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WALGA SPECIFICATIONS

Appendix Two - Granular Pavement Materials

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SPECIFICATION





**WALGA SPECIFICATION
GRANULAR PAVEMENT MATERIALS SPECIFICATIONS
REVISION REGISTER**

Date	Clause Number	Description of Revision	Authorised By



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1.0 SCOPE

This standard specifies the requirements of unbound (and lightly bound) granular pavement materials including basecourse and sub-base materials. The standard covers crushed or otherwise manufacture materials and naturally occurring materials such as laterite gravels. Specifications for the supply of road making materials sourced from by-products of the construction and demolition industry are provided in IPWEA Specification and Performance of Recycled Road Pavements.

Specifications are provided to suite a range of traffic and climatic conditions to allow selection to the optimum local materials to suite the conditions of use.

The specifications are based on use of the materials in a well drained sealed pavement and assume good practice road construction processes will be used.

The gravel specifications are based on lateritic materials but alternative materials may be used if local experience supports their use.

Quotations are to be supplied as set out in a Schedule of Rates included in Annexure A1 and in a Lump Sum Bill of Quantities included in Annexure A2.

Acknowledgment: The use of Main Roads WA specifications and guidelines and the Institute of Public Works Engineering Australia (WA Division) Local Government Guidelines for Subdivisional Development are gratefully acknowledged as the basis for these specifications.

2.0 REFERENCES

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.

Equivalent Australian Standard test methods may be substituted for the Main Roads test methods quoted in the specifications.

Australian Standards

AS 1141	Methods for Sampling and Testing Aggregates
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1672	Limes and Limestones for Building
AS 3972	Portland and Blended Cement
AS 2008	Residual Bitumen for Pavements
AS 1160	Bitumen Emulsion for Construction and Maintenance of Pavements
AS 4133.4.1	Point Load Index
AS 1141.22	Wet/Dry Strength Variation
AS 1141.26	Secondary Mineral Content
AS 1141.29	Accelerated Soundness

Austrroads Test Methods

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

MAIN ROADS Publications

A guide to the Selection and Use of Naturally Occurring Materials as Base and Subbase inroads in Western Australia



MAIN ROADS Test Methods

WA 0.1	Random Sample Site Location
WA 100.1	Sampling Procedures for Soil and Granular Pavement Materials
WA 105.1	Preparation of Disturbed Soil and Granular Pavement Material Samples
WA 110.1	Moisture Content: Convection Oven Method
WA 110.2	Moisture Content: Microwave Oven Method
WA 115.1	Particle Size Distribution: Sieving and Decantation Method
WA 115.2	Particle Size Distribution: Abbreviated Method for Coarse Materials
WA 120.2	Liquid Limit: Cone Penetrometer Method
WA 122.1	Plasticity Index
WA 123.1	Linear Shrinkage
WA 133.1	Dry Density/Moisture Content Relationship: Modified Compaction Fine and Medium Grained Soils
WA 133.2	Dry Density/Moisture Content Relationship: Modified Compaction Coarse Grained Soils
WA 134.1	Dry Density Ratio
WA 136.1	Moisture Ratio (Percent)
WA 140.1	Maximum Dry Compressive Strength
WA 141.1	California Bearing Ratio
WA 143.1	Determination of the Unconfined Compressive Strength of Laboratory Compacted Specimens
WA 216.1	Flakiness Index
WA 220.1	Los Angeles Abrasion Value
WA 220.2	Los Angeles Abrasion Value of Crushed Limestone
WA 717.1	Dispersion of Bitumen in Soil
WA 717.1	Bitumen Dispersion
WA 910.1	Chlorides and Total Soluble Salts in Soils and Water
WA 915.1	Calcium Carbonate Content

MAIN ROADS Specifications

SPECIFICATION 501 PAVEMENTS
SPECIFICATION 201 QUALITY SYSTEMS

WALGA Specifications

WALGA SPECIFICATION GRANULAR PAVEMENT MATERIALS
WALGA SPECIFICATION SPRAYED BITUMINOUS SURFACING
IPEA/AAPA TECHNICAL SPECIFICATION FOR SUPPLY AND LAYING OF ASPHALT
WALGA SPECIFICATION EARTHWORKS AND PAVEMENT CONSTRUCTION

Acts and Regulations

Environmental Protection Act 1986
Environmental Protection Regulations 1987
Aboriginal Heritage Act 1972
Wildlife Conservation Act 1950
Environmental Protection (Clearing of Native Vegetation) Regs 2004
Health Pesticide Regulations 1956
Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007
Occupational Safety and Health Act 1984
Occupational Safety and Health Regulations 1996
Rail Safety Act
Road Traffic Code 2000
Main Roads Act 1930



3.0 DEFINITIONS

The following particular definitions shall apply:

- "pavement" shall be any layer above subgrade and will include shoulders.
- "basecourse" shall be any granular layer immediately beneath the bituminous wearing surface of a sealed road or the top layer of a granular pavement structure.
- "sub-base" shall be the material laid on the subgrade below the base to provide extra pavement thickness or to provide a working platform.
- "equivalent standard axle" (ESA), the number of standard axle loads that are equivalent in damaging effect on a pavement to a standard axle load of 8.2 tonne applied over a single axle with dual tyred wheels at each end of the axle.

4.0 CRUSHED ROCK BASECOURSE MATERIALS

4.1 Type 1.1 Crushed Rock Basecourse Material

4.1.1 Applications

Type 1.1 Crushed rock basecourse material is suitable for use on all classes of road including freeways and controlled access highways.

4.1.2 General

All crushed rock base shall consist of a uniformly blended mixture of coarse and fine aggregate.

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.

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.

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.

4.1.3 Particle Size Distribution

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 1. 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, and shall conform as closely as possible to the specified target grading.



Table 1: Type 1.1 Crushed Rock Base Particle Size Distribution

AS 1152 Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
26.5		100
19.0	100	95-100
13.2	82	70-90
9.5	70	60-80
4.75	50	40-60
2.36	38	30-45
1.18	25	20-35
0.600	19	13-27
0.425	17	11-23
0.300	13	8-20
0.150	10	5-14
0.075	8	5-11

4.1.4 Other Acceptance Limits

The crushed rock base shall also meet the other limits as shown in Table 2.

Table 2: Type 1.1 Crushed Rock Base Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.35 to 0.6	-
Liquid Limit (Cone Penetrometer)	25% 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) 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

Notes:

- 1) The Secondary Mineral Content in Basic Igneous Rock test in Table 2 is only applicable to basic igneous rock.
- 2) The Accelerated Soundness Index test in Table 2 is only applicable to basic igneous rock.



4.1.5 Moisture Content

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

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

4.2 Type 1.2 Crushed Rock Basecourse Material

4.2.1 Applications

Type 1.2 Crushed rock basecourse material is suitable for use on most WALGA Member roads.

4.2.2 General

All crushed rock base shall consist of a uniformly blended mixture of coarse and fine aggregate.

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.

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.

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.

4.2.3 Particle Size Distribution

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 3. 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, and shall conform as closely as possible to the specified target grading.

Table 3: Type 2.1 Crushed Rock Base Particle Size Distribution

AS 1152 Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
19.0	100	100
9.5	75	70-80
4.75	52	40-65
2.36	40	30-50
0.425	21	12-30
0.075	7	3-12



4.2.4 Other Acceptance Limits

The crushed rock base shall also meet the other limits as shown in Table 4.

Table 4: Type 2.1 Crushed Rock Base Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.4 to 0.6	-
Plastic Limit	20% Maximum	WA 120.2
Liquid Limit (Cone Penetrometer)	25% Maximum	WA120.2
Plasticity Index	5% Maximum	WA 120.2
Linear Shrinkage	1% Maximum	WA123.1
Flakiness Index	30% Maximum	WA 216.1
Los Angeles Abrasion Value	35% Maximum	WA 220.1
Maximum Dry Compressive Strength	1.75 MPa Minimum	WA 140.1
California Bearing Ratio (Soaked 4 days) 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

Notes:

- 2) The Secondary Mineral Content in Basic Igneous Rock test in Table 4 is only applicable to basic igneous rock.
- 3) The Accelerated Soundness Index test in Table 4 is only applicable to basic igneous rock.

4.2.5 Moisture Content

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

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

5.0 GRAVEL BASECOURSE MATERIALS

5.1 Type 2.1 Gravel Basecourse Material

5.1.1 Applications

Type 2.1 Gravel basecourse material is suitable for use with a design traffic loading of up to 1×10^7 ESAs except on freeways and controlled access highways in the metropolitan area (Gravel basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area).

5.1.2 General

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. Basecourse material having any particle dimension greater than 50 mm shall be deemed oversize and shall not be accepted.

5.1.3 Particle Size Distribution

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 5. 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, and shall conform as closely as possible to the specified target grading.



Table 5: Type 2.1 Basecourse Particle Size Distribution

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5	100	100
19.0	80	72-100
9.5	57	50-78
4.75	43	36-58
2.36	31	25-44
1.18	23	18-35
0.600	18	13-28
0.425	15	11-25
0.300	13	9-22
0.150	9	6-17
0.075	7	4-13
0.0135	4	2-9

5.1.4 Other Acceptance Limits

The material shall also comply with the limits shown in Table 6.

Table 6: Type 2.1 Gravel Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.3 to 0.6	-
Liquid limit	25% Maximum	WA 120.2
Linear Shrinkage	2% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) 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

Notes:

- 1) The Secondary Mineral Content in Basic Igneous Rock test in Table 6 is only applicable to basic igneous rock.
- 2) The Accelerated Soundness Index test in Table 6 is only applicable to basic igneous rock.

5.2 Type 2.2 Gravel Basecourse Material

5.2.1 Applications

Type 2.2 Gravel basecourse material is suitable for use on roads with a design traffic loading of less than 5×10^6 ESAs (Gravel basecourse is not suitable for use in freeways and controlled access highways in the metropolitan area).

5.2.2 General

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. Basecourse material having any particle dimension greater than 50 mm shall be deemed oversize and shall not be accepted.



5.2.3 Particle Size Distribution

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 7. 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, and shall conform as closely as possible to the specified target grading.

Table 7: Type 2.2 Gravel Basecourse Particle Size Distribution

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5	100	100
19.0	74	71-100
9.5	54	50-81
4.75	40	36-66
2.36	29	25-53
1.18	21	18-43
0.425	13	11-32
0.075	6	4-19
0.0135	3	2-9

5.2.4 Other Acceptance Limits

The material shall also comply with the limits shown in Table 8.

Table 8: Type 2.2 Gravel Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.3 to 0.7	-
Liquid limit	25% Maximum	WA 120.2
Plasticity Index	6% Maximum	WA 120.2
Linear Shrinkage	3% Maximum	WA 123.1
Maximum Dry Compressive Strength	2.3 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
$P_{0.425} \times$ Linear Shrinkage	150 Maximum	-
Secondary mineral content in basic igneous rock	25% Maximum	AS 1141.26
Accelerated soundness index by reflux	94% Minimum	AS 1141.29

Notes:

- 1) The Secondary Mineral Content in Basic Igneous Rock test in Table 8 is only applicable to basic igneous rock.
- 2) The Accelerated Soundness Index test in Table 8 is only applicable to basic igneous rock.

5.3 Type 2.3 Gravel Basecourse Material

5.3.1 Applications

Type 2.3 Gravel basecourse material is suitable for use on roads with a design traffic loading of less than 5×10^6 ESAs in arid or semi-arid hot or warm areas of the state. It is also suitable for use on roads with a design traffic of less than $\times 10^6$ ESAs in sub-humid hot and sub-humid warm areas of the state (See map in Annexure B for suitable areas).



5.3.2 General

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. Basecourse material having any particle dimension greater than 50 mm shall be deemed oversized and shall not be accepted.

5.3.3 Particle Size Distribution

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 9. 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, and shall conform as closely as possible to the specified target grading.

Table 9: Type 2.3 Basecourse Particle Size Distribution

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5		100
19.0	100	95-100
9.5	75	50-100
4.75	58	36-81
2.36	45	25-66
1.18	35	18-53
0.425	25	11-39
0.075	13	4-23
0.0135	6	2-11

5.3.4 Other Acceptance Limits

The material shall also comply with the limits shown in Table 10.

Table 10: Type 2.3 Gravel Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.3 to 0.7	-
Liquid limit	30% Maximum	WA 120.2
Plasticity Index	10% Maximum	WA 120.2
Linear Shrinkage	5% Maximum	WA 123.1
Maximum Dry Compressive Strength	1.7 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
$P_{0.425} \times$ Linear Shrinkage	200 Maximum	-
Secondary mineral content in basic igneous rock	25% Maximum	AS 1141.26
Accelerated soundness index by reflux	94% Minimum	AS 1141.29

Notes:

- 1) The Secondary Mineral Content in Basic Igneous Rock test in Table 5.03.02 is only applicable to basic igneous rock.
- 2) The Accelerated Soundness Index test in Table 5.03.02 is only applicable to basic igneous rock.



5.4 Type 2.4 Gravel Basecourse Material

5.4.1 Applications

Type 2.4 Gravel basecourse material is suitable for use on roads with a design traffic loading of less than 5×10^5 ESAs in arid hot, arid warm areas of the state, less than 10^5 ESAs in semi-arid hot areas of the state and less than 5×10^4 ESAs in semi-arid warm areas of the state (See map in Annexure B for suitable areas).

5.4.2 General

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. Basecourse material having any particle dimension greater than 50 mm shall be deemed oversize and shall not be accepted.

5.4.3 Particle Size Distribution

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 11. 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, and shall conform as closely as possible to the specified target grading.

Table 11: Type 2.4 Basecourse Particle Size Distribution

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5		100
19.0	100	95-100
9.5	75	50-100
4.75	58	36-81
2.36	45	25-66
1.18	35	18-53
0.425	25	11-39
0.075	13	4-23
0.0135	6	2-11



5.4.4 Other Acceptance Limits

The material shall also comply with the limits shown in Table 12.

Table 12: Type 2.4 Gravel Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.3 to 0.7	-
Liquid limit	35% Maximum	WA 120.2
Plasticity Index	16% Maximum	WA 120.2
Linear Shrinkage	8% Maximum	WA 123.1
Maximum Dry Compressive Strength	1.7 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
$P_{0.425} \times$ Linear Shrinkage	250 Maximum	-
Secondary mineral content in basic igneous rock	25% Maximum	AS 1141.26
Accelerated soundness index by reflux	94% Minimum	AS 1141.29

Notes:

- 1) The Secondary Mineral Content in Basic Igneous Rock test in Table 12 is only applicable to basic igneous rock.
- 2) The Accelerated Soundness Index test in Table 12 is only applicable to basic igneous rock.

5.5 Type 2.5 Gravel Basecourse Material

5.5.1 Applications

Type 2.5 Gravel basecourse material is suitable for use on most local government roads with a design traffic loading of less than 5×10^6 ESAs.

5.5.2 General

Gravel basecourse material shall consist of durable laterite 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. Basecourse material having any particle dimension greater than 50 mm shall be deemed oversize and shall not be accepted.

5.5.3 Particle Size Distribution

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 13. 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, and shall conform as closely as possible to the specified target grading.

Table 13: Type 2.5 Basecourse Particle Size Distribution

As Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
19.0	100	100
4.75	58	45-65
2.36	45	30-50
0.425	25	12-30
0.075	13	0-12



5.5.4 Other Acceptance Limits

The material shall also comply with the limits shown in Table 14.

Table 14: Type 2.5 Gravel Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.4 to 0.67	-
Plastic Limit	20% Maximum	WA 120.2
Liquid limit	25% Maximum	WA 120.2
Plasticity Index	5% Maximum	WA 120.2
Linear Shrinkage	1% Maximum	WA 123.1
Maximum Dry Compressive Strength	1.7 MPa Minimum	WA140.1
California Bearing Ratio (Soaked 4 days) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
$P_{0.425} \times$ Linear Shrinkage	250 Maximum	-
Secondary mineral content in basic igneous rock	25% Maximum	AS 1141.26
Accelerated soundness index by reflux	94% Minimum	AS 1141.29

Notes:

- 1) The Secondary Mineral Content in Basic Igneous Rock test in Table 14 is only applicable to basic igneous rock.
- 2) The Accelerated Soundness Index test in Table 14 is only applicable to basic igneous rock.

6.0 FERRICRETE BASECOURSE MATERIALS

6.1 Type 3.1 Ferricrete Basecourse Material

6.1.1 Application

Type 3.1 Ferricrete basecourse material is generally suitable for use on most roads except freeways and controlled access highways.

6.1.2 Source Rock

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 50%. The material shall be generally free from organic matter and other deleterious materials.

The source rock shall also conform to the following limits shown in Table 15.

Table 15: Source Rock Acceptance Limits (Ferricrete Basecourse)

Test	Limits	Test Method
Los Angeles Abrasion Value	60% Maximum	WA 220.1

6.1.3 Particle Size Distribution

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 16. 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, and shall conform as closely as possible to the specified target grading.



Table 16: Type 3.1 Ferricrete Basecourse Particle Size Distribution

AS Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5	100	100
19	80	72-100
9.5	57	50-78
4.75	43	36-58
2.36	31	25-44
1.18	23	18-35
0.600	18	13-28
0.425	15	11-25
0.300	13	9-22
0.150	9	6-17
0.075	7	4-13
0.0135	4	2-9

6.1.4 Other Acceptance Limits

The material shall also conform to the following limits shown in Table 17.

Table 17: Type 3.1 Ferricrete Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.3 to 0.7	-
Liquid limit	25% Maximum	WA 120.2
Linear Shrinkage	2% 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) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Flakiness Index	20% Maximum	WA 216.1

6.2 Type 3.2 Ferricrete Basecourse Material

6.2.1 Application

Type 3.2 Ferricrete basecourse material is suitable for use on roads with a design traffic loading of up to 5×10^6 ESAs.

6.2.2 Source Rock

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 50%. The material shall be generally free from organic matter and other deleterious materials.

The source rock shall also conform to the following limits shown in Table 18.



Table 18: Source Rock Acceptance Limits (Ferricrete Basecourse)

Test	Limits	Test Method
Los Angeles Abrasion Value	60% Maximum	WA 220.1

6.2.3 Particle Size Distribution

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 19. 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, and shall conform as closely as possible to the specified target grading.

Table 19: Type 3.2 Ferricrete Basecourse Particle Size Distribution

AS Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5	100	100
19	74	71-100
9.5	54	50-81
4.75	40	36-66
2.36	29	25-53
1.18	21	18-43
0.425	13	11-32
0.075	6	4-19
0.0135	3	2-9

6.2.4 Other Acceptance Limits

The material shall also conform to the following limits shown in Table 20.

Table 20: Type 3.2 Ferricrete Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.3 to 0.7	-
Liquid limit	25% Maximum	WA 120.2
Linear Shrinkage	3% 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) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Flakiness Index	20% Maximum	WA 216.1



6.3 Type 3.3 Ferricrete Basecourse Material

6.3.1 Application

Type 3.3 Ferricrete basecourse material is suitable for use on most local government roads.

6.3.2 Source Rock

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 60%. The material shall be generally free from organic matter and other deleterious materials.

The source rock shall also conform to the following limits shown in Table 21.

Table 21: Source Rock Acceptance Limits (Ferricrete Basecourse)

Test	Limits	Test Method
Los Angeles Abrasion Value	45% Maximum	WA 220.1
Point Load Index I50 (average of tests on 20 samples)	0.5 MPa Minimum	AS 4133.4.1

6.3.3 Particle Size Distribution

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 22. 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, and shall conform as closely as possible to the specified target grading.

Table 22: Type 3.3 Ferricrete Basecourse Particle Size Distribution

AS Sieve Size (mm)	% Passing by Mass Target Grading	% Passing by Mass Minimum and Maximum Limits
37.5	100	100
19	74	71-100
9.5	54	50-81
4.75	40	36-66
2.36	29	25-53
1.18	21	18-43
0.425	13	11-32
0.075	6	4-19
0.0135	3	2-9

6.3.4 Other Acceptance Limits

The material shall also conform to the following limits shown in Table 23.



Table 23: Type 3.3 Ferricrete Basecourse Other Acceptance Limits

Test	Limits	Test Method
Dust Ratio (% passing 0.075 mm sieve/% passing 0.425 mm sieve)	0.4 to 0.6	-
Liquid limit	30% Maximum	WA 120.2
Plasticity Index	6% Maximum	WA 120.2
Linear Shrinkage	3% 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) at 96% of MDD and 100% of OMC	80% Minimum	WA 141.1
Flakiness Index	20% Maximum	WA 216.1

7.0 STABILISED BASECOURSE MATERIALS

7.1 Type 4.1 Bitumen Stabilised Limestone Basecourse Material

7.1.1 Application

Bitumen stabilised limestone (Tamala limestone) basecourse material is suitable for use on all classes of road except freeways and controlled access highways.

7.1.2 General

Bitumen stabilised limestone (BSL) shall be produced by the addition of 2.0% residual bitumen by dry mass of crushed limestone material as specified in this Clause. The limestone shall be free from sand, roots and other foreign material.

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 unless otherwise agreed by the WALGA Member Representative. The bitumen used in the manufacture of the emulsion shall be class 170 bitumen conforming to AS 2008, Residual Bitumen for Pavements. Contractors shall nominate the source of supply of bitumen emulsion with their quotation. 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.

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 L of wetting agent per 4000 L of water used.

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% 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.

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.

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.



Prior to modification of the basecourse, the Contractor shall give the Superintendent at least three (3) working days notice of such modification.

7.1.3 Particle Size Distribution

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 24.

Table 24: Type 4.1 BSL Particle Size Distribution

As Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
26.50	100
19.00	90-100
4.75	60-90
1.18	35-75
0.075	0-15

7.1.4 Other Acceptance Limits

The Bitumen Stabilised Limestone shall also meet the other acceptance limits as shown in Table 25

Table 25: Type 4.1 BSL Other Acceptance Limits

Test	Limits	Test Method
Los Angeles Abrasion Value of Crushed Limestone	20% Minimum 60% Maximum	WA 220.2
Calcium Carbonate Content	60% Minimum 80% Maximum	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
Maximum Dry Compressive Strength (unconfined, cured for 1 day and oven dried for 16 hours)	10.5 kPa Minimum	WA 140.1

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.

8.0 SUB-BASE MATERIALS

8.1 Type 5.1 Gravel Sub-Base Material

8.1.1 General

Gravel sub-base material shall consist of durable pebble in 4soil 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.

8.1.2 Particle Size Distribution

The sub-base material shall meet the grading requirements shown in Table 26 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.



Table 26: Type 5.1 Gravel Sub-Base Particle Size Distribution

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

8.1.3 Other Acceptance Limits

The material shall also comply with the limits shown in Table 27.

Table 27: Type 5.1 Gravel Sub-Base Other Acceptance Limits

Test	Limits	Test Method
Liquid limit	30% Maximum	WA 120.2
Plasticity Index	10% Maximum	WA 122.1
Linear Shrinkage	4% Maximum	WA 123.1
California Bearing Ratio (Soaked 4 days) at 94% of MDD and 100% of OMC	30% Minimum	WA 141.1

8.2 Type 5.2 Crushed Limestone Sub-Base Material

8.2.1 General

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

Note Type 5.2 Crushed Limestone Sub-Base Material may be used as a basecourse material on very low traffic roads where the performance of material from a known source has been proven to provide satisfactory performance for this type of use.

8.2.2 Particle Size Distribution - WA 115.1

The material shall comply with the grading limits shown in Table 28.

Table 28: Type 5.2 Crushed Limestone Sub-Base Particle Size Distribution

AS Sieve Size (mm)	% Passing by Mass Minimum and Maximum Limits
75	100
19	55-85
2.36	35-65
0.075	0-15



8.2.3 Other Acceptance Limits

The material shall also comply with the limits shown in Table 29.

Table 29: Type 5.2 Crushed Limestone Sub-Base Other Acceptance Limits

Test	Limits	Test Method
Los Angeles Abrasion Value of Crushed Limestone	20% Minimum 60% Maximum	WA 220.2
Calcium Carbonate Content	60% Minimum 80% Maximum	WA 915.1
California Bearing Ratio (Soaked 4 days) at 94% of MDD and 100% of OMC	50% Minimum	WA 141.1

9.0 MATERIAL QUALITY

The pavement material supply Contractor shall implement a quality control system to ensure material supplied under this contract complies in all respects to the specified requirements for the type of material purchased.

The quality system shall include the minimum testing requirements given in Table 30 unless otherwise approved by the WALGA Member.

Testing shall be carried out in accordance with the relevant Main Roads or equivalent Australian Standard test method. Unless otherwise approved by the WALGA Member all Test Reports/Certificates shall be NATA endorsed.

Prior to the supply of any material the Contractor shall certify that material supplied by the Contractor complies in all respects with the specified requirements and shall provide test certificates that demonstrate compliance.

The Contractor shall provide ready access of WALGA Member representative to inspect the quarry, pit or production and or manufacturing site and to take samples.



WALGA SPECIFICATION 1 - GRANULAR PAVEMENT MATERIALS

Table 30: Minimum Testing Frequency

Sub-Base	<u>for control of SUB-BASE SUPPLIED BY THE CONTRACTOR:</u>	
	• PSD (WA 115.1)	1 per 1,000 m ³ of stockpile
	• LA Abrasion (WA 220.2)	1 per 5,000 m ³ of stockpile
	• CaCO ₃ (WA 915.1)	1 per 5,000 m ³ of stockpile
	• MDCS (WA 140.1)	1 per 5,000 m ³ of stockpile
	• Liquid Limit (WA 120.2)	1 per 1,000 m ³ of stockpile
	• Plasticity Index (WA 122.1)	1 per 1,000 m ³ of stockpile
	• Linear Shrinkage (WA 123.1)	1 per 1,000 m ³ of stockpile
	• Soaked CBR (WA 141.1)	1 per 5,000 m ³ of stockpile
Basecourse	<u>FOR CONTROL OF BASECOURSE SUPPLIED BY THE CONTRACTOR</u>	
	• PSD (WA 115.1)	1 per 1,000m ³ of stockpile
	• LA Abrasion (WA 220.1)	1 per 5,000m ³ of stockpile
	• Flakiness Index (WA 216.1)	1 per 5,000m ³ of stockpile
	• CaCO ₃ (WA 915.1)	1 per 5,000m ³ of stockpile
	• MDCS (WA 140.1)	1 per 5,000m ³ of stockpile
	• Liquid Limit (WA 120.2)	1 per 1,000m ³ of stockpile
	• Plasticity Index (WA 122.1)	1 per 1,000m ³ of stockpile
	• Linear Shrinkage (WA 123.1)	1 per 1,000m ³ of stockpile
	• Dust Ratio (Contract)	1 per 1,000m ³ of stockpile
	• Soaked CBR (WA 141.1)	1 per 5,000m ³ of stockpile
	• Wet/Dry Strength Variation (AS 1141.22)	1 per 5,000m ³ of stockpile
	• Secondary mineral content in basic igneous rock (AS 1141.26)	1 per 10,000m ³ of stockpile
	• Accelerated soundness index by reflux (AS 1141.29)	1 per 10,000m ³ of stockpile
	• PSD & Bitumen Content (WA 730.1)	1 per 5,000m ³ of stockpile
	• LA Abrasion for bitumen stabilised limestone (WA 220.2)	1 per 5,000m ³ of stockpile
	• Bitumen Emulsion (AS 1160)	1 per 10,000m ³ of stockpile
	• Bitumen Dispersion (WA 717.1)	1 per 1,000m ³ of stockpile
	• Emulsifiers & Wetting Agents (as per Tech Spec)	Information to be provided by the Supplier



10.0 SUPPLY OF MATERIALS

The source of the pavement materials supplied by the Contractor shall be nominated with the quotation.

Where specified, the Contractor shall supply the materials into nominated stockpile sites at the time specified by the WALGA Member and shall make all necessary arrangements with the WALGA Member Representative concerning load size, rate for supply, timing of the delivery and documentation. Different material types shall be placed in clearly identified and separate stockpiles.

Any contamination of material during delivery or stockpiling that is due in any way to the Contractor's activities shall be corrected at no cost to the WALGA Member.

Where specified, the Contractor shall provide for the WALGA Member to have ready access to the quarry or pit and shall load the WALGA Member trucks with the specified material.

11.0 REGULATORY REQUIREMENTS

The Contractor shall conform to all statutory and regulatory requirements concerning the environment, aboriginal heritage, wildlife conservation, dangerous goods, occupational safety and health, rail safety, and road safety.



12.0 ANNEXURE A1 – SCHEDULE OF RATES

The quantities in this Schedule of Rates are the estimated quantities of the Works and are not to be taken as the actual or correct quantities. The Contractor shall be paid for the measured quantity of each section or item of work described below and executed under the contract at the rates and amounts entered applicable thereto.

Item	Description	Unit	Qty	Rate (i)	Amount	
					\$	¢
1	Type 1.1 CRB	m ³				
2	Type 1.2 CRB	m ³				
3	Type 2.1 Gravel	m ³				
4	Type 2.2 Gravel	m ³				
5	Type 2.3 Gravel	m ³				
6	Type 2.4 Gravel	m ³				
	Type 2.5 Gravel	m ³				
	Type 3.1 Ferricrete	m ³				
	Type 3.2 Ferricrete	m ³				
	Type 3.3 Ferricrete	m ³				
	Type 4.1 BSL	m ³				
	Type 5.1 Gravel Sub-base	m ³				
	Type 5.2 Crushed Limestone Sub-base	m ³				
	Cartage	m ³ /km				
GST EXCLUSIVE TOTAL						
GST AMOUNT						
TOTAL AMOUNT OF QUOTE						

Note (i): Rate to include all overheads, incidentals, mobilisation and demobilisations, testing and aggregate loading.



13.0 ANNEXURE A2 – PRICE SCHEDULE (LUMP SUM BILL OF QUANTITIES)

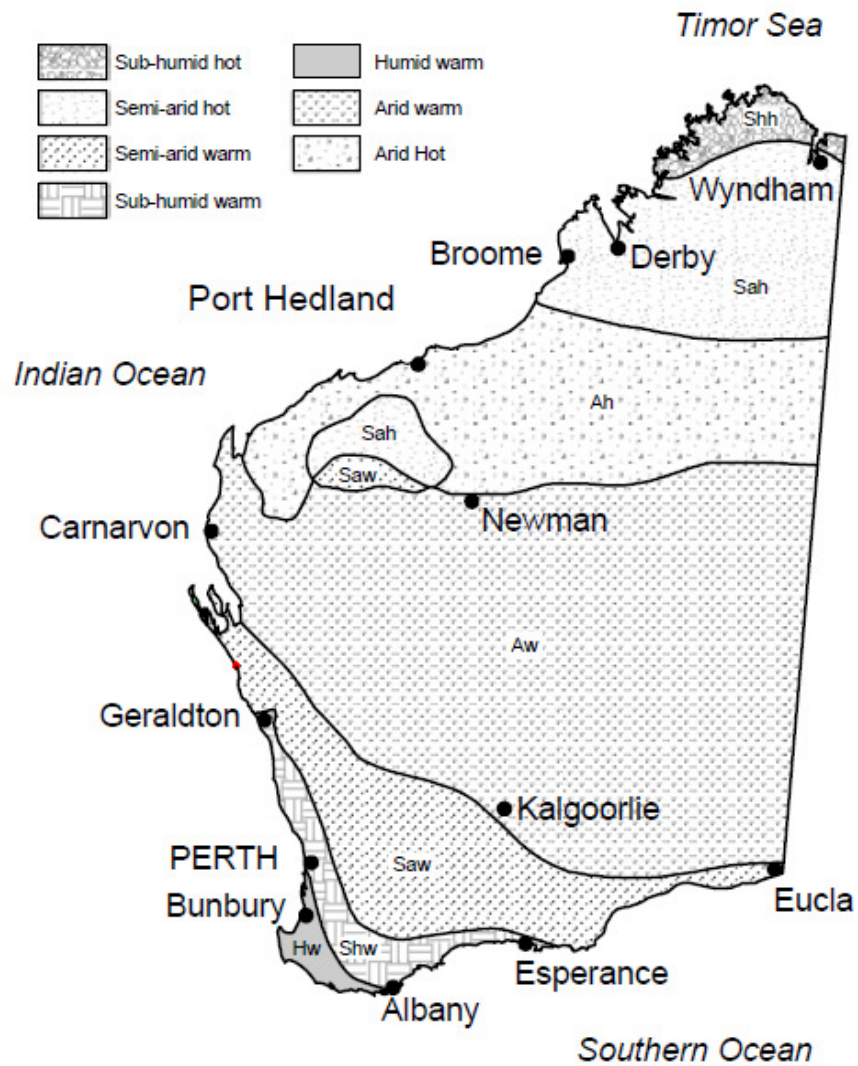
All items in this Bill of Quantities shall be priced and extended by the Contractor and the lump sum accepted by the WALGA Member shall equal the TOTAL AMOUNT GST INCLUSIVE. Any errors in the rates or prices entered in this Schedule shall be corrected by agreement between the Contractor and the WALGA Member. Where no agreement can be reached, any errors shall be corrected as determined by the WALGA Member so that the total amount of quotation for all items in this Schedule continues to equal the lump sum accepted by the WALGA Member.

Item	Description	Unit	Qty	Rate (i)	Amount	
1	Type 1.1 CRB	m ³			\$	¢
2	Type 1.2 CRB	m ³				
3	Type 2.1 Gravel	m ³				
4	Type 2.2 Gravel	m ³				
5	Type 2.3 Gravel	m ³				
6	Type 2.4 Gravel	m ³				
	Type 2.5 Gravel	m ³				
	Type 3.1 Ferricrete	m ³				
	Type 3.2 Ferricrete	m ³				
	Type 3.3 Ferricrete	m ³				
	Type 4.1 BSL	m ³				
	Type 5.1 Gravel Sub-base	m ³				
	Type 5.2 Crushed Limestone Sub-base	m ³				
	Type 1.1 CRB	m ³				
	Type 1.2 CRB	m ³				
	Type 2.1 Gravel	m ³				
	Type 2.2 Gravel	m ³				
	Type 2.3 Gravel	m ³				
	Type 2.4 Gravel	m ³				
	Type 2.5 Gravel	m ³				
	Type 3.1 Ferricrete	m ³				
	Type 3.2 Ferricrete	m ³				
	Type 4.1 BSL	m ³				
	Type 5.1 Gravel Sub-base	m ³				
	Type 5.2 Crushed Limestone Sub-base	m ³				
	Cartage	m ³ /km				
GST EXCLUSIVE TOTAL						
GST AMOUNT						
TOTAL AMOUNT OF QUOTE						

Note (i): Rate to include all overheads, incidentals, mobilisation and demobilisations, testing and aggregate loading.



14.0 ANNEXURE B - GRAVEL TYPE SELECTION FOR CLIMATIC REGIONS AND TRAFFIC



Climatic Regions of Western Australia
Thornthwaite's Method (After Gentilli 1972)



Gravel Type Selection for Climatic Regions and Traffic

Climatic Region	Traffic Loading (ESAs)				
	$\leq 5 \times 10^6$	$\leq 10^6$	$\leq 5 \times 10^5$	$\leq 10^5$	$\leq 5 \times 10^4$
	Type of Gravel				
Sub-humid hot	2.2	2.2	2.2	2.3	2.3
Semi-arid hot	2.3	2.3	2.3	2.4	2.4
Arid hot	2.3	2.3	2.4	2.4	2.4
Arid warm	2.3	2.3	2.4	2.4	2.4
Semi-arid warm	2.3	2.3	2.3	2.3	2.4
Sub-humid warm	2.2	2.2	2.2	2.3	2.3
Humid warm	2.2	2.2	2.2	2.2	2.2

Note gravel selection in accordance with these criteria assumes that the pavement will be well drained and not subject to inundation.



Report Signature Page

GOLDER ASSOCIATES PTY LTD

Reg Leach
Senior Consultant - Pavements and Surfacing

RDL/DK/shp

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