LG TRRIP

Local Government Transport & Roads Research & Innovation Program

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Practitioners Guideline: Considerations for Sealing Local Government Roads in WA

Author: Georgia O'Connor, Jeremy van Dijk, Peter Awad and Tyrone Toole

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About LG TRRIP

The Local Government Transport and Roads Research and Innovation Program (LG TRRIP) is an initiative between Main Roads Western Australia and the Western Australian Local Government Association.

LG TRRIP has a strategic commitment to the delivery of collaborative research and development that positively contributes to the design, construction and maintenance of safe, sustainable transport infrastructure in Western Australia.

Summary

This *Practitioners Guideline: Considerations for sealing local government roads in WA* presents on a multi-step process where a user provides key inputs which define the candidate road section subject to review to determine its viability for sealing, and a strategy for the section. It is supported by a detailed technical basis document – *Technical report: considerations for sealing local government roads in WA* which documents the creation of a selection process and supporting reviews.

A key consideration for Local Government in Western Australia in managing their networks is the impact of vehicle traffic on both sealed and unsealed local roads, and the associated cost of road upkeep and costs to road users. Increasingly over time, there has been greater utilisation of unsealed local roads by heavy vehicles and light traffic resulting from increased traffic from various sources, including general use through subdivision growth, industry, and local tourism. This has had a direct impact on the condition of the roads concerned. As a result, local governments are facing significant increases in costs due to road wear. The aim of this guideline is to equip Local Government Agencies with the necessary information to make informed decisions regarding the sealing of unsealed roads within their jurisdiction.

The guideline adopts a practical multi-step user-oriented approach to selecting a specific solution for a candidate road section based on a catalogue of solutions which provide a basis for selecting an upgrade solution, or retaining the candidate as a maintained unsealed road for the foreseeable future. This methodology provides solutions which have whole of life cycle costs and benefits embedded. This accounts for maintenance, rehabilitation and upgrade decisions, rather than focussing solely on upfront upgrade costs and maintenance costs. The approach covers comparative assessments of the continuation (and potentially optimisation) of the management of an unsealed road and options for sealing the road accounting for the following factors:

- Road category.
- Climate zone.
- Cost level, representing the cost of upgrade to seal reflecting the standard of construction and location which can influence project cost.
- Quality of unsealed road maintenance practice where the applied techniques and materials impact performance and upkeep costs.
- Initial traffic counts, including the proportion of heavy vehicles, with future 'normal' traffic growth, and accounting for diverted and generated traffic.

By implementing the process detailed in this guideline local government can undertake comprehensive analysis of the potential benefits and drawbacks of sealing unsealed roads, taking into consideration the whole-of-life cost implications, likely impacts of traffic generated by new developments, and quantifiable safety benefits.

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NTRO – YOUR NATIONAL TRANSPORT RESEARCH ORGANISATION

ABN 68 004 620 651
National Transport Research Centre and Head Office: 80a Turner St, Port Melbourne, 3207 VIC, Australia
With offices in Perth, Brisbane, Sydney, Adelaide, and Canberra.
arrb.com.au

Acronyms and Glossary

Acronyms

AADT	Annual Average Daily Traffic
C	Compliant
CLOS	Customer-based Levels of Service
GC	Grading Coefficient
HV	Heavy Vehicle
LGA	Local Government Agency
LG TRRIP	Local Government Transport and Roads Research and Innovation Program
LVU	Light Vehicle Unit
MBCR	Marginal Benefit Cost Ratio
MRWA	Main Roads Western Australia
NC	Non-compliant
NTRO	National Transport Research Organisation
PCU	Passenger Car Unit
RAC	Road Agency Costs
RUC	Road User Costs
TTC	Total Transport Costs
WALGA	Western Australian Local Government Association

Glossary of Terms

Alternative upgrade	This level indicates a standard quality upgrade based on design traffic from an unsealed road to a sealed road but using desirable 'preventative' intervention levels for cracking, rutting and roughness and intervening on the basis of structural strength when the strength is 59% of the original in-service strength.
Annual Average Daily Traffic	The total volume of traffic passing a roadside observation point over the period of a calendar year, divided by the number of days in that year (365 or 366 days) (Austroads 2015).
Base upgrade	This level signifies a standard quality upgrade based on design traffic from an unsealed road to a sealed road but using delayed intervention levels for cracking, rutting and roughness and not intervening on the basis of structural strength.
Good practice	Good practice is where medium or heavy grading is applied involving cutting and reshaping of the surface (> 50 mm depth) under moist conditions with a minimum of free-roller or traffic compaction, or mechanical compaction.
Heavy vehicle	A two-axle vehicle with the minimum axle spacing greater than 3.2 m, or a three- or more-axle vehicle configured at least with two axle groups (excluding short towing vehicles, e.g. trailer, caravan, boats, etc.) (Austroads 2015).
High cost	Representing parts of the State more than 250 kilometres from Perth, generally including the Gascoyne, Pilbara and Kimberly regions, Goldfields-Esperance, and other locations.
Non-compliant practice	High rate of material loss (> 20 – 40 mm per year per 100 AADT) with surface ravelling and corrugations common under traffic in drier conditions and an SP below 100, whereas the Grading Coefficient (GC) may vary widely. Uniformly graded fine materials with a low GC display low resistance to erosion and coarsely graded higher GC materials tend to ravel badly and are generally unsuitable. Similar rates of gravel loss may also where the SP is above 600 with the surface tending to rut and become slippery in the wet. Performance can improve with regular grading/cushioning operations.
Sealed road	Sealed local roads have a pavement structure which, in many instances, has evolved over time rather than having been designed and upgraded according to systematic procedures. In general, the main pavement structure is a flexible pavement consisting of unbound layers with a surface of spray seal or asphaltic mix (ARRB 2020).
Typical cost	Representing locations where good access to materials and services exists, typically representing locations in the Outer Metropolitan, South West and parts of Mid-West, Wheatbelt South and Wheatbelt North, and Great Southern within 250 km of Perth.
Typical Practice	Typical practice is where light grading involving minimal cutting and reshaping (< 25-50 mm depth) of the surface or respreading of loose material is applied in mainly dry conditions, in the absence of moisture and without any compaction applied.

Unsealed Road	An unsealed road is a road that has been formed and constructed but is not sealed (ARRB 2020).
Whole-of-life costs	Takes into account the road agency costs described under life-cycle cost as well as road user costs. In an ideal scenario where the road budget is not constrained, the total cost to the community could be minimised by optimising road agency costs and road user costs. In reality, the majority of road agencies operate in an environment where the total of road agency and road user costs is suboptimal (Austroads 2015).

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1 Introduction

A key consideration for local government in Western Australia is the impact of vehicle traffic on both sealed and unsealed local roads, and the associated costs of road upkeep and the costs to road users. Increasingly over time, there has been greater utilisation of unsealed local roads by heavier axle loads and axle configurations and light traffic resulting from an increase in traffic related to various sources, including general use through subdivision growth, industry, and local tourism. This has had a direct impact on the condition of the roads and, as a consequence, local government is facing significant increases in costs from road wear.

Previous local research in this space has focused on the impacts of additional freight tasks on sealed and unsealed roads, with these informed by national and international research findings. These studies resulted in the development of guides to determine the cost of road wear related to heavy vehicle usage to inform the contribution from operators that local government agencies (LGAs) could use to maintain local roads. However, whilst heavy freight impacts are well documented, there is no specific guidance for local government in terms of when an unsealed road should be sealed as a result of increased traffic.

For regional local government agencies (LGAs) it is important to consider all of these factors to ensure good planning, including the need to determine all sources of costs and whether the direct infrastructure-related costs should be borne solely by the LGA or whether a user-related charge or development contribution is appropriate.

Given the complexity of the factors to be accounted for in evaluating unsealed roads and the justification for an upgrade, LGAs would benefit from guidance and further research in this area so that timely, planned upgrades of roads can occur in a transparent, fair and well considered manner. This has led to a need for an extension of existing studies to better understand the impacts associated with all the varying factors.

Improving the performance and management of Western Australia's extensive unsealed road network would result in improved safety, ride quality, reduced road use costs and lower whole of life-cycle costs of the network (ARRB 2020).

This *Practitioners guideline: considerations for sealing local government roads in WA* has been developed by the National Transport Research Organisation (NTRO) for the Western Australian Local Government Association (WALGA) with the support of Main Roads Western Australia (MRWA) under the Local Government Transport and Roads Research and Innovation Program (LG TRRIP).

LG TRRIP was established in 2022 by MRWA and WALGA as a research and innovation program dedicated to the needs of the local government road network in Western Australia (WA). The objective of the program is to achieve better implementation of innovative practice by improving the specialist capability of local government through a collaborative program of projects which deliver advanced technology and cost-effective solutions to roads and transport issues for the people of WA.

To assist in the development of this guideline, a technical report was developed which included (LG TRRIP 2023a):

- A literature review to identify previous research, guidelines, and technical documents.
- Subject matter expert discussion to expand on the content of the literature review.
- Stakeholder consultation/request for Information with local government practitioners to identify the current practices and future needs of local government.
- Application of a whole-of-life asset management approach using the information gathered as part of the literature review, stakeholder consultation and a stakeholder workshop. A comprehensive set of analysis cases, and a selection of example studies were also developed that apply a whole-of-life asset management approach in determining when to seal an unsealed road, or when to leave a road unsealed.

1.1 Purpose

The purpose of the *Practitioners guideline: considerations for sealing local government roads in WA* is to equip local government with the necessary information to make informed decisions about the sealing of unsealed roads within their jurisdiction. The Guideline aims to succinctly summarise the technical basis for identifying the potential benefits and drawbacks of sealing unsealed roads, taking into consideration the whole-of-life cost implications, likely impacts of traffic generated by new developments, and quantifiable safety benefits. The Guideline covers a range of loading scenarios and application conditions specific to WA.

The Guideline provides transparency and equity in asset investment decision-making, including the appropriate conditions for the development of approvals and access conditions for freight movements with respect to unsealed road upgrades. It supports forward planning of road upgrades based on anticipated growth in traffic volumes and justify Local Planning Schemes and development contribution planning. Additionally, it provides justifications for user contributions and upgrade conditions related to the approval of access and concessional loading permit applications.

1.2 Structure

The structure of the practitioners guideline is similar to the current WALGA guidelines outlining the steps in investigating and informing cases for an upgrade, with simple illustrated guidance (tables, figures, etc.) to inform the selection of candidate upgrade projects.

The guideline:

- is user friendly and practical
- is linked to the technical report (LG TRRIP 2023a)
- provides a summarised Framework Flowchart of steps in the assessment
- provides a catalogue of solutions
- provides worked examples.

A catalogue of solutions for sealing unsealed roads is provided in Appendix A.

The correct application of this guideline will enable Local Government Agencies (LGAs) to make well-informed decisions about whether to seal unsealed roads and how to proceed in a manner that maximises benefits while minimizing costs and potential negative impacts.

2 Factors Influencing Sealing

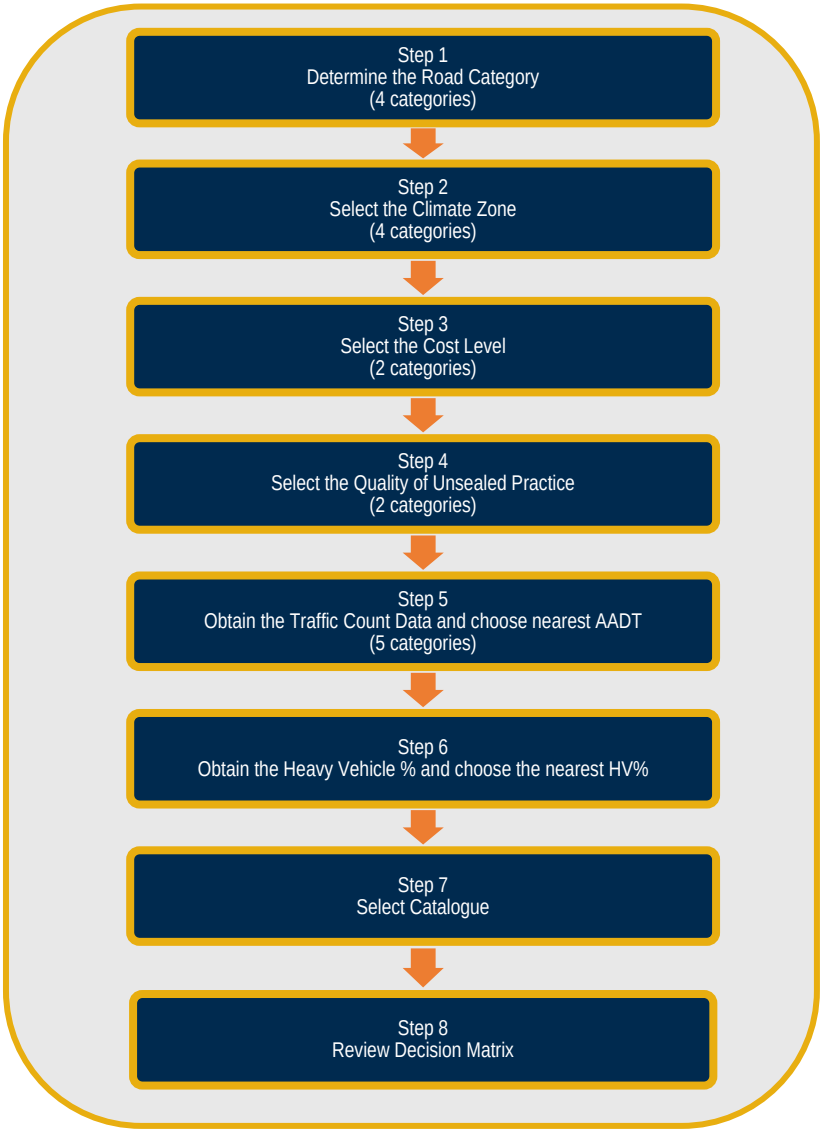
The main factors influencing the decision to seal an unsealed road areas follows.

1. The road condition –the historical deterioration of unsealed road networks, predicting future conditions, and assessing current conditions through deterioration modelling and works effects modelling. The performance of unsealed road materials was also evaluated.
2. Traffic levels and the composition of traffic (i.e. types of vehicles) on unsealed road networks.
3. Environmental factors such as soil reactivity, stability, erosion, sedimentation, roadside vegetation, biodiversity, and wildlife protection
4. The impact of climate and extreme weather events on unsealed road asset management.
5. The whole-of-life costs associated with unsealed road maintenance and preservation, providing insights into economic evaluations and optimization strategies.
6. Road safety considerations, particularly the potential trade-offs between road safety and increased speed on sealed roads. Reference was made to the *Practitioners guideline: low-cost road safety improvements for rural local government roads in WA* (LG TRRIP 2023b).
7. Community expectations and customer-based levels of service in road maintenance, including public pressure and road user complaints.

3 How to use this Guideline

The guideline is structured around the simple eight-step process illustrated in Figure 3-1. Details for completing each step are presented below. A series of typical worked examples are also presented.

Figure 3-1: Process for selecting an upgrade option for an unsealed road



What information is required?

The user will need the following information:

1. The type and number of vehicles which will utilise the candidate road section. This data can be estimated using reliable traffic count data, and accounting for any seasonal differences in traffic flow or other reasons which impact traffic flows, including traffic generated or diverted following the upgrade.
2. The estimated cost of the upgrade, including all asset components, and accounting for the projected traffic to ensure an adequate pavement design and cross-section.
3. Information on maintenance practices, including the quality of road materials and the effectiveness of grading techniques.

The following sections outline the sequential steps followed in selecting an upgrade strategy, including 'do nothing' other than maintaining the unsealed road.

3.1 Step 1: Determine the Road Category

The user must select the road category from the following list:

- access road
- local distributor
- regional distributor
- district distributor.

The road categories are based on the Main Roads WA classification system (Appendix B). Every local road will fall into one of these categories.

Because of the expected differences in design and intervention standards and the resulting variability in performance of these four road categories, users need to select a category for each candidate road section as the catalogue is associated with defined intervention levels (base and alternative) for each road category.

If the upgrade project traverses multiple road categories or involves multiple road sections with varying characteristics (climate, cost level, unsealed practice, etc.) then these sections of road must be assessed separately (see example in Step 7).

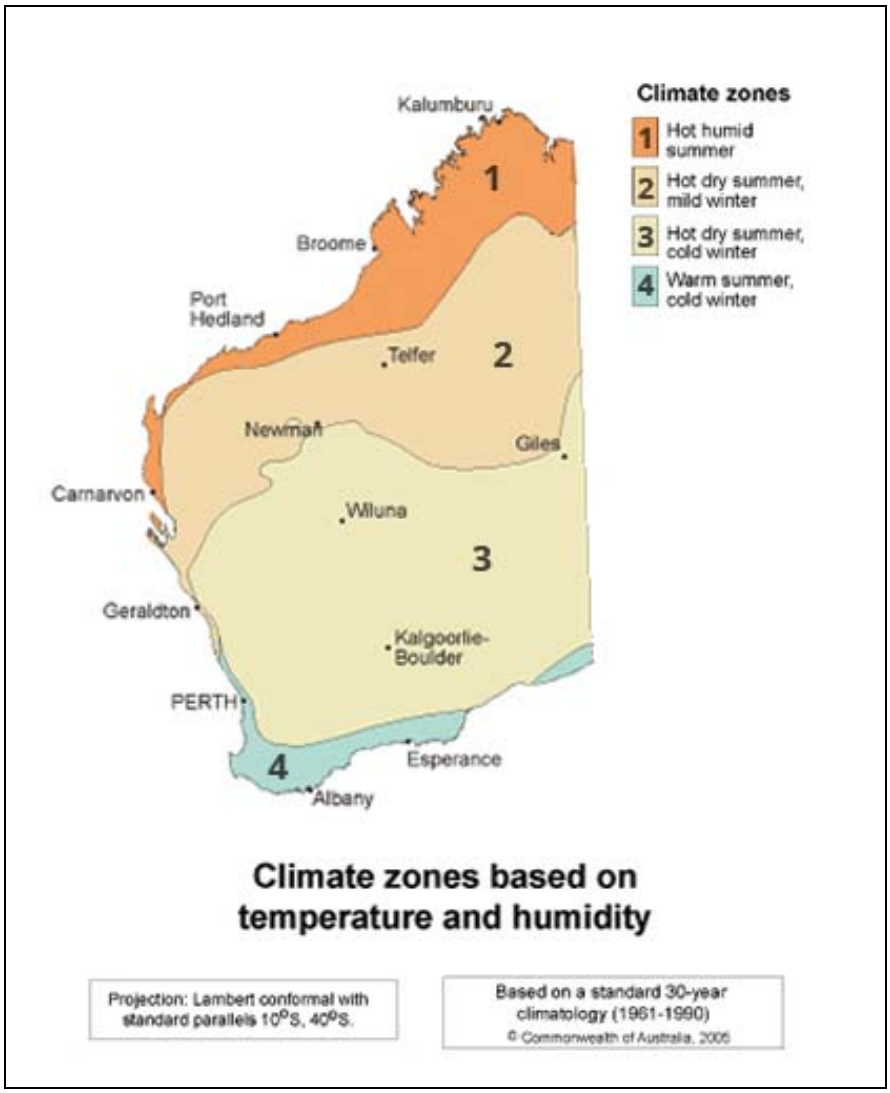
The technical report (LG TRRIP 2023a) provides details of the design traffic that was assigned to each of these categories for model development, and the assigned intervention criteria. Some roads may be constructed to levels that are markedly different to the road category design assumptions and users must adjust their choice accordingly.

3.2 Step 2: Select Climate Zone

The appropriate climate zone must be selected from one of the four zones shown in Figure 3-2, and listed below.

1. Hot humid summer
2. Hot dry summer, mild winter
3. Hot dry summer, cold winter
4. Warm summer, cold winter

Figure 3-2: Climate zones



Source: Bureau of Meteorology (2023).

Appendix B of this guideline contains a list of shires and the assigned closest climate zone.

3.3 Step 3: Select Cost Level

The appropriate cost level must be selected from one of the categories listed below. The upgrade cost is a function of traffic level and HV%, and the required structural strength is based on a 20-year design period incorporating a single traffic growth rate. Assumptions are provided in LG TRRIP (2023a).

- Typical – representing locations where good access to materials and services exists, typically representing locations in the Outer Metropolitan, South West and parts of Mid-West, Wheatbelt South and Wheatbelt North, and Great Southern within 250 km of Perth,
- High – representing other parts of the State including the Gascoyne, Pilbara and Kimberly regions, Goldfields-Esperance, and other locations more than 250 km from Perth.

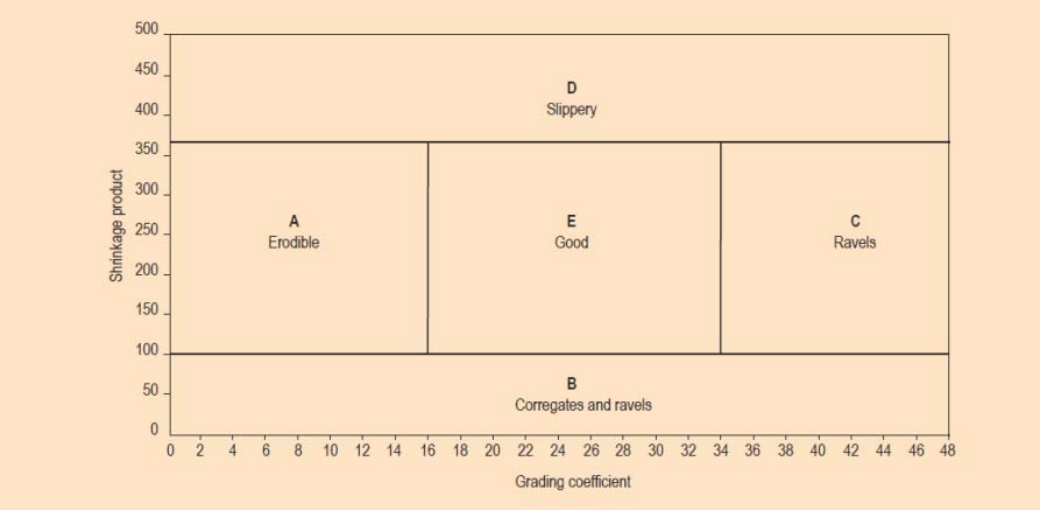
A user may choose to interpolate or extrapolate solutions to account for the cost rates for upgrades in their local government area, or specific to the candidate project.

3.4 Step 4: Select Quality of Unsealed Road Practice

The following two aspects need to be considered when determining the quality of unsealed road practice:

- Compliance of gravel wearing course materials – refers to the materials characteristics relative to a gravel that has optimum characteristics that minimise gravel loss and deformation under traffic. The material grading and plasticity are the two most important performance criteria. Select the appropriate gravel compliance level from the descriptions below, with two categories defined, namely compliant (C) and non-compliant (NC), with the effect being to substantially increase the rate of gravel loss where a non-compliant material is employed, with the aim being to select a material in Zone E of Figure 3-3.
  - Compliant – Low rate of material loss, typically less than 5 – 10 mm per year per 100 AADT, although this can increase up to 20 mm per year under higher annual rainfall. The surface should be well-knit, resulting from a mechanically stable particle size distribution with few weak particles and containing a sufficient quantity of plastic fines. Ideal materials typically have a shrinkage product (SP) greater than 200 with an upper limit of 600 depending on the proportion of heavy traffic and tolerance for dust, and a grading coefficient (GC) of between 20 and 30. Arm-chair type (or gap) gradings are acceptable with concretionary materials, such as calcretes and laterites.
  - Non-compliant – High rate of material loss (> 20 – 40 mm per year per 100 AADT) with surface ravelling and corrugations common under traffic in drier conditions and an SP below 100; the grading coefficient (GC) may vary widely. Uniformly-graded fine materials with a low GC display a low resistance to erosion while coarsely-graded higher GC materials tend to ravel badly and are generally unsuitable. Similar rates of gravel loss may also occur where the SP is above 600 with the surface tending to rut and become slippery in the wet. Performance can improve with regular grading/cushioning operations.
- Grading type and effectiveness – two categories are defined, being typical practice and good practice. The effectiveness of grading (reduction in roughness after grading) is significantly lower under typical practice than good practice, and the rate of roughness progression is significantly greater post grading under typical practice than under good practice. Typical practice is where light grading involving minimal cutting and reshaping (< 50 mm depth) of the surface or respreading of loose material is applied in mainly dry conditions, in the absence of moisture and without any compaction applied. Good practice is where medium or heavy grading is applied involving cutting and reshaping of the surface (> 50 mm depth) under moist conditions with a minimum of free-roller or traffic compaction, or mechanical compaction.

Figure 3-3: Relationship between gravel wearing surface properties and performance



Notes:

1. Shrinkage product = linear shrinkage x % passing the 0.425 mm sieve
2. Grading coefficient = (% passing the 26.5 mm sieve - % passing the 2 mm sieve) x per cent passing the 4.75 mm sieve/100

Source: Paige-Green (1987).

If there are sections of the road with distinctly different gravel quality characteristics, then it may be appropriate to assess these sections independently. In most cases an experienced practitioner will be able to select the appropriate level from a visual inspection. However, if grading and linear shrinkage testing results can be obtained, then Figure 3-3 can be employed in selecting the most appropriate level of compliance.

With respect to grading practices, their effectiveness and deterioration rates usually go hand-in-hand with materials compliance and are reflective of the grading practice and therefore any re-sectioning of a road would only be done based on materials compliance.

3.5 Step 5: Collect Traffic Count Data and Choose Nearest AADT

The user will need to gain a good appreciation of the current level of traffic using the road by arranging traffic surveys or based on well-informed desk studies. Any data collection should account for seasonal flows and concentrations of use, e.g. weekend or holiday use, with data required to be representative of these and an equivalent AADT level computed for the whole year. The average annual daily traffic (AADT) levels accounted for in this guideline are:

- 50
- 100
- 175
- 250
- 500.

The user should select the nearest AADT level when using the catalogue. The catalogues are based on normal traffic growth as explained in LG TRRIP 2023a.

3.6 Step 6: Choose Nearest HV%

Based on the assembled traffic information, which should include the composition in terms of passenger cars and light vehicles and heavy vehicles, the user should select a composition of heavy vehicles (by percentage) nearest to the values below:

- 5%
- 15%
- 25%
- 50%.

The applied value should account for seasonal flows and concentrations of use and employ a value representative of the whole year. The catalogues are based on a defined composition within the heavy vehicles: see assumptions in Appendix A of this guide. For circumstances where this differs significantly guidance is offered later in this guideline on how to select an alternative solution.

3.7 Steps 7 & 8: Select Catalogue & Review Decision Matrix

Using

Table 3-1 (extract from Appendix A), input the road category, climate zone, cost level, quality of unsealed road maintenance practice, then select the applicable chart and choose the solution based on current AADT and HV % from the chart (Table 3-2).

For example:

- Given the following data:
  - Road category – Regional distributor
  - Climate zone – 1
  - Cost level – High
  - Quality of unsealed road maintenance practice – Good.

Select Table A-7 and Table A-14 of this guideline (represented by Table 3-2 and Table 3-3).

1. Then, using

Table 3-1 select the applicable solution for the following current AADT and HV:

- Current AADT = 205 (use 175 as nearest)
- HV % = 23% (use 25% as nearest)
- Solution Test Criterion 1 (from Table 3-2) = apply Base Upgrade, i.e. upgrade justified and should be maintained to base intervention levels.
- Solution Test Criterion 2 (from Table 3-3) = Both base and alternative ('preventative') seal maintenance strategies are strongly viable investments. The LGA may therefore choose either of the two sealed road strategies with this considered based on: a) aiming to fulfil desirable intervention levels to deliver consistent performance standards, and b) minimising costs, in which case intervention levels would be relaxed in favour of the base strategy The fact that b) minimised total transport costs suggests that the desirable standards may be too high.

Table 3-1: Catalogue of solutions – example for regional distributor

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
Regional distributor	1	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7/ Table 3.2	Table A-14 / Table 3.3	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7/ Table 3.2	Table A-14/ Table 3.3	Select solution
	2	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	3	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	4	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution

Note:

- Extract from Appendix A.1.
- * Using AADY & %HV, Select solution: Base Upgrade, Alternative Upgrade, or Not Viable.

Table 3-2: Test Criterion 1: Optimum sealing strategy – decision matrix/good practice/regional distributor (extract Table A-7 of this guide)

			Heavy Vehicle (%)			
			5	15	25	50
Climate Zone 1	Typical Costs	AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
			5	15	25	50
	High Costs	AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

Note: All other road categories., practices, and climate zones are provided in Appendix B.

Table 3-3: Test Criterion 2: Sealing strategy viability matrix / good practice / regional distributor (extract Table A-14 of this guide

Seal + base maintenance 'Base Upgrade'		Seal + preventative maintenance 'Alternative Upgrade'	
	Heavy Vehicle (%)		Heavy Vehicle (%)

Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Viable	Viable	AADT_50	Not Viable	Marginal	Viable	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

3.8 Limitations

Practitioners need to be aware that the solutions presented in the guideline have been developed by modelling a synthetic set of characteristic road sections and upgrade options designed to represent the majority of scenarios likely to be encountered in WA. There are a multitude of variables that will influence the justification for upgrading an unsealed road to a sealed road of, and the solutions provided are only an estimate. Users need to be aware that many factors may render the solutions inappropriate, a number of which are as follows:

2. The catalogue of solutions is based on a synthetic set of characteristic road sections and upgrade options and the user should select the scenario that best fits the circumstances. There may be aspects at a project level that require a review of the calculated cost. Possible examples are:
    a. The upgrade option may differ from the assumed sprayed seal granular pavement adopted throughout the catalogue. Examples include alternative types of road base, including stabilised (cement, lime, bitumen) base as opposed to unstabilised granular bases and asphalt surfacings, and the use of recycled materials, etc.
    b. The upgrade option is required to be designed and constructed to a level that is markedly different to the road class design assumptions employed.
    c. The upgrade option requires other conditions to be considered, e.g. flooding or very weak subgrades, or special/additional drainage assets.
3. The method does not calculate the costs for associated infrastructure, e.g. bridges, culverts and guardrails.
4. The heavy vehicle fleet compositions and loading may differ from the actual composition and loading values employed. Therefore the guideline may not be valid for scenarios that lie well outside the modelled limits.
5. In its current form the guideline does not address differences in geometry, which will alter the scale of road agency costs and road user costs. A separate investigation is warranted noting variations in geometry – e.g. from flat and mostly straight or slightly curvy, to rolling and curvy and hilly or mountainous – will affect both road agency costs (RAC), road user costs (RUC), and crash costs.
6. The unit rates for all cost-based inputs, including infrastructure, vehicle operation and travel time costs, employed in developing the solutions are current for 2023. Provided the relative cost rates are maintained then the solutions should remain valid. However, with the emergence of new vehicle technologies this need not be the case and updating of the catalogue will be necessary.
7. Notwithstanding point 5, guidance is provided to allow the user to account for a number of these conditions by interpolating or extrapolating accordingly, or by accounting for a difference in cost between the options, with the possibility that the optimum solution is changed.

Finally, this guideline has been developed for the WA Local Government road network and the catalogue of solutions (and underlying assumptions) may not be valid in other jurisdictions.

4 Example Calculations

4.1 Worked Example #1

The Town of Port Hedland in the Pilbara Region is developing a five-year investment and asset management plan. This includes a review of their network, accounting for road conditions and traffic levels, upkeep costs, and customer feedback. This is against a background of increased normal and development traffic. The outcome of this review indicated a desire for upgrades from unsealed roads to sealed roads, and justification was sought from available guidance.

One regional distributor road (e.g. Figure 4-1) is of particular interest, as it is a key route connecting to a variety of services for the community and industry. This route has a measured AADT of 205, with 23% HVs. As this regional distributor road is located in the Town of Port Hedland shire, materials and construction costs are high. It is located within climate zone 1. The historical quality of unsealed maintenance practice has been good.

Figure 4-1: Regional distributor road in Pilbara region

Source: Strewe (2020).

Table 4-1: Worked Example #1 – Key Information

Steps	Information	Notes
1. Determine your Road Category	Regional Distributor	
2. Select your Climate Zone	Climate Zone 1	
3. Select your Cost Level	High	
4. Select your Quality of Unsealed Practice	Good	
5. Obtain your Traffic Count Data and choose nearest AADT	205	Round AADT to closest level: 175
6. Obtain your Heavy Vehicle % and choose the nearest HV%	23%	Round HV% to closest level: 25%
7. Select Catalogue	Table A.1	
8. Review Decision Matrices	Table A-7: Test Criterion 1 – Optimum sealing strategy decision matrix/good practice/regional distributor Table A-14: Test Criterion 2 – Sealing strategy viability matrix/good practice/regional distributor	Test Criterion 1 Choose Base Upgrade. Test Criterion 2 Choose Base or Alternative Upgrade

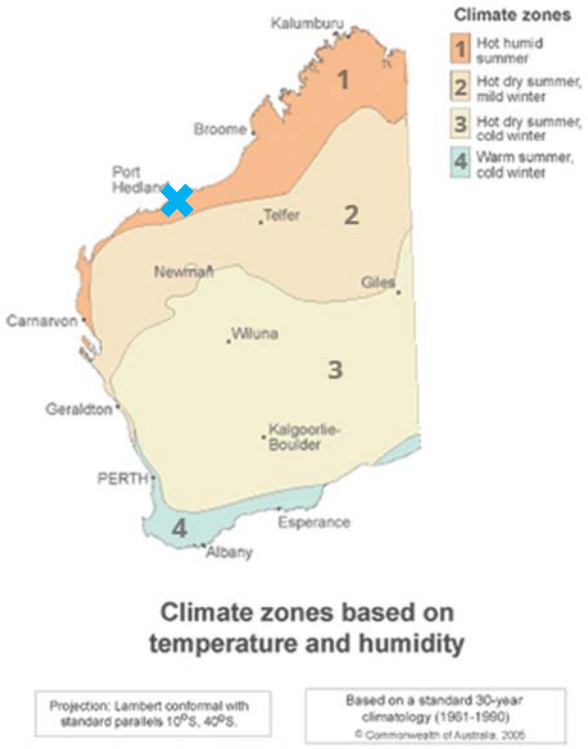
Step 1: Determine Road Category

Select the road category from the following list:

- access road
- local distributor
- regional distributor
- district distributor

Step 2: Select Climate Zone

Select your climate zone using Figure 3-2.



The Town of Port Hedland shire is located in climate zone 1.

Step 3: Select your Cost Level

Select general roads maintenance and construction cost level:

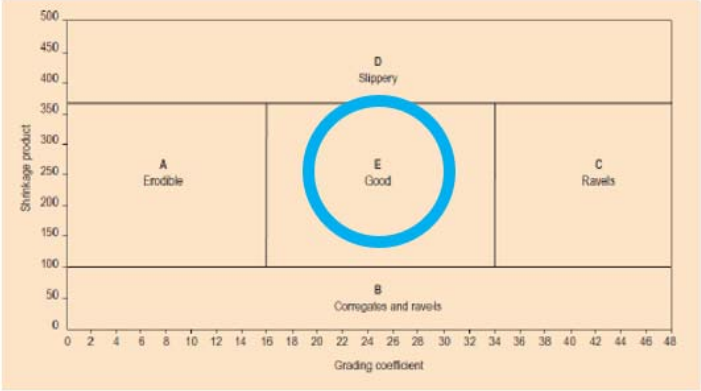
Typical	Representing locations where good access to materials and services exists, typically representing locations in the Outer Metropolitan, South West and parts of Mid-West, Wheatbelt South and Wheatbelt North, and Great Southern within 250 km of Perth.
High	Representing other parts of the State including the Gascoyne, Pilbara and Kimberly regions, Goldfields-Esperance, and other locations more than 250 km from Perth.

Step 4: Select Quality of Unsealed Practice

Determining the level of unsealed practice quality is based on two factors:

- compliance of gravel wearing course materials
- grading type and effectiveness.

Figure 3-3 provides an indication of where ‘good’ materials compliance lies.



This road in the Pilbara uses good quality materials and has good grading practice.

Step 5: Collect Traffic Count Data and choose nearest AADT

This road's AADT has been measured at 205. This is rounded to the nearest category level – 175.

Step 6: Obtain Heavy Vehicle % and choose the nearest HV%

The proportion of heavy vehicles has been measured at 23%. This is rounded to the nearest category level – 25%.

Step 7: Select Catalogue

Using the catalogue table of solutions table (Table A.1), select the rows in each column from left to right to find the applicable decision-making tools.

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
Regional distributor	1	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	2	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	3	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	4	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution

Step 8: Review Decision Matrices

Finally, employing the previously tabulated information, the optimum sealing strategy is identifies using the optimum sealing strategy decision matrix for Test Criterion 1 shown below.

Test criterion 1

Using this road's AADT and HV% levels, the Base Upgrade is the optimal strategy and minimises the lifetime TTC.

Climate zone 1			Heavy Vehicle (%)			
			5	15	25	50
	Typical costs	AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
			5	15	25	50
	High costs	AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

Test criterion 2

Applying the second criterion suggests both the base and alternative ('preventative') seal maintenance strategies are strongly viable investments. The LGA may therefore choose either of the two sealed road strategies based on: a) aiming to fulfil desirable intervention levels to deliver consistent performance standards, and b) minimising costs, in which case intervention levels would be relaxed in favour of the base strategy The fact that b) minimised total transport costs suggests that the desirable standards may be too high for this particular case.

Climate zone 1			Seal + base maintenance "Base Upgrade"				Seal + preventative maintenance "Alternative Upgrade"				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
			5	15	25	50		5	15	25	50
	Typical costs	AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
			5	15	25	50		5	15	25	50
	High costs	AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Conclusion

In summary, in this case the strategy that best minimises the lifetime TTC is to upgrade to a sealed surface and maintain to a base standard ('base upgrade'). Both base maintenance and alternative maintenance strategies, however, are strongly viable investments.

4.2 Worked Example #2

Approximately 26.1 million tonnes of wheat was harvested in WA in 2022 across 8.9 million hectares (Aspermont Ltd 2023). The region most prominently known for wheat production in WA is the Wheatbelt. In fact, approximately 40% of Western Australia's wheat production comes from within a 100 km radius around

the town of Merridin (Shire of Merridin 2023). The wheat harvest season runs in WA from October to January (i.e. in the spring and summer). During this period, there is a significant increase in the heavy vehicle traffic due to trucks hauling the harvested grain. There is a relatively low level of daily traffic from normal agricultural operations and residents during the remainder of the year.

One regional distributor road is of particular interest due to its importance as a haulage route for wheat. On this road the baseline AADT level from normal resident and operations traffic is approximately 250 veh/day, with 10% heavy vehicles. In the harvest season, representing about 90 days of the year, there is an average of 710 extra heavy vehicles per day (i.e. 355 return trips). Summing the baseline and the seasonal additional heavy vehicles across the entire year gives 155,150 total vehicle movements, of which 73,025 are heavy vehicles. Averaged across the year, the calculated AADT is 425 with 47.1% HVs. This road has been managed with a good quality of unsealed road practice. The Shire of Merredin is located in Climate Zone 3: it is not considered remote as it lies within 250 km of Perth. There is good access to materials and services, so the cost level is 'Typical'.

Figure 4-2: Regional distributor road in Wheatbelt Region – agricultural route

Source: CBH Group (2021).

Table 4-2: Worked Example #2 – Key Information

Steps	Information	Notes
1. Determine Road Category	Regional Distributor Road	
2. Select Climate Zone	Climate Zone 3	
3. Select Cost Level	Typical	
4. Select Quality of unsealed practice	Good	
5. Collect traffic count data and choose nearest AADT	425	Round AADT to closest level: 500
6. Obtain Heavy Vehicle % and choose the nearest HV%	47.1%	Round HV% to closest level: 50%
7. Select Catalogue	Table A.1	
8. Review decision matrices	Table A-7: Test Criterion 1 – Optimum sealing strategy decision matrix/good practice/regional distributor Table A-14: Test Criterion 2 – Sealing strategy viability matrix/good practice/regional distributor	Test criterion 1 Choose Alternative Upgrade Test criterion 2 Choose Base or Alternative Upgrade

Step 1: Determine Road Category

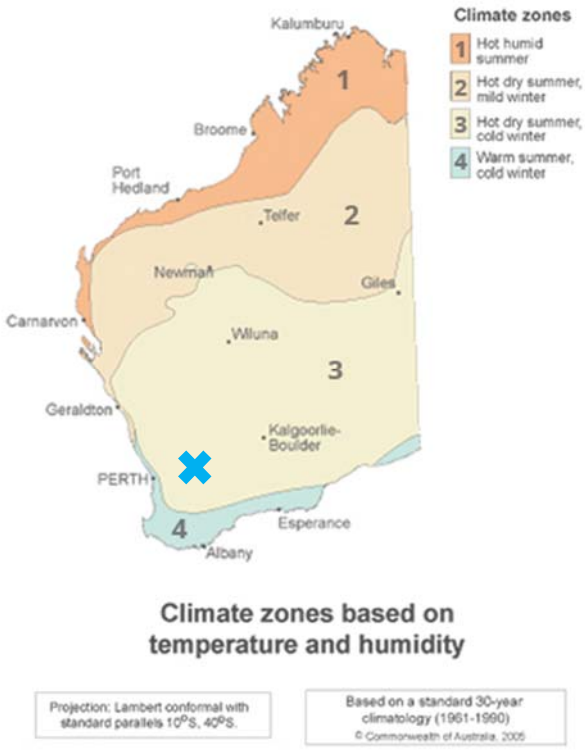
Select the road category from the list below:

- access road
- local distributor

- regional distributor
- district distributor.

Step 2: Select Climate Zone

Select your climate zone using Figure 3-2.



The Shire of Merredin is located in climate zone 3.

Step 3: Select Cost Level

Select your general roads maintenance and construction cost level:

Typical	Representing locations where good access to materials and services exists, typically representing locations in the Outer Metropolitan, South West and parts of Mid-West, Wheatbelt South and Wheatbelt North, and Great Southern within 250 km of Perth.
High	Representing other parts of the State including the Gascoyne, Pilbara and Kimberly regions, Goldfields-Esperance, and other locations more than 250 km from Perth.

Step 4: Select Quality of Unsealed Practice

Determining the level of unsealed practice quality is based on two factors:

- compliance of gravel wearing course materials
- grading type and effectiveness.

Figure 3-3 provides an indication of where 'good' materials compliance lies.

This Shire of Merredin road uses good quality materials, and has good grading practice.

Step 5: Collect Traffic Count Data and choose nearest AADT

This road's base AADT (in the non-grain harvest season) has been measured at 250. In the harvest season, about 90 days on average, there are an additional 710 heavy vehicle movements (355 return trips) along the road per day. We must calculate the new AADT that accounts for this seasonal traffic. For comparison, we will demonstrate the outcome in the base case, as well as with the additional seasonal traffic.

- Base case: 250 AADT
- Including seasonal grain harvest traffic:
  - Sum the 100 AADT over the entire year = 250 x 365 days = 91,250
  - Sum the additional seasonal traffic over the season = 710 x 90 days = 63,900
  - Add the two together and average over the year to calculate AADT = (91,250 + 63,900) = 155,150 / 365 days = 425 AADT
  - Round this to the nearest category level in the catalogue – 500 AADT.

Step 6: Obtain Heavy Vehicle % and choose the nearest HV%

The proportion of heavy vehicles outside of the grain harvest time has been measured at 10%. During the harvest season, all additional traffic is from heavy vehicles. We must calculate the new average HV% that accounts for this seasonal traffic. For comparison, we will demonstrate the outcome in the base case, as well as with the additional seasonal traffic.

- Base case: 10% HV
- Including seasonal grain harvest traffic:
  - From Step 5, there are 91,250 baseline vehicle movements, of which 10% are heavy = 9,125 HV.
  - The additional 63,900 seasonal vehicle movements are all heavy vehicles = 63,900 HV
  - Summing the number of HVs and calculating the proportion over the total vehicle movements (from step 5) gives (9,125 + 63,900) = 73,025 / 155,150 = 47.1% HV
  - Round this to the nearest category level in the catalogue – 50% HV.

Step 7: Select Catalogue

Using the catalogue table of solutions table (Table 3-1), select the rows in each column from left to right to find the applicable decision-making tools.

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
Regional distributor	1	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	2	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	3	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	4	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution

Step 8: Review Decision Matrices

Finally, employing the previously tabulated information, identify the optimum sealing strategy by using the optimum sealing strategy decision matrix for Test Criterion 1 shown below.

Test criterion 1

Using this road's AADT and HV% levels, the Alternative Upgrade is the optimal strategy and minimises the lifetime TTC.

For comparison, using the baseline values of 250 AADT and 10% HV would indicate the optimal decision to be a base seal.

Climate zone 3		Heavy Vehicle (%)			
		5	15	25	50
Typical costs	AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_500	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		5	15	25	50
High costs	AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
	AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade

Test criterion 2

Applying the second criterion suggests both the base and alternative ('preventative') seal maintenance strategies are strongly viable investments. Whilst the LGA could choose either of the two sealed road strategies, given the level of traffic and the fact the alternative strategy minimises TTC is well justified as an option.

			Seal + base maintenance "Base Upgrade"				Seal + preventative maintenance "Alternative Upgrade"				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
			5	15	25	50		5	15	25	50
Climate zone 3	Typical costs	AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Conclusion

In summary, in this case the strategy that minimises the lifetime TTC is to upgrade to a sealed surface and maintain to a preventative standard ('alternative upgrade'). Both base maintenance and alternative maintenance strategies, however, are strongly viable investments.

Th process demonstrates how failing to account for seasonal or periodic traffic in AADT and HV calculations can lead to the 'incorrect' decisions which most likely would have led to substantially higher road user costs and poorer road operating conditions for the community and heavy vehicle operators.

4.3 Worked Example #3

The Margaret River Wine Region in Western Australia is one of South WA's premier weekender and tourist destinations. In recent years, several new cellar doors and wedding/event venues have opened, increasing weekend and public holiday light-vehicle traffic on the unsealed roads. In particular, along a certain local distributor road three new cellar doors/event venues have opened in the last 24 months, attracting approximately 150 additional weekend groups of patrons per weekend day. The background AADT level for weekly residents and farm/winery operations is 100, with 15% HVs. However, with the increased patronage, there is an additional 300 extra light vehicle movements per weekend day. Summing over the year, including public holidays, gives about 109 days of extra traffic flow, with 32,700 vehicle movements over the year. Adding this to the baseline of 36,500 vehicles over the year gives a total of 69,200 vehicles and a new AADT of 190. The heavy vehicle proportion becomes 8% of the new AADT. The Margaret River Wine region is located in Climate Zone 4, and as it is within 250 km of Perth. There is good access to materials and services, so the cost level is Typical. The local distributor road in question has been managed with a typical quality of unsealed road practice.

Figure 4-3: Unsealed roads in Margaret River Wine Region – New Cellar Doors recently constructed

Source: The Royal Automobile Club of WA (2020).

Table 4-3: Worked Example #3 – Key Information

Steps	Information	Notes
1. Determine Road Category	Regional Distributor Road	
2. Select Climate Zone	Climate Zone 4	
3. Select Cost Level	Typical	
4. Select Quality of Unsealed Practice	Typical	
5. Collect traffic count data and choose closest AADT	190	Round AADT to closest level: 175
6. Obtain HV % and choose the closest HV%	8%	Round HV% to closest level: 5%
7. Select Catalogue	Table A.1	
8. Review Decision Matrix	Table A-6: Test Criterion 1 – Optimum sealing strategy decision matrix/typical practice/regional distributor Table: Test Criterion 2 – Sealing strategy viability matrix/typical practice/regional distributor	Test criterion 1 Choose Base Upgrade Test criterion 2 Choose Base or Alternative Upgrade

Step 1: Determine Road Category

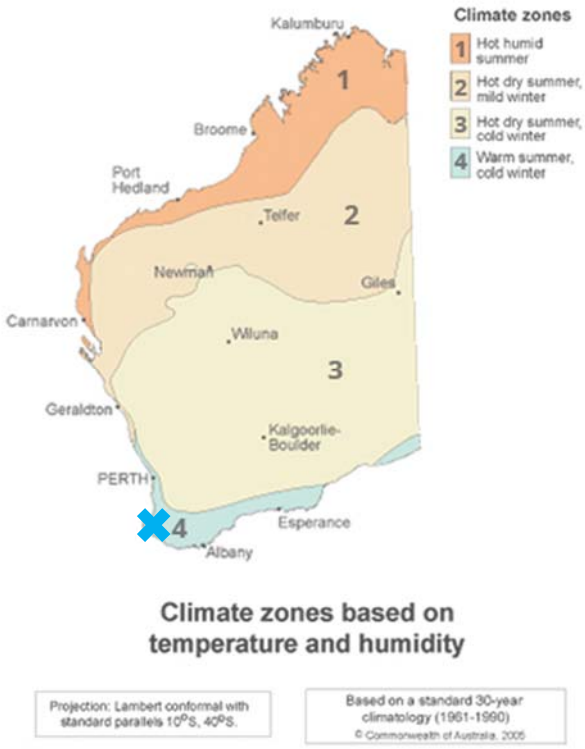
Select the road category from the list below:

- access road

- local distributor
- regional distributor
- district distributor.

Step 2: Select Climate Zone

Select your climate zone using Figure 3-2.



Margaret River is located in climate zone 4.

Step 3: Select Cost Level

Select your general roads maintenance and construction cost level:

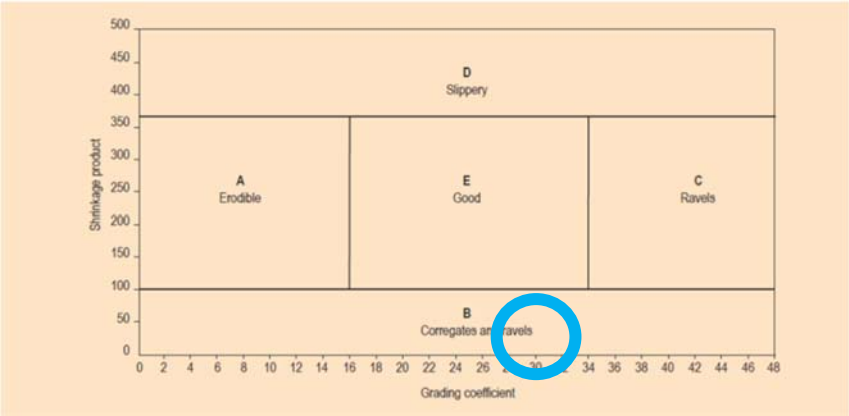
Typical	Representing locations where good access to materials and services exists, typically representing locations in the Outer Metropolitan, South West and parts of Mid-West, Wheatbelt South and Wheatbelt North, and Great Southern within 250 km of Perth.
High	Representing other parts of the State including the Gascoyne, Pilbara and Kimberly regions, Goldfields-Esperance, and other locations more than 250 km from Perth.

Step 4: Select Quality of Unsealed Practice

Determining your level of unsealed practice quality is based on two factors:

- compliance of gravel wearing course materials
- grading type and effectiveness.

Figure 3-3 provides an indication of where ‘good’ materials compliance lies for comparison.



This road in Margaret River uses typical quality materials, and has typical grading practice.

Step 5: Obtain Traffic Count Data and choose nearest AADT

This road's base AADT, on weekdays and prior to the cellar door openings, was 100. On weekends there are an additional 300 vehicle movements per day due to increased tourist patronage (150 return trips). A new AADT must be calculated that accounts for this additional weekend traffic. For comparison, the outcome in the base case will be demonstrated, as well as with the additional seasonal traffic.

- Base case: 100 AADT
- Including weekender traffic:
  - Sum the 100 AADT over the entire year = 100 x 365 days = 36,500
  - Sum the additional weekender traffic over the year = 300 x 109 weekend and public holiday days = 32,700
  - Add the two together and average over the year to calculate AADT = (36,500 + 32,700) = 69,200/365 days = 190 AADT
  - Round this to the nearest category level in the catalogue – 175 AADT.

Step 6: Obtain HV % and choose the closest HV%

The base proportion of heavy vehicles outside of the weekender traffic is 15%. On weekends the additional traffic is all from light vehicles. A new average HV% must be calculated that accounts for this periodic traffic. For comparison, the outcome in the base case will be demonstrated, as well as with the additional seasonal traffic.

- Base case: 15% HV
- Including weekender traffic:
  - From Step 5, there are 36,500 baseline vehicle movements, of which 15% are HVs = 5,475 HV.
  - The additional 32,700 weekend vehicle movements are all light vehicles = 0 HV
  - Summing the number of HVs and calculating the proportion over total vehicle movements (from step 5) gives (5,475 + 0) = 5,475 / 69,200 = 8% HV
  - Round this to the closest category level in the catalogue – 5% HV.

Step 7: Select Catalogue

Using the catalogue table of solutions table (Table 3-3), select the rows in each column from left to right to find the applicable decision-making tools.

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
	1	Typical	Typical	Table A-6	Table	Select solution

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
Regional distributor			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	2	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	3	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	4	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution

Step 8: Review Decision Matrices

Finally, employing the previously tabulated information, the optimum sealing strategy is identified using the decision matrix for Test Criterion 1. Using this road's updated AADT and HV% levels – 175 AADT and 5% HV –sealing with base maintenance is the lifetime cost-minimising strategy.

For comparison, using the baseline values of 100 AADT and 15% HV would in this case also lead to an optimal decision of sealing the unsealed road with base-level maintenance.

This process demonstrates how fully accounting for periodic or seasonal traffic in AADT and HV calculations can lead to the decisions that are evidence-based, which can be used to justify not over-expending on unnecessarily sealing a road due to potential user demands.

Finally, employing the previously tabulated information, the optimum sealing strategy can be identified using the optimum sealing strategy decision matrix for Test Criterion 1 shown below.

Test criterion 1

Using this road's AADT and HV% levels, the Base Upgrade is the optimal strategy and minimises the lifetime TTC.

For comparison, using the baseline values of 175 AADT and 5% HV would indicate the optimal decision to be a base upgrade.

Climate zone 4			Heavy Vehicle (%)			
			5	15	25	50
	Typical costs	AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
			5	15	25	50
	High costs	AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade

Test criterion 2

Applying the second criterion suggests both the base and alternative ('preventative') seal maintenance strategies are strongly viable investments. Whilst the local government could choose either of the two sealed road strategies, given the level of traffic and the fact the base strategy minimises TTC is well justified as an option since the route has few heavy vehicles. A possible issue, however, is tourists may desire a higher level of service, but this needs to be considered against affordability of the local government to service the route.

Climate zone 4			Seal + base maintenance "Base Upgrade"				Seal + preventative maintenance "Alternative Upgrade"				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
			5	15	25	50		5	15	25	50
	Typical costs	AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
			5	15	25	50		5	15	25	50
	High costs	AADT_50	Not Viable	Marginal	Marginal	Marginal	AADT_50	Not Viable	Marginal	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Conclusion

In summary, in this case the strategy that minimises the lifetime TTC is to upgrade to a sealed surface and maintain to a base standard ('base upgrade'). Both base maintenance and alternative maintenance strategies, however, are strongly viable investments.

The above process demonstrates how failing to account for traffic during non-working days and holiday periods can potentially alter decisions, although in this case the overall answer did not differ. The fact that light vehicles dominate the overall traffic means that there is little risk that a base maintenance strategy is an appropriate approach.

5 Recommended Applications

This *Practitioners Guideline* equips LGAs with the necessary information to make informed decisions about the sealing of unsealed roads within their jurisdiction.

By applying this process LGAs can undertake comprehensive analyses of the benefits of sealing unsealed roads, taking into consideration the whole-of-life cost implications, likely impacts of traffic growth from many sources, and road safety costs. The analyses can be used in business cases, budget preparation, bids and plans.

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Appendix A Catalogue of Solutions for Sealing Unsealed Roads

A.1 Catalogue of Solutions

Table A.1: Full catalogue of solutions

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
Access Road	1	Typical	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
		High	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
	2	Typical	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
		High	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
	3	Typical	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
		High	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
	4	Typical	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
		High	Typical	Table A-2	Table A-10	Select solution
			Good	Table A-3	Table A-11	Select solution
Local distributor	1	Typical	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
		High	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
	2	Typical	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
		High	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
	3	Typical	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
		High	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
	4	Typical	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
		High	Typical	Table A-4	Table A-12	Select solution
			Good	Table A-5	Table A-13	Select solution
	1	Typical	Typical	Table A-6	Table	Select solution

From Step 1 Road category	From Step 2 Climate zone	From Step 3 Cost level	From Step 4 Unsealed practice	Catalogue link		From Steps 5 & 6 AADT & HV% *
				Test Criterion 1	Test Criterion 2	
Regional distributor			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	2	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	3	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
	4	Typical	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
		High	Typical	Table A-6	Table	Select solution
			Good	Table A-7	Table A-14	Select solution
District distributor	1	Typical	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
		High	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
	2	Typical	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
		High	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
	3	Typical	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
		High	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
	4	Typical	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution
		High	Typical	Table A-8	Table A-15	Select solution
			Good	Table A-9	Table A-16	Select solution

A.2 Test Criterion 1: Decision Matrices – Net Present Value

The outcome of the analyses has been used to develop a catalogue of solutions presented in various formats, including:

- a decision matrix (tabular output)
- a set of indicative breakeven traffic levels (tabular and chart outputs).

Table A-2 demonstrates optimum choices in a decision matrix for roads with typical (lower) and high construction and maintenance costs, including crash costs and safety features. The decisions are that an upgrade to a sealed road is "not viable" (red) from a TTC-perspective, a "base upgrade" (orange) has the lowest lifetime TTC, or an "alternative upgrade" (green) has the lowest lifetime TTC.

A.2.1 Access Road

Table A-2: Test Criterion 1 – Optimum sealing strategy decision matrix/typical practice /access road

			Heavy Vehicle (%)			
			5	15	25	50
Climate zone 1	Typical costs	AADT_50	Alt Upgrade	Alt Upgrade	Alt Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Alt Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Alt Upgrade	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 4	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

Table A-3: Test Criterion 1 – Optimum sealing strategy decision matrix/good practice/access road

			Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50
		AADT_50	Not Viable	Alt Upgrade	Alt Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Not Viable	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 4	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

A.2.2 Local Distributor

Table A-4: Test Criterion 1 – Optimum sealing strategy decision matrix/typical practice/local distributor

			Heavy Vehicle (%)			
			5	15	25	50
Climate zone 1	Typical costs	AADT_50	Alt Upgrade	Alt Upgrade	Alt Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Alt Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate Zone 2	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate Zone 3	Typical costs		5	15	25	50
		AADT_50	Alt Upgrade	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 4	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Alt Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade

Table A-5: Optimum sealing strategy decision matrix/good practice/local distributor

			Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50
		AADT_50	Not Viable	Alt Upgrade	Alt Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Not Viable	Alt Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Alt Upgrade	Alt Upgrade	Base Upgrade
		AADT_175	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 4	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Alt Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade

A.2.3 Regional Distributor

Table A-6: Test Criterion 1 – Optimum sealing strategy decision matrix/typical practice/regional distributor

			Heavy Vehicle (%)			
			5	15	25	50
Climate zone 1	Typical costs	AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
Climate Zone 4	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50

		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade

Table A-7: Test Criterion 1 – Optimum sealing strategy decision matrix/good practice/regional distributor

			Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
Climate Zone 4	Typical costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade

		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade

A.2.4 District Distributor

Table A-8: Test Criterion 1 – Optimum sealing strategy decision matrix/typical practice/district distributor

			Heavy Vehicle (%)			
			5	15	25	50
Climate zone 1	Typical costs	AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade

	High cCosts		5	15	25	50
		AADT_50	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
Climate zone 4	Typical costs		5	15	25	50
		AADT_50	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade

Table A-9: Test Criterion 1 – Optimum sealing strategy decision matrix/good practice/district distributor

			Heavy Vehicle (%)			
			5	15	25	50
Climate zone 1	Typical costs	AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_175	Not Viable	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 2	Typical costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Not Viable
		AADT_100	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_175	Not Viable	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Alt Upgrade	Alt Upgrade

		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 3	Typical costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Base Upgrade
		AADT_100	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_175	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
Climate zone 4	Typical costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_100	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_175	Base Upgrade	Base Upgrade	Base Upgrade	Alt Upgrade
		AADT_250	Base Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade
	High costs		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Not Viable
		AADT_100	Not Viable	Not Viable	Base Upgrade	Base Upgrade
		AADT_175	Not Viable	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_250	Base Upgrade	Base Upgrade	Base Upgrade	Base Upgrade
		AADT_500	Alt Upgrade	Alt Upgrade	Alt Upgrade	Alt Upgrade

A.3 Test Criterion 2: Viability Matrices – Marginal Benefit-Cost Ratio

A.3.1 Access Road

Table A-10: Test Criterion 2 – Sealing strategy viability matrix/typical practice /access road

		Seal + base maintenance 'Base Upgrade'					Seal + preventative maintenance 'Alternative Upgrade'				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Viable	AADT_50	Not Viable	Not Viable	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate	Typical		5	15	25	50		5	15	25	50

		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Table A-11: Test Criterion 2 – Sealing strategy viability matrix/good practice/access road

			Seal + base maintenance 'Base Upgrade'				Seal + preventative maintenance 'Alternative Upgrade'				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Marginal	AADT_100	Not Viable	Marginal	Marginal	Marginal
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Climate Zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Marginal	AADT_100	Not Viable	Marginal	Marginal	Marginal
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

A.3.2 Local Distributor

Table A-12: Test Criterion 2 – Sealing strategy viability matrix/typical practice/local distributor

			Seal + base maintenance 'Base Upgrade'					Seal + preventative maintenance 'Alternative Upgrade'			
			Heavy Vehicle (%)					Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Viable	AADT_50	Not Viable	Not Viable	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate	Typical		5	15	25	50		5	15	25	50

		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Not Viable	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Table A-13: Test Criterion 2 – Sealing strategy viability matrix/good practice/local distributor

		Seal + base maintenance 'Base Upgrade'					Seal + preventative maintenance 'Alternative Upgrade'				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Marginal	AADT_100	Not Viable	Marginal	Marginal	Marginal
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable

		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Marginal	AADT_100	Not Viable	Marginal	Marginal	Marginal
		AADT_175	Not Viable	Marginal	Viable	Viable	AADT_175	Not Viable	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

A.3.3 Regional Distributor

Table: Test Criterion 2 – Sealing strategy viability matrix/typical practice/regional distributor

			Seal + base maintenance 'Base Upgrade'				Seal + preventative maintenance 'Alternative Upgrade'				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Marginal	AADT_50	Not Viable	Marginal	Marginal	Marginal
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable

		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Marginal	AADT_50	Not Viable	Marginal	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Table A-14: Test Criterion 2 – Sealing strategy viability matrix/good practice/regional distributor

			Seal + base maintenance 'Base Upgrade'					Seal + preventative maintenance 'Alternative Upgrade'			
			Heavy Vehicle (%)					Heavy Vehicle (%)			
Climate zone 1	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Viable	Viable	AADT_50	Not Viable	Marginal	Viable	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Viable	Viable	AADT_50	Not Viable	Marginal	Viable	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Viable	Viable	AADT_50	Not Viable	Marginal	Viable	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal

		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Marginal	Marginal	Viable	AADT_100	Not Viable	Marginal	Marginal	Viable
		AADT_175	Marginal	Marginal	Viable	Viable	AADT_175	Marginal	Marginal	Viable	Viable
		AADT_250	Marginal	Viable	Viable	Viable	AADT_250	Marginal	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

A.3.4 District Distributor

Table A-15: Test Criterion 2 – Sealing strategy viability matrix/Typical Practice/District Distributor

			Seal + base maintenance 'Base Upgrade'				Seal + preventative maintenance 'Alternative Upgrade'				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
			5	15	25	50		5	15	25	50
Climate zone 1	Typical costs	AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Viable	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Marginal	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Viable	Viable	Viable	AADT_50	Marginal	Marginal	Viable	Viable
		AADT_100	Viable	Viable	Viable	Viable	AADT_100	Viable	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable

		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Marginal	Marginal	Viable	AADT_50	Not Viable	Not Viable	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Marginal	Marginal	Viable	Viable	AADT_50	Not Viable	Marginal	Viable	Viable
		AADT_100	Marginal	Viable	Viable	Viable	AADT_100	Marginal	Viable	Viable	Viable
		AADT_175	Viable	Viable	Viable	Viable	AADT_175	Viable	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Not Viable	Marginal	Viable	Viable	AADT_100	Not Viable	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable

Table A-16: Test Criterion 2 – Sealing strategy viability matrix/good practice/district distributor

		Seal + base maintenance 'Base Upgrade'					Seal + preventative maintenance 'Alternative Upgrade'				
			Heavy Vehicle (%)					Heavy Vehicle (%)			
			5	15	25	50		5	15	25	50
Climate zone 1	Typical costs	AADT_50	Not Viable	Not Viable	Marginal	Viable	AADT_50	Not Viable	Not Viable	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Not Viable	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Not Viable	Marginal	Marginal	AADT_100	Not Viable	Not Viable	Marginal	Marginal
		AADT_175	Not Viable	Marginal	Marginal	Viable	AADT_175	Not Viable	Marginal	Marginal	Viable
		AADT_250	Marginal	Marginal	Viable	Viable	AADT_250	Marginal	Marginal	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 2	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Not Viable	Marginal	Viable	Viable	AADT_100	Not Viable	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Not Viable	AADT_50	Not Viable	Not Viable	Not Viable	Not Viable
		AADT_100	Not Viable	Not Viable	Marginal	Marginal	AADT_100	Not Viable	Not Viable	Marginal	Marginal
		AADT_175	Not Viable	Marginal	Marginal	Viable	AADT_175	Not Viable	Marginal	Marginal	Viable
		AADT_250	Marginal	Marginal	Viable	Viable	AADT_250	Marginal	Marginal	Viable	Viable

		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate zone 3	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Viable	AADT_50	Not Viable	Not Viable	Marginal	Viable
		AADT_100	Marginal	Marginal	Viable	Viable	AADT_100	Marginal	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Marginal	AADT_50	Not Viable	Not Viable	Not Viable	Marginal
		AADT_100	Not Viable	Not Viable	Marginal	Marginal	AADT_100	Not Viable	Not Viable	Marginal	Marginal
		AADT_175	Not Viable	Marginal	Marginal	Viable	AADT_175	Not Viable	Marginal	Marginal	Viable
		AADT_250	Marginal	Marginal	Viable	Viable	AADT_250	Marginal	Marginal	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
Climate Zone 4	Typical costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Marginal	Marginal	AADT_50	Not Viable	Not Viable	Marginal	Marginal
		AADT_100	Not Viable	Marginal	Viable	Viable	AADT_100	Not Viable	Marginal	Viable	Viable
		AADT_175	Marginal	Viable	Viable	Viable	AADT_175	Marginal	Viable	Viable	Viable
		AADT_250	Viable	Viable	Viable	Viable	AADT_250	Viable	Viable	Viable	Viable
		AADT_500	Viable	Viable	Viable	Viable	AADT_500	Viable	Viable	Viable	Viable
	High costs		5	15	25	50		5	15	25	50
		AADT_50	Not Viable	Not Viable	Not Viable	Not Viable	AADT_50	Not Viable	Not Viable	Not Viable	Not Viable
		AADT_100	Not Viable	Not Viable	Marginal	Marginal	AADT_100	Not Viable	Not Viable	Marginal	Marginal
		AADT_175	Not Viable	Marginal	Marginal	Viable	AADT_175	Not Viable	Marginal	Marginal	Viable
		AADT_250	Marginal	Marginal	Viable	Viable	AADT_250	Marginal	Marginal	Viable	Viable
		AADT_500	Marginal	Viable	Viable	Viable	AADT_500	Marginal	Viable	Viable	Viable

Appendix B Road Hierarchy for Western Australia

Table B.1 provides an overview of the Main Roads WA road hierarchy system for Western Australia, including road types and criteria.

Table B-1: Road Hierarchy for Western Australia

CRITERIA	PRIMARY DISTRIBUTOR (PD) (see Note 2)	DISTRICT DISTRIBUTOR A (DA)	DISTRICT DISTRIBUTOR B (DB)	REGIONAL DISTRIBUTOR (RD)	LOCAL DISTRIBUTOR (LD)	ACCESS ROAD (A)
Primary Criteria						
1. Location (see Note 3)	All of WA incl. BUA	Only Built Up Area.	Only Built Up Area.	Only Non Built Up Area. (see Note 4)	All of WA incl. BUA	All of WA incl. BUA
2. Responsibility	Main Roads Western Australia.	Local Government.	Local Government.	Local Government.	Local Government.	Local Government.
3. Degree of Connectivity	High. Connects to other Primary and Distributor roads.	High. Connects to Primary and/or other Distributor roads.	High. Connects to Primary and/or other Distributor roads.	High. Connects to Primary and/or other Distributor roads.	Medium. Minor Network Role Connects to Distributors and Access Roads.	Low. Provides mainly for property access.
4. Predominant Purpose	Movement of inter regional and/or cross town/city traffic, e.g. freeways, highways and main roads.	High capacity traffic movements between industrial, commercial and residential areas.	Reduced capacity but high traffic volumes travelling between industrial, commercial and residential areas.	Roads linking significant destinations and designed for efficient movement of people and goods between and within regions.	Movement of traffic within local areas and connect access roads to higher order Distributors.	Provision of vehicle access to abutting properties
Secondary Criteria						
5. Indicative Traffic Volume (AADT)	In accordance with Classification Assessment Guidelines.	Above 8 000 vpd	Above 6 000 vpd.	Greater than 100 vpd	Built Up Area - Maximum desirable volume 6 000 vpd. Non Built Up Area – up to 100 vpd.	Built Up Area - Maximum desirable volume 3 000 vpd. Non Built Up Area – up to 75 vpd.
6. Recommended Operating Speed	60 – 110 km/h (depending on design characteristics).	60 – 80 km/h.	60 – 70 km/h.	50 – 110 km/h (depending on design characteristics).	Built Up Area 50 - 60 km/h (desired speed) Non Built Up Area 60 – 110 km/h (depending on design characteristics).	Built Up Area 50 km/h (desired speed). Non Built Up Area 50 – 110 km/h (depending on design characteristics).
7. Heavy Vehicles permitted	Yes.	Yes.	Yes.	Yes.	Yes, but preferably only to service properties.	Only to service properties.

CRITERIA	PRIMARY DISTRIBUTOR (PD) (see Note 2)	DISTRICT DISTRIBUTOR A (DA)	DISTRICT DISTRIBUTOR B (DB)	REGIONAL DISTRIBUTOR (RD)	LOCAL DISTRIBUTOR (LD)	ACCESS ROAD (A)
8. Intersection treatments	Controlled with appropriate measures e.g. high speed traffic management, signing, line marking, grade separation.	Controlled with appropriate measures e.g. traffic signals.	Controlled with appropriate Local Area Traffic Management.	Controlled with measures such as signing and line marking of intersections.	Controlled with minor Local Area Traffic Management or measures such as signing.	Self controlling with minor measures.
9. Frontage Access	None on Controlled Access Roads. On other routes, preferably none, but limited access is acceptable to service individual properties.	Prefer not to have residential access. Limited commercial access, generally via service roads.	Residential and commercial access due to its historic status Prefer to limit when and where possible.	Prefer not to have property access. Limited commercial access, generally via lesser roads.	Yes, for property and commercial access due to its historic status. Prefer to limit whenever possible. Side entry is preferred.	Yes.
10. Pedestrians	Preferably none. Crossing should be controlled where possible.	With positive measures for control and safety e.g. pedestrian signals.	With appropriate measures for control and safety e.g. median/islands refuges.	Measures for control and safety such as careful siteing of school bus stops and rest areas.	Yes, with minor safety measures where necessary.	Yes.
11. Buses	Yes.	Yes.	Yes.	Yes.	Yes.	If necessary (see Note 5)
12. On-Road Parking	No (emergency parking on shoulders only).	Generally no. Clearways where necessary.	Not preferred. Clearways where necessary.	No – emergency parking on shoulders – encourage parking in off road rest areas where possible.	Built Up Area – yes, where sufficient width and sight distance allow safe passing. Non Built Up Area – no. Emergency parking on shoulders.	Yes, where sufficient width and sight distance allow safe passing.
13. Signs & Linemarking	Centrelines, speed signs, guide and service signs to highway standard.	Centrelines, speed signs, guide and service signs.	Centrelines, speed signs, guide and service signs.	Centrelines, speed signs and guide signs.	Speed and guide signs.	Urban areas – generally not applicable. Rural areas - Guide signs.
14. Rest Areas/Parking Bays	In accordance with Main Roads' Roadside Stopping Places Policy.	Not Applicable.	Not Applicable.	Parking Bays/Rest Areas. Desired at 60km spacing.	Not Applicable.	Not Applicable.

NOTES

*Definitions

- Built Up Areas: See Note 3 below. The criteria was provided by Clive Shepherd from the Western Australian Local Government Grants Commission (WALGGC).
- Primary Criteria: A road, or road section, must meet all of these criteria to qualify for the category.
- Secondary Criteria: These criteria are provided as indicators of the likely characteristics of a road designated under a particular road type. Ideally, a road should have all of these characteristics, but it is recognised that is unlikely to occur in a number of instances, particularly for traffic volumes in rural areas.
- Vpd: vehicles per day

1. The type designated to each road should represent the role that the road is intended to perform. It may not necessarily reflect the current conditions on the road.
2. Declared Roads under the Main Roads Act ('highways' and 'main roads')
3. Built Up Areas (as defined by the Western Australian Local Government Grants Commission) Built up areas are identified because roads within them generally involve greater expenditure than roads in non built up areas. This is because roads in built up areas :
    - have high traffic volumes;
    - have large numbers of intersections, necessitating intersection treatments, pavement markings, signs, etc;
    - require kerbing for traffic control and or drainage;
    - require an asphalt surface where traffic volumes are high, or where noise reduction is important;
    - require underground drainage because surface drainage is impractical;
    - involve high cost of service alterations during reconstruction;
    - involve high costs because road works have to be carried out under heavy traffic.

    The following definition is intended to limit built up areas to localities where the above conditions prevail.

    Residential localities, which have lots with areas less than 0.45 ha, and commercial and industrial areas that meet the following criteria are classed as built up:
    - at least half the blocks are developed;1
    - existing roads have a minimum standard of a gravel road for old subdivisions and a sealed road for new subdivisions.

    Areas serving sporting complexes, schools and caravan parks are classed as built up where:
    - they are located in an area which is developed as residential; or
    - the existing roads serving these facilities are already sealed and kerbed.

    A road connecting two built up areas is classed as a road in a built up area where the connecting road is less than 300m in length.
4. Except where the Regional Distributor is passing through, or terminating in a town.
5. Buses may need to use Access Roads in some instances e.g. Rural areas for school buses and in cities and towns to provide connectivity for a route.

Source: Main Roads WA (n.d.)

A description of this road hierarchy is as follows:

- Primary Distributors :
  - Provide for major regional and inter-regional traffic movement and carry large volumes of generally fast moving traffic. Some are strategic freight routes and all are State Roads. They are managed by Main Roads Western Australia.
- District Distributor A : Urban area roads - (Built Up Area -)
  - Carry traffic between industrial, commercial and residential areas and generally connect to Primary Distributors. These are likely to be truck routes and provide only limited access to adjoining property. They are managed by local government.
- District Distributor B : Urban area roads - (Built Up Area)
  - Perform a similar function to type A District Distributors but with reduced capacity due to flow restrictions from access to and roadside parking alongside adjoining property. These are often older roads with a traffic demand in excess of that originally intended. District Distributor A and B roads run between land-use cells and generally not through them, forming a grid which would ideally space them around 1.5 kilometres apart. They are managed by local government.
- Regional Distributor : Rural - (Non Built Up Area)
  - Roads that are not Primary Distributors but which link significant destinations and are designed for efficient movement of people and goods within and beyond regional areas. They are managed by local government.
- Local Distributor :
  - Urban - (Built Up Area)
    - Roads that carry traffic within a cell and link District Distributors or Regional Distributors at the boundary, to access roads. The route of Local Distributors should discourage through traffic so that the cell formed by the grid of District Distributors only carries traffic belonging to, or serving the area. These roads should accommodate buses, but discourage trucks.
  - Rural - (Non Built Up Area)
    - Connect to other Rural Distributors and to Rural Access Roads.
    - Not Regional Distributors, but which are designed for efficient movement of people and goods within regional areas
  - Urban and Rural Local Distributor roads are managed by local government.
- Access Roads :
  - Provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function. These roads are bicycle and pedestrian friendly. They are managed by local government.

Appendix C Defined Climate Zones

Four climate zones have been defined for Western Australia based on the Bureau of Meteorology classification (BOM 2023). Table B-1 provides a summary of the climate zones, their characteristics and how they have been utilised in the cases. The climate zones play a vital role in assessing the performance and resilience of road infrastructure. By considering the specific climatic conditions of each zone, valuable insights can be gained to inform the rate of road deterioration, material selection, design considerations, and maintenance strategies.

Table C-1: Climate Zone details

Climate Zone	Description	Maximum Average Monthly Temperature (ºC)	Minimum Average Monthly Temperature (ºC)	Thornthwaite Moisture Index	Average annual rainfall (mm)
Climate Zone 1	Hot humid summer	33.83	20.68	-22.30	601.4
Climate Zone 2	Hot dry summer, mild winter	31.70	18.78	-19.75	435.8
Climate Zone 3	Hot dry summer, cold winter	33.34	11.8	-34.5	273.0
Climate Zone 4	Warm summer, Cold winter	22.77	10.97	7.20	713.4

Table B-2 provides information on climate and associated zone by WA LGA.

Table C-2: Climate information and zone for WA LGAs

Region	LGA Name	Max daily temperature (°C)	Min daily temperature (°C)	Thornthwaite Moisture Index	Climate zones
Kimberley	Shire of Broome	33.6	20.4	-3.8	1
Kimberley	Shire of Halls Creek	33.8	20	-7.8	1,2
Kimberley	Shire of Derby–West Kimberley	35.2	19.9	-6.8	1,2
Kimberley	Shire of Wyndham–East Kimberley	34.4	20.8	17.5	1
Pilbara	Shire of Ashburton	33.5	19.2	-26.8	1,2
Pilbara	Shire of East Pilbara	32.7	17.4	-26.3	1,2
Pilbara	Port Hedland, Western Australia	33.7	19.6	-24	1
Pilbara	Roebourne, Western Australia	34.4	20.1	-28	2
Gascoyne	Carnarvon	30.7	17.7	-39	1,2
Gascoyne	Shark Bay	29.8	16.3	-39.1	2
Gascoyne	Upper Gascoyne	32.2	16.7	-36.7	2
Gascoyne	Exmouth	31.9	20	-36.4	1
Goldfields-Esperance	Coolgardie	26.3	11.8	-35.8	3
Goldfields-Esperance	Dundas	25.3	10.7	-29.8	3,4
Goldfields-Esperance	Esperance	23.1	10.9	-6.4	3,4
Goldfields-Esperance	Kalgoorlie - Boulder (C)	26.2	11.6	-36	3
Goldfields-Esperance	Laverton	27.3	12.8	-35.5	3
Goldfields-Esperance	Leonora	28.6	14.3	-36.5	3
Goldfields-Esperance	Menzies	27.4	12.8	-35.8	3
Goldfields-Esperance	Ngaanyatjarraku	29.8	14.5	-30.7	2,3
Goldfields-Esperance	Wiluna	30	14	-33.9	2,3
Great Southern	Albany (C)	20.9	10.7	16	4

Region	LGA Name	Max daily temperature (°C)	Min daily temperature (°C)	Thornthwaite Moisture Index	Climate zones
Great Southern	Broomehill - Tambellup	22.5	9.6	-8.7	4
Great Southern	Cranbrook	21.8	9.9	9	4
Great Southern	Denmark	20.9	9.7	32.6	4
Great Southern	Gnowangerup	22.5	9.8	-13.7	4
Great Southern	Katanning	23.1	9.8	-12.8	4
Great Southern	Kent	23.6	9.7	-17.7	4
Great Southern	Kojonup	22.7	9.8	-4.2	4
Great Southern	Plantagenet	21.3	10	15.5	4
Great Southern	Woodanilling	23.3	10	-15.1	4
Great Southern	Jerramungup	22.4	9.6	-5.8	4
Great Southern	Ravensthorpe	22.8	10.8	-7	4
South West	Augusta - Margaret River	22.4	10.9	36.9	4
South West	Bridgetown - Greenbushes	22.6	9.2	26.8	4
South West	Bunbury (C)	22.7	10.9	34	4
South West	Busselton	22.9	10.6	38.2	4
South West	Capel	22.7	11	33.8	4
South West	Collie	22.9	9.8	31.2	4
South West	Dardanup	22.8	10	38	4
South West	Waroona	22.3	10.2	72	4
South West	Harvey	22.4	10.1	63.2	4
South West	Mandurah (C)	22.6	11.7	54.7	4
South West	Manjimup	21.3	9.9	52.1	4
South West	Boddington	23.7	8.5	6.2	4
South West	Murray	22.1	10.9	70.1	4
South West	Nannup	22.6	9.6	36.7	4
South West	Donnybrook - Balingup	22.8	9.4	31.2	4
South West	Boyup Brook	22.4	9.6	21.2	4
Wheat Belt South	Dumbleyung	24.2	10.2	-19.8	3,4
Wheat Belt South	Lake Grace	24	9.9	-17.2	3,4
Wheat Belt South	Wagin	23.5	10.1	-16.4	3,4
Wheat Belt South	West Arthur	23.1	9.7	-5.3	3,4
Wheat Belt South	Beverley	25.9	9.9	-24.5	3,4
Wheat Belt South	Brookton	24.8	9.9	-17.3	3,4
Wheat Belt South	Bruce Rock	25.7	10.3	-27.7	3,4
Wheat Belt South	Corrigin	25.4	10.3	-25.6	3,4
Wheat Belt South	Cuballing	24.1	10.1	-15.2	3,4
Wheat Belt South	Kondinin	25.5	10.1	-25.4	3,4
Wheat Belt South	Kulin	25.3	10.2	-24.8	3,4
Wheat Belt South	Narembeen	26	10.5	-28.6	3,4
Wheat Belt South	Narrogin (T)	23.5	10.1	-14	3,4
Wheat Belt South	Narrogin	23.9	10.1	-16.3	3,4
Wheat Belt South	Pingelly	24.4	10.1	-15.8	3,4
Wheat Belt South	Quairading	25.5	9.3	-27	3,4

Region	LGA Name	Max daily temperature (°C)	Min daily temperature (°C)	Thornthwaite Moisture Index	Climate zones
Wheat Belt South	Wandering	24.7	9.9	-11.5	3,4
Wheat Belt South	Wickepin	24.6	10.2	-20.4	3,4
Wheat Belt South	Williams	23.5	9.5	-6.5	3,4
Wheatbelt North	Cunderdin	25.9	10.3	-25.8	3,4
Wheatbelt North	Dowerin	26	11.2	-26.6	3,4
Wheatbelt North	Goomalling	26	11	-25	3,4
Wheatbelt North	Kellerberrin	25.9	10.6	-29.1	3
Wheatbelt North	Shire of Merridan	25.8	10.5	-29.2	3
Wheatbelt North	Koorda	26	11.8	-30	3
Wheatbelt North	Trayning	26	11.4	-30	3
Wheatbelt North	Merredin	26	10.9	-29.5	3
Wheatbelt North	Mount Marshall	26.3	11.8	-30.4	3
Wheatbelt North	Mukinbudin	26.1	11.3	-30.1	3
Wheatbelt North	Northam	26	10.3	-24	3,4
Wheatbelt North	Nungarin	26.1	11.1	-29.8	3
Wheatbelt North	Tammin	25.8	10.2	-28.1	3
Wheatbelt North	Toodyay	26.1	10.5	-22.9	3,4
Wheatbelt North	Westonia	26.1	10.8	-29.3	3
Wheatbelt North	Wyalkatchem	25.9	11.6	-29.9	3
Wheatbelt North	York	25.8	10	-22.9	3,4
Wheatbelt North	Chittering	25.4	11.1	-7.7	3,4
Wheatbelt North	Dalwallinu	26.8	12.1	-30.8	3
Wheatbelt North	Dandaragan	26	12.1	-20.9	3,4
Wheatbelt North	Gingin	25.4	11.5	-6.8	3,4
Wheatbelt North	Moora	26.3	11.9	-27	3,4
Wheatbelt North	Victoria Plains	26.1	11.5	-23.7	3,4
Wheatbelt North	Wongan - Ballidu	26.1	11.7	-28.3	3
Wheatbelt North	Yilgarn	26.1	10.7	-28.8	3
Metropolitan	Armadale (C)	24.3	11.3	12	4
Metropolitan	Kalamunda	24.3	11.3	12	4
Metropolitan	Cockburn (C)	24.3	11.3	12	4
Metropolitan	Gosnells (C)	24.3	11.3	12	4
Metropolitan	Kwinana (T)	24.3	11.3	12	4
Metropolitan	Mundaring	24.9	10.9	0.5	4
Metropolitan	Rockingham (C)	22.9	11.1	50.5	4
Metropolitan	Serpentine - Jarrahdale	23.2	11.1	41.1	4
Metropolitan	Swan (C)	25	11.1	0.1	4
Metropolitan	Wanneroo (C)	25.2	11.1	-2.4	4
Metropolitan	Bassendean (T)	24.3	11.3	12	4
Metropolitan	Bayswater (C)	24.3	11.3	12	4
Metropolitan	Belmont (C)	24.3	11.3	12	4
Metropolitan	Canning (C)	24.3	11.3	12	4
Metropolitan	Claremont (T)	24.3	11.3	12	4

Region	LGA Name	Max daily temperature (°C)	Min daily temperature (°C)	Thornthwaite Moisture Index	Climate zones
Metropolitan	Cottesloe (T)	24.3	11.3	12	4
Metropolitan	East Fremantle (T)	24.3	11.3	12	4
Metropolitan	Fremantle (C)	24.3	11.3	12	4
Metropolitan	Melville (C)	24.3	11.3	12	4
Metropolitan	Mosman Park (T)	24.3	11.3	12	4
Metropolitan	Nedlands (C)	24.3	11.3	12	4
Metropolitan	Peppermint Grove	24.3	11.3	12	4
Metropolitan	Perth (C)	24.3	11.3	12	4
Metropolitan	Stirling (C)	24.4	11.3	10.1	4
Metropolitan	South Perth (C)	24.3	11.3	12	4
Metropolitan	Subiaco (C)	24.3	11.3	12	4
Metropolitan	Cambridge (T)	24.3	11.3	12	4
Metropolitan	Victoria Park (T)	24.3	11.3	12	4
Metropolitan	Vincent (T)	24.3	11.3	12	4
Metropolitan	Joondalup (C)	25.2	11.1	-4	4
Metropolitan	Kings Park	24.3	11.3	12	4
Metropolitan	Rottnest Island	24.3	13.1	11	4
Mid West	Carnamah	27.8	12.6	-30.4	3
Mid West	Geraldton - Greenough (C)	26.6	14.4	-31.7	3
Mid West	Irwin	27.5	13.7	-30.5	3
Mid West	Mingenew	28.7	13.5	-32.8	3
Mid West	Morawa	28.6	13.1	-33.3	3
Mid West	Mullewa	28.6	13.8	-34.9	3
Mid West	Northampton	27.2	15.6	-36	3
Mid West	Perenjori	27.9	12.6	-30.9	3
Mid West	Three Springs	28.4	13	-30.8	3
Mid West	Chapman Valley	27.5	14.4	-34.3	3
Mid West	Coorow	27.3	12.5	-28	3
Mid West	Sandstone	29.1	13.5	-35.4	3
Mid West	Cue	29.7	15.6	-36.9	3
Mid West	Meekatharra	30.9	15.8	-35.5	3
Mid West	Mount Magnet	29.1	14.7	-35.8	3
Mid West	Murchison	30.3	14.4	-36	3
Mid West	Yalgoo	28.8	14	-34.4	3

Perth, Western Australia