SPECIFICATION 501

PAVEMENTS

REVISION REGISTER			
Clause Number	**Description of Revision**	**Authorised By**	**Issue Date**
Annexure 501C	Deleted CRC test frequencies	MME	18/01/2022
Various	Changed references to Specification 201 Quality Systems to Quality Management		
Annexure 501F	Amended Table 501F1 and Table 501F3		
501.01	Amended to delete stabilisation	MME	04/10/2021
References	Amended MRWA Specifications and Test Methods		
Tables 501.05, 501.07, 501.09 and 501.11	Deleted Target Grading		
501.10	Added limitations for gravel basecourse		
501.12	HCTCRB shifted from 501.12 to Guidance Notes		
501.12	Ferricrete shifted from Guidance Notes to 501.12		
501.14	Added Crushed Recycled Concrete (CRC) Subbase		
501.26.2	Deleted reference to stabilised construction		
501.26.4	Amended Ferricrete restriction		
501.26.5	Added curing requirement		
501.26.10	Adding trimming		
501.26.11	Added rework requirements		
501.29.02 501.29.04	HCTCRB shifted to Guidance Notes Removed Cement Stabilised Basecourse Gravel		
501.30	Cement stabilisation moved to Specification 515		
501.32.03	Amended Installation of Geotextile		
Annexure 501A	Removed Cement Stabilised Pavements Removed Lime Stabilised Pavements		
Table 501A1	Added CRC and Ferricrete and Included note		
Annexure 501B	Amended Cementitious Materials Registration		
Annexure 501C	Added CRC Subbase 501.92		
Guidance Note 1	Basecourse amended		
Guidance Note 2.2	WBR specifications amended		
Guidance Note 2.7	GSR basecourse specification amended		
References	Amended title of AS 2008	MME	20/02/2020
References	Added WA 144.1		
Table 501.02	Amended CBR criterion for Gravel Subbase		
Table 501.06	Amended CBR criterion for CRB Subbase		
501.13.2	Amended title of AS 2008		
501.45.01	Added General		
501.45.03	Amended		
501.47	Amended		
Table 501A1	Added pavement layer and dry density ratios. Amended Other Basecourse Materials		
Table 501A3	Amended		
Guidance Note 2	Amended		

Guidance Note Tables	All reference numbering has been amended		
Guidance Note 2.2	Additions and Amendments		
Table 501.G05	Added		
Guidance Note 2.3	Amended GER Gravel Specifications		
Guidance Note 2.4	Added Kimberley Region Gravel Specifications		
Guidance Note 2.5	Added Pilbara Region Gravel Specifications		
Guidance Note 2.6	Added Mid West Gascoyne Region Gravel Specifications		
Guidance Note 2.7	Added Great Southern Region Gravel Specification		
Guidance Note 7	Added 7.3 Final Trim		
Guidance Note 15	Amended to clarify when testing is required		
Guidance Note 17	Added Pavement Material Selection		
Table 501.15	Amended Resilient Modulus criterion for Ferricrete Basecourse		
Table 501.15	Amended Resilient Modulus criterion for Ferricrete Basecourse		
Guidance Note 17	Added advice regarding material selection		
501.26.9	Added Final Trim		

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SPECIFICATION 501

PAVEMENTS

GENERAL

501.01 SCOPE

1. The work under this specification consists of the supply of materials and construction of all types of unbound granular and modified granular Pavement Layers.

501.02 REFERENCES

1. Australian Standards, MAIN ROADS Western Australia Standards and MAIN ROADS Western Australia Test Methods are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are shown below:

Australian Standards

AS 1141	Methods for Sampling and Testing Aggregates
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1672	Limes and Limestones for Building
AS 2008	Bitumen for Pavements
AS 2350	Methods of Testing Portland and Blended Cements
AS 3705	Geotextiles - Identification, Marking and General Data
AS 3706	Geotextiles - Methods of Test
AS 3972	Portland and Blended Cement

Austroads

AG:PT04G	Geotextiles and Geogrids

Austroads Test Methods

AG:PT/T053	Determination of Permanent Deformation and Resilient Modulus Characteristics of Unbound Granular Materials Under Drained Conditions

MAIN ROADS Publications

Engineering Road Note 5	Interim Guide to Prediction of Pavement Moisture for Strength Assessment of Granular Basecourse and Sub-Base Materials

Engineering Road Note 8	Statistically Based Quality Control for Density in Road Construction
Engineering Road Note 9	Procedure for the Design of Flexible Pavements
6706-02-133	Water to be used in Pavement Construction

MAIN ROADS Test Methods

A complete list of Main Roads Test Methods is available on Main Roads' website at : https://www.mainroads.wa.gov.au/technical-commercial/technical-library/?q=&take=20&filter=&type=&node=Materials%20Engineering,Test%20Methods&page=1&sectionFilter=731

MAIN ROADS Specifications

A number of Specifications form part of the Contract and are referenced in this specification. The Contractor must refer to the Contract for details of such Specifications.

Australian Technical Infrastructure Committee (ATIC) Specification

SP43 CEMENTITIOUS MATERIALS FOR CONCRETE

501.03 DEFINITIONS

1. The portion of the road placed above the design Subgrade level including shoulders. ***Pavement***

2. A portion of the pavement placed and compacted as an entity. ***Pavement Layer***

3. One or more layers of material usually constituting the uppermost structural element of a pavement on which the surfacing may be placed. ***Basecourse***

4. The material laid on the Subgrade and below the Basecourse either for the purpose of making up the additional pavement thickness required, to prevent intrusion of the Subgrade into the base, or to provide a working platform. ***Sub-Base***

5. The trimmed or prepared portion of the formation on which the pavement is constructed. The Subgrade may comprise in situ or imported materials. ***Subgrade***

501.04 NOT USED

501.05 SUSTAINABILITY CONSIDERATIONS

1. Materials for road pavements shall be managed under the sustainability hierarchy of REDUCE, REUSE and RECYCLE.

2. Unless defined otherwise, the materials described in this specification shall be sourced from pits or quarries of natural materials, and shall be blended, crushed or processed as applicable to produce a homogenous material. These materials are a finite resource and waste shall be reduced to a minimum. ***Reduce***

3. Where practical, redundant pavement materials should be recovered and reused, or otherwise recycled to the highest level use practical. Reused materials shall be processed to produce a homogenous material and shall meet the specified applicable requirements for sub-base or basecourse. ***Reuse***

4. This specification also includes manufactured materials sourced from recycled Construction & Demolition Waste. Recycled materials for pavement construction shall be blended, crushed or processed as applicable to produce a homogenous material by a recycling premises licensed by DWER. Recycled materials shall only be included in materials which are designated as recycled. ***Recycle***

PRODUCTS AND MATERIALS

501.06 WATER

1. Water used in any pavement construction or pavement material manufacture process shall comply with the requirements of Main Roads Western Australia publication 6706-02-133 “Water to be used in Pavement Construction” and shall be clean and substantially free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances. Water sources classified by the relevant Water Authority as potable water shall be exempt from this requirement. ***Water***

501.07 GRAVEL SUBBASE SUPPLIED BY THE CONTRACTOR

1. Gravel Subbase material shall consist of durable pebble in soil mortar. The material shall be free from cobbles greater than 75.0 mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials. ***General***

2. The Subbase material shall meet the grading requirements shown in Table 501.01 when tested in accordance with Test Method WA 115.1. The grading of material passing the 75.0 mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size. ***Particle Size Distribution***

TABLE 501.01: PARTICLE SIZE DISTRIBUTION (GRAVEL SUBBASE)

AS Sieve Size (mm)	% Passing by mass Minimum and Maximum Limits
75.0	100
37.5	80 - 100
19.0	50 - 100
9.5	36 - 81
4.75	25 - 66
2.36	18 - 53
1.18	13 - 43
0.425	8 - 32
0.075	3 - 19

TABLE 501.02: OTHER ACCEPTANCE LIMITS (GRAVEL SUBBASE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	10.0% Maximum	WA 122.1
Linear Shrinkage	4.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 94% of MDD and 100% of OMC	30 - 60% Minimum See Guidance Notes and delete this Note	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

501.08 CRUSHED LIMESTONE SUBBASE SUPPLIED BY THE CONTRACTOR

1. The source material for the supply of crushed limestone shall be free of organic material, clay lumps, cap rock or any other foreign material deleterious to its performance in the pavement. ***General***

2. The material shall comply with the grading limits shown in Table 501.03 when tested in accordance with Test Method WA 115.1. ***Particle Size Distribution***

TABLE 501.03: PARTICLE SIZE DISTRIBUTION (CRUSHED LIMESTONE SUBBASE)

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
75	100
19	55 – 85
2.36	35 – 65

3. The material shall also comply with the limits shown in Table 501.04. ***Other Acceptance Limits***

TABLE 501.04: OTHER ACCEPTANCE LIMITS (CRUSHED LIMESTONE SUB-BASE)

Test	Limits	Test Method
Los Angeles Abrasion Value of Crushed Limestone	20% Minimum 60% Maximum	WA 220.2
Calcium Carbonate Content	60% Minimum	WA 915.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 94% of MDD and 100% of OMC	50% Minimum	WA 141.1

501.09 CRUSHED ROCK BASE SUBBASE SUPPLIED BY THE CONTRACTOR

1. All crushed rock base Subbase shall consist of a uniform blended mixture of coarse and fine aggregate. The mixture shall be free from vegetable matter, lumps of clay, overburden or any other deleterious matter. ***General***

2. The Particle Size Distribution of the material when tested in accordance with Test Method WA 115.1 shall comply with the requirements shown in Table 501.05. ***Particle Size Distribution***

3. The crushed rock base subbase shall also meet the other limits as shown in Table 501.06. The Secondary Mineral Content in Basic Igneous Rock test is only applicable to basic igneous rock. The Accelerated Soundness Index test is only applicable to basic igneous rock. ***Other Acceptance Limits***

TABLE 501.05: PARTICLE SIZE DISTRIBUTION (CRUSHED ROCK BASE SUBBASE)

AS 1152 Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
26.5	100
19.0	95 - 100
9.5	60 - 85
4.75	40 - 70
2.36	30 - 55
1.18	20 - 42
0.600	13 - 32
0.425	11 - 28
0.300	8 - 25
0.150	5 - 20
0.075	5 - 15

TABLE 501.06: OTHER ACCEPTANCE LIMITS (CRUSHED ROCK BASE SUBBASE)

Test	Limits	Test Method
Plasticity Index	5.0% Maximum	WA122.1
Linear Shrinkage	2.0% Maximum	WA123.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 96% of MDD and 100% of OMC	70% Minimum	WA141.1
Secondary Mineral Content in Basic Igneous Rock	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

501.10 GRAVEL BASECOURSE SUPPLIED BY THE CONTRACTOR

General

1. Gravel Basecourse material shall consist of durable pebble in soil mortar. The material shall be free from particles having any dimension greater than 50 mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials.

Limitations

2. Gravel Basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area.

3. When the stockpiled material contains oversized material, the Contractor shall screen the stockpiles to ensure that the pavement material does not contain more than 20% by mass of material retained on a 37.5 mm sieve. ***Oversized Material***

4. The screen aperture shall be selected so that only the minimum quantity of material is removed from the existing stockpile to satisfy this requirement. ***Screen Aperture***

5. Basecourse material having any dimension greater than 50 mm shall be deemed oversize and shall not be delivered to the pavement construction area.

(NOTE: Check need for alternative paragraphs 1 to 4, and then delete this note – refer Guidance Note 3)

6. The Particle Size Distribution shall be determined in accordance with Test Method WA 115.1. The particle size distribution of the portion passing a 37.5 mm AS sieve shall conform to the grading limits shown in Table 501.07. The grading of material passing the 37.5 mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size. ***Particle Size Distribution***

7. The material shall also comply with the limits shown in Table 501.08. The Secondary Mineral Content in Basic Igneous Rock test is only applicable to basic igneous rock. The Accelerated Soundness Index test is only applicable to basic igneous rock. ***Other Acceptance Limits***

TABLE 501.07: PARTICLE SIZE DISTRIBUTION (GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
37.5	100
19.0	72 – 100
9.5	50 - 78
4.75	36 - 58
2.36	25 - 44
1.18	18 - 35
0.600	13 – 28
0.425	11 - 25
0.300	9 – 22
0.150	6 – 17
0.075	4 - 13
0.0135	2 - 9

TABLE 501.08: OTHER ACCEPTANCE LIMITS (GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	25.0% Maximum	WA 120.2
Linear Shrinkage	2.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rock	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29
Resilient Modulus (Additional requirement if specified in Pavement Design) at 99% of MDD and 60% of OMC	See Guidance Notes and delete this note	AG:PT/T053 & WA 142.2

501.11 CRUSHED ROCK BASE BASECOURSE SUPPLIED BY THE CONTRACTOR

1. All crushed rock base (CRB) shall consist of a uniformly blended mixture of coarse and fine aggregate. The mixture of fine and coarse aggregate forming the rock base shall be free from vegetable matter, lumps of clay, overburden, or any other deleterious matter. ***General***

2. Coarse aggregate (retained 4.75 mm sieve) shall consist of clean, hard, durable, angular fragments of rock produced by crushing sound unweathered rock and shall not include materials which break up when alternately wetted and dried. ***Coarse Aggregate***

3. Fine aggregate (passing 4.75 mm sieve) shall consist of crushed rock fragments or a mixture of crushed rock fragments with natural sand or clayey sand. Crushed rock fine aggregate from each source shall, except as to size, comply with all the provisions specified for coarse aggregate. ***Fine Aggregate***

4. The Particle Size Distribution of the material when tested in accordance with Test Method WA 115.1 shall comply with the requirements shown in Table 501.09. The grading of material passing the 26.5 mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size. ***Particle Size Distribution***

TABLE 501.09: PARTICLE SIZE DISTRIBUTION (CRUSHED ROCK BASE BASECOURSE)

AS 1152 Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits	
	General CRB	CRB for HCTCRB Manufacture
26.5	100	100
19.0	95 – 100	99 – 100
13.2	70 – 90	74 – 90
9.5	60 – 80	64 – 80
4.75	40 – 60	45 – 60
2.36	30 – 45	33 – 45
1.18	20 – 35	23 – 35
0.600	13 – 27	16 – 27
0.425	11 – 23	14 – 23
0.300	8 – 20	11 – 20
0.150	5 – 14	8 – 14
0.075	5 – 11	7 - 11

Dust Ratio

5. The Dust Ratio, defined as the ratio of the percentage passing by mass the 0.075 mm sieve to the percentage passing by mass the 0.425 mm sieve, shall be within the range 0.35 to 0.60.

Other Acceptance Limits

6. The crushed rock base shall also meet the other limits as shown in Table 501.10. The Secondary Mineral Content in Basic Igneous Rock test is only applicable to basic igneous rock. The Accelerated Soundness Index test is only applicable to basic igneous rock.

TABLE 501.10: OTHER ACCEPTANCE LIMITS (CRUSHED ROCK BASE BASECOURSE)

Test	Limits	Test Method
Liquid Limit (Cone Penetrometer)	25.0% Maximum	WA120.2
Linear Shrinkage	2.0% Maximum 0.4% Minimum	WA123.1
Flakiness Index	30% Maximum	WA 216.1
Los Angeles Abrasion Value	35% Maximum	WA 220.1
Maximum Dry Compressive Strength	1.7 MPa Minimum	WA 140.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 99% of MDD and 100% of OMC	100% Minimum	WA141.1
Wet/Dry Strength Variation	35% Maximum	AS1141.22
Secondary Mineral Content in Basic Igneous rock	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29
Resilient Modulus (Additional requirement if specified in Pavement Design) at 99% of MDD and 60% of OMC	See Guidance Notes and delete this note	AG:PT/T053 & WA 142.2

8. Crushed rock base shall be thoroughly mixed with water using a pugmill to produce a homogeneous product suitable for placement into final position. ***Mixing***

9. Crushed rock base shall be pre-wet to greater than 95% of the Optimum Moisture Content as determined by Test Method WA 133.1. ***Pre-wetting***

501.12 FERRICRETE BASECOURSE SUPPLIED BY THE CONTRACTOR

1. Ferricrete Basecourse shall predominantly consist of crushed indurated ferricrete and may include natural fragmented ferricrete and lateritic gravel. For blended materials the proportion of crushed material shall not be less than 30%. The material shall be generally free from organic matter and other deleterious materials. ***General***

Particle Size Distribution

2. The Particle Size Distribution of the material when tested in accordance with Test Method WA 115.1 shall comply with the requirements shown in Table 501.11 PARTICLE SIZE DISTRIBUTION (FERRICRETE BASECOURSE). The grading of material passing the 37.5 mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size.

TABLE 501.11: PARTICLE SIZE DISTRIBUTION (FERRICRETE BASECOURSE)

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
37.5	100
19.0	71 – 100
9.5	50 – 81
4.75	36 – 66
2.36	25 – 53
1.18	18 – 43
0.425	11 – 32
0.075	4 – 19
0.0135	2 – 9

Dust Ratio

3. The Dust Ratio, defined as the ratio of the percentage passing by mass the 0.075 mm sieve to the percentage passing by mass the 0.425 mm sieve, shall fall within the range 0.3 to 0.7.

Other Acceptance Limits

4. The material shall also conform to the following limits shown in Table 501.12.

TABLE 501.12: OTHER ACCEPTANCE LIMITS (FERRICRETE BASECOURSE)

Test	Limits	Test Method
Liquid limit	25.0% Maximum	WA 120.2
Linear Shrinkage	2.0% Maximum *	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum **	WA 140.1
Maximum Dry Density	2.0 t/m^3 Minimum	WA 133.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Flakiness Index	20% Maximum	WA 216.1
Los Angeles Abrasion	60% Maximum	WA 220.1
Resilient Modulus (Additional requirement for asphalt surfacing) at 98% of MDD and 70% of OMC	See Guidance Notes and delete this note	AG:PT/T053 & WA 142.2

* For design traffic < 1.0 x 10^7 ESA, a maximum Linear Shrinkage of 3.0% is acceptable
** For design traffic < 1.0 x 10^7 ESA, a minimum MDCS value of 1.7 MPa is acceptable

501.13 BITUMEN STABILISED LIMESTONE BASECOURSE SUPPLIED BY THE CONTRACTOR

1. Bitumen stabilised limestone (BSL) shall be produced by the addition of 2.0% residual bitumen by dry mass of crushed limestone material. The limestone shall be free from sand, roots and other foreign material. ***General***

2. The bitumen emulsion used to stabilise (modify) the crushed limestone shall comply with the requirements of AS 1160, "Bitumen Emulsion for Construction and Maintenance of Pavements" for Grade ASS/170-60 emulsion. The emulsifier used in the manufacture of the emulsion shall be Vinsol resin. The bitumen used in the manufacture of the emulsion shall be Class 170 bitumen conforming to AS 2008, Bitumen for Pavements. Tenderers shall nominate the source of supply of bitumen emulsion with their tender. The Contractor shall make arrangements for the Superintendent to sample the emulsion or any of its components at any time during normal working hours. These arrangements shall include a means of identifying lots of emulsion or the component material, which will be used in the Works. ***Bitumen Emulsion***

3. All water added during the mixing process and field moisture requirements during construction, shall contain a wetting agent such as "Teepol", "Comprox", or similar, which shall be added at a rate of 1 litre of wetting agent per 4000 litres of water used. ***Wetting Agent***

4. All stabilised limestone shall be stockpiled for at least three days before delivery to site. The mixture shall have a moisture content of at least 95% ***Moisture Content***

of the Optimum Moisture Content as determined by Test Method WA 133.1. The Moisture Content shall be determined in accordance with Test Method WA 110.1 from samples taken from trucks prior to delivery.

5. The mixing process shall produce a homogeneous mixture of limestone, bitumen and water in which the bitumen is uniformly distributed in the form of a thin film covering the particles of the crushed limestone. Mixing shall be carried out as either a batch or continuous process in a suitable plant. This plant shall include measuring equipment which will determine the mass of bitumen emulsion added to a known mass of crushed limestone at all stages of the mixing process. ***Mixing Process***

6. **Prior to the use of the plant proposed to be used for the modification process, the Contractor shall certify to the Superintendent that the plant is capable of determining the amount of bitumen emulsion added to the Basecourse to within -0.0% to +0.2% of the dry mass of the limestone.** ***HOLD POINT***

7. **Prior to modification of the Basecourse, the Contractor shall give the Superintendent at least three (3) working days' notice of such modification.** ***HOLD POINT***

8. The Particle Size Distribution of the BSL after mixing and delivery shall be determined in accordance with Test Method WA 730.1 and shall comply with the details shown in Table 501.13. ***Particle Size Distribution***

TABLE 501.13: PARTICLE SIZE DISTRIBUTION (BSL)

As Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
26.5	100
19.0	90 – 100
4.75	60 – 90
1.18	35 - 75

9. The Bitumen Stabilised Limestone shall also meet the other acceptance limits as shown in Table 501.14. ***Other Acceptance Limits***

TABLE 501.14: OTHER ACCEPTANCE LIMITS (BSL)

Test	Limits	Test Method
Los Angeles Abrasion Value of Crushed Limestone	20.0% Minimum 60% Maximum	WA 220.2
Calcium Carbonate Content	60% Minimum	WA 915.1
Dispersion of Bitumen in Soil #	Class 1	WA 717.1
Bitumen Content – Centrifuge Method	2.0% Minimum 2.2% Maximum	WA 730.1
Resilient Modulus (Additional requirement if specified in Pavement Design) at 98% of MDD and 70% of OMC	See Guidance Notes and delete this Note	AG:PT/T053 & WA 142.2

Compliance for bitumen dispersion of any lot shall be based on the results of the assessment of 3 samples randomly selected from the lot being judged and tested in accordance with Test Method WA 717.1. All results must have a dispersion of Class 1; however, the Superintendent may accept the material if one of the three samples has a dispersion of Class 2.

501.14 CRUSHED RECYCLED CONCRETE SUBBASE

501.14.01 GENERAL

Crushed recycled concrete may be used as subbase material under full depth asphalt pavements, subject to the environmental and other limitations detailed in Annexure 501C.

501.15 – 501.25 NOT USED

CONSTRUCTION

501.26 GENERAL

1. Pavement construction includes the supply, placing, compacting and finishing of pavement materials in accordance with the Specifications and Drawings to the prepared Subgrade surface.

2. Where a drainage layer has been constructed on the prepared Subgrade surface, the drainage layer shall be the foundation for the subsequent Pavement Layer(s). ***Drainage Layers***

3. **Prior to the construction of any pavement layer, the Contractor shall certify to the Superintendent that the underlying layer has been constructed as specified.** ***HOLD POINT***

4. Natural gravels, including cement stabilised natural gravels, shall not be used as Basecourse material for freeway pavements or future freeway pavements in the metropolitan area. Ferricrete may only be used as basecourse material for freeway pavements or future freeway pavements if it is proven up to meet all mechanistic design requirements and approved by the Principal. ***Gravel & Ferricrete Restrictions***

5. All gravel Basecourse or Sub-Base materials shall be mixed to a uniform moisture content in the range of 85% to 115% of Optimum Moisture Content and left to “cure” for at least 24 hours prior to compaction commencing. Compaction shall be carried out within 72 hours of gravel curing commencing. ***Curing***

6. Pavers, including those that utilise transverse augers, shall not be used for pavement construction. ***Pavers***

7. Transverse joints shall be offset from one layer to the next by not less than 5 metres. ***Transverse Joints***

8. Longitudinal joints shall be located within 300 mm of the planned position of traffic lane lines or within 300 mm of the centre of a traffic lane. ***Longitudinal Joints***

9. Final trim must be completed while the basecourse layer is still “green”, prior to dry back. Final trim is limited to removing no more than 20 mm of material at any point. If more than 20 mm is to be removed the lot must be reworked. ***Final Trim***

10. Trimmings may be used in the construction of another Lot, provided the trimmings are uniformly mixed with any other material used to construct the Lot. If more than approximately 5% of the material utilised to construct the Lot comprises trimmings then the particle size distribution and linear shrinkage of the combined material must be retested. ***Trimmings***

11. In the case that the basecourse Lot is reworked pursuant to clause 501.26.9 or due to failing to meet any acceptance criteria, reworking shall comprise mixing to a minimum depth of 100 mm and testing. ***Rework***

501.27 DRYBACK REQUIREMENTS

1. Pavement construction shall not commence until the layer 150 mm below the Subgrade has dried back to the requirements specified in Clause 501.43. ***Subgrade Dryback***

2. Basecourse construction shall not commence until the Sub-Base has dried back to the requirements specified in Clause 501.43. ***Sub-Base Dryback***

3. No binder shall be applied to a Basecourse lot until it has dried to the requirements specified in Clause 501.43. ***Basecourse Dryback***

501.28 SPREADING

1. Each Pavement Layer worked shall be generally parallel to the finished pavement surface and shall extend the full width of the layer. ***General***

2. Sub-Base shall be worked in compacted layers not greater than 250 mm nor less than 100 mm. Where less than 100 mm is required to be worked the underlying Sub-Base shall be scarified to such a depth that the resulting compacted thickness of the layer to be worked is not less than 100 mm. ***Sub-Base Layer***

3. Basecourse shall be worked in compacted layers not more than 250 mm nor less than 100 mm compacted thickness. Except that HCTCRB Basecourse shall be worked in compacted layers not less than 150 mm compacted thickness. ***Basecourse Layer***

4. For in situ rehabilitation works the Superintendent may give approval for the Basecourse to be worked in a compacted layer of up to 300 mm compacted thickness. This approval shall not be unreasonably withheld, but can be withdrawn at any time if the Superintendent is not satisfied that all the requirements of the contract are being met. ***Rehabilitation Works***

501.29 COMPACTION

501.29.01 GENERAL

1. Pavement material shall be spread, mixed and compacted to achieve uniformity free from any evidence of segregation.

2. Compaction shall be carried out at a Construction Moisture Content, at any point in the lot within the range of 90% - 110% of the Optimum Moisture Content and with a uniform compactive effort applied longitudinally and transversely to the road alignment to achieve the density as shown in Annexure 501A as well as the width, shape, level and surface finish as specified in Clauses 501.44 to 501.47. ***Construction Moisture Content***

501.29.02 BITUMEN STABILISED LIMESTONE (BSL)

1. During the construction process bitumen stabilised limestone (BSL) shall not be ripped up and reworked more than once. If the BSL has dried back to less than 80% of OMC it shall not we reworked. BSL trimmed from one lot shall not be incorporated into another lot. ***Trimming, rework***

501.30 IN SITU STABILISATION

1. Refer to Specification 515 IN SITU STABILISATION OF PAVEMENT MATERIALS.

501.31 BLEND AREAS

Cut Edge

1. In areas denoted as “blend areas” or “match existing pavement” on the drawings, the cut edge of the existing bituminous surfacing and the wall of the excavation shall be in accordance with the requirements stated in Specification 302 EARTHWORKS.

2. The work shall comprise removal of the existing pavement to a sufficient depth to place the new pavement to the required levels, shaping and compaction.

3. Pavement shall be supplied, placed and compacted in accordance with this Specification.

4. Within the blend areas the level of the Subgrade or Pavement Layer shall be in accordance with the detail shown on the Drawings.

5. The appropriate bituminous surfacing treatment shall then be applied in accordance with Specification 503 BITUMINOUS SURFACING and, where applicable, with Specification 504 ASPHALT SURFACING or Specification 510 FULL DEPTH ASPHALT PAVEMENT, to provide a flush join and smooth transition between new and old construction, including any required matching of concrete kerbing to line and level.

501.32 DRAINAGE LAYER

501.32.01 GENERAL

1. The drainage layer shall consist of a Geotextile lining and a sand material of the material type and thickness as shown in Annexure 501A. The drainage layer shall be constructed immediately below the Pavement to the details shown in the drawings and connected to a positive drainage system.

501.32.02 GEOTEXTILE

1. The Geotextile shall be a non-woven fabric consisting of long chain synthetic polymer fibres composed of at least 85% by mass of polyesters, polyolefins or polyamides. The fibres shall be formed into a fabric by needle punching, heat or chemical bonding processes such that they are capable of retaining their relative position in the Geotextile.

2. In addition, the fibres shall be stabilised against ultra-violet (UV) radiation and shall have low water absorbency.

3. The Geotextile shall be free of any flaws or defects that may adversely affect the mechanical or physical properties of the fabric.

Covering

4. Each roll of Geotextile shall be provided with a suitable covering to protect the fabric against moisture and ultra-violet radiation. Each roll shall be marked in conformance with AS 3705.

5. Rolls shall be stored on site under a waterproof cover and shall be supported off the ground. The Contractor shall take appropriate measures to protect the Geotextile from damage. ***Storage***

6. The Geotextile shall comply with the requirements shown in Table 501A6 and Table 501A7 of Annexure 501A. ***Properties***

7. All properties represent minimum roll values, that is, the test result from any sampled roll shall exceed the minimum value in Table 501A6.

501.32.03 INSTALLATION OF GEOTEXTILE

1. The Contractor's process of installation of the Geotextile shall ensure that fabric is not damaged.

2. The initial lift thickness of fill materials placed directly over the Geotextile shall be a minimum uncompacted thickness of 300 mm. Unless otherwise approved in writing by the Superintendent, do not use vibratory and heavy compaction plant on the initial layers of fill materials. ***Initial Lift***

3. Unless otherwise shown on the Drawings, the minimum overlap requirement shall be 500 mm. Successive sheets of Geotextile shall be overlapped a minimum of 500 mm with the upslope section overlying the down slope. ***Overlap***

4. The period of time between laying out and cover of the Geotextile shall not exceed 14 days. ***Timing***

5. Damaged areas of Geotextile may be repaired by overlaying the damaged section with a patch. The patch shall extend a minimum of 1 metre beyond the area of damage. ***Repairs***

6. The Contractor shall certify that the Geotextiles delivered to site meet the Specification requirements. Sampling, conditioning and statistical analysis of results shall be carried out in accordance with AS 3706.1. Sampling frequency shall be in accordance with Appendix A of the Standard. If directed otherwise, duplicate samples shall be provided to the Superintendent. ***Sampling and Testing***

501.32.04 DRAINAGE LAYER SAND

1. The Particle Size Distribution of the drainage layer sand shall comply with the requirements shown in Table 501A8 of Annexure 501A when tested in accordance with Test Method WA 115.1. ***Particle Size Distribution***

2. The Linear Shrinkage of the drainage layer sand shall not exceed 1.0% when tested in accordance with Test Method WA 123.1. ***Linear Shrinkage***

3. Construction of the drainage layer shall be as specified for Sub-Base. ***Construction***

501.33 – 501.40 NOT USED

ACCEPTANCE

501.41 GENERAL

1. Each Pavement Layer shall be constructed to the dimensions and details shown on the drawings and shall be constructed in accordance with this Specification to satisfy the criteria shown in Annexure 501A.

2. Where a pavement material has been supplied by the Contractor, the Contractor must undertake required testing of that material sampled from the stockpiles, in accordance with Specification 201 QUALITY MANAGEMENT, to demonstrate that the material complies in all respects with the specified requirements. ***Stockpile Material***

3. **Prior to the construction of any Pavement Layer, the Contractor shall certify to the Superintendent that the pavement material supplied by the Contractor complies in all respects with the specified requirements.** ***HOLD POINT***

4. Where a pavement material appears to degrade during the construction process, the Contractor must undertake required testing of that material sampled from the pavement, after compaction is completed, to demonstrate that the pavement material particle size distribution and linear shrinkage complies with the specified requirements. ***Pavement Material***

5. **Prior to the application of Bituminous Surfacing, the Contractor shall certify to the Superintendent that the pavement material supplied by the Contractor complies with the specified linear shrinkage and particle size distribution after compaction into the pavement.** ***HOLD POINT***

501.42 COMPACTION

1. Each Pavement Layer shall be compacted to the Characteristic Dry Density Ratio shown in Annexure 501A or greater. ***General***

2. The Characteristic Dry Density Ratio shall be determined in accordance with Specification 201 QUALITY MANAGEMENT ANNEXURE 201A 1.2.1. ***Characteristic Dry Density Ratio***

3. Where the pavement material contains more than 20% by mass of material retained on a 37.5 mm sieve, the Maximum Dry Density shall be determined on that portion of the material that passes a 37.5 mm sieve. ***Oversize Material***

501.43 DRYBACK

1. Each Pavement Layer and the layer 150mm below the Subgrade shall be dried back such that the Dryback Characteristic Moisture Content (DMc) is equal to or less than the proportion of the Optimum Moisture Content as shown in Annexure 501A as determined by Test Method WA 133.1 or WA 133.2 as appropriate. ***General***

2. The Dryback Characteristic Moisture Content shall be determined in accordance with Specification 201 QUALITY MANAGEMENT ANNEXURE 201A 1.3. ***Dryback Characteristic Moisture Content***

3. Where the pavement material or the material in the layer 150 mm below the Subgrade contains more than 20% by mass of material retained on a 37.5 mm sieve, the Optimum Moisture Content and the Maximum Dry Density shall be determined on that portion of the material that passes a 37.5 mm sieve. ***Oversize Material***

501.44 LAYER WIDTH

1. The outer top edge of any layer of the pavement shall be no closer to the road centreline and no more than 100 mm further away from the road centreline than the positions shown in the drawings.

501.45 SURFACE SHAPE

501.45.01 GENERAL

1. Surface shape of Sub-Base and Basecourse must be tested in accordance with Test Method WA 313.2.

501.45.02 SUB-BASE

1. The shape of the Sub-Base in granular Pavement shall be judged to be acceptable when the maximum deviation from a 3 metre straight edge placed in any position on the surface does not exceed 10 mm. ***Max Deviation 10mm***

2. The shape of the Sub-Base under Full Depth Asphalt shall be judged to be acceptable when the maximum deviation from a 3 metre straight edge placed in any position on the surface does not exceed 15 mm. ***Max Deviation 15mm***

3. Additionally, for pavement widening work, the crossfall at any position on the new surface measured at right angles to the centreline shall be within 0.5% of the existing crossfall on the outer 2 metres of the adjacent traffic lane at that location. ***Widening***

501.45.03 BASECOURSE

1. The shape of the Basecourse is acceptable when the maximum deviation from a 3 metre straight edge placed in any position on the surface does not exceed 6 mm. ***Max Deviation 6mm***

2. Additionally, for widening work, the crossfall measured at any position on the new surface at right angles to the centreline shall be within 0.5% of the existing crossfall or of the crossfall on the outer 2 metres of the adjacent traffic lane at that location. ***Widening***

501.46 SURFACE LEVELS

501.46.01 SUB-BASE

1. The level of the completed Sub-Base surface shall be deemed to be conforming when the level measured at any point on the surface is within +5 mm, -25 mm of the Sub-Base level at that point as determined from the drawings. ***Construction Sections***

2. For pavement widening sections, the level of the completed Sub-Base surface shall be deemed to be conforming when the levels of the Sub-Base at its junction with the existing pavement are within +5 mm, -25 mm of the levels as determined from the Basecourse depth making due allowances for the effect of the existing crossfall of the pavement. ***Widening Sections***

501.46.02 B**A**SECOURSE

1 The level of the completed Basecourse surface shall be judged to be acceptable when the level measured at any point on the surface is within the following tolerances for the Basecourse level for that point as determined from the drawings: ***Construction Sections***

   a) where final surface is asphalt -5 mm, +10 mm

   b) elsewhere -5 mm, +20 mm

2 For pavement widening sections the level of the completed Basecourse surface shall be judged to be acceptable when the levels of the Basecourse at its junction with the existing seal are within -0 mm, +5 mm of the top cut edge level of the existing seal. ***Widening Sections***

501.47 SURFACE FINISH

1. Completed Pavement Layers shall be in a homogeneous, uniformly bonded condition with no evidence of layering, cracking, disintegration or surface tearing. ***Pavement***

2. The finished surface should appear as a stone mosaic interlocked with fine material and shall be dense, even textured and tightly bonded. Slurrying of fines to the surface shall be avoided.

3. Basecourse must retain the above characteristics after rotary brooming and be suitable to receive bituminous surfacing.

4. Prior to the application of a bituminous surfacing the surface of the Basecourse shall be uniformly dry.

501.48 – 501.50 NOT USED

MAINTENANCE

501.51 MAINTENANCE OF COMPACTED LAYERS

1. The surface of any compacted Pavement Layer or prepared Subgrade shall be maintained in such a way as to minimise dust, prevent ravelling, erosion, deformation or any other damage to the layer resulting from environment conditions, traffic or construction activities. The layer shall be kept free from contamination until any subsequent pavement work under the Contract is commenced. ***General***

2. Completed Subgrade and Pavement Layers shall be maintained to the specified standards of surface shape, level, dryback and compaction up to the time of construction of the subsequent Pavement Layer or application of the bituminous surfacing. ***Shape, Level, Dryback, Compaction***

3. Watering shall be continued as necessary to prevent, dusting or loosening of the surface. ***Watering***

501.52 – 501.80 NOT USED

AS BUILT AND HANDOVER REQUIREMENTS

501.81 – 501.90 NOT USED

CONTRACT SPECIFIC REQUIREMENTS

501.91 – 501.99 NOT USED

ANNEXURE 501 A

CONSTRUCTION REQUIREMENTS

1. COMPACTION OF PAVEMENT LAYERS

1.1 Pavement Layers shall be compacted to the densities shown in Table 501A1. Compaction requirements for embankments and Subgrades can be found in Specification 302 EARTHWORKS Annexure 302B

TABLE 501A1: COMPACTION VALUES

Pavement Layer	Minimum Characteristic Dry Density Ratio % (Rc)
Drainage Layer	94%
All Principal Shared Path Pavement	94%
All Subbase (except CRB)	94% - 96% **(Select appropriate value then delete this note. Refer to Guidance Notes)**
Crushed Rock Base Subbase	96%
Crushed Recycled Concrete Subbase	96%
Crushed Recycled Concrete Basecourse	99%
Crushed Ferricrete Basecourse	99%
Bitumen Stabilised Limestone Basecourse	98%
Crushed Rock Base Basecourse	99%
Hydrated Cement Treated Crushed Rock Base Basecourse	99%
Other Basecourse Materials (final surfacing – sprayed seal)	96% - 98%
Other Basecourse Materials (final surfacing – asphalt)	98% **(Select appropriate value then delete this note. Refer to Guidance Notes)**

(Consider adjusting CBR and RLT density test conditions to match selected compaction values then delete this note)

2. DRYBACK OF PAVEMENT LAYERS

2.1 Pavement Layers shall be dried back to the requirements shown in Table 501A2 or Table 501A3 prior to the application of bituminous binder or the construction of the overlying layer.

TABLE 501A2: DRYBACK ON SUBGRADE OR SUBBASE LAYERS

Subgrade or Pavement Layers	Maximum Dryback Characteristic Moisture Content (DMc) as a proportion of Optimum Moisture Content
Layer 150mm below Subgrade surface (except for Perth sand)	85%
Drainage Layer	Not required
Crushed Rock Base Subbase	70%
All other Subbase	85%

TABLE 501A3: BASECOURSE DRYBACK

Basecourse Material Type	Maximum Dryback Characteristic Moisture Content (DMc) as a proportion of Optimum Moisture Content
All Basecourse with sprayed seal final surfacing (except CRB)) CRB	70 – 85% (Select appropriate value then delete this note. Refer to Guidance Notes) 60%
All Principal Shared Path Pavement	85%
All Basecourse with asphalt final surfacing (except CRB) CRB	70% 60%

3. DRAINAGE LAYER

3.1 GEOTEXTILE

TABLE 501A6: MECHANICAL PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Minimum G Rating as defined in AUSTROADS Guide to Geotextiles #	1700	1350	AS 3706.4 & AS 3706.5

Note 1: # Burst Strength (CBR Plunger Method) shall be the 5th percentile value determined in accordance with A S3706.1 & AS 3706.4 and Puncture Resistance (Drop Cone Method) shall be the 5th percentile value determined in accordance with AS 3706.1 & AS 3706.5.

TABLE 501A7: HYDRAULIC PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Maximum Equivalent Opening Size (EOS) (μm)	200	200	AS 3706.7#
Minimum Q_{100} (L/m²/sec)	50	50	AS 3706.9#

Note 1: # Maximum Equivalent Opening Size (EOS) and Minimum Q100 are mean values.
Note 2: Q_{100} = Flow rate under 100 mm constant head determined using the Perpendicular Flow Test.

3.2 DRAINAGE LAYER SAND

Drainage Layer sand shall comply with the requirements shown in Table 501A8, and shall have linear shrinkage not exceeding 1.0% when tested in accordance with Test Method WA 123.1.

TABLE 501A8: PARTICLE SIZE DISTRIBUTION

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
37.5	90 - 100
2.36	30 – 100
0.075	< 1%

ANNEXURE 501 B

CEMENTITIOUS MATERIALS

ATIC/NATSPEC - CEMENTITIOUS MATERIALS REGISTRATION SCHEME (CMRS)

REQUEST FOR REGISTRATION OF CEMENTITIOUS MATERIALS

Product Details	
Product Name	
Type	
Proportions (if blend)	
Manufacturer	
Place of Manufacture	
Source of Constituent Materials	
Cement Clinker	
Fly Ash	
Slag	
Limestone	
Grinding Aids	
Supply Details	
Supplier Name	
Dispatch Centre (Address in Australia)	
Contact Name	
Contact Phone No.	
Contact Address	
Suppliers ABN	

Send this form with the sample to:

Transport for NSW

Attn: CMRS Administrator

Level 3 Pod H, 110 George Street
Parramatta NSW 2150

Email: cmrs@transport.nsw.gov.au

For Transport for NSW Use Only:

Date of Registration:

Registration No:

ANNEXURE 501 C

CRUSHED RECYCLED CONCRETE SUBBASE

GENERAL

SCOPE

1. This document is an extract of Main Roads Specification requirements relating to the supply and handling of Crushed Recycled Concrete and includes:

   Specification Clause 501.02 References (specifically relating to Crushed Recycled Concrete)

   Specification Clause 501.92 Crushed Recycled Concrete Sub-base

   Specification 201 Annexure A Section 2.0 Minimum Testing Frequency additional requirements for Crushed Recycled Concrete Sub-base

501.02 REFERENCES

1. Australian Standards, and other reference documents are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are shown below:

   Australian Standards

   AS 4964 Method for the Qualitative Identification of Asbestos in Bulk Samples

   Other Reference Documents

   DWER Asbestos Guidelines: Department of Water and Environment Regulation Guidelines for managing asbestos at construction and demolition waste recycling facilities, December 2012

   Waste Authority RtR Specification: Waste Authority Roads to Reuse Product Specification for recycled roads base and recycled drainage rock, March 2021

501.92 CRUSHED RECYCLED CONCRETE SUB-BASE SUPPLIED BY THE CONTRACTOR

501.92.01 GENERAL

1. Crushed Recycled Concrete shall only be sourced from a premises that is licensed under Part V of the Environmental Protection Act 1986 to accept, store and process construction and demolition waste, and that has been approved by the Department of Water and Environmental Regulation to supply Crushed Recycled Concrete in accordance with the Waste Authority Roads to Reuse (RtR) Specification. ***DWER Approved Supplier***

2. **Prior to delivery of Crushed Recycled Concrete to site, the Contractor shall provide the Superintendent with a copy of the Supplier's letter of approval from the Department of Water and Environmental Regulation confirming that the Supplier has management systems compliant with the Waste Authority RtR Specification. A copy of this document shall be included in as-constructed records.** ***HOLD POINT***

3. Crushed Recycled Concrete shall not be used in the following locations: ***Limitations on Usage***

    a) Any location not covered by Full Depth Asphalt pavement

    b) Within 0.5 m of the maximum groundwater level

    c) Within the following locations in Public Drinking Water Source Areas:

    - Priority 1 (P1) areas
    - Wellhead protection zones
    - Reservoir protection zones

4. The Contractor shall ensure that it is aware of its responsibilities under occupational health and safety legislation and implement appropriate controls to protect its employees and other persons in relation to the use of recycled construction products from construction and demolition material. ***Health and Safety***

5. Crushed Recycled Concrete shall be clearly identified and referred to as Crushed Recycled Concrete in Laboratory Test Requests, Test Reports and in As-Constructed Records. ***Transparency***

6. **Prior to placement of Crushed Recycled Concrete, the Contractor shall certify to the Superintendent that the material supplied by the Contractor fully complies with the specified requirements, including in relation to health and safety and limitations on usage.** ***HOLD POINT***

501.92.02 FOREIGN MATERIAL

1. Foreign material content shall be limited to the values shown in Table 501.92A. Testing for foreign material other than asbestos and hazardous metals is to be undertaken by visual identification of each foreign material type retained on a 4.75 mm sieve. The percentage by mass of each foreign material type shall be calculated to the nearest 0.1% as the mass of all of that material type identified compared to the total sample mass.

TABLE 501.92A: CRUSHED RECYCLED CONCRETE LIMITS OF FOREIGN MATERIAL

Material	Maximum Limit	Sampling, Monitoring and Analytical Methods
Recycled Asphalt Pavement (RAP): % by mass retained on 4.75 mm sieve	15%	Test Method WA 144.1
High Density Materials (brick and tile): % by mass retained on 4.75 mm sieve	15%	Test Method WA 144.1
Low Density Materials (plastic, plaster, etc.): % by mass retained on 4.75 mm sieve	1.5%	Test Method WA 144.1
Organic Matter (wood etc.): % by mass retained on 4.75 mm sieve	1.0%	Test Method WA 144.1
Unacceptable high density materials (inert metals, glass and ceramics): % by mass retained on 4.75 mm sieve	3.0%	Test Method WA 144.1
Bound Asbestos (as Asbestos Containing Material): % by mass retained on 7 mm sieve	0.01%	In accordance with DWER Asbestos Guidelines
Fibrous Asbestos and Asbestos Fines:	0.001%	In accordance with DWER Asbestos Guidelines
Hazardous Metals:	Refer to Waste Authority RtR Specification	In accordance with Waste Authority RtR Specification

2. All deliveries, stockpiles and unsealed sections of Crushed Recycled Concrete must be kept watered to prevent airborne dust. ***Dust Control***

3. **If any asbestos or hazardous metals are identified as exceeding the maximum permissible limits in Table 501.92A, the supply of Crushed Recycled Concrete must be immediately suspended, and not resumed until resolved and agreed with the Principal.** ***HOLD POINT***

501.92.03 MATERIALS PROPERTIES

1. The material shall consist of a uniformly blended mixture of coarse and fine aggregate resulting from the crushing of recycled concrete from construction and demolition material. ***Blending***

2. Coarse aggregate (retained on 4.75 mm sieve) shall consist of hard durable angular fragments and shall not break up after wetting and drying. ***Coarse aggregates***

3. Fine aggregate (passing 4.75 mm sieve) shall consist of crushed material or crushed material and sand with similar durability properties to that of the coarse aggregate. ***Fine aggregates***

4. The particle size distribution shall be determined in accordance with WA 115.1, and shall conform to the limits shown in Table 501.92B. The grading of material passing the 37.5 mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size.

Particle Size Distribution

TABLE 501.92B: PARTICLE SIZE DISTRIBUTION (CRUSHED RECYCLED CONCRETE SUB-BASE)

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
26.5	100
19.0	95 – 100
9.50	59 - 82
4.75	41 – 65
2.36	29 – 52
1.18	20 - 41
0.600	13 - 29
0.425	10 - 23
0.300	8 - 20
0.150	5 - 14
0.075	3 - 11

5. The material shall also conform to the following limits shown in Table 501.92C when tested in accordance with the listed Test Methods:

Other Acceptance Limits

TABLE 501.92C: OTHER ACCEPTANCE LIMITS (CRUSHED RECYCLED CONCRETE SUB-BASE)

Test	Limits	Test Method
Los Angeles Abrasion Value	42.0% Maximum	WA 220.1
Linear Shrinkage	4.0 Maximum	WA 123.1
California Bearing Ratio (CBR) (Soaked 4 days) at 94% of MDD and 100% of OMC	100% Minimum	WA 141.1
Unconfined Compressive Strength (UCS- 7 days cured and 4 hours immersed)	1.0MPa Maximum	WA 143.1

6. Crushed recycled concrete sub-base material shall be pre-wet to greater than 95% of the optimum moisture content as determined from Test Method WA 133.1 or WA 133.2 as appropriate. The moisture content shall be determined in accordance with WA 110.1. ***Moisture Curing***

7. Crushed recycled concrete sub-base material and water shall be thoroughly mixed using a pugmill, grader or any other alternative approved method to produce a homogeneous product suitable for placement in the final position. ***Mixing***

8. Site specific controls shall be implemented to minimise run off from exposed crushed recycled concrete to environmentally sensitive receptors during construction. ***Minimise Run off***

ANNEXURE 501D

SOUTH WEST REGIONAL GRAVEL SPECIFICATION

1. GRAVEL SUBBASE

For South-West Regional roads with a design traffic loading of less than or equal to 5.0×10^6 ESA, specification for Gravel Subbase remains the same as in Clause 501.07 GRAVEL SUBBASE SUPPLIED BY THE CONTRACTOR with the following exceptions:

The portion of the sample passing the 0.425 mm sieve shall conform to the following:

- Liquid Limit WA 120.2 - not greater than 25.0%
- Linear Shrinkage WA 123.1 - not greater than 3.0%

2. GRAVEL BASECOURSE

For South-West Regional roads with a design traffic loading of less than or equal to 5.0×10^6 ESA, Gravel Basecourse shall meet the grading requirements in Table 501D1 and comply with the other requirements in Table 501D2.

TABLE 501D1: PARTICLE SIZE DISTRIBUTION (SOUTH-WEST GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
37.5	100
19.0	71 – 100
9.5	50 – 81
4.75	36 – 66
2.36	25 – 53
1.18	18 – 43
0.425	11 – 32
0.075	4 – 19
0.0135	2 – 9

TABLE 501D2 OTHER ACCEPTANCE LIMITS (SOUTH-WEST GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	25.0% Maximum	WA 120.2
Linear Shrinkage	3.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

ANNEXURE 501E

WHEATBELT REGION GRAVEL SPECIFICATION

1. NATURAL LATERITE PEDOCRETE GRAVEL – UNALTERED BASECOURSE

1.1 For Wheatbelt Region roads the natural laterite pedocrete gravel Basecourse in Wheatbelt Region shall be un-altered in any way and shall meet the grading requirements in Table 501.G03 and comply with the limits in Table 501.G04. Should the material be altered through crushing, screening or blending then the material shall comply with the Limits in Tables 501.07 and 501.08.

1.2 Natural Laterite Pedocrete Gravel-Unaltered Basecourse shall be compacted at 100% of OMC and shall achieve Characteristic Density no less than:

- 96% of MDD for Design Traffic < 1.0 x 106 ESA;
- 98% of MDD for Design Traffic ≥ 1.0 x 106 ESA.

1.3 This specification permits the use of marginal materials that have been used in previous works with successful outcomes. However, using this Specification for basecourse may require the use of specialised techniques and associated compaction equipment to obtain the specified minimum Characteristic Density and a final surface finish that is suitable to accept a spray seal application. It is upon the user to develop appropriate methods and processes to apply the Specification to achieve the desired outcomes.

TABLE 501E1: PARTICLE SIZE DISTRIBUTION (WHEATBELT REGION NATURAL LATERITE PEDOCRETE GRAVEL – UNALTERED BASECOURSE)

AS Sieve Size (mm)	% Passing by mass Minimum and Maximum Limits
37.5	100
19.0	72 - 100
9.5	50 - 88
4.75	36 - 58
2.36	18 - 44
1.18	14 - 35
0.600	13 - 28
0.425	11 - 25
0.300	9 - 22
0.150	6 - 17
0.075	4 - 13

TABLE 501E2: OTHER ACCEPTANCE LIMITS (WHEATBELT REGION NATURAL LATERITE PEDOCRETE GRAVEL-UNALTERED BASECOURSE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Linear Shrinkage	4% Maximum	WA 123.1
Dryback	Upper Half 70% Maximum * Lower Half 70% Maximum	WA 136.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 100% of OMC and 96% of MDD	80% Minimum (for design traffic loading < 10^7 ESA) 110% at 2.5mm or 100% at 5.0mm penetration (for design traffic loading of 10^7 to 10^8 ESA)	WA 141.1

2. NATURAL LATERITE PEDOCRETE GRAVEL – UNALTERED SUBBASE

2.1 For Wheatbelt Region roads the natural laterite pedocrete gravel Sub-base in Wheatbelt Region shall be un-altered in any way and shall meet the grading requirements in Table 501.E1 and comply with the limits in Table 501E3. Should the material be altered through crushing, screening or blending then the material shall comply with the Limits in Tables 501.01 and 501.02.

2.2 Natural Laterite Pedocrete Gravel – Unaltered Subbase shall be compacted at 100% of OMC and shall achieve Characteristic Density no less than:

- 94% of MDD for Design Traffic < 1.0 x 106 ESA;
- 96% of MDD for Design Traffic ≥ 1.0 x 106 ESA.

TABLE 501E3: OTHER ACCEPTANCE LIMITS (WHEATBELT REGION NATURAL LATERITE PEDOCRETE GRAVEL-UNALTERED SUBBASE)

Test	Limits	Test Method
Liquid Limit	35.0% Maximum	WA 120.2
Linear Shrinkage	4.0% Maximum	WA 123.1
Dryback	70% Maximum full depth	WA 136.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 100% of OMC and 96% of MDD	60% Minimum	WA 141.1

ANNEXURE 501F

GOLDFIELDS ESPERANCE REGION GRAVEL SPECIFICATIONS

For Goldfields Esperance Region roads the following specification requirements in Tables 501F1 and 501F2 for Basecourse and 501F3 and 501F4 for Subbase are suitable for all roads. These specifications has been developed from the Spargoville pit on Coolgardie Esperance Highway and Great Eastern Highway pits at 376.5, 506.5 and 519 SLK and South Coast Highway at 405.5 SLK.

TABLE 501F1: PARTICLE SIZE DISTRIBUTION (GOLDFIELDS ESPERANCE GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
53.0	100
37.5	72 - 100
19.0	50 - 100
9.5	36 - 78
4.75	25 - 60
2.36	18 - 45
1.18	13 - 38
0.425	11 - 28
0.075	4 - 13
0.0135	2 - 9

TABLE 501F2: OTHER ACCEPTANCE LIMITS (GOLDFIELDS ESPERANCE GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	9.0% Maximum	WA122.1
Linear Shrinkage	4.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	1.7 MPa Minimum	WA 140.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 98% of MDD and 100% of OMC	80% Minimum	WA 141.1

TABLE 501F3: PARTICLE SIZE DISTRIBUTION (GOLDFIELDS ESPERANCE GRAVEL SUBBASE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
75.0	100
37.5	80 - 100
19.0	50 - 100
9.5	36 - 100
4.75	25 - 81
2.36	18 - 66
1.18	13 - 53
0.425	8 - 39
0.075	3 - 23
0.0135	2 - 11

TABLE 501F4: OTHER ACCEPTANCE LIMITS (GOLDFIELDS ESPERANCE GRAVEL SUBBASE)

Test	Limits	Test Method
Liquid Limit	35.0% Maximum	WA 120.2
Plasticity Index	15.0% Maximum	WA122.1
Linear Shrinkage	5.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	30% Minimum	WA 141.1

ANNEXURE 501G

KIMBERLEY REGION GRAVEL SPECIFICATION

The material specification requirements outlined in tables 501G1 and 501G2 for subbase and tables 501G3 and 501G4 for basecourse are suitable for use on all roads in Kimberley Region. These specifications have been developed from material sourced from the Robb Hill pit on Gibb River Road.

TABLE 501G1: PARTICLE SIZE DISTRIBUTION (KIMBERLEY GRAVEL SUBBASE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
53	100
37.5	80 - 100
19	50 - 100
9.5	36 - 90
4.75	25 - 62
2.36	18 - 50
1.18	13 - 47
0.425	8 - 44
0.075	3 - 16

TABLE 501G2: OTHER ACCEPTANCE LIMITS (KIMBERLEY GRAVEL SUBBASE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	10.0% Maximum	WA122.1
Linear Shrinkage	4.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 96% of MDD and 100% of OMC	30% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

TABLE 501G3: PARTICLE SIZE DISTRIBUTION (KIMBERLEY GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
53	100
37.5	95 - 100
19	63 - 100
9.5	45 - 90
4.75	32 - 62
2.36	26 - 50
1.18	21 - 47
0.600	17 - 46
0.425	15 - 44
0.300	13 - 43
0.150	10 - 30
0.075	7 - 16
0.0135	2 - 9

TABLE 501G4: OTHER ACCEPTANCE LIMITS (KIMBERLEY GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	25.0% Maximum	WA 120.2
Linear Shrinkage	2.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA 140.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

ANNEXURE 501H

PILBARA REGION GRAVEL SPECIFICATIONS

The material specification requirements outlined in tables 501H1 and 501H2 for subbase and tables 501H3 and 501H4 for basecourse are suitable for use on all roads in Pilbara Region. These specifications have been developed from material sourced from the pit at approximately 356 SLK on Marble Bar Road.

TABLE 501H1: PARTICLE SIZE DISTRIBUTION (PILBARA GRAVEL SUBBASE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
75	100
37.5	80 - 100
19	50 - 100
9.5	36 - 81
4.75	25 - 66
2.36	18 - 53
1.18	13 - 43
0.425	8 - 32
0.075	3 - 16

TABLE 501H2: OTHER ACCEPTANCE LIMITS (PILBARA GRAVEL SUBBASE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	15.0% Maximum	WA 122.1
Linear Shrinkage	6.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 96% of MDD and 100% of OMC	50% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

TABLE 501H3: PARTICLE SIZE DISTRIBUTION (PILBARA GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
75	100
37.5	80 - 100
19	60 - 100
9.5	36 - 78
4.75	25 - 58
2.36	18 - 44
1.18	13 - 35
0.600	10 - 28
0.425	8 - 25
0.300	7 - 22
0.150	4 - 17
0.075	3 - 16
0.0135	2 - 9

TABLE 501H4: OTHER ACCEPTANCE LIMITS (PILBARA GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	12.0% Maximum	WA 122.1
Linear Shrinkage	5.0% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA 140.1
California Bearing Ratio (Soaked 4 days with 6.75 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

ANNEXURE 501I

MIDWEST GASCOYNE REGION GRAVEL SPECIFICATION

The basecourse material specification requirements outlined in tables 501I1, 501I2 and 501I3 are suitable for use on all roads in Mid West Gascoyne Region. The *Other Acceptance Limits* in Table 501I3 are applicable to the Particle Size Distributions in Tables 501I1 and 501I2. These specifications have been developed from material sourced from a range of established pits on GNH between 350 and 900 SLK.

TABLE 501I1: PARTICLE SIZE DISTRIBUTION (MWGR GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
53	100
37.5	85 - 100
19	75 - 100
9.5	60 - 90
4.75	39 - 72
2.36	20 - 40
1.18	14 - 34
0.600	12 - 28
0.425	11 - 25
0.300	9 - 22
0.150	6 - 17
0.075	4 - 13
0.0135	2 - 9

TABLE 501I2: OTHER ACCEPTANCE LIMITS (MWGR GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing By Mass Minimum and Maximum Limits
53	100
37.5	85 - 100
19	62 - 100
9.5	50 - 82
4.75	48 - 78
2.36	33 - 58
1.18	22 - 43
0.600	16 - 34
0.425	13 - 31
0.300	10 - 29
0.150	6 - 21
0.075	4 - 14
0.0135	2 - 9

TABLE 501I3: OTHER ACCEPTANCE LIMITS (MWGR GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	10.0% Maximum	WA 122.1
Linear Shrinkage	4.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26
Accelerated Soundness Index by Reflux	94% Minimum	AS 1141.29

ANNEXURE 501J

GREAT SOUTHERN REGION

1. The material specification requirements outlined in tables 501J1, 501J2, 501J3 and 501J4 for subbase and basecourse are suitable for use on all roads in the Great Southern Region.

2. Gravel subbase and basecourse material shall consist of durable pebble in soil mortar. The material shall be free from particles having any dimension greater than 75 mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials.

3. The Particle Size Distribution shall be determined in accordance with Test Method WA 115.1. The particle size distribution of the portion passing a 75.0 mm AS Sieve shall conform to the grading limits shown in Table 501J1 and 501J3. The grading of material passing the 75.0 mm sieve shall vary from coarse to fine in a uniform and consistent manner. The material shall not be gap graded as represented by the grading crossing from the maximum limit for one sieve size to the minimum limit for another sieve size, and shall conform as closely as possible to the specified target grading.

4. The material shall also comply with the limits shown in Table 501J2 and 501J4. The Secondary Mineral Content in Basic Igneous Rock test is only applicable to basic igneous rock.

TABLE 501J1: PARTICLE SIZE DISTRIBUTION (GSR GRAVEL SUBBASE)

AS Sieve Size (mm)	% Passing by mass Minimum and Maximum Limits
75.0	100
37.5	80 - 100
19.0	50 - 100
9.5	36 - 81
4.75	25 - 66
2.36	18 - 53
1.18	13 - 43
0.425	8 - 32
0.075	3 - 19

TABLE 501J2: OTHER ACCEPTANCE LIMITS (GSR GRAVEL SUBBASE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Plasticity Index	8.0% Maximum	WA 122.1
Linear Shrinkage	3.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	60% Minimum	WA 141.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26

TABLE 501J3: PARTICLE SIZE DISTRIBUTION (GSR GRAVEL BASECOURSE)

AS Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
75.0	100	100
53.0	98	95 - 100
37.5	92	87 - 98
19.0	76	70 - 90
9.5	64	50 - 76
4.75	47	36 - 58
2.36	35	25 - 44
1.18	27	18 - 35
0.600	21	13 – 28
0.425	18	11 - 25
0.300	16	9 – 22
0.150	12	6 – 17
0.075	9	4 - 13
0.0135	6	2 - 9

TABLE 501J4: OTHER ACCEPTANCE LIMITS (GSR GRAVEL BASECOURSE)

Test	Limits	Test Method
Liquid Limit	30.0% Maximum	WA 120.2
Linear Shrinkage	2.0% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days with 4.5 kg Surcharge) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA 140.1
Secondary Mineral Content in Basic Igneous Rocks	25% Maximum	AS 1141.26

GUIDANCE NOTES

FOR REFERENCE ONLY – DELETE GUIDANCE NOTES FROM FINAL DOCUMENT

1. All edits to downloaded Specifications shall be made using *Track Changes*, to clearly show added/deleted text.

2. If **all** information relating to a clause is deleted, the clause number should be retained and the words "**NOT USED**" should be inserted.

3. The proposed documents with tracked changes shall be submitted to the Project Manager for review, prior to printing the final batch of documents. When this final printing is carried out, the tracked changes option is to be turned off.

4. Before printing accept all changes in the document, turn off Track Changes and refresh the Table of Contents.

5. The Custodian of this specification is Manager Materials Engineering.

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1. PAVEMENT MATERIAL SPECIFICATIONS

1.1 SUBBASE

1. The applicable CBR criterion depends on traffic loading and drainage environment. In lower traffic more arid zones 30% CBR is generally adequate, however in localities with high traffic loading and/or less favourable drainage CBR values of up to 60% may be applicable.
2. For very heavy traffic routes the specified density for gravel subbase may be increased from 94% to up to 96%.

1.2 GRAVEL REWORK (refer Clause 501.26)

The Clause below may be required for inclusion in Clause 501.26 for Basecourse material with gravel particles prone to excessive wear during mixing and compaction. A high Los Angeles Abrasion value or past experience of excessive breakdown during construction with similar material would justify the use of this clause to limit rework of gravel Basecourse.

1. Gravel Basecourse material is prone to breakdown under the action of construction plant. The Contractor shall compact any lot using this material for Basecourse only twice. Any Basecourse that requires rework after having been already compacted twice shall be removed and replaced at no cost to the Principal.

Gravel Basecourse Rework

1.3 CONSTRUCTION OF PLASTIC MATERIALS (refer Clause 501.26)

For construction of plastic materials, the following clause should be included in Clause 501.26 for gravel Basecourse or gravel Sub-Base materials.

1. All gravel Basecourse or Sub-Base materials shall be mixed to a uniform moisture content in the range of 90% to 110% of Optimum Moisture Content and left to "cure" for at least 24 hours prior to compaction commencing. Compaction shall be carried out within 72 hours of gravel curing commencing. ***Gravel Material Curing***

2. REGIONAL SUBBASE AND BASECOURSE GRAVEL SPECIFICATIONS

Regional pavement material specifications are presented in Annexures 501D to 501J. It should be noted that Test Methods AS 1141.26 and AS 1141.29 are only applicable to basic igneous rock such as Basalt. For all other materials Test Methods AS1141.26 and AS 1141.29 requirements should be deleted from the materials specifications.

The relevant Materials Manager should be consulted before adopting regional materials specifications.

3. GRAVEL BASECOURSE – OVERSIZE MATERIAL (refer Clause 501.10)

3.1 An alternative paragraphs 1 to 4 in Clause 501.10 is provided where it is considered necessary to ensure the removal or treatment of oversize material in excess of 300 mm in size.

3.2 If applicable, insert the alternative paragraphs 1 to 4 in Clause 501.10 provided below (and remove grid lines)

1. Gravel Basecourse material shall consist of durable pebble in soil mortar. The material shall be free from particles having any dimension greater than 37.5 mm and free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials. ***Component***

2. The Contractor shall remove all oversize material with any dimension greater than 300 mm and this material shall not be delivered to the pavement construction area. This material and all other oversize material are to be included in the measurement of the stockpile for determining the volume of material used. ***Removal of materials > 300mm***

3. All other oversize material shall be crushed by rolling with a minimum of six (6) passes of a grid roller as specified in the "Compaction: Principal's Method Specification" Clause 302.54 of Specification 302 EARTHWORKS. ***Rolling Crush***

4. After the initial crushing, any material having any dimension greater than 50 mm shall be deemed to be oversize and shall not be used in pavement construction. Additional crushing shall then be undertaken until the pavement material does not contain more than 20% by mass of material retained on a 37.5 mm sieve. ***Additional Crushing***

4. PRINCIPAL SUPPLIED MATERIALS (refer Clause 501.91)

4.1 Materials are normally required to be supplied by the Contractor. Where supply is by the Principal (for example, gravel in stockpiles), Clause 501.91 in the section CONTRACT SPECIFIC REQUIREMENTS (or a suitably edited version of this clause) is applicable.

4.2 Amend this clause as shown to indicate whether the material is supplied at a cost to the Contractor, or is supplied free of charge. Applying a charge may conserve material where there is a limited supply, but appropriate supervision and a suitable means of measurement must be established.

4.3 Insert details of any other Principal supplied materials as required.

5. OPTIONAL PAVEMENT MATERIALS (refer Clauses 501.92 to 501.94)

5.1 The section PRODUCTS AND MATERIALS includes commonly used pavement materials. Other pavement materials should be included under CONTRACT SPECIFIC REQUIREMENTS and selected as required.

5.2 Pavement materials not listed should be researched and approved as required before inclusion.

6. DRAINAGE LAYER (refer Clause 501.32

6.1 GEOTEXTILE

1. Where a drainage layer is required, it is usually constructed immediately below the lower Pavement Layer.

2. A Geotextile may or may not be required as part of the drainage layer. Typical details of Geotextile are as follows

TABLE 501.G30: MECHANICAL PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Minimum G Rating as defined in AUSTROADS Guide to Geotextiles #	1700	1000	AS 3706.4 & AS 3706.5

(NOTE: Typical G Rating values only are shown - insert appropriate values to suit specific conditions)

TABLE 501.G31: HYDRAULIC PROPERTIES

	Subsoil Drains	Drainage Blanket	Test Method
Maximum Equivalent Opening Size (EOS) (μm)	200	200	AS3706.7#
Minimum Q100 (L/m²/sec)	50	50	AS3706.9#

(NOTE: Typical EOS and Q_{100} values only are shown - insert appropriate values to suit specific conditions)

6.2 SAND FOR DRAINAGE LAYER

1. Bassendean Sand is commonly used as a drainage layer in the Metro area, with the grading limits following Table 501A8.

2. Insert appropriate details of the specified drainage layer material.

7. PAVEMENT COMPACTION

7.1 Where a range is given for the minimum characteristic dry density ratio in Table 510 A1, the higher value in the range should be selected unless there is evidence that the Basecourse properties will be damaged by so doing (e.g. if a higher compactive effort causes breakdown of the stone and adversely affects the grading or the linear shrinkage of the Basecourse).

A higher compactive effort will reduce the risk of post construction wheel path rutting under traffic loading.

A more uniform Pavement Layer can be expected when a higher minimum characteristic dry density ratio is specified. To achieve the higher density, the Contractor will need to exercise greater control over the uniformity of the mixing and compaction processes (e.g. especially over the amount and uniformity of moisture in the Pavement Layer during compaction).

7.2 Plastic pavement materials should be moist cured for at least 24 hours before compaction takes place if the in situ or imported Basecourse is in a dry condition. Refer Guidance Note 1.4

7.3 Compaction testing is normally completed prior to final trim and the layer may be marginally above the upper bound of level tolerance at that time. Final trim is required to be carried out while the pavement is still “green”, otherwise the layer needs to be reworked to achieve level, shape, compaction and surface finish requirements.

8. DRYBACK OF PAVEMENT AND SUBGRADE LAYERS

8.1 The dry back criterion of 85% for Basecourse with a spray seal surface is usually suitable however; consideration should be given to adjusting the criterion, if required, to reduce aggregate embedment and the risk of subsequent seal flushing. The risk is higher when commercial vehicle numbers are high.

9. DIEBACK CONTROL

9.1 Insert as a CONTRACT SPECIFIC REQUIREMENT if dieback controls should be included in pavement construction.

9.2 Refer to any general requirements shown in Specification 204 ENVIRONMENT.

10. DURABILITY OF BASIC IGNEOUS ROCKS

Tests (AS1141.26 & AS1141.29) have been included for the purpose of excluding material that has the potential to degrade in service when used as Sub-Base and Basecourse. The colour of the rocks may be green, grey or black, but the basaltic rocks that most commonly present a risk of degradation are often dark green. Standard classification and strength tests are not suitable to identify the presence of material prone to degradation. Vic Roads Code of Practice RC 500.00 provides additional guidance on this topic.

11. HYDRATED CEMENT TREATED CRUSHED ROCK BASE (HCTCRB) (refer Clause 501.15)

11.1 A Geotextile Reinforced Seal must be specified whenever HCTCRB Basecourse is used. The GRS must comprise a double/double seal (14 mm / 7 mm with heavy grade fabric) in accordance with the requirements in Specification 503 or Specification 509 as applicable.

The purpose of the GRS is to maintain a waterproof seal on the HCTCRB Basecourse.

HCTCRB should not be specified for pavements with a sprayed seal wearing course or pavements at intersections.

501.15 HYDRATED CEMENT TREATED CRUSHED ROCKBASE BASECOURSE SUPPLIED BY THECONTRACTOR

501.15.01 MANUFACTURE OF HCTCRB

General

1. The hydrated cement treated crushed rock base (HCTCRB) shall be manufactured by blending 2.0 ±0.1% by dry mass of cement with crushed rock base (CRB). The untreated CRB must comply with the requirements for CRB as specified in Clause 501.11 and the Particle Size Distribution in Table 501.15.

TABLE 501.15: PARTICLE SIZE DISTRIBUTION OF HYDRATED CEMENT TREATED CRUSHED ROCK BASE

AS 1152 Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
26.5	100
19.0	99 – 100
13.2	74 – 90
9.5	64 – 80
4.75	45 – 60
2.36	33 – 45
1.18	23 – 35
0.600	16 – 27
0.425	14 – 23
0.300	11 – 20
0.150	8 – 14
0.075	7 - 11

Cement Type

2. The cement used in the manufacture of HCTCRB shall be General Purpose (Type GP).

Blending

3. The HCTCRB shall be manufactured by blending water and a target 2.0 % by dry mass of cement with the CRB. The mixing process shall produce a homogeneous mixture of crushed rock base, cement and water in which

the water and cement are uniformly distributed. Mixing shall be carried out as either a batch or continuous process in an approved plant. This plant shall include measuring equipment, which will determine the mass of cement added to a known mass of crushed rock base at all stages of the mixing process. The Superintendent's approval of the Tenderer's plant will be conditional on this equipment being capable of determining the mass of cement added to the Basecourse to within ±0.1% of the dry mass of the CRB.

4. **Prior to the use of the plant proposed to be used for the modification process, the Contractor shall certify to the Superintendent that the plant is capable of determining the mass of cement added to the Basecourse to within ±0.1% of the dry mass of the CRB.** ***HOLD POINT***

5. During the initial hydration period the moisture content of the mixed and stockpiled HCTCRB shall be at least 90% of the optimum moisture content (OMC) of the crushed rock base used to produce the HCTCRB. The moisture content shall be determined in accordance with Test Method WA 110.1. ***Moisture Content***

6. The HCTCRB shall be stockpiled at the quarry for a period of not less than 21 days after the addition of cement and water to the CRB (i.e. minimum initial hydration period). ***Initial Hydration Period***

7. The HCTCRB must be compacted into the pavement in its final position not less than 30 days or greater than 60 days after the addition of cement and water to the CRB (i.e. minimum and maximum construction hydration periods). ***Construction Hydration Period***

8. The hydrated cement treated crushed rock base shall also meet the other limits as shown in Table 501.16. ***Other Acceptance Limits***

TABLE 501.16: OTHER ACCEPTANCE LIMITS (HYDRATED CEMENT TREATED CRUSHED ROCK BASE SUPPLIED BY THE CONTRACTOR)

Test	Limits	Test Method
Unconfined Compressive Strength at 7-days. At the in service density condition	0.8 MPa Maximum	WA 143.2
Unconfined Compressive Strength at 28-days. At the in service density condition	1.0 MPa Maximum	WA 143.2
Vertical Modulus of the top sub-layer At the in service conditions, including in-service stress, construction hydration period, moisture and density conditions	1000 MPa Minimum 1500 MPa Maximum	Laboratory Repeated Load Triaxial Test AG:PT/T053 using internal displacement measuring device & WA 142.3

501.15.02 HCTCRB TRIAL MIXES

5. The Contractor shall prepare trial mixes from each source of HCTCRB to be used in the Works. The trial mixes must cover the range of crushed rock base material and cement properties from each source that will be used to manufacture HCTCRB for the Works. The mixes must be made using the plant and degree of quality control proposed for the Works. ***Trial Mixes***

2. As a minimum the Contractor must undertake sufficient particle size distribution, LA abrasion, flakiness index, MDCS, linear shrinkage and soaked CBR tests on the crushed rock from each source to establish the range of its properties. Repeated load triaxial tests and unconfined compressive strength tests must be undertaken to establish that the HCTCRB from each source conforms to the specified acceptance limits (i.e. within the range of the source materials properties, construction hydration period, density and dryback moisture that will occur within the Works). As a minimum repeated load triaxial tests and unconfined compressive strength tests must be undertaken on samples compacted at hydration periods of 30 days and 60 days after the cement and water are added to the crushed rock base ***Laboratory Testing***

3. **Prior to the manufacture of any HCTCRB for use in the Works the Contractor must provide to the Superintendent for approval results of the trial mixes demonstrating that the HCTCRB and its constituents conform with all specified requirements. In seeking this approval the Contractor must specify the construction hydration period range that will be used in the Works. The construction hydration period must not be less than 30 days or greater than 60 days.** ***HOLD POINT***

501.15.03 CEMENT FOR HCTCRB

6. Cement for use in HCTCRB shall comply with the requirements of AS 3972, Type GP. Any sampling and testing of cement shall be in accordance with AS 2350. The cement shall be sufficiently dry to flow freely during mixing with the CRB. ***Cement***

2. Cement used for the manufacture of HCTCRB shall comply with the requirements of Australian Technical Infrastructure Committee (ATIC) Specification SP43 ATIC – SP43). The Cementitious Material Registration Scheme (CMRS) shall be used to confirm that the cement complies to ATIC - SP43. The standard application form for CMRS registration is shown in Annexure 501B.

3. **Prior to commencing the manufacture of the HCTCRB the Contractor shall confirm that the cement complies with ATIC – SP43 and shall provide the CMRS registration number for the cement to the Superintendent for approval of the cement.** ***HOLD POINT***

4. The Contractor shall use cement in approximately the chronological order in which it is delivered from the manufacturer ***Chronological Order***

5. Transportation units and storage bins for bulk cement shall be weatherproof and shall be constructed so that there is no dead storage. The Contractor shall demonstrate that the storage bins for bulk cement do not have any dead storage. If dead storage exists the bins shall be emptied completely at least once every three months. Cement delivered in bags shall be stored in weatherproof structures having floors raised above the ground. Cement that is more than three months old shall not be used. ***Storage***

6. **Prior to commencing the manufacture of the HCTCRB, the Contractor shall certify to the Superintendent that the cement is no more than 3 months old.** ***HOLDPOINT***

501.29 COMPACTION

501.29.03 HYDRATED CEMENT TREATED CRUSHED ROCK BASE (HCTCRB)

1. Compaction and trimming of HCTCRB to shape and level shall be completed within twelve (12) hours of the incorporation of the HCTCRB into the Pavement Layer. HCTCRB Basecourse shall be compacted to a Characteristic Dry Density Ratio shown in Annexure 501A, or greater. ***Timing***

2. The maximum dry density used in the calculations shall be determined on pre-treated material sampled from the Basecourse lots prior to compaction and shall be determined in accordance with Test Method WA 133.1. Pre-treatment shall comprise mixing HCTCRB material at a moisture content dry of OMC in a cement mixer with a bowl of approximately 0.06 cubic metres for 560 ±20 revolutions, at the construction hydration period that corresponds to that of the lot being tested. ***Sample Pre-treatment***

3. Basecourse dryback prior to bituminous surfacing shall be in accordance with Annexure 501A and shall be based on the OMC determined at Clause 501.29.02.2. ***Basecourse Dryback***

4. Bituminous surfacing of the HCTCRB shall not commence until the Basecourse stiffness has achieved a Characteristic Clegg Impact Value of 55 or greater when tested in accordance with AS 1289.6.9.1. The Clegg Impact Values shall be determined at 9 locations per lot. The locations shall be selected in accordance with WA 0.1. ***Basecourse Stiffness***

5. The Characteristic Clegg Impact Value (CIVc) is defined by the expression: ***Clegg Impact Value***

$$CIVc = CIV - 0.59s$$

Where CIV = the mean of the results of Clegg Impact Value on the lot being assessed reported to the nearest 1.0.

s = the standard deviation of the results of the Clegg Impact Value on the lot being assessed, calculated in accordance with Specification 201 QUALITY MANAGEMENT ANNEXURE 201A 1.4 and reported to the nearest 0.1.

6. HCTCRB trimmed from a lot shall not be incorporated into another Basecourse lot. If a completed layer of HCTCRB Basecourse does not satisfy all of the requirements of the Specification and has to be reworked, the Contractor shall repeat all the requirements for HCTCRB at no cost to the Principal. Rework shall include any disturbance to the surface of the HCTCRB Basecourse during trimming to meet shape or level requirements that occurs more than twelve (12) hours after the incorporation of the HCTCRB into the Pavement Layer. The rework depth shall not be less than the full depth of the affected layer.

Trimming, Rework

12. RESILIENT MODULUS

The basecourse vertical modulus adopted in the pavement design should be inserted in the relevant Table. Refer to the pavement design for the appropriate criterion. The criterion will typically be in the range 500 MPa – 700 MPa in accordance with Engineering Road Note 9 and Austroads Guide to Pavement Technology Part 2 Pavement Structural Design.

The moisture and density conditions applicable in the test procedure are the density and dry back criteria specified in the Contract. Typically, the criteria are 99% of MDD and 60% of OMC for CRB and 98% of MDD and 70% of OMC for other basecourse materials.

Resilient Modulus testing is not normally specified for pavements with a spray seal surfacing because vertical modulus is not a design input in the empirical process used to design spray seal surfaced pavements.

13. RECLAIMED PAVEMENT SUBBASE

If it is likely that existing pavement material will be reused as Subbase compliance to the appropriate Sub-Base specifications is applicable.

14. PAVEMENT MATERIAL SELECTION

In addition to material specifications, product cost and lead to project site, other factors to consider in selection are;

- Crushed Rock Base Basecourse (CRB) requires a prime.
- Achieving CRB dry back and prime curing in cool conditions may be problematic
- CRB is normally unsuitable to be constructed under traffic because it is prone to ravelling
- Bitumen Stabilised Limestone can tolerate light traffic while drying back
- Cement stabilised or Lime Stabilised Basecourse must not be used under asphalt wearing courses unless approved by the Manager Materials Engineering.
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- 15 CRUSHED RECYCLED CONCRETE SUBBASE

Annexure 501K shall be implemented when crushed recycled concrete (CRC) subbase will be used in full depth asphalt pavements. Use of CRC is currently limited to full depth asphalt pavements.

17. CONTRACT SPECIFIC REQUIREMENTS

The following clauses are to be placed under the CONTRACT SPECIFIC REQUIREMENTS, as required. After inserting the clause, change the clause number and heading to style “H2 SP” so it appears in the Table of Contents.

501.91 PAVEMENT MATERIALS – PRINCIPAL SUPPLIED

1. Where pavement materials are supplied by the Principal, details of such materials are provided in Specification 100 GENERAL REQUIREMENTS Annexure 101E.

2. Pavement material will be made available to the Contractor free of charge / at a specified cubic metre rate * (measured in the stockpile) from stockpiles located as described in Specification 100 GENERAL REQUIREMENTS Annexure 101E. The material shall be extracted from the stockpiles without contamination from the underlying strata and shall be free from boulders, clods, stumps, roots, stocks, vegetable matter or other deleterious material prior to loading and carting. ***Availability***

   (* Authors – select as applicable)

3. If the pavement material is made available from borrow pits, any removed vegetation or material that is discarded may be stockpiled separately and used later in pit reinstatement in accordance with Specification 303 PITS AND QUARRIES. ***Vegetation***

4. When the stockpiled subbase material contains oversize material, the Contractor shall screen the stockpiles to ensure that the pavement material does not contain more than 20% by mass of material retained on a 75 mm sieve. The screen aperture shall be selected so that only the minimum quantity of material is removed from the existing stockpile to satisfy this requirement. Subbase material having any dimension greater than 100 mm shall be deemed oversize and shall not be used in pavement construction. ***Subbase Oversize Material***

5. When the stockpiled basecourse material contains oversized material, the Contractor shall screen the stockpiles to ensure that the pavement material does not contain more than 20% by mass of material retained on a 37.5 mm sieve. The screen aperture shall be selected so that only the minimum quantity of material is removed from the existing stockpile to satisfy this requirement. Basecourse material having any dimension greater that 50 mm shall be deemed oversize and shall not be used in pavement construction. ***Basecourse Oversize Material***

6. Any oversize material discarded in the stockpile area or any oversize material discarded from the pavement shall be removed to be stockpiled in borrow pits and respread evenly over the pit excavation area prior to the rehabilitation of the Pit.

7. Access tracks to pavement material stockpiles and pits shall be constructed and maintained in accordance with Specification 303 PITS AND QUARRIES. ***Access Tracks***

501.95 – 501.99 NOT USED

AMENDMENT CHECKLIST

Specification No. **501** Title: **PAVEMENTS** Revision No: _____

Project Manager: _____ Signature: _____ Date: _____

Checked by: _____ Signature: _____ Date: _____

Contract No: _____ Contract Description: _____

ITEM	DESCRIPTION	SIGN OFF
Note: All changes/amendments must be shown in Tracked Changes mode until approved.		
1.	Project Manager has reviewed Specification and identified Additions and Amendments.	
	CONTRACT SPECIFIC REQUIREMENTS addressed? Contract specific materials, products, clauses added? (Refer Specification Guidance Notes for guidance).	
	Any unlisted materials/products proposed and approved by the Project Manager? If "Yes" provide details at 16.	
	Standard clauses amended? **MUST SEEK** approval from Manager Contracts.	
	Clause deletes shows as **"NOT USED"**.	
	Appropriate **INSPECTION AND TESTING** parameters included in Spec 201 (Text Methods, Minimum Testing Frequencies verified).	
	ANNEXURES completed (refer Specification Guidance Notes).	
	HANDOVER and **AS BUILT** requirements addressed.	
	Main Roads QS has approved changes to **SMM**.	
	Project Manager certifies completed Specification reflects intent of the design.	
	Completed Specification – independent verification arranged by Project Manager.	
	Project Manager's review completed.	
	SPECIFICATION GUIDANCE NOTES deleted.	
	TABLE OF CONTENTS updated.	
	FOOTER updated with Document No., Contract No. and Contract Name.	
	Supporting information prepared and submitted to Project Manager.	
Further action necessary:		

Signed: _____ *(Project Manager)* Date: _____