PROTOCOL FOR THE SELECTION OF UNSEALED ROAD MATERIAL FOR REGIONAL LOCAL GOVERNMENT

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Abstract
A model has been developed to introduce a balance of science and practical approaches to allow Council’s to experiment with methods to improve the performance properties of materials selected in resheeting unsealed roads.

In order to control new innovative ideas in resheeting activities, a best practice approach to material selection involves:

- Staff training.
- Material testing and reporting.
- Analysis of testing results.
- Options for material improvement through blending of materials (e.g. clay).
- Whole of life analysis of options to test the benefits of a solution based on expected performance.
- Options for liquid/powder binder additives.
- Site trials and monitoring.

Subject to the right level of testing and analysis, options can be filtered out and others developed into trials to experiment on cost effective treatments. These trials can be setup in a controlled environment on sections of road and monitored to record key deterioration factors in order to compare performance.

This report presents local government with a framework and tool set to trial different material selections in order to adopt best practice to ensure informed decision making

Key Words: Protocol for the selection of unsealed road material for local government
Introduction
Tonkin Consulting in collaboration with the Australian Road Research Board (ARRB) have worked with Barossa, Goyder, Adelaide Hills and Loxton Waikerie Councils to explore new ways of assessing the performance of various resheeting materials. The project involved trialling new techniques for improving the proportions of materials with a view to ultimately improving the in service performance.

While results of the trials have been established the main focus of the project was to develop a protocol which will assist Councils in the assessment process and decision making together with monitoring performance of trials prior to applying new treatments to the wide road network. An important element of the process is to explore the whole of life benefits on investing upfront in more expensive treatments.

Trial Process
Loxton Waikerie, Goyder and Adelaide Hills Council’s agreed to use a set of processes to set up trials to compare current practices with new treatments.

The process includes the following key steps:

a. Pit material testing and assessing against the ARRB unsealed road material specification.
b. Assessing options to improve material properties through blending, additives and adapting work practices.
c. Examining the whole of life benefit of various treatments based on assumed performance expectations and the selection of options that look financially attractive in the long term.
d. Setup and monitor trial sites.
e. Record and review findings.

In order to assist in the project Tonkin/ARRB used the following tools:

1. Grading Assessment spreadsheet.
2. Whole of Life spreadsheet.

Key learning from Materials

Key Learning 1
Local Government need to recognise the difference between commercial products for base course, sub base course and material from pits for sealed roads to those attributes which contribute to a good wearing surface for unsealed roads.

Key Learning 2
Prior to considering use of additives, every effort needs to be made to source material that fits into the acceptable range of grading and plasticity presented in this report. For this to occur clear specifications are needed for suppliers and where material is sourced from local pits, the pit operator needs to blend the stone, gravel and fines in proportion to develop a particle size distribution that is acceptable.

Key Learning 3
While testing material from the pit provides indicative results, testing material post compaction on the road is seen as a requirement to observe how the process of crushing and placing the material is impacting on the final material properties on the road. These are ultimately the properties to assess against.

Key learning from use of additives

Key Learning 4
The use of lime should be limited where PI is high. The trial used lime on low PI material and in hindsight an alternative binder should have been selected.
Key Learning 5
Liquid binder additives need fines in the material to work. Further monitoring is recommended for each Council to determine if there are longer term benefits. After 2 years of monitoring there were position indicators.

Key learning from monitoring
The monitoring methodology used was deliberately made simple to allow Councils field staff to collect and take ownership of the data rather than be highly theoretical. In all cases the field record sheets were designed to allow for a systematic and consistent approach to record keeping, which is seen as important should other Council’s embark on trials.

The visual assessment observed Dust, Corrugation, Potholes and Loose Material on a course ratting of LOW, MEDIUM and HIGH.

The site measurement assessment consisted of:

- depth of rutting depth (mm)
- window height (depth) mm
- loose material (kg/0.5m²)
- Corrugations (depth mm, spacing (m))

Key Learning 6
Dust assessment discernment is very difficult visually. The extent of humidity at time of assessment i.e. overcast, clear or recent rain needs to be recorded.

Key Learning 7
While visual assessment of loose material may not be discernible, the measurement of windrow height and loose material are more indicative.

Key Learning 8
Trial sites should be left without maintenance grading interventions if possible to develop a longer term trend of deterioration. Several Councils undertook grading operation during the trial period.

Protocol for development of sheeted road material
In order to develop a discipline around the development of treatment options the following protocol flow chart is presented for implementation making use of the tools provided as part of this report, namely the Whole of Life Spreadsheet and the Grading Spreadsheet.

This flow chart is a key outcome of this project which introduces a set of protocols to follow to assist Councils with assessing materials, identifying ways to improve material properties, assess the financial benefits of certain treatments and introduce trials to monitor performance.

Every effort is needed to blend and improve material properties to comply with the “grading and PI” requirements prior to using additives. (refer Key Learning 2)

Use of findings to the wider local government
Key elements to up skill local government as a result of this project are set out in the following sections
Grading

A grading specification to provide Council staff some guidance in the winning and manufacture of pavement materials to be used was provided as part of the project.

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Range Percent Finer (passing through sieve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>95 – 100</td>
</tr>
<tr>
<td>26.5</td>
<td>90 - 100</td>
</tr>
<tr>
<td>19.0</td>
<td>80 – 100</td>
</tr>
<tr>
<td>9.5</td>
<td>60 – 90</td>
</tr>
<tr>
<td>2.36</td>
<td>35 – 65</td>
</tr>
<tr>
<td>0.425</td>
<td>15 - 50</td>
</tr>
<tr>
<td>0.075</td>
<td>10 - 40</td>
</tr>
</tbody>
</table>

Plasticity Index – 6% Min and 15% Max (where greater than Pi=15, lime or chemical stabilisation should be considered). This may vary across the state due to annual average rainfall

In addition for limestone consideration is needed where the material at low PI provides a natural binding quality.

By sampling a grading curve can be plotted against the desired envelope provided in this report to determine material deficiency and the type of material needed for blending.

Material Performance Chart

As part of this project there has been a number of tools used that were developed as part of the LGA Research and Development project.

Of the software tools a spreadsheet which can calculate mix proportions of two different materials to meet a suggested specification including a material performance chart based upon grading and plasticity determinations as shown below (South African Department of Transport 2009):

Using this diagram the following are recommended for unsealed road surfaces:

- Maximum size (mm) 37.5
- Maximum oversize index (Io)*5%
- Shrinkage product (Sp) 100 – 365 (Max. of 240 preferable)
- Grading coefficient (GC) 16 – 34
- Io = Oversize index (percent retained on 37.5mm sieve)
- † Sp = Linear shrinkage x percent passing 0.425mm sieve
- ‡ Gc = Percent passing 26.5mm – percent passing 2.0mm) x percent passing 4.75mm)/100

This spreadsheet tool will be made available to local government organisations that wish to undertake trials.

Whole of Life Analysis

As part of this project there have been a number of tools used.

In order to assess the whole of life benefit of a treatment a WOL spreadsheet was developed. This enables interactive analysis of the annual cash flow comparisons of a Net Preliminary Value calculation after a certain life for a treatment. Provision was made for a discounted rate.

Factors considered for compulsory treatments include:

Resheet frequency and cost

Maintenance frequency and cost
Binder addition costs

The lowest annual cash flow provides the optimum outcome.

Outline of trial and monitoring process
Between 1998 and 2010, ARRB undertook federal government sponsored project to develop standard testing protocols for conducting field trials on unsealed roads (Andrew & Sharp 2010). Based upon this development Tonkin developed a formal protocol for local government roads as part of the LGA Research and Development involving four rural councils in South Australia.

The material evaluation and performance monitoring process established together with operational instruction and standard reporting forms:

- Condition Assessment Guideline
- Visual Assessment Form
- Site Measurement Form

In order to complement a monitoring regime the following explanatory notes are provided.

The period (preferable monthly) performance monitoring of the pavement is conducted as follows:

- Drive through at 40km/hr – rate the severity of loose material, corrugations, potholes and erosion channels which affect the rideability of the pavement ((low/medium/high) which would necessitate maintenance intervention by patrol grading.
- Surface wear – sweep away the outer and centre windrow (between the outer and inner wheelpaths) in order to bed a 3 metre straight edge on a hard surface and measure the rut depths in both wheelpaths. Use his data to estimate the resurfacing (resheeting) intervals.
- Ravelling – use a 3 metre straight edge, located in the longitudinal direction, to measure outer windrow heights. This provides an indication of the amount of material being ravelled out of the pavement.
- Loose material – mark a 1 metre square area centrally over the centre windrow (between the outer and inner wheelpaths as shown on the diagram below), remove the loose material by sweeping, place it in a bag and retain for future evaluation. Clearly tag the location from which the sample was taken.
- Take a full photographic record of the site, including the testing protocols.
- Note weather information on the day of monitoring.
- Access rainfall records from the nearest meteorology station.
- Install a traffic counter (e.g. pneumatic counter) to record traffic volumes.

It is important that the pavement cross-sections are clearly identified and marked as monitoring locations to ensure that measurements are always taken at the same location. This ensures some consistency in the data and assists in the identification of photographs, etc. The following information should also be recorded:

- Locations close to trial section boundaries: each section may have different performance attributes, e.g. dust transfer at trial section boundaries.
- Drainage channels and culverts.
- Bends where shear forces are significant in terms of promoting greater material loss.

Within these trials it is possible to undertake life cycle analyses from estimates of gravel loss and grading intervention frequencies to evaluate the benefits of such thing as:
f. Additional costs associated with material blending/mobile crushing or roadbed treatments.

g. Effect of transporting better performing limestone as a wearing course and only using laterite as a sub-base material.

h. Performance improvement from alternate maintenance intervention techniques i.e. the trials provide the opportunity to investigate alternate patrol grading maintenance such as wet maintenance practices scarify water and compact processes as well as inclusion of stabilisation binders if considered appropriate.

Conclusion
This project has created an opportunity for the 4 local government organisations involved to collaborate with industry to help develop a set of processes to enable further developments in approaching unsealed road resheeting.

The introduction of some science balanced with involvement of local government works managers has enabled a more systematic approach to experimenting with ways to improve performance of unsealed road construction.

The project lays the foundation for further work across local governments in SA and the authors would encourage local government to continue to create awareness of the project to encourage other Councils to develop trial sites. The states Road Conference and Works supervisor groups have been used to present the finding. Since the project completion report in July 2012, there has been some work undertaken with Kangaroo Island Council and Kingston Council in the South East of South Australia.

However at present there is no drive for local councils to continue with the development of trials.

There remains limited accountability in the selection and placement of unsealed road materials and as a result works managers are not driven to produce long life solutions and have not embraced these concepts. However as knowledgeable people retire from local government there will be an increased need in the future for assistance to inexperience operators. In addition as access to raw materials becomes more difficult innovative solutions will be needed. Accordingly it is anticipated this work will be used to gradually build robust process in the selection of material and construction techniques in the future.

References
Austroads Pavement technology Series Part 6 “Unsealed Pavements”.

