TECHNOLOGY AND ENVIRONMENT DIRECTORATE

GUIDELINES FOR SURFACING TYPE SELECTION

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1. PURPOSE

To provide guidance on the selection of surfacings as a wearing course appropriate for use on the Main Roads’ network.

2. SCOPE

The guidelines describe common surfacing treatments used in Western Australia but include other treatments that could be used subject to availability or economic reasons. The guideline draws from the AUSTROADS Guide to the Selection of Surfacing Treatments but relates specifically to surfacing treatments that are suited to Western Australian practices or circumstances.

3. REFERENCES

AUSTROADS AP-G63 - Guide to the Selection of Road Surfacings.
Main Roads Specification 503 – Bituminous Surfacing.
Main Roads Specification 509 – Polymer Modified Bituminous Surfacing.
Main Roads Engineering Road Note 3 – Surface Blistering and Soil Fluffing.
Main Roads Standard 6706/02/133 – Water to Be Used in Pavement Construction.
APRG/AAPAWork Tip No. 7 - Treatment of Bleeding or Flushed Surfaces.

4. TYPES OF SURFACING TREATMENTS

The general types of surfacing treatments used on the Main Roads' network are described in the following text. Details on the application and limitations of the treatments described below are described in Section 6 along with descriptions of less common types of surfacing treatments.

4.1 Sprayed Seals

Sprayed treatments can be considered as being either an initial, final or special purpose treatment. Each type of treatment has a purpose that is described in the following sections.

4.1.1 Initial Seal Treatments

An initial treatment is that which is applied to a prepared basecourse surface or bridge deck. Dependant upon the type of treatment the lifetime of initial treatments could range from days or weeks for a prime and more than 10 years for a prime and double/double seal. Examples of initial treatments include:

- Prime - the application of cutback bitumen to a prepared basecourse surface as a preliminary treatment prior to the application of a seal. The role of a prime is to promote a good bond between subsequent treatments and the granular pavement material.
- Tack coat - the application of bitumen emulsion to a prepared surface prior to the application of an asphalt treatment.
- Prime and Seal – the application of a cutback prime and a single or double/double seal.
- Aggregate Primerseal – the application of a cutback bitumen to a prepared basecourse followed by the application of a 7 or 10mm aggregate.
- Sand or Metal Dust Primerseal - the application of a cutback bitumen to a prepared basecourse followed by the application of screened sand or metal dust.
- Two Coat Emulsion Primerseal - the application of two coats of an emulsion primerbinder and two coats of single sized aggregate on to a prepared basecourse surface.
- Bridge Deck Waterproof Membrane – the application of a sprayed scrap rubber binder to a prepared concrete bridge deck as a waterproofing membrane prior to the application of a final surface treatment.

4.1.2 Final or Subsequent Seal Treatments

Is the application of a sprayed treatment to an existing bituminous substrate, such as a primerseal, seal, waterproof membrane, asphalt or slurry surface. These treatments are intended to be durable long term treatments. Examples include:

- Single Coat Seal - one coat of a suitable bituminous binder followed by the application of a single layer of cover aggregate. A ‘reseal’ is the term used to describe the application of a sprayed seal over an existing seal as part of a cyclic maintenance program.
- Double/Double Seal - the separate application of two coats of binder and two coats of different sized aggregate.

4.1.3 Special Purpose Treatments

These are variants of typical seals to provide improved aggregate retention, minimise crack reflection and extend the life of a seal coat.

- Strain Alleviating Membrane (SAM) – is usually the application of a modified binder followed by a 10 or 14mm cover aggregate, intended to minimise reflection cracking from an underlying pavement and is a final wearing surface.
- Strain Alleviating Membrane Interlayer (SAMI) – is the application of a modified binder and cover aggregate, intended to minimise reflection cracking in a subsequent asphalt overlay.
- High Stress Seal – a seal or reseal incorporating a stiffer binder with improved aggregate retention, preventing rolling or dislodgement of the aggregate.
- Scatter Coat – the application of a 5 or 7mm aggregate on to a single coat seal to provide mechanical interlock between the larger particles, preventing rolling or dislodgement of the larger particles whilst the seal binder is relatively soft. Applicable to initial or final seals.
**4.2 Asphalt**

Asphalt is commonly referred to by its nominal size and type of grading, eg dense or open graded. Nominal size refers to the largest aggregate particle size present within the asphalt. It approximates the sieve size that the bulk of the aggregate material passes through and is often used to gauge the minimum and maximum asphalt lift thickness.

4.2.1 Dense Graded Asphalt (DGA)

Dense graded asphalt is also described as asphaltic concrete or hotmix. It is a dense, continuously graded mixture of coarse and fine graded aggregates, mineral filler and bituminous binder that is mixed in a plant and placed hot. By varying the aggregate combinations and binder properties, the properties of an asphalt mix can be varied to suit a wide range of applications, from low-traffic areas (such as bicycle paths), to freeways and heavy-duty areas such as intersections and freight assembly areas.

4.2.2 Open Graded Asphalt (OGA)

Open graded asphalt predominantly uses coarse aggregate within the mix and only small amounts of fine material to assist mix stability. This type of asphalt contains 18 – 23% air voids and is permeable by design. The nature of this type of asphalt provides lower tyre noise, improved skid resistance and reduced water spray contributing to improved visibility and road safety. Main Roads practice has been to apply open graded asphalt over dense graded asphalt. The DGA improves waterproofing of the pavement, drains effectively and protects the underlying seal from damage when OGA is planed off and replaced.

4.2.3 Stone Mastic Asphalt (SMA)

SMA is a gap graded asphalt that contains a large proportion of coarse aggregate with stone on stone contact, with the remaining volume partially filled with a mastic consisting of fines, filler, fibre and bituminous binder. Compacted stone mastic asphalt has a surface finish similar in appearance to open graded asphalt but does not provide the same level of surface drainage. This type of asphalt mix has good resistance to deformation and fatigue. The use of the product is experimental and it should not be used without prior consultation with Pavements Engineering.

4.2.4 Cold Mix

Cold Mix is a combination of fine and coarse aggregates, plus a bituminous binder, which may be cut and/or fluxed bitumen or a mixing grade emulsion. Cold mix has many of the same design objectives as hot applied asphalt, however it has the additional requirement that the mix must be workable at ambient temperature. Its properties are compromised by cutting and fluxing and its performance is inferior when compared to hot mixed asphalt.
4.3 **Slurry and Microsurfacing**

4.3.1 Slurry Seals

Slurry seals are composed of a graded mixture of sand and crushed rock containing filler, cement and a bituminous binder usually in the form of anionic emulsion and are generally placed in thicknesses around 1 to 1.5 times the nominal maximum size. Slurry seals are thin (<12mm), have a low surface texture and are relatively brittle when compared with asphalt.

4.3.2 Microsurfacing

Microsurfacing is similar to the slurry sealing process except that the binder is a polymer modified bitumen emulsion, used to provide faster setting for earlier trafficking, greater resistance to rutting, greater durability and improved flexibility. Larger sizes of aggregate and multiple application treatments are also feasible. Microsurfacing is usually based on the use of cationic emulsion. The nominal size of microsurfacing is usually in the range 4mm to 10mm and is typically placed in layers between 1 and 3 times the nominal mix size. Microsurfacing may be used for wearing coarse applications at nominal depths of around 8mm or may be used for significant shape correction such as wheel rut repair.

5. **GUIDELINES**

5.1 General

This guideline is intended to assist asset managers, maintenance staff, project managers and supervisors in the selection of appropriate bituminous road surfacings for particular conditions. The guidelines reflect Main Roads' historic practices and may not include all possible combinations of treatments and types of treatments currently available. Omission of discussion of other treatments does not discount their potential use, as they may be valid for particular locations and circumstances, though expert advice should be sought before specification of alternate treatments. In selecting a treatment a number of factors need to be considered including the characteristics of the surfacings. Examples of characteristics to be considered include:

- Shape
- Roughness
- Noise
- Skid resistance
- Surface texture

The characteristic of texture is discussed in the following section. Further information on the other characteristics is available in the AUSTROADS publication AP-G63.
5.2 Surface Texture Depth

The surface texture depth of a surfacing is an indication of its capacity to drain water away from the interface between a vehicle tyre and the road surface. The surface texture is an important component of the skid resistance characteristic of a surfacing treatment. Without adequate surface texture the potential for vehicle hydroplaning to occur increases significantly, especially with higher vehicle speeds. This is highly undesirable to the road user. The requirement for texture will vary, depending upon a number of factors including:

- Vehicle speed zoning.
- Rainfall characteristics.
- Pavement drainage conditions.
- Risk factors associated with the specific site location. Such as steep grades, curves, intersections and where there is the need to stop or reduce speed quickly.

Pavement surfacing types have inherently different surface texture depths. This characteristic will influence the selection of surfacing types based on a location’s surface texture needs. The following table indicates the relative surface texture of typical surfacing types used by Main Roads.

| RELATIVE TEXTURE |
|------------------|------------------|
| Lowest texture   | 5 – 7mm DGA      |
|                  | 10mm DGA         |
|                  | 14mm DGA         |
|                  | Slurry Seal      |
|                  | Microsurfacing   |
|                  | 10mm SMA         |
|                  | 7mm sprayed seal |
|                  | 10mm OGA         |
|                  | 10mm sprayed seal|
| Highest texture  | 14mm sprayed seal|
|                  | 16mm sprayed seal|

The following table has minimum recommended surface textures for a range of locations, with suggested surfacing treatments that should satisfy the minimum texture requirements. The suggested treatments cover a range of different conditions that may be encountered. For example, while a 10mm sprayed seal should provide >0.6mm surface texture it is usually an inappropriate treatment to place at a difficult site, tight bend or intersection when the zoned speed limit is <80 km/h.
### MINIMUM RECOMMENDED TEXTURE

<table>
<thead>
<tr>
<th>Speed Zone</th>
<th>Location</th>
<th>Minimum Surface Texture (mm)</th>
<th>Commonly used Surfacings to meet Minimum Texture Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤80 km/h</td>
<td>Difficult sites, tight bends and intersections</td>
<td>0.6</td>
<td>10mm DGA, 14mm intersection mix</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0.4</td>
<td>10mm DGA</td>
</tr>
<tr>
<td>&gt; 80 and ≤90 km/h</td>
<td>Difficult sites, tight bends and intersections</td>
<td>0.8</td>
<td>14mm intersection mix, 10mm SMA (note)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0.7</td>
<td>Sprayed seal (≥ 7mm), 14mm intersection mix</td>
</tr>
<tr>
<td>&gt;90 km/h</td>
<td>All locations</td>
<td>0.8</td>
<td>OGA, SMA-(note), Sprayed seal (≥10mm)</td>
</tr>
</tbody>
</table>

Note: The use of Stone Mastic Asphalt on construct only contracts must not be done without prior consultation with Pavements Engineering.

#### 5.3 Guidance on the Selection of Sprayed Sealing Aggregate Size

A consideration that should be made prior to resealing is the nominal size of the resealing aggregate to be used. The selection of aggregate size should be influenced by:

- Traffic volume and composition.
- Existing seal aggregate size and texture.
- Desired surface texture.
- Adjacent land use (impact of noise generation from tyre/aggregate interaction).

To ensure a pavement surfacing has a uniform texture depth across both wheel path and non-wheel path areas, it is preferable to alternate the size of reseal aggregate sizes used to assist aggregate interlock with the underlying sealing aggregate. This surfacing practice will result in a more uniform surface texture across the road. Repeated use of same sized resealing aggregate can result in significant differences in surface texture depth between wheel path and non-trafficked areas of a lane. This variation in surface texture can be difficult to successfully reseal. Spraying heavier rates of binder in the high texture and/or untrafficked areas will assist in producing a reseal with more uniform texture. Preparatory treatments to improve the uniformity of texture may be considered prior to resealing. Examples of such treatments include:

- Enrichment of “hungry” areas outside the wheelpaths.
- Applying a 7mm seal to part of the area to be resealed, eg to increase texture in a flush wheelpath or to reduce the texture outside the wheelpaths.

Examples of recommended aggregate combinations are listed in the following table.
### SELECTION of RESEAL AGGREGATE SIZE

<table>
<thead>
<tr>
<th>Existing treatment</th>
<th>Proposed treatment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10mm seal</td>
<td>14mm reseal</td>
<td>Standard alternating treatment of 10mm and 14mm</td>
</tr>
<tr>
<td>10mm seal</td>
<td>7/10mm reseal</td>
<td>If noise is an issue, either repeated use of 10mm aggregate or use of 7mm aggregate at a reduced service life.</td>
</tr>
<tr>
<td>14mm seal</td>
<td>10mm reseal</td>
<td>If the existing seal has sufficient surface texture and reseal is scheduled to alleviate stone loss or to improve waterproofing, surface enrichment may be an alternative cost effective option.</td>
</tr>
<tr>
<td>16mm seal</td>
<td>10mm reseal</td>
<td>Few occurrences of this aggregate size remain in service. Generally, these seals will have considerable variation in surface texture across the road and will require a smaller aggregate to achieve a uniform finish.</td>
</tr>
</tbody>
</table>

### 6. APPLICATION AND LIMITATIONS OF SURFACING TREATMENTS

This section describes the range of surfacing treatments that are normally specified for use on the Main Roads road network, their application, advantages, disadvantages and limitations. The reasons for the nominated use or conditions on use are provided to assist users in the process of selecting the most appropriate surfacing types for their project.

#### 6.1 Initial Sprayed Treatments

**6.1.1 Tack Coat**

- **Description/Use** - Tack coats are usually applied to existing asphalt surfaces and are also used on a concrete bridge deck prior to the application of a waterproof membrane. The role of a tack coat is to improve the bond between a new surfacing and the substrate.

- **Conditions/Limitations** – Tack coats do not have cover aggregate applied and are not intended to carry traffic. Bituminous emulsions are preferred for use as a tack coat, such that volatile materials are not entrapped within the subsequent treatment. Caution should be taken with application to a bridge deck where the dilute emulsion may run into the gutters and underneath any waterproofing sheet membrane. The tack coat is best applied by hand to the deck and screeded by hand.

**6.1.2 Cutback Bitumen Prime**

- **Description/Use** – All granular basecourse surfaces, especially crushed rock basecourses. The role of a prime is to promote a good bond between the basecourse and the subsequent treatment.

- **Conditions/Limitations** – The viscosity and/or application rate of the cutback bitumen needs to be modified to ensure that the primer achieves good penetration into the Basecourse surface. Subsequent treatments should be deferred for at least 24 hours and up to 7 days to enable loss of volatiles from the primed Basecourse. The period before undertaking a subsequent treatment depends primarily upon ambient conditions. In hot dry conditions only 1-2 days may be necessary whilst in cool or damp conditions the primed base should be left for 3-7 days.
Main Roads practice is not to use emulsion for priming a Basecourse because it is unlikely to penetrate into a hard and tightly bound finish. A prime does not normally include a cover aggregate and is not intended to carry significant traffic.

6.1.3 10mm Aggregate Cutback Primerseal

- **Description/Use** - All granular basecourse surfaces. Provides an initial wearing course that is capable of lasting up to 5 years before requiring another cover treatment.

- **Conditions/Limitations** – The primerbinder needs to be cutback bitumen, usually a blend of 95/5 Bitumen/MC Cutter. To reduce the amount of pholing in the primerbinder the basecourse surface must be well swept and the basecourse surface damp when the binder is applied. Minimal penetration of the primerbinder will occur at the time of sealing. Not suitable for application in cool or damp conditions. Prone to flushing and stripping in high stress areas such as intersections. Not suitable for floodways. The application of a binder to a primed basecourse is termed as an Seal (see below) and is not a primerseal.

6.1.4 10/5mm Two Coat Emulsion Primerseal

- **Description/Use** - The application of two coats of a CRS/170-60 bitumen emulsion primerbinder and two coats of 10 and 5mm aggregate on to a prepared basecourse surface. When applied to a primed basecourse this treatment should be referred to as a two coat emulsion seal. Provides an initial wearing course that is capable of lasting 2 to 5 years before requiring another cover treatment.

- **Conditions/Limitations** - Useful as an initial treatment under asphalt as minimal curing is required. Suitable for low volume intersections under traffic. Requires sufficient time to cure before being opened to traffic at any speed. Curing time may vary between 1 and 8 hours, dependant upon conditions. Preferable treatment than hot bitumen primerseal late in the season when the weather is cooler or wet. Both coats must be applied before trafficking. The emulsion primerbinder does not penetrate the basecourse surface. The surface must be well swept to expose the stone mosaic of the basecourse.

6.1.5 Sand or Crusher Dust Primerseal

- **Description/Use** – The application of a cutback primerbinder to a prepared basecourse surface and covered with sand or crusher dust. Provides an initial wearing course with a lifetime of 3 to 18 months before requiring another cover treatment.

- **Conditions/Limitations** – The cover material must be graded to enhance stability of the primerseal. The primerbinder needs to be modified to suit the properties of the cover material. This treatment is not recommended for locations with high traffic volumes where a more robust treatment is recommended.

6.1.6 Single Coat Seal (7mm aggregate and larger)
- **Description/Use** – Applied to a primed basecourse. Presents a sound, durable, waterproofing treatment with good skid resistance characteristics.

- **Conditions/Limitations** - Not a desirable treatment when heavy commercial traffic entering from side roads, for controlled intersections or where adjacent residential development will be affected by noise generated by the surfacing. In high stress situations consider using a double/double or high stress seal. At farm gates consider using a scatter coat.

### 6.1.7 Double/Double Seals

- **Description/Use** – Where additional waterproofing is required, eg floodways or high stress environments such as intersections or climbing lanes. In addition double/double seals are applied on pavements where a basecourse material may be prone to “blistering and fluffing” (refer to Engineering Road Note 3 and Main Roads Standard 6706/02/133).

- **Conditions/Limitations** – should be applied to a primed basecourse, especially floodways. If being used on materials prone to blistering and fluffing it is usually expedient to not apply a prime and apply the treatment direct to the basecourse surface. In this scenario it is important that the basecourse surface be well swept and sufficiently dampened before spraying to minimise the consequences of pinholes in the first coat of the seal binder.

Class 170 bitumen is sufficient for double/double seals as the mechanical interlock of the different sized aggregates protects the aggregate from being rolled or plucked out. Where it is considered necessary to use a polymer modified binder the PMB should only be applied to the first coat. A PMB in the second coat may not completely flow into the voids of the larger aggregate, as would a less viscous binder such as Class 170 bitumen. Where additional stiffness is required in the seal binder consideration could be given to using a Class 320 bitumen for both coats.

### 6.1.8 Bridge Deck Waterproof Membrane

- **Description/Use** - Waterproof membrane for bridge decks prior to the application of an asphalt wearing course on the bridge. The standard treatment for a concrete bridge deck is to treat the deck with an emulsion prime with the subsequent treatment being the application of a 20% scrap rubber binder, into which a 5mm aggregate is incorporated. The intention of a waterproof bridge deck membrane is to provide a thick and stable layer of the mastic material on to which asphalt is to be placed as the final surfacing.

- **Conditions/Limitations** - The membrane is not intended to carry traffic. It is not designed like a single coat seal in that the 5mm aggregate must penetrate into the rubber binder to create a mastic type membrane, rather than being left on top of the binder like a traditional sprayed seal.
6.2 Subsequent or Final Sprayed Treatments

6.2.1 Single Coat Seal (10mm aggregate and larger)

- **Description/Use** – Applied as a seal on a primerseal or as a reseal over an existing seal, asphalt or slurry surface. Presents a sound, durable, waterproofing treatment with good skid resistance characteristics.

- **Conditions/Limitations** - Preferred treatment when strength of surfacing is not an issue. Not desirable treatment when heavy commercial traffic entering from side roads, for controlled intersections or where adjacent residential development will be affected by noise generated by surfacing. In high stress situations consider using a double/double seal, high stress seal or asphalt. At farm gates consider using a scatter coat.

6.2.2 Double/Double Seal

- **Description/Use** – Where additional waterproofing is required, eg floodways or high stress environments such as intersections or climbing lanes.

- **Conditions/Limitations** - When substantive sprayed seal treatment is required and asphalt not available, generally for rural locations. Provides sound, robust waterproofing when inundation is anticipated, however it is important that there be a sound bond to the substrate. Greater mechanical strength is achieved through use of smaller aggregate being locked into the void spaces of the larger aggregate applied on the first coat of binder. Combinations of aggregate should be 20/10, 16/10 or 14/7mm aggregates. Combinations of 14/10mm aggregate should not be used because the void spaces of the first 14mm coat are too small to accommodate the 10mm aggregate. The 10mm aggregate is likely to be removed by vehicles leaving the 14mm aggregate and two coats of binder.

Class 170 bitumen is sufficient for double/double seals as the mechanical interlock of the different sized aggregates protects the aggregate from being rolled or plucked out. Where it is considered necessary to use a polymer modified binder the PMB should only be applied to the first coat. A PMB in the second coat may not completely flow into the voids of the larger aggregate as would a less viscous binder such as Class 170 bitumen. Where additional stiffness is required in the seal binder consideration could be given to using a Class 320 bitumen for both coats.

Cutter **must not** be used in the first coat of a double/double seal as it will be trapped by the second coat, leaving the seal binder too soft, resulting in bleeding. Where each coat of a double/double seal is applied a number of days or weeks apart the use of cutter in the first coat can be considered dependant upon the weather conditions and the anticipated time interval between application of the two coats.

6.2.3 Single Coat Seal (7mm aggregate)

- **Description/Use** – Used on low traffic volume roads or as a corrector seal to regulate surface texture, possibly prior to a larger aggregate size reseal the following year. Typically applied in the wheelpath areas.
- **Conditions/Limitations** - This aggregate size will not yield high surface texture, typical initial texture depth range will be about 0.6 – 1.0mm. Not intended for long term usage, should be followed up with larger aggregate reseal. The treatment will produce a continuous aggregate matrix across the width of the seal. May provide “armour-coating” of flushed seals, care must be taken with bitumen application rates.

### 6.3 Special Purpose Sprayed Treatments

#### 6.3.1 Enrichment

- **Description/Use** - A light application of bitumen emulsion to an existing aged seal to extend its service life. Cover material is not used and the aim is to rejuvenate the existing binder and assist with retention of aggregate. Enrichments are also used on newer seals to retain cover aggregates that may be lost due to poor adhesion or insufficient binder to retain the aggregate.

- **Conditions/Limitations** - Essential to exclude traffic flow from treated lanes while the emulsion cures. Dilute emulsion is used to ensure that the binder is sufficiently fluid to flow down into the voids of the existing seal, thus increasing the amount of binder retaining the aggregate. Care must be taken to ensure that sufficient surface texture will be available for skid resistance requirements after the application of the enrichment seal. Enrichments should not be applied when the pavement temperature is very high. Further details about enrichment seals can be obtained from the Enrichment Design Manual available on the Pavements Engineering web page.

#### 6.3.2 Strain Alleviating Membrane (SAM)

- **Description/Use** - The application of a modified binder (Scrap Rubber or PMB) to a prepared bituminous surface, followed by a cover aggregate (10 or 14mm), intended to minimise reflection cracking from an underlying pavement and is a final wearing surface.

- **Conditions/Limitations** - Treatment will behave similarly to a single coat sprayed seal. Rubberised binder with 18% crumb rubber. Further information is available on the Pavements Engineering web page and within the design section of Specification 509. Polymer modified binders require clean aggregates and enhanced work practices to ensure a successful outcome.

#### 6.3.3 Strain Alleviating Membrane Interlayer (SAMI)

- **Description/Use** – Is similar to a SAM but is placed as an interlayer on an existing surfacing, usually asphalt, prior to an asphalt overlay. Used to minimise reflection cracking from the underlying surfacing and is not a final wearing surface.

- **Conditions/Limitations** - This treatment will alleviate reflection cracking from underlying asphalt through the new asphalt overlay. The membrane is not intended to be the final surfacing, however placement of the asphalt overlay should wait a minimum of 24 hours. The delay is required to allow volatiles to evaporate from the SAMI binder, especially scrap rubber binders. A SAMI is not intended to provide a final surfacing, though it may be trafficked for a short time. This treatment is usually applied with 10mm sealing aggregate,
however, the use of a 14mm aggregate allows the application of a greater binder film thickness, improving the performance of the binder in minimising reflection cracking. The surface texture of a finished SAMI should be sufficient to ensure the binder is not picked up by vehicle tyres during trafficking and allow void space to ensure that binder expanding in hot weather does not bleed into the asphalt wearing course.

6.3.4 Geotextile Reinforced Seal (GRS)

- **Description/Use** – The application of a geotextile membrane and sprayed seal treatment to a badly cracked surfacing. The membrane prevents cracks reflecting through and waterproofs the pavement.

- **Conditions/Limitations** - Effective treatment for badly cracked and distressed surfacings. Where the treatment is applied to a pavement in poor condition the life of the treatment is likely to be reduced. The treatment requires the application of additional binder, typically about 1 L/m², to compensate for absorption by the Geotextile fabric. Excess absorption by the fabric may result in extra binder being drawn away from the seal coat into the fabric, resulting in stone loss. Consideration can be given to the application of a 14/7 double/double seal to protect from stone loss in this scenario.

Cutter should not be used in the bond coat applied below the geotextile as this will become trapped below the fabric leaving the membrane unstable. Special equipment is required for the application of the geotextile to ensure that it does not become folded. Alleviation of cracks is provided by the geotextile and therefore there is no need to use a modified binder as described for a SAM seal.

6.3.5 High Friction Surfacing (HFS)

- **Description/Use** - The application of an aggregate (calcined bauxite) with a high Polished Aggregate Friction Value (PAFV), held in place by a thin layer of a synthetic binder, similar to a chip seal but using alternative materials. The purpose of the treatment is to provide a high level of surface friction to vehicles during braking or cornering movements. Typical applications of binder and aggregate result in an initial surface texture of about 2mm and friction values in excess of 90 British Pendulum units.

- **Conditions/Limitations** – This treatment is expensive, of the order of $35-50/m² or more dependant upon the location and amount of work plus costs preparing the existing surface. The treatment should only be considered where other engineering or surfacing options are considered to be not satisfactory or not feasible. The binder is a thin layer and should only be applied to substrates with low surface texture, such as asphalt or microsurfacing, an even shape and should not be applied over contaminated areas, pavement markings, older asphalt and cracked areas. If applied to a textured surface extra synthetic binder will be required increasing the time to complete the work and the cost. The treatment should not be applied to relatively new surfacings. Any remedial works prior to the application of a HFS should not be covered for a period of 3 to 6 months.

The existing surface requires cleaning to remove detritus and oils. Treatment should be applied to the full width of area where vehicles require high surface friction, ensuring a vehicle has all its tyres in the HFS during
braking or cornering. The aggregate is usually 3mm in size, however nominal 1mm aggregate is used in areas where pedestrians need to cross the high friction surfacing. The aggregate is available in grey or buff colours. The treatment is applied by hand with the rate of application restricted by the time it takes the two part binder to cure and hold the aggregate in place, therefore only small areas can be applied in a single shift. The treatment should be applied in warm and dry conditions. Application during Winter is not recommended as there is an increased risk of delamination of the treatment or stone loss.

6.4 Treatment of Bleeding and Flushed Seals

6.4.1 Solvent/Gilsonite Treatment

- **Description/Use** - A volatile solvent containing a bitumen hardener is sprayed on to excess binder, usually in a wheelpath area, and a small sized aggregate is applied and rolled. The solvent initially reduces the viscosity of the existing binder, allowing it to wet the new aggregate and create some embedment, after which the hardener (Gilsonite) reacts to increase the overall binder viscosity improving aggregate retention and making the binder less susceptible to further bleeding.

- **Conditions/Limitations** - Dependant upon the amount of excess binder a 5, 7 or 10mm aggregate could be used with 7mm being the most common size used. The solvent/gilsonite treatment may be suitable where there is insufficient excess binder to hold the new aggregate in place or where the binder is relatively soft, eg. new seal. The treatment is only a remedial measure and cannot be expected to produce a resultant surface texture similar to that of normal sprayed seals. This can be achieved through the application of a reseal after a suitable period of curing of the solvent/gilsonite treatment.

6.4.2 High Pressure Water Treatment

- **Description/Use** - The removal of excess binder or road contaminants by the application of high pressure water on to the road surface. Application of the high pressure water can be delivered using hand sprays, hand held rotary washers or large truck mounted units with multiple nozzles.

- **Conditions/Limitations** - Suitable for dense graded and stone mastic asphalts and older sprayed seals with harder binders. The treatment may not be suitable for seals with soft or lively binders and is not recommended for thin initial seals such as primerseals or a seal on a prime. Where removal of excess binder is considered necessary from a newer seal undertake the work in the cooler part of the year when the binder wil be at its hardest state. Applying the treatment to thin sprayed seals may result in the waterproofing capability of the seal being compromised at the time of the remedial work or afterwards under the action of tyres.
6.5 Asphalt & Microsurfacing (Slurry) Surfacing

6.5.1 14mm Intersection Mix

- **Description/Use** - Intersections and other locations subjected to high stresses, eg. on/off ramps, approaches to traffic lights where traffic backs up and heavy haulage routes.

- **Conditions/Limitations** – Suitable for use on roads with speed zones to 90 km/hr, beyond 90 km/hr the asphalt surface needs to have a minimum texture depth of 0.8mm. May not be suitable for use on high speed roads with large traffic volumes where excessive water spray may be generated.

6.5.2 10mm Dense Graded Mix

- **Description/Use** - General purpose mix for use in many areas not subject to excessive stresses. Used in mid block situations where traffic is moving at speeds close to the speed limit. Suitable for use as a drainage layer below open graded asphalt on freeways or highways with similar surfacings.

- **Conditions/Limitations** - Can be used on roads with speed zones up to 80 km/h. Not suitable for roundabouts and should not be laid where traffic stops or is moving slowly.

6.5.3 5 & 7mm Dense Graded Mix

- **Description/Use** - Dual use paths, cycle ways, non-trafficked areas requiring asphalt surface.

- **Conditions/Limitations** - Not to be used for general vehicle traffic, may be use for shape correction but not as a wearing course. Stability and surface texture of this type of asphalt does not lend itself for use on Main Roads traffic environs.

6.5.4 Laterite Dense Graded Mix (5/7mm Red Mix)

- **Description/Use** - Dual use paths, cycle ways, non-trafficked areas requiring colour contrasting asphalt surface.

- **Conditions/Limitations** – This surfacing has a very low surface texture and the laterite aggregates are prone to becoming quite polished. The asphalt should not be used in trafficked locations.

6.5.5 10mm Granite Open Graded Mix

- **Description/Use** – Porous asphalt for use where water spray reduction, noise abatement and skid resistance are the principal selection concerns.

- **Conditions/Limitations** - Good water draining capability, delivers a quiet wearing course. Generally not robust enough as a wearing course for high stress use. The asphalt drains water through the layer and requires a
drainage layer underneath or good waterproofing of the substrate. Consideration has to be given to potential damage to the open grade during its removal. This mix has a shortened fatigue life in comparison to dense graded mixes.

6.5.6 10mm Laterite Open Graded (Red Mix)

- **Description/Use** - For use on emergency stopping lanes of freeways and controlled access highways. Should only be used where colour differentiation is required.
- **Conditions/Limitations** - Not for use on traffic lanes due to potential for the aggregate to polish.

6.5.7 7 & 10mm Stone Mastic Asphalt

- **Description/Use** - On high speed/traffic volume highways where spray and noise reduction is required.
- **Conditions/Limitations** – 7mm SMA is also suitable for inner city highways to reduce spray generated by vehicles, especially commercials. SMA must not be used without prior consultation with Pavements Engineering.

6.5.8 Coldmixed Asphalt

- **Description/Use** - Cold Mix is usually limited in its application to low volume roads or to temporary patching or repair works and for use on bridge decks in remote locations.
- **Conditions/Limitations** – Not suitable for high stress areas such as intersections.

6.5.9 7 & 10mm Microsurfacing (Slurry)

- **Description/Use** – Thin screeded treatment for correction of shape, remediation of uneven surface textures, paths and sealed shoulders.
- **Conditions/Limitations** – Microsurfacing should not be used in heavy traffic situations. In high speed environs the surface texture of the treatment may not comply with specified minimum requirements. Where used on seals for correction of minor rutting or surface irregularities the seal should be reinstated during the next sealing season. Smaller sized microsurfacings (4 or 5mm) have been used for roads carrying bicycles. Microsurfacings should not be applied to cracked surfacings or weak pavements.
7. **SELECTION OF SURFACING TREATMENTS**

The surfacing guideline is subdivided into urban and rural environments in recognition of the significant difference in functional requirements, gross traffic and commercial vehicle volumes. In addition, guidance is provided on the selection and application of treatments for repairs or remedial works.

### 7.1 Surfacing Treatments for Urban Environments

The traffic environment within the urbanised regions of Western Australia may place higher demands on surfacings, thereby requiring treatments that are more robust and capable of withstanding stress. Higher traffic volumes, greater variations in vehicle speeds and more braking and turning movements on urban roads demand specific treatments that are safe and robust. Advice on rehabilitation treatments to be carried out before the new surfacing is applied is not addressed in this document. This is an important site-specific task and requires detailed pavement investigations to be conducted prior to the application of surfacing treatments. The following table summarises suggested surfacing types for a range of different circumstances within urban environments on the Main Roads' network. If specific locations are not covered within the following table, then expert advice should be sought. The surfacing treatment options listed reflect the performance and functional criteria required for each situation and a typical sequence of surfacing treatments.

**SURFACING TREATMENTS FOR URBAN ENVIRONMENTS**

<table>
<thead>
<tr>
<th>Type of Road</th>
<th>Speed Zone</th>
<th>Specific Detail</th>
<th>Surfacing Treatment Options and Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>&gt; 90</td>
<td>Large volume of traffic and high speeds</td>
<td>Prime and seal or primerseal (Note 1) covered with 30mm of 10mm dense graded asphalt and 30mm of 10mm open graded asphalt.</td>
</tr>
</tbody>
</table>
| Highway or Main Road | > 90  | Moderate to large traffic volumes and average vehicle speed close to the speed limit | Prime and seal or primerseal (Note 1) covered with 30mm of 10mm dense graded asphalt and 30mm of 10mm open graded asphalt.  
Prime and seal or primerseal (Note 3) covered with 10mm SMA (Note 2). |
| Highway or Main Road | ≤ 110 | Low traffic volume and average speed close to limit                                 | Prime and double/double seal (Note 5)  
Primeseal (Note 1) and 10 or 14mm seal (Note 5) |
| Highway or Main Road | ≤ 80 | Slow moving and/or frequently stopping traffic, eg. intersections and approaches (Note 4) such as parts of Tonkin or Leach Hwys | Prime and seal or primerseal (Note 3) covered with 14mm Intersection Mix asphalt  
For existing asphalt SAMI seal (Note 3) and 14mm Intersection Mix asphalt |
### SURFACING TREATMENTS FOR URBAN ENVIRONS (continued)

<table>
<thead>
<tr>
<th>Type of Road</th>
<th>Speed Zone</th>
<th>Specific Detail</th>
<th>Surfacing Treatment Options and Sequence</th>
</tr>
</thead>
</table>
| Highway or Main Road | ≤ 80 | Free moving traffic close to speed limit, limited stopping | **Prime and seal or primerseal (Note 3)** covered with 10mm dense graded asphalt or 7 or 10mm SMA (Note 2)  
**For existing asphalt SAMI seal (Note 3) and asphalt option as above** |
| Highway or Main Road | ≤ 80 | High proportion of heavy vehicles moving freely | **Prime and seal or primerseal (Note 3)** covered with 14mm Intersection Mix asphalt  
**For existing asphalt SAMI seal (Note 3) and 14mm Intersection Mix asphalt** |
| Highway or Main Road | ≤ 80 | Major Intersections with very large volume of heavy trucks, eg Leach & Stock, Tydeman & Stirling | As for previous scenario except that the Intersection Mix asphalt be produced with a modified binder such as Multigrade Bitumen (spray or asphalt grade) or an elastomer type PMB, eg A10E or A15E |
| Highway or Main Road | NA | Sealed shoulders (little or no traffic) | **Prime and:**  
- Microsurfacing 7 or 10mm  
- 7 or 10mm dense graded asphalt |
| Roads Adjoining Network | Refer to scenarios for Highways/Main Roads | |
| Residential | Light traffic only | **Prime and seal or primerseal (Note 3)** covered with 10mm dense graded asphalt, or 7mm Stone Mastic Asphalt (Note 2) |
| DUP or PSP | NA | Service traffic only | **Microsurfacing 7 or 10mm**  
- 7 or 10mm dense graded asphalt  
- 7mm dense graded laterite asphalt |
| Bridge Decks | All | | **Prime and scrap rubber membrane as prescribed in Specification 503, covered with 50mm dense graded asphalt** |

**Note 1:** Regardless of the type of primerbinder used the primerseal should be trafficked for a minimum period of time before a subsequent and final seal is applied. Refer to Main Roads’ Guidelines for the Timing of Bituminous Treatments for advice.

**Note 2:** The use of Stone Mastic Asphalt is not recommended without consultation with Pavements Engineering. SMA is only practical for use within 100km of a suitable asphalt plant which as of 2003 means Perth.

**Note 3:** Caution should be exercised with the application of a cutback primerseal or SAMI under asphalt. Refer to Main Roads’ Guidelines for the Timing of Bituminous Treatments for advice.

**Note 4:** Consideration needs to be given to using intersection mix to the area beyond the intersection where traffic is queuing or moving slowly.

**Note 5:** Where vehicle generated noise may be an issue, smaller aggregate sized sprayed seals will create less tyre/road noise than large aggregate seals. Where noise is a significant issue, open graded or stone mastic asphalt may be necessary.
## 7.2 Surfacing Treatments for Rural Environments

The majority of road surfaces on the rural road network are sprayed seals. Sprayed sealing is suitable for surfacing rural roads in all but very heavily trafficked/high stress locations. The following table summarises suggested surfacing types for a range of different circumstances on new works within the Main Roads WA rural road network. If seal treatments are being considered subsequent to construction works then ignore references to primes and primerseals. If specific locations are not covered within the following table then expert advice should be sought from Pavements Engineering. The surfacing treatment options listed and their sequence reflect the performance and functional criteria required for a generic location.

### SURFACING TREATMENTS FOR RURAL ENVIRONS

<table>
<thead>
<tr>
<th>Speed Zone km/h</th>
<th>Specific Detail</th>
<th>Surfacing Treatment Options and Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 90</td>
<td>Excluding heavy duty sections, floodways or major intersections</td>
<td>• Prime and single coat seal with 10 or 14mm aggregate&lt;br&gt;• Primerseal and single coat seal with 10 or 14mm aggregate (Note 1)</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>Floodways</td>
<td>• Prime and double/double seal (16/10mm aggregate or 14/7mm) with Class 170 bitumen</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>Heavy duty sections, e.g. climbing lanes</td>
<td>• Prime and single coat seal with 14mm or 16mm aggregate, use of PMB (S35E) or a Class 320 bitumen is an option&lt;br&gt;• Prime and double/double seal (14/7mm or 16/10mm aggregate) with Class 170 bitumen</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>Major intersections</td>
<td>• Prime and single coat PMB (S35E) seal with or without a scatter coat&lt;br&gt;• Prime and double/double seal with 14/7mm aggregate&lt;br&gt;• Primerseal (Note 2) and Stone Mastic Asphalt (Note 3)&lt;br&gt;• Prime and a Cape Seal (Note 4)</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>Minor intersections</td>
<td>• Prime and single coat PMB (S35E) seal with or without a scatter coat&lt;br&gt;• Prime and double/double seal with 14/7mm aggregate</td>
</tr>
<tr>
<td></td>
<td>Adjacent to farm gates or other minor access points (final seal)</td>
<td>• 14mm Single coat seal and a 7mm scatter coat</td>
</tr>
<tr>
<td>≤90</td>
<td>Heavy duty sections, e.g. climbing lanes and major intersections</td>
<td>• Prime and single coat seal with 14mm or 16mm aggregate, use of PMB (S35E) or a Class 320 bitumen is an option&lt;br&gt;• Prime and double/double seal (14/7mm or 16/10mm aggregate) with bitumen&lt;br&gt;• Primerseal (Note 2) and Intersection Mix asphalt</td>
</tr>
<tr>
<td>≤80</td>
<td>Minor intersections</td>
<td>• Prime and single coat PMB (S35E) seal with or without a scatter coat&lt;br&gt;• Prime and double/double seal with 14/7mm aggregate&lt;br&gt;• Primerseal (Note 2) and 10mm asphalt or Intersection Mix asphalt</td>
</tr>
</tbody>
</table>
### SURFACING TREATMENTS FOR RURAL ENVIRONS  
(continued)

<table>
<thead>
<tr>
<th>Speed Zone km/h</th>
<th>Specific Detail</th>
<th>Surfacing Treatment Options and Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;80</td>
<td>Rural town streets</td>
<td>▪ Prime and single coat seal (7, 10 or 14mm aggregate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ 10mm aggregate primerseal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Prime + 10mm seal or 10mm primerseal covered with microsurfacing (Note 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Prime + 10mm seal or 10mm primerseal covered with asphalt</td>
</tr>
<tr>
<td>All</td>
<td>Sealed shoulders</td>
<td>▪ Prime and single coat seal with 7, 10 or 14mm aggregate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Primerseal and single coat seal with 10 or 14mm aggregate (Note 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Prime and double/double seal with 14/7mm aggregate</td>
</tr>
<tr>
<td>All</td>
<td>Basecourse Blistering and Fluffing</td>
<td>▪ Prime and double/double seal with 14/7mm or 16/10mm aggregate (refer to Section 7 for notes on this treatment)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Two coat emulsion primerseal and seal within one day</td>
</tr>
<tr>
<td>All</td>
<td>Bridge Decks</td>
<td>▪ Prime and scrap rubber membrane as prescribed in Specification 503</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Prime and double/double seal using 14/7mm aggregate</td>
</tr>
</tbody>
</table>

**Note 1:** Regardless of the type of primerbinder used the primerseal should be trafficked for a minimum period of time before a final seal is applied. Refer to Main Roads’ Guidelines for the Timing of Bituminous Treatments.

**Note 2:** Caution should be exercised with the application of a cutback primerseal under asphalt. Refer to Main Roads’ Guidelines for the Timing of Bituminous Treatments.

**Note 3:** Stone Mastic Asphalt must not be used without prior consultation with Pavements Engineering. SMA is only practical for use within 100km of a suitable asphalt plant which as of 2004 means Perth.

**Note 4:** The technology of a true Cape Seal has yet to be applied in WA and involves a certain amount of experimentation. This treatment **must not** be considered without the approval of the Director Design Services.

**Note 5:** Microsurfacing is suitable for low volume residential streets. It may not be suitable for high volume roads or those with a large proportion of heavy vehicles, especially where there are braking or turning movements.

#### 7.3 Surfacing Treatments for Pavement Repairs and Remedial Works

Pavement repairs, aggregate retention and shape correction treatments use a variety of surfacing treatments in addition to the surfacing treatments listed in the tables above. Generally, these treatments should be considered temporary in nature, similar to primerseals. They are still however, required to meet the criteria applied to permanent surface treatments. Some guidance on the benefits of these treatments and cautionary comments on their performance are provided within the following table.
## REMEDIAL TREATMENTS

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Benefits</th>
<th>Conditions on use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense graded asphalt.</td>
<td>If carried out in conjunction with planing (Note 1) asphalt can achieve good surface shape improvements. Difficulties with “feathering” asphalt to edges of correction area may be experienced.</td>
<td>Asphalt (&lt;10mm nominal size) is unlikely to have an average texture depth &gt;0.6mm, as recommended for roads with speed limits &gt;80 km/hr. The asphalt should be sealed before the next winter. If unable to reseal, use of regulatory signs, “Slippery when Wet”, or speed limit reduction should be considered.</td>
</tr>
<tr>
<td>Cold mix</td>
<td>Able to be manufactured locally and placed at ambient conditions. Difficulties with “feathering” the asphalt to edges of the area requiring correction may be experienced.</td>
<td>Cold mix may not meet the minimum recommended surface texture of &gt;0.6mm for roads with a speed limit of &gt;80 km/hr. Cold mix should not be sealed before the material has hardened via evaporation of volatiles in the binder. Shape correction with cold mix is usually programmed a year before resealing is scheduled, giving adequate time for volatiles to evaporate.</td>
</tr>
<tr>
<td>Micro-surfacings</td>
<td>Able to water level shape correction. Feathering of this treatment is better than either asphalt or cold mix.</td>
<td>This treatment may not have an average texture depth &gt;0.6mm, as recommended for roads with speed limits &gt;80 km/hr. Therefore, micro-surfacings should be sealed before the next winter after placement. If unable to reseal, use of regulatory signs, “Slippery when Wet”, or speed limit reduction should be considered. May be necessary to place successive layers for deep shape correction.</td>
</tr>
<tr>
<td>Solvent/Gilsonite</td>
<td>Reinstates some surface texture in flushed wheelpath areas. The result after treatment is that the binder is harder and less susceptible to bleeding again.</td>
<td>Process and limitations are described in Work Tip No. 7. Requires protection from unrestricted traffic. Binder application rates are usually low and will require amended spraying practices, eg. faster sprayer speed or smaller nozzles.</td>
</tr>
<tr>
<td>Enrichment</td>
<td>Extends the life of older seals exhibiting isolated stone loss due to binder fatigue. Can be used where there is insufficient binder to hold aggregate in place. May be applied outside “normal” sealing season. Suitable for hair type cracks (&lt;1mm) in an existing aged seal.</td>
<td>Where an existing aged seal has hair type cracks (&lt;1mm) an enrichment will reduce the rate of formation of further such cracks. An enrichment does not repair other types of cracking. Skid resistance may be reduced temporarily and enrichment is not recommended for high traffic volumes. Sufficient texture must be present to maintain adequate texture for skid resistance after enrichment. A minimum design texture of 1mm is suggested.</td>
</tr>
<tr>
<td>High Pressure Water</td>
<td>Removes excess binder from the surface of a seal or asphalt and reinstates surface texture.</td>
<td>Care should be taken when removing fresh lively binders. Waste needs to be disposed of in a manner meeting EPA requirements. Treatment not recommended for thin initial seals such as primerseals or a seal on a prime. Applying the treatment to thin sprayed seals may result in the waterproofing capability of the seal being compromised.</td>
</tr>
<tr>
<td>Dry Matting</td>
<td>Replaces aggregate lost in small areas of a seal as a result of stone loss or pick up of the seal. Reinstates aggregate but does not result in the same surface finish or texture.</td>
<td>Need to use aggregate one size smaller than that used in the previous seal. Dry aggregate requires careful placement in the void spaces in a single layer thickness. After spraying with binder a smaller sized aggregate is spread over the treatment.</td>
</tr>
</tbody>
</table>
Note 1: If the pavement is planed, the cut edge of the surfacing treatment must be waterproofed.