MINO-0492 Maintenance paper

31 October 2022

Providing the Minister of Transport with information on state highway maintenance.

Waka Kotahi NZ Transport Agency's response:

Upon reading BRI-2594 titled *Refining our approach to maintenance, renewals and wider resilience activities*, you have raised some follow up questions and comments. We will respond to each of your comments raised.

17. Maintenance costs from one three-year period to the next typically require a 15% increase in the three-year total expenditure to sustain service levels. In 2021/22, the first year of the current National Land Transport Programme (NLTP), maintenance costs rose by approximately 12%. In real terms, this has led to a 10% loss of purchasing power in the local road and state highway maintenance activity classes. *Graph 1: actual and predicted cost of state highway maintenance for the period 2010/11 to 2023/34 in nominal dollars*

Waka Kotahi notes your question about how to drive value as Graph 1 in BRI-2594 shows that the state highway Maintenance requirement doubling from approximately $450 million in 2015/6 to $900 million in 2023/24.

The approach to road maintenance is changing to a least long-term cost style to further improve long term value for money, but the pace of change is constrained by many factors. This requires investment in sector capability and capacity, and confidence in a 10-year pipeline of investment.

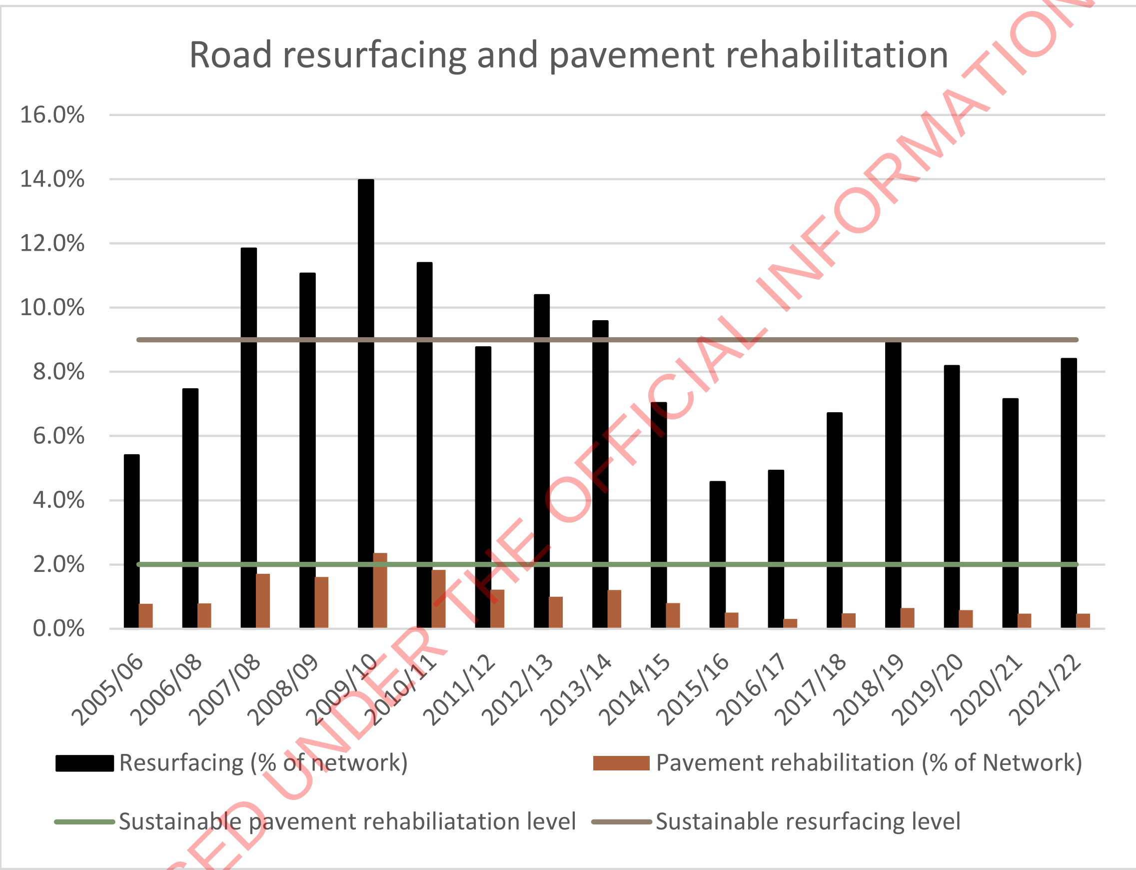
To optimise productivity and work quality, we are bundling future works together in larger work sites rather than continuing to focus work on sites with existing maintenance challenges due to affordability constraints. There is an increase of productivity of approximately 10 – 20 percent from larger work sites. This is because these larger sites include sections of road that are *near* the end of their service life and those *at* the end of their service life, which may be relevant to consider partial financing of the cost.

As included in our advice to Te Manatū Waka | the Ministry of Transport for the next Government Policy Statement, there is also an opportunity to widen roads for safety reasons, improve roadside drainage and enlarge culverts and provide for fish passage, conduct preventive works (minor slope protection works etc) in the same bundled work sites. This approach will accelerate improvement in resilience, biodiversity and road safety and reduce disruption from this work at another time.

24. Fewer roads have been rehabilitated since 2009 than before 2009. We need to replace 9% of road surfaces each year and rehabilitate 2% of the network, on average, to cost effectively sustain access. We also need to undertake preventative works such as drainage maintenance and bank stability. Part fixes are sub optimal and we are experiencing repetitive failures over common corridors, meaning lengthy repetitive closures on some corridors are becoming more common as seen on State Highway 4 and the Mangamuka Gorge. Consequentially, our networks are less resilient to high intensity rain events.

You have requested a graph to show how the replacement and rehabilitation of road surfaces have tracked over the last 20 years.

Graph 1 below shows quantities from 2005/06 as an update to the 2019 white paper on state highway road maintenance. The earlier data is not readily available in the format now used.



37. These contracts had risk allocated to the contractors for preventative maintenance and Waka Kotahi for renewals. Consequently, contractors must manage the effects of a degrading network within their profit margins, under contracts that have lean margins (quoted as 4.5% as being the most profitable). This approach to risk allocation is resulting in reduced levels of service and a backlog of network renewal activity, much of which is currently not funded. The objective of the review is to better balance renewals and repair. To achieve this better balance, the contract review is considering the commercial form of the contract, how maintenance works are specified, how quality is managed, and the related roles of the parties in planning works and managing risks.

We note your comment that this is an important issue, and historically there was a workable risk allocation approach with our contractors. We are looking to address this under our review of the Network Outcome Contracts (NOC), along with a number of efficiency and effectiveness improvements and commercial changes.

46. As part of supporting Te Manatū Waka advice on GPS 2024, and as input to the Waka Kotahi Investment Proposal, we are developing a range of investment scenarios for our continuous programmes. This work includes developing a series of proposals to improve long-term value for money from road maintenance. A key finding in our scenario development work is that we will need to spend more in the short-term to save more in the long-term. We need to bring forward a significant amount of capital expenditure to improve the underlying condition of the network if we are to reduce the long-term cost of maintenance, particularly emergency works, in the future.

You have noted our comments about the industry capacity. We understand you would like to be informed on how we can ramp up the ability and capacity due to labour and other constraints.

Renewal programmes are being heavily scrutinised for contractors' capacity to complete the required work. We managed to achieve a significant increase in the last years' pavement and reseal programme compared to the previous year, despite COVID-19 impacts on resources (from 1,800 lane kilometres to 2,200 lane kilometres).

While we are confident that we can increase our renewals programme again this year (to 2,450 lane kilometres), we are fully aware of the current market being under pressure to retain maintenance workforce. The ability to deliver to a growing work programme needs to be managed via a longer-term plan and to provide confidence for contractors to invest in plant and workforce. The NOC review has a capability and capacity workstream looking at both internal and external workforce development.

We are currently delivering about 200 lane kilometres of pavement rehabilitation, with a backlog of about 2,000 lane kilometres (the sustainable level of delivery is about 480 lane kilometres per annum). With lead time of a year and transition time of three years, and a forward pipeline of works, we expect the sector will be able to increase its delivery through 2024/27 period to reach 500 lane kilometres per annum in 2026/27, and continue the increase to address the backlog before returning to the sustainable level.

This increase would be delivered partly by the maintenance contractors and partly through specific contracts, particularly where work is bundled on longer lengths to utilise the resource from construction contracts.

47. This is not about spending more overall but addressing strategic weaknesses in the network. Doing so will deliver greater resilience to climate change impacts and more sustainable maintenance expenditure in the future. For example, if we were to invest in building structural pavements on all high traffic volume routes instead of rehabilitating with unbound granular pavements, this would significantly reduce the incidence of road defects and the frequency of resurfacing requirements.

Overall, this will reduce our maintenance expenditure. We are working with Te Manatū Waka to explore this opportunity, including the potential for innovative financing options to spread the cost.

You would like to understand this further in terms of whole life cost.

In New Zealand, as in other countries with comparatively low population and recent infrastructure construction compared to Europe, we have adopted a low construction cost, higher maintenance cost design and construction using selected compacted gravels in the road pavement with a thin flexible chip seal to exclude water and provide a safe running surface.

While this style of construction is adequate where freight loads are lower and surface water is well managed, it is not ideal for roads with greater traffic and greater freight. Structural pavements are better suited to areas of high traffic such as rural freight routes, roads near distribution centres such as ports or rail heads, and trunk bus routes.

Structural pavements are commonly used around the world because:

- they have lower long term average costs of construction and maintenance
- are faster to build and require fewer repairs so there is less traffic disruption
- have lower long-term embodied carbon
- are resistant to moisture so more resilient, and
- deform less under freight loads meaning vehicle fuel consumption and maintenance are lower.

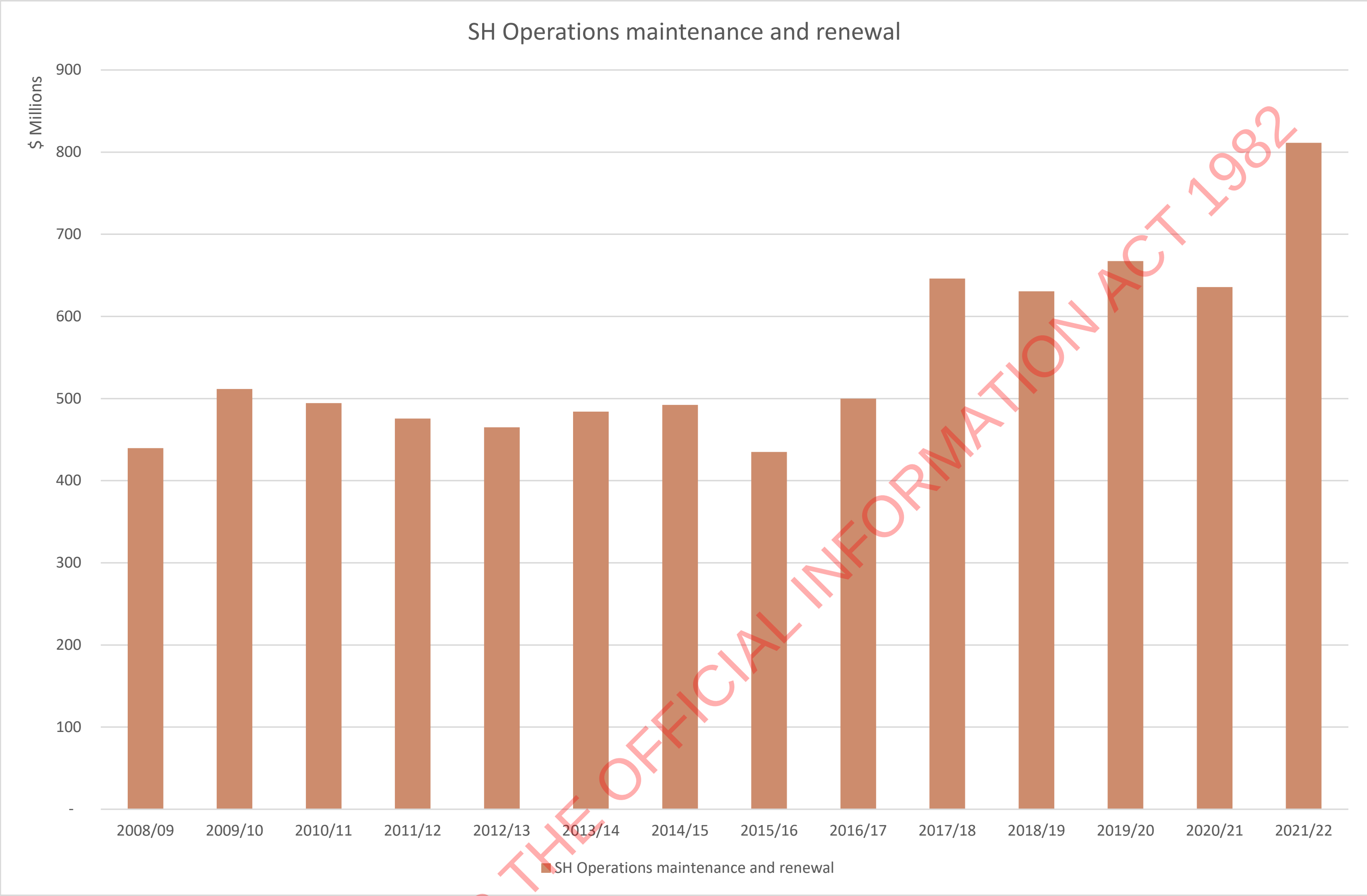
However, these cost more than three times the cost of unbound granular pavements. Structural pavements are constructed using a form of concrete, often using bitumen as the “glue”, or sometimes cement. They have a service life of 75 – 150 years or more compared to 25 – 50 years for granular pavements on more heavily trafficked roads.

The impact to New Zealand is substantial at the time of construction because of the relative speed of these works to ones where unbound granular pavements are used, which take about three times longer. This gain is reflected in lower traffic disruption costs from queuing or from diversion.

The payback to road agencies begins about 7-10 years after construction because resurfacing lasts longer so fewer resurfacing works are required over the life of a pavement, and fewer repairs are required because the road does not deform as much and potholes don’t form as it is resistant to water.

You have also asked for graphs in the white paper to be updated

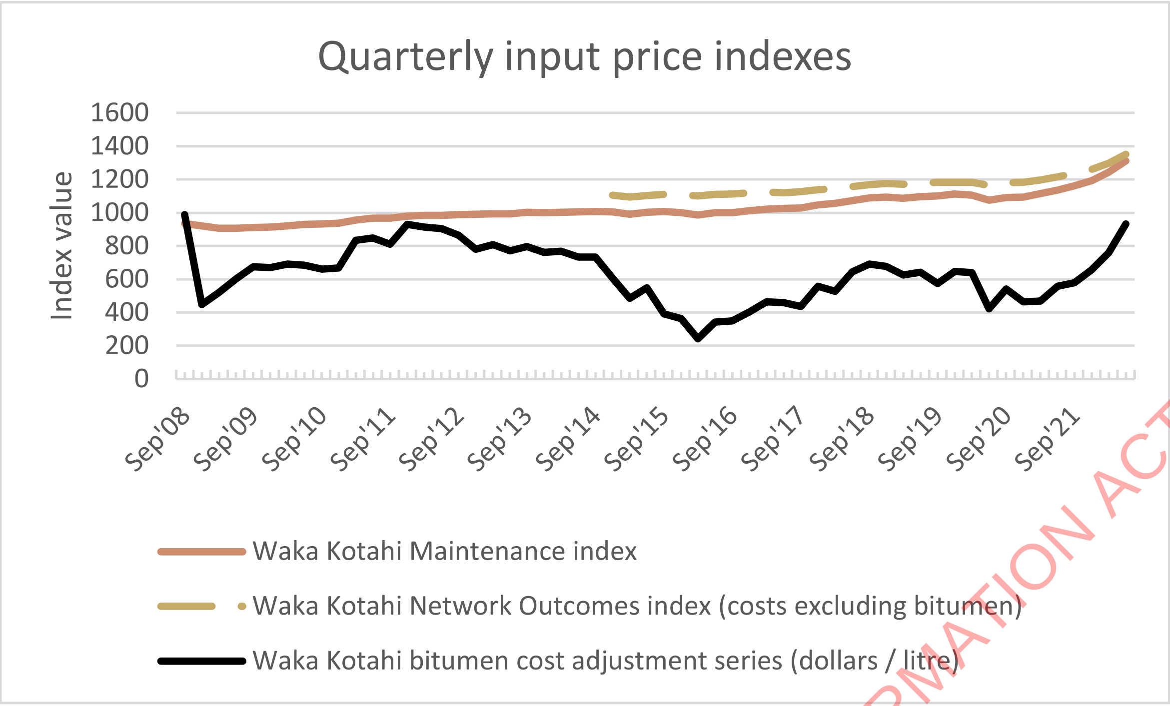
- **An updated version of the graph on page 1 up to the present (this is similar to what's in the most recent BRI-2594, but is over a longer time horizon)**



- **An update on the sentence on page 1: "plant and materials grew by 12%, general traffic grew by 22% and freight distance travelled by 32%. The size and complexity of our asset has increased by over 9% because of the significant investment in the improvement programme, and net transfers of local roads to the state highway network" to reflect changes from 2009/10 to now, a table of accompanying figures would also be helpful. An update to graph 2 on page 9 might also cover this off.**

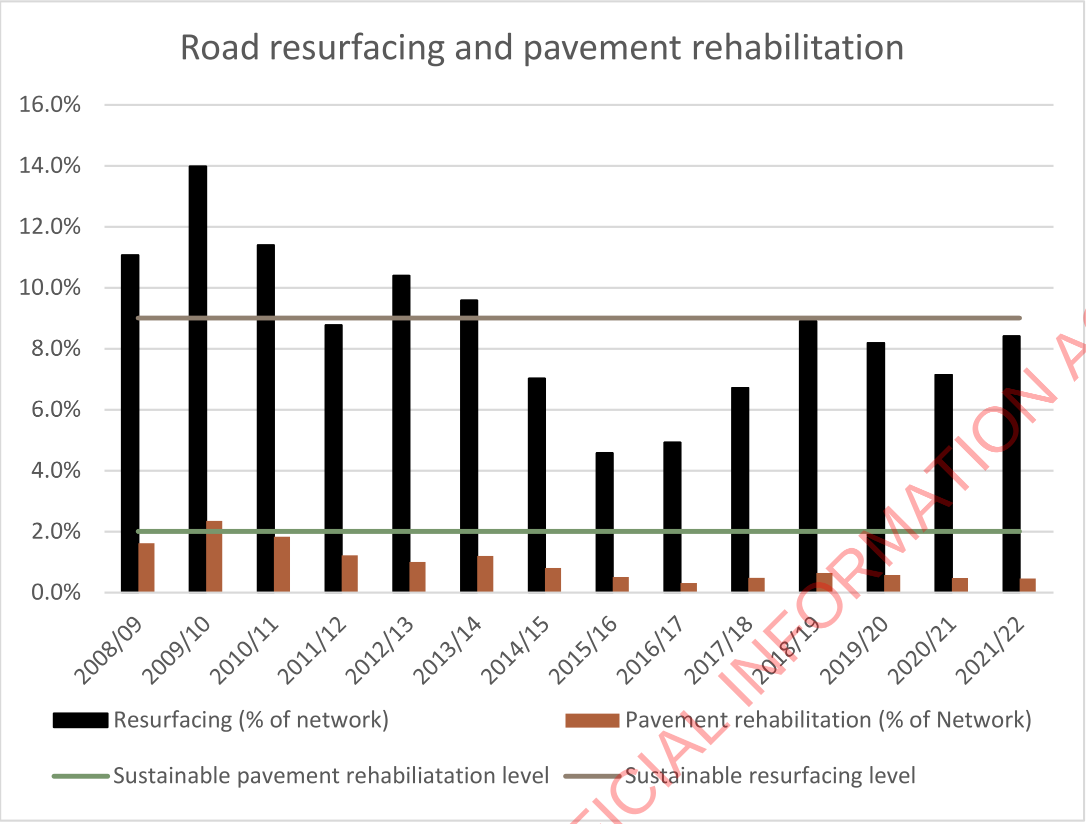
The graph below shows movements in the state highway NOC specific index used to reflect inflation of input costs, and the Maintenance index more commonly used for local roads maintenance contacts. It also reflects the separate index used to inflate the approximately 15% of costs associated with bitumen for state highway. Note that because the volatility in the bitumen price is greater than in labour, plant and other materials it is treated separately to better manage price risk.

Plant materials and labour grew by 25%, freight by 28% distance travelled, size by 10% and complexity by 14% (or we could conflate these two and say size and complexity grew by 25%)



		2008/09	2020/21	Growth	Change from 2008/09		2021/22	Growth	Change from 2008/09
SH Network	lane km	22,099	24,262	2,163	10%		24,297	2,198	10%
SH total vkt		19,322,539,000	22,322,202,702	2,999,663,702	16%		23,088,599,375	3,766,060,375	19%
SH heavy vkt		1,945,122,000	2,341,608,911	396,486,911	20%		2,484,065,770	538,943,770	28%
Maintenance index		1,012	1,182	170	17%		1,261	249	25%
Complexity index		887	1,000	113	13%		1,010	123	14%

- **An updated version of the graph on page 2 up to the present. Any other relevant statistics about the host**



- **Any information on the impact of allowing heavier vehicles onto the network and the damage they're doing to the roads**

Heavy vehicles cause more damage to road surfaces and pavements when their axle loads are greater than those of lighter vehicles.

When we allowed 50max freight vehicles on the road replacing 44 tonne with 50 tonne vehicles, there was also an increase in the number of axles and tyres, which means the increased payload imposed no more damage on the road than it had been previously when carried on more trucks. However, this balance is not always the case with HPMV vehicles or with busses. In the case of busses, the recent increase in axle load and thus pavement damage is as a result of adding batteries.

The damage grows in line with the "fourth power" rule. This means that when axle load doubles, the damage increases sixteen-fold, which is an average impact. On structural pavements, damage from doubling axle load would increase four-fold, and on weak pavements, it would likely to increase approximately 60 – 250-fold (which is why carting logs to port across a low volume unsealed country road built to carry the occasional sheep truck from the previous hill country farms can rapidly cause damage).

A recent testing conducted at the pavement testing laboratory managed by Waka Kotahi, confirms the fourth power rule. That research was initiated because the same rule is used in the cost allocation model that is used to propose Road User Charges (RUC) rates for different freight vehicles.

Nominally, RUC compensates for damage through the RUC rates, but this does not provide revenue to offset local share in the way RUC offsets the National Land Transport Fund (NLTF) share.

Currently, weigh stations are being built across the country. As the proposed network is completed, we are getting a better picture nationwide of how laden freight looks like. Traffic counts and RUC records convey travel distance, but not how laden vehicles are particularly on the back haul, and neither do they tell whether a freight truck is fully loaded because it is full of light content ("bulked out") or at the weight limit ("massed out").

Weigh stations and associated enforcement also affect loading, for example when the Gisborne station was opened more vehicles were overweight than is the case now.

- **An updated version of the table at point 4 on page 10.**

		2008/09	2020/21	Growth	Change from 2008/09		2021/22	Growth	Change from 2008/09
SH Network	lane km	22,099	24,262	2,163	10%		24,297	2,198	10%
SH total vkt		19,322,539,000	22,322,202,702	2,999,663,702	16%		23,088,599,375	3,766,060,375	19%
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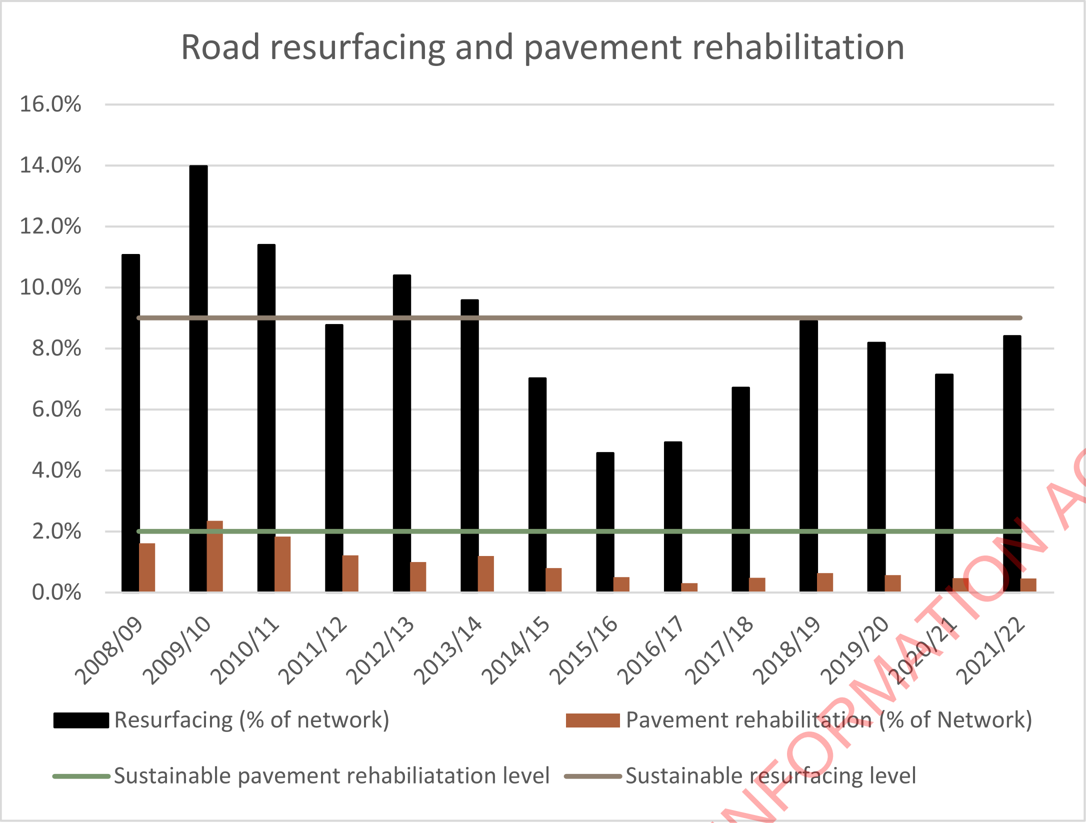
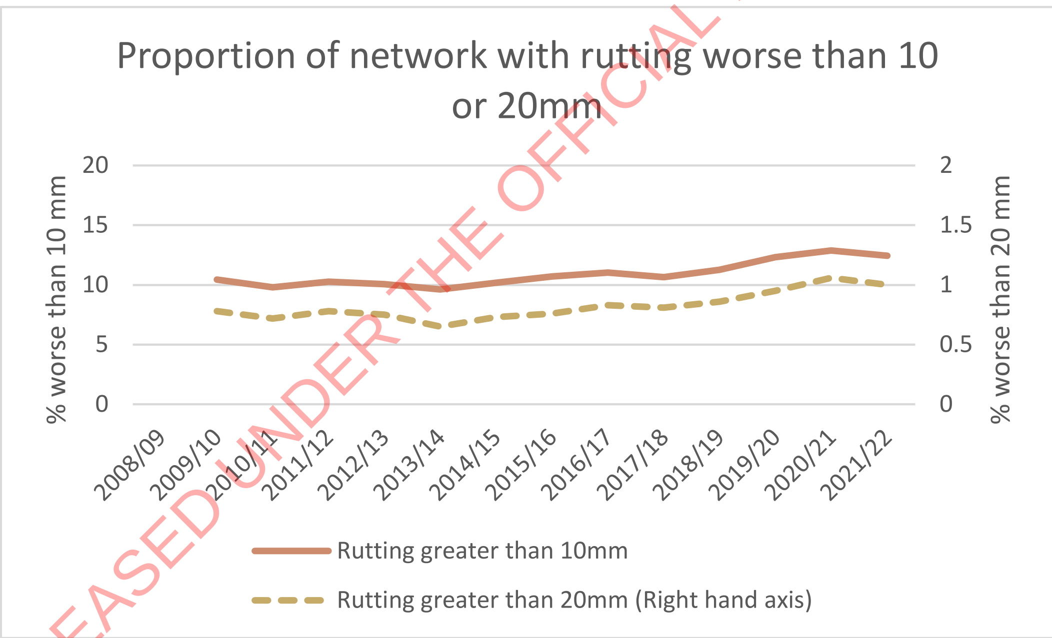
Maintenance index		1,012	1,182	170	17%		1,261	249	25%
Complexity index		887	1,000	113	13%		1,010	123	14%

- **An updated version of the two graphs on page 11 (and the one on page 12). It would be helpful to know whether the road pavement renewals referred to are now being completed at a sustainable level. Also is the 9% figure referred to at item 9 still correct? The office's assumption is that the raw number of lane kms that require resurfacing is longer now because the network is larger.**

Please refer to Graph 4 and 5 below.

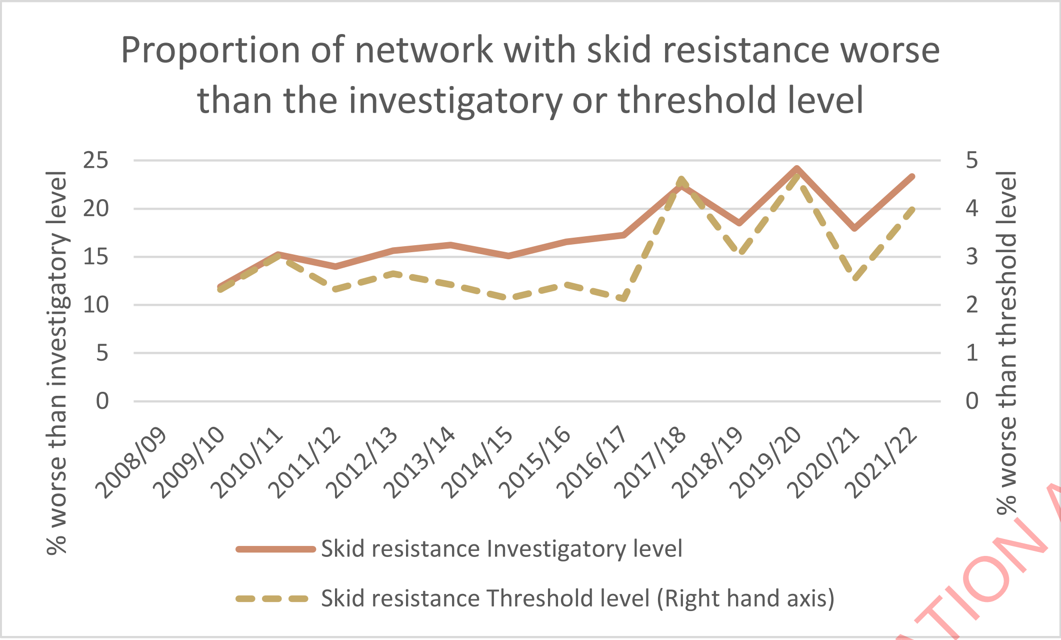
Graph 4 shows that resurfacing works are approaching the sustainable level, but pavement rehabilitation is not, and neither work programme has made up the gap between the programmes of 2014/14 to 2017/18 and the sustainable level.





- **Any other materials that would provide the Minister's office with a sense of the state of the network as a whole historically from 2009 to the present.**

Graph 6 shows the skid resistance of the network compared to the investigatory (or warning level) and the target level. This shows a worsening in skid resistance. This graph shows the approximate amount of the state highway network worse than the investigatory (or warning) level , and the threshold or target level.



With regard to the white paper, it is also prudent to provide an update on the issues raised in the section at the top of page 20 “Exclusions and assumptions” and the opportunities affecting those issues in the items listed at the bottom of that pages, and described in more detail on pages 21-27. We have provided additional information in the appendix.

Appendix

Update of data and issues referenced in the 2019 white paper BR-1737

The white paper noted that it excluded forthcoming enhancements to safety and environmental practice on page 20. It explored opportunities on pages 20 – 27. The exclusions and opportunities (in many cases) are now required to be addressed through the maintenance programme because of subsequent developments in Government policy and improvements to safe work practices. These developments affect the scope and cost of road maintenance activity costs.

We expect to increase the scope of maintenance activities from 2024 onwards as described below.

Enhanced safety practice

The 2019 white paper excluded costs associated with enhancing workplace safety identified under *opportunity 18* (as indicated in the heading of the paper). Since 2019, there have been improved safety requirements including the development and implementation of temporary traffic safety management at worksites. Since 2019:

- Improvements have been made to road works safety to protect road worker and those travelling past roadworks.
- These have improved road safety, which transferred the cost of road worker safety events (previously occurring as injured road workers) and its associated costs of ACC and the hospital system to the cost of event prevention born by clients. It also changed the relative economic cost to clients of proactive works to reduce the need for repairs compared to prior lower direct costs of repairs.
- For example, this makes it better for road safety and for long term average costs to resurface roads earlier than has happened in the past, before road surfaces start to crack as they deteriorate at the end of their service life, admit water to the pavement below initiating pothole formation. This appears as a shorter service life of treatments, and therefore an increased amount and cost of works per year.
- Associated initiatives are the introduction of safer practices and materials, such as replacing hot spray chip seal surfaces with emulsion based chip seal surfaces, improving worker safety by roughly halving the temperature of the bitumen used.

Enhanced climate change and environmental practices

The 2019 white paper excluded costs associated with what it called enhanced environmental practices, though these are now reflected as climate change adaptation and mitigation, and environmental initiatives such as those related to water quality and biodiversity.

Since 2019, there has been considerable change in the policy environment with the release of the Emissions Reduction plan, the National Adaptation Plan etc. and the development of subsidiary requirements and activities to deliver the plans' objectives, though there is still policy development work required to finalise requirements and enable road maintenance responses to be developed in detail. For example:

- New reporting regimes are required but the details not yet finalised
- The requirements to support bio-diversity require retrofit of existing infrastructure but the scope and pace of the required works have not yet been finalised in detail.

These topics were raised in the white paper as opportunities: 1 Mode shift, 2 Sustainability Action Plan, 3 maintaining Transport system [throughput], 10 Pavement and road surface requirements in towns, and 12 [Improved] drainage to protect pavements and improve network resilience. These opportunities are leading to enhanced additional activities compared to the base programme of 2019. The scope and pace of requirements are still being developed, so the impact on road maintenance cannot be quantified yet. For the maintenance programme component, these can be summarise as the following:

1) Mode shift and Vehicles Kilometres Reduction(VKT) reduction, item 1, maintaining Transport system [throughput] item 3
    a. The policy framework has developed from that envisaged in mid-2019. The Government's Emissions Reduction Plan has now been published. Waka Kotahi and Local Government are developing VKT reduction plans and delivering the Transport Choices package. The Plan, and the National Adaptation plan for climate adaptation responses, expect that state highway and local road maintenance works programmes will be designed to renew infrastructure in a form that serves the future multi-modal function of routes in the future context.
    b. This means that, where appropriate, roads will be reconfigured and additional works will be implemented to efficiently improve road configuration when work crews are on site, though this would cause an additional cost to core road maintenance. For example:
        i. kerbs might be relocated, and road markings different than before,

        and works augmented at extra cost by, for example:

        ii. replacing culverts with those with greater capacity,
        iii. providing pedestrian platforms to improve pedestrian safety at urban intersections,
        iv. providing priority lanes and changes to traffic signals at intersections to give priority to specific modes of transport,
        v. widening road shoulders, or providing separate paths, when renewing road pavements to provide greater safety for active modes.
    c. Similar programme interventions in the past have been budgeted at 4-8% of road maintenance for minor works.

2) Sustainability action plan, items 2, and 12
    a. The policy framework and subsidiary requirements and activities are under development. They include the Carbon Neutral Government Programme (CNGP), Emission Reduction Plan (ERP), Climate Emergency Response Fund (CERF), Heritage Management, Air Quality monitoring, Waste Minimisation (Information Requirements) Regulations 2021, NPS Indigenous Biodiversity, Review of the Wildlife Act, aspects of the National Adaptation Plan and the Spatial Planning Act, Waste Minimisation Act, and others. These require, or will require, new monitoring regimes, new practices to protect biodiversity, the use of nature based solutions, the indigenous species to maintain biodiversity and sequester carbon (while maintaining road safety), changes to how integrated stormwater catchments are managed, for example.
    b. These mean that work practices and materials must change, and new activities added to mitigate and eliminate the adverse impacts of transport on the environment and to adapt to climate change, including:
        i. New measurement and monitoring regimes to report on GHG emissions, air quality, resource efficiency, waste minimisation
        ii. Transition costs of waste disposal as resource efficiency improves
        iii. The retrofit of fish passage through culverts
        iv. The replacement of roadside vegetation with indigenous vegetation
        v. The use of nature based solutions such as swales or wetlands to improve water quality and mitigate stormflows
        vi. Increased use of recycled materials, eg when rehabilitating pavements, often in conjunction with additives such as cement to improve pavement strength
        vii. Increased use of low noise road surfaces, and noise barriers to reduce the impacts of traffic on roadside neighbours

viii. Replacing older road lighting with LEDs to reduce energy consumption and GHG emissions because of the fewer road maintenance works required because LEDs have longer service lives

c. The scale, cost and rate of change in impact from such activities depend on developing policy, the targets and the period until the targets must be met as well as on developing the capacity and capability of the sector to implement changes and additional works.

Expected road surface and road pavement service lives.

Recent deterioration modelling provided the 9 percent estimate, which was consistent with sustainable prior practice. Note that this applies to state highways only.

However potential changes to practice will affect the following:

1) The greater use of structural pavements will extend the life of road surfaces
2) The need to resurface earlier to reduce the likelihood of road defects due to more intense rainfall, and to reduce the need for repairs to improve road worker safety will reduce road surface service life
3) Emerging approaches to reducing embedded carbon require:
    a. More durable treatments to reduce the frequency of roadworks, and their adverse impact on GHG emissions from disrupted traffic and from road workers travelling to site
    b. Potentially using different materials, or recycling existing materials with new additives which may affect service life and cost
4) The continued growth in freight (including heavy vehicles such as busses) and any increase in axle loads as payload limits rise, and as vehicle motive power sources change axle loading, depending on the changes to axle numbers and configuration, will affect pavement and surface life not only of freight routes but also on bus routes and other arterials in urban centres

When structural road pavements are used in place of the granular pavements used in most road in New Zealand

- Road surfaces have a longer service life
- Fewer defects such as potholes form
- Pavement rehabilitation cycles are extended from 25-50 years to 75 – 150 years
- There is significantly less disruption to traffic during pavement rehabilitation using structural pavements because they can be built much faster, and subsequently because fewer defects form, and road surfaces do not need to be replaced as often
- They are more resilient because they are not as vulnerable to water damage as granular pavements
- The pavements do not deform as fast or as much as granular pavements giving smoother ride for longer, reducing traffic energy consumption, and vehicle maintenance, and safety risks particularly to motorcycles
- Long term average road maintenance and renewal costs reduce on routes with significant freight and other traffic and GHG emissions reduce.

Structural road pavements would have benefits when used on routes such as:

- Bus routes where frequency is higher and busses have high axle loads as a result of electrification
- Inter-regional State highways and access to and from distribution or manufacturing centre.