NOTES TO THE SPECIFICATION FOR SKID RESISTANCE DEFICIENCY INVESTIGATION AND TREATMENT SELECTION.

These notes are for guidance and are not to be included in the contract documents.

1. SCOPE

These notes are to provide background information for addressing skid resistance deficiencies in conjunction with the SCRIM Deficiency Report User Guidelines - Transit New Zealand 1998 (User Guidelines) and to assist with the understanding required for the prioritisation of treatment.

2. MODIFICATION OF THE INVESTIGATORY LEVELS (IL's)

Sites that have a history of crashes are investigated as part of the regular Safety Management Strategy (SMS). If these crashes involve "loss of control" or "skidding in the wet" and the road surface at the site has a SCRIM value at or above the IL, this would be a valid reason to review the IL. The guidelines for assigning skid resistance levels attached as Appendix A, may be used by the Engineer responsible for inspecting sites, to adjust the IL at these sites. It is important when modifying the IL that a pragmatic approach is taken and that sites are only adjusted where the required increase in side force coefficient (SFC) is warranted.

3. ANALYSIS OF SKID RESISTANCE DEFICIENCIES

A SCRIM machine travels over the highway network at regular intervals to measure the in situ road surface friction which is recorded as New Zealand Mean Summer SCRIM Coefficient (NZMSSC) averaged over 10 metre lengths.

A skid resistant deficient site is one identified in the RAMM SCRIM deficiency programme as having an average deficiency over a complete site category, rolling average or individual lengths measured in 10m intervals. The deficiencies are identified after analysis of SCRIM data which is compared against the IL.

Using the latest SCRIM data contained in the RAMM database, SCRIM Deficiency Reports are available showing all the deficient sites with a deficiency greater than the nominated threshold level at which the SCRIM value below the IL is to be treated. The current intervention value (threshold level) is 0.1 or greater below the required IL.

3.1 Site Categories

The state highway network has been divided into 5 categories which reflect the required level of friction at each location. These site categories have been grouped into two demand categories.

Using Table 1 in the specification, the SCRIM deficiency report shows two site demand categories; High Demand and Low Demand.

HIGH DEMAND	Sites with an Investigatory Level Value in Categories 1, 2 or 3 from Table 1 in the specification. (IL $\geq$0.45) Due to the high demand for skid resistance at these sites, they are considered for treatment as deficiencies of 50m or greater in length.
LOW DEMAND	Sites with an Investigatory Level Value in Categories 4 or 5 from Table 1 in the specification. (IL $<$0.45) Due to the low demand for skid resistance at these sites, they are considered for treatment as deficiencies of 100m or greater in length.

The Demand Levels are used to determine the minimum length of deficiency as explained in the User Guidelines.

Several new site definitions have been included within Table 1 to ensure that 'at risk' sites are given the appropriate level of SFC. For example, approaches to Stop and Give Way intersections where the control occurs on the State Highway and approaches to One Lane Bridges including the bridge deck have been included in Site Category 1.

Motorway On and Off ramps have been included in Site Category 3.

3.2 Priority for Analysing Deficiencies

The report labelled "SCRIM Deficiency by Seal Length and Site Category" is characterised by seal length and identifies Site Categories within a seal length that have average deficiencies over the length of the Site Category, greater than or equal to 0.1 below the required IL.

Analysis of the deficient sites is summarised using 3 levels.

Level 1 provides the first filter and identifies site categories with an average deficiency $\leq$ the required threshold value over the total length of the site category, for each seal length. An example of the SCRIM report identifying these deficient sites is shown in the User Guidelines along with information to help with analysing the detail within this report.

Level 2 is the second filter with deficiencies highlighted in the report showing deficiencies in rolling averages of minimum lengths based on the Demand Category e.g. minimum 50m rolling average deficiency for High Demand and 100m for Low Demand. (The rolling average length is automatically increased in increments of 10m intervals) To assist with determining appropriate lengths to treat, the report has break points for each unique seal length.

Level 3 is the balance of the deficient lengths. These are usually individual isolated lengths with a skid resistance deficiency below the threshold value, but due to their intermittent nature have not been targeted in Levels 1 or 2. These should be treated as soon as practicable with an appropriate treatment under the routine maintenance programme.

3.3 Anomalies with SCRIM Results

Where a sudden drop-off in skid resistance values occurs and it has been established that it is not due to the aggregate polishing, the cause of the deficiency should be established and the site treated appropriately. Aggregate PSV is a measure of the ultimate state of polish for that particular aggregate under a defined traffic volume. Typically an aggregate has initially high skid resistance and polishes over the first 3 to 4 years until it reaches a state of equilibrium with only minor variations in skid resistance due to seasonal factors. If the traffic changes significantly, especially the number of heavy vehicles then the skid resistance will vary (either as an increase or decrease in skid resistance) but will plateau when traffic volumes stabilise). The PSV test reproduces this polishing effect and represents the ultimate state of polish of the aggregate.

Recent SCRIM results have revealed other causes of sudden decrease in skid resistance, namely sites where bleeding bitumen has spread across the top of the chips as binder has been tracked along the road. Typically this occurs where sites are flushed. Even where small patches (generally badly flushed) have bled during the hot summer months, the binder has been tracked for kilometres in the wheel paths and low SCRIM results have been recorded for these lengths. Generally, isolated flushed sites have low macrotexture and should be programmed for treatment to restore the texture depth.

Where the texture is above the required minimum and indications are that the site is not deficient through chip polishing. Compare the previous years SCRIM values for the site to confirm that the reduction in skid resistance values is sudden. A graph showing the current year's SCRIM data compared with the previous year's data can be generated using the SCRIM RAMM data.

An example of this graph is shown in Appendix B. This example depicts a typical Route Station (RS) length and shows the average deficiency using the Threshold Level of 0.1 below the Site Category Investigatory Levels measured as NZMSSC values in one direction (one lane, the average of both wheelpaths). It is evident that there is a sudden reduction in values between 3.0 - 6.3 and 11.3 – 15.5 km. For this site, an inspection revealed that pavement repairs immediately prior to these lengths with excessive binder had bled and tracked along the wheelpaths for several kilometres, hence the sudden drop in NZMSSC values recorded by SCRIM during the 1998 survey, compared to the 1997 survey. This decrease in skid resistance is far greater than would normally be associated with chip polishing.

Prior to a site inspection, analysis of the maintenance records should confirm whether or not the site experienced bleeding during the summer months, e.g. whether grit was applied or other maintenance treatments were undertaken.

A subsequent site inspection of sites where bleeding occurred during the summer months may not show obvious signs of bleeding after the event (for example during late autumn the tracked binder has generally worn off) and consequently the skid resistance has been restored. Some engineering judgement is required to determine the exact cause of skid resistance anomalies, particularly sudden reductions in skid resistance. If confirmation of the skid resistance is necessary an instrument such as the Griptester may be used for a comparison between sites as explained in Clause 4.

The first course of action is to eliminate the cause of the problem as even temporary low skid resistance creates a safety risk to motorists. Secondly, the Engineer must consider all the historic data associated with the site and make a judgement call as to the reason for the lost in skid resistance, especially whether it is temporary or permanent. The SCRIM results should not be disregarded until completely satisfied that the cause has been identified and targeted for treatment.

3.4 Treatment Selection

There are three methods for programming treatment of the deficiencies.

- Resurfacing — Where significant lengths of deficiency are included in the annual resurfacing programme.
- Area Treatment — Where the length is rehabilitated using recycling methods, programmed on a length by length basis. (Typically used for areas where flushing and/or a build up of sealcoats is causing a continual problem.)

- Maintenance Treatment — Where smaller lengths of deficiency are included for treatment during routine highway maintenance. As well as resurfacing, other treatments such as burning or the use of diluent and chip may be used to treat these lengths. For more details on possible treatments refer to the TNZ Flushing Guidelines.

It is important to note that all three treatments may require a higher Polished Stone Value (PSV) chip than has been used in the past.

4. SITE INSPECTION

A field visit is necessary to confirm the deficiency. This site visit requires an inspection to determine the actual deficiency and consider other possible unforeseen contributing factors.

If the deficiency as indicated from the RAMM records is not obvious or in doubt, in exceptional circumstances, confirmation of the required SFC by physical measurement may be necessary. Skid resistance testers such as the Griptester are suitable for performing this evaluation. However, if the Griptester is not available, the British Pendulum Tester (which has questionable accuracy) may be used to compare the recorded deficient site with an adjacent road surface that has a known acceptable level of skid resistance. Currently research is underway to determine a correlation between the Griptester and SCRIM. As yet there appear to be many variables, hence a direct relationship has not been established. Instruments other than SCRIM may be used for comparative testing between the site in question and an adjacent site with good skid resistance thereby eliminating variables such as seasonal differences.

The site visit is required to confirm the treatment selection and to determine the final treatment length for resurfacing. The reason for the deficiency may be an isolated 'flushed' patch(s) or numerous short intermittent lengths indicating a possibility of chip polishing for the length of the previous reseal. The site visit will confirm the exact cause of the deficiency and assist with determining the appropriate treatment.

5. TREATMENT SELECTION

Clause 5.1 of the specification provides a formula to determine the appropriate PSV for the chip to be used.

Where a higher PSV chip is required than can be provided from natural aggregate, metallurgical slag or processed synthetic chip such as "calcined bauxite" may be appropriate. The requirement for high PSV aggregates may involve importing chip from outside the region but is necessary when this initial increase in cost is compared to the potential reduced life of the surface due to the polishing of the aggregates to a level below the IL.

Where chip of the required PSV is unavailable locally and the cost of importing the appropriate chip is exorbitant, consideration should be given to alternative treatment solutions. These may include alignment or geometric improvements or more frequent resurfacing. The analysis may include benefit/cost comparisons for each option.

A new specification for high PSV aggregates, M/21 Specification for High Polished Value Sealing Chip, has been developed and is to be trialed with 'pilot' status. This specification will allow the use of marginal materials with PSV's typically 60+ that would not normally meet the requirements of the M/6 Specification for Sealing Chip.

It is important to consider the use of correct PSV aggregates for maintenance repairs which sometimes cause isolated areas of deterioration in the skid resistance of the surface inconsistent with the adjacent areas.

6. CONTINUING INVESTIGATION

Further investigation is necessary to determine the extent of deficient sites that are less than 0.1 below the required IL. (e.g. Between the IL and the Threshold Level)

It is anticipated that SCRIM readings will be recorded annually, providing a more up to date picture of the extent of deficiencies.

The RAMM SCRIM deficiency report allows the identification of sites that have a deficiency ≤ 0.1 below the IL. The new report (extensively revised in 1998) allows adjustment of the threshold (intervention) level to report all deficient lengths.

Although these deficiencies are less critical, the sites should be included in a ranking procedure for determining the need to resurface, along with other candidates for resurfacing such as chiploss, cracking, low texture, etc. A 'weighting' is to be assigned to determine the priority for treatment based on the degree of deficiency, using the modified Maintenance Allocation Review Group (MARG) formula.

APPENDIX A

GUIDELINES FOR ASSIGNING SKID RESISTANCE LEVELS.

Skid resistance Investigatory Levels (IL) are warning levels. If a section of road is below the IL shown in Table 1 of the specification, an investigation of the site is required to establish whether remedial work should be undertaken. IL are not minimum standards or intervention levels. The actual skid resistance level of any site is set by using the IL as the initial basis and using the specific site characteristics to raise, lower or maintain this level.

Reason for Reducing the Skid Resistance Level

The following site characteristics may indicate that the skid resistance (SR) level (measured as sideways force coefficient - SFC) could be lower than the IL.

Low Traffic Volumes

Low traffic volumes reduce the risk of accidents simply by reducing the number of times a manoeuvre is required. New South Wales and Victoria in Australia reduce the SR by 0.05 from the IL for roads carrying less than 2500 vehicles per lane per day (v/l/d). Insufficient research has been carried out to confirm this reduction, consequently it is suggested that a conservative view be taken and a reduction of 0.05 off the IL is considered acceptable only when the traffic volumes are lower than 500 v/l/d.

Up Hill Gradients

It requires less SR to stop within the same distance going up a hill than it does on the flat. The SR may be reduced by 0.05 if the site is on an up hill gradient of >10%. However, it is also important to consider vehicles travelling downhill who may use the up hill lane to overtake. If this is the case this may negate the SR reduction.

Reasons for Increasing the Skid Resistance Level

The following site characteristics may indicate that the SR level (measured as SFC) could be raised above the IL.

Multiple events

If a site has more than one event and the combined events place an additional requirement on the skidding resistance of the surface, this is good justification to increase the SR of the site beyond that of the IL. For example, if a curve is on a downhill gradient, or an approach to traffic lights is on a curve it is recommended that the SR be increased by 0.05 to 0.1 SFC depending on the demands of the combined events.

Superelevation on Curves

In the case of a negative superelevation (the road is lower on the outside of the curve) of greater than 5% the SR should be increased by 0.05 SFC.

Road Roughness

Normally road roughness is not related to skid resistance. However, on very rough roads greater skid resistance is required to be able to manoeuvre successfully. Therefore, it is suggested that an increase in the SR of 0.05 be considered for roads with NAASRA counts of greater than 120.

Isolated Events Causing Driver Surprise

Any area where a surprise manoeuvre may be necessary could be a candidate for increased SR. This could include an isolated curve on a high speed and otherwise event free road. Or event free roads that are prone to sudden braking due to congestion, such as certain motorways in peak periods. In these areas the SR may be increased by 0.05 to 0.1 SFC.

Crashes

Another factor which may affect the required SR value is the frequency of 'loss of control' and 'wet skidding' crashes where loss of SR was a contributing factor at the deficient site. These sites are generally identified through regular Safety Inspections and the problem highlighted for further investigation.

If 2 or more crashes (generally over a maximum 5 year period) have occurred at the site which may be associated with the level of skid resistance, then this is a good reason to increase the SFC by 0.05.

Responsibility of the Assessor

The reductions and increases in the SR outlined above are only indicative and it is the responsibility of the Network Consultant to consider all the characteristics of the site to assign the optimum SR values to a site.

The newly assigned SR value is termed the **Modified Investigatory Level** Value.

SCRIM (NZMSSC - IL)
EXAMPLE