

Assessment of the Vulnerability of Road Pavements (Pavement Vulnerability Index)

Version History

Version	Release Date	Release Notes
1.0	December 2025	Initial release of NTRO Best Practice document

Foreword

NTRO Best Practice References exist to articulate how a transport network owner or operator should require a specific, contemporary issue/challenge to be solved/resolved to ensure that it is delivering positive outcomes and meeting its statutory safety-, serviceability- and sustainability-related obligations effectively and efficiently. Rather than being totally prescriptive, NTRO Best Practice References identify the key building blocks to be followed to arrive at a desired outcome or solution and how they interrelate and combine. They are supported by NTRO and other specifications and/or test methods that set out which things must be done and specifically how they are to be done.

Disclaimer and Conditions of Use (NTRO Best Practice Guides/Models/References)

By accessing or using this NTRO Best Practice Guide/Model/Reference, you acknowledge and agree to these Disclaimer and Conditions of Use.

1. This NTRO Best Practice Guide/Model/Reference is technical guidance intended for use by appropriately qualified professionals. It sets out methods and minimum requirements but does not replace project-specific engineering judgment, statutory duties, or jurisdictional specifications. Where this guide/model/reference differs from any applicable law, regulation, or agency specification, that law, regulation or agency specification prevails.
2. NTRO does not warrant that this guide/model/reference is complete, error-free, or that it is fit for any particular purpose. To the maximum extent permitted by law, NTRO excludes all warranties, guarantees and representations (including under the Australian Consumer Law) relating to the guide/model/reference or its use. Users are responsible for the following:
 - determining whether the guide/model/reference is appropriate for their circumstances;
 - selecting acceptance limits and frequencies where the guide/model/reference leaves these to the user;
 - ensuring conformity with local specifications, contract terms and project-specific requirements.
3. No reproduction of third-party standards content. References to Austroads, AS/NZS, ISO or jurisdictional specifications are by citation only. Users must obtain and consult the official documents; NTRO does not reproduce protected text, tables, or figures from those third-party standards, and users must not copy such content from this guide.
4. Versioning and updates. Only the current version of this guide/model/reference published on NTRO's LMS/website at any point in time is current. NTRO may update, correct, suspend, or withdraw this guide/model/reference at any time and may issue notices or errata without individual notification. Users must check that they are using the current version before relying on this guide/model/reference.
5. Limits on liability. To the maximum extent permitted by law, NTRO is not liable for any indirect, special or consequential loss, loss of profit, loss of opportunity, delay or disruption costs arising out of, or in connection with the use of, or reliance on, this guide/model/reference. Where liability cannot be excluded, NTRO's liability is limited to the re-supply of the guide/model/reference or the cost of re-supply of the guide/model/reference.
6. Independence and conflicts. NTRO maintains appropriate separation between the authorship of any standards and Best Practice Guides/Models/References and any certification or assessment activities. Publication of this guide/model/reference does not constitute approval, endorsement, or certification of any product, process, organisation, or project.
7. Patents and proprietary methods. Implementation of this guide/model/reference may involve third-party intellectual property, including patents or proprietary methods. Users are responsible for identifying and obtaining any necessary licences. NTRO does not grant any rights relating to any third-party IP.
8. Governing law. This notice is governed by the laws of Victoria, Australia, and disputes are subject to the non-exclusive jurisdiction of its courts. You submit to the non-exclusive jurisdiction of the courts of Victoria and any courts that may hear appeals from those courts.

COPYRIGHT

© NTRO 2025. This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without the prior written permission of NTRO.

Contents

1.	Introduction	1
1.1	Scope.....	1
1.2	Referenced Documents	1
1.3	Terms, Definitions, Acronyms/Abbreviations	2
1.4	Assumptions and Background Principles	3
2.	Data Requirements	4
2.1	Data Specifications Overview	4
2.2	Equipment Specifications	4
2.3	Pavement Type.....	4
2.4	Traffic Level	5
2.5	Surfacing Condition	5
2.6	Pavement Condition	5
2.7	Materials Standards	6
2.8	Shoulder Condition	6
2.9	Drainage	6
3.	Analysis	7
3.1	Software and Analysis Tools	7
3.2	Pavement Vulnerability Index	7
3.3	Network Adjusted Pavement Vulnerability Index.....	13
4.	Reporting	15
	References	16

Tables

Table 1.1:	Classification of traffic levels	2
Table 1.2:	Classification of roughness condition levels	2
Table 2.1:	Framework parameters and corresponding inputs	4
Table 2.2:	Classification of pavement type	4
Table 2.3:	Preferred classification of surfacing condition	5
Table 2.4:	Surface condition of sprayed seals using SSAR	5
Table 2.5:	Materials standards classification	6
Table 2.6:	Shoulder condition classification	6
Table 2.7:	Drainage classification	6
Table 3.1:	Sprayed seal–surfaced unbound granular pavements – ratings and weighting factors	8
Table 3.2:	Thin asphalt–surfaced unbound granular pavements – ratings and weighting factors	9
Table 3.3:	Sprayed seal–surfaced pavements with bound bases – ratings and weighting factors	10
Table 3.4:	Thin asphalt–surfaced pavements with bound bases – ratings and weighting factors	11
Table 3.5:	Asphalt-based pavements – ratings and weighting factors	12
Table 3.6:	Rigid pavements – ratings and weighting factors	13
Table 3.7:	Pavement type factors	14
Table 4.1:	PVI level categorisation	15

1. Introduction

1.1 Scope

The purpose of the pavement vulnerability index (PVI) is to reflect the vulnerability of a given length of road pavement if subjected to a flooding event.

The index reflects the potential vulnerability of a pavement based on its current conditions and composition. The index does not consider the likelihood of a flooding event occurring.

In general terms, the calculation of the PVI considers the damage caused to a road pavement due to flooding and the speed of flooding waters, and the additional consequence of traffic loading of the pavement while the pavement is in a saturated state.

The PVI is intended for use in road network management. The index calculation is based on pavement engineering judgement.

The actual damage caused by a specific flooding event on a specific length of road pavement is highly dependent upon local conditions, the duration of the flooding, the speed of flowing waters, the exact material composition of the pavement and the amount of heavy vehicle trafficking that occurred while the pavement was in the process of drying out. The PVI does not attempt to model these highly variable factors. Instead, it uses a broad-brush approach to assist network managers in identifying those sections of road that likely warrant more attention than others if they were subjected to a major flooding event.

This assessment framework was developed to provide a standard method to assess the vulnerability of the following types of road pavements:

- sprayed seal–surfaced pavements with unbound granular bases and subbases
- sprayed seal–surfaced pavements with bound bases
- thin asphalt–surfaced pavements with unbound granular bases and subbases
- thin asphalt–surfaced pavements with bound bases
- asphalt base pavements
- rigid pavements.

Unsealed roads are not considered.

Thin asphalt–surfaced pavement types are considered to have 50 mm or less of total asphalt thickness.

1.2 Referenced Documents

The definitions of pavement base types align with:

Austrroads *Guide to pavement technology part 2: pavement structural design*, 2017

1.3 Terms, Definitions, Acronyms/Abbreviations

Term	Definition
AADT	Annual average daily traffic
AADT _{lane}	Annual average daily traffic in a single lane (the outermost lane)
IRI	International roughness index (m/km)
PVI	Pavement vulnerability index
PVI(x)	Network adjusted pavement vulnerability index, using a baseline of pavement type x
PTF	Pavement type factor
x	Network baseline pavement type code, one of: G, B, A or R
w _{SC}	Surfacing condition weighting
w _{PC}	Pavement condition weighting
w _{MA}	Materials weighting
w _{SH}	Shoulder weighting
w _{DR}	Drainage weighting
R _{SC}	Surfacing condition rating
R _{PC}	Pavement condition rating
R _{MA}	Materials rating
R _{SH}	Shoulder rating
R _{DR}	Drainage rating
Traffic level	Classified as <i>low</i> , <i>moderate</i> and <i>high</i> based on AADT _{lane} as shown in Table 1.1
Roughness	Roughness condition (IRI) classified as shown in Table 1.2
SSAR	Sprayed seal age ratio. The ratio of the current age of a sprayed seal surfacing and the typical replacement age of seals of that type and locality

Table 1.1: Classification of traffic levels

Traffic level	Definition
Low	AADT _{lane} < 750
Moderate	750 ≤ AADT _{lane} < 3,750
High	AADT _{lane} ≥ 3,750

Table 1.2: Classification of roughness condition levels

Roughness level	Traffic level		
	Low	Moderate	High
Low	IRI < 2.5	IRI < 2.0	IRI < 1.5
Moderate	2.5 ≤ IRI < 6.5	2.0 ≤ IRI < 5.5	1.5 ≤ IRI < 4.5
High	IRI ≥ 6.5	IRI ≥ 5.5	IRI ≥ 4.5

1.4 Assumptions and Background Principles

The PVI can be used to rate the vulnerability of any length of road pavement. The length of road that the index represents is defined by the length over which the input data parameters are homogeneous.

For example, road condition data reported every 100 m can be used to determine a PVI for each 100 m length of road pavement. Similarly, average road condition data for an entire road link will only enable the determination of an average PVI for the whole link.

The factors, and the weightings applied to each factor, in the calculation of the PVI are based on the following broad principles:

- Cracks in pavement and shoulder surfacings will let water enter the pavement structure.
- Shoulders provide some measure of protection for pavement base water ingress. The wider the shoulder, the more protection it provides.
- Road roughness, measured in IRI, is used as a means of reflecting the current structural state of the pavement and, to some degree at least, the amount of recent maintenance activity that has been applied.
- Materials that meet established standards are presumed to be fit for purpose and to offer the highest protection against water infiltration that is possible for that material type. Marginal and poor materials are more vulnerable.
- The effectiveness of drainage in removing water from the pavement environment is dependent upon the maintenance upkeep of the drainage system.

2. Data Requirements

2.1 Data Specifications Overview

The inputs required for this Best Practice Reference are listed in Table 2.1. These parameters are described in more detail in the remainder of this section.

Table 2.1: Framework parameters and corresponding inputs

Parameter	Values
Pavement type	Classification of the type of pavement.
Traffic level	Classification of the level of traffic in a single lane (the outermost) in terms of AADT.
Surfacing condition (preferred)	Classification of the pavement surfacing being uncracked or cracked (including sealed cracks).
Surfacing condition (alternate)	<ol style="list-style-type: none"> 1. Age (years) of the current pavement surfacing. 2. Typical replacement age of the surfacing type in that location.
Pavement condition	Measurement or estimation of roughness of pavement length expressed in terms of IRI.
Materials standard	Classification of the standard of the material quality used in the pavement: standard, marginal or poor.
Shoulder condition	Classification of the presence and type of shoulders provided to the pavement, and whether sealed shoulders are cracked or not.
Drainage	Classification of the presence and level of maintenance of surface and subsurface drainage system.

2.2 Equipment Specifications

This Best Practice Reference does not specify equipment, if any, used to determine the input parameters. The input data can be:

- estimated
- the results of a visual inspection
- the outputs of automated pavement condition survey equipment surveys
- extracted from pre-existing pavement inventory and condition databases
- a combination of the above.

2.3 Pavement Type

The pavement type must be classified as one of the 6 types listed in Table 2.2.

Table 2.2: Classification of pavement type

Pavement type	Notes
Sprayed seal–surfaced pavements with unbound granular bases and subbases	Includes pavements with bases modified with cement but not pavements lightly or fully bound with cementitious, bituminous or other binders.
Thin asphalt–surfaced pavements with unbound granular bases and subbases	
Sprayed seal–surfaced pavements with bound bases	Includes pavement with cementitiously, bituminously or otherwise lightly or heavily bound bases. Does not include modified bases.
Thin asphalt–surfaced pavements with bound bases	
Asphalt base pavements	Pavements with asphalt bases.
Rigid pavements	Pavements with concrete bases. Includes all rigid pavement types.

Note: Pavements that contain a total asphalt thicknesses of 50 mm or less are considered thin asphalt–surfaced pavements.

2.4 Traffic Level

The traffic level of the pavement must be categorised using the AADT of a single lane. If traffic counts exist for multiple lanes in a single travel direction, the left outermost lane shall be used, as this lane is usually the most heavily trafficked. Table 1.1 shows the 3 traffic level categorisations.

2.5 Surfacing Condition

The preferred means of classifying the condition of the pavement surfacing is shown in Table 2.3.

Table 2.3: Preferred classification of surfacing condition

Surfacing condition	Notes
Surface uncracked	The surfacing of the pavement does not contain cracking.
Surface cracked	<ul style="list-style-type: none"> The surfacing contains cracking (any type of cracking). The surface does not contain cracking except for cracks that have been filled with crack sealant.

As a less preferred alternative to the classification in Table 2.3, the known age of the current sprayed seal surfacing can be compared to the typical age of sprayed seals in that locality to consider the likely amount of bitumen oxidation that has occurred and the potential for cracks to soon form. The ratio of these 2 ages is termed the sprayed seal age ratio (SSAR) and is calculated using Equation 1.

$$SSAR = \frac{\text{current age of sprayed seal}}{\text{typical replacement age of seals of that type and locality}} \quad 1$$

The SSAR method is limited to sprayed seal surfacings only.

Once SSAR values have been calculated, the surfacing condition is classified as shown in Table 2.4.

Table 2.4: Surface condition of sprayed seals using SSAR

Surfacing condition	Definition
Lively	SSAR < 0.8
Mature	0.8 ≤ SSAR < 1.2
Oxidised	SSAR ≥ 1.2

2.6 Pavement Condition

The current pavement condition is categorised using the roughness of the pavement. Roughness, expressed in IRI, is typically measured by automated road condition monitoring equipment. Estimates of IRI can be made if using well-established visual reference material.

The quality of the derived PVI is dependent upon the quality of the input data.

Table 1.2 shows the 3 levels of pavement condition categorisation.

2.7 Materials Standards

The quality of the materials used in the pavement base and subbase is classified using the system shown in Table 2.5. If lacking historical records, case-by-case classification of pavement materials requires considerable engineering judgement.

Table 2.5: Materials standards classification

Materials standard	Definition
Standard material	The materials fully meet a fit-for-purpose materials standard for that material and locality.
Marginal materials (not moisture sensitive)	The materials marginally do not meet the standard materials requirements. The lack of conformance to the standard materials specification is not related to moisture-sensitive material properties.
Marginal materials (moderately moisture sensitive)	The materials marginally do not meet the standard materials requirements. The lack of conformance to the standard materials specification is related to moisture-sensitive material properties, but not to a large degree.
Marginal materials (highly moisture sensitive)	The materials marginally do not meet the standard materials requirements. The lack of conformance to the standard materials specification is related to moisture-sensitive material properties, and to a high degree.
Poor materials	Materials that do not meet standard specification requirements and, also, are not marginal. That is, the lack of conformance of the materials is significantly beyond the limits of the standard materials specification.

2.8 Shoulder Condition

The presence of road shoulders and their condition, or extra sealed surface beyond the trafficked area, are classified in Table 2.6.

Table 2.6: Shoulder condition classification

Shoulder condition	Definition
Sealed shoulders (uncracked)	Sealed shoulder is present, and the seal is not cracked.
Unsealed/Cracked shoulders	<ul style="list-style-type: none"> Unsealed shoulder is present, or Sealed shoulder is present, but cracked.
No shoulder: extra seal > 0.5 m	No shoulder is present, and the surfacing extends greater than 0.5 m beyond the edge line.
No shoulder: extra seal ≤ 0.5 m	No shoulder is present, and the surfacing extends less than 0.5 m beyond the edge line.

2.9 Drainage

The presence of a drainage system, that may or may not include subsurface drains, and the condition of any system is classified as shown in Table 2.7.

Table 2.7: Drainage classification

Drainage	Definition
Drainage present and maintained	A drainage system is present, and that system is maintained to ensure it functions as designed.
Drainage present but not maintained	A drainage system is present, but that system is not well maintained and is not considered to be operating as fully as designed.
Drainage not present	A drainage system is not present.

The height of the road formation crown height relative to the surrounding terrain can be considered in the assessment of drainage systems. A formation sitting high above the surrounding areas can be considered to have a drainage system if compared to a formation at level or in cut.

3. Analysis

3.1 Software and Analysis Tools

No software or tools are specified for calculating the PVI.

3.2 Pavement Vulnerability Index

The PVI for a given length of road pavement is calculated using Equation 2.

$$PVI = (w_{SC} \cdot R_{SC}) + (w_{PL} \cdot R_{PL}) + (w_{MA} \cdot R_{MA}) + (w_{SH} \cdot R_{SH}) + (w_{DR} \cdot R_{DR})$$

2

where

PVI	=	pavement vulnerability index for a length of pavement
w_{SC}	=	surfacing condition weighting factor
w_{PL}	=	pavement condition weighting factor
w_{MA}	=	materials standard weighting factor
w_{SH}	=	shoulder condition weighting factor
w_{DR}	=	drainage weighting factor
R_{SC}	=	surfacing condition rating
R_{PL}	=	pavement condition rating
R_{MA}	=	materials standard rating
R_{SH}	=	shoulder condition rating
R_{DR}	=	drainage rating

Ratings and weighting factors for each pavement type considered are shown in Table 3.1 to Table 3.6.

Table 3.1: Sprayed seal–surfaced unbound granular pavements – ratings and weighting factors

Ratings	Traffic level		
	Low	Moderate	High
Surfacing condition rating, R_{SC}	$w_{SC} = 0.35$	$w_{SC} = 0.35$	$w_{SC} = 0.35$
Surface uncracked	100	100	100
Surface cracked	50	35	0
Alternate: Lively	100	100	95
Alternate: Mature	75	65	50
Alternate: Old	50	35	0
Pavement condition rating, R_{PC}	$w_{PC} = 0.10$	$w_{PC} = 0.20$	$w_{PC} = 0.25$
Roughness: Low	100	100	100
Roughness: Moderate	75	60	40
Roughness: High	50	40	25
Materials standards, R_{MA}	$w_{MA} = 0.10$	$w_{MA} = 0.10$	$w_{MA} = 0.15$
Standard material	100	100	100
Marginal materials (not moisture sensitive)	100	100	100
Marginal materials (moderately moisture sensitive)	70	60	50
Marginal materials (highly moisture sensitive)	40	35	25
Poor materials	40	35	25
Shoulder condition, R_{SH}	$w_{SH} = 0.10$	$w_{SH} = 0.15$	$w_{SH} = 0.15$
Sealed shoulders (uncracked)	100	100	100
Unsealed/Cracked shoulders	50	50	50
No shoulder: extra seal > 0.5 m	50	40	25
No shoulder: extra seal ≤ 0.5 m	0	0	0
Drainage, R_{DR}	$w_{DR} = 0.35$	$w_{DR} = 0.20$	$w_{DR} = 0.10$
Drainage present and maintained	100	100	100
Drainage present but not maintained	50	50	50
Drainage not present	0	0	0

Notes:

- Traffic level categories defined in Table 1.1.
- Roughness condition level categories defined in Table 1.2.

Table 3.2: Thin asphalt-surfaced unbound granular pavements – ratings and weighting factors

Ratings	Traffic level		
	Low	Moderate	High
Surfacing condition rating, R_{SC}	$w_{SC} = 0.35$	$w_{SC} = 0.35$	$w_{SC} = 0.35$
Surface uncracked	100	100	100
Surface cracked	50	35	0
Alternate: Lively	100	100	95
Alternate: Mature	75	65	50
Alternate: Old	50	35	0
Pavement condition rating, R_{PC}	$w_{PC} = 0.10$	$w_{PC} = 0.20$	$w_{PC} = 0.25$
Roughness: Low	100	100	100
Roughness: Moderate	75	60	40
Roughness: High	50	40	25
Materials standards, R_{MA}	$w_{MA} = 0.10$	$w_{MA} = 0.10$	$w_{MA} = 0.15$
Standard material	100	100	100
Marginal materials (not moisture sensitive)	100	100	100
Marginal materials (moderately moisture sensitive)	70	60	50
Marginal materials (highly moisture sensitive)	40	35	25
Poor materials	40	35	25
Shoulder condition, R_{SH}	$w_{SH} = 0.10$	$w_{SH} = 0.15$	$w_{SH} = 0.15$
Sealed shoulders (uncracked)	100	100	100
Unsealed/Cracked shoulders	50	50	50
No shoulder: extra seal > 0.5 m	50	40	25
No shoulder: extra seal ≤ 0.5 m	0	0	0
Drainage, R_{DR}	$w_{DR} = 0.35$	$w_{DR} = 0.20$	$w_{DR} = 0.10$
Drainage present and maintained	100	100	100
Drainage present but not maintained	50	50	50
Drainage not present	0	0	0

Notes:

- Traffic level categories defined in Table 1.1
- Roughness condition level categories defined in Table 1.2.

Table 3.3: Sprayed seal-surfaced pavements with bound bases – ratings and weighting factors

Ratings	Traffic level		
	Low	Moderate	High
Surfacing condition rating, R_{SC}	$w_{SC} = 0.30$	$w_{SC} = 0.30$	$w_{SC} = 0.30$
Surface uncracked	100	100	100
Surface cracked	65	50	15
Alternate: Lively	100	100	95
Alternate: Mature	100	75	60
Alternate: Old	75	50	0
Pavement condition rating, R_{PC}	$w_{PC} = 0.15$	$w_{PC} = 0.25$	$w_{PC} = 0.30$
Roughness: Low	100	100	100
Roughness: Moderate	65	50	35
Roughness: High	45	30	15
Materials standards, R_{MA}	$w_{MA} = 0.15$	$w_{MA} = 0.15$	$w_{MA} = 0.20$
Standard material	100	100	100
Marginal materials (not moisture sensitive)	100	100	100
Marginal materials (moderately moisture sensitive)	70	60	50
Marginal materials (highly moisture sensitive)	40	35	25
Poor materials	40	35	25
Shoulder condition, R_{SH}	$w_{SH} = 0.10$	$w_{SH} = 0.15$	$w_{SH} = 0.15$
Sealed shoulders (uncracked)	100	100	100
Unsealed/Cracked shoulders	80	75	75
No shoulder: extra seal > 0.5 m	75	60	50
No shoulder: extra seal ≤ 0.5 m	65	45	30
Drainage, R_{DR}	$w_{DR} = 0.30$	$w_{DR} = 0.15$	$w_{DR} = 0.05$
Drainage present and maintained	100	100	100
Drainage present but not maintained	80	80	80
Drainage not present	70	70	70

Notes:

- Traffic level categories defined in Table 1.1.
- Roughness condition level categories defined in Table 1.2.

Table 3.4: Thin asphalt-surfaced pavements with bound bases – ratings and weighting factors

Ratings	Traffic level		
	Low	Moderate	High
Surfacing condition rating, R_{SC}	$w_{SC} = 0.30$	$w_{SC} = 0.30$	$w_{SC} = 0.30$
Surface uncracked	100	100	100
Surface cracked	50	35	15
Alternate: Lively	100	100	95
Alternate: Mature	100	75	60
Alternate: Old	10	50	0
Pavement condition rating, R_{PC}	$w_{PC} = 0.15$	$w_{PC} = 0.25$	$w_{PC} = 0.30$
Roughness: Low	100	100	100
Roughness: Moderate	65	50	35
Roughness: High	45	30	15
Materials standards, R_{MA}	$w_{MA} = 0.15$	$w_{MA} = 0.15$	$w_{MA} = 0.20$
Standard material	100	100	100
Marginal materials (not moisture sensitive)	100	100	100
Marginal materials (moderately moisture sensitive)	70	60	50
Marginal materials (highly moisture sensitive)	40	35	25
Poor materials	40	35	25
Shoulder condition, R_{SH}	$w_{SH} = 0.10$	$w_{SH} = 0.15$	$w_{SH} = 0.15$
Sealed shoulders (uncracked)	100	100	100
Unsealed/Cracked shoulders	80	75	75
No shoulder: extra seal > 0.5 m	75	60	50
No shoulder: extra seal ≤ 0.5 m	65	45	30
Drainage, R_{DR}	$w_{DR} = 0.30$	$w_{DR} = 0.15$	$w_{DR} = 0.05$
Drainage present and maintained	100	100	100
Drainage present but not maintained	80	80	80
Drainage not present	70	70	70

Notes:

- Traffic level categories defined in Table 1.1.
- Roughness condition level categories defined in Table 1.2.

Table 3.5: Asphalt-based pavements – ratings and weighting factors

Ratings	Traffic level		
	Low	Moderate	High
Surfacing condition rating, R_{SC}	$w_{SC} = 0.20$	$w_{SC} = 0.20$	$w_{SC} = 0.20$
Surface uncracked	100	100	100
Surface cracked	100	90	85
Alternate: Lively	N/A	N/A	N/A
Alternate: Mature	N/A	N/A	N/A
Alternate: Old	N/A	N/A	N/A
Pavement condition rating, R_{PC}	$w_{PC} = 0.30$	$w_{PC} = 0.30$	$w_{PC} = 0.30$
Roughness: Low	100	100	100
Roughness: Moderate	85	85	80
Roughness: High	80	75	60
Materials standards, R_{MA}	$w_{MA} = 0.10$	$w_{MA} = 0.10$	$w_{MA} = 0.10$
Standard material	100	100	100
Marginal materials (not moisture sensitive)	100	100	90
Marginal materials (moderately moisture sensitive)	90	80	80
Marginal materials (highly moisture sensitive)	80	70	50
Poor materials	70	60	30
Shoulder condition, R_{SH}	$w_{SH} = 0.20$	$w_{SH} = 0.20$	$w_{SH} = 0.20$
Sealed shoulders (uncracked)	100	100	100
Unsealed/Cracked shoulders	100	95	90
No shoulder: extra seal > 0.5 m	100	95	90
No shoulder: extra seal ≤ 0.5 m	100	85	80
Drainage, R_{DR}	$w_{DR} = 0.20$	$w_{DR} = 0.20$	$w_{DR} = 0.20$
Drainage present and maintained	100	100	100
Drainage present but not maintained	90	90	90
Drainage not present	80	80	80

Notes:

- Traffic level categories defined in Table 1.1.
- Roughness condition level categories defined in Table 1.2.

Table 3.6: Rigid pavements – ratings and weighting factors

Ratings	Traffic level		
	Low	Moderate	High
Surfacing condition rating, R_{SC}	$w_{SC} = 0.10$	$w_{SC} = 0.10$	$w_{SC} = 0.10$
Surface uncracked	100	100	100
Surface cracked	100	95	90
Alternate: Lively	N/A	N/A	N/A
Alternate: Mature	N/A	N/A	N/A
Alternate: Old	N/A	N/A	N/A
Pavement condition rating, R_{PC}	$w_{PC} = 0.40$	$w_{PC} = 0.40$	$w_{PC} = 0.40$
Roughness: Low	100	100	100
Roughness: Moderate	90	85	80
Roughness: High	80	75	60
Materials standards, R_{MA}	$w_{MA} = 0.10$	$w_{MA} = 0.10$	$w_{MA} = 0.10$
Standard material	100	100	100
Marginal materials (not moisture sensitive)	100	100	90
Marginal materials (moderately moisture sensitive)	90	80	80
Marginal materials (highly moisture sensitive)	80	70	50
Poor materials	70	60	30
Shoulder condition, R_{SH}	$w_{SH} = 0.20$	$w_{SH} = 0.20$	$w_{SH} = 0.20$
Sealed shoulders (uncracked)	100	100	100
Unsealed/Cracked shoulders	100	95	90
No shoulder: extra seal > 0.5 m	100	95	90
No shoulder: extra seal ≤ 0.5 m	100	85	80
Drainage, R_{DR}	$w_{DR} = 0.20$	$w_{DR} = 0.20$	$w_{DR} = 0.20$
Drainage present and maintained	100	100	100
Drainage present but not maintained	100	100	100
Drainage not present	100	100	100

Notes:

- Traffic level categories defined in Table 1.1.
- Roughness condition level categories defined in Table 1.2.

3.3 Network Adjusted Pavement Vulnerability Index

The PVI values determined in Section 3.2 range from 0 to 100, with 100 representing the lowest level of vulnerability. PVI is relative to the type of pavement, that is a rating of 100 represents the least vulnerable that pavement type could achieve. Different pavement types have overarching different degrees of vulnerability.

When considering a group of multiple pavements comprised of different pavement types, such as may occur in a typical road network, the PVI is adjusted to produce the network adjusted pavement vulnerability.

To make this network adjustment, a baseline pavement type is selected and the PVIs of all pavements within the network are scaled up or down using the ratio of the given pavement type factor and the pavement type factor for the selected baseline pavement type.

Pavement type factors are listed in Table 3.7.

Table 3.7: Pavement type factors

Pavement type	Pavement type factor	Network baseline pavement type code
Sprayed seal-surfaced pavements with unbound granular bases and subbases	0.65	G
Thin asphalt-surfaced pavements with unbound granular bases and subbases	0.65	G
Sprayed seal-surfaced pavements with bound bases	0.75	B
Thin asphalt-surfaced pavements with bound bases	0.75	B
Asphalt base pavements	0.90	A
Rigid pavements	1.00	R

The calculation for network adjustment of PVI is should in Equation 3.

$$PVI(x) = PVI \cdot \frac{\text{Pavement type factor for specific pavement}}{\text{Pavement type factor for baseline pavement type}}$$

3

where

$PVI(x)$ = network adjusted pavement vulnerability index for a length of pavement, with
network baseline of pavement type code x
Pavement type codes are defined in Table 3.7

PVI = pavement vulnerability index for a length of pavement

For example, the PVI of a sprayed sealed unbound granular pavement can be network adjusted to a baseline of asphalt base pavement as $PVI(A) = PVI \times (0.65/0.90)$.

4. Reporting

The PVI value for a single pavement type can be calculated and reported simply as the PVI. Network adjusted PVIs, however, must be reported in conjunction with the network baseline pavement type as PVI(G), PVI(B), PVI(A) or PVI(R).

A suggested scheme to categorise PVI results into 5 levels is shown in Table 4.1. Alternative schemes may be more appropriate for specific network management needs.

Table 4.1: PVI level categorisation

PVI level	PVI range	Rating
1	80–100	Excellent
2	60–80	Good
3	40–60	Mediocre
4	20–40	Poor
5	0–20	Very poor

References

Austroads 2017, *Guide to pavement technology part 2: pavement structural design*, Austroads, Sydney, NSW.