# An Overview of NZ History with Skid Resistance on the Highway Network

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## ABSTRACT:

This paper is a look back over the last 20 years of evolving skid resistance policy and actions for New Zealand's highways.

In the mid 1990's, Transit New Zealand [now the New Zealand Transport Agency] (NZTA) took a bold and proactive approach to addressing the skidding resistance demands on the ~11,000km highway network in NZ and adopted a policy to reduce skidding related crashes.

This paper highlights the benefits of this policy and the learnings to date. It outlines the initial potential to reduce wet road crashes highlighted by a high benefit-to-cost ratio using a an analysis of predicted crashes. The evidence to date demonstrates there has been a notable crash reduction.

The adoption of this policy has come with some challenges, including technical delivery, material availability and on-road performance. The skill set challenges and resource requirements are significant, and NZTA has embarked upon extensive training workshops on a regular basis to inform and upskill engineers and contract suppliers.

Ongoing advancemens in technology and knowledge, what works and what doesn't; has seen the need for continuous upskilling and knowledge transfer. Recent advancements of the policy have seen the introduction of out-of-context curve analysis to priortise the areas of highest risk and greatest need for treatment.

Developments of SCRIM vehicle based on issues and experiences, are now seen as internationally leading edge in how road network surface condition is measured.

This success story is notable for a demonstrated reduction in skid related crashes and remains a key focus of our Asset Managers & Safety Engineers.

# 1. THE POLICY AND GUIDLINES

In the early 1990's, Transit NZ [now NZTA] as the highway network manager, awarded 2 separate surveys for high speed pavement data collection; one focused on roughness and laser surface texture measurements; and the other on skid resistance, with SCRIM being preferred method of survey.

Previous M/6 aggregate specification required a certain Polished Stone Value (PSV) based on UK Highways Agency standards and in an early study by Dr. J Donbavand[1] this principle was adopted for surfacing of highways across New Zealand (NZ).

## 1.1 INITIAL RESEARCH

WDM conducted research on behalf of Transit NZ[2] to look at the correlation between the PSV of aggregates used in NZ road surfaces, and wet road 'loss of control' crashes. This research using Sideways Force Coefficient Routine Investigation Machine (SCRIM) as the tool for measuring in situ aggregate performance determined there was a second order correlation between crashes and micro-texture and thus led to the development of a technical specification to target the appropriate surface aggregate necessary to address the risk factors for each network segment.

Later research has determined that while PSV may be a useful measure to compare stone polishing, it does not always correlate well with in situ performance of each type of aggregate on the road. In NZ, given the many variables, including young geological material, leading to variability of aggregate from one source, weather conditions, including high rainfall and variable summer to winter conditions, tight curves on steep winding alignments and high percentage of heavy commercial vehicles, temporary surface contamination through bleeding and resultant contamination of the stone; and loss of micro-texture leading to notable drops in skidding resistance; - all contribute to the variability of performance of aggregates across the country.

Given the skid policy has been in place for 15+ years, and annual results recorded in the Road Asset Maintenance Management (RAMM) database, we are building up a significant history of in situ aggregate performance which will be a better predictor of on road performance, than the PSV test. These two measures can be used together to determine the appropriate aggregate for each location and thereby maximise the use of the finite aggregate resources.

Once a relationship between road surface friction or skidding resistance and crashes (loss of control in the wet) was developed, a decision was made to stick with the SCRIM vehicle as the tool to measure network skid resistance, given the number of variances in collecting data and the different ways each type of measuring device assesses surface friction. Correlation trials of a variety of measuring devices has been undertaken in Australasia including, one on runways at Sydney Airport, Australia and another following the 2005 1st International Roads and Runways Roads Surface

[1] Donbavand,J. "Skidding Resistance of Road Surfaces – Implications for New Zealand" RRU Bulletin 81, Wellington (1989)

[2] WDM Limited "Investigation into the Relationship Between Aggregate Polished Stone Value and Wet-Road Skid Resistance – January 1998

Friction Conference[3] in Canterbury NZ. While there is some consistency in measurement, there are still a huge number of variables that make it difficult to compare road networks year on years with any consistency. Therefore, NZ decided to continue with the SCRIM vehicle for annual high speed pavement condition data surveys, mainly due to the reliable skid resistance method of measurement and the correlation to predicted wet road crash rates.

Given the variety of highway maintenance contracts, this did create some challenges, especially with the longer term performance based maintenance contracts, where the maintenance suppliers (contractor) are required to collect and verify their own condition data to confirm that they are meeting the outcome focused performance criteria. It made sense to use the same equipment and methodology as the Client organisation. However, due to potential data ownership issues, there was a requirement for this information to be collected by the maintenance supplier. If the Client also required network pavement data to be collected independently, often the survey vehicle would travel over the same entire network within a matter of days. This did highlight some variances with the skid data which can vary on a daily basis given NZ variable weather conditions (hot summer days when Chipseal surfaces can melt and binder bleeds, giving temporary contamination to the micro-texture of the stone; or heavy rainfall in the tropical or western regions, which helps to rejuvenate the surface) Thus, even with the seasonal corrections and some locational variances (ie tracking of the survey vehicle in or outside the wheelpaths), the data from repeat surveys would be considered repeatable for network length but did present some reproducible differences at the individual 10 m lengths.

## 1.2 MAINTENANCE FUNDING

Following the research it was determined that while benefit costs ratio's (BCR's) used to prioritise and justify new Capital investment projects used historic crash records, this new policy[4] used a predictive analysis across the whole highway, given the random nature of crashes.

This new policy determined that, when a section of highway was due for maintenance resurfacing, if an aggregate was used that had higher skidding resistance properties applicable for that location, there were significant benefits to be gained in reducing wet road loss of control crashes, over and above the renewals value of the maintenance surfacing. Consequently, timely maintenance treatments would now include the additional spin-off benefits of improving safety through targeted surfacing treatments. Initial investment focused on immediate change to PSV for surfacing aggregates with an additional ~$5M invested to advance surfacing, and a further ~$1M in the first year for increased transportation costs to cart the higher PSV aggregate to where it was needed across the country.

The policy identified a BCR ratio of >20 which demonstrates excellent value for money and while this was a model based on predicted crash trends, even if only half the benefits were realised, the policy demonstrated a strong correlation between providing improved road surface friction and savings lives and reducing trauma from road crashes in the wet.

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[3] International Conference On Road Surface Friction (2005) Christchurch, New Zealand: Report On Skid Resistance Test Device Trials, 5 and 6 May 205

[4] Submission to the Transit New Zealand Authority: Skidding Resistance Policy for State Highways – June 1997

In more recent years, the limited availability of high PSV naturally occurring aggregates from small numbers of quarries has led NZTA to look at other source materials. Testing of a by-product from steel production has determined that melter slag, processed to aggregate size/shape and with it's mid 60's PSV is a valuable source of road surfacing material for areas where higher skid resistance is required. It hasn't been without initial teething problems, as outlined in David Cook's paper; "Using waste material to improve skid performance: Melter Slag on SH 5, Hawkes Bay NZ"[5]

## 1.3 NEW T10 SKID RESISTANCE SPECIFICATION

This technical specification was developed to document the requirements for maintenance suppliers to apply the new policy. T10 (1997) set levels of service for skid resistance, together with the methodology for analysing annual skid data and determining priority for treatment. It linked to the material's specification for surfacing aggregates (M6) to ensure correct aggregates were used for the relevant situation, for the life of the surface. Initially there was a separate requirement for minimum macro-texture levels to mitigate the risk of vehicles aqua-planning in the wet.

These minimum requirements have made changes to the type of materials that are acceptable at various locations and moved asphalts on high speed real areas away from smooth asphaltic concrete mixes to asphalts mixes with good macro-texture such as Stone Mastic Asphalt (SMA) and Macadam's. The aggregates used in these asphalt mixes together with chip seal surfaces have minimum PSV requirements in an effort to ensure the aggregates polish to state of equilibrium but above the investigatory level ( typically in the first 2 years of the surface life, then varies summer to winter each year), for the rest of the design life of the surface.

## 1.4 T10 SPECIFICATION EVOLUTIONS

In the mid 2000's it was decided to include the minimum macro-texture within the T10 specification, given that macro-texture and micro-texture are collected by the same vehicle and both contribute to the frictional properties of a road surface.

The current T10 skid resistance specification for highways in NZ is dated 2013 and is the 5$^{th}$ update. Each edition has taken onboard previous learning's and technological advancements, to refine the site category requirements and improve the understanding and interpretation of the adoption of the skid performance data. This latest edition includes the requirements for assessing and treating sites identified though the annual network pavement condition surveys, including recent refinements to the site category table, as explained in David Cook's paper; "Improving a great skid resistance policy: New Zealand's State Highways"[6]

It was found that in New Zealand the majority of wet road crashes were occurring on curves, particularly what we termed out of context curves therefore in our prioritisation process we have now included these areas. These are sites where it was determined that the curve was out of context with the rest of the road environment, typically those

[5] Cook D, Cenek P, Perrin S: "Using waste material to improve skid performance: Melter Slag on SH 5, Napier-Taupo Road, Hawkes Bay NZ

[6] Cook D: "Improving a great skid resistance policy: New Zealand State Highways"

with high approach speeds and/or where the curve radius were difficult to determine by the driver of a vehicle. These curves were ranked accordingly and given and higher priority for funding and treatment and were often those with the highest loss of control crash rates.

The challenge with any national policy is that every update takes time to fully implement, given the number of maintenance contracts across the country and the stage they are at in their tenure. Unless the specification requirements can be easily negotiated into existing contracts the level of service will vary across the highway network until all contracts are renewed. NZTA has adopted a new form of contract model to ensure consistent levels of service are applied across a range of road classifications.

### 1.5 MAINTENANCE METHODOLOGIES ADOPTED

Following the adoption of the new skid resistance policy in mid 1990's Transit NZ earmarked maintenance funding to enable a stepped change to resurfacing to be implemented immediately, with a view that within a couple of years the specification would become business as usual. The target was to predict end of life so road surfacing and by targeting the appropriate aggregate for each road section including relevant site conditions, traffic mix, etc. A surfacing would last the desired design life and provide the appropriate level of safety for each discreet road segment. This injection of funding enabled higher skid resistance (higher PSV) aggregates to be sourced and transported around NZ to areas of need, rather than using local aggregates that may not have provided sufficient skid resistance for those higher demand areas.

Once the policy settled in and was adopted, the vision was that following each annual high speed skid resistance survey, sections of the highway trending below the investigatory levels would be programmed for sealing in the following season, thereby providing the necessary skid resistance through the winter months and the following summer months the surfacing would be applied 'just in time'

## 2. MEASUREMENT AND ANALYSIS

### 2.1 APPLICATION TO OTHER ENVIRONMENTS

During the late 1990's and early 2000's there was an attempt to work with other agencies who undertake surface friction measurements. Airport runways are regularly tested for frictional values, however this only requires straight line friction testing with all the complexities that go with a typically windy, undulating, variable surface rural road network, minimised. Therefore a variety of equipment is used internationally. A correlation test run of a variety of test vehicles on the Sydney Airport runway in early 2000's demonstrated how difficult it is to compare the results suitable for accurate correlation from one type of instrument to another. Also, the aircraft pilots typically require one number as a measure of runway surface friction, to determine the safety rating for landing.

As well as road surfaces, paint markings were identified as a potential risk, particularly for motorcyclist and cyclists. Therefore a minimum friction level was determined for all paint and special road/lane markings (eg cycle ways, bus lanes, etc) to ensure that tyre road friction demand is maintained.

## 2.2 AUSTROADS GUIDELINES DEVELOPED

Mal-feasance and misfeasance are prevalent drivers in Australia with respect to road agency culpability and therefore any policy may give rise to potential legal claims if the policy is not achieved in all circumstances. These claims can rise into the millions of dollars where there has been serious injury or vehicle damage, and the achievement of that policy comes in the question. With these significant claims by crash victims against Client roading organisations for below standards road surfaces that may have been a contributing factor in a crash resulting in vehicle damage and personal injury. Hence Australia embarked upon developing a comprehensive Austroads Guideline[7] to help Roading Authorities develop their own policies for road surface condition performance.

This Guideline was produced under the Austroads banner but has subsequently been superseded by the revised Austroads Publications Series.

## 2.3 POLICE AND CRASH ANALYSIS

Police in NZ typically use an entirely different technique for measuring skidding resistance of a road surface following a crash. Some use a cut down tyre dragged across the road surface, however more recently they have a dash mounted in-car de-accelerometer that is used to measure the braking resistance of a police car, within a day or so of the crash, This information is presented as part of the Police evidence in Court and then compared alongside the Roading Authorities SCRIM or other such measurements (often taken at a different time of years and under varying conditions) and this often takes experts to explain this in 'layman's' terms.

## 2.4 ANALYSIS AND PRINCIPLES

Measurement and analysis of road surface friction and skidding resistance is a complex topic. Given the number of variables and issues that can impact upon skid resistance properties across a road network, the changes to NZTA has required and extensive and ongoing education and upskilling requirement.

During the early days of skid policy implementation a series of regional workshops were provided to inform Client and supplier organisations of the skid resistance properties, how to analysis road condition data and how to apply the policy to discreet segments of the road network. Complexities included:

- rolling average data versus spot measurements (typically 10 m intervals)
- lane versus wheelpath measurements
- macro versus micro texture
- Investigatory Levels (IL) versus Threshold Levels (a level of service below IL and based on acceptable level of risk typically an international level.)
- aggregate properties

[7] Guidelines for the Management of Road Surface Skid Resistance

- treatment selection and design
- when to rejuvenate the existing surface versus applying a new surfacing
- how to assess sites highlighted from SCRIM results in the field and verify measurements that may have initially appeared low
- initially but were due to temporary loss of skid resistance
- the importance of actioning skid sites below TL
- assessment of the exception report results with uncorrected data
- changes to the specification, which has required ongoing training of staff and suppliers
- presenting information in crash reports and presenting to coronial inquests, a very technical area, which is left to a few specialist people

The need to retain this level of understanding requires ongoing training and updating of the skid resistance material to ensure Industry are kept up to speed with latest skid resistance technical requirements and methodology on how to address skidding resistance issues. This is also necessary to ensure the Roading Agency risk is mitigated and managed consistently across a road network.

## 2.5 ANNUAL SURVEYS & EXCEPTION REPORTS

Within 10 working days of surveying a maintenance network area (typically 300-500km areas) an exception report is available. This exception report lists all the 10m lengths that are below the threshold level. The skid resistance data in these reports are corrected for speed and temperature and adjusted by a Sideway-Force Coefficient (sfc) factor of 0.0078 but are not corrected for seasonal variation at this stage. These sites can be assessed in conjunction with network video (which are clear images taken at approximately 5m intervals) which help to determine any sections of highway where there may have been a dramatic drop in skid resistance and/or where sites fall well below the defined Threshold Level for each particular site category. Often these photos in conjunction with a field inspection and further verification testing (ie where the surface friction is retested) show that there has been a temporary loss in survey friction, that may not be as a result of the aggregate polishing For example, if there has been contamination of the site as the result of a spillage, it is likely the next rains will clean the surface. Once the reason is determined the engineer can decide if any urgent treatment is necessary, before the higher risk wetter winter months.

## 2.6 EFFECTS OF TEMPORARY CONTAMINATION

With softer penetration grade binders, combined with additives and high road temperatures during the summer months, some of NZ road surfaces are susceptible to binder falling below a critical viscosity and being picked up by vehicles tyres and tracked along the road surface - termed bleeding. This fine coat of binder tends to coat the surface of the aggregate and reduces the micro-texture properties of the aggregate and often leads to a temporary loss of friction properties of the aggregate, but typically wears off with trafficking.

If the surface has been contaminated by bitumen bleeding and tracking along the road (a common problem in NZ's hotter areas where road surface temperature can exceed 50 deg Celsius) then some form of water or sand blasting may be necessary to remove this excess binder and/ or the engineer may determine that traffic wear may be sufficient to remove this binder and restore the micro-texture properties of the surface aggregate.

### 2.7 EFFECTS OF SEASONAL VARIATIONS

New Zealand has varying weather patterns producing unique climatic conditions across both islands, compounded by the high dividing mountain range running the full length of most of the country. Consequently, the typically summer polishing and winter restoration of the surface aggregate does vary and therefore in order to obtain the mean summer skid coefficient for different regions, seasonal corrections sites are measured before and after the annual survey to plot the mean summer values and adjust the final results accordingly. Since the annual surveys have commenced, localised seasonal areas have continued to be identified and more seasonal sites have been added, whereby there are 114 sites that are measured three times over the summer period to provide localised seasonal correction factors.

## 3. THE CHALLENGES AND DEVELOPMENTS

### 3.1 REVIEW OF MACRO-TEXTURE REQUIREMENTS

While micro texture is the dominant feature that determines the skid resistance properties of a particular surface, the macro texture offered by that surface also plays an important role in the road tyre interface and ability for that surface to displace water as a tyre rides over it. NZTA has increased the macro texture requirements of new surfaces, partially in high speed rural areas, including a tolerance for the wear of that surface over time. For example, the minimum requirement is to have 1.0mm Mean Profile Depth (MPD) on new Chipseal surfaces, with a trigger level for review when that surface reaches 0.7mm MPD. This is for 2 reasons firstly to ensure that there is sufficient texture to remove the water under tyres and secondly to provide sufficient distance between the top surface and the binder layer to prevent vehicle tyres picking up bitumen from the interstices. This value is lowered for AC surfaces so for high speed roads the value is set at 0.9mm but this value is significantly lowered in urban area, where the minimum is set at 0.4mm MPD for a new surface and trigger level of 0.3mm MPD.

These macro-texture requirements have been somewhat difficult to achieve for asphaltic concrete surfaces in the higher speed areas (ie >0.9mm MPD) and this has led to alternative surface designs. Where previously traditional dense graded asphalt mixes have been used, alternatives such as Stone Mastic Asphalts or Macadam mixes have been used, often at a higher cost to produce, but necessary to provide the level of skidding resistance required to maintain macro-texture and acceptable levels of service for road safety.

### 3.2 REVIEW OF INVESTIGATORY LEVELS (IL'S) AND THRESHOLD LEVELS (TL'S)

NZTA has adopted a two-pronged approach to assessing a treating sites identified as having a loss of skid resistance from annual pavement condition monitoring. The first trigger that a surface may need further inspection is the IL. As not all sites require immediate treatment a second level was established, where it was deemed necessary to intervene. This was described as the TL and is the accepted level of risk subject to wet road crash history, for the funding available.

## 3.3 INTRODUCTION OF EQUILIBRIUM SCRIM COEFFICIENT (ESC)

NZTA in conjunction with WDM continue to explore opportunities to improve the accuracy of site specific surfacing condition information.

After several years of data and a review of seasonal trends, NZTA decided to adopt Equilibrium SCRIM Coefficient (ESC) correction values, whereby 3 years historic data was averaged with current year’s survey data to provide a 4 years average and to normalise any one off seasonal variations that tend to distort the annual data.

## 3.4 TRIAL OF NEW SURFACING PRODUCTS

In areas of extremely high demand, and where previous natural aggregates may not have provided long life skid resistance surfacing and where there has been a history of wet road crashes, NZTA has applied calcined bauxite. This typically requires a very strong epoxy or polyurethane binder to hold this extremely high PSV aggregate, usually hand laid, at very high cost. Often the underlying pavement/surfacing has to be relaid, to ensure that is has the strength to hold the calcined bauxite surfacing and avoid delamination. However the benefits have been realised with notable reduction in crashes at these sites and as these surfacing are typically applied over very short lengths ( ie in the area of greatest frictional demand) they have proven to be a very effective surfacing solution.

## 3.5 CHALLENGES WITH AGGREGATE PROPERTIES

As technical knowledge has increased following data analysis over a number of years, information of the performance of particularly road surfaces has emerged. One of the notable findings is that while PSV is a method for comparing the micro-texture properties of one type of aggregate compared to another, it is not always a definitive measure of on-road performance. However the data gathered where a particular quarry aggregate has been used can be compared for differing environment and geometrical alignments, to provide a better indication of that particular source aggregate performs.

This information has helped to show that some quarries have variability in their source properties, and has led to the higher PSV supply sources coming under increasing pressure to supply quantities of high PSV aggregate. Some quarries have a limited aggregate supply which has led to investigating other sources of alternative type aggregates eg melter slag which is a by-product of steel manufacturing. This has proved to be a very effective aggregate.

## 3.6 MULTIPLE SEAL LAYERS

With the introduction of the skid resistance policy in the mid 1990's there was a notable increase in the resurfacing of the highway network. Often sites were sealed before they had reached the end of their predicted design life and consequently led to a build up of seal layers. In more recent years this build up of seal layers has led to excessive bitumen in the seal layers which has migrated to the surface causing flushing and bleeding problems. Various techniques have been adopted to address this problem such as, re-texturising, water blasting, pavement recycling, however to fully mitigate the occurrence, further research is still underway.

### 3.7 LONG TERM PERFORMANCE BASED MAINTENANCE CONTRACTS

In the late 1990's long term performance based maintenance contracts were introduced to NZ highways. These contracts focused on outcomes rather than inputs and relied upon the supplier owning the annual performance of the highway as measured by key performance measures (KPM's). As skid resistance was one of these network KPM's, the supplier was required to verify the annual skid resistance values and this necessitated them arranging their own survey data, which could be compared against the Clients results. Initially this appear to be duplication of survey information, given the fact that often the full network area survey was only days apart, however the key principle was differentiation and ownership by each party of their own survey results, especially where performance payments relied on confirmation that the contractor had achieved the minimum KPM's. However, more recently, given the calibration of the survey equipment and reliability of results, most contractors in performance based contracts have accepted the Client's annual survey and used this data as their own to confirm achievement against the annual network performance measures.

## 4. THE PEOPLE AND APPLICATION

### 4.1 TRAINING AND UPSKILLING STAFF & SUPPLIERS

As the lead Agency, NZTA (and predecessor Transit NZ) have been the leaders in developing training material and coordinating this through technical experts and training organisations. Internally NZTA has a dedicated panel of experts called the Skid Technical Advisory Group (STAG). This panel of staff meet regularly to review policy developments and the uptake of research results. Their role includes peer review of relevant research and shaping the results for successful rollout across the staff and suppliers, to ensure successful uptake. Any new developments are tested by this group to ensure applicability to our highway maintenance activities.

### 4.2 SUSTAINABILITY OF SKILLED STAFF

Maintaining the required skid resistance skill set in each of the 24 network management areas across NZ has presented a challenge. While there was some intensive training and upskilling in the early years when the new skid resistance policy was being implemented, many have relied upon passing on this information internally. The ongoing development and somewhat increased complexity of the skid resistance analysis has led to some perverse behaviours and a drop off in focus. This has been evident with some areas seeing an increase in the failure rate of surfaces during annual pavement condition surveys, creating a backlog of sites needing treatment.

The skid resistance policy was developed to be a proactive approach to addressing skid resistance and designing surfaces that should reach their expected design lives, and not fail early due to polishing of the aggregate. Hence the need to be vigilant and continue to provide training for both new engineers and roading practitioners to the maintenance and safety arena, together with the provision of refresher courses for engineers, as the new technologies advancements are made.

Annual skid surveys and development of SCRIM vehicle eg water application, constant pressure on tyre, increased layers, wheel tracking, use of video, locational accuracy, survey speed increased to 80km/hr are a few of the technological advancements that NZTA has adopted in partnership with WDM to improve the overall accuracy of the SCRIM measurements

# 5. THE SUCCESS AND FUTURE

## 5.1 CRASH REDUCTION – THE SUCCESS STORY

The whole preface of adopting a skid resistance policy was to reduce road trauma through a reduction in wet road loss of control crashes. While the investment into improved road surfaces has been significant, so are the potential life saving benefits through crash reduction. The initial assessment of potential to reduced crashes produced and benefit to cost ratio (BCR) 40.[8] Subsequent post implementation analysis has shown a notable downward trend in wet road crashes[9] pointing to the success of this policy adopted for highways in NZ of BCR >20.

This is a notable trend and while other road safety factors have contributed, given that the local road network is not showing as positive reduction in wet road crashes, given the many local councils do not have a comprehensive skid resistance policy, clearly shows that the policy has been a wise investment and can be attributed to reducing road trauma.

## 5.2 WHERE WE ARE TODAY

The following is a list of current and ongoing development initiatives:

- Adoption of a new Network Outcomes Maintenance Contract for NZ highways, to realise efficiencies and increased network ownership
- National prioritisation of funding for addressing skidding related surfacing problems, based on defined levels of service and acceptable risk
- Ongoing research into the cause of flushing (binder rise) on road surfaces (typically chipsealed surfaces) and mitigation measures
- A review of causal factors and aim to be more efficient with expenditure
- A review of macro-texture trigger levels to ensure value for money surfacing are achieved
- The annual SCRIM survey now involved two SCRIM vehicles, so opportunity to get skid results early and address any significant outliers (ie poor skid resistance sites as identified in the annual SCRIM Exception Reports, where

[8] Submission to the Transit New Zealand Authority: Skidding Resistance Policy for State Highways – June 1997
[9] Cenek P, Donbavand J, :Effect of the New Zealand Skid Resistance Policy on the Crashes and Skid Resistance at Different Site Categories Over the Last Decade

lengths of highway are well below the Thresh hold level). Often our treatment involves resealing which must be undertaken in the warmer/drier summer months, so with these early results urgent reseals can be addressed pre-winter

- An ongoing analysis of skidding related crashes

Exploring opportunities to share current knowledge with other road agencies eg local councils, whereby they can adapt local skid resistance policies to suit local conditions and budgets

# 6. SUMMARY

Assessment and analysis of road surface friction is a complex dimension to managing road networks. Typically this key surfacing condition performance measure is used in crash analysis by a number of interested parties. Unlike other performance measures it is complex and highly variable and has a significant correlation with wet road crash rates.

The collection and management of this skid resistance information is a multidisciplinary task requiring asset managers, safety engineers and those presenting the information in litigation and coronial situations to understand the sensitivity and interpretation of this data. The measurement of road surface skid resistance properties is an important component in operating a safe road network. Upskilling of road owners and practitioners is a vital and ongoing requirements to ensure they have the latest knowledge and skill to determine the requirements where the 'rubber meets the road'

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## Author Biography

Mark is currently the New Zealand Transport Agency's (NZTA), Regional Performance Manager for the Central Region of New Zealand. In this role, Mark is has responsibility for the operations and maintenance of the highways in the Wellington and Nelson/Tasman regions and has oversight of the maintenance performance of the wider Wellington Business Unit, covering the Central and Lower North Island and top of the South Island. Mark has held this role for over 8 years.

Mark originally joined Transit NZ in 1996, having migrated from Local Authority. His roles have included technical policy development, national asset management and annual planning; and more recently maintenance management and highway operations. Mark was instrumental in the development of the original skid resistance specifications for Transit NZ (now NZTA) and has been a representative on the steering group of the 4th International Surface Friction and Safer Roads Conference.

Mark is a Technical Member of IPENZ and has completed a Master of Technology (Pavements) through the Deakin University in Geelong, Victoria, Australia.