The NZ Transport Agency maintains regional and a national risk register to ensure that understanding what monitoring is required, what safety systems need to be managed and what are the hotspots is recorded and reported. It is expected that the register will be actively managed and that when opportunities arise to reduce the recorded risks by appropriate means those opportunities will be taken so that the balance of risk is improved over time.

9.1.7 Civil defence

The NZ Transport Agency has the responsibilities of a lifeline utility under the Civil Defence and Emergency Management Act. The duty of a lifeline utility is for it as an organisation to be able to function at the fullest possible extent after an event. That requires the Agency to undertake emergency response and business continuity planning so that its employees understand what is expected of them after an emergency event. The Agency works with partner organisations to plan ahead for the likeliest risks to its infrastructure and for the response required from it.

9.1.8 Resource management planning

The roadscape of the network is continually changing and the NZ Transport Agency is tasked with managing the impacts of land use changes on its infrastructure under the Resource Management Act. The Agency works with the consenting authorities to ensure that it is aware of proposed developments and works with developers to mitigate the impacts of their developments. It also works with consenting authorities reviewing plans to ensure the best possible balance between protection and development.

9.1.9 Stock effluent

The NZ Transport Agency Board has a set policy for defining the boundaries of the shared responsibility for maintaining stock effluent collection/dumping facilities on the state highway network. There is a shared responsibility with the appropriate local authority to establish and maintain these facilities. In general the Agency is responsible for on-carriageway and turn-off works and the local authority is responsible for the remainder of the access, parking areas, the receiver and treatment facilities.

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9.1.10 Vehicle weighing

The NZ Transport Agency provides services for managing the on-road facilities for weighing heavy vehicles, in liaison with the NZ Police. The Agency will maintain the access, working area and weigh pit itself. If agreed, the Agency may provide fixed signs, lighting, power supply and a hut and maintain them, but any fitting out of the hut is a cost to NZ Police.

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10. MAINTENANCE AND RENEWAL PLAN

Maintenance and renewal activities

Pavement maintenance and renewal activities are summarised in the table below:

Table 21: Pavement maintenance vs. renewal activities and definitions

	Maintenance	Renewal
Definition	Pavement maintenance provides for the care and repair required to maintain the serviceability of the both the top surface and pavement base, as well as to prevent premature failure. Pro-active maintenance: includes network inspections, defect identification, treatment selection, work prioritization and schedule and repair. Reactive maintenance: repair pavement and surfacing where the asset has defects. Preventative maintenance: undertaken in a gradually deteriorating situation. Eg completion of crack sealing as required rather than allowing moisture to enter the lower layers causing the pavement to fail necessitating the need for dig out repair.	Pavement renewal is the replacement of asset components that have deteriorated in condition and/or serviceability and have reached the end of their useful life. The time for renewal is when it becomes more cost effective to replace an asset rather than continuing to repair it. Predictive renewals: planned resurfacing and rehabilitation. Reactive renewals (both resurfacing and rehabilitation) may be triggered if pavement is badly damaged by a weather event, earthquake, etc.
Activities	Routine sealed pavement maintenance: includes inspection, defect identification, prioritisation and repair. Works include crack sealing, pavement patching and repairs, rut filling, and shoulder maintenance to rectify defects such as surface bumps, potholes, deformations, heaves and shoves, rutting, flushing, edge break, low shoulder and edge rutting. Emergency repairs: includes repairs following accidents, spills, slips or adverse weather or geological events. Pre-resurfacing: maintenance work carried out to a high level to ensure all pavement and drainage repairs are done before the resurfacing. Pre-resurfacing repairs are completed in the year/season prior to re-surfacing.	Resurfacing: resurfacing is a relatively minor intervention that maintains the integrity of the pavement surface to avoid the implications of a sudden failure. Resurfacing is defined as the resurfacing of a section of road, including shoulders, over a continuous length of at least 60 lane metres for Site Category 1 and 100 lane metres for Site Categories 2, 3, 4 and 5 (see NZTA T/10). The treatment may include single or multi-layer chipseal, thin asphaltic surfacing or other surfacing treatments and works include pre-reseal repairs (at least one construction season in advance of the programmed resurfacing date) and resurfacing construction. Rehabilitation: rehabilitation of the pavement is major intervention requiring restoration of the pavement base to a

Click here to enter text.

	Maintenance	Renewal
	Holding: a minimum amount of work is undertaken for the one to two years preceding rehabilitation. A ‘keep safe’ strategy is adopted.	standard similar to its original condition. Pavement Rehabilitation is defined as the treatment (including pavement recycling treatments) over a continuous lane length of at least 100 metres.

Figure 42: Typical maintenance cost distribution

Source: 2009-2013 NOC and NMA dimensions and achievements v2.1_FINAL 20140526

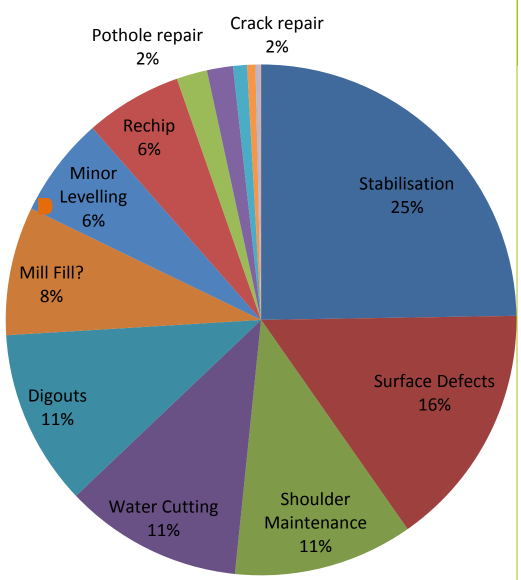
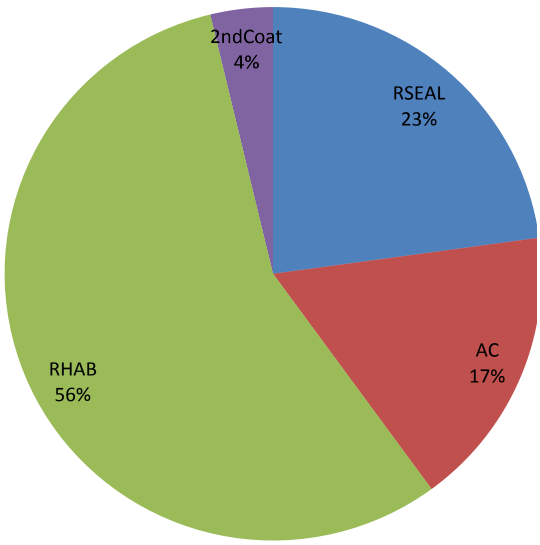


Figure 43: Recommended renewal percentages

Source: National Pavement Performance Modelling: Establishing Contractual Quantities Prepared for NZTA June 2013



Assessment tools and techniques

Key assessment tools and techniques for maintenance and renewal of the state highway network are described below.

10.1.1 Pavement condition and net present value

Skid resistance, texture, surface condition, roughness and rutting results feed into the maintenance and renewals forward works programme. The figure below provides a model of the typical deterioration of the pavement condition and the intervention activities undertaken at various asset condition levels.

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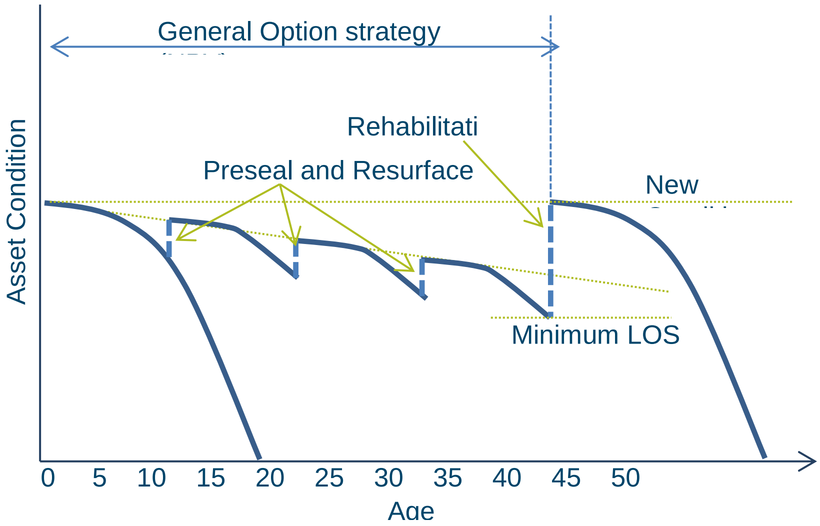
Figure 44: Pavement deterioration and intervention process conceptual model



The NZ Transport Agency is in the process of implementing a modified net present value (NPV) process, which aims to prioritise renewals based on long-term economic value.

Net present value analysis is undertaken for all pavement renewals and asphaltic concrete proposals. Key aspects of this process relating to management of the pavement and surfacing renewals programme are:

- Projects that do not meet the NPV criteria will not be carried through to the approved annual plan
- The criteria to be met include achieving a positive NPV, and an Economic Indicator that is either negative, or within the range 0.8 to 2.0. The Economic Indicator is used to gauge the validity of maintenance cost inputs and subsequent renewal timing
- There are robust expectations for the development of predicted future maintenance costs
- The NPV process requires the consideration of at least three options to test the validity of the renewal proposal

    - A do maintenance option – the minimum level of maintenance inputs to achieve safety and level of service outcomes
    - A do something option – typically a heavy maintenance and seal option targeting a seven year life extension
    - The renewal option – if there are an number of options with different life expectancies and risk profiles it may be necessary to consider many of these.

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10.1.2 Long term predictive modelling (dTIMS)

Long term predictive modelling using dTIMS focuses on the optimisation of pavement lifecycle benefits for a given funding level and predicts pavement performance for different funding scenarios.

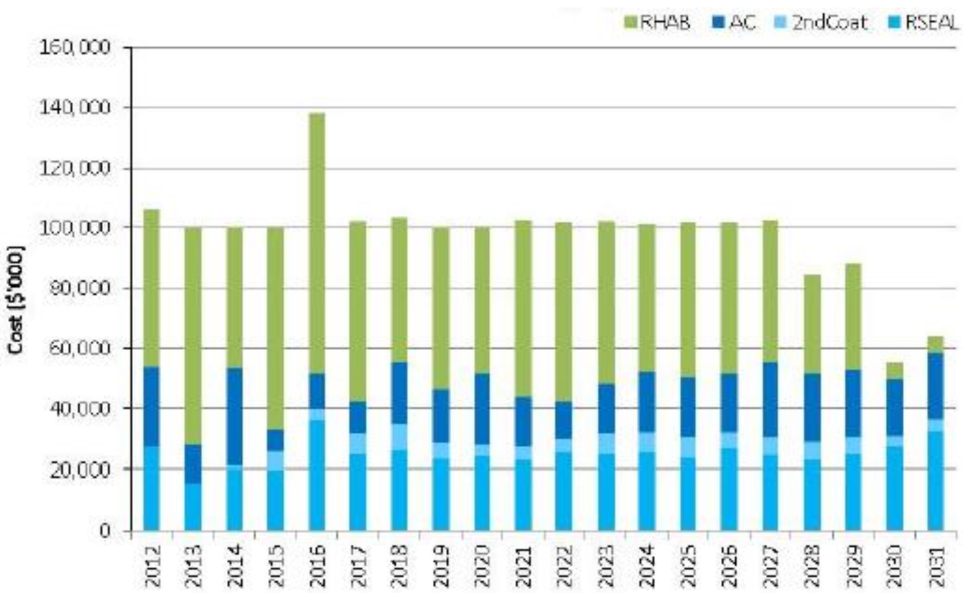
In 2013, the Transport Agency commissioned a study to determine the minimum preservation maintenance levels using dTIMS. The following table presents results of the analysis.

Table 22: Recommended quantities for the SH network treatment unit quantity
Source: National Pavement Performance Modelling: Establishing Contractual Quantities Prepared for NZTA June 2013

Treatment	Length/year (km)	% of Network/year	Cost/year ($000)
RSEAL	561.8	5.50	24,072
AC	61.1	5.34	18,029
RHAB	160.5	1.41	59,326
2ndCoat	111.6	1.09	3,960
TOTAL			105,387

The annualised treatment costs for the minimum preservation levels identified in the study are provided in the figure below:

Figure 45: Annualised treatment costs for minimum preservation levels
Source: National Pavement Performance Modelling: Establishing Contractual Quantities Prepared for NZTA June 2013



10.1.3 Tension levels and RAPT review

Before carrying the pavement and surfacing renewal proposals into the final annual plan, the renewals schedule is subjected to an internal peer review process that the Agency refers to as its RAPT (Review and Prioritisation Team) process.

A team of experiences asset management practitioners visits each proposed renewal site and approves projects that can be included in the annual plan submission. The RAPT team:

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- Reviews deferrals made in the last annual plan process to comment on whether deferral is still seen as an appropriate strategy and what lessons can be learned from this
- Reviews the network statement supporting the strategic intent of the proposed programme
- Approves projects to be submitted into the annual plan process
- Attaches to each project a RAPT timing indicator (see below)
- Provides any necessary instruction for each proposal. For example, they may provide design consideration guidance, specify a chip size. etc
- Looks at the following years programme providing an indication of appropriateness.

The Review and Prioritise Team (RAPT) undertakes an annual site based efficiency review of the road pavements renewal programme to assess if renewals are either overdue or too early. The timing of proposed reseals and rehabilitations are evaluated with the following scoring system:

- -1 treatment proposals that appeared to be one or more years too late
- 0 treatments that appear to be about right, and
- +1 treatments that could be deferred one or more years

The current targets (tension targets) and results from the April 2013 review is summarised in the table below:

Table 23: Tension Levels – Current and Targeted Tension Levels

Source: April 2013 RAPT Review

	-1 Timing is a year too late	0 Timing is correct	+1 Timing is a year too early (defer)
Current Level (national average)	7%	55%	30%
Tension Target	15%	75%	10%

Figures for 2014 are being developed.

The table indicates that a much higher level of tension is expected. Forward works programmes have been modified based on the consensus reached by the RAPT team. The challenge is to get all programmes conforming to these tension targets before the RAPT process is undertaken. The figure below provides the tension levels by region.

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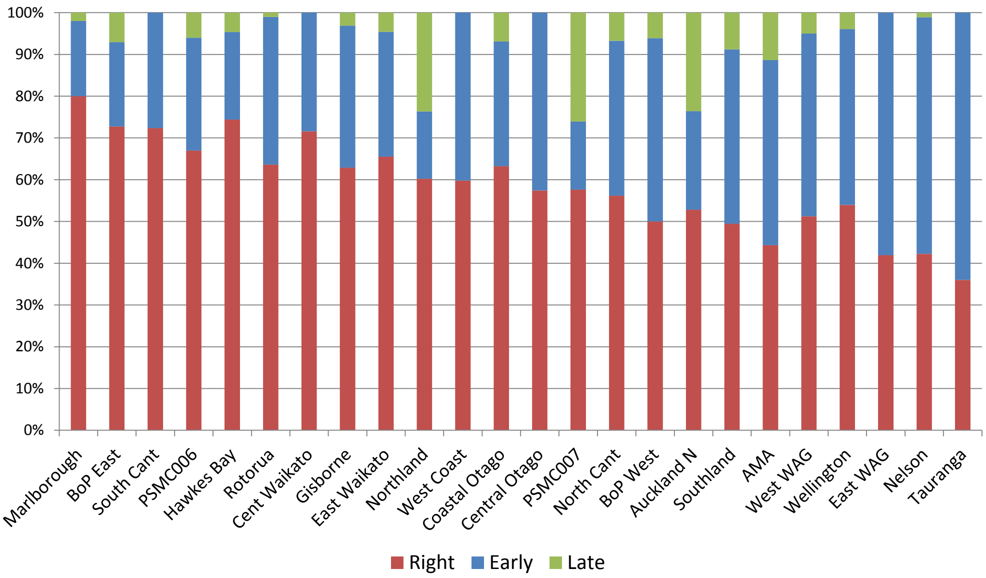
Figure 46: Renewals timing by region
Source: RAPT Report April 2013

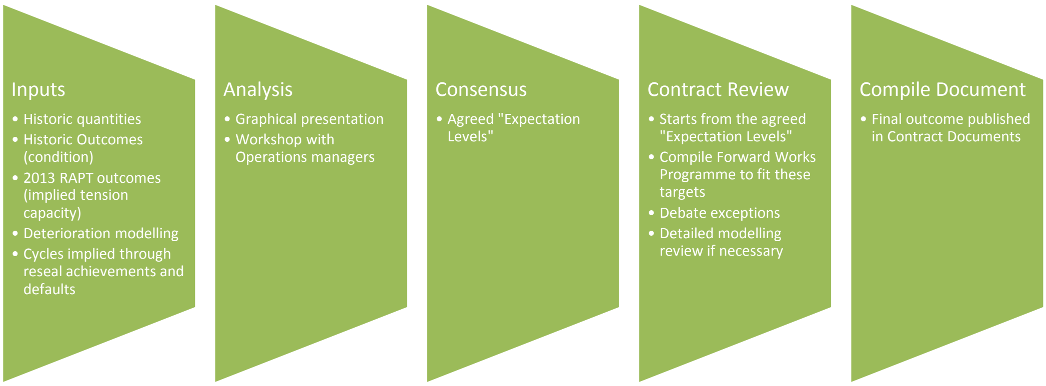


10.1.4 Base renewal preservation quantities

The deterioration modelling and RAPT review are used as inputs to determine base renewal preservation quantities that are included in the network contracts.

An overview of methodology used to assess the base preservation quantities for the renewals programme is provided in the figure below.

Figure 47: Methodology to assess base preservation quantities
Source: VAC Paper June 2013 OMC Renewals Base Quantities Methodology



Stochastic modelling

The NZ Transport Agency uses a stochastic model to test scenarios for pavements and surfacing both in terms of asset preservation and skid resistance. Stochastic modelling involves carrying out simulations in which ranges of values for each variable, or index, (in the form of probability distributions) are used. Three separate simulation models for (1) pavement renewal, (2) surface renewal, and (3) skid resistance were completed in 2014. The total cost to maintain each of stochastic modelling the asset groups to existing condition was calculated to be $76m. The annual budgets assessed in 2014 were $22m, $32m and $46m.

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Table 24: Budgets split into asset groups

Source: Opus Research Report 14-521193.00 Development of a Stochastic Model for Network Cost Forecasting: Pavements

	To Maintain $76M	Per-centage	Budgets ($000)			
			$ 22,000.00	$ 32,000.00	$ 46,000.00	$ 56,000.00
Low ESA Chipseal	$ 36,763,282	48.4%	$ 10,653.79	$ 15,496.42	$ 22,276.11	$ 27,118.74
Mod. ESA Chipseal	$ 26,352,311	34.7%	$ 7,636.75	$ 11,108.00	$ 15,967.75	$ 19,439.00
High ESA Chipseal	$ 3,509,368	4.6%	$ 1,017.00	$ 1 ,479.27	$ 2 ,126.44	$ 2 ,588.71
AC	$ 9,290,940	12.2%	$ 2,692.46	$ 3 ,916.31	$ 5 ,629.69	$ 6 ,853.54

10.1.5 Increase in length of the state highway, vehicle kilometres travelled and freight

The increase in length of state highways, vehicle kilometres travelled and freight are discussed in this section. This increase will not only have an impact on capital expenditure, but on maintenance and renewal expenditure as well.

Our pavements are designed in terms of lifetime equivalent standard axle (ESA) load. A standard axle carries 8.2 tonnes; cars therefore contribute an insignificant amount to pavement loading. The ESA travelling on the network has been rising steadily. As the relationship between axle load and damage done to the pavement is exponential the Agency continues to monitor the effects of these increased loads on the network closely.

10.1.6 Vehicle dimensions and mass changes

The Transport Agency has approved the use of high-productivity motor vehicles on routes where there is demand and high uptake. This recent legislative change will allow larger and heavier trucks on the network, increasing wear and resulting in shorter asset lives and increased replacement costs. This will likely be restricted to existing freight routes or localised short-haul highway sections.

10.1.7 Variability across regions

New Zealand has variability across the regions that influence the lifespan and therefore maintenance/renewals of the roads.

North Island (particularly Bay of Plenty, Waikato, Auckland)

- Poorer sub-soils; volcanic ash; swamp
- Poorer aggregate; weaker gravels
- Central North Island – extreme summer and winter conditions

South Island

- Alluvial; river gravels
- Southland, Milford – extreme summer and winter conditions

The figure below provides a breakdown of the cost per lane-kilometre for different regions.

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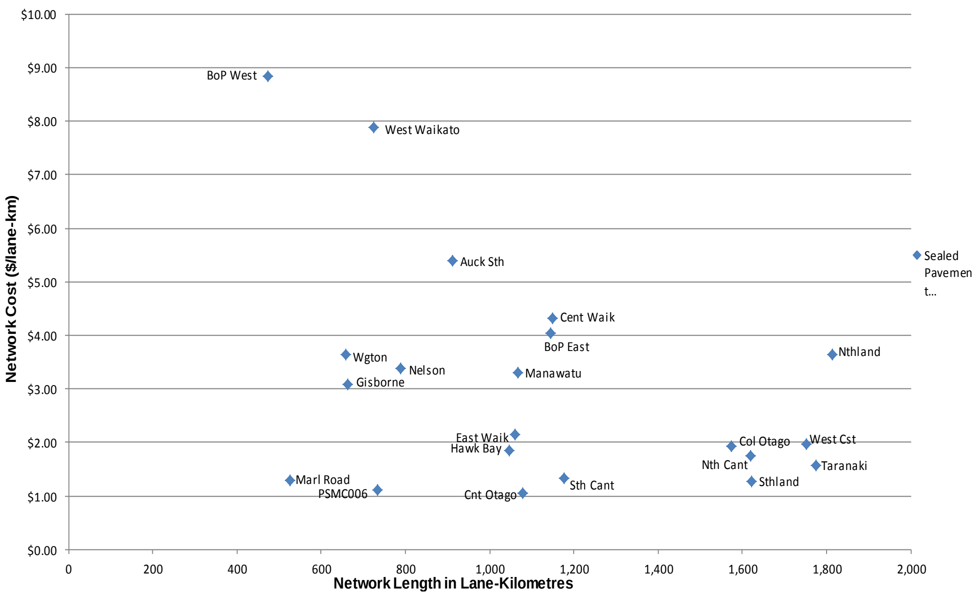
Figure 48: 2012/13 Cost per lane km for sealed pavement maintenance
Source: SHAMP 2012-2015



10.1.8 Weather and programme timing

The weather and timing of the renewal can have an impact on maintenance expenditure. Maintenance costs are higher if the resurfacing is delayed until just after winter because the pavement is 'held' with reactive maintenance until resurfacing is possible. Seasonal influences such as periods of very wet weather can also have an impact on expenditure.

10.1.9 Material types

Material types impact on the maintenance and renewal requirements. These include:

- Surfacing materials (asphalt type, chip seal type and component materials)
- Changing sub grade or pavement material characteristics
- Quality of the surfacing work and surfacing material components

10.1.10 Drainage

Deterioration of pavement is variable due to pavement drainage characteristics.

10.1.11 Accidents

Accidents or spillage cause damage to pavement surface and triggers maintenance or renewals.

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10.1.12 High stress areas

High stress areas such as steep vertical or tight horizontal geometry, weaving areas, ramp terminations, interchanges, side road junctions and pedestrian crossings.

Networks Outcomes Contracts

The planning and delivery processes described elsewhere are implemented through the Network Outcomes Contracts, which will all be in place by the end of 2016. This section describes how those processes are implemented through the Network Outcomes Contracts.

- The contracts reflect the base preservation quantities. These are the nationwide estimates of the minimum renewal quantities required to effectively sustain access at least cost.

- A network by network verification process finalises these quantities as NOCs are tendered. Recent network level experience has been that the base preservation quantities align well with verified network needs giving confidence that the base nationwide base preservation quantities are reasonable. However the short to mid-term levels are about two thirds of the long term sustainable level. This is possible as the average condition of the network is drawn down to a sustainable level.

- The outcome is that renewal quantities over the next 7 years will be lower than before. We forecast that renewal quantities will rise as the network condition stabilises at the new sustainable level.

- Some factors that have influenced this outcome include:

  - Initially the Agency will be consuming some very good asset condition. After 5 to 7 years the investment requirement will increase above the current forecast levels
  - In particular, the lower classification networks are in better condition than expected under the new classification and level of service definition
  - The Agency will continue to invest in sealing to maintain and improve skid resistance performance and this expenditure that affects both surfacing and to a lesser extent pavement renewals is additional to the preservation inputs.
- As a result of the measures introduced to lower the costs of maintaining and operating the network, the Agency expects that the network will look different. For example:

  - Refining the targeting of renewals to the area of need will result in shorter treatment sections and some networks will take on a 'patchwork quilt' appearance
  - Defects that are not affecting safety or customer level of service will be more apparent – the Agency will not be repairing blemishes
  - The average roughness of the network will increase particularly on lower classification routes. The Agency will be focussed on addressing areas of very high roughness that do affect the customer experience and will be less concerned about gradual increases in average roughness that affects the customer experience less.
- The Agency expects to be taking more risk with renewal investment particularly on lower classification routes. This means that renewals will be implemented later in the service life when condition is worse than before. Deterioration may be greater than forecast in some cases leading to a greater than expected amount of repairs to maintain service levels.

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10.1.13 Maintenance and renewal delivery

There are two key aspects of the Network Outcomes Contracts operational context that are significant to the effectiveness of delivering the results expected in terms of the pavements and surfacing management context described thus far:

- The renewal quantity flexibility provisions, and
- The requirement to document all decision making processes in a Maintenance Management Plan.

10.1.14 Renewal quantity flexibility

The NOC contract specifies the quantity of pavement and surfacing renewals representing the base preservation level determined from the assessment described thus far. Implicit within the methodology used to determine these is an expectation that the quantities will increase above these base preservation levels where there is sound economic justification to do so. This requirement for flexibility recognises the subjectivity of the assessment, and that circumstances may change.

The contractor is required to propose a Contractors Baseline Plan with its tender submission that proposes its distribution of the specified quantity of renewals by year across the period of the contract. Then to refine this plan to indicate how this distribution will be applied to locations on the network – essentially the contractors forward work plan showing the treatment length segmentation of the network and where treatments will be timed on these for each year of the contract.

The intent of the renewal quantity flexibility provisions is to recognise that there is some subjectivity associated with the specified quantities, and:

- Ensure that there is a transparent adjustment mechanism to avoid contractors building unnecessary risk into their lump sum
- Ensure that the Agency will always respond with best for asset solutions when something changes (for example an extraordinarily wet winter)
- Encourage suppliers to find clever preventive and alternate treatment strategies to stretch the life of the existing asset, and to
- Ensure that in spite of the net quantities attached to the contract, and the distribution of these across time assessed at tender time, in any given year only well justified treatments will proceed.

Key elements of the renewals quantity flexibility provisions are:

- All renewal proposals on an annual basis will be subjected to the gatekeeping approval criteria that apply to the Agencies Annual Plan process including the RAPT review
- Generally, the quantity of resealing specified will be applied as long as the technical approval through the RAPT process is achieved. There is currently no economic justification criteria that is applied to resurfacing proposal (for example, the NPV criteria applying to pavement renewals)
- The Agency may approve additional pavement renewals or asphalt surfacing where the NPV confirms that the additional work is economic
- The Agency can elect to reduce the quantity of pavement renewals and asphalt surfacing where the economic justification for the work is demonstrated but then the risk and cost of increased routine maintenance inputs, and level of service non-compliance shifts to the Agency.

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The contractor is rewarded if the rehabilitation or asphalt surfacing quantities can be reduced over the entire contract period. This provision is intended to encourage the pursuit of intervention strategies that may defer the need for pavement or asphalt surfacing renewals.

The Agency will fund any approved innovative alternative strategies. For example, rejuvenation seals for asphalt surfacings. Thus the contract has established a minimised preservation level of renewal investment that together with the contractor's lump sum inputs into routine maintenance will deliver the level of service specified, but has introduced flexibility measures to mitigate the pricing risk and prioritise least life-cycle cost asset management practices.

10.1.15 Review of forward works programme

The Agency manages the long term plan for pavement and surfacing renewals in NOMAD, an application included in the RAMM software. Currently the NOMAD software provides a comprehensive capability to manage pavement and surfacing forward programmes for interventions on each treatment length across the network over a 30 year time frame. It has limitations relating to the current asset management requirements that the Agency intends to address:

- It cannot easily capture planned drainage maintenance and renewal needs that may extend over a different segmentation of treatment lengths and may be specific to only one side of the road.
- It cannot currently capture all of the data outcomes of all of the annual planning processes, for example:
  - The RAPT ranking outcomes and RAPT instructions
  - The NPV analysis results
  - A summary of the prioritisation data
- The annual plan process commences with a review of the long term forward works programme and updating of the programme in NOMAD. The updating process includes:
  - Updating the previous years' renewal achievements
  - Periodic dTIMS performance modelling
  - Review of condition trends and outcomes
  - Consideration of the prioritisation outcomes
  - Field review of the programme based on these inputs.

The programme review will generally be carried out by the Network Outcomes Contract supplier based on the requirements of the contract including its strategies to manage the balance between renewals and routine maintenance inputs, and the baseline preservation quantities specified in the contract. The Agency's Contract Manager and Network Manager will review the programme with the contractor before it is submitted into the annual plan process.

Following the review of the long term forward works programme, the programme for the upcoming year is extracted to form the basis for the annual plan renewals schedules and the review of these.

10.1.16 Maintenance and renewal strategies

The Maintenance Management Plan required of the NOC contractors, details the decision framework that will apply to all maintenance and renewal activities. It is intended to demonstrate how the contractor will be a good asset management steward. Focussing on documenting and agreeing the detailed decision processes provides some extent of risk mitigation to ensure that planned interventions are coordinated well with the reactive maintenance effort, to minimise the risk of strategies resulting in unintentional asset consumption occurring, and that long term outcomes are not compromised by the short term objectives of the supplier.

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The Maintenance Management Plan:

- meets the requirements the Transport Agency has set
- clearly documents the decision processes to be used in the operational asset management environment
- incentivises the development of smarter processes and
- ensures sustainability by providing a resource that will assist with transfer of knowledge to new resources coming into the long term contract

The content is laid out in six sections:

- Strategic
- Development and Maintenance of Forward Works Programmes
- Pavement Strategies
- Surfacing Strategies
- Drainage Strategies
- Maintenance Activity Requirements

10.1.17 Contract payment model

The payment model designed for use in the NOCs is designed to optimise expenditure across the two key investment areas; pavement and surfacing renewals, and the routine maintenance work.

In general terms the model is based on the Agency determining the minimum level of renewal investment and specifying these in the contract documents. This work is priced as a lump based on a schedule of specimen treatments, but paid as measure and value based on the actual treatments applied. The supplier prices all routine maintenance activities as a lump sum based on its determination of the level of routine maintenance inputs required to deliver the specified levels of service taking into account the impact of the specified level of renewal investment.

Thus the supplier is incentivised to:

- Minimise the level of routine maintenance executed,
- Ensure that the renewals are applied carefully to the right locations to minimise the routine maintenance inputs required, and maximise the service level improvement achieved, and
- Achieve a high quality of renewal work - since any routine maintenance required to correct deficiencies will be at the contractor's cost, and if the expected outcomes are not achieved there will be a financial and tenure penalty through Operational Performance Measure non-compliance.

The Agency's gatekeeping functions (NPV, technical audit, etc) that are described in section ensure that the right treatments are applied. The requirements of the Contractor's Maintenance Management Plan ensure that renewal treatments are addressing valid failure mechanisms.

The payment methodology is illustrated in the following diagram.

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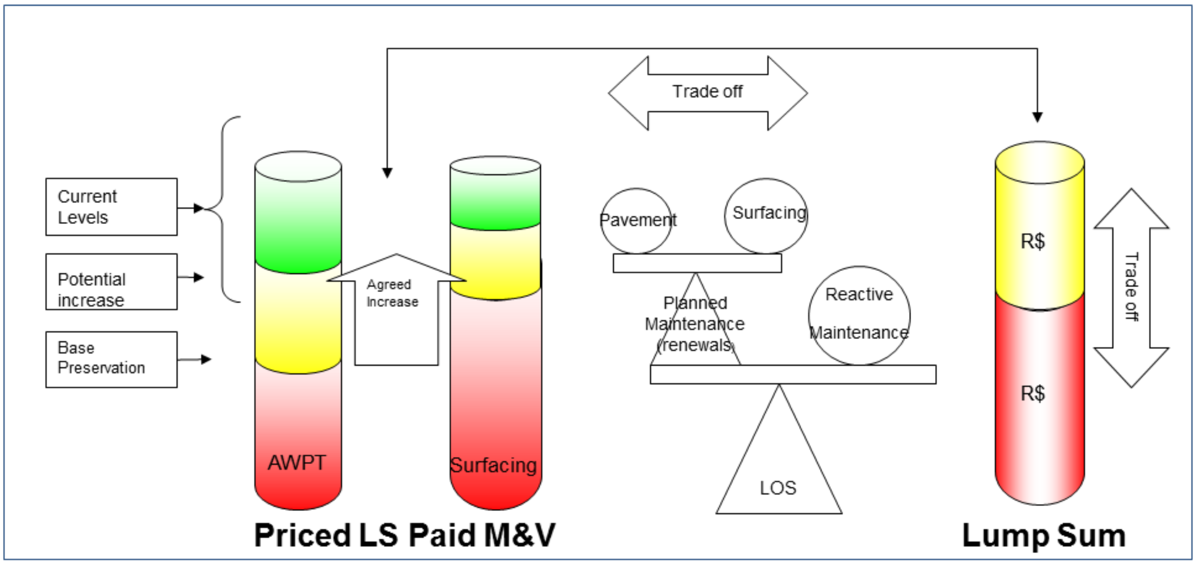
Figure 49: NOC payment methodology



Other key elements of the payment model that are explained in subsequent sections include:

- The methodology for determining the base preservation levels that form the basis for the specified renewals quantities
- Contract flexibility provisions that provide for any economically justified increases in base preservation quantities over the period of the contract
- Incentives that are included to encourage the supplier to exploit any opportunities to lower the renewals quantities below the base preservation level specified.

Given the payment model that has been described, the flexibility provided for in the NOCs, and the subjectivity of any assessment to determine minimum preservation levels, the objective is to establish the level of forecast investment such that they;

- are not so minimalistic to suggest a significant risk to suppliers in pricing the routine maintenance lump sum component,
- nor so conservative that the Agency will not achieve the efficiency gains sought.

The rationalisation has tended to err towards minimal quantities accepting some risk of a need to increase the actual investment level on an ongoing basis because the contract has mechanisms to achieve an increase in a balanced manner with good justification criteria to assess the justification on a case by case basis. The incentive to reduce the quantities is less compelling.

Clearly the base preservation levels cannot be used in isolation to extrapolate the forecast of future funding needs – the methodology described makes it clear that they will be adjusted on an ongoing basis where justification can be demonstrated at a project level.

To date all suppliers involved in tendering the new contracts are indicating that they are comfortable with the specified renewals quantities in terms of their effect on the pricing risk associated with the lump sum maintenance components.

10.1.18 Maintenance and renewal plan development

The new business case approach forms the basis for activity and programme development for investment from the National Land Transport Programme (NLTP). The business case approach is a structured process that integrates best practice decision-making, programme management and investment assurance tools and is integral in the development of the forward works programme.

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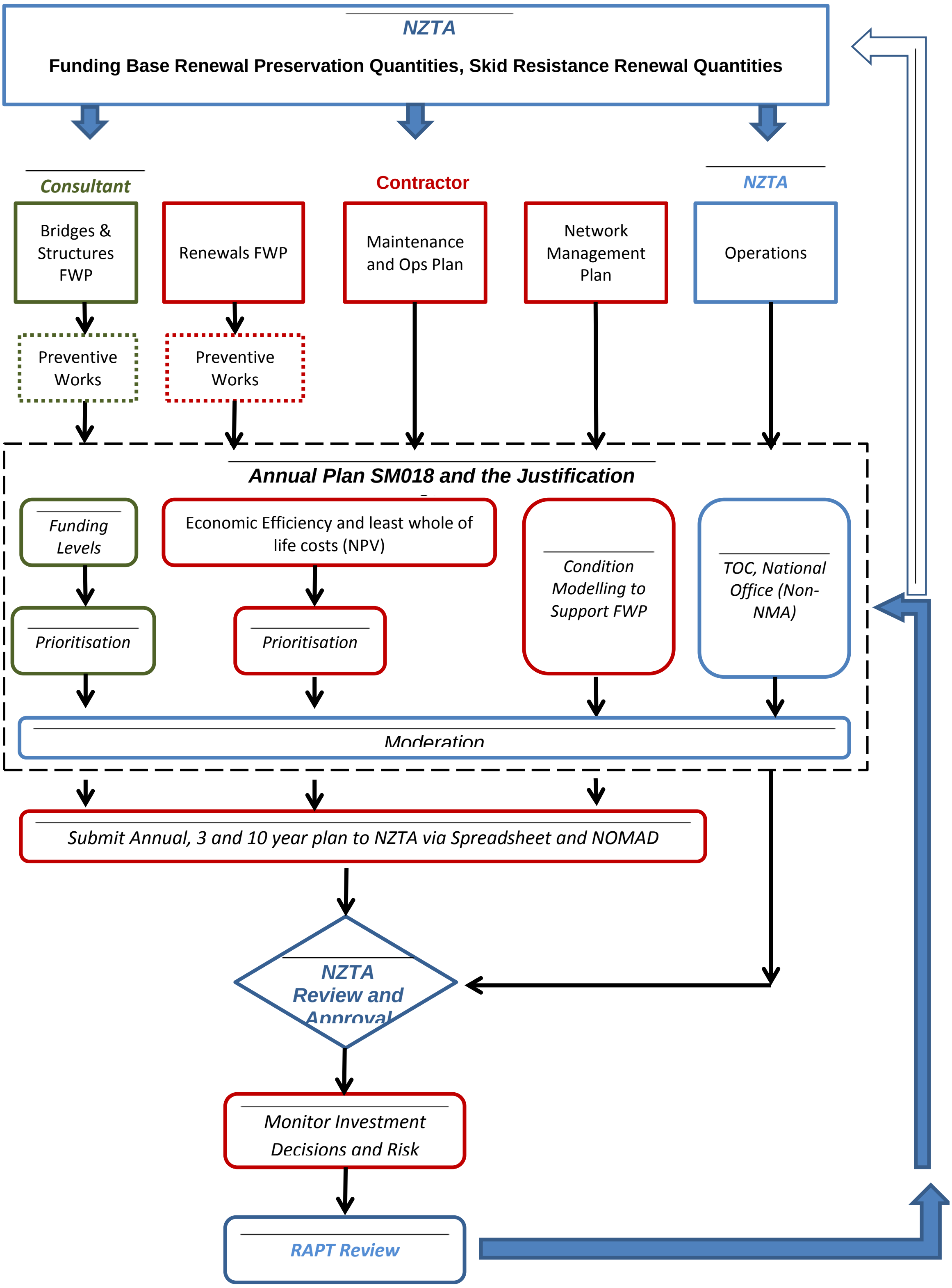

The key inputs that inform the development of the forward works programme are:

Pavement, surfacing and drainage renewal requirements

- Prioritisation and justification is based on the network outcomes level of service.

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- New modified economic efficiency NPV process with 3 treatment level options, including heavy maintenance option, to prioritise renewals based on long-term economic value.
- Structures are prioritised into high, medium and low priority categories based on an engineering assessment of the importance of the work and the potential consequences of not doing the work.
- Treatment selection algorithm (TSA) in RAMM (refer to Pavements LCMP for more information).
- RAPT inspections: the Transport Agency's Review and Prioritisation Team (RAPT) process involves an independent team of experts who 'self-audit' the proposed renewals programmes in each region, through field inspections, discussion with network managers, and reference to network and condition data. The process typically results in deferral of upwards of 10% of the programme by at least one year and confidence that the remainder of the programme is well justified.

Maintenance activity cost information

- With the implementation of the new NOCs, maintenance cost history will be recorded in RAMM. The contracts will allow for improved information collection and recording, allowing national and regional offices to readily access information, and analyse maintenance and renewals requirements.

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11. PROPOSED PROGRAMMES

Basis for programme

The way in which the 10 year programme was built took into account different parameters, which demonstrated an efficient and fit for purpose plan.

The 14/15 budget was used as a base for building the programme over the next 10 years. This was because the 14/15 programme showed an emphasis and a greater effort from the Agency to achieve savings via increased engagement between regions and other national inputs. This resulted in a 2% saving in total.

This strategy has acknowledged that this aggressive method for building a programme will certainly lead to an increase in the need for operational and maintenance works.

The elements taken into account are:

- Inflation increase of 2.7% pa
- Increasing demand due to a 0.6% increase from ongoing capital improvement projects, which will increase maintenance needs by 1% per year

These elements will require an additional 4% saving and these savings will be gained from a series of efficiency strategies from the Agency.

With the implementation of the Network Outcomes Contracts, the goal is to acquire a rigorous control process on resurfacing/rehab works, which will result in the longer life of the asset. This will guarantee a sufficient return on a short investment, giving a certain security on how to target the 4% per annum saving.

The Agency is concentrating on monitoring these sites through the Performance Management Team and managing this risk. This aims to develop an advanced Asset Management Strategy and a better understanding of the best intervention points whilst delivering the same levels of service to customers.

The Agency has invested in a Traffic Speed Deflectometer (TSD) over the next 5 years. It is a fully functional research tool capable of measuring the structural condition of asphalt road pavements at a traffic speed of 80km/h. This can detect cracks in the pavement, thereby providing more confidence in pavement performance. Moreover, it will incorporate the Ground penetrating radar which detects moisture content inside pavements.

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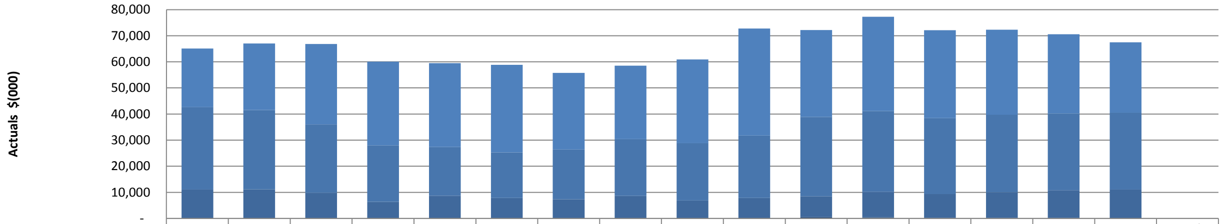
Maintenance expenditure

Historical, current and forecasted expenditure on pavement maintenance is shown in the graphs below.

Figure 50: Historical maintenance expenditure ($000) in 2014 base dollars

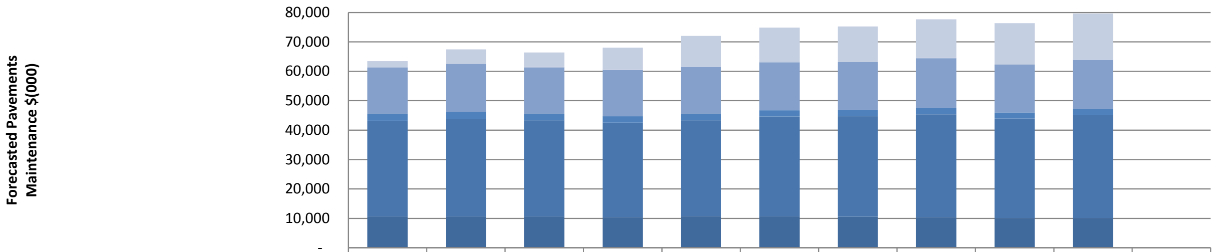
Source: 03 PromanExtract_AllYears_combined_data_only v1 20140828



	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	% of Total (Average)
Other	22,438	25,518	30,805	32,047	32,144	33,514	29,359	28,131	32,059	41,022	33,266	36,079	33,654	32,553	30,381	27,017	47.3%
Pavement Maintenance	31,539	30,372	26,264	21,649	18,670	17,479	19,066	21,812	21,975	23,841	30,398	30,966	29,090	29,778	29,382	29,389	38.9%
Surfacing Maintenance	11,032	11,000	9,701	6,335	8,600	7,763	7,280	8,522	6,784	7,767	7,956	9,755	9,174	9,782	10,652	10,933	13.5%
Unsealed Roads	58	132	70	20	61	72	57	81	84	109	540	438	173	175	168	145	0.2%
TOTAL	65,068	67,022	66,840	60,051	59,476	58,828	55,761	58,546	60,901	72,738	72,160	77,238	72,092	72,289	70,582	67,484	

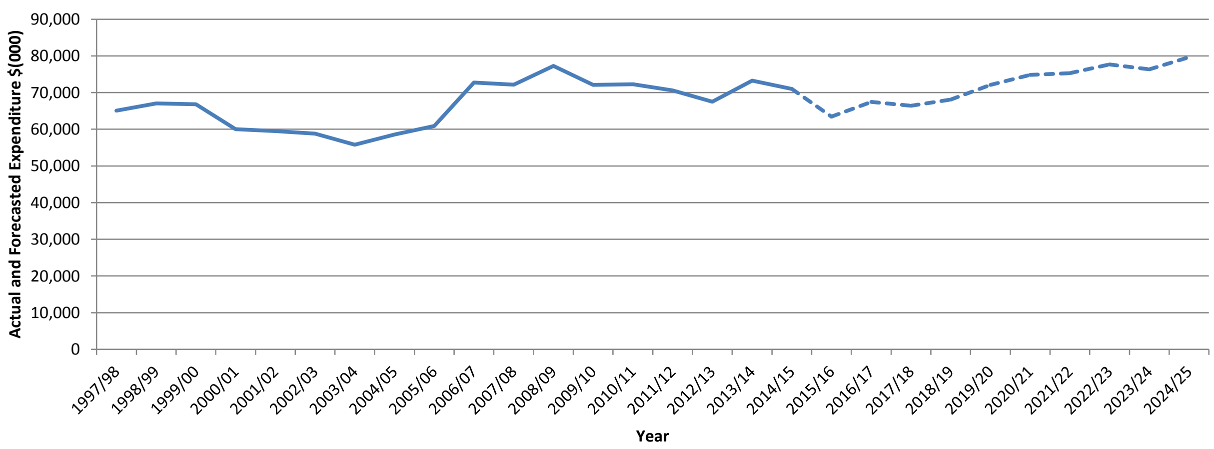
Figure 51: 10 year forecast of estimated maintenance expenditure ($000) in 2014 base dollars

Source: SHAMP budget calculations (Tight budget) –NZTA 20140626 NZTA 20140828



	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	% of Total (Average)
Volume increase, Transferable RONS and Freight	1,991	4,833	4,944	7,451	10,476	11,606	11,970	13,063	13,906	15,559	13%
Unsealed Roads	127	159	157	153	155	162	162	166	158	178	0%
Surfacing Maintenance	15,851	16,228	15,806	15,766	15,988	16,292	16,321	16,917	16,269	16,671	22%
Shoulder Maintenance	2,291	2,384	2,167	2,117	2,090	2,132	2,113	2,132	2,096	2,126	3%
Pavement Maintenance	32,520	33,232	32,726	32,114	32,585	33,929	34,094	34,915	33,881	34,970	46%
Other	10,664	10,634	10,609	10,466	10,776	10,712	10,604	10,469	10,026	10,125	15%
Total Pavement Maintenance	63,444	67,469	66,409	68,067	72,070	74,833	75,264	77,662	76,336	79,630	

Figure 52: Combined historical and forecasted maintenance expenditure ($000) in 2014 base dollars



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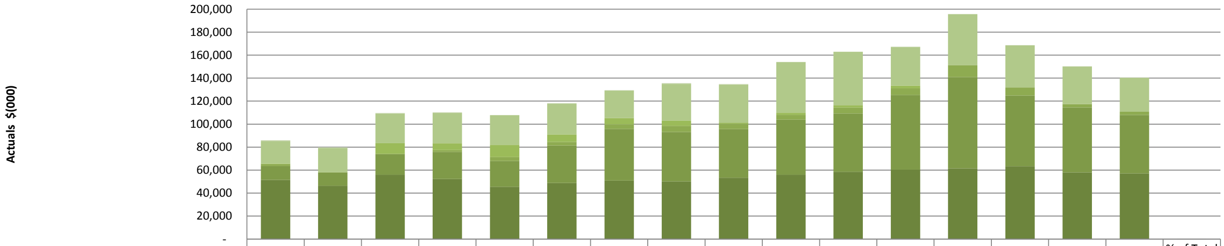
Renewal expenditure

Historical, current and forecasted expenditure on pavement renewal is shown in the graphs below.

Figure 53: Historical renewal expenditure ($000) in 2014 base dollars

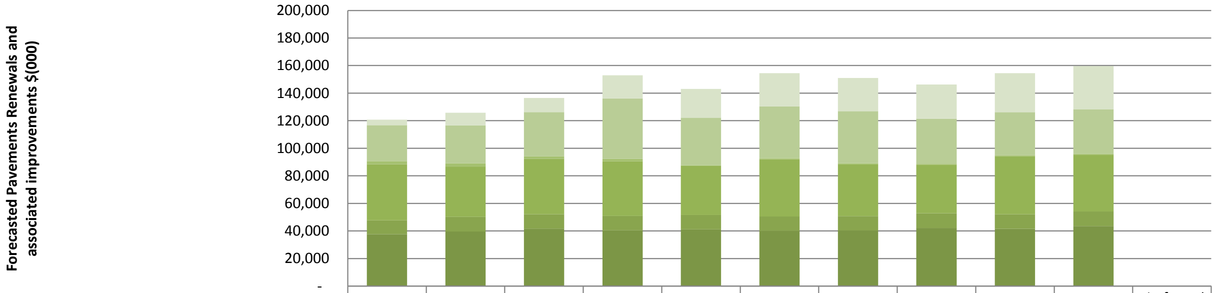
Source: 03 Proman Extract_All Years_combined_data_only v1 20140828



	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	% of Total (Average)
Unsealed Road Metalling	803	492	387	393	-	584	564	682	475	407	-	237	367	129	123	122	0.3%
Thin Asphaltic Surfacing	19,232	21,081	25,820	26,406	25,869	26,639	23,663	31,911	33,277	44,041	46,587	33,565	44,088	36,676	32,703	29,618	23.3%
Surfacing Maintenance	615	183	9,390	5,869	10,629	6,517	5,657	4,541	1,085	1,707	1,911	2,394	-	-	-	-	2.3%
Seal Widening (in conjunction with Rehab)	1,800	274	237	1,651	3,329	3,005	3,743	5,368	4,394	4,124	5,117	5,777	10,337	7,022	2,958	2,741	2.9%
Other	11,947	11,425	17,848	23,502	22,548	32,651	44,900	43,064	42,260	47,922	50,755	64,903	79,535	61,437	56,433	50,870	30.8%
Maintenance Chip Seals	51,544	46,398	55,970	52,332	45,455	48,829	50,977	50,085	53,358	55,982	58,517	60,429	61,481	63,379	58,047	57,098	40.4%
Total	85,941	79,854	109,653	110,152	107,830	118,227	129,503	135,651	134,849	154,184	162,886	167,306	195,808	168,644	150,263	140,449	

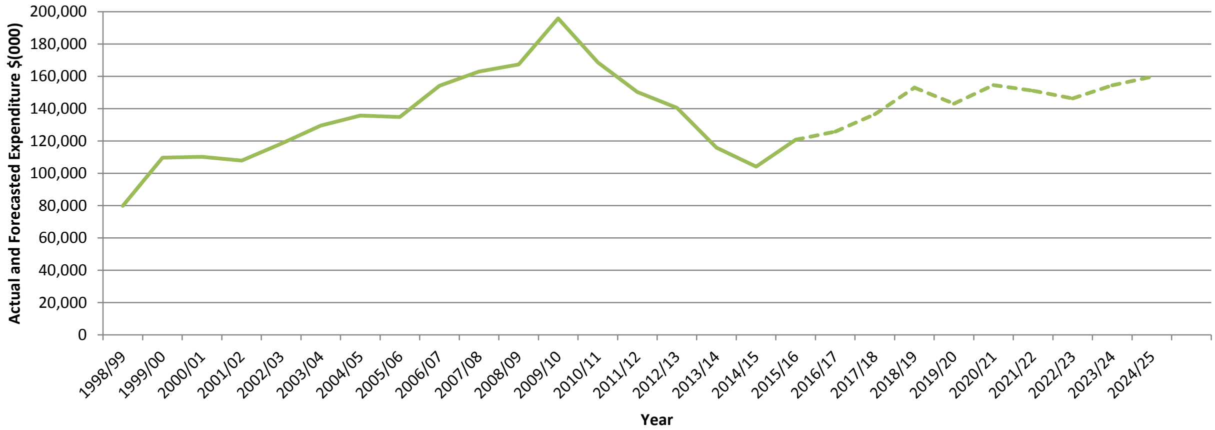
Figure 54: 10 year forecast of estimated renewal expenditure ($000) in 2014 base dollars

Source: SHAMP budget calculations (Tight budget) –NZTA 20140626 NZTA 20140828



	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	% of Total (Average)
Volume increase, Transferable RONS and Freight	3,788	9,008	10,162	16,748	20,798	23,962	24,015	24,608	28,131	31,201	13%
Unsealed Road Metalling	153	166	163	157	166	174	175	183	177	189	0%
Thin Asphaltic Surfacing	26,112	27,399	32,032	43,803	34,438	37,633	37,687	32,891	31,130	32,287	23%
Structural Asphaltic Pavement Rehabilitation	2,257	2,426	1,804	1,729	575	654	789	423	641	566	1%
Sealed Pavement Rehabilitation and Widening	40,676	36,576	40,185	39,599	35,464	41,536	37,530	35,368	42,202	41,339	27%
SCRIM	10,000	10,548	10,483	10,516	10,490	10,503	10,513	10,620	10,558	10,617	7%
Maintenance Chip Seals	37,720	39,622	41,656	40,449	41,147	40,046	40,292	42,200	41,582	43,484	28%
Total Pavement Renewal	120,708	125,745	136,486	153,002	143,078	154,509	151,001	146,293	154,422	159,682	

Figure 55: Combined historical and forecasted renewals expenditure ($000) in 2014 base dollars



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Expenditure review

The following table provides a review of forecast expenditure information in terms of historical expenditure information, asset valuation and maintenance and renewal strategies.

Table 25: Review of forecasted expenditure

	Item	Value	Comment	Correlation
Maintenance	Forecast expenditure	Varies between $63 million and $80 million	Information built up from Annual Plans for all regions and includes growth (extra maintenance due to Capital Replacement and freight) but excludes projected savings and cost escalation.	
	Historical expenditure	Varied between $55 million and $77 million	Correlates well with the forecasted expenditure.	Good
Renewal	Forecasted expenditure	Varies between $120 million and $160 million	Information built up from Annual Plans for all regions and includes growth but excludes projected savings and cost escalation.	
	Annual depreciation	$171 million	Annual depreciation provides an indication of the annual renewal expenditure requirements. The annual depreciation is higher than the forecasted expenditure which is an indication of how NZTA are planning to work the asset harder.	Poor, but expected
	Historical expenditure	Varies between $85 million and $195 million	Since 2009 there has been a downward trend from the maximum $195m to $140m in 2013 with an average of 6% reduction per year.	Good
	Estimated replacement cost based on performance (dTIMS model)	Varies between $100 million and $139 million	This includes base preservation modelling and correlates with the forecasted expenditure above.	Good

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	Stochastic modelling	The budget to maintain of $76M is split into $66 million for Chipseal and $9 million for AC	For 2015/16 Maintenance chipseal is $38 million. Thin Asphaltic Surfacing (AC) is $26 million and SCRIM is $10 million. This total of $74 million is comparable with the Stochastic model budget to 'maintain' but does not compare well with the split into surface types.	TBC
New/Improvements	Forecasted expenditure	Varies between $510 million and $1,300 million	These are indicative expenditure only and have not yet been finalised.	
	Historical expenditure	Varied between $300 million and $1,000 million		

12. LAMP IMPROVEMENT PLAN – MOVING TO THE NEXT NTLP 18

This plan displays the methodology and mechanism which supports a robust, affordable and convincible strategy.

In the next NLTP submission the Agency intends to fill the gaps that are shown in this LAMP. These are:

- Full ownership of the risks associated with the scope and treatment of the renewals programme within the NOC model
- Understanding the impact of quality works in stretching the life of the pavement asset and gaining a better return on the investment ie more assurance on aggregate quality and getting more out of skid resurfacing life
- Building a robust programme through the information gained from the Traffic Speed Deflectometer with an emphasis on cracking and scabbing detections and moisture analysis.

The Agency is aiming to fill the following gaps with new improvement plans:

- Understanding why Gisborne has started a worsening trend in rutting values over the last 2 years.
- Understanding what average life will be achieved with a methodical performance analysis versus the life expectancy declared by the supplier for any individual elements of the pavement construction.
- Analyse the impact of increasing freight volume in areas of inadequate geometry. This may induce the case for developing a new skid resistance life cycle methodology in order to invest in high performance aggregate.

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13. APPENDIX A

Traffic Speed Deflectometer

The Agency is concentrating on monitoring these sites through the Performance Management Team and managing this risk. This aims to develop an advanced Asset Management Strategy and a better understanding of the best intervention points whilst delivering the same levels of service to customers.

The Agency has invested in a Traffic Speed Deflectometer (TSD) over the next 5 years. It is a fully functional research tool capable of measuring the structural condition of asphalt road pavements at a traffic speed of 80km/h. This can detect cracks in the pavement, thereby providing more confidence in pavement performance. Moreover, it will incorporate the Ground penetrating radar, which detects moisture content inside pavements.

Figure 56: TSD traffic vehicle

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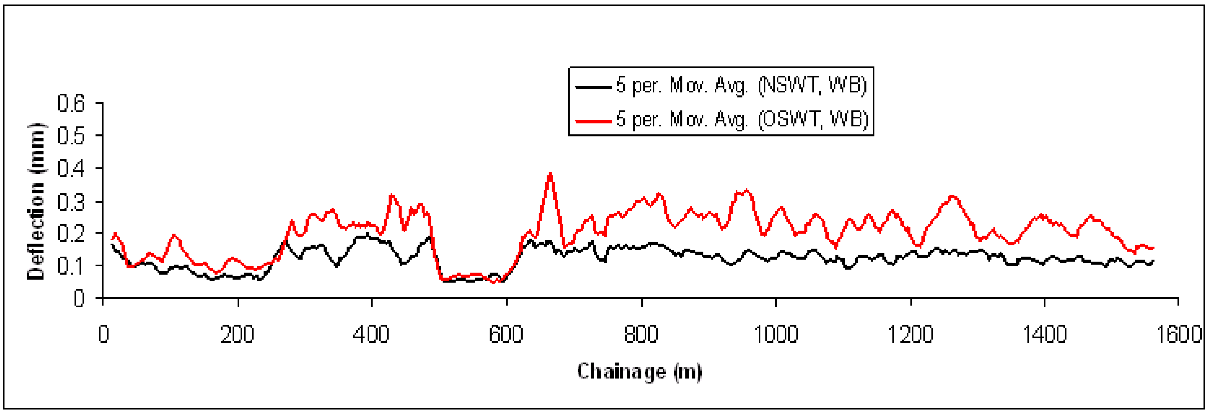
Figure 57: Surface distress associated with flooding during heavy rain.

Figure 58: TSD reading



The area of high deflection is located near the flooded area, with possible weakening of the foundation due to water seepage.

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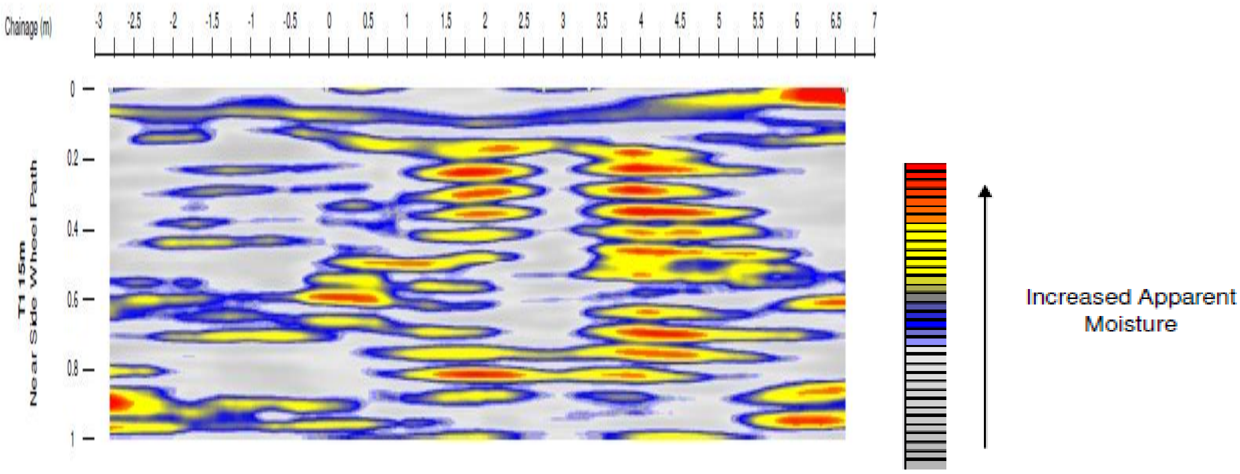
Figure 59: GPR reading



Typical moisture content plot from GPR data.

The Agency will embark on advanced methodology to investigate performance of the pavement due correlation of water moisture content and high deflection in pavements. Therefore the data provided by the GPR will contribute also to develop forward works for drainage as well.

Historical, current and forecasted expenditure on pavement maintenance is shown in the graphs below.

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14. APPENDIX B: NETWORK GOOD SKID EXPOSURE

Good Skid Exposure – Threshold Level by Road Classification

Figure 59.0: National GSE

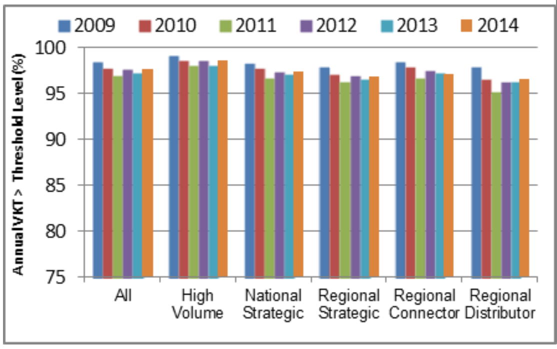

Figure 59.1: Northland

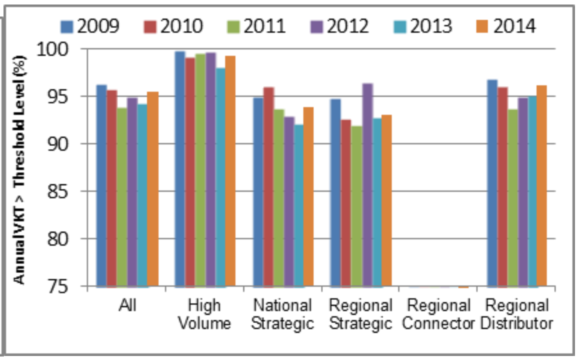

Figure 59.2: Auckland

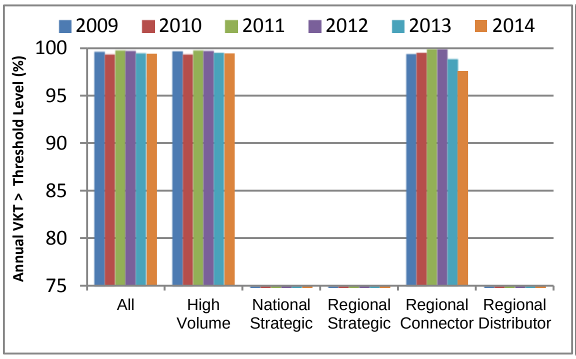

Figure 59.3: Central Waikato

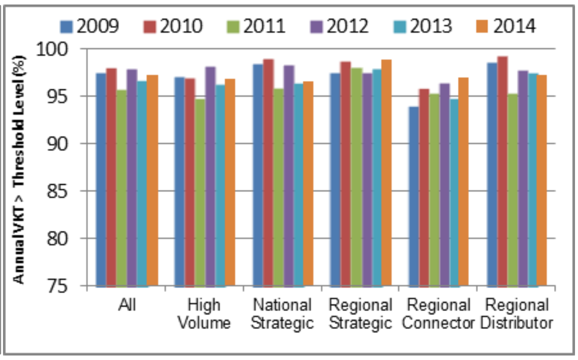

Figure 59.4: East Waikato

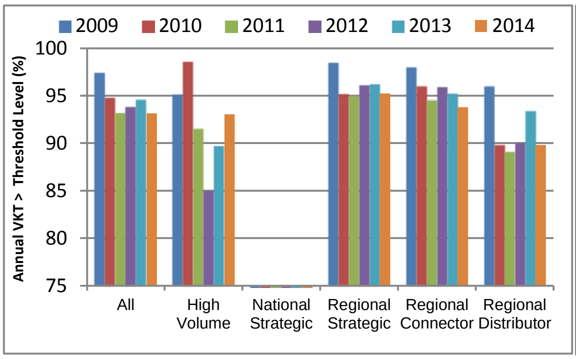

Figure 59.5: West Waikato

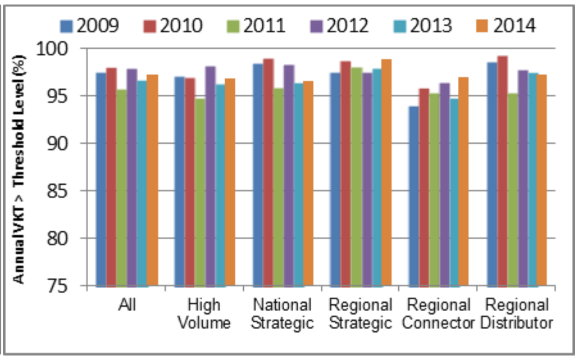

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Figure 59.6: BOP East

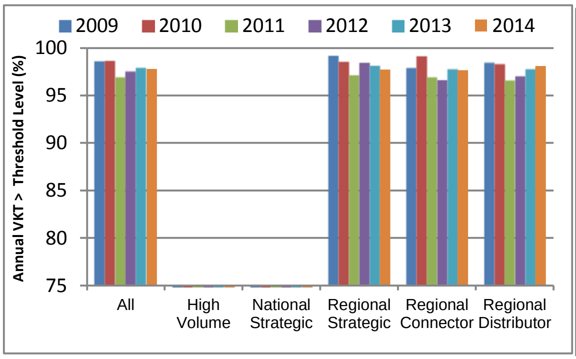

Figure 59.7: BOP West

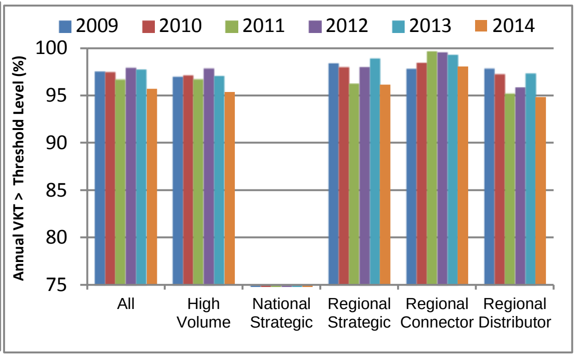

Figure 59.8: Gisborne

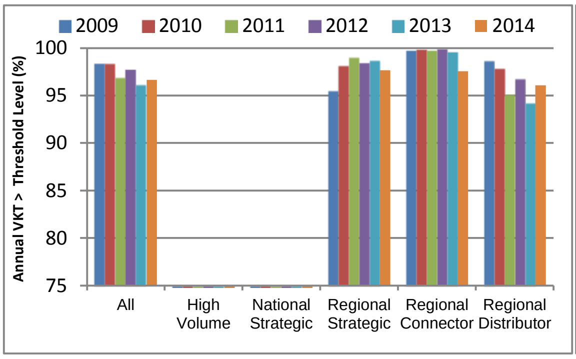

Figure 59.9: Hawkes Bay

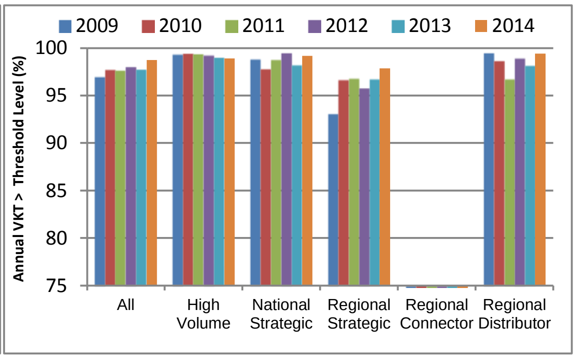

Figure 59.10: Taranaki

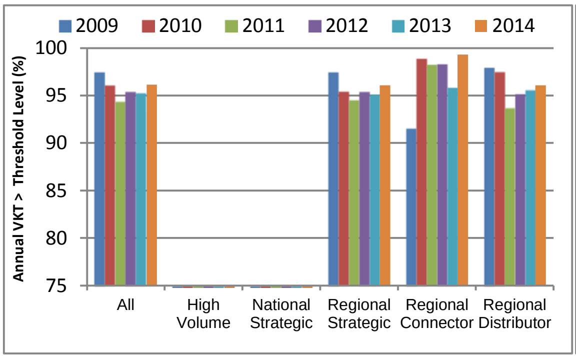

Figure 59.11: Manawatu Whanganui

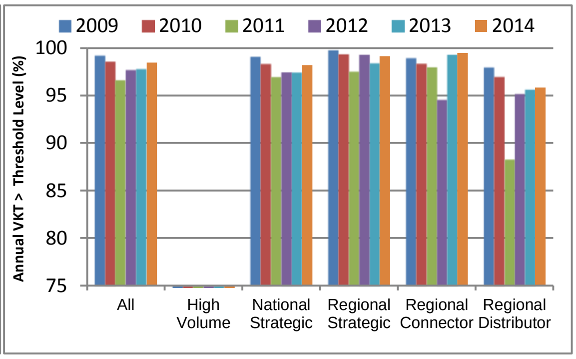

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Figure 59.12: Wellington

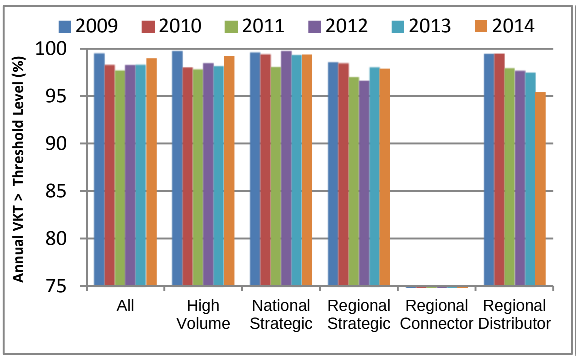

Figure 59.13: Nelson Tasman

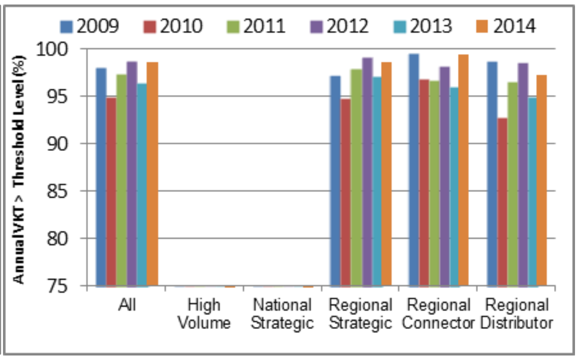

Figure 59.14: Marlborough

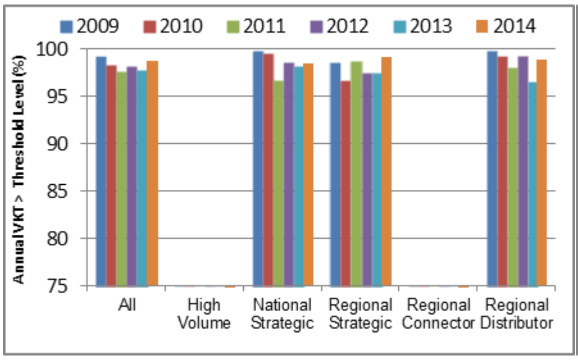

Figure 59.15: North Canterbury

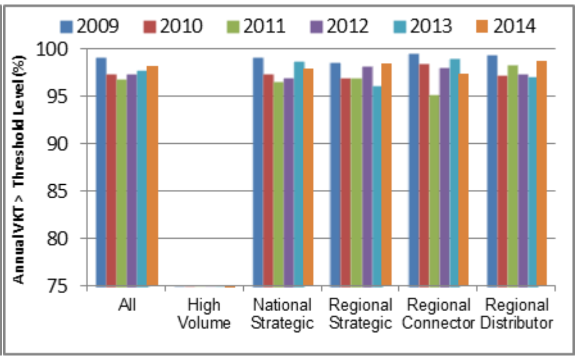

Figure 59.16: Christchurch

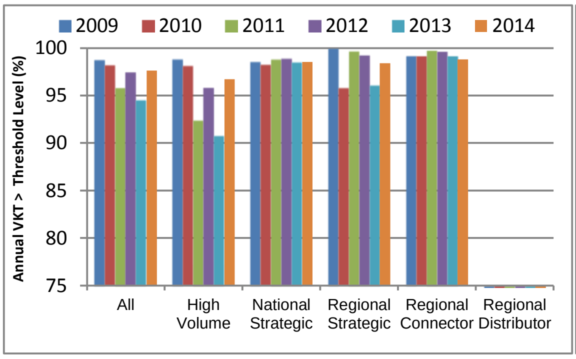

Figure 59.17: South Canterbury

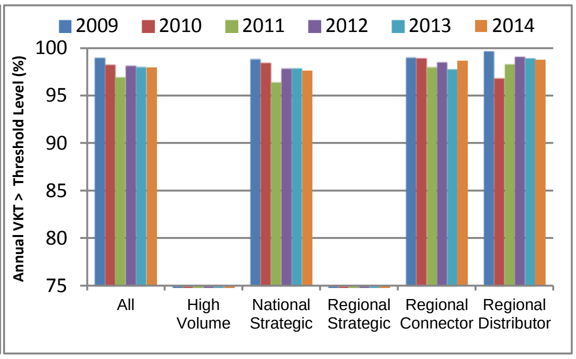

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Figure 59.18: Milford Sound

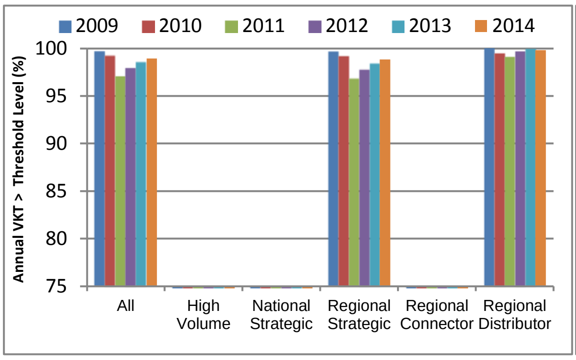

Figure 59.19: West Coast North

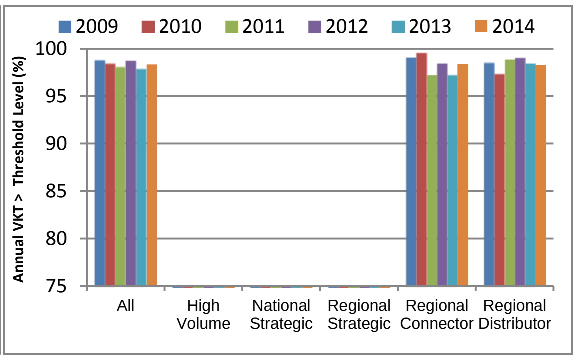

Figure 59.20: West Cost South

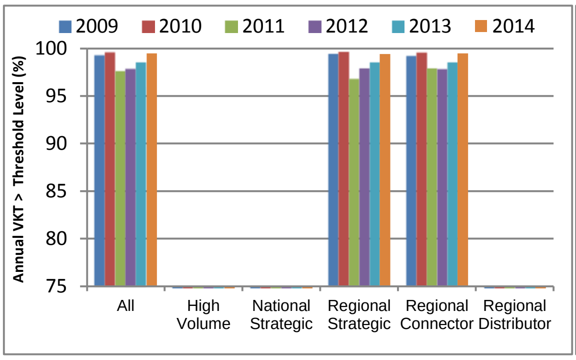

Figure 59.21: Central Otago

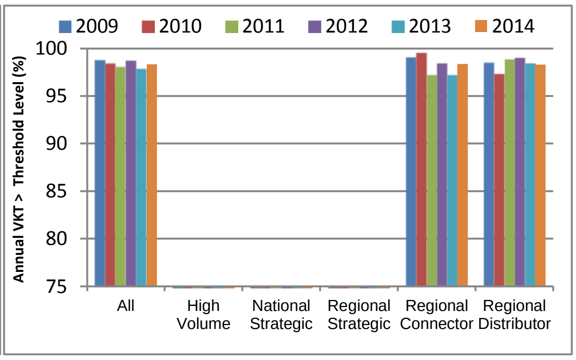

Figure 59:22: Coastal Otago

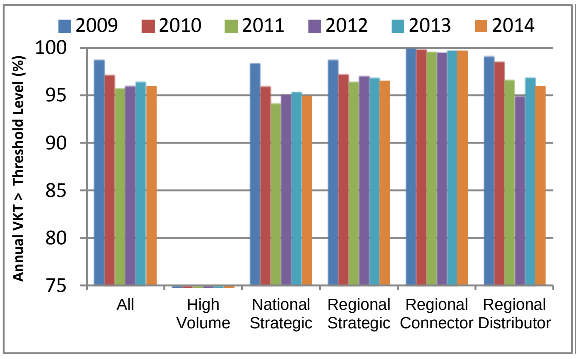

Figure 59.23: Southland