

## Effective lifecycle management of rural roads using AUS-SPEC

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### ABSTRACT:

*AUS-SPEC, a joint venture between IPWEA and NATSPEC, has released the new AUS-SPEC Rural Roads Package, responding to challenges faced by regional, rural and remote councils. AUS-SPEC national documents have been specifically tailored towards local government. Rural and remote councils will benefit from the new AUS-SPEC Rural roads specifications package by:*

- Easily documenting the design, construction and maintenance of their road network using SPECbuilder, specification compiler.*
- Bridging the gap where there is lack of in-house engineering capability to efficiently deliver road assets.*
- Significantly improving the structural integrity, safety and performance of sealed and unsealed roads.*

*The new AUS-SPEC Rural roads specification package will equip councils to implement improved practices across the asset life cycle. It covers documentation for planning, design, tendering, contract preliminaries, construction, maintenance and operation of regional and rural roads. This paper will highlight the updates to the existing specifications, and present various new specifications and reference documents included in this new package to allow rural councils to effectively manage their large network of road assets.*

*Sealed and unsealed local roads are dynamic systems whose performance is influenced by traffic, environment, road profile and material characteristics. Materials and placement techniques are especially important as these are the only factors that can be controlled and improved. AUS-SPEC has identified ways councils can extend the life of constructed assets. These life extension methods, include techniques for pavement preservation, which are documented in the appropriate AUS-SPEC specifications as well as other supporting reference documents.*

**KEYWORDS:** assets, construction, design, documentation, life cycle, management, maintenance, materials, preservation, rural roads, sealed, specifications, unsealed.

## 1 Introduction

Local councils manage approximately 80% of the total road network in Australia, comprising sealed and unsealed roads. Rural and remote councils manage a large local government area for a small rate payer base, for which they provide a greater range of services than urban councils. Roads in regional and rural areas provide a vital link between local communities and major road networks.

Road safety is a primary concern for regional and local councils as their network accounts for over half of Australian road accidents. Compared to their urban counterparts, rural councils are also more adversely affected by environmental factors and are financially more vulnerable. Thus, to improve service delivery and meet local community needs, rural councils

need better ways to design, construct and proactively maintain their road assets.

## 2 Challenges faced by rural councils

Traditional materials and practices are generally used for the design, construction and maintenance of local rural roads. This is partly due to lack of in-house technical capability and incomplete understanding of the relationships between geometric road design, pavement design, maintenance and road safety.

Unsealed roads are dynamic systems with traffic, environment, road profile and material characteristics influencing their performance. Material and placement techniques are the only factors that can be controlled and improved. Appropriate selection of wearing course material is a significant way councils' can

extend the life of their road surfaces and reduce the demand for frequent maintenance.

The unpredictable nature of unsealed roads makes them particularly difficult to maintain, making it challenging when attempting to forecast optimal expenditures or allocate resources. Improving the performance and management of rural roads will therefore deliver cost reductions, in addition to greater safety and ride quality.

Many council engineers apply traditional practices inherited from past practitioners without much technical input, or refer to either Austroads or State Road Authority requirements as a guide for all roadworks. However, while these documents are comprehensive, they are aimed at major arterial roads and are unsuitable for rural roads. Thus, the new *AUS-SPEC Rural Roads Package* has been developed to address the challenges faced by rural councils.

### **3 New ways for rural councils to manage their local roads**

Since 1997, local councils have been using AUS-SPEC, the national local government specification system for the life cycle management of infrastructure assets. In 2018, AUS-SPEC, a joint venture between IPWEA and NATSPEC, released the new *AUS-SPEC Rural roads specification package*. This new package is part of an ongoing investment by AUS-SPEC to help rural councils better maintain their largest asset - roads.

The new Rural Roads Specification package, developed for regional, rural and remote councils, provides a simplified set of specifications and supporting documents based on the existing *AUS-SPEC Roadworks and Bridges Package*.

The new package equips councils to implement better practices and improved methods for the design, construction, maintenance and operation of local roads.

It also includes additional information for sealed and unsealed roads for rural councils. In all, it includes 6 new worksections, 11 cut-down worksections, 111 existing worksections, and new design and construction references. A new TECHreport and TECHnotes also provide guidance on how to adopt a scientific approach to improve material performance, as well as new ways of maintaining unsealed roads.

**AUS-SPEC TECHnote GEN 023** *Using AUS-SPEC for management of unsealed roads* provides guidance on using the AUS-SPEC

specification system for the design, construction and maintenance of unsealed roads. This TECHnote is attached as an Appendix to this paper.

### **3.1 What's new in road design**

#### **New Design specifications**

The new AUS-SPEC design worksections help form uniform design processes for civil infrastructure works. These worksections can be used for either council capital works or developmental works.

As part of the new release, the AUS-SPEC design specifications now include geometric road design and pavement design for sealed and unsealed roads in regional, rural and remote councils. The performance of unsealed road surfaces varies considerably with changes in traffic, climate and materials. Hence, the new cut-down versions of existing worksections assist councils to better design road networks based on road purpose, expected traffic, available resources and the environment.

New design worksections include:

- 0051 *Geometric rural road design - sealed*
- 0052 *Geometric rural road design - unsealed*
- 0053 *Rural pavement design - sealed*
- 0054 *Rural pavement design - unsealed*

These generic specifications will prompt councils' engineers to consider essential requirements for geometric road design and pavement design of sealed and unsealed roads. They can consequently introduce a scoring system to make an assessment on whether to seal an unsealed road.

#### **New Design reference specification**

Local government personnel and engineering consultants will find the new *Design reference* useful for all types of roads and associated infrastructure. It provides essential quality requirements for the design of sealed and unsealed roads, pathways and cycleways, subsurface drainage and stormwater drainage. The document helps councils to bridge the gap where there is lack of in-house engineering capability to deliver efficient design of rural and regional roads. The design reference is available in a PDF format and can be used both for in-house design or as part of a brief for external consultants.

## Design Checklists

The *Design checklists* is a companion document to the *Design reference* and is available in an editable format. The checklists can be used to verify that all the design requirements have been addressed, provide a record of the design process and allow the flexibility of integrating additional design criteria as necessary.

### Scoring sheet for sealing an unsealed road

The scoring sheet provides a guide to assess the feasibility of sealing an unsealed road. It is based on the traffic, rainfall, defects and availability of material and haulage costs.

## 3.2 What's new in road construction

### New Construction Specifications

The new AUS-SPEC construction worksections provide specifications for quality control and integrated management systems, contract elements associated with most councils' engineering activities. These worksections have been developed for councils to better control the quality of works performed by contractors and developers.

Existing construction specifications (54) for road reserves were reviewed from the perspective of rural councils. Information was added where it was deemed to further assist rural councils in the construction of their road reserve assets. For example, the *1113 Stabilisation* worksection has been reissued with considerable updates, including information for unsealed roads.

In addition, the following new worksections have been released:

- *1130 Rural concrete base* includes the construction of plain reinforced concrete bases (by mechanical or hand placement), including slab anchors and terminal slabs. It includes the construction of reinforced concrete approach slabs at bridge abutments.
- *1140 Wearing course, base and subbase - unsealed* is applicable to the supply, spreading, compaction and trimming of flexible base, subbase and wearing courses of pavements for local unsealed roads (with light to medium traffic levels).

### AUS-SPEC TECHnotes

The new construction worksections are also supported by the following TECHnotes:

- *NTN GEN 026 Otta seal – A different approach to road sealing:* Aims to assist road owners in understanding the feasibility of using Otta seal for low traffic volume unsealed gravel roads.
- *NTN DES 034 Pavement stabilisation for unsealed roads:* Discusses factors affecting stabilisation of unsealed roads and provides basic procedure for binder selections.
- *NTN DES 035 Improvement and stabilisation of unsealed roads:* Describes how existing unsealed roads can be economically and effectively preserved.

### AUS-SPEC Construction Reference Specification and Schedules

The *AUS-SPEC Construction reference and Schedules* provide an alternative approach to specify road construction requirements. This two-part specification includes non-editable construction specification and *Schedules* which can be customised with project specific information. This reference document provides essential quality management requirements for the construction of sealed and unsealed road reserves. The document has been developed to help rural and regional councils with the engineering capability to deliver efficient roads, drainage and related assets.

The *Construction reference specification* is available in PDF format and can be used as a reference specification for a road construction contract. Construction Schedules are available in an editable format and need to be completed with project specific requirements. Schedules include material selection schedules, *Summary of hold points and witness points*, *Maximum lot sizes and test frequencies* and *Pay items* for every construction worksection.

### AUS-SPEC TECHreport

On local roads in rural and remote areas, traffic is less frequent and includes more long-haul trucking. A TECHreport has been developed to support the new *AUS-SPEC Rural roads specification package* to help councils effectively manage their gravel pits and improve the performance of available material resources:

*TR08 Management of council gravel pits in country areas – A case study:* This TECHreport can be used by councils who operate licensed gravel pits to fulfil their duty of care and comply with the legal requirements of state governments. Councils can build and maintain

better roads using a system of materials extraction and blending from marginal gravel pits to meet the required performance standards to produce defect-free unsealed roads. This report focuses on how to attain greater impermeability and waterproofing in order to extend pavement life and deliver better useability. This report includes a case study of Lachlan Shire Council to demonstrate how councils can achieve better whole-of-life costs and reduce budget expenditures for both sealed and unsealed roads.

### 3.3 What's new in road maintenance

Councils recognise that maintenance aims to preserve an asset and includes regular checking, repairs and minor improvements to remove the cause of any defects as well as avoid excessive repetition of maintenance effort. Likewise, councils understand they must adopt a maintenance policy and strategy to effectively manage assets at an appropriate level of service and structural integrity at the lowest possible cost to the asset owner and users. Delayed or neglected maintenance triggers additional direct and indirect costs. Asset management and asset maintenance are ongoing processes which require planning and prioritising of work, regular checking and monitoring due to greater variation in the level of service and maintenance practices required on rural roads.



To support better maintenance practices, the new package includes:

**AUS-SPEC TECHnote GEN 027 Maintenance of unsealed roads (NEW):** This TECHnote aims to assist local road authorities to maintain low volume unsealed gravel roads.

#### Pavement Preservation

AUS-SPEC has introduced the concept of pavement preservation in the suite of construction and maintenance specifications for sealed and unsealed roads. Pavement preservation is a long-term strategy, employed at a network level, that enhances pavement performance by using an integrated and cost-

effective set of practices that extend pavement life, improve safety and meet community expectations. It is an approach to preventive maintenance to 'place the right treatment, on the right road, at the right time.' Preventive maintenance is a tool for pavement preservation and involves non-structural application to restore serviceability and prevent further deterioration. Pavement preservation is the sum of all activities to provide and maintain serviceable roadways, including corrective and preventive maintenance and minor rehabilitation.



Pavements deteriorate due to various factors, predominantly vehicle loading and environmental exposure over their lifetime. However, where council roads are lightly trafficked and surfaced with sprayed seals or asphalt, deterioration of these roads is due to the breakdown of the surfacing, primarily due to oxidation. Some early failures could be due to the breakdown in the construction process, such as materials, site preparation or placement practices. These are avoidable if proper construction methods and placement techniques are used in conformance to the specifications. Improved construction methods, appropriate treatment methods and specifications all contribute towards improved pavement performance, minimum maintenance, safer roads, and delay the need for costly rehabilitation.

#### Pavement preservation treatments for sealed roads

For flexible pavements, the quality construction and material practices include sprayed seals, slurry seals, microsurfacing, asphalt overlay and pavement preservation treatments. Each surfacing type has particular characteristics and specific types of treatments are required in different sets of service conditions. The following AUS-SPEC specifications can be used for sprayed treatments for sealed roads:

- Sprayed seals – 1143 *Sprayed bituminous surfacing*.
- Asphalt overlay – 1144 *Asphalt*.

- Slurry surfacing, slurry seal and microsurfacing – *1146 Microsurfacing*.
- Sprayed preservation surfacing treatments including rejuvenation, enrichment and polymer modified emastic (PME) – *1147 Sprayed preservation surfacing* helps to specify the right preservation treatments and *TECHnote GEN 023 Sprayed preservations surfacing treatments* provides further guidance on treatment methods.

### **Pavement preservation treatments for unsealed roads**

Unsealed roads that are maintained efficiently are considerably more cost effective than sealed roads for low volume roads.

### **Surface performance**

The surface performance and deterioration of gravel is influenced by interrelated factors including material properties, road geometry, pavement design, drainage, environmental variations and traffic conditions. AUS-SPEC documents assist councils in considering all these factors in specific road design and construction worksections. Road condition deteriorations are categorised into surface types including rutting, dust, loose material, stoniness, corrugations, potholes and scouring. These are covered in the AUS-SPEC workgroup *16 Maintenance and operations – road reserve* worksections.

### **Material properties**

A well-graded gravel sand mixture with a small portion of clay fines performs well as a wearing course material in most cases. The distribution of materials from coarse to fine creates shear strength in the wearing surface, which performs well in traffic and weather conditions. *TECHreport TR08* provides guidance to improve the performance and properties of available materials through local gravel pits.

### **Environmental influences**

Seasonal dryness and increased traffic volumes can result in higher dust emissions and ravelling. Drier areas tend to form corrugations under traffic due to the local materials being of lower plasticity, hence increasing the demand on maintenance regimes. When cold, however, wet weather can introduce further deficiencies, including scouring and washouts, freeze-thaw (causing impassable slushy surfaces) or wet slippery surfaces, and less daylight available to dry out the road surface.

### **Preservation and reduced intervention**

Preservation of existing unsealed gravel roads can be an economical and effective alternative to:

- Frequent grading maintenance intervention.
- Frequent gravel resheeting.
- Full construction of a sealed road.

The required intervention levels and timing of maintenance intervention resources may not be sufficient to protect council's duty of care to provide safe roads.

### **Blending**

Construction and maintenance costs can be reduced by improving an unsealed road by blending a combination of road materials for resheeting or using stabilisers to mix into the existing road material. The councils aim to:

- Increase the time between subsequent grading interventions;
- Increase accessibility after rain; and
- Reduce bull dust hole hazards due to long dry spells.

Using the following blending options improves the performance of the unsealed roads:

- With the right gravel blends, the increase in density leads to longer life cycle for unsealed pavements, while the reduced porosity of the denser product reduces the risk of subgrade pavement potholing.
- Using blended gravel improves construction workability and thus reduces the cost of construction. For unsealed roads, the use of granular blending or other binder stabilisation increases the time between grading interventions and consequently reduces maintenance costs and increases accessibility after rain.

There are many options for councils to save costs using stabilisation of existing road pavements.

AUS-SPEC *TECHreport TR08* provides guidance on the blending of locally available materials and *1113 Stabilisation* worksection includes information on how to specify stabilisation treatments in different conditions. It also provides additional information on chemical binders, foamed bitumen, dust suppression additives and other treatments for unsealed roads. Councils should be exploring pavement development as ongoing initiatives

for total asset management and to get better roads for a lower cost.

### **AUS-SPEC approach to maintenance management**

AUS-SPEC's approach to the management of lower volume roads includes:

- Applying scientific methodology to the selection of surfacing materials for a given traffic loading and environmental conditions;
- Constructing/maintaining roads to a standard that satisfies the target level of service and enables the road to operate at optimal maintenance investment.
- Using the appropriate form of treatment for specific pavement defects.

The AUS-SPEC maintenance system includes reporting of asset inspections, defects, programmed and prioritised works and monthly 'works-as-executed' reports to continually improve maintenance history and asset inventory. They also provide necessary records for defence against litigation. The components of the maintenance framework are:

- Maintenance management plans: To provide an appropriate and effective methodology towards quality management where the councils provide a Maintenance Management Plan for the Contractor. This includes a maintenance defect register, an essential part of asset management which records the defects found during programmed inspections.
- Activity specifications: To provide a list of requirements covering the work. The scheduled activity specifications define the scope and performance requirements of each task.
- Activity contract requirements: To provide a series of council nominated distress levels, response times and compulsory intervention levels to allow better level control and timeliness of maintenance/repairs. This is valuable since an important part of the AUS-SPEC maintenance contract model is defining and reporting on performance parameters, such as 'distress' to be rectified (e.g. footpath trip slab or pothole) or the 'need' for remedial action (e.g. impeded open drain or long grass on footpath). Towards this, a series of forms are also provided to

help control the process of management and work payment (often done in parallel with specifications).

- *1602 Maintenance schedules – road reserve:* This schedule is now a spreadsheet and includes 10 worksheets for work cost review, bitumen reseals, seal preservation, proposed construction, road reserve assets, gravel pit testing, gravel resheeting, schedule of rates and samples for plant hire and labour rates.

Using more science in the selection of local marginal gravel materials, including stabilisation, can save councils considerable costs when these resources are utilised to correctly extend intervention times between maintenance cycles for unsealed roads. Similarly, the manufacture of impermeable gravel pavements using mechanical blending and chemical stabilisation will result in reduced edge breaks for sealed road shoulders and reduced pavement damage for flood prone roads.

### **3.4 Specifications made easy with SPECbuilder**

AUS-SPEC specifications can be accessed and easily compiled using SPECbuilder, NATSPEC's online specification compiler. It permits the relevant documents to be compiled for a project specification, or a master specification for council projects. The worksections are collated from a menu in SPECbuilder and edited in Microsoft Word to the detail required for the work situation, either simple or complex. Council's design, construction and maintenance teams can all use SPECbuilder while working on specific projects in their road networks.

AUS-SPEC case studies and papers, are available at [www.natspec.com.au](http://www.natspec.com.au) provide more information and examples of how different councils have used the AUS-SPEC specification system for their own council projects.

### **4 Conclusions and recommendations**

The unsealed road network in Australia represents a significant portion of local government infrastructure. Regional and rural councils will find the new *AUS-SPEC Rural roads specification package* incredibly useful to document the design, construction and maintenance of their road network. A greater emphasis on design considerations,

construction quality, material selection and appropriate maintenance techniques will lead to long-lasting sealed and unsealed pavements. Implementing pavement preservation as a long-term strategy at the network level will further enhance pavement performance by using integrated, cost-effective practices that extend the life of the pavement. The most important aim of pavement preservation is to apply the right type of treatment to the right pavement, at the right time. Specifying the correct treatments using the appropriate AUS-SPEC documents can help Councils to preserve and prolong the asset life whilst simultaneously minimise life cycle costs of their road assets. Using the appropriate information in the new *Rural roads specification package* will significantly improve the structural integrity, safety and performance of sealed and unsealed roads. This package will be extremely valuable to councils in enabling them to better serve their rural and remote communities.

## References

1. Austroads AGPT03, 2009, *Guide to pavement technology – Pavement surfacings*.
2. Austroads AGPT06, 2009, *Guide to pavement technology – Unsealed pavements*.
3. *Forgotten best practices for unsealed roads*, 2014 Glenda Visini and Markham Parker.
4. *2018 AUS-SPEC Rural roads specification package*.
5. AUS-SPEC *Design reference*.
6. AUS-SPEC *Construction reference*.
7. AUS-SPEC *TECHnotes*.
8. AUS-SPEC *TECHreport TR08 Management of council gravel pits in country areas – A case study*.



## USING AUS-SPEC FOR MANAGEMENT OF UNSEALED ROADS

### INTRODUCTION

This TECHnote provides guidance on using the AUS-SPEC specification system for the design, construction and maintenance of unsealed roads. Unsealed roads account for approximately 484 000 km from a total of 810,000 Km of Australia's road network and provide access to rural and remote areas for passenger and commercial vehicles, haulage vehicles routes and emergency services access. They comprise either natural material or gravel and do not have a permanent water-resistant surface like bitumen spray seal, asphalt or concrete.

### TYPES OF UNSEALED ROADS

Unsealed roads can be classified in two ways:

- Stage of construction: e.g. unformed, formed and formed and gravelled.
- Traffic volume: Austroads AGPT06 Table 2.1 classifies unsealed roads as Class U1 to U5, with U1 having the highest traffic volume. Similarly, Australian Road Research Board (ARRB) identifies unsealed road Classes 4A to 4D, with 4A having the highest traffic volume.

Pavement selection is based on consideration of the following:

- Traffic volume and type.
- Desired speed.
- Importance of the pavement for all weather access.
- Availability of local materials.
- Available funds.

### MANAGEMENT OF UNSEALED ROADS

Unsealed roads can deteriorate rapidly due to weather conditions, traffic volume, construction quality, lack of availability of materials, poor drainage provisions and inadequate maintenance. Effective and efficient life cycle management of unsealed roads is a significant issue faced by most regional, rural and remote councils. The guiding principles of unsealed road management include:

- Maintenance of road safety through quality design
- Providing a high-density impervious gravel pavement to deflect rainfall away from the weaker subgrade.
- Reduction of road maintenance costs by using mechanical blending and chemical stabilisation to reduce defects such as potholes, slippery, dusty, ravelling, corrugating and rutting.
- Testing of materials crushed and screened in each quarry to ensure better service and extended resheeting life.

The AUS-SPEC specification system of *Templates* and procedures can be used for the design, construction and maintenance of unsealed roads and the *new Rural Roads Package* will assist local government to effectively manage these extensive assets.

#### Design

The 00 PLANNING AND DESIGN workgroup covers quality requirements, bushfire protection, site regrading, control of erosion and sedimentation, geometric road design, pavement design, pathways and cycleways, design of stormwater drainage. These *Templates* can be used to document design requirements such as stage of construction, design life, pavement materials, construction documentation requirements.

#### Construction, rehabilitation and renewal

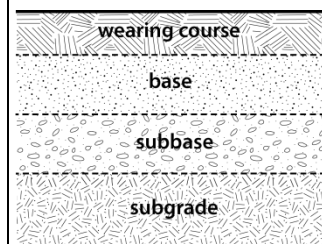
The following AUS-SPEC workgroups can be used to document the construction, rehabilitation and renewal requirements for unsealed roads:

**01 GENERAL:** For tendering requirements, quality assurance, schedule of rates, integrated management, environmental management and standard contract checklists.

**02 SITE, URBAN AND OPEN SPACES:** For construction of bushfire perimeter tracks, pathways, masonry walls, crib retaining walls, gabions and rock mattresses.

**03 STRUCTURE:** For auxiliary concrete works.

**11 CONSTRUCTION – ROAD RESERVE:** For construction requirements of various elements relating to unsealed roads including control of traffic, control of erosion and sedimentation, clearing and grubbing, earthworks, stabilisation, pavement base and subbase, road openings, drainage elements such as subsoil and formation drains, pavement drains and various ancillary items like signposting and boundary fences.



Layers associated with unsealed roads



Unformed road



Formed road



Formed and gravelled road

Stages of construction in unsealed roads



## USING AUS-SPEC FOR MANAGEMENT OF UNSEALED ROADS

**13 CONSTRUCTION – PUBLIC UTILITIES:** For construction of drainage elements relating to unsealed road construction including stormwater drainage, pipe drainage, precast box culverts and drainage structures.

### Maintenance

Maintenance practices aim to slow down the rate of deterioration by ensuring the key factors affecting maintenance of unsealed roads as shown in the figure are adequately managed. Proactive maintenance and inspection programs aim to provide continued structural integrity, safety, minimise erosion and sedimentation and provide a free draining surface to the formation. Maintenance normally includes reshaping pavement cross-sections, replacing lost wearing course material, adding material where weaknesses occur, cleaning of table drains, and extending roadside drainage, and removal of surface defects. Details on improving materials and maintenance are provided in *TECHreport TR08* and *TECHnote GEN 027*.

The larger City Councils have introduced integrated proactive and reactive maintenance systems based on priority response rankings determined by inspections. This information is converted by the works engineer into job instructions for the selected work team and links to the financial system for budget allocation.

In smaller country councils the Customer Request Management (CRM) forms are sent to the overseer who sorts the complaints into work team instructions. The overseer may inspect the defect prior to giving the CRM to the relevant team leader. The concept of reactive and proactive maintenance is sorted by the experience of the overseer.



### Factors affecting maintenance of unsealed roads

Councils can use the AUS-SPEC maintenance system to collect records and prepare documentation relating to asset inspections, program and prioritise works, align service levels to maintenance and operations budgets, and manage risks relating to unsealed roads through a systematic set of processes. The following AUS-SPEC workgroups can be used for effective unsealed roads maintenance:

**11 CONSTRUCTION – ROAD RESERVE:** For control of traffic, control of erosion and sedimentation, stabilisation, wearing course, base and subbase, subsoil drains, signposting and guide posts related to rehabilitation and renewal of unsealed roads.

**14 MAINTENANCE AND OPERATIONS – URBAN AND OPEN SPACES:** For tree and vegetation control in road reserves, and boundary fence repairs.

**16 MAINTENANCE AND OPERATIONS – ROAD RESERVE:** For general requirements relating to road reserve maintenance, maintenance schedules and road reserve maintenance plan. Activity specifications include Templates for local shape correction, grading and resheeting of unsealed roads, grading and resheeting of unsealed shoulders, pothole repairs, stabilisation, ancillary works such as signage, road traffic control and storm damage response for road safety.

**18 MAINTENANCE AND OPERATIONS – PUBLIC UTILITIES:** For procedures on general maintenance of drainage elements and structures, including pits, culverts and drains located in the road reserve.

### CONCLUSION

Unsealed road networks represent a significant portion of Australia's infrastructure. Rural and remote Councils using the AUS-SPEC specification system to document the design, construction and maintenance of unsealed roads may significantly improve the structural integrity, safety and performance of unsealed roads and better serve their rural and remote communities using the AUS-SPEC Rural roads package.

### Relevant publications

#### Austroroads

AGPT01 *Guide to pavement technology Part 1: Introduction to pavement technology*.

AGPT04 *Guide to pavement technology Part 4: Pavement materials*.

AGPT06 *Guide to pavement technology Part 6: Unsealed pavements*.

#### Australian Road Research Board

ARRB Group 2009, *Unsealed roads manual - guidelines to good practice*.

#### Australian Rural Road Group

Juturna Consulting for Australian Rural Road Group 2010, *Going nowhere - the rural local roads crisis, its national significance and proposed reforms*.

Juturna Consulting for Australian Rural Road Group 2011, *Worth Feeding - case studies of rural local road efficiency and reform of Australia's road pricing and investment systems*.

### Relevant NATSPEC TECHreport

*TECHreport TR08 Management of council gravel pits in country areas – A case study*

### Relevant NATSPEC TECHnotes for unsealed roads

*NTN GEN 017 Using AUS-SPEC for asset management*

*NTN GEN 018 Using AUS-SPEC for asset maintenance*

*NTN GEN 019 Using AUS-SPEC for contract documentation*

*NTN GEN 026 Otta seal - A different approach to road sealing*

*NTN GEN 027 Maintenance of unsealed roads*

### Relevant AUS-SPEC workgroups for unsealed roads

00 PLANNING AND DESIGN

01 GENERAL

11 CONSTRUCTION - ROAD RESERVE

13 CONSTRUCTION - PUBLIC UTILITIES

14 MAINTENANCE AND OPERATIONS - URBAN AND OPEN SPACES

16 MAINTENANCE AND OPERATIONS - ROAD RESERVE

18 MAINTENANCE AND OPERATIONS - PUBLIC UTILITIES