

## Rural Road Asset Management Practitioners' Guideline



First Edition: December 2019

## Acknowledgements

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## Foreword

Despite the vital contribution that roads make to a country’s economic growth and the well-being of society, they are often taken for granted. Effective management of a country’s road network is key to the quality of the environment its citizens live in.

Road infrastructure, whether in urban or rural areas, is crucial for the attainment of economic growth, alleviating poverty, promoting entrepreneurship and increasing a country’s competitiveness. Roads play a critical role in the transportation of goods, services and people and in the socio-economic development of a country. They are the arteries (main roads) and the veins (rural roads) of the economy. Rural roads contribute to social and economic development in rural areas, which acts as a deterrent to inward migration to the cities.

Those who work in road sector institutions, which are often the largest capital spending departments of a government, are duty-bound to maximize value for money on behalf of those they serve – the citizens. This can be achieved by reducing overall spending through efficient design, construction and maintenance of roads within budgetary constraints, without compromising standards, quality and the level of service expected by the road user. The sustainable provision of roads depends on the efficient use of the available resources and the adoption of a holistic approach to road asset management.

The ReCAP research project “Economic Growth through Effective Road Asset Management”, or “GEM”, promoted a change in the approach of rural road agencies towards the management of their road networks. Traditional approaches focus on technical aspects such as network management systems and contracting modalities for road maintenance works. However, the GEM project encouraged a holistic approach, where road agencies consider all six building blocks of the Road Preservation Pyramid (see below). Particularly important of these building blocks are the external/political and the institutional building blocks. The reputation of the people that determine the political and institutional environment for roads depends on whether they manage to keep these two blocks, upon which all the other building blocks rest, intact!

The operational building block is a small part of the pyramid, but it represents the aspects of road asset management that road users come into contact with on a daily basis. The importance of maintenance is often underestimated in the preservation of the road infrastructure asset. Timeous maintenance of roads, using accurate data collected through regular monitoring, contributes to their longevity and is an effective use of limited financial resources. Maintenance operations are an important component of rural road asset management upon which the socio-economic development in rural areas rests.

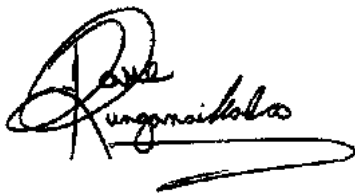


**The Road Preservation Pyramid**

The GEM project culminated in the preparation of this Rural Road Asset Management Practitioners' Guideline. The guideline is intended to assist road authorities responsible for the management of rural access roads. It is a comprehensive guideline, not a policy manual, and advocates for good practice in the preservation of a vital asset of each country. Tools are provided for rural road agencies to assess their performance in road asset management and to identify gaps where improvement is necessary. The guidelines promote accountability and self-improvement.

We look forward to the adoption of the GEM approach not only by the country members of the ReCAP Programme and the rest of the African countries, but by all developing countries and their respective agencies responsible for rural roads.

We acknowledge the contribution of the many individuals, roads agencies and academics who contributed to the development of this guideline. Thank you all.



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## Preface

The Research for Community Access Partnership (ReCAP) provided technical assistance and capacity building to foster sustainable improvements in performance in rural road asset management. The countries that participated in the project were Zambia, Uganda, Sierra Leone, Tanzania and the Western Cape region of South Africa. District road networks were selected in each country as a focus for the research project. Simple tools were developed and piloted in the five participating countries to assess performance in rural road asset management and to achieve sustainable improvements. The project was known as “Economic Growth through Effective Road Asset Management” (GEM).

Central to the research methodology was the development of a specification to enable road agencies to assess their performance in asset management as a basis for self-improvement. The specification is based on the development of an objectively determinable “Road Sector Sustainability Index” which measures the extent to which six building blocks considered essential for achieving effective road asset preservation are satisfied in practice. Periodic measurements of the condition of the project road networks, coupled with the collection of socio-economic data, were used monitor trends in road asset value and assess the impact of road condition on the well-being of rural communities.

The purpose of this guideline is to provide the tools needed by rural road agencies to assess and improve their performance in road asset management. It guides users in the process of adopting and implementing asset management approaches to the delivery of road networks and assists rural road agencies in obtaining support from political representatives and senior decision makers. The guideline covers the management of rural roads, focussing mainly on gravel and earth roads. Tools are provided for the road agency performance self-assessment, developing asset management policies and road maintenance strategies, undertaking road condition surveys and asset valuation, and planning and implementing maintenance works. Simple approaches are recommended as a basis for more sophisticated management systems that may be required in the future.

## Acronyms, Initialisms, Units and Currencies

\$	United States Dollars
AfCAP	Africa Community Access Partnership
AM	Asset Management
AsCAP	Asia Community Access Partnership
AWP	Annual Work Plan
CAV	Current Asset Value
CDS	Civil Design Solutions
CRV	Current Replacement Value
DFID	Department for International Development
DM	District Municipality
GAT	GEM Advisory Team
GDP	Gross Domestic Product
GEM	Economic Growth through Effective Road Asset Management
GPS	Global positioning system
GRZ	Government of the Republic of Zambia
IAMM	Infrastructure Asset Management Manual
IQL	Information Quality Level
KDC	Kamuli District Council
km	kilometre
KLG	Kamuli Local Government
LVR	Low Volume Road
MLGH	Ministry of Local Government and Housing
MOWT	Ministry of Works and Transport
mUSD	Million United States Dollars
NCI	Network Condition Index
NCI <sub>f</sub>	Network Condition Index (Formation)
NCI <sub>p</sub>	Network Condition Index (Pavement)
NFI	Network Functionality Index
NRFA	National Road Fund Agency (Zambia)
PCA	Public and Corporate Affairs
PMU	Project Management Unit
PIT	Project Implementation Team
PO-RALG	President's Office – Regional and Local Government
RAI	Rural Access Index
RA	Roads Agency
RAFI	Road Asset Funding Index
RAM	Road Asset Management
RAPI	Road Asset Preservation Index

RCI	Road Condition Index
RCI <sub>F</sub>	Road Condition Index (Formation)
RCI <sub>P</sub>	Road Condition Index (Pavement)
RDA	Road Development Authority (Zambia)
ReCAP	Research for Community Access Partnership
RFI	Road Functionality Index
RMFA	Road Maintenance Fund Administration
RSSG	Road Sector Sustainability Grade
RSSI	Road Sector Sustainability Index
RTSA	Road Transport and Safety Agency
RUC	Road User Charge
SADC	Southern African Development Community
SC	Steering Committee
SLoCaT	Partnership on Sustainable, Low Carbon Transport
SLRA	Sierra Leone Roads Authority
SLRF	Sierra Leone Road Fund
TARURA	Tanzania Rural and Urban Roads Agency
TC	Trading Centre
TDC	Tonkolili District Council
TMD	Trunk, Main and District roads
TMH	Technical Methods for Highways
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid
UoB	University of Birmingham
UNRA	Uganda National Road Authority
URF	Uganda Road Fund
ZMK	Zambia Kwacha
ZDF	Zambia Defence Force

## Definitions

Rural Road Asset Management	A systematic method of information collection, evaluation and decision-making, resulting in the optimisation of resources for the provision and maintenance of rural roads in a transparent and inclusive manner.
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Level of Service	LOS is a qualitative measure used to categorise traffic flow and quality levels of traffic based on performance measures like passability, vehicle speed, density, congestion and safety. LOS is described through broad statements that can be easily understood by road users and stakeholders and describe the performance of the road network that the road agency undertakes to provide.
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### Asset Management Performance Indicators

Road Condition Index (RCI)	Engineering index, a result of aggregation of visually assessed degree and extent of defects at road level. It can be further aggregated to give a Network Condition Index (NCI).
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Road Functionality Index (RFI)	Provides an indication of the level of service offered by a road vis a vis comfort, safety and capacity at road segment level. A result of the aggregation of defects relevant to road functionality combined with the general passability of the road. It can be aggregated to give a Network Functionality Index (NFI).
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Condition Index – Pavement (CI <sub>P</sub> )	Aggregation of degree and extent of defects relevant to the gravel layer only, at road segment level. The CI <sub>P</sub> feeds into the Asset Value calculation. It can be aggregated to give a Network Condition Index – Pavement (NCI <sub>P</sub> ).
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Condition Index – Formation (CI <sub>F</sub> )	Aggregation of degree and extent of defects relevant to the road formation only, at road segment level. The CI <sub>F</sub> feeds into the Asset Value calculation. It can be aggregated to give Network Condition Index - Formation (NCI <sub>F</sub> ).
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Condition Index – Structure (CI <sub>S</sub> )	Aggregation of degree and extent of defects of culvert or bridge structure components. The CI <sub>S</sub> feeds into the Asset Value calculation. It can be aggregated to give a Network Condition Index - Structures (NCI <sub>S</sub> ).
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Road Sector Sustainability Index (RSSI)	The extent to which the necessary policies, funding and institutional capacity are in place to ensure the sustainable provision of roads. Calculated as the weighted aggregation of attainment under the 6 Building Blocks in the Road Preservation Pyramid: External, Institutional, Funding, Managerial, Technical + Operations.
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Current Asset Value (CAV)	CAV is an estimate of the remaining value of an asset based on current condition, expected and remaining useful life.
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Current Replacement Value (CRV)	CRV is an estimate of cost of replacing the asset with a modern equivalent of similar nature, based on current unit rates.
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Road Asset Preservation Index (RAPI)	The ratio of the current road network Current Asset Value (CAV) divided by the road network Current Replacement Value (CRV).
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Road Asset Funding Index (RAFI) Capital funds provided for asset renewal (periodic, rehabilitation and reconstruction) divided by quantified asset renewal needs of the agency.

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Road Maintenance Funding Index (RMFI) The amount of routine maintenance funds provided for road network asset sustenance divided by the quantified maintenance needs of the agency.

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# 1 Introduction

## 1.1 Background

### 1.1.1 *The management of rural roads in Sub-Saharan Africa*

A review carried out under the GEM project showed that there are very few examples of sustainable rural road asset management programmes currently operational in sub-Saharan Africa<sup>1</sup>. Systems tend to be focussed on preparing and implementing annual work programmes rather than adhering to long-term strategic plans. Governments tend to pay more attention to the construction of new roads than maintenance of existing infrastructure, and many countries have not yet developed a culture of prioritising maintenance.

Funding for maintenance has improved in recent years with the establishment of road funds, but priority tends to be given to maintenance of national trunk road networks. The disparate demands made on the fiscus leads to challenges with respect to the funds required for maintaining the rural roads.

Where there are improvements in funding this is not always reflected in improved maintenance due to inefficiencies in the road agencies, failure to utilise available resources in the most effective way, and lack of accountability. Uninformed interventions by politicians are common and invariably undermine the efficiency and effectiveness of sector organisations. Opaque and unethical procurement processes are a significant factor affecting performance.

Governments continue to grapple with their policies on decentralisation of road maintenance. Most countries now follow a policy of decentralisation of service delivery in key sectors, but the most effective rural roads maintenance programmes tended to be those that are managed centrally. The lack of clear policy on decentralisation results in unclear roles and responsibilities for sector institutions.

Contracting out of road maintenance has been promoted in SSA countries through conventional term contracts as well as output-based performance contracts. However, these well-intended policies of commercialisation of road management and maintenance have not always led to capacity development in the private sector. Funding constraints have hindered growth in the sector and the small size of maintenance contracts is not attractive to bigger players. Small firms cannot afford to invest in equipment and staff development. Maintenance contracts that use performance-based specifications are seen as risky by contractors and can be expensive.

Examples exist of good practice in road asset management under donor-funded programmes with high levels of technical assistance; but these initiatives tend to flounder when the donor support is withdrawn.

### 1.1.2 *Why promote effective rural roads asset management?*

Effective road asset management (RAM) follows a well-planned and systematic approach that examines the technical and administrative requirements for planning and implementing road upgrading and maintenance works. The processes followed are guided by agreed policies at high level, the policies having been developed through a process that is inclusive of all stakeholders. Asset management encourages transparency and adoption of good business approaches and sound engineering methods that yield good results and encourage accountability. Research has shown that there is a direct link between improvements in rural

<sup>1</sup> Geddes, R.N. et al, Civil Design Solutions (2016). Economic Growth through Effective Road Asset Management (GEM), Final Formulation Phase Report, Project No. 10636A GEN2018A, London: ReCAP for DFID

road asset management and the reduction in poverty levels. It therefore makes economic sense for countries to adopt sound road asset management principles and practices.

### 1.1.3 GEM project outcomes and applicability

The GEM project was implemented in sub-Saharan Africa as part of ReCAP between November 2015 and the end of 2018. The project devised a series of tools that can be used to measure and monitor the performance of roads agencies in the management of their road assets. These tools are designed to function with relatively small amounts of data and detailed analysis. The GEM performance indicators can be used by a roads agency to track changes in their asset management performance over time. They can also be used to compare the performance of roads agencies within the same country or region. Roads agencies can identify specific actions that need to be taken to improve their performance.

The GEM approach is not dependent on the model for road maintenance adopted by the road agency. It is equally relevant whether maintenance is implemented through force account, small local contractors, community-based organisations, or larger output- and performance-based contracts.

## 1.2 About this guideline

The purpose of this guideline is to provide the tools needed by rural road agencies to assess their performance in road asset management and to identify gaps where improvement can be achieved. It promotes accountability and self-improvement. In so doing, it provides a guide to actions that will lead to improved asset management of rural road networks based on lessons learnt from the implementation of the GEM project. Adoption of the processes described in this guideline will lead to improved performance in rural road asset management. The guideline encourages good governance and business practices in rural road provision and maintenance as well as the active selection of appropriate technical approaches suited to the circumstances of each road agency or local authority. It provides guidance for obtaining support for road management from political representatives, senior decision makers and non-technical sections of management, whose support is of paramount importance. The guideline is not a replacement for road management systems that may already be working well, but it is intended to complement and strengthen existing arrangements.

The guideline covers asset management of rural roads, focussing mainly on gravel and earth roads. The scope includes tools for road asset management self-assessment by road agencies as well as a step by step approach to developing asset management policies, road maintenance strategies, undertaking road condition surveys and asset valuation, planning and programming maintenance works as well as implementation and monitoring. Simple approaches are recommended, which can form the foundation for more sophisticated systems that may be required in the future.

This guideline has been designed to be concise, practical and user friendly. Throughout the document key actions that the road agency needs to take have been indicated in bold and italic text. The guideline includes annexes with standard forms that are simple and ready for use.

Users of the guideline should be aware that a rational approach is always necessary when applying the recommendations. Whenever necessary the user should refer to the reference documents included in the bibliography (Chapter 12) for a more detailed treatise of a topic. Users are encouraged to seek the support of senior decision makers for the structured approach to road asset management that is recommended in the guideline. Broad stakeholder support is crucial to ensure transparency, accountability and sustainability in road maintenance operations.

### 1.3 Structure of the guideline

The structure of the guideline is as follows:

- Chapter 1 provides the background to the development of the guideline and its purpose.
- Chapter 2 provides guidance on the basic enablers of road infrastructure asset management.
- Chapter 3 provides guidance on steps to be taken to prepare an Asset Management Framework.
- Chapter 4 guides the user on the basics of asset management planning which includes attention to road provision and maintenance policies and preparation of strategies.
- Chapter 5 provides guidance on establishing an AM Policy and Strategy and defining the Level of Service. Guidance is provided on setting performance targets.
- Chapter 6 presents the RAM Self-assessment Questionnaire as a tool for use by road agencies in assessing their overall road asset management capabilities.
- Chapter 7 is for use by road agencies to set up road asset inventories, undertake condition monitoring, analyse the condition data and calculate the value of the assets. The chapter, in a simplistic way, assists the road agencies to determine road preservation needs and evaluate the level of financial resources that are being laid out to preserve the road asset.
- Chapter 8 provides a brief guide to programming and implementing maintenance works.
- Chapter 9 is intended to assist road agencies to determine the impact of RAM interventions on the communities through tracking of a few appropriate indicators of the socio-economic status of local communities.
- Chapter 10 provides road agencies with guidance on developing and implementing effective communication plans.
- Chapter 11 lays out simple pointers on road asset management performance monitoring, evaluation and review.



## 2 Towards Sustainable Road Infrastructure Asset Management

### 2.1 Introduction

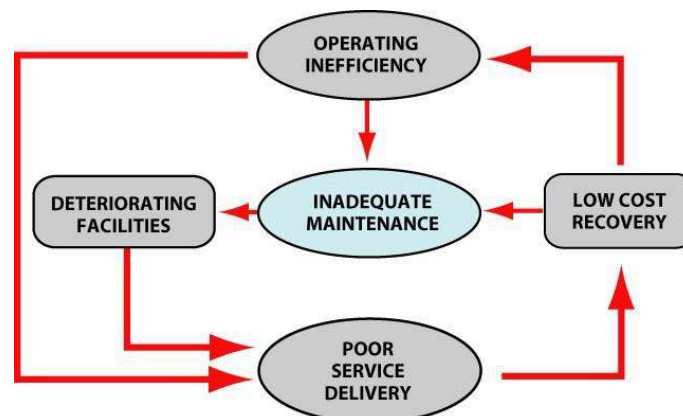
The purpose of this chapter is to provide a summary of the basic enablers of road infrastructure asset management. This includes institutional and management requirements, leadership, skills development and stakeholder engagement. The high economic cost of ineffective road maintenance is emphasised.

### 2.2 Developing a culture of maintenance

Developing countries tend to concentrate on building new road infrastructure which is attractive to politicians and guarantees future votes. Roads in bad condition are attended to first and tend to take up most of the resources available. There is a need to take a more holistic approach to the provision and maintenance of road infrastructure and adopt policies that encourage maintenance of existing infrastructure. This approach results in savings to the road agency and road users and benefits to the national economy.

The cycle of inadequate maintenance is illustrated in Figure 1. Inadequate maintenance leads to poorly maintained road surfaces which results in increased vehicle depreciation, tyre wear, vehicle maintenance and need for spare parts. The user costs and operating inefficiency related to these increases are substantial and in most developing countries these costs are in foreign exchange.

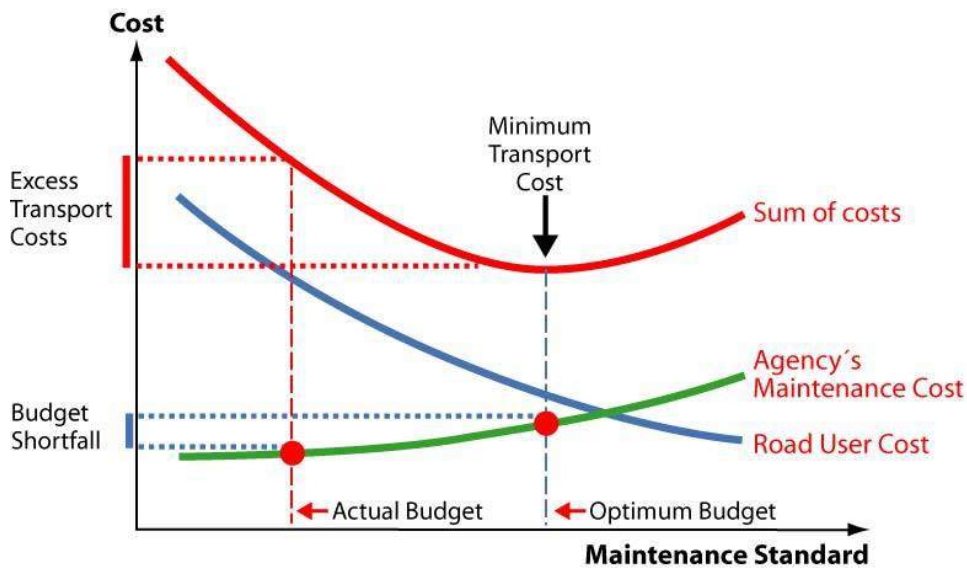
Figure 1: Cycle of inadequate road maintenance



Source: SATCC Guideline for Low Volume Sealed Roads (2006).

When a road is not maintained adequately and is allowed to deteriorate from good to poor condition, the money saved from not carrying out maintenance increases vehicle operating costs by two to three times. This is illustrated in Figure 2. Cutting back on road maintenance (“budget shortfall”) increases the costs of road transport (“excess transport costs”) and raises the net cost to the national economy.

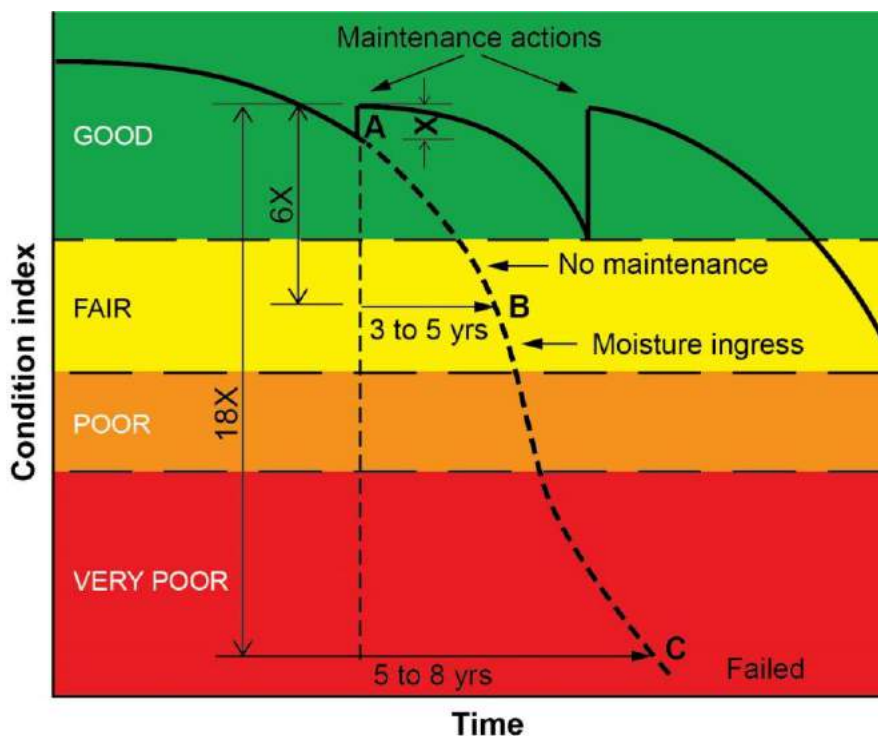
Figure 2: Relationship between maintenance standard and transport cost



Source: SATCC Guideline for Low Volume Sealed Roads (2006).

Research has shown that the cost of restoring a paved road to good condition may be up to 6 times the cost of deferred maintenance if the road reaches a “fair” condition, and 18 times the cost of the deferred maintenance if the road falls into very poor condition. This is illustrated in Figure 3.

Figure 3: Cost of deferred maintenance (paved roads)



Source: South Africa National Roads Agency Limited (SANRAL).

### 2.3 Engendering an informed and committed leadership

The culture and behaviour of an organisation reflects the characteristics and calibre of the leadership. It is incumbent upon managers of road agencies to demonstrate their leadership

by committing to asset management principles and applying them when making investment decisions.

A certain level of knowledge of asset management is required by leaders of road agencies for them to support the recommended approaches. Senior managers and technical experts in road agencies must be able to explain the key issues and benefits of asset management in non-technical terms to political decision makers and the public.

To ensure a committed and informed leadership, a review of the asset management arrangements should be undertaken annually. Refresher courses in all asset management areas should be held for the road sector leadership including agency boards and roads committees, as well as for technical and non-technical staff who are involved in road asset management.

## **2.4 Achieving stakeholder and road user participation**

Any party that can affect or be affected by policies and actions of the road agency is a stakeholder in the road sector. The road agency is responsible for managing stakeholder expectations and attending to their needs.

Stakeholders in rural roads include local communities, businesses, transport operators, representatives of different ministries, non-governmental organisations and other interest groups. Stakeholders are primarily interested in the functional condition of the roads and will immediately express concern if there is difficulty accessing public services or social facilities due to the poor condition of the roads. Representatives of rural communities are key players in implementing road projects that are aimed at reducing poverty and must be actively called upon to participate.

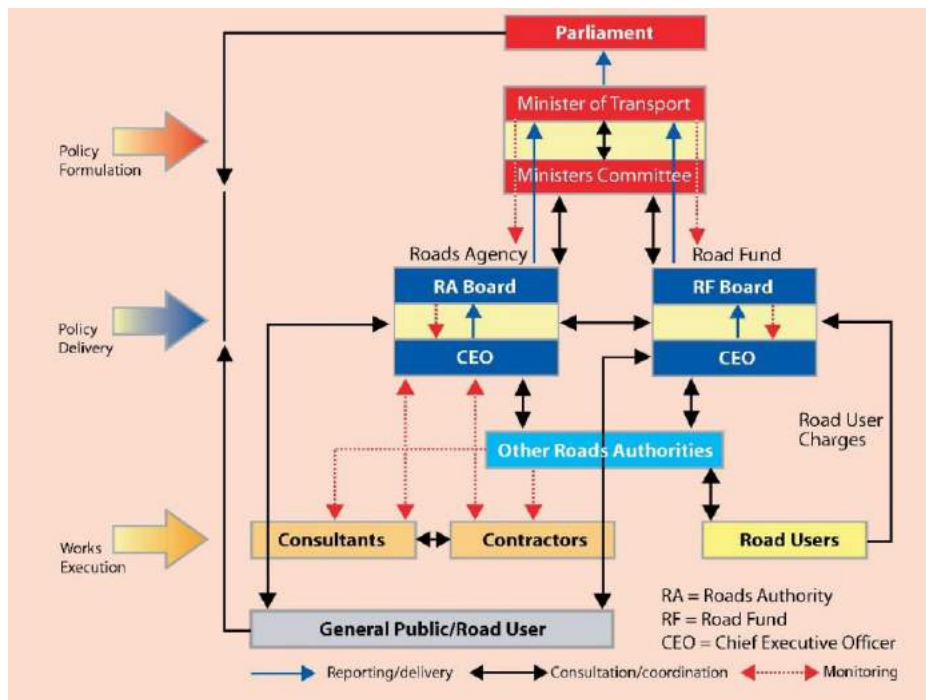
The management of stakeholder expectations is best done by engaging the different groups and involving them in the road asset management process. This engagement should be carried out in an informed and structured manner. Stakeholders are expected by the road agency to accept the level of service (LOS) that is provided by the road network, and this LOS will be more easily accepted if the stakeholders are involved in the process of setting it.

Various means including public meetings and opinion surveys can be used to establish stakeholder views. The asset management approach must be explained in clear terms so that they can be understood by the stakeholders, thereby allowing the attention to local needs to be balanced with the overall requirements of the network.

## **2.5 Defining clear institutional responsibilities**

Responsibility for the various parts of the road network must be clearly allocated within the institutional arrangements for the road sector. This allocation must be associated with strong independent institutions, whether public agencies or private. The hierarchy of such institutions must always be respected. The recommended institutional set for the road sector is shown in Figure 4. This model is encouraged under the Road Maintenance Initiative (RMI) which started in the 1990s.

**Figure 4: Institutional arrangements for management and financing of roads**



Source: SATCC Guideline on Low Volume Sealed Roads, 2006.

## 2.6 Developing a sustainable skills base

Most rural road agencies have inadequate staff and experience high staff turnover. Some agencies may have individuals in key positions who lack requisite skills or experience. Capacity development plans, which include training programmes for each individual staff member, should therefore be implemented by the agency. The capacity building activities should be designed to attend to specific shortcomings and must adopt a long-term growth perspective. A principle of the RMI is that public sector staff should receive similar remuneration to their counterparts in the private sector.

## 2.7 Structuring a viable communication strategy

Most road agencies are aware of the importance of transparency in the way they undertake their activities and therefore endeavour to provide relevant information to the public. Transparency should be demonstrated in decision making for the identification, appraisal, prioritising and programming of road projects, including maintenance works.

The involvement of the public in the decision-making process must be allowed for. The public must be provided with good quality information on the benefits of asset management, current on-going activities, expected results, challenges being faced and their likely impact of the quality of services. Road agencies should implement communication strategies that describe how the agencies will relate to stakeholders in setting requirements, agreeing on levels of services, prioritising projects and reporting on performance. Further guidance on communications is provided in Chapter 110.

## 3 Defining the Rural Roads Asset Management Concept and Framework

### 3.1 Introduction

The chapter provides guidance on steps to be taken to prepare an Asset Management Framework. The concepts of “Asset Management” and “maturity levels” are defined. The components for a rural road asset management framework are listed, and the process to be followed by a rural road agency to introduce and sustain RAM in the organisation is described. The components of the framework are described in further detail in Chapter 4.

### 3.2 The importance of rural roads

Rural roads are usually the lowest tier in any road classification system. They consist of paths, tracks, earth and gravel roads, and, increasingly, some low volume sealed roads. Rural roads usually carry not more than about 300 vehicles per day.

Rural roads have a relatively low asset value compared to national highways, but typically serve more than 60% of the population in developing countries. Although rural roads are viewed as “non-economic” and offering more of a social service than economic benefit, their condition is closely linked to levels of poverty in rural communities. Properly planned interventions on rural roads can have significant social and economic impacts.

### 3.3 The asset management approach for rural road infrastructure

Based on international practice in asset management (British Standards Institution (BSI), 2004), the definition of rural road asset management can be stated as:

“A systematic method of information collection, evaluation and decision-making, resulting in the optimisation of resources for the provision and maintenance of rural roads in a transparent and inclusive manner”.

Asset management in the provision of rural roads results in more efficient and effective management of the road network. Resources are used optimally to satisfy the road agency’s obligations and the expectations of road users.

Rural road infrastructure asset management is expected to conform to the norms of standard asset management practices and be based on the following principles:

- Systematic and strategic approaches over a long-term period (5-10 years);
- Full consideration of stakeholder needs;
- Optimal allocation of resources;
- Consideration of life-cycle costing;
- Meeting performance requirements in the most efficient way; and
- Proactive management of risks.

### 3.4 Rural road asset management maturity levels

The development, implementation and improvement of asset management by an organisation takes a significant amount of time. Commitment and concerted effort are required for a road agency to grow from a simple level of RAM to what can be termed as “mature”.

Maturity levels in asset management in the context of this manual are defined from Stage 0 to Stage 5 as follows:

### **Stage 0: Absent Systems/ Very Poor**

The road agency has no systems in place and the extent of the road asset, or its condition is largely unknown. Investments on the network do not follow any prescribed criteria.

### **Stage 1: Initiative/ Poor**

Awareness has been created of the potential benefits of adopting asset management approaches. However, the approaches have not been adopted by the organisation and whatever is implemented is largely the unrecognised effort of individuals using their own initiative.

### **Stage 2: Proficient/ Fair**

At this maturity stage, the RAM approaches are relatively well embedded in the agency, with a well-structured road inventory system. Road condition is regularly monitored and the data are used to provide probable indications of amounts of funding required for maintenance works.

### **Stage 3: Advanced/ Good**

The asset management system is well developed, and data are collected and analysed according to pre-set calendars. The results of the AM system influence the programmes and work methods adopted by the agency.

### **Stage 5: Mature/Proficient/ Very Good**

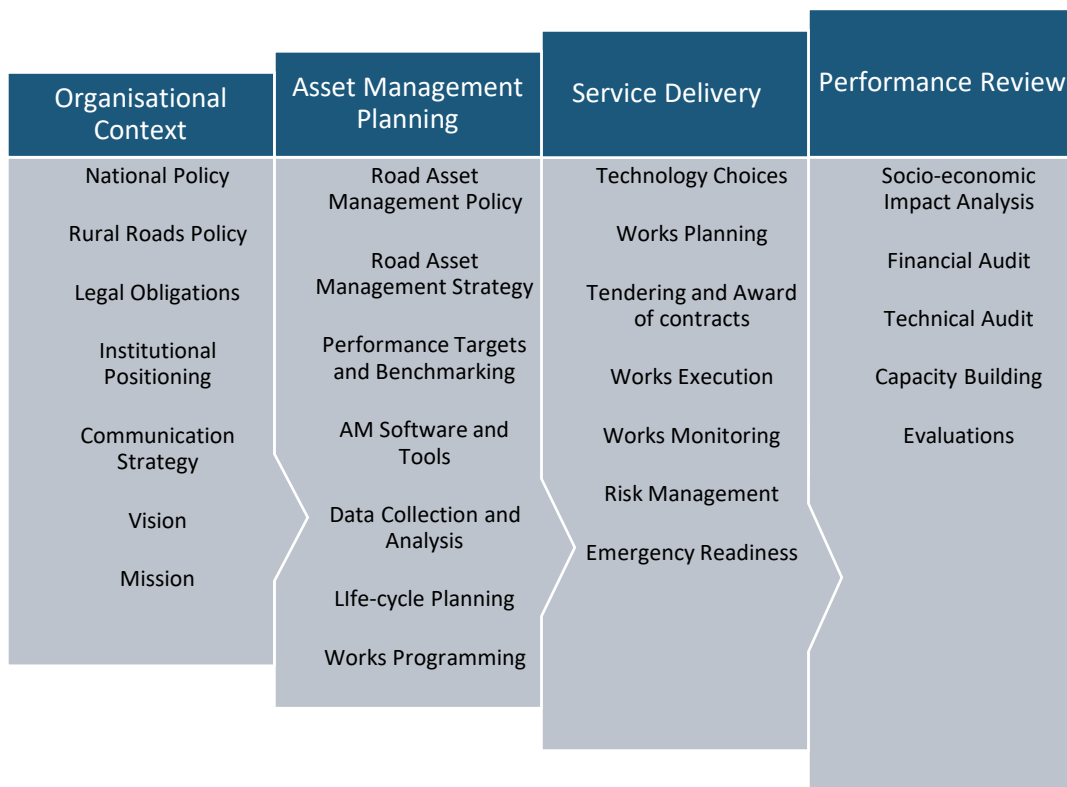
At this stage all asset management policies and procedures are in place and are subject to continuous review and improvement. The results generated by the asset management system are used to dictate the interventions on the network for all classes of works, including emergency works, upgrading, rehabilitation, periodic maintenance and routine maintenance.

## **3.5 Framework for Rural Road Asset Management**

The framework for rural road asset management identifies the processes and attributes that are a pre-requisite for successful implementation of RAM. The framework and its processes are aimed at identifying and establishing the legal, institutional, political, social and environmental setting within which the agency endeavours to deliver its services. Furthermore, the framework sets up clear, agreed and approved asset management planning, implementation and review processes. Enablers for the successful management of the road asset must be identified, including organisations, systems and tools.

Figure 5 shows the necessary components of a rural road asset management framework (Austroads, 2018).

**Figure 5: Rural Road Asset Management Framework**



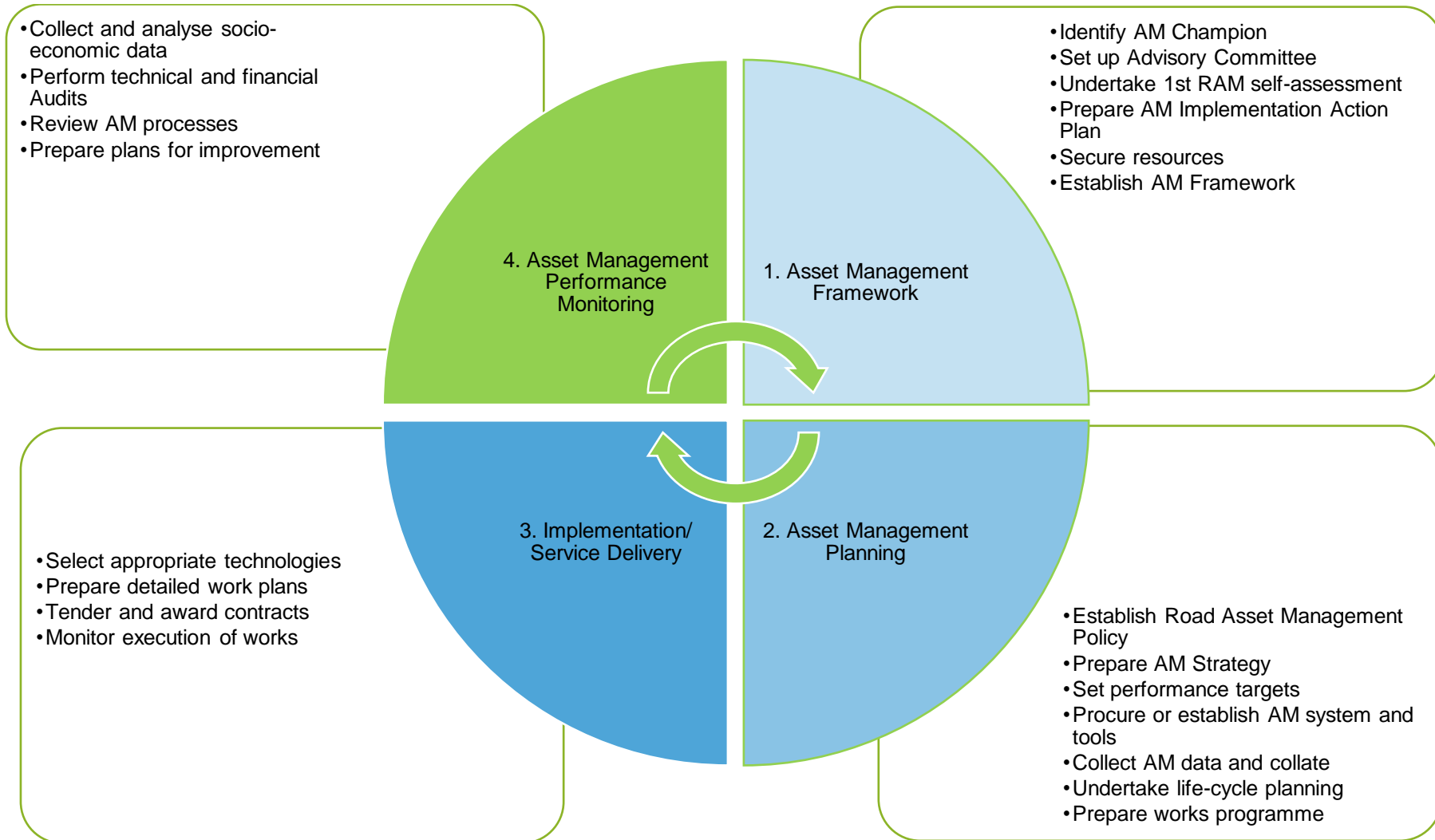
### 3.6 The rural road asset management cycle

The rural road asset management cycle is shown in Figure 6. This process is followed by rural road agencies as they endeavour to introduce and sustain RAM in the organisation.

In summary the cycle entails:

- Identifying a champion for asset management and obtaining their commitment to steering the process;
- Setting up an advisory committee (or using an existing road committee) with responsibility for RAM;
- Undertaking the first round of self-assessment of asset management performance;
- Identifying weaknesses and drawing up an action plan to address deficiencies in the short, medium and long term;
- Securing adequate funds to undertake the process of introducing asset management practices, including technical assistance and training;
- Developing the asset management framework;
- Implementing the asset management approach;
- Monitoring performance and evaluating the impact of the approach; and
- Reviewing and improving all components of the framework.

**Figure 6: Rural Road Asset Management Cycle**





## 4 Developing Effective and Efficient Rural Road Asset Management

### 4.1 Introduction

The starting point in the journey towards effective and efficient rural road asset management is for the road agency to be conscious of the framework for road asset management as described in Chapter 3. Chapter 4 describes the components of the framework in more detail and highlights actions that road agencies need to take to establish it.

### 4.2 The link to national roads and transport policy

National governments set national policies on transport and road infrastructure. These national policies guide formulation of policy at local level where rural roads are provided and maintained. National policy usually leads to preparation of a National Transport Masterplan.

#### Action:

Local authorities must be actively involved in the preparation of national road and transport policies to ensure local perspectives and needs are taken into account.

### 4.3 Rural roads agency as custodians of rural roads policy

Rural road agencies are guided by national policy and have the responsibility for developing local policies that attend to local needs for a defined road network. Rural roads policies should follow the expectations of national policies. Local road agencies must be aware of national policies on rural roads and request and keep copies of relevant documents.

#### Action:

Rural road agencies must be at the fore-front of the development of any rural roads policies. Where the policy exists, the document must be given the prominence it deserves and be available in the agency's documents library at all times. Constant reference must be made to such policies in the preparation of the asset management framework.

### 4.4 Road Asset Management Policy – where RAM starts!

Road asset management policies should follow the expectations of national and rural roads policies. Road agencies should be guided by national policies. Where relevant national policies are not available this should be communicated to central government with recommendations for immediate attention.

#### Action:

Rural road agencies shall develop their rural road asset management policies as a first step towards adopting and implementing road asset management approaches.

### 4.5 Managing stakeholder expectations

It is the responsibility of the road agency to manage expectations of all stakeholders. This is best done by engaging the different groups and involving them in the road asset management process.

**Action:**

The agency must develop a communication plan that uses various tools such as public meetings and opinion surveys to establish local views. The asset management approach must be explained in clear terms so that they can be understood by the stakeholders thereby allowing the balancing of attention to local needs with the overall requirements of the network.

#### **4.6 The institutional, organisational and management context**

The road agency must be clear about the definition of its institutional positioning in road provision and maintenance in the national context. The agency will likely have responsibility for part of the national network and will be required to report to a central ministry. The organisational structure of the agency must be clear, and roles and responsibilities of each position must be documented and included in contracts of employment. The mandates of any road committees or board of directors must be clear and up to date.

**Action:**

Carry out annual reviews of the institutional and organisational context within which the agency operates as well as keep the organisational structure up to date. The roles and responsibilities of each position must be part of the contract of employment with a clear definition of personal key performance indicators.

#### **4.7 Road asset management planning**

For effective and efficient RAM, the agency must possess an Asset Management Plan. Such a plan will include details of the asset management policies, strategies, definitions and listing of expected levels of service, approaches to data collection and management. Asset management calls for lifecycle planning and this should be part of the overall Asset Management Plan. Further guidance on this aspect of road asset management planning is given in Chapter 5.

**Action:**

The road agency should prepare an all-encompassing Asset Management Plan and update it on an annual basis.

#### **4.8 Selection of asset management systems**

Road asset management performance can be enhanced by adopting and using computerised asset management systems. There are many systems available on the market, albeit at a high purchase price and high support cost. As road agency budgets are usually limited, the selection of an appropriate system should depend on envisaged usage and cost. The GEM project encouraged adoption of a simple spreadsheet-based system in the first instance from which road agencies can build as their budgets increase. Further details and guidance are given in Chapters 6 and 7.

**Action:**

The road agency shall judiciously establish its current level of development vis a vis use of computerised systems before purchasing what can be expensive and unsustainable systems on the market. A staged approach shall be adopted wherein the agency shall adopt simple spreadsheet-based solutions and build on these as the organisation matures.

## 4.9 Road asset management maturity level self-assessment

There is no organisation that can be said to be perfect at road asset management. At any time, gaps exist in the manner the road agency plans and delivers its services. It is important that a standard process of determining the gaps be embedded in the culture of the organisation and its operations.

**Action:**

The road agency shall determine gaps in its AM capacity and capabilities using the GEM RAM Self-Assessment Questionnaire Tool. The process must be undertaken at the same date each year.

## 4.10 Road asset management delivery

Once the road asset management plan is in place and funds for works are available, the delivery of a functional and effective road network will depend significantly on the coordination of efforts by various departments or divisions within the road agency. The procurement section needs to ensure that resources are supplied or engaged when required. The technical department is responsible for the selection of appropriate solutions for works provision and maintenance, which requires detailed knowledge of material sources, appropriate technology and project management.

**Action:**

Each road project shall be allocated a responsible person who shall take full charge of the project management function, from commencement to end, including coordination of the designated technical team and selection of appropriate maintenance standards and implementation technologies.

## 4.11 Measuring the socio-economic impact of asset management

The GEM project established that improved rural road asset management can result in improved road conditions and thereby contribute towards a general improvement of the socio-economic condition in rural communities. Road improvements result in reduced transport costs and improved access to local services, economic administrative centres and employment opportunities.

**Action:**

Road agencies shall routinely collect socio-economic data to assess and demonstrate the impact of maintenance interventions on rural communities.

## 5 Setting Asset Management Policies, Strategies and Levels of Service

### 5.1 Introduction

This chapter provides guidance on developing an AM Policy and Strategy and defining an appropriate Level of Service for roads under the management of the agency. The concept of “Performance Measures” is introduced along with guidance on setting performance targets.

### 5.2 Asset Management Policy

The road asset management policy adopted by a road agency should demonstrate the commitment of senior decision makers to implementing asset management approaches in full. The policy should outline the principles and approaches to be adopted to deliver a functional road infrastructure network to the agreed levels of service. The policy must not contradict guidance given by national transport policy published at central government level.

The road agency asset management policy should be a concise document that describes the principles adopted in asset management to achieve the agency’s strategic objectives. It is a broad statement of intent that provides overall guidance to other policies and procedures applied in road provision and maintenance. The road agency should use facilitated stakeholder workshops to arrive at an agreed policy. The process should be repeated at least every five years and should include a review and assessment of the agency’s official documents such as its Vision, Mission, corporate plans etc.

A typical asset management policy is given in Annex A. The policy statement must be prominently displayed in the road agency’s facilities and quoted in correspondence and other documentation where relevant.

### 5.3 Asset Management Strategy

The asset management strategy is a high-level document setting out how the road asset management will be implemented by the road agency to meet its long-term goals and objectives (HMEP, U.K., 2013). Detailed justification is given for the adoption of the asset management approaches, clearly outlining the benefits to road users and communities. Current and future requirements are defined, set and agreed by all parties. The document sets out statutory obligations that govern the functioning of the road agency. Constraints are identified. Above all the document should detail how asset management activities will be implemented and measured, and how lessons drawn from the results will be built into future improvements.

The strategy must be prepared by staff responsible for asset management and endorsed by senior decision makers. It must be arrived at via a process of stakeholder consultation. The document must be reviewed every two to three years to capture any changes that may have occurred in the road agency’s policies or operating conditions.

Development of the Asset Management Strategy will normally follow the following steps:

- Analysis of the current management systems and asset performance under current conditions and traffic;
- Review of community satisfaction with the performance of the road network;
- Establishment of acceptable and affordable target standards and condition of various components of the road network;
- Prediction of future changes in the requirements of the communities for access and levels of service; and
- Establishment of a broad outline of strategic priorities for network interventions to achieve and sustain appropriate performance.

## 5.4 Defining the level of service

### 5.4.1 Objectives

The objective of defining levels of service is to create the basis for measuring performance in asset management and setting performance targets that will enable continuous monitoring of the delivery of the asset management strategy (HMEP, U.K., 2013). Clearly defined levels of service facilitate effective communication with stakeholders using an agreed basis for performance measurement.

### 5.4.2 Level of Service

The road agency must define the levels of service to be delivered on the road network. These should be broad and high-level statements that describe the performance of the road network in a manner that stakeholders will understand. They must relate to outcomes in areas such as safety, serviceability accessibility, sustainability, etc. The level of service varies across the road network; for example, a provincial road will have a different level of service from a farm access road. Where the agreed level of service is provided on a particular road, this implies that the road is “fit for purpose”.

Levels of service should be developed at the same time as the asset management strategy is prepared and each level of service must be associated with a framework of performance indicators. Road asset managers should describe the proposed performance levels in terminology that can be easily understood by non-technical persons such as elected representatives. The level of service adopted for each class of road must be clearly communicated with road users and communities as part of the asset management strategy and plan. Examples of level of service definitions are given in Table 1.

**Table 1: Examples of Level of Service Definitions**

Attribute	Current Performance	Desired Performance	Action Required
Roads are reliably open and accessible	Ten percent of the roads are closed on average for 7 days during the rainy season	Closure must not be more than 2 days	Raise road levels at the flooding crossings
Road safety	Annually there are 30 injuries and 2 fatalities on the road network	Not more than 15 injuries and NIL fatalities	Carry out safety audits and implement safety enhancing measures
Road safety	Vehicles operate at high speed in trading centres	Maximum speed must be 40 km/h	Install speed calming measures including signage
Average Operational Speed	An average speed of 40 km/h is attained on the network	Desired average speed in 60 km/h	Reduce road roughness through improved maintenance

## 5.5 Performance measures

### 5.5.1 Definition

Performance measures are used to determine whether agreed levels of service are being met. They can be technical or non-technical. The performance measures are usually numbers that have meaning to most stakeholders. The following classification of performance measures is recommended:

- Strategic performance measures – these provide a snapshot of the overall performance of the agency;
- Tactical performance measures – these provide management information to senior decision makers; and
- Operational performance measures – these relate to information on the operational aspects of road construction and maintenance and can be used to monitor performance of parties undertaking maintenance activities.

In each of the above classifications, the performance measures should refer to inputs, outputs or outcomes or efficiencies of interventions on the roads.

### 5.5.2 Setting performance targets

Performance targets should be set by the staff responsible for asset management and agreed with senior decision makers, formally endorsed, approved, and published for the public to view and comment. Ideally, they should be set for 3 to 5-year periods, with reviews on an annual basis.

A consultative process must be followed in setting targets and requirements of central government may need to be considered. Experience on previous programmes must inform the process as well as good practices by other similar institutions. Road agencies should set performance benchmarks through borrowing from the experience of peers in the sector in-country, regionally and internationally. The gap between current and desired performance will inform the actions that must be taken by the road agency to achieve the requirements of the asset management strategy.

Table 2 gives examples of asset management performance indicators and targets that can be adopted for rural roads. Each road agency must select appropriate indicators for each class of road and define its own specific targets.

**Table 2: Examples of asset management performance indicators**

Asset or Attribute	Performance Indicator	Current Performance	Desired Performance	Benchmark	
Adherence to asset management principles and norms	Road Sector Sustainability Index (RSSI)	Poor, initiatives made	Good, advanced	Very good, mature, proficient	Strategic
Level of sustainable preservation of assets	Road Asset Preservation Index (RAPI)	0.65	0.75	0.85	
Road asset funding adequacy	Road Asset Funding Index (RAF)	0.45	0.75	1.0	
Gravel roads	Gravel thickness	Average of 35% of design thickness	Average of 65% of design thickness	Average of 75% of design thickness	Tactical
Gravel roads	Road Condition Index (RCI)	Poor	Fair	Good	
Gravel roads	Condition Index – Pavement (CI <sub>p</sub> )	Poor	Fair	Good	
Gravel roads	Condition Index Formation (CI <sub>f</sub> )	Poor	Fair	Good	
Earth roads	Road Condition Index (RCI)	Poor	Fair	Good	
Earth roads	Condition Index Formation (CI <sub>f</sub> )	Poor	Fair	Good	
Bridges and culverts	Condition Index -Structure (CI <sub>s</sub> )	Poor	Fair	Good	
Repair of potholes	Response time	Yearly	Bi-annually	Within 2 weeks	Operational
Grass cutting	Height of grass on verges	1m plus	25 cm	10 cm	
Clearing of drains	Percent siltation	85%	30%	10%	
Speed of travel on gravel and earth roads	Average travel speed	35 km/h <sup>2</sup>	60 km/h	60 km/h	
Maintenance grading - motorised	No of cycles per year	One/year	Two/year	Two/year	
Tyre dragging	No of cycles per year	Once/year	Two/year	Three/year	

Note: Where speed of travel is used as a performance indicator care must be taken to avoid creating potentially dangerous conditions.

<sup>2</sup> The target for the average travel speed could be a proportion of the design speed for the road.

## 6 Road Asset Management Maturity Self-Assessment Process

### 6.1 Introduction

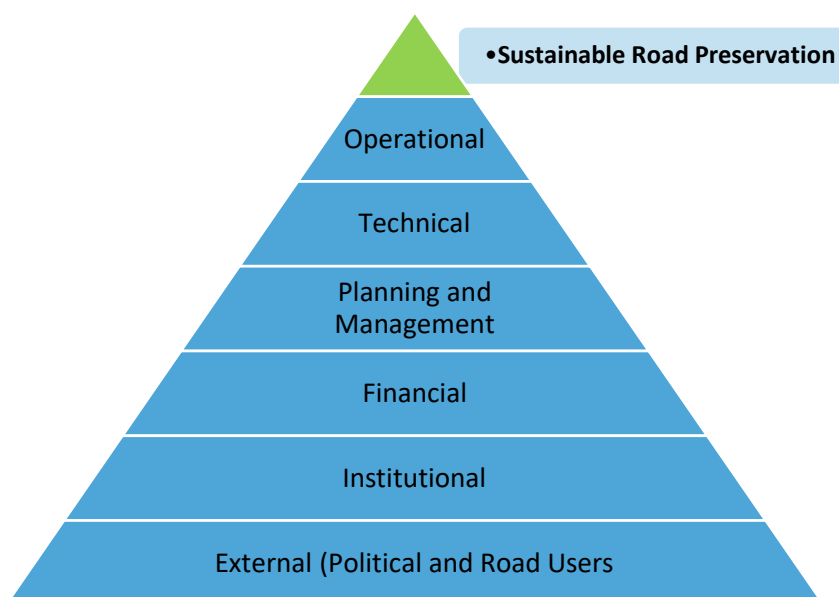
This chapter presents the Road Asset Preservation Pyramid and the RAM Self-Assessment Questionnaire. The questionnaire is used by road agencies to assess their overall performance in road asset management, determine their level of maturity, and identify weak areas in their capabilities which must be addressed. The self-assessment process is not dependent on the approach to road maintenance adopted by the road agency. It is equally relevant whether maintenance is implemented through force account, small local contractors or larger output- and performance-based contracts.

### 6.2 The Road Asset Preservation Pyramid

#### 6.2.1 Overview

The GEM project has developed a questionnaire which enables any roads agency to assess its performance in the six building blocks of the Road Preservation Pyramid (Figure 7) which are considered necessary for effective asset management. The questionnaire follows the principles of the BSI PAS 55 Specification, which is widely used for the appraisal of asset management (British Standards Institution, 2014). The questions are designed to be pertinent to a rural road agency, simple to understand and easy to answer. Each question requires a simple “Yes” or “No” answer.

**Figure 7: Road Asset Preservation Pyramid**



#### 6.2.2 Block 1: External and Political Environment

The questions under the External building block assess the existence of an asset management policy that is relevant to the rural transport sector, supported by senior decision makers and adopted at the highest level in government. Stakeholder engagement by the road agency is assessed in terms of the level of informed consultation and open communications in order to understand stakeholder needs and expectations. The level of engagement by the roads agency with other ministries and sector agencies is assessed.

#### 6.2.3 Block 2: Institutional Arrangements

The questions under the Institutional building block assess a range of issues contributing to the performance of the agency.

These include whether:

- the agency has a corporate vision and mission statement which considers stakeholder needs and expectations;
- the basic levels of service for roads been defined;
- emergency responses are in place and understood by key members of staff;
- the agency's organisational structure identifies roles, responsibilities and competencies of key staff (see Annex B) and is aligned with its AM policy, strategies, objectives and plans;
- the agency provides training opportunities for staff; and
- road agency engineer salaries are comparable with private sector positions.

#### **6.2.4 Block 3: Funding of Road Provision and Maintenance**

The questions under the Financial building block assess the existence of stable, adequate and sustainable funding for road maintenance. This includes whether an annual valuation is carried out of road infrastructure assets, a costing framework is in place for determining unit costs of works, a budgeting and programming processes is in place for a prioritised maintenance and investment plan, and whether there are adequate financial accounting and auditing procedures in place.

#### **6.2.5 Block 4: Management**

The questions under the Management building block assess the existence of an appropriate asset management system that contains network definition (road and bridge inventory information) and network condition data and facilitates the preparation of prioritised annual, medium and long-term maintenance and development plans.

#### **6.2.6 Block 5: Technical**

The questions under the Technical building block assess the existence of:

- an adequate road referencing system and inventory;
- a system for systematic and documented data collection for all principal road assets;
- annual visual condition assessment surveys;
- annual gravel loss surveys; and
- asset utilization estimates and forecasts, including the existence of bottlenecks on the network.

#### **6.2.7 Block 6: Operational**

The questions under the Operational building block assess the efficiency of operations at road agency including planning and scheduling of maintenance, procurement of service providers and technical compliance. Procurement of services is assessed in terms of appropriate type of contract, outsourcing of non-core activities, scheduling of maintenance works and technical auditing.

### **6.3 RAM self-assessment questionnaire tool**

The self-assessment questionnaire has been developed in the format of a spreadsheet and traditional table format. The spreadsheet in both formats can be obtained from the following web link: [www.research4cap.org](http://www.research4cap.org). Traditional tabular format of the questionnaire is included in Annex C.

Annex C includes two questionnaires, one of which is designed for use at the "national" level and the other at the "district" level. The questionnaire can be further adapted to meet the specific requirements of the road agency. For example, some modifications may be required to the questions under the Operational building block if the agency is using multi-year performance based contracts for the maintenance of its roads.



## 6.4 RAM self-assessment process

### 6.4.1 Frequency of assessment

The frequency with which a road agency should undertake the process of self-assessment depends on the intensity of on-going activities towards self-improvement. Where concerted AM building programmes are running it may be prudent to undertake the assessment every quarter or half-yearly. Under normal circumstances it is recommended that the roads agency undertakes the process annually.

### 6.4.2 Internal asset management self-assessment process

The self-assessment process includes the following steps to be implemented by the responsible manager:

- 1 Select the respondent group to receive the questionnaire for completion from within the road agency. The respondents should include representatives of all stakeholder groups such as councillors, members of the board of directors in the case of promulgated road agency set up, etc.
- 2 Conduct training of the respondents in the background to the questionnaire and how to complete it. The training must be carried out by experienced asset managers and may need to be outsourced. Respondents who may need direct assistance in completing the questionnaire shall be identified and special attention given to them.
- 3 Allow each respondent at least 14 days to complete the questionnaire.
- 4 Collect the completed forms (soft or hard copies) and collate the results into a single spreadsheet for analysis.
- 5 Analyse the results to determine the various indices and trends over the years or any other period of analysis.
- 6 Following the analysis of the data prepare a listing of gaps in RAM and make appropriate recommendations for consideration by all respondents and senior decision makers.
- 7 Convene a meeting to discuss the findings of the process and discuss the way forward.
- 8 Repeat the above process at least once every year.

### 6.4.3 External asset management assessment process

The asset management process can be undertaken by bodies external to the organisation at the discretion of the agency, for example using consultants or members of peer organisations. The same steps outlined above are followed. Where external respondents are participating, adequate exposure to the agency's road asset management systems must be provided well in advance.

## 6.5 Analysis of the questionnaire results

The structure of the questionnaire includes four questions under each topic included under each of the six building blocks. The maximum score for each topic is therefore four. Each building block typically includes about seven topics. The average of the scores for each topic gives a score (out of four) for each building block.

The building blocks are weighted according to their perceived importance towards sustainable road asset management. The External building block is given the highest weighting of 2 as it is regarded as the most important determinant of performance. The Institutional, Financial, Management, Technical and Operational blocks are given weightings of 1.8, 1.6, 1.4, 1.2 and 1.0 respectively.

The weightings are converted to coefficients by dividing the weighting by the sum of all of the weightings. The coefficients are then multiplied by the self-assessment questionnaire score for each building block to yield a score for each block. The sum of these results gives the "Road Sector

Sustainability Assessment Score”. The maximum value for this score is 4. This score is divided by four to give the Road Sector Sustainability Index (RSSI) applicable to the road agency.

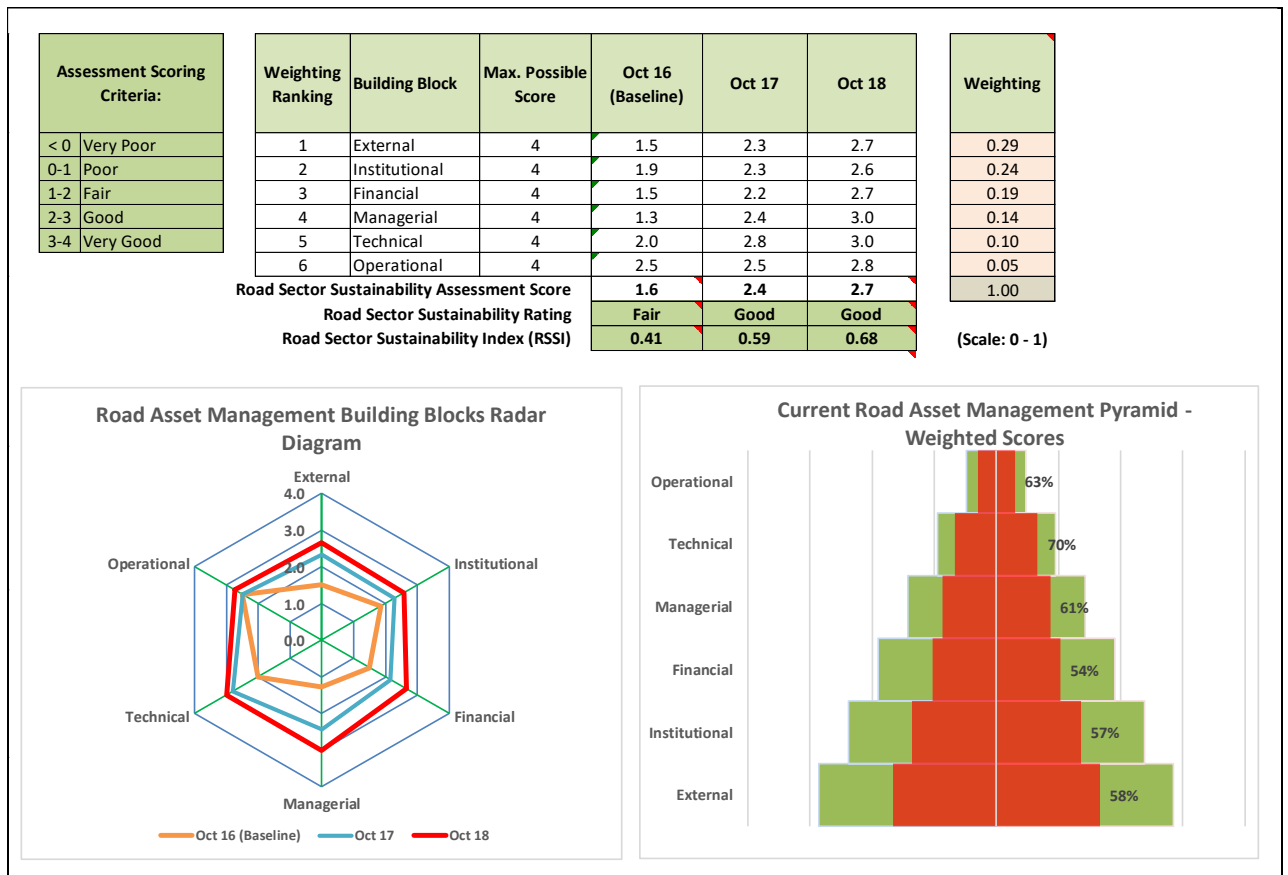
Table 3 provides an illustrated example of the scoring of the questionnaire for a typical rural road agency. The derivation of the RSSI and a graphical representation of the results are given in Figure 8.

**Table 3: Typical road agency scoring for the six building blocks over a 3-year period<sup>3</sup>**

AM building block	#	Item assessed	Score achieved out of 4		
			Oct 16 (Baseline)	Oct 17	Oct 18
<b>External</b>	1.1	National policy for rural roads		4	4
	1.2	Existence of rural road maintenance strategy		2	2
	1.3	Stakeholder consultation	2	3	3
	1.4	Tabling of budgets		2	4
	1.5	Reporting back to stakeholders		1	1
	1.6	Involvement in programmes at local level	1	2	2
<b>Average</b>			<b>1.5</b>	<b>2.3</b>	<b>2.7</b>
<b>Institutional</b>	2.1	AM policy development	2	3	3
	2.2	Level of service - existence	1	3	3
	2.3	Level of service - use	1	3	1
	2.4	Emergency response plan	2	1	3
	2.5	Staff roles and responsibilities	1	2	3
	2.6	Staff training and capacity building	2	1	2
	2.7	Staff salaries	4	3	3
<b>Average</b>			<b>1.9</b>	<b>2.3</b>	<b>2.6</b>
<b>Financial</b>	3.1	Provision of road maintenance funding	3	1	3
	3.2	Budget funding against perceived need	3	2	3
	3.3	Asset valuation	0	2	2
	3.4	Budget funding - asset value	0	2	2
	3.5	Financial forecasting	0	3	3
	3.6	Accounting system	3	3	3
<b>Average</b>			<b>1.5</b>	<b>2.2</b>	<b>2.7</b>
<b>Managerial</b>	4.1	AM system	1	1	4
	4.2	Maintenance intervention levels	0	2	2
	4.3	Maintenance plans - existence	3	3	4
	4.4	Maintenance plans - methods used	2	3	3
	4.5	Maintenance backlog	1	3	2
	4.6	Traffic forecasting	0	2	3
	4.7	Capital expenditure - basis for	2	3	3
<b>Average</b>			<b>1.3</b>	<b>2.4</b>	<b>3.0</b>
<b>Technical</b>	5.1	Road referencing system - existence	4	3	4
	5.2	Road inventory - existence	2	2	2
	5.3	Road inventory data	2	2	2
	5.4	Road condition assessment	1	3	3
	5.5	Asset utilisation	1	4	4
<b>Average</b>			<b>1.9</b>	<b>2.7</b>	<b>3.0</b>
<b>Operational</b>	6.1	Service delivery mechanisms	3	3	3
	6.2	Maintenance planning	3	3	3
	6.3	Reporting	2	2	2
	6.4	Auditing	2	2	3
<b>Average</b>			<b>2.5</b>	<b>2.5</b>	<b>2.8</b>

<sup>3</sup> Additional questions were included for the External building block after the baseline assessment.

**Figure 8: Analysis of Asset Management Self-Assessment Scores**



## 6.6 Using RAM self-assessment results

### 6.6.1 Gap analysis

A score of 100% on the assessment questionnaire indicates that the road agency is fully mature and is operating at excellent levels in terms of employment of asset management practices. It is highly unlikely that any road agency will attain this level and it will remain a level to which all aspire, the ideal and ultimate level.

Hence there will always be a gap in asset management that the agency must address. Once the process of analysing the questionnaire has been completed, the asset managers can identify the gaps that exist under each asset management building block and identify actions needed to address the deficiencies.

### 6.6.2 Trend analysis

A table should be prepared that indicates the movement in the various asset management aspects since the last assessment. The trend over the years should also be prepared and analysed. Table 4 gives a typical trend analysis of the RSSI value over a three-year period.

**Table 4: RSSI trend analysis of a typical road agency over a 3-year period**

AM Building Block	2016 (Baseline)	2017	2018	Change since baseline
External	0.50	0.38	0.54	+8%
Institutional	0.46	0.54	0.79	+69%
Funding	0.63	0.71	0.71	+14%

AM Building Block	2016 (Baseline)	2017	2018	Change since baseline
Managerial	0.61	0.61	0.75	+24%
Technical	0.65	0.80	0.75	+15%
Operations	0.67	0.67	0.75	+13%
Road Sector Sustainability Index (RSSI)	0.41	0.59	0.70	+70%

### 6.6.3 Action planning

Results of the asset management self-assessment process should be presented to senior management and decision makers. Various formats can be used including the format shown in Figure 8. Proposals for attending to the identified gaps must be prepared by the asset managers and presented for adoption by senior management. It is necessary that resources be set aside annually to improve the agency's asset management capacity.

### 6.7 Reporting and publishing

The results of the asset management assessment process must be made available to the public and for use by decision makers. They should be included in annual reports, brochures, newsletters, websites and public notice boards. The agency's communication plan should include publicising this information. This will build trust in the organisation amongst stakeholders.

## 7 Assessing Road Condition, Determining Needs and Valuation of Road Assets

### 7.1 Introduction

This chapter is for use by road agencies to set up road asset inventories, undertake condition monitoring, analyse the condition data and calculate the value of the road assets. These processes enable the road agency to determine road preservation needs and assess the adequacy of the financial resources that are being allocated to preserve the road asset.

### 7.2 GEM tools for condition monitoring and asset valuation

The processes outlined below have been developed in the format of a spreadsheet for ease of use by the road agencies. The spreadsheet can be obtained from the following web link: [www.research4cap.org](http://www.research4cap.org).

A detailed description of the processes and standard forms pertaining to road condition monitoring are included as Annexes D and E. Guidelines for road asset valuation are given in Annex F.

### 7.3 Road condition monitoring

#### 7.3.1 Objectives

The objective of undertaking road condition surveys is to identify structural and functional defects of road assets in a simple, sustainable and affordable manner. The data generated must be of an appropriate quality and reflect, as far as possible, the actual situation on the ground.

#### 7.3.2 Road inventory

An inventory of assets on the road network is a pre-requisite to undertaking any road condition monitoring exercise. Roads are to be identified by their allocated road numbers as well as the start and end kilometres. Bridges must be assigned register numbers as well. Minor culverts and other elements can be identified by the kilometre or chainage along the road. All reference points should have their coordinates established using a GPS receiver.

#### 7.3.3 Road condition survey method

Road condition surveys must be undertaken annually with the method recommended for adoption being based on the conventional visual inspection described in the Technical Methods for Highways (TMH) 9 from South Africa [4] for paved roads and TMH 12 for gravel roads. According to the method defects observed on 5 km road segments are rated on a scale of 1 to 5 according to their “degree” and “extent”, with degree representing severity of the defect, and extent estimating the quantity or magnitude of the defect. The defects that are assessed include gravel loss, usable road width, erosion of the carriageway, erosion of the side drains, potholes, corrugations, rutting and impassability.

The assessors that are engaged in the road condition survey must be trained in the assessment process to ensure consistency of results. The training should include theoretical and practical sessions and the assessors should be required to pass an examination before being allowed to carry out the condition assessments.

#### 7.3.4 Calculation of condition indices

The “deduct” method described in TMH9 and TMH22 was adapted under the GEM project for calculation of road condition indices. An Excel macro sheet was developed to combine the effects of any group of defects into one index. The scores for each defect are given weightings depending on the perceived importance of each defect and combined into a single score representing an assessment of road condition.

The following indices are derived for the purposes of asset valuation and determining preservation needs:

- The “**Road Condition Index (RCI)**”, which is an appraisal of the road in terms of both functional and structural of the road; all defects on the road are taken into account and the index is useful for checking the integrity of the collected road condition data.
- The “**Road Functionality Index (RFI)**”, which is an appraisal of the road in terms of functional characteristics that affect the quality of use, notably comfort (convenience) safety, congestion and operating cost;
- The “**Condition Index – Pavement (CI<sub>P</sub>)**”, which is the numerical rating of the road pavement and gravel layer depending on its structural integrity or condition, remaining layer thickness and usable width; and
- The “**Condition Index – Formation (CI<sub>F</sub>)**”, which is the numerical rating of the road formation depending on remaining usable width, integrity of the formation and erosion of the side drains.

These indicators are derived from the condition survey data by considering selected defects that are relevant to the index. For example, the  $RF_I$  is obtained from the degree and extent of potholes, rutting and corrugations. All three indices can be aggregated to determine a value for the network level. They are then known as the “Network Functionality Index ( $NF_I$ )”, “Network Condition Index – Pavement ( $NCI_P$ )” and “Network Condition Index – Formation ( $NCI_F$ ).”

Alternative methods may be used to monitor road condition including those that may already be in use by the road agency or already adopted as a national standard. Reference is made to condition monitoring indicators developed under the South-East Asia Community Access Programme (SEACAP) (Rolt, J. *et al*, 2009A and 2009B).

## 7.4 Determining road asset preservation needs

### 7.4.1 Categories of interventions

The following are interventions that may be considered by road agencies in rural road asset management:

- **Routine maintenance:** this category will include works that are carried out on cyclical basis (e.g. full width grading or blading, tyre dragging, grass cutting, shoulder grading) or in response to the condition (e.g. pothole filling, drainage repair, repair of ancillary components). This category of works includes spot regravelling.
- **Periodic maintenance:** regravelling of significant lengths through importation of material to replace lost material.
- **Rehabilitation:** repairs to restore pavement to its original condition and functionality.
- **Reconstruction:** total reconstruction of the road formation and pavement.
- **Upgrading:** upgrading from one type of road to another, in this context mainly from earth road to gravel road.

### 7.4.2 Criteria for determining road asset preservation needs

The overall needs on the road network according the categories mentioned in Section 7.4.1 are based on the road preservation strategies as set by the road agency following stakeholder consultations. As an example, a typical road agency may have a strategy as indicated in the box below.

1. All roads shall be subjected to routine maintenance on an annual basis.
2. A factor of 1.5 shall be applied to cater for spot improvements and emergency works.
3. Only roads that are in fair condition shall be candidates for periodic maintenance.
4. The agency will undertake periodic maintenance on 100% of the roads indicating Fair condition.
5. The agency shall, on a yearly basis, rehabilitate 50% of the roads in Poor condition
6. The agency shall, on a yearly basis, reconstruct 50% of roads in Very Poor condition.
7. On a yearly basis, funds shall be sought to upgrade 20% of the earth roads.

## 7.5 Road Asset Valuation

### 7.5.1 Objectives

The objective of undertaking asset valuation is to determine the current and future value of the road asset portfolio held by the agency. Tracking of asset value encourages accountability and effective utilisation of resources (Scheissler et. Al. (2004).

### 7.5.2 Summary of asset valuation process

The process for estimating the asset value is as follows:

- A structured inventory is established indicating the type and length of each road in the selected network;
- The expected useful life of the road formation and pavement are determined (typically 50 years for the road formation and 7 years for the gravel wearing course);
- The condition of the pavement and road formation are established through the condition surveys;
- The remaining useful life of the pavement and formation are determined based on the current condition;
- Unit rates are set for the calculation of replacement cost of the formation and the pavement; and
- The Current Replacement Value (CRV) and Current Asset Value (CAV) of each road are calculated.

Table 5 is an example of asset value calculation. More details are given in Annex F.

**Table 5: Example of asset value calculation for a gravel and earth road network**

BASIC INFORMATION ON ROAD AND SECTIONS					CURRENT REPLACEMENT COST			EXPECTED THRESHOLD VALUE					CURRENT ASSET VALUE				
GEM Road No.	Road Name	Road Type	Segment No.	Length (km)	Expected Useful Life - EUL (Yrs)		Current Replacement Cost (\$)	Min. Threshold Condition - Rating		Depreciated Remaining Cost (DRC) at Threshold Condition (\$)		Asset Value at Threshold Condition (\$)	Current Condition Rating		Depreciated Remaining Cost (DRC) at Current Condition (\$)		Current Asset Value (\$)
					Formation	Pavement		Formation	Pavement	Formation	Pavement		Formation	Pavement	Formation	Pavement	
1	Iganga - Kamuli	Gravel	1	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	2	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	3	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	4	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	5	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	6	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	7	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	8	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	9	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	10	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	11	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
1	Iganga - Kamuli	Gravel	12	2.00	50	7	90,000.00	Fair	Fair	28,350.00	34,650.00	63,000.00	Very Good	Very Good	38,475.00	47,025.00	85,500.00
2	Kamuli - Bukungu	Gravel	1	5.00	50	7	225,000.00	Fair	Fair	70,875.00	86,625.00	157,500.00	Very Good	Poor	96,187.50	61,875.00	158,062.50
2	Kamuli - Bukungu	Gravel	2	5.00	50	7	225,000.00	Fair	Fair	70,875.00	86,625.00	157,500.00	Very Good	Poor	96,187.50	61,875.00	158,062.50
2	Kamuli - Bukungu	Gravel	3	5.00	50	7	225,000.00	Fair	Fair	70,875.00	86,625.00	157,500.00	Very Good	Poor	96,187.50	61,875.00	158,062.50
2	Kamuli - Bukungu	Gravel	4	5.00	50	7	225,000.00	Fair	Fair	70,875.00	86,625.00	157,500.00	Very Good	Poor	96,187.50	61,875.00	158,062.50
2	Kamuli - Bukungu	Gravel	5	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Poor	71,250.00	37,500.00	108,750.00
2	Kamuli - Bukungu	Gravel	6	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Poor	71,250.00	37,500.00	108,750.00
2	Kamuli - Bukungu	Gravel	7	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
2	Kamuli - Bukungu	Gravel	8	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00
2	Kamuli - Bukungu	Gravel	9	5.00	50	7	150,000.00	Fair	Fair	52,500.00	52,500.00	105,000.00	Very Good	Very Good	71,250.00	71,250.00	142,500.00



## 7.6 Asset valuation and preservation indices

Three indices based on the road asset valuation and calculation of preservation needs were developed under the GEM project to monitor performance of a road agency in the preservation of their road assets and are recommended for adoption by road agencies.

These are:

- The “**Road Asset Preservation Index (RAPI)**”, which is defined as the ratio of the road network Current Asset Value (CAV) divided by the road network Current Replacement Value (CRV);
- The “**Road Asset Funding Index (RAFI)**”, which is the capital funds provided for road network asset renewal (periodic maintenance, rehabilitation and reconstruction) divided by the quantified needs of the agency for the same., and
- The “**Road Maintenance Funding Index (RMFI)**”, which is the routine maintenance funds provided for road network asset sustenance divided by the quantified needs of the agency for the same.

## 7.7 Reporting

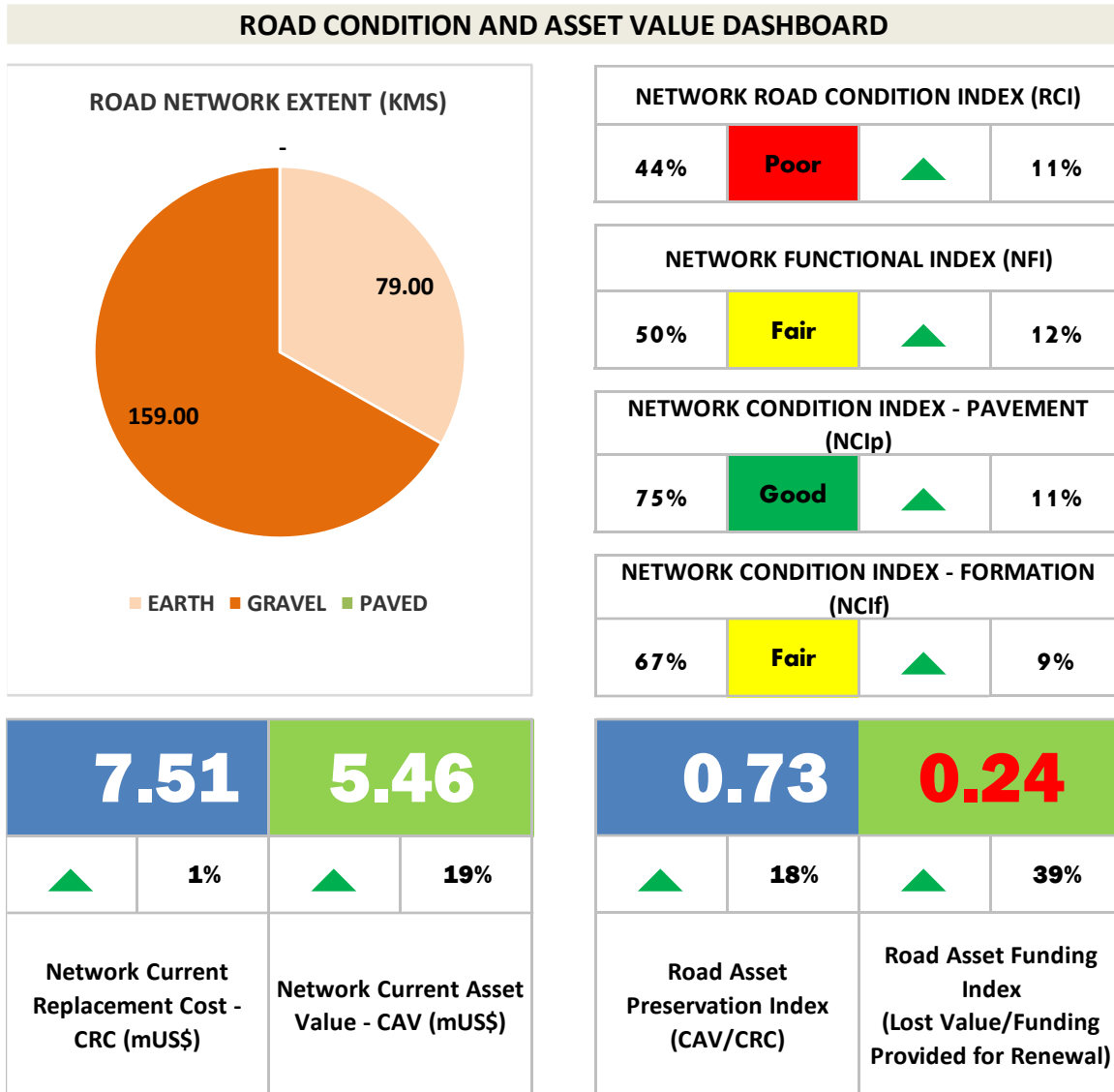
The following reports are expected to be generated from the Condition Monitoring and Asset Valuation processes:

- Asset knowledge reports – extent of network, type of roads, bridge structures, etc.;
- Current Network Asset Value;
- Percent of the network in condition worse than the threshold – by type – where the threshold level is defined as the asset condition level which the road agency strategically aspires to achieve;
- Trends in asset value over the several years set in the reporting requirements of the road agency - typically reports should aim at showing trends over periods of 3 to 5 years;
- Trends in condition of road network by type over at least 3 to 5 years;
- Projected trends in asset value and condition following planned improvements in asset management and funding; and
- Expenditure split – capital investment, rehabilitation, periodic and routine maintenance agency costs over 3 to 5 years.

## 7.8 GEM road asset preservation dashboard

Figure 9 represents a simple “Dashboard” that is generated from the road condition monitoring and asset valuation process, details of which are given in Annex F.

Figure 9: Road Condition and Asset Value Dashboard



## 8 Maintenance Works Planning and Implementation

### 8.1 Introduction

The objective of carrying out road maintenance work is to ensure that the roads provide all weather access throughout the year and to the required level of service. Planning for road maintenance should be guided by the agency's Road Asset Management Plan. This ensures the implementation of long-term strategies that enable road managers to efficiently allocate resources and to produce work programmes that will guide operations. The Asset Management Plan is also important to help road agencies to remain focused and achieve the long-term objective of supporting socio-economic development through provision of good and safe roads.

This chapter provides a brief guide to the planning, programming and implementation of maintenance works. The concept of the annual works planning calendar is introduced and the importance of accurate maintenance surveys is stressed. Guidance is provided on site record keeping and reporting as part of effective maintenance management.

The guidance in this chapter typically applies to routine and periodic maintenance works carried out on rural roads using small contractors, community-based organisations, length-workers or force account. The guidance is less relevant to large scale multi-year maintenance contracts, such as those that employ output- and performance-based specifications, where more of the management of the operations is the responsibility of the contractor, and supervision is out-sourced to consultants. Such models are not commonly implemented by district road agencies.

### 8.2 Summary of maintenance works programming, planning and implementation process

In summary, the planning for maintenance should follow a process of:

- Budget preparation and request for funding based on policy guidelines and procedures outlined by the parent Ministry;
- Road condition surveys and costing of works to be carried out on all roads to be included under maintenance;
- Establishing road maintenance priorities based on available resources, in consultation with the relevant stakeholders, and using a multi-criteria analysis approach;
- Preparation of the annual and 3 to 5 multi-year rolling work programmes;
- Procurement of contractors and works supervisors;
- Implementation of maintenance work following the work programmes;
- Continuous monitoring of work quality and progress;
- Regular weekly and monthly reports on expenditure and progress;
- Analysis of the information in the weekly and monthly reports to bench mark costs for each activity; and
- Use of the information from the cost analysis to update the planning and budgeting for the following year.

### 8.3 Works planning calendar and timing of routine road maintenance works

The timing of routine maintenance planning and implementation are in most cases dictated by rain seasons. Wet season maintenance activities are different from those carried out during the dry season. Maintenance activities also vary according to the traffic volumes, terrain and soil types.

Water is the biggest enemy on the roads and should be kept away from the road as much as possible. During the rainy season, the objective is to cope with the rains by clearing any debris blocking drainage structures and grading the road surface in order to provide road users with a

good running surface and keep the road safe for traffic users. After the rains the objective is to repair the damage caused by the rains and provide road users with a comfortable riding surface. Similarly, after the rains the aim is to repair damage caused by the rains and to provide farmers with good accessibility to market farm produce and to other socio - economic services.

Table 6 shows a typical routine and periodic maintenance planning calendar. Each road agency needs to develop a calendar that is appropriate to the conditions.

**Table 6: Typical maintenance planning calendar and works timing**

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RAINY SEASON		HARVEST SEASON				DRY SEASON				RAINY SEASON	
Cope with the rains		Repair damage caused by the rains				Prepare for the rains				Cope with the rains	
GRADING		DRY SEASON PAVEMENT MAINTENANCE						GRADING			
BUDGET PREPARATION			BUBGET SUBMISSION				BUDGET APPROVAL				

Maintenance Activities by Colour Code				
Grass cutting	Tyre dragging		Cleaning culverts	Grass cutting
Drain clearing	Painting headwalls		Repair culvert headwalls	Drain clearing
Pothole filling	Sign maintenance		Re - gravelling	Pothole filling
Grading			Repair & service equipment	Grading
Erosion repairs			Bridge maintenance	Erosion repairs

## 8.4 Prioritisation of Maintenance Works<sup>4</sup>

### 8.4.1 Principles of Prioritisation

Maintenance is most effective when applied to ‘maintainable’ routes, that is roads that serve the needs of the road users and have only minor defects that can be rectified using routine maintenance. This is preferable to trying to maintain roads that do not serve the needs of the road users as a result of major defects which require rehabilitation, for example un-drained tracks and sunken road sections. Maintenance of roads in very poor condition may consume a lot of resources with limited impact. Maintenance should always take importance over any route upgrading or improvement works. A roads agency should protect what it has before extending its assets and liabilities.

The first questions to ask in the prioritisation process are:

- Which routes can be maintained with the annual budget? and
- Which maintenance activities should be undertaken?

### 8.4.2 Prioritisation Process

The routes with the highest maintenance priorities should be determined by the road agency in consultation with community representatives. The information on road priorities should be displayed at prominent community locations.

For simplicity and clarity, it is best to divide the roads into 3 or 4 priority groups based on the following criteria:

- Is the road a strategic inter-community or main road link;

<sup>4</sup> This section is based on the “Manual for Low Volume Roads, Part E - Road Maintenance” prepared under ReCAP for Sierra Leone and Liberia (2019) and Overseas Road Note 1 (Third Edition 2003).

- Is the traffic high (e.g. more than 50 motor vehicles/day) or low?
- What is the population served by the road?
- What value of crops is extracted each year from the area served by the road?
- Does the road serve markets, educational or health facilities? and
- Is the road maintainable - that is, does it already have camber and working drainage system and is it passable all year round?

The above factors can be combined using a Multi Criteria Analysis (MCA) with values and weightings given to each factor in order to establish the highest priority routes for maintenance. The MCA should be repeated annually, though most of the data will not change significantly from one year to the next.

An example of a simplified road prioritisation is given in Table 7.

**Table 7: Example of simplified road prioritisation**

Route	Length (km)	Daily traffic in motor vehicles	Days impassable last year	Reasons for priority
<b>Priority A</b>				
Main road to Town A	6.0 km gravel	65	0	Main access road serving high population
Town A to Village B	3.5 km gravel	50	0	Access for school and timber exports
<b>Priority B</b>				
Town A to Village C	4.5 km gravel	20	0	Horticultural area
<b>Priority C</b>				
Village B to Village C	5.0 km earth	15	5	School access
Village C to Village D	7.0 km earth	< 10	15	Access to brick factory, sunken sections

Table 8 is an *example* of a matrix that can be used to assign priorities to the maintenance activities. Maintenance activities are numbered from 1 (highest priority – emergency maintenance on strategic roads) to 15 (lowest priority – rehabilitation works on earth roads with very low levels of traffic). The matrix is designed to ensure that every road in the network receives at least the minimum maintenance needed to keep it operational, while at the same time focusing routine pavement and periodic maintenance on the economically important roads with high traffic levels.

**Table 8: Example matrix of maintenance priorities**

Hierarchy of maintenance activity	Road hierarchy		
	A	B	C
1. Emergency works	1	6	7
2. Routine maintenance (drainage)	2	8	9
3. Routine maintenance (pavement)	3	10	11
4. Periodic maintenance	4	12	13
5. Rehabilitation	5	14	15

The road agency should develop a matrix appropriate to local conditions. The numbering scheme in Table 8 is not meant to be inflexible. There may be local conditions of soil type, topography,

climate etc. that influence maintenance requirements on different parts of the network. These may warrant an amended order of priority.

## 8.5 Quantifying maintenance work

The assessment of a road network condition relies on a good road inventory that has roads classified according to their hierarchy. Road defects are recorded during the road condition assessment surveys. Standard survey procedures are used to record road condition surveys so that there is consistency in the planning for maintenance activities. Based on the surveys and road condition, the road engineer will be able to identify if the road is going to be considered for routine or periodic maintenance based on available resources and in consultation with all relevant stakeholders.

The collection of this data forms the basis for the work programme. The accuracy of the information recorded is important so that the limited resources are put to good use. The maintenance surveys should provide details of the maintenance activities to be carried out, where each activity is needed and the quantity of each operation and resource needs.

This information should be based on actual measurements taken during the surveys. An example of the detail needed to produce a work programme is shown in Table 9.

**Table 9: Typical Quantification of Maintenance Works**

<b>ROAD NUMBER:</b>			
<b>ROADNAME:</b>			
<b>Defect</b>	<b>Routine Maintenance Activity</b>	<b>Quantities Length/sq.m/cu.m</b>	<b>Location, Chainage</b>
Corrugations and potholes	Towed grading	30 km	0 +000 – 30+000
Overgrown verge	Clearing verges	14 km	5+020 – 19+020
Blocked culverts and side drains	Clearing drains	500m	10+100 – 10+600
Potholes	Filling potholes	60sq.m	The whole road
Erosion damage	Minor erosion repair	15cu.m	2+320
Broken head walls and gabion repair	Protection works	20sq.m	2+390

## 8.6 Works procurement and use of appropriate technology

Routine maintenance works can be done either in house using work gangs under the road agency or through private contractors. If the works are contracted out the maintenance work must be quantified and packaged into contracts. The contract should provide details and specifications to be followed during measuring and certification of work. The units of measurements should be determined prior to tendering out the works and standard procedures for measurement and payment established. Similarly, where in-house gangs are used, the supervisors should be able to check the works based on predetermined performance indicators confirming that the work has been done to the specifications.

The use of low-cost appropriate technology for carrying out routine road maintenance on low volume roads is recommended as it makes maintenance viable and affordable given the limited resources usually available for such works. The use of heavy expensive equipment is not appropriate and cost effective. Tractor based road maintenance techniques are recommended<sup>5</sup>.

<sup>5</sup> For details of tractor-based maintenance refer to Gongera, K. and Petts, R. (2003). A Tractor and Labour Based Routine Maintenance System for Unpaved Rural Roads. Low Cost Road Surfacing (LCS) Project. LCS Working Paper No. 5.

## 8.7 Maintenance works record keeping<sup>6</sup>

Road maintenance management requires keeping of records of all the activities carried out during the maintenance of the road. The site clerk records daily activities on daily report forms and summarises the records to form a weekly report. The site clerk, whether in house or employed by the contractor records:

- The number of people working per activity;
- Progress achieved each day;
- Equipment usage;
- Materials used on the maintenance; and
- The total cost of the work done per day.

The progress achieved by the both labour and equipment should be recorded, and the time taken per activity. The cost of the work is calculated using these inputs.

The information recorded by the site clerk helps the contractor/road agent to monitor expenditure and progress of the work. The contractor/road agent is also able to calculate the profit margin before the work is completed while the road agency can make informed estimates of how much work can be done using the available resources. Any remedial action required is taken based on the information gathered.

Each maintenance unit should have appropriate stationery to compile information. The clerk at the unit should be trained to keep records of all the material brought to the camp. On a daily basis, the clerk will issue tools and keep a record of who has taken what and for which road project. At the end of the day all the tools are surrendered back to the storeroom and the site clerk checks if all the tools have been returned. This is done to ensure accountability of assets and to manage the use of resources. The clerk maintains records of:

- fuel stocks on site;
- tools in the storeroom;
- expenditure records per project;
- number of workers employed on the project;
- financial allocations provided per road; and
- complete inventories for all roads under maintenance.

## 8.8 Works reporting

The reporting system is part of the management system because it accounts for the use of all the resources on the road. These resources include:

- materials used during maintenance;
- equipment hired for various operations;
- personnel involved to carry out activities;
- funds spent on the project; and
- time taken to complete different activities.

The above inputs are managed using report forms designed to capture all the details required for this purpose. These forms are completed in the field and submitted to the engineer's office where

<sup>6</sup> Section 8.7 and 8.8 describe good practice that is applicable to most maintenance models, but in some cases, it may be less relevant.

the clerk responsible for reports collates information for all the roads under the district and completes requisite forms. These forms are checked by the supervisor and signed before handing over the engineer. The engineer cross checks the information and verifies the inputs. The cost of work for that week is calculated and entered to the expenditure register. The Weekly Labour Return is used to capture this detail.

Typical forms used in the management of road maintenance are included in Annex G.



## 9 Assessing the Socio-Economic Impact of Interventions on Rural Roads

### 9.1 Introduction

Rural roads are of utmost importance for the social and economic development of a country. Good rural roads contribute to economic growth by enabling efficient transportation of people and goods and access to socio-economic opportunities and employment. The provision of well-maintained rural roads improves access to social services like education that will in turn increase opportunities for local communities and especially women to gain skills that are necessary for socio-economic advancement.

In order to justify investments in the maintenance of rural roads, it is important to systematically measure the impacts of good road asset management periodically in a systematic manner. Results are needed firstly to provide the basis for communication and feedback on the actual performance (value for money) of road agencies on the ground, as well and secondly to provide evidence-base to influence policies and strategies for rural roads development and maintenance. Methodology for socio-economic impact assessment

This chapter provides guidance to road agencies on the collection of appropriate indicators of the socio-economic status of local communities to determine the impact of RAM interventions on the local economy. This includes the analysis and reporting of the data.

### 9.2 Methodology

The GEM project applied a simple **‘before and after’** situation or **‘reflexive’** approach combined with qualitative data (supportive illustrative information) to enrich the quantitative data. The approach considers socio-economic benefits other than vehicle operating costs and value of travel time savings, which are used in the conventional approach to economic appraisal of roads. The procedure is as follows:

- Adopt a simple methodology for socio-economic impact assessment of rural roads maintenance that is appropriate to the contexts of countries, including their evaluation priorities and available resources. The methodology must be easy to understand and internalize by local road agency staff.
- Measure the selected indicators at baseline (*‘before’* situation) and then periodically e.g. after one year (*‘after’* situation) and onwards to be able to determine any changes occurring as a result of (or lack of) maintenance.

The methodology should consider the variations in transport characteristics in the survey areas, noting that the performance of rural transport services is a key element of the impact of rural road investment. This includes the prevalence of motorcycles in some countries as the main form of transport services operating on rural roads.

### 9.3 Unit of observation

An appropriate unit of observation is selected that will provide reliable and representative data. The unit of observation for the GEM project socio-economic impact assessment was a *Trading Centre* (TC) connected to rural roads which are subject to routine road condition surveys. Most of the data were collected at the TC level to determine changes in socio-economic conditions as a result of maintenance. TCs represent small rural townships with population ranging from approximately 500 to 3,000 people, most of them socially and economically active.

**Figure 10: Typical Trading Centres – Sierra Leone and Uganda**



#### **9.4 Selection of socio-economic impact indicators**

The selection of indicators for the socio-economic impact assessments must consider the institutional and management structures of the road agency, staff capabilities and availability of resources.

A list of indicators from which the agency can select is presented in Annex H. The recommended priority indicators are:

- The distance from the Trading Centre to the District Centre;
- Average travel time to the District Centre;
- Road Condition Index (if available);
- Number of transport operators from the District Centre to the Trading Centre;
- Fares on public transport – light vehicles, bus/minibuses, motorcycles;
- Cost of freight transport – trucks, light vehicles, motorcycles;
- Number of available trips to the DC per day on a normal day;
- Road Safety – number of accidents on the road serving the TC for the past year;
- Prices of goods imported and exported from the TC; and
- Number of shops/kiosks, local industries/factories in and around the TC.

#### **9.5 Data collection**

The data collection procedure is as follows:

- Define the data requirements for each indicator and the method of data collection (e.g. surveys, traffic counts, focus group discussions) prior to the field surveys.
- Use a questionnaire (see example in Annex I) to capture quantitative socio-economic data through interviews to be conducted at the Trading Centres, schools and health centres.
- Undertake baseline surveys (data collection) are undertaken at the selected TCs to establish as a solid benchmark for future comparison. The data should come from both primary sources and authentic secondary sources.
- Carry out subsequent comparative surveys should be carried out at the same time of the year as the baseline survey to ensure harmonisation of seasonal effects affecting the impacts of rural roads. Data requirements for each indicator and the method of data collection (e.g. surveys, traffic counts, focus group discussions) must be defined prior to the field surveys.
- Collect additional qualitative information from selected individuals and groups in the zone of influence using focus group meetings to illustrate specific impacts of the roads.

A typical agenda for a focus group meeting is as follows:

- General challenges on transport and access, and how they affect the different categories of people (gender, age, physically disabled, etc.) and sectors.
- Specific transport related incidents (positive and negative) and their consequences over the last three years.
- Main channels of communication with the road agency and their effectiveness in reporting on roads and transport related incidents.
- Efficiency of the road agency in attending to problems on the road.
- Existence of ongoing road maintenance and improvement in the survey area, and how the local communities are benefiting socially and economically? Which category of people are benefiting most, and why? Which category is likely to be marginalised, and why?

The level of community consultation and participation in the management and operations of rural road maintenance.

Respondents should include men, women, youth, transport operators and associations, traders, health workers, school teachers, etc.

The survey team members require training before being mobilised to the field. The training should be carried out by an experienced researcher. It should include a thorough explanation of each indicator and how it is measured. Guidance should be provided (preferably in the field) on how the team members should introduce themselves to the community and go about the data collection. The survey team must at all times be aware of the following issues when interacting with the community:

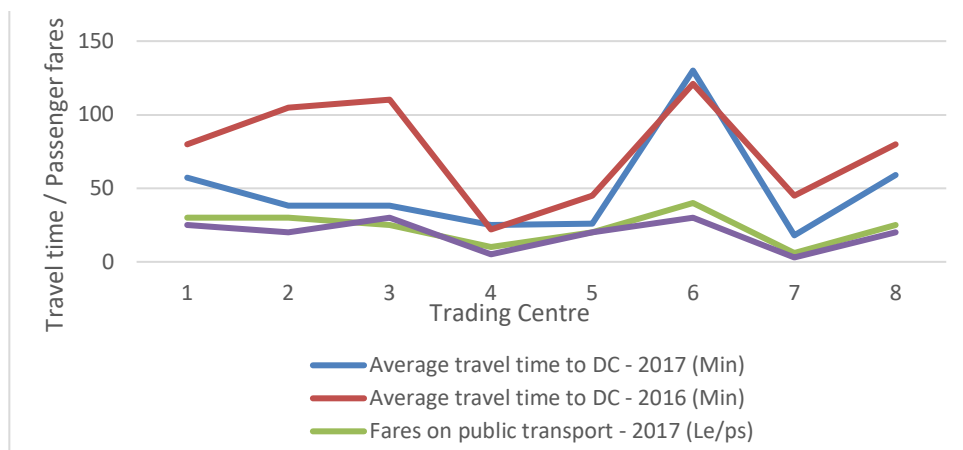
- Thorough familiarity with the questionnaire is required in order to obtain detailed, realistic, sensible and useful data.
- A good understanding of the general transport situation in the survey areas is important, including dynamics at local level.
- Enumerators must be aware that there is wealth of information and knowledge available at local level to be able to apply their skills fully into the survey process and to ensure that the information gathered is reliable and useful.
- Enumerators must pay attention to general social and economic conditions pertaining to the TC and the surrounding areas to fully understand the transport situation and thereby strengthen the survey results.
- Effective communication using friendly and dignified language must be established with the local communities - this starts with an appreciation of their way of life and being able to listen.
- Feedback meetings must be conducted by the survey teams in the field in order to clarify at an early stage any discrepancies in the data, repeat parts of the survey if necessary, and thereby improve the overall survey results.
- Time management, especially in the field, is necessary to get the best out of the limited resources normally available for these surveys. Do not underestimate the amount of time needed to obtain reliable data!

## 9.6 Data analysis

The value of data collection for socio-economic impact assessment of rural roads maintenance depends on the ability to interpret the findings and derive useful information to report at local, operational and policy levels. The analysis procedure is as follows:

- Define appropriate and sustainable framework of analysis for socio-economic impacts of rural roads considering available and potential capacities in the local road agencies to process the data to its useful purpose. The GEM project used a basic data analysis method based on a single difference reflexive comparison (before and after situation). This method is easy to understand and manage by local agencies. It can become more sophisticated with time and as more data are collected.
- Ensure that data from the field is verified by an experienced researcher and then summarised in simple spreadsheets following the structure of the questionnaire. Standardisation of the analysis allows for systematic comparisons of variables between the baseline and subsequent surveys.
- Plot tables and charts of variables to provide a rapid snapshot of the data set as well as to demonstrate patterns and relationships between dependent variables. Annex J includes an example of data analysis. A second example is provided below for the comparison between the average travel times from the District Centre to a Trading Centre in Sierra Leone and the trend in passenger fares on the dominant mode of public transport between the 2016 and 2017 surveys (see Figure 11).

**Figure 11: Average travel time and fares on public transport**



Note: "ps" refers to passenger-trip

## 9.7 Reporting of socio-economic impacts

Reporting of the identified socio-economic impacts should include:

- Package the processed information strategically to respond to the study purpose, which is to provide an evidence base to influence policies and strategies for rural roads maintenance and influence maintenance financing. . The results are also useful for fostering greater accountability of road agencies to stakeholders.
- Scrutinise the findings of the study to determine socio-economic impacts of varying road conditions, and any other useful information that can be used to develop evidence-based conclusions that may affect policy and decision-making for rural road maintenance. Guidance for roads agencies on communicating this information is provided in Chapter 10.
- Record and publicise lessons learned from the study process in order to inform the design of similar studies and the subsequent rounds of data collection.

# 10 Developing an Effective Communication Plan

## 10.1 Introduction

Good communication is a fundamental requirement for road asset management. The road agency must establish effective communication with policy makers in the local authority and national government, and with road users and local communities. Good communication can lead to greater support from the government for road maintenance. It enables the road agency to be proactive in avoiding misunderstandings which may damage the image of the agency. By clearly communicating its strategies and plans to the public, a greater sense of responsibility and accountability is developed within the agency to deliver the plans. Good communication enables a healthy relationship between all parties. This chapter provides road agencies with guidance on developing a communication policy and strategy and implementing an effective communication plan.

## 10.2 Communication policy

Policies set the rules, direction and framework for the development of communication for the road agency. The communication policy must put stakeholders in a position to have access to information that is relevant for decision making safe use of the roads or their livelihoods. Information must be presented in a way that is can be understood and used by stakeholders.

The communication policy should allow free and independent generation of information, communication with different media and a variety of providers, through appropriate channels available to the identified stakeholder groups. The policy should promote effective quality management for the content of information that is shared with stakeholders and the inputs of media providers. The policy should be proactive in supporting access to information for disadvantaged rural people.

## 10.3 Communication strategy

Communication relates directly to sustainable development because it contributes to people's participation and social appropriation of the process of change. Rural programmes and projects that implement participatory communication activities guarantee people's engagement and promote ownership of development objectives. If communities become part of the leadership of programmes and projects intended to improve their lives, those programmes are likely to be more effective and sustainable. Effective communication is driven by the purpose of the message campaign: what must change and who needs to be reached so as to bring about change? Within the overall campaign strategy, the communication strategy defines how to capture the attention of the target audiences and convey a compelling campaign message.

During the communication campaign planning process, the problem has been identified, the situation analysed, the stakeholders and target audiences identified, and the campaign objectives or intended outcomes set. This forms the basis to begin crafting a communications strategy.

The following are the main considerations in developing a communications strategy:

1. **Set the communication goal and objectives:** In some campaigns for behaviour-change, communication goals and objectives may be identical to the overall project goals and objectives, for example to achieve acceptance of the importance of road maintenance in rural areas. In general, the communication goals vary according to different target audience. In road asset management the purpose of communicating with national level policy makers is different from the purpose of communicating with local road users.
2. **Identify the target audience:** For rural road asset management the audience may include:
  - national level policy makers including government ministers and the senior management of the road authority and road fund;
  - local politicians and community leaders;

- senior management of the local authority;
  - transporter associations;
  - private sector investors;
  - rural communities.
3. **Develop key messages that effectively speak to target audiences:** Messages should be tailored to resonate with each target audience – various versions of the message may need to be prepared to reach different audiences. For example, the message ‘importance of roads maintenance in rural areas, as part of effective road asset management’ could be understood differently by a parliamentarian or a village elder. It may need to be adjusted to be clearly understood, while maintaining the essence of the meaning.
  4. **Identify the most effective way to deliver the message:** For example, behaviour-change messages resonate better from peer groups of the target audience, but awareness and advocacy messages might resonate better from celebrities and politicians via conventional mass media.

Communication is important to support participatory development. Communication and participation are in fact two sides of the same coin. Communication is about bridging understanding within a human community by exchanging messages to enrich meaning and common knowledge, often with the purpose of embracing change.” Ramirez and Quarry, 2004

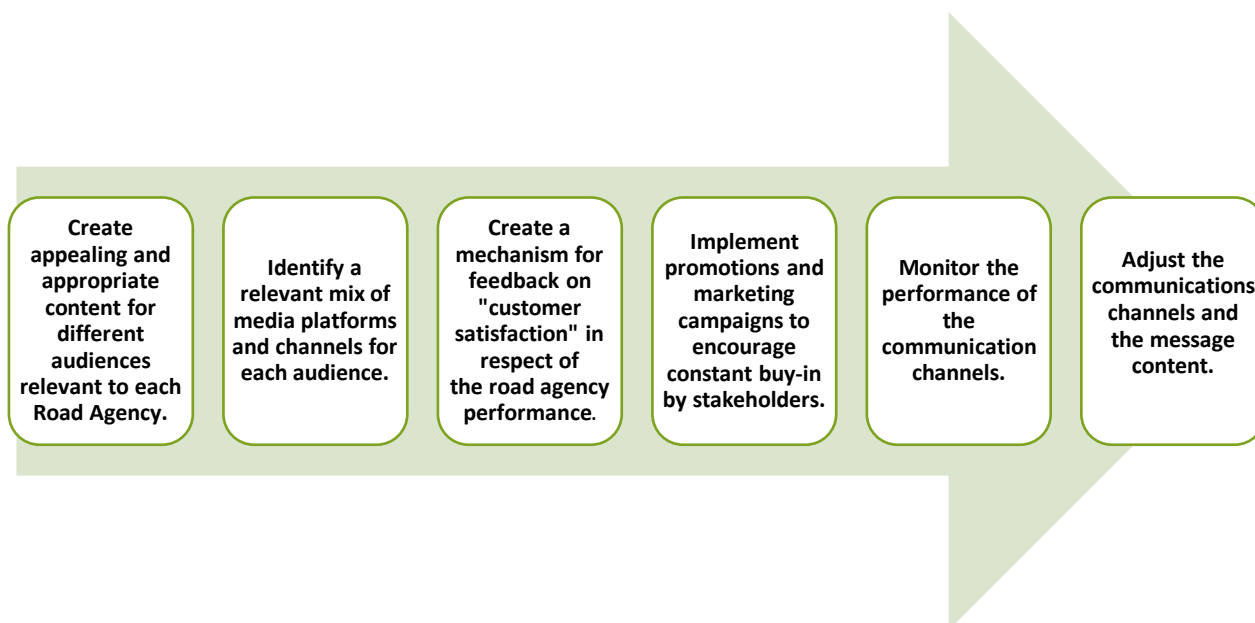
## 10.4 Developing a communication plan

### 10.4.1 Overall requirements

A clear communication plan enables the road agency to implement the communication strategy with respect to the road management policies and plans. The communication plan includes identification of stakeholders that are the target audiences. A good communication plan establishes a conducive environment for effective communication, assesses risks and opportunities, and promotes information exchange to bring about positive social change and sustainable development.

The communication plan should include a creative mix of media strategies borrowing from the best possible practices in the public and corporate sectors. It should be based on the understanding that development involves engaging with people as individuals or in their various stakeholder formations, allowing them to articulate their concerns and values, while at the same time creating the necessary mechanisms for the road agencies to promote and communicate their objectives in a clear and transparent manner. Communication is a two-way process that encourages mutual learning and understanding and the crafting of a joint vision for the future. This is illustrated in Figure 12.

**Figure 12: Process for communication in the road asset management context**



The communication plan should provide a platform from which the road agency provides a diverse range of communication outputs appropriate to a variety of its stakeholders. It should provide a mechanism through which communities and other stakeholders provide feedback to the road agency with regard to its policies, plans and performance.

#### **10.4.2 Information and messages**

The information and messages that a road agency needs to convey to the target audiences are diverse and may include:

- The expected level of service for different classes of road (see Section 5.4);
- Annual road maintenance plans;
- Details of upcoming road improvement projects;
- Prior information and warnings of road closures;
- Road safety issues including campaigns for improved driver behaviour and awareness of black spots on the network;
- The outcome of bidding processes for contractors and supervisors;
- Routine reporting on the fulfilment of maintenance and investment plans;
- The outcome of technical and financial audits; and
- Human stories from socio-economic impact studies and analysis of data that demonstrate the impact of road condition on local communities.

#### **10.4.3 Tools for communication**

Having identified the target audiences and messages, and set of advocacy activities, the next task is to select a set of advocacy communication tools that will be used to deliver the messages and support the chosen activities. This issue is often referred to as selecting “formats” and “packaging” of messages.

As with all aspects of the message and activities in the development process, the target audiences will guide the choice of communication tools. The communication tools must be:

- recognisable to the target audiences;
- commonly used;

- designed to provide the level and type information that suits the capacity and expectations of target audiences; and
- easily accessible to the target audience.

When the right tools are chosen for the target audiences, there will be a better chance of engaging them and building the credibility of the messages and advocacy campaign. It is important to avoid the classic mistake of sending a 120-page technical policy paper to a non-expert decision maker, who not only does not have time to read it, but also does not have the capacity to engage with the evidence or arguments. Such an approach will usually mean that the decision maker will not read the report and those sending it are unlikely to receive a response, apart from the negative impression they have created.

In choosing communication tools, the following three main types of audience should be considered:

- Experts — those who have a deep technical knowledge and background in the target policy area. These are commonly advisors, bureaucrats, and people from international organizations, research institutes, think tanks, and universities. In order to convince this audience, they need to see the full argument including literature, evidence, proposals, predictions, and research (methodology and analysis). Such groups are more heterogeneous in background and experience than those from a single academic discipline, which must be considered in designing the communication activities.
- Informed non-experts — managers, decision makers and practitioners who work in the target policy area and are users rather than producers of data and information. These people can normally be convinced by seeing the significant outcomes of research and do not need all the in-depth academic and research detail. These people will consult experts to confirm if their reading of a policy proposal is correct. This is usually a more homogeneous group than the expert group in terms of educational background and experience.
- The general public — unless they have a stake in the issue or it is a matter of broad public concern, the public are not normally interested in policy research. If a policy proposal will divide them into winners or losers or feeds into their hopes and fears, they may become interested. Advocacy efforts must target the specific relevant sector of the general public to get them to buy into the ideas. What is needed in this case is a simple and clear presentation of the evidence or proposal.

A wide range of media and communications options are available as part of the annual communication plan. They include:

- Formal reporting on maintenance plans and progress with implementation;
- Local radio programmes including live phone-in talk-shows;
- Radio messages;
- Newspaper and magazine articles;
- Web sites including social media (Facebook. LinkedIn etc);
- WhatsApp messages; and
- Community meetings.

#### **10.4.4 Resource considerations**

The communication plan must be backed by sufficient resources for its implementation. This includes human resources and financial resources. Each road agency should have a communications department staffed by at least one permanent communications officer. The department should be represented at senior management meetings. A separate budget line should be created for communications in the annual operational budget of the agency.



During the preparation of the annual communications plan the agency should be able to answer the following questions:

- Who is going to implement each activity identified in the plan?
- What funds are required?
- What funds are available?
- If the available funds are not sufficient, are there other funding options or do some of the proposed communication activities have to be deferred or cancelled?

#### **10.4.5 Media linkages**

Establishing relationships with media representatives and media outlets is an important part of a communication plan for the road agency, as is establishing relationships with influential individuals and institutions in the community and target audiences. The agency communications officer should establish personal contacts with key media providers such as the local radio station and newspapers, printers etc., giving these providers reasons to want to support the agency, and following through over time to sustain and build the relationships. Other individuals that can assist to spread information and messages include community leaders (elected officials, managers of local businesses, clergy, etc.) and heads of local organisations including schools and colleges, clinics and hospitals, service clubs, churches etc.

#### **10.5 Monitoring and evaluation of the communication plan**

The implementation of communication activities should be monitored by the road agency in accordance with the plan. The communications officer should report at least monthly to the senior management of the agency. The report should summarise the activities carried out during the reporting period, difficulties faced and successes. It should include details of the amount spent versus the budget and details of activities planned for the next reporting period. By tracking inputs, outputs and intermediate outcomes of the communications activities the agency can adjust the plan to improve its effectiveness.

Evaluation of the communications activities should be carried out annually as part of the preparation of the plan for the following year. It involves a comprehensive assessment of the effectiveness of activities carried out during the year, identification of activities that may not have been successful, and details of the actual amount spent. Constraints that were experienced in the implementation of the plan should be identified along with recommendations for how these could be overcome in the future.

Output indicators that can be used to assess the effectiveness of the agency communication activities include:

- Number of communications activities carried out, by type;
- Timeliness of submission of technical reports to senior management and parent ministries;
- Number of participants in community meetings, radio talk-shows, etc;
- Number of visits to the agency web site or Facebook page; and
- Number of responses to WhatsApp communications.

Effective communication should lead to:

- greater support from central government and the local authority for road maintenance, including more reliable funding;
- improved relations with road users including less negative feedback and fewer complaints; and
- Improved sense of achievement and job satisfaction within the road agency.

# 11 RAM Performance Monitoring and Reviews

## 11.1 Introduction

Monitoring and reviewing all components of the asset management framework is of importance and ensures continuous improvement. The process must be a well-structured and easily understood by all relevant stakeholders. The monitoring exercise should not be a policing process, but to encourage individuals and organisations to learn from previous experiences.

The measurement of the road agency's asset management performance will provide the following:

1. Measurement of actual against desired levels of customer service.
2. Information to demonstrate the achievement of the agency's strategic goals.
3. Accountability to road users and stakeholders in the use of funding and other resources.
4. Identification of areas for correction or improvement.
5. Benchmarking with other road agencies in-country or external.

This chapter provides a summary of the key aspects of road asset management performance monitoring, evaluation and review including technical and financial audits. The guidance includes performance monitoring at the agency level as well as at the higher strategic and political levels.

## 11.2 Performance monitoring

The measurement of a road agency's performance should be over set periods against set targets and benchmarks as defined in the asset management framework.

As a minimum, the monitoring should on an annual basis with tracking of performance in the three main areas using the techniques described in this guideline: road asset management capability; road condition, asset value and overall maintenance needs; and socio-economic impact of interventions on rural roads.

## 11.3 Performance reporting

There are a number of ways in which road asset management performance can be summarised and reported. In choosing a reporting format, considerations should be given to the following:

1. Showing the alignment of measures with outcomes/strategic goals.
2. Reflecting a balance among competing demands.
3. Presenting only the information that the stakeholders require.
4. Keeping the number of measures manageable.

Performance status is reported through internal reports, publication of annual reports, use of social media and on the agency's website. In addition, balanced scorecard and dashboards can be adopted as tools for rapid dissemination of information. The communication plan should guide the reporting of asset management performance.

## 11.4 Strategic monitoring and review

High level review of the road agency's asset management policies and strategies should be undertaken every three years to gauge whether stakeholder requirements and expectations are being met. Agreed processes should be employed to test the integrity of the asset management framework.

Preferably an external service provider should be engaged to lead the process thus ensuring objectivity. The strategic process should result in the revision and strengthening of the rural road agency's asset management policies and strategies

## 11.5 Technical and financial audits

All designs and works contracts including in-house works implementation should be subjected to technical and financial audits. Such audits should follow guidelines approved by the road agency's council or board of directors.

Audits should be both internal and external and the results should be published for consumption by all road users and stakeholders. Road agencies are encouraged to display audit reports for inspection by the public at the agency's offices as well making them available on agency websites.

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## Annex A. Example of AM Policy Statement

{Insert Agency Name}

{Insert Agency Name} recognises that developing and adopting Road Asset Management approaches will deliver significant benefits to road users and our stakeholders and ensure that we achieve our vision, mission and objectives.

We are committed to optimal utilisation of resources towards preservation of our road network in line with our organisational strategic objectives, and hereby endorse commitment to the following:

- Managing the road infrastructure assets to best practice according to international asset management standards.
- Implementing, operating, maintaining and continuously improving a suitable road asset management system that will provide relevant decision support information to guide us in the management of our road infrastructure assets.
- Provide a safe and well-managed, maintained and resilient road network.
- *Add other items as necessary.....*

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

Chief Executive Officer

Council Chairperson/Board Chairperson

## Annex B. Asset Management Roles and Responsibilities

<b>Councillors and Senior Decision Makers</b>	
Leadership, culture and direction for asset management across the agency	
<b>Directors/Managers</b>	
Demonstration of commitment	
<b>Director for Infrastructure</b>	
Leadership, culture and direction	Delivery of asset management benefits
Embedment of behaviours related to a whole life view	Liaise with stakeholders
<b>Director of Roads/Chief Engineer</b>	
Development of asset management strategy	Review asset management activities and develop improvements where necessary
Develop documentation to support asset management	Ensure work programmes are consistent with levels of service
Develop the asset management plan and resource requirements	Coordinate with other departments to ensure AM success
<b>Engineering Department</b>	
Road condition data collection	Data analysis and asset valuation
Programme development	Procurement of contractors and consultants
Works implementation (where applicable)	Works inspection and monitoring
Designs and drawings	Safety audits
Technical Audits	
<b>Other Departments</b>	
Collection of socio-economic data, analysis and reporting	Financial audits
Preparation of communication strategies, plans and implementing	

## Annex C. Agency RAM Self-Assessment Questionnaire

### GEM Rural Road Sector Sustainability Self-Assessment Questionnaire

<b>Background</b>
This self-assessment framework has been developed which seeks to assess the performance of a rural road agency in the following six key areas, or building blocks, which are considered necessary for effective asset management: (1) external/political environment (2) institutional (3) funding (4) managerial (5) technical (6) operational/implementation.
<b>Questionnaire Structure</b>
The questionnaire consists of over 300 questions which have been designed to be pertinent to a rural road agency, simple to understand and easy to answer. For each of the building blocks a set of questions has been developed. Each question requires a “yes” or “no” answer and has been developed, on its own, to establish the level of maturity of an agency with respect to one aspect of a building block.
<b>Completing the Questionnaire</b>
(1) To complete the questionnaire the respondent shall only attend to sheets with a Pink Tab Colour and there-in to cells with Pink Shading only. (2) In the Questionnaire Form, the respondent is required to enter Yes or No as an answer to the respective question and also provide a commentary or remarks where necessary.
<b>Results</b>
The questionnaire is designed to automatically calculate the indices as the respondent provides Yes or No answers.
<b>Save your Responses!!</b>
It is advised to regularly save your work as you proceed with responding to the Questionnaire.

## Self-Assessment Performance Evaluation (National Level)

INSERT NAME OF ROAD AUTHORITY

### Building Block 1: External

Key objective:	Facilitate delivery of a broad range of benefits to rural communities through effective interaction with external stakeholders.
Element:	AM policy and strategy
Issue:	The existence of an AM policy that is: <ul style="list-style-type: none"> <li>• Relevant to the rural transport sector;</li> <li>• Supported by senior decision makers;</li> <li>• Adopted at the highest level in government.</li> </ul>
Element:	Stakeholder engagement
Issue:	Engagement with stakeholders by means of informed consultations and a culture of open communications and knowledge sharing in order to: <ul style="list-style-type: none"> <li>• Understand their needs and expectations by helping to identify local requirements, alternatives and solutions to problems;</li> <li>• Lobby political support for adequate AM plans and related maintenance funding;</li> <li>• Influence the development of the district's AM strategies;</li> <li>• Communicate the district's programmes and targets;</li> <li>• Assess how the district's performance is rated by stakeholders.</li> </ul>

QUESTION	YES/NO	JUSTIFICATION/COMMENT
1.1 (a) Is there a national policy for rural roads which has been adopted by the central government?		
1.1 (b) Does the national policy define the roles and responsibilities of the agencies responsible for managing rural roads?		
1.1 (c) Does the national policy identify funding sources that are adequate for maintenance of the rural road network?		
1.1 (d) Does the national policy define stakeholder groups to be consulted in the management of rural roads?		
1.2 (a) Is there a national policy for maintenance of rural roads?		
1.2 (b) Does the rural roads maintenance policy require the development of a strategy for undertaking sustainable rural road maintenance?		
1.2 (c) Does the rural roads maintenance strategy ensure that rural road improvement is linked to a simultaneous commitment to the annual maintenance costs?		
1.2 (d) Does the rural roads maintenance strategy require the rural road agencies to minimise the total costs of ownership by adopting whole-life approaches (leading to optimum balance between capital and recurrent budgets)?		



1.3 (a) Does the agency generally communicate with road users, local inhabitants and local businesses/stakeholders?		
1.3 (b) Does the agency conduct consultations with members of the public (road users, local inhabitants and local businesses) at least annually?		
1.3 (c) Does the agency use a range of techniques to communicate with stakeholders e.g. surveys, public notices, community radio, media releases, newsletters, telephone hotlines and social media?		
1.3 (d) Does the agency have developed strategies and guidelines for community consultation and information dissemination?		
1.4 (a) Does the agency actively seek participation of local stakeholders and road users in the preparation of strategic plans, programmes and budgets for road works?		
1.4 (b) Does the agency present its strategic plans at Ministry/ Parliament meetings to map out plans for short, medium and long term programmes?		
1.4 (c) Does the agency actively participate in inter-sectoral/ministerial and inter-agency district development programmes at regional and national level through established structures?		
1.4 (d) Does the agency table road budgets at ministry meetings before implementing works?		
1.5 (a) Does the agency table periodic roadworks progress reports to the Ministry for information?		
1.5 (b) Does the agency maintain a public display of road works acquittal reports for accessing by the public?		
1.6 (a) Does the agency actively communicate with the local government ministry, districts and the Road Fund through established structures on road preservation matters?		
1.6 (b) Does the agency participate through established structures at regional and national level in development programmes for other sectors?		

## Building Block 2: Institutional

Key objective: Successful implementation of road asset preservation practice through support of the district executives, an adequate organisational structure, adequate number of trained staff.

Element: AM policy and strategy

Issue:

- The existence of an AM policy and strategy that is supported by senior leadership;
- Need to recruit and retain capable staff by offering competitive salaries;
- An appropriate organisational structure with an adequate complement of appropriately trained staff with the necessary core competencies;
- The extent to which staff involved in the process understand and support it and are willing to contribute and improve it;
- KPIs that can be used to measure the quality of the service the agency provides;
- Means (funding) for outsourcing of all strategic, non-core activities (e.g. instrumented surveys such as roughness and deflection measurements).

QUESTION	YES/NO	JUSTIFICATION/COMMENT
2.1 (a) Does the agency have an informal AM policy and associated strategy?		
2.1 (b) Does the agency have a formal AM policy?		
2.1 (c) Does the agency's AM policy align with its corporate vision and mission?		
2.1 (d) Does the agency's AM policy take into account stakeholder needs and expectations?		
2.2 (a) Have the basic levels of service been defined?		
2.2 (b) Are the differing requirements of stakeholders understood?		
2.2 (c) Are stakeholders/road users consulted when determining the levels of service?		
2.2 (d) Is the level of service consultation strategy developed and implemented?		
2.3 (a) Is the contribution of the road network to the road agency's objectives defined?		
2.3 (b) Are the levels of service linked to measures of asset performance?		
2.3 (c) Is the cost to fulfil the level of service requirements known?		
2.3 (d) Are the levels of service integral to decision making and business planning?		
2.4 (a) Are emergency responses understood by key members of staff?		
2.4 (b) Does the agency have a formal emergency response plan?		
2.4 (c) Is the safety of infrastructure routinely assessed?		

2.4 (d) Are formal debriefs given to appropriate staff after severe damage to infrastructure as a result of a traffic accident (e.g. bridge strike) or climate induced event (e.g. washout)?		
2.5 (a) Does the agency's organisational structure identify roles, responsibilities and competencies of key staff, aligned with its AM policy, strategies, objectives and plans?		
2.5 (b) Are the roles, responsibilities and organisational commitment for AM documented and communicated to all relevant people?		
2.5 (c) Does the agency have an adequate complement of appropriately qualified staff with designated responsibilities to undertake its AM mandate?		
2.5 (d) Is the agency able to outsource its non-core activities (e.g. instrumented surveys such as roughness and deflections)?		
2.6 (a) Does the agency offer training opportunities for staff?		
2.6 (b) Does AM specific training occur for primary staff?		
2.6 (c) Has the agency implemented an on-going training programme to address required AM competencies?		
2.6 (d) Is there a formal AM capacity building programme which is routinely monitored?		
2.7 (a) Are agency engineer salaries less than 50% of comparable private sector positions?		
2.7 (b) Are agency engineer salaries 50-80% of comparable private sector positions?		
2.7 (c) Are agency salaries roughly the same as comparable private sector positions?		
2.7 (d) Are RA salaries greater than comparable private sector positions?		

### Building Block 3: Financial

Key objective: The achieve stable, adequate and sustainable funding for maintenance.

Element: Financial arrangements

Issue:

- A stable, adequate and sustainable source(s) of funding for maintenance;
- Annual asset valuation of road infrastructure assets;
- Costing framework for determining unit costs of works;
- Budgeting and programming processes;
- Prioritised maintenance investment plan;
- Risk strategy to address potential consequences of inadequate funding (e.g. emergency response);
- Financial accounting and auditing of expenditure.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
3.1 (a) Does the agency depend only on the consolidated fund for road maintenance?		
3.1 (b) Is the funding received from the consolidated fund related to road asset condition and performance?		
3.1 (c) Does the agency get a fixed share of its maintenance funding requirement from a Road Fund and/or central government?		
3.1 (d) Does the agency get a variable share of its maintenance funding requirement from the Road Fund and/or central government that is related to road asset condition and performance?		
3.2 (a) Is the percentage of the budgeted funding for routine and periodic maintenance obtained < 30 % of that required?		
3.2 (b) Is the percentage of the budgeted funding obtained 30% - 59% of that required.		
3.2 (c) Is the percentage of the budgeted funding obtained 60% - 89% of that required?		
3.2 (d) Is the percentage of the budgeted funding obtained 90% - 100% of that required?		
3.3 (a) Does the agency carry out asset valuation?		
3.3 (b) If the agency carries our asset valuation, is the value of the agency's road asset decreasing?		
3.3 (c) If the agency carries our asset valuation, is the value of the agency's road asset stable?		

3.3 (d) If the agency carries out asset valuation, is the value of the agency's road asset increasing?		
3.4 (a) Is the percentage of the maintenance funding obtained $\geq 0.1\%$ of the asset value of the road network?		
3.4 (b) Is the percentage of the maintenance funding obtained $\geq 0.5\%$ of the asset value of the road network?		
3.4 (c) Is the percentage of the maintenance funding obtained $\geq 1\%$ of the asset value of the road network?		
3.4 (d) Is the percentage of the maintenance funding obtained $\geq 1.5\%$ of the asset value of the road network?		
3.5 (a) Does the agency carry out annual and multi-annual financial forecasting for maintenance and rehabilitation works?		
3.5 (b) Are the financial forecasts for maintenance works and rehabilitation works based on current Asset Management Plan (AMP) outputs?		
3.5 (c) Are the financial forecasts for maintenance works based on current comprehensive AMPs with reasoned supporting assumptions?		
3.5 (d) Are the financial forecasts for maintenance and rehabilitation works based on current comprehensive advanced AMPs with detailed supporting assumptions and high confidence in accuracy?		
3.6 (a) Does the agency operate an accounting system?		
3.6 (b) Are the annual accounts finalised within the first quarter of the following year?		
3.6 (c) Are the accounts audited annually?		
3.6 (d) Are the accounts published annually?		

### Building Block 4: Managerial

Key objective: Successful implementation of road asset preservation practice through support of the district executives, an adequate organisational structure, adequate number of trained staff

Element: Network management

Issue:

- Use of appropriate AM system that contains:
  - Network definition (road and bridge inventory information),
  - Network condition (roads and bridges)
  - Network usage (traffic)
  - Financial/cost information on works activities
  - Storage, update, analysis and reporting of data collected
- Appropriate levels of service and intervention standards that determine gaps in network performance?
- Prioritised annual, medium (3- 5yrs) and long term (> 5 yrs) maintenance and development plans and related investment plans?
- A risk management strategy (for unfunded works);
- Annual reporting on the overall management of the road asset (AM plan);
- Demand forecasting.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
4.1 (a) Does the roads agency have an AM system(s) in place which can store current and historical asset inventory, condition and asset utilization data (e.g. traffic)?		
4.1 (b) Does the AM system enable treatment cost and historical maintenance information to be stored and accessed?		
4.1 (c) Does the AM system allow for the comparison of the current condition of assets with intervention levels to determine maintenance requirements?		
4.1 (d) Can the AM system facilitate the prioritisation of road sections requiring maintenance?		
4.2 (a) Has the road agency developed intervention levels for all its principal asset types which require periodic maintenance (carriageway, shoulders, bridges, culverts)?		
4.2 (b) Are the intervention levels directly associated with defined levels of service?		
4.2 (c) Have the intervention levels been determined using an economic analysis.		
4.2 (d) Have the intervention levels been determined using socio-economic-political (i.e. multi-criteria) analysis?		
4.3 (a) Does the agency produce annual maintenance and development plans?		
4.3 (b) Does the agency produce annual prioritised maintenance and development plans?		
4.3 (c) Does the agency provide prioritised medium term (3-5 year) maintenance plans?		

4.3 (d) Does the agency provide prioritised long term (> 5 year) maintenance plans?		
4.4 (a) Does the agency keep records of maintenance and rehabilitation work activities?		
4.4 (b) Is maintenance and rehabilitation planned and prioritised according to asset condition?		
4.4 (c) Is maintenance and rehabilitation prioritised using a cost benefit approach?		
4.4 (d) Is maintenance and rehabilitation expenditure prioritised using techniques which consider economic and social benefit?		
4.5 (a) Does the agency keep a record of maintenance works backlog?		
4.5 (b) Does the agency have a strategy to reduce maintenance backlog based on a percentage of the available development budget?		
4.5 (c) Does the agency prioritise the reduction of maintenance backlog using an economic analysis process?		
4.5 (d) Does the agency prioritise the reduction of maintenance backlog using risk management techniques?		
4.6 (a) Does the agency carry out basic demand (traffic) forecasting?		
4.6 (b) Are the forecasts of traffic demand based on traffic counts carried out in the last 5 years using robust economic indicators (e.g. GDP)?		
4.6 (c) Is traffic demand forecast based on mathematical analysis of historical trends?		
4.6 (d) Are primary economic factors used when forecasting demand?		
4.7 (a) Does the agency schedule capital projects using staff judgement, taking into consideration government policy and political drivers?		
4.7 (b) Are projects identified using input from operational staff, estimates of service lives, traffic demand modelling and accident analysis?		
4.7 (c) Are major capital projects for the next 10 years identified and prioritised taking into account socio-political-economic requirements?		

4.7 (d) Does the agency use advanced formalised socio- economic-political decision making techniques to identify major capital expenditure?		



### Building Block 5: Technical

Key objective: Identification and description of road assets including inventory, condition data and performance monitoring; and availability of data to network managers.

Element: Road network database

Issue:

- Existence of a road referencing system;
- Existence of a classified road inventory;
- Standard procedures for developing a road inventory, data collection and performance monitoring;
- Use of asset register to store all road asset information.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
5.1 (a) Does the agency have a road referencing system based on routes and nodes between centres of population?		
5.1 (b) Is the road referencing system based on road sections (< 1 km) with homogeneous characteristics?		
5.1 (c) Is the road referencing system based on sub-sections (homogenous sections of 200 m lengths)?		
5.1 (d) Is the road referencing system GIS based?		
5.2 (a) Does the agency have an item inventory recording basic road surface types (earth, gravel or sealed)?		
5.2 (b) Does the agency undertake an inventory of all principal assets (carriageway, shoulders, bridges, culverts, side drains)?		
5.2 (c) Does the inventory include the service lives of all principal assets?		
5.2 (d) Does the agency have deterioration models for all principal assets?		
5.3 (a) Is the road inventory based on assumptions or incomplete data?		
5.3 (b) Is there a system of systematic and documented data collection for all principal assets (carriageway, shoulders, bridges, culverts, side drains) on a road by road basis?		
5.3 (c) Is there an established system of systematic and documented data collection for all principal assets (carriageway, shoulders, bridges, culverts, side drains) on a section basis?		
5.3 (d) Is there an established system of systematic and documented data collection for all principal assets on a sub-section basis?		

5.4 (a) Does the agency carry out annual visual condition assessment surveys for carriageways, shoulders of gravel and earth roads?		
5.4 (b) Are the visual condition assessments of gravel and earth carried out in accordance with well documented, standardised procedures?		
5.4 (c) Does the agency measure gravel loss?		
5.4 (d) Are the results of the gravel and earth road condition assessment recorded in a computerised AM system?		
5.5 (a) Does the agency estimate asset utilization (traffic) on its network?		
5.5 (b) Does the agency measure asset utilization (traffic) annually on its major roads?		
5.5 (c) Does the agency project asset utilization across its network from annual measures of utilization of a sampled number of roads		
5.5 (d) Does the agency assess bottlenecks on its network?		

## Building Block 6: Operational

Key objective: Efficient operations at district level including planning and scheduling of maintenance, procurement of service providers and technical compliance.

Element: Procurement of services

Issue:

- Appropriate type of contract;
- Outsourcing of strategic, non-core activities;
- Maintenance scheduling of works;
- Auditing of maintenance works.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
6.1 (a) Are service delivery roles within the agency clearly allocated?		
6.1 (b) Does the agency have provision for outsourcing of non-core activities?		
6.1 (c) Are competitive tendering practices used?		
6.1 (d) Are service delivery mechanisms reviewed annually to identify risks, benefits and costs of various outsourcing options?		
6.2 (a) Does the agency plan day to day maintenance activities?		
6.2 (b) Are the needs of stakeholders considered when scheduling day to day maintenance?		
6.2 (c) Is the planning of day to day maintenance optimised in terms of the availability and use of resources?		
6.2 (d) Is day to day planning of maintenance optimised by considering the availability of resources and impacts on road users?		
6.3 (a) Does the agency prepare day to day reports on road maintenance activities?		
6.3 (b) Does the agency prepare weekly reports on road maintenance activities?		
6.4 (a) Does the agency undertake technical audits of designs?		
6.4 (b) Does the agency regularly undertake technical audits of maintenance, construction and rehabilitation works?		
6.4 (c) Does the agency provide guidelines for undertaking the road audits?		
6.4 (d) Does the RA require service suppliers to be ISO 9000 certified?		

## Self-Assessment Performance Evaluation (District Level)

INSERT COUNTRY AND DISTRICT NAME

Building Block 1: External		
Key objective:	Facilitate delivery of a broad range of benefits to rural communities through effective policies for the rural transport sector and interaction with external stakeholders.	
Element:	AM policy and strategy	
Issue:	The existence of an AM policy that is: <ul style="list-style-type: none"> <li>• Relevant to the rural transport sector;</li> <li>• Supported by senior decision makers;</li> <li>• Adopted at the highest level in government.</li> </ul>	
Element:	Stakeholder engagement	
Issue:	Engagement with stakeholders by means of informed consultations and a culture of open communications and knowledge sharing in order to: <ul style="list-style-type: none"> <li>• Understand their needs and expectations by helping to identify local requirements, alternatives and solutions to problems;</li> <li>• Lobby political support for adequate AM plans and related maintenance funding;</li> <li>• Influence the development of the district's AM strategies;</li> <li>• Communicate the district's programmes and targets;</li> <li>• Assess how the district's performance is rated by stakeholders.</li> </ul>	
QUESTION	YES/NO	JUSTIFICATION/COMMENT
1.1 (a) Is there a national policy for rural roads which has been adopted by the central government?		
1.1 (b) Does the national policy define the roles and responsibilities of the agencies responsible for managing rural roads?		
1.1 (c) Does the national policy identify funding sources that are adequate for maintenance of the rural road network?		
1.1 (d) Does the national policy define stakeholder groups to be consulted in the management of rural roads?		
1.2 (a) Is there a national policy for maintenance of rural roads?		
1.2 (b) Does the rural roads maintenance policy require the development of a strategy for undertaking sustainable rural road maintenance?		
1.2 (c) Does the rural roads maintenance strategy ensure that rural road improvement is linked to a <u>simultaneous commitment</u> to the annual maintenance costs?		

1.2 (d)	Does the rural roads maintenance strategy require the rural road agencies to minimise the total costs of ownership by adopting whole-life approaches (leading to optimum balance between capital and recurrent budgets)?		
1.3 (a)	Does the district generally communicate with road users, local inhabitants and local businesses/stakeholders?		
1.3 (b)	Does the district conduct consultations with members of the public (road users, local inhabitants and local businesses) at least annually?		
1.3 (c)	Does the district use a range of techniques to communicate with stakeholders e.g. surveys, public notices, community radio, media releases, newsletters, telephone hotlines and social media?		
1.3 (d)	Does the district have developed strategies and guidelines for community consultation and information dissemination?		
1.4 (a)	Does the district actively seek participation of stakeholders and road users in the preparation of strategic plans, programmes and budgets for road works?		
1.4 (b)	Does the district discuss its strategic plans at council meetings to map out plans for short, medium and long-term road works programmes?		
1.4 (c)	Does the district coordinate inter-sectoral district road development programmes through established council structures?		
1.4 (d)	Does the district table road works budgets at council meetings for approval before implementing works?		
1.5 (a)	Does the district table periodic road works roadworks acquittal reports at council meetings for approval?		
1.5 (b)	Does the district maintain a public display of road works acquittal reports for accessing by the public?		
1.6 (a)	Does the district participate in programmes at provincial/regional and national level and through established council structures?		
1.6 (b)	Does the district actively communicate with the local government ministry, the national roads authority and the Road Fund through established structures on road preservation matters?		

## Building Block 2: Institutional

Key objective: Successful implementation of road asset preservation practice through support of the district executives, an adequate organisational structure, adequate number of trained staff.

Element: AM strategy and institutional arrangements.

Issue:

- The existence of an AM strategy that is supported by senior leadership;
- Ability to recruit and retain capable staff by offering competitive salaries;
- An appropriate organisational structure with an adequate complement of appropriately trained staff with the necessary core competencies;
- The extent to which staff involved in the AM process understand and support it and are willing to contribute and improve it;
- KPIs that can be used to measure the quality of the service the agency provides;
- Means (funding) for outsourcing of strategic, non-core activities (e.g. instrumented surveys such as roughness and deflection measurements).

QUESTION	YES/NO	JUSTIFICATION/COMMENT
2.1 (a) Does the district have a corporate vision and mission statement?		
2.1 (b) Does the district's mission statement consider stakeholder needs and expectations?		
2.2(a) Have the basic levels of service for roads been defined?		
2.2 (b) Are stakeholders consulted when determining the levels of service?		
2.3 (a) Is the contribution of the road network (asset value) to the district understood?		
2.3 (b) Is the cost to fulfil the level of service requirements known?		
2.4 (a) Are emergency responses understood by key members of staff?		
2.4 (b) Does the district have a formal emergency response plan?		
2.4 (c) Is the safety of infrastructure routinely assessed?		
2.4 (d) Are formal debriefs given to staff after severe damage to infrastructure as a result of a traffic accident (e.g. bridge strike) or climate induced event (e.g. washout)?		
2.5 (a) Does the district's organisational structure identify roles, responsibilities and competencies of key staff, aligned with its AM policy, strategies, objectives and plans?		
2.5 (b) Are the roles, responsibilities and organisational commitment for AM documented and communicated to all relevant people (job descriptions)?		

2.5 (c)	Does the district have an adequate complement of appropriately qualified staff with designated responsibilities to undertake its AM mandate?		
2.5 (d)	Is the district able to outsource its non-core activities (e.g. instrumented surveys such as roughness and deflections)?		
2.6 (a)	Does the district receive/offer training opportunities for staff?		
2.6 (b)	Does AM specific training occur for primary staff?		
2.6 (c)	Does the district implement an on-going training programme to address required AM competencies?		
2.6 (d)	Is there a formal AM capacity building programme which is routinely monitored?		
2.7 (a)	Are district engineer salaries less than 50% of comparable private sector positions?		
2.7 (b)	Are district engineer salaries 50-80% of comparable private sector positions?		
2.7 (c)	Are district engineer salaries roughly the same as comparable private sector positions?		
2.7 (d)	Are district engineer salaries greater than comparable private sector positions?		

### Building Block 3: Financial

Key objective: The achieve stable, adequate and sustainable funding for maintenance.

Element: Financial arrangements

Issue:

- A stable, adequate and sustainable source(s) of funding for maintenance;
- Annual asset valuation of road infrastructure assets;
- Costing framework for determining unit costs of works;
- Budgeting and programming processes;
- Prioritised maintenance investment plan;
- Risk strategy to address potential consequences of inadequate funding (e.g. emergency response);
- Financial accounting and auditing of expenditure.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
3.1 (a) Does the district depend only on the consolidated fund (own funds) for road maintenance?		
3.1 (b) Is the funding received from the consolidated fund related to road asset condition and performance?		
3.1 (c) Does the district get a fixed share of its maintenance funding requirement from a Road Fund and/or central government?		
3.1 (d) Does the district get a variable share of its maintenance funding requirement from the Road Fund that is related to road asset condition and performance?		
3.2 (a) Is the percentage of the budgeted funding obtained < 30 % of that required?		
3.2 (b) Is the percentage of the budgeted funding obtained 30%- 59% of that required?		
3.2 (c) Is the percentage of the budgeted funding obtained 60% - 89% of that required?		
3.2 (d) Is the percentage of the budgeted funding obtained 90% - 100%of that required?		
3.3 (a) Does the district carry out asset valuation?		
3.3 (b) Where the district carries out asset valuation, is the value of the district's road asset decreasing?		
3.3 (c) Where the district carries out asset valuation, is the value of the district's road asset stable?		
3.3 (d) Where the district carries out asset valuation, is the value of the district's road asset increasing?		



3.4 (b)	Is the percentage of the maintenance funding obtained $\geq 0.5\%$ of the asset value of the road network?		
3.4 (c)	Is the percentage of the maintenance funding obtained $\geq 1\%$ of the asset value of the road network?		
3.4 (d)	Is the percentage of the maintenance funding obtained $\geq 1.5\%$ of the asset value of the road network?		
3.5 (a)	Does the district carry out annual and multi-annual financial forecasting for maintenance works?		
3.5 (b)	Are the financial forecasts for maintenance works based on current Asset Management Plan (AMP) outputs?		
3.6 (a)	Does the district operate an accounting system?		
3.6 (b)	Are the accounts audited annually?		
3.6 (c)	Are the accounts published annually?		

### Building Block 4: Managerial

Key objective: Successful implementation of road asset preservation practice through support of the district executives, an adequate organisational structure, adequate number of trained staff

Element: Network management

Issue:

- Use of appropriate AM system that contains:
  - Network definition (road and bridge inventory information),
  - Network condition (roads and bridges)
  - Network usage (traffic)
  - Financial/cost information on works activities
  - Storage, update, analysis and reporting of data collected
- Appropriate levels of service and intervention standards that determine gaps in network performance?
- Prioritised annual, medium (3- 5yrs) and long term (> 5 yrs) maintenance and development plans and related investment plans?
- A risk management strategy (for unfunded works);
- Annual reporting on the overall management of the road asset (AM plan);
- Demand forecasting.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
4.1 (a) Does the district have an AM system(s) in place which can store current and historical asset inventory, condition and asset utilization data (e.g. traffic)?		
4.1 (b) Does the AM system enable road treatment cost and historical maintenance information to be stored and accessed?		
4.1 © Does the AM system allow for the comparison of the current condition of road assets with intervention levels to determine maintenance requirements?		
4.1 (d) Can the AM system facilitate the prioritisation of road sections requiring maintenance?		
4.2 (a) Has the district developed intervention levels for all its principal asset types which require periodic maintenance (carriageway, bridges, and culverts)?		
4.2 (b) Are the intervention levels directly associated with defined levels of service?		
4.2 (c) Have the intervention levels been determined using an economic analysis?		
4.2 (d) Have the intervention levels been determined using socio-economic-political (i.e. multi-criteria) analysis?		
4.3 (a) Does the district produce annual maintenance and development plans?		
4.3 (b) Does the district produce annual prioritised maintenance and development plans?		

4.3 (c)	Does the district provide prioritised medium term (3-5 year) maintenance plans?		
4.4 (a)	Does the district keep records of maintenance and development work activities?		
4.4 (b)	Is maintenance and development prioritised according to asset condition?		
4.4 (c)	Is maintenance and development prioritised using a cost benefit approach?		
4.4 (d)	Is maintenance and development expenditure prioritised using techniques which consider economic and social benefit?		
4.5 (a)	Does the district keep a record of maintenance works backlog?		
4.5 (b)	Does the district have a strategy to reduce maintenance backlog based on a percentage of the available development budget?		
4.5 (c)	Does the district prioritise the reduction of maintenance backlog using an economic analysis?		
4.5 (d)	Does the district prioritise the reduction of maintenance backlog using risk management techniques?		
4.6 (a)	Does the district carry out basic demand (traffic) forecasting?		
4.6 (b)	Are the forecasts of traffic demand based on traffic counts carried out in the last 5 years using robust economic indicators (e.g. GDP)?		
4.7 (a)	Does the district schedule capital projects using staff judgement, taking into consideration government policy and political drivers?		
4.7 (b)	Are projects identified using input from operational staff, estimates of service lives, traffic demand modelling and accident analysis?		
4.7 (c)	Are major capital projects for the next 10 years identified and prioritised taking into account socio-political-economic requirements?		
4.7 (d)	Does the district use advanced formalised socio- economic-political decision-making techniques to identify major capital expenditure?		

## Building Block 5: Technical

Key objective: Identification and description of road assets including inventory, condition data and performance monitoring; and availability of data to network managers.

Element: Road network database

Issue:

- Existence of a road referencing system;
- Existence of a classified road inventory;
- Standard procedures for developing a road inventory, data collection and performance monitoring;
- Use of asset register to store all road asset information.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
5.1 (a) Does the district have a road referencing system based on routes and nodes between centres of population?		
5.1 (b) Is the road referencing system based on road sections (< 5 km) with homogeneous characteristics?		
5.1 (c) Is the road referencing system based on sub-sections (homogenous sections of 200 m lengths)?		
5.1 (d) Is the road referencing system GIS based?		
5.2 (a) Does the district have an item inventory recording basic road surface types (earth, gravel or sealed)?		
5.2 (b) Does the district undertake an inventory of all principal assets (carriageway, shoulders, bridges, culverts, side drains)?		
5.2 (c) Does the inventory include the service levels of all principal assets?		
5.2 (d) Does the district have deterioration models for all principal assets?		
5.3 (a) Is the road inventory based on assumptions or incomplete data?		
5.3 (b) Is there a system of systematic and documented data collection for all principal assets (carriageway, shoulders, bridges, culverts, side drains) on a <u>road</u> by road basis?		
5.3 (c) Is there an established system of systematic and documented data collection for all principal assets (carriageway, shoulders, bridges, culverts, side drains) on a <u>section</u> basis?		
5.3 (d) Is there an established system of systematic and documented data collection for all principal assets on a <u>sub-section</u> basis?		

5.4 (a)	Does the district carry out annual visual condition assessment surveys for carriageways, shoulders of gravel and earth roads?		
5.4 (b)	Are the visual condition assessments of gravel and earth roads carried out in accordance with well documented, standardised procedures?		
5.4 (c)	Does the district measure gravel loss annually?		
5.4 (d)	Are the results of the road condition assessment and other road recorded in a computerised AM system?		
5.5 (a)	Does the district estimate asset utilization (traffic) on its network?		
5.5 (b)	Does the district measure asset utilization (traffic) annually on its major roads?		
5.5 (c)	Does the district forecast asset utilization across its network from annual measures of utilization of a sampled number of roads?		
5.5 (d)	Does the district assess bottlenecks on its network?		

### Building Block 6: Operational

Key objective: Efficient operations at district level including planning and scheduling of maintenance, procurement of service providers and technical compliance.

Element: Procurement of services

Issue:

- Appropriate type of contract;
- Outsourcing of strategic, non-core activities;
- Maintenance scheduling of works;
- Auditing of maintenance works.

QUESTION	YES/NO	JUSTIFICATION/COMMENT
6.1 (a) Are service delivery roles within the district council clearly allocated?		
6.1 (b) Does the council have provision for outsourcing of non-core activities?		
6.1 (c) Are competitive tendering practices used?		
6.1 (d) Are service delivery mechanisms reviewed annually to identify risks, benefits and costs of various outsourcing options?		
6.2 (a) Does the district plan day to day maintenance activities?		
6.2 (b) Are the needs of stakeholders considered when scheduling day to day maintenance?		
6.2 © Is the planning of day to day maintenance optimised in terms of the availability and use of resources?		
6.2 (d) Is day to day planning of maintenance optimised by considering the availability of resources and impacts on road users?		
6.3 (a) Does the district prepare day to day reports on road maintenance activities?		
6.3 (b) Does the district prepare weekly reports on road maintenance activities?		
6.4 (a) Does the district undertake technical audits of designs?		
6.4 (b) Does the district regularly undertake technical audits of maintenance, construction and rehabilitation works?		
6.4 (c) Does the district provide guidelines for undertaking the road audits?		
6.4 (d) Does the district require service suppliers to be ISO 9000 certified?		

## Annex D. Road Inventory, Condition Surveys and Data Analysis

### ROAD INVENTORY

#### Network Referencing

The network under the jurisdiction of the road agency shall be linear referenced, and the following attributes must be noted:

- Road or route name
- Route number
- Road class
- Node names and details
- Lengths of sections
- Chainages
- Coordinates.

#### Inventory Data

If not already in place the agency must establish a road network inventory that captures the following:

- Road or route name
- Route number
- Road class
- Node names and details
- Lengths of sections
- Chainages
- Coordinates of all the above, etc.
- Pavement type
- Surface type
- Construction history
- Routine maintenance history
- Periodic maintenance history
- Carriageway type and width
- Bridges types and locations
- Culverts types and locations
- Annual budgets and expenditure history.

### DESCRIPTION OF TYPICAL UNPAVED ROADS DEFECTS

This guideline applies to road agencies that are responsible for provision and maintenance of unsealed gravel and earth roads. Condition monitoring of these types of road requires different approaches to surfaced roads. Condition monitoring of unpaved roads will typically measure the various aspects described below.

**Poor Cross-fall and Profile:** An unsurfaced road must be built so water drains quickly off the roadway. If it is not, water stays in ponds or puddles, soaks into the roadbed, and softens it. Building

a crown into the road—making the centre of the road higher than the shoulder—enhances drainage. Normally, a gravel road will have 100-150 mm of crown, or fall, from its centre to the edge [Walter et al, 2002]. Poor cross-fall shape accelerates the formation and progression of structural and functional problems.

**Erosion and Scour:** Erosion or scour occurs when water flows on the road surface and surfacing material is washed away and usually deposited in drains or culverts. The loss of materials can result in the formation of run-off channels causing unsafe driving conditions. Erosion can be prevented by increasing the shear strength of the wearing course material or with an effective drainage system [CSRA, 2009].

**Drainage:** Roadside drains and culverts must be able to handle surface water flow. Without adequate side drains, water will pond on the roadway and soften the gravel wearing course. The side drain must be wide and deep enough to accommodate all the surface water. It must slope so water drains and does not form local ponds. The bottom of the side drain must be below the formation level. Side drains and culverts must be maintained to prevent erosion or the build-up of debris. [Walter et al, 2002].

**Gravel Loss:** Gravel loss is experienced on roads with unbound wearing courses. The rate of gravel loss can be reduced by selecting materials with high plastic properties, well-graded gravels and using high degree of compaction (Van Zyl, 2007).

**Passability:** A road becomes impassable when there are severe structural and functional problems. Impassability is predominantly experienced in wet weather and vehicles fail to progress due to slipperiness and/or formation of deep ruts. Wash-aways of low-lying crossing points due to heavy rains also result in impassability. The problem is more severe on earth roads than gravel roads.

**Potholes:** Potholes on gravel roads are a result of low strength of the base course usually under humid conditions. Development of potholes is rapid especially where there is combination of traffic, poor drainage and water ponding. Potholes are mostly observed at the bottom of vertical curves, on level road sections and near bridges and culverts [CSRA, 2009].

**Rutting:** Rutting is usually caused by ravelling of low-cohesive materials or deformation of cohesive wearing course materials under traffic. Rut occur parallel to the direction of travel.

**Stoniness:** Stoniness is the presence of oversize material in the wearing course, present either as embedded or as loose material on the surface. Stoniness is usually a result of poor material type or selection of the same.

**Dustiness:** Dust is material released from the road surface as a result of tractive forces from wheels of moving vehicles. Dust results in safety and health problems, negative effect on crops in agricultural areas, general discomfort and damage to vehicles [CSRA, 2009]

**Corrugations:** Corrugations are parallel crests that form at right angles to the direction of travel. The wavelengths of the crests depend on the prevalent type of vehicle and speed of travel. Corrugations result in uncomfortable rides on gravel roads and poor vehicle control.

## **SELECTION OF DEFECTS FOR MONITORING**

Poor performance of unpaved roads is usually as a result of the structural or functional problems summarised above. Structural problems (impassability, potholes and rutting) arise when the pavement loses its capability to support traffic loads under prevailing environmental conditions. Functional defects (poor cross-fall and section stoniness, dustiness, ravelling and gravel loss, erosion and scour) are usually a result of poor material selection and construction methods [CSRA, 2009].

Surface conditions on gravel roads and earth roads constantly change in response to variable environmental and operational conditions. On the one hand, heavy rains and sudden increases in heavy traffic can result in dramatic changes in surface conditions in very short spaces of time. On



the other, simple maintenance activities such as blading or tyre dragging can change the condition from very poor to good following as much as one pass of a grader or tractor respectively.

The GEM project focussed on monitoring the road conditions and demonstrating changes in road asset value over a period of time, ranging from 12 months and longer. Over periods shorter than 12 months unpaved road conditions may vary significantly as a result of weather conditions or maintenance activities. Hence, the monitoring of the road conditions for the purposes to quantifying improvements in asset management has to be based on major long-term deterioration factors associated with each road type.

The major criteria proposed for monitoring for asset value tracking purposes on the earth and gravel roads include:

- Camber
- Usable cross-section
- Drainage
- Gravel thickness.

It must be noted that RAs are expected to continuously monitor the following aspects of road condition in a responsive manner and at shorter intervals than the above, as input into their maintenance management systems:

- Surface defects – rutting, corrugations, potholes, stoniness, dust;
- Roughness; and
- Passability.

Condition survey forms included in Annex E allow for the capturing of the condition ratings over segments of length to be determined by the agency. In practical terms, for network level planning, segments can be up to 5 kilometres in length. Simple averages of sections ratings will be adopted to define the condition index at link level. The end result of the condition rating will be defining the condition of each link on the five level scale from Very Poor through Poor, Fair, Good to Very Good. The assessment of condition is summarised in Table 10.

**Table 10: Summary of Condition Rating**

Condition Rating	Description	Observations	Remarks
5	Very Good	<ul style="list-style-type: none"> <li>• No distress.</li> <li>• Excellent surface condition and ride.</li> </ul>	<ul style="list-style-type: none"> <li>• New construction or total</li> <li>• Re-construction.</li> <li>• Excellent drainage.</li> <li>• Little or no maintenance needed.</li> </ul>
4	Good	<ul style="list-style-type: none"> <li>• Dust under dry conditions.</li> <li>• Moderate loose aggregate.</li> </ul>	<ul style="list-style-type: none"> <li>• Recently regraded.</li> <li>• Good camber and drainage throughout.</li> <li>• Adequate gravel for traffic.</li> <li>• Routine grading may be needed.</li> </ul>
3	Fair	<ul style="list-style-type: none"> <li>• Good camber (75-150mm).</li> <li>• Adequate drains on more than 50% of roadway.</li> <li>• Gravel layer mostly adequate</li> <li>• But additional work may be needed in some locations to correct corrugations</li> </ul>	<ul style="list-style-type: none"> <li>• Shows traffic effects.</li> <li>• Re-grading (reworking) necessary.</li> <li>• Side drain improvement and culvert maintenance required.</li> <li>• Some areas may need additional gravel.</li> </ul>
2	Poor	<ul style="list-style-type: none"> <li>• Little or no roadway camber (less than 75mm).</li> <li>• Adequate side drains on less than 50% of roadway. Portions of the side</li> </ul>	<ul style="list-style-type: none"> <li>• Travel at slow speeds (less than 30km/r is required).</li> <li>• Needs additional new gravel.</li> <li>• Major side drain construction and culvert maintenance also required.</li> </ul>

		drains may be filled, overgrown and/or show erosion. <ul style="list-style-type: none"> <li>• Some areas (25%) with little or no gravel.</li> </ul>	
1	Very Poor	<ul style="list-style-type: none"> <li>• No roadway camber or road is bowl shaped with extensive ponding.</li> <li>• Little if any side drains.</li> <li>• Filled or damaged culverts.</li> </ul>	<ul style="list-style-type: none"> <li>• Travel is difficult and road may be closed at times.</li> <li>• Needs complete rebuilding and/or new culverts.</li> </ul>

## ROAD CONDITION MONITORING

### Road Condition Survey Method

Road condition surveys must be undertaken annually. The recommended method is being based on the conventional visual inspection described in the Technical Methods for Highways (TMH) 9 from South Africa. According to the method, defects observed on 5 km road segments are rated on a scale of 1 to 5 according to their “degree” and “extent”, with degree representing severity of the defect, and extent estimating the quantity or magnitude of the defect. The defects that are assessed include gravel loss, usable road width, erosion of the carriageway, erosion of the side drains, potholes, corrugations, rutting and impassability. The forms for undertaking the survey are included in Annex E as follows:

- Road Inventory Data Collection Form;
- Culvert Inventory and Condition Form;
- Bridge Inventory and Condition Form; and
- Unpaved Road Condition Survey Form.

### Calculation of Condition Indices

The “deduct” method described in TMH9 and TMH22 was adapted for calculation of road condition indices. An Excel macro spreadsheet developed under the GEM project shall be used to combine the effects of any group of defects into one index. The scores for each defect mentioned in the foregoing sub-section are given weightings depending on the perceived importance of each defect and combined into a single score representing a particular depiction of road condition.

The following indices are derived for the purposes of asset valuation and determining preservation needs:

- The “**Road Condition Index (RCI)**”, which is an appraisal of the road in terms of both functional and structural of the road; all defect on the road are taken into account and the index is useful for checking the integrity of the collected road condition data.
- The “**Road Functionality Index (RF<sub>I</sub>)**”, which is an appraisal of the road in terms of functional characteristics that affect the quality of use, notably comfort (convenience) safety, congestion and operating cost;
- The “**Condition Index – Pavement (CI<sub>P</sub>)**”, which is the numerical rating of the road pavement and gravel layer depending on its structural integrity or condition, remaining layer thickness and usable width; and
- The “**Condition Index – Formation (CI<sub>F</sub>)**”, which is the numerical rating of the road formation depending on remaining usable width, integrity of the formation and erosion of the side drains.

These indicators are derived from the condition survey data by considering selected defects that are relevant to the index. For example, the RF<sub>I</sub> is obtained from the degree and extent of potholes, rutting and corrugations. All three indices can be aggregated to determine a value for the network level. They are then known as the “Network Functionality Index (NF<sub>I</sub>)”, “Network Condition Index – Pavement (NCI<sub>P</sub>)” and “Network Condition Index – Formation (NCI<sub>F</sub>).” A typical calculation of the indices is shown in

Table 11: Calculation of Road Condition Indices

ROAD FUNCTIONALITY AND CONDITION INDICES																																													
D - DEGREE/SEVERITY 1. Slight 2. Slight to Warning 3. Warning 4. Warning to Severe 5. Severe										E - DEFECT EXTENT/OCCURRENCE/QUANTITY % of length: 1.<5% 2.5-10% 3.10-25% 4.25-50% 5>50%										CONDITION RATING CRITERIA Very Poor:<30% Poor:30-50% Fair:50-70% Good:70-85% Very Good:>85%																									
Calculate Segment Indices										Gravel Loss Usable Width Erosion C-Way Erosion S/Drains Potholes Corrugations Rutting Impassability										Road Condition Index - RCI (%)				Functionality Index - FI (%)				Condition Index - Pavement - CIP (%)				Condition Index - Formation - CIF (%)													
GEM Road No	Road No	Road Name	Road Type	Segm No	Start Km	End Km	Length (km)	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	Segment CI	Segment Rating	RCI	RCI Rating	Segment FI	Segment Rating	Road FI	Road Rating	Segment CIP	Segment Rating	Road CIP	Road Rating	Segment CIF	Segment Rating	Road CIF	Road Rating
1		Mpemba - Mulenje	Gravel	1	+0	5+000	5.0	4	3	1	1	3	3	4	5	3	3	1	2	1	1	2	1	1	2	1	1	44.4	Poor	46.2	Poor	60.3	Fair	61.3	Fair	66.4	Fair	47.6	Poor	96.8	Very Good	91.8	Very Good		
1		Mpemba - Mulenje	Gravel	2	5+000	10+000	5.0	3	3	1	1	2	2	4	5	3	3	1	2	1	1	2	1	1	2	1	1	46.8	Poor	46.2	Poor	60.3	Fair	61.3	Fair	76.4	Good	47.6	Poor	96.8	Very Good	92.6	Very Good		
1		Mpemba - Mulenje	Earth	3	10+000	15+200	5.2	0	0	1	1	3	3	4	5	3	3	1	2	1	1	5	1	1	1	1	1	47.5	Poor	46.2	Poor	60.3	Fair	61.3	Fair	-	n/a	47.6	Poor	96.8	Very Good	96.8	Very Good		
2	U1/U2	Mwalumina - Chongwe River	Gravel	1	+0	5+000	5.0	4	5	2	1	3	2	2	2	3	3	1	3	2	2	4	1	1	1	1	46.4	Poor	52.2	Fair	59.1	Fair	53.4	Fair	59.3	Fair	91.6	Very Good	91.8	Very Good					
2	U1/U2	Mwalumina - Chongwe River	Gravel	2	5+000	10+000	5.0	3	5	1	1	2	2	1	3	4	1	3	2	2	0	0	0	0	0	0	56.3	Fair	52.2	Fair	55.7	Fair	59.1	Fair	64.4	Fair	59.3	Fair	96.8	Very Good	92.6	Very Good			
2	U1/U2	Mwalumina - Chongwe River	Gravel	3	10+000	15+000	5.0	3	5	2	1	2	1	3	2	3	2	3	2	3	1	2	4	2	2	2	56.6	Fair	52.2	Fair	62.3	Fair	59.1	Fair	63.4	Fair	59.3	Fair	91.6	Very Good	93.5	Very Good			
2	U1/U2	Mwalumina - Chongwe River	Gravel	4	15+000	20+000	5.0	3	5	1	1	1	1	1	2	2	2	2	2	1	1	0	0	0	0	0	60.2	Fair	52.2	Fair	79.5	Good	59.1	Fair	64.4	Fair	59.3	Fair	96.8	Very Good	89.9	Very Good			
2	U1/U2	Mwalumina - Chongwe River	Gravel	5	20+000	25+000	5.0	3	5	1	1	1	1	2	2	3	2	2	2	1	1	0	0	0	0	0	57.9	Fair	52.2	Fair	63.9	Fair	59.1	Fair	64.4	Fair	59.3	Fair	96.8	Very Good	93.1	Very Good			
2	U1/U2	Mwalumina - Chongwe River	Gravel	6	25+000	30+000	5.0	3	5	2	3	2	1	3	3	4	2	3	1	1	0	0	0	0	0	0	54.8	Fair	52.2	Fair	55.4	Fair	59.1	Fair	61.4	Fair	59.3	Fair	81.6	Good	84.9	Good			
2	U1/U2	Mwalumina - Chongwe River	Gravel	7	30+000	35+000	5.0	4	5	2	2	2	2	5	1	3	2	3	4	1	1	0	0	0	0	0	44.5	Poor	52.2	Fair	56.6	Fair	59.1	Fair	52.2	Fair	59.3	Fair	85.6	Very Good	85.6	Very Good			
2	U1/U2	Mwalumina - Chongwe River	Gravel	8	35+000	40+200	5.2	4	5	3	3	3	1	1	4	4	3	4	3	4	3	2	3	2	2	2	41.1	Poor	52.2	Fair	38.0	Poor	59.1	Fair	50.4	Fair	59.3	Fair	76.4	Good	76.4	Good			
3	U16	lukoshi - Nchute	Earth	1	+0	5+000	5.0	0	0	1	1	1	1	1	1	2	2	1	3	1	1	0	0	0	0	0	83.5	Good	72.8	Good	80.3	Good	64.5	Fair	-	n/a	0.0	n/a	96.8	Very Good	91.8	Very Good			
3	U16	lukoshi - Nchute	Earth	2	5+000	10+000	5.0	0	0	1	1	2	2	1	1	3	3	1	3	1	1	0	0	0	0	0	72.9	Good	72.8	Good	63.0	Fair	64.5	Fair	-	n/a	0.0	n/a	96.8	Very Good	92.6	Very Good			
3	U16	lukoshi - Nchute	Earth	3	10+000	15+000	5.0	0	0	1	1	3	3	2	2	3	4	1	3	1	1	0	0	0	0	0	65.3	Fair	72.8	Good	63.0	Fair	64.5	Fair	-	n/a	0.0	n/a	96.8	Very Good	93.5	Very Good			
3	U16	lukoshi - Nchute	Earth	4	15+000	18+300	3.3	0	0	1	1	2	2	3	3	3	3	2	3	2	1	2	1	0	0	0	69.5	Fair	72.8	Good	61.7	Fair	64.5	Fair	-	n/a	0.0	n/a	96.8	Very Good	96.8	Very Good			
4		Ndipula - lwimba River	Earth	1	+0	5+000	5.0	0	0	1	1	3	2	1	1	4	4	3	2	1	1	0	0	0	0	0	59.2	Fair	55.2	Fair	42.7	Poor	42.7	Poor	-	n/a	0.0	n/a	96.8	Very Good	91.8	Very Good			
5		Jakapa - Chibwalu	Earth	1	+0	5+000	5.0	0	0	3	2	3	3	1	1	4	4	3	3	2	2	0	0	0	0	0	52.4	Fair	38.1	Poor	39.8	Poor	28.0	Very Poor	-	n/a	0.0	n/a	81.4	Good	84.9	Good			
5		Jakapa - Chibwalu	Earth	2	5+000	10+000	5.0	0	0	3	3	4	4	1	1	5	5	3	3	4	4	2	3	2	2	2	23.9	Very Poor	38.1	Poor	16.3	Very Poor	28.0	Very Poor	-	n/a	0.0	n/a	76.4	Good	92.6	Very Good			
6		Kasubanya	Earth	1	+0	5+000	5.0	0	0	2	2	2	1	1	3	3	2	3	2	2	2	0	0	0	0	0	70.5	Good	63.3	Fair	61.5	Fair	53.1	Fair	-	n/a	0.0	n/a	85.6	Very Good	91.8	Very Good			
6		Kasubanya	Earth	2	5+000	8+600	3.6	0	0	1	2	2	2	1	1	4	4	2	2	1	1	0	0	0	0	0	56.2	Fair	63.3	Fair	44.8	Fair	53.1	Fair	-	n/a	0.0	n/a	93.8	Very Good	95.3	Very Good			
7	U14	Mwampatisha	Earth	1	+0	5+000	5.0	0	0	3	1	3	3	2	1	4	4	1	1	2	3	2	1	1	1	1	53.5	Fair	48.2	Poor	42.1	Poor	40.9	Poor	-	n/a	0.0	n/a	87.8	Very Good	91.8	Very Good			
8	U3	Mutumbisha	Earth	1	+0	6+800	6.8	0	0	3	2	4	5	1	1	3	2	1	1	2	2	1	1	1	1	1	48.6	Poor	48.2	Poor	39.6	Poor	40.9	Poor	-	n/a	0.0	n/a	66.2	Fair	66.2	Fair			
9	U13	Mufweshia	Earth	1	+0	4+200	4.2	0	0	4	3	5	4	1	1	4	3	0	0	3	3	1	1	1	1	1	35.8	Poor	48.6	Poor	44.1	Poor	44.1	Poor	-	n/a	0.0	n/a	81.4	Good	81.4	Good			
10		Chishiko - Kabeleka	Earth	1	+0	4+500	4.5	0	0	1	2	1	3	2	3	2	2	0	0	2	1	1	1	1	1	1	77.1	Good	78.4	Good	72.5	Good	78.4	Good	-	n/a	0.0	n/a	96.8	Very Good	96.8	Very Good			
10		Chishiko - Kabeleka	Earth	2	4+500	8+600	4.1	0	0	1	1	1	1	1	1	2	1	0	0	3	2	1	1	1	1	1	79.8	Good	78.4	Good	83.9	Good	78.4	Good	-	n/a	0.0	n/a	96.8	Very Good	95.3	Very Good			
11		Kalulu	Earth	1	+0	5+000	5.5	0	0	4	4	5	5	1	1	3	3	0	0	2	2	1	1	1	1	1	27.1	Very Poor	27.1	Very Poor	27.7	Very Poor	27.7	Very Poor	-	n/a	0.0	n/a	60.2	Fair	60.2	Fair			
12		Matipula	Gravel	1	+0	3+000	3.0	4	2	2	2	2	1	2	1	3	2	2	2	1	4	2	0	0	0	0	63.6	Fair	59.7	Fair	68.6	Fair	66.1	Fair	70.2	Good	67.8	Fair	85.6	Very Good	85.6	Very Good			
12		Matipula	Gravel	2	3+000	6+300	3.3	4	3	2	1	4	2	2	4	2	3	2	2	1	4	2	0	0	0	0	55.0	Fair	59.7	Fair	63.4	Fair	66.1	Fair	65.4	Fair	67.8	Fair	91.6	Very Good	91.6	Very Good			
13	U18	Mapulanga-Chiyota	Earth	1	+0	5+000	5.0	0	0	1	1	2	2	1	1	2	2	1	2	2	3	0	0	0	0	0	77.0	Good	69.8	Fair	78.5	Good	67.7	Fair	-	n/a	0.0	n/a	96.8	Very Good	91.8	Very Good			
13	U18	Mapulanga-Chiyota	Earth	2	5+000	10+000	5.0	0	0	1	1	2	2	1	1	3	2	1	1	3	3	0	0	0	0	0	71.6	Good	69.8	Fair	70.2	Good	67.7	Fair	-	n/a	0.0	n/a	96.8	Very Good	92.6	Very Good			
13	U18	Mapulanga-Chiyota	Earth	3	10+000	15+500	5.5	0	0	2	1	4	3	3	1	3	2	1	1	2	2	4	1	1	1	1	60.9	Fair	69.8	Fair	54.1	Fair	67.7	Fair	-	n/a	0.0	n/a	91.6	Very Good	91.6	Very Good			
14	U9	T4 - Kapete	Gravel	1	+0	4+000	4.0	3	4	1	2	4	2	2	1	2	2	2	1	2	2	0	0	0	0	0	63.4	Fair	66.1	Fair	66.5	Fair	75.6	Good	70.8	Good	71.2	Good	93.8	Very Good	93.8	Very Good			
14	U9	T4 - Kapete	Gravel	2	4+000	8+000	4.0	3	3	1	1	2	1	1	1	2	2	2	2	1	1	0	0	0	0	0	72.0	Good	66.1	Fair	79.4	Good	75.6	Good	76.4	Good	96.8	Very Good	96.8	Very Good					
14	U9	T4 - Kapete	Gravel	3	8+000	13+000	5.0	4	3	1	1	1	1	1	1	2	2	2	2	1	2	1	0	0	0	0																			

**Figure 13: Graphical representation of road condition indices**



## Annex E. Road Inventory and Condition Assessment Forms

### Road Inventory Data Collection Form

ROAD AGENCY NAME:   
DISTRICT:  ASSESSOR:  DATE:

---

**ROAD AND SECTION DETAILS:**

ROAD NAME:  TRAFFIC: 

1	2	3	4	4
<20	20-50	50-100	100-200	>200

ROAD NO.:

ROAD START POINT:  Km

ROAD END POINT:  Km

START POINT COORD: X   
Y

END POINT COORD: X   
Y

Section Name:

Road Reserve Avg Width:  m

Section Start Point:  Km

Section End Point:  Km

Start Point Coords: X   
Y

End Point Coords: X   
Y

---

**INVENTORY DATA:**

**Vert. Alignment:**

Flat	Rolling	Steep

**Horizontal Alignment:**

S/Curves	Gentl Curves	Straight

**Vegetation:**

Grass	L/Bush	H/Bush

**Pavement Surface Types:**

1	2	3	4	5
Earth	Gravel			

**Pavement Material Types:**

1	2	3	4	5
Clay/Silt	Sandy Clay	Sand	Gravel	Stoney Gravel

**Pavement Surface Type & Width:**

Chainage:	From	To	Type	Width (m)

**Pavement Material Type:**

Chainage:	From	To	Type	Remark

**Shoulder Type:**

None	Earth	Gravel
1	2	3

**Side Drain Type:**

None	Flat	V-Drain	Trapez.
1	2	3	4

**Shoulder Type & Width:**

Chainage:	From	To	Type	L/R	Width(m)

**Side Drain Type, Width, Depth:**

Chainage:	From	To	Type	Width (m)

**Road Furniture:**

Chainage	Type	Remark	Chainage	Type	Remark

**Roadside Facilities:**

Chainage	Type	Remark

# Culvert Inventory

Road Agency Name: \_\_\_\_\_ District: \_\_\_\_\_ Reported By: \_\_\_\_\_ Date: \_\_\_\_\_

Road No: \_\_\_\_\_ Road Name: \_\_\_\_\_ Section Name: \_\_\_\_\_ Start Km: \_\_\_\_\_ End Km: \_\_\_\_\_

Location (km)	Coordinates		Type (Refer to A below)	Number of Barrels/Openings	Length (m)	Width/Dia. (m)	Condition Rating (Refer to B below)	Remarks
	X	Y						

- Culvert Types (A)**
- 1. Armco
  - 2. Concrete Pipe
  - 3. Concrete Box
  - 4. Plastic Pipe
  - 5. Steel Pipe
  - 6. Arched Culvert
  - 7. Spillway

- Culvert Condition (B)**
- 1. Good (no work required)
  - 2. Fair (minor work required)
  - 3. Poor (major work required)
  - 4. Very Poor (in danger of failure)

# Bridge Inventory

Road Agency Name: \_\_\_\_\_ District: \_\_\_\_\_ Reported By: \_\_\_\_\_ Date: \_\_\_\_\_

Road No: \_\_\_\_\_ Road Name: \_\_\_\_\_ Section Name: \_\_\_\_\_ Start Km: \_\_\_\_\_ End Km: \_\_\_\_\_

Location (km)	Coordinates		Name	Type (Refer to A below)	Number of Spans	Length (m)	Height (m)	Width (m)	Condition (Refer to B below)	Remarks
	X	Y								

- Bridge Types (A)**
- 1 Reinforced Concrete Single Spans
  - 2 Reinforced Concrete Continuous
  - 3 Bailey
  - 4 Steel Truss
  - 5 Composite
  - 6 Arch
  - 7 Timber
  - 8 Other

- Bridge Condition (B)**
- 1 Good (no work required)
  - 2 Fair (minor work required)
  - 3 Poor (major work required)
  - 4 Bad (in danger of failure)











## Annex F. Road Asset Valuation Guidelines

### DEFECTS APPLICABLE TO ASSET VALUATION

Not all road defects are relevant to monitoring of trends in road network asset value. Only the following defects will be assessed to judge the condition of a road or road section for purposes of road asset valuation:

- camber/road cross section;
- drainage; and
- gravel thickness.

### ASSET VALUATION PROCESS

To determine the value of the road asset the following steps must be undertaken:

- Gathering, collation and review of existing relevant information;
- Establishment of an asset register with hierarchy clearly defined;
- Determining Expected Useful Life for each asset;
- Condition Assessment for each asset;
- Determining Remaining Useful Life;
- Setting unit rates for calculation of replacement cost;
- Calculation of Current Replacement Cost; and
- Calculation of Current Asset Value.

### INFORMATION AND DATA COLLECTION

Before undertaking the road asset valuation process, existing available information must be collected, collated and assessed for its relevance to the asset management process. Any shortfalls should be identified and noted from the onset. Potential sources of information and data that may be held by RAs, central government ministries, statutory bodies such as Road Funds will include:

- Statutes, regulations and by-laws;
- Strategic plans;
- Road maintenance plans;
- Asset registers;
- Annual reports;
- Proceedings of authority meetings;
- Project plans;
- Project completion reports; and
- Manuals and guidelines.

### ESTABLISHMENT OF AN ASSET REGISTER

The following steps will need to be undertaken to establish a road network asset register:

- Define the asset hierarchy;
- Design an asset register format, starting off with a simple spreadsheet;
- Establish Estimated Useful Life for each asset as well as unit costs for replacement;
- Determine existing asset data sources;
- Plan data collection to supplement existing data;

- Collect data and capture in database;
- Validate data; and
- Carry out periodic updating and re-evaluations.

Table 12 includes an example of a road infrastructure asset hierarchy. Each RA is expected to define its own hierarchy.

**Table 12: Example of Road Asset Register Hierarchy**

Infrastructure	Asset Group	Asset
Roads and Bridges	Gravel Roads	Right of Way
		Formation
		Gravel Wearing Course
		Bridges
		Major culverts
		Minor Culverts
		Information Signs
		Regulatory Signs
		Fences
		Bus Shelters
		Kerbs and Channels
		Guardrails
		Earth Roads
	Formation	
	Bridges	
	Culverts	
	Road signs	
	Right of Way	

### EXPECTED USEFUL LIVES OF ASSETS

Each asset in the asset register must be assigned an Expected Useful Life. This will be a function of the following: standard of design and construction, utilisation rates, the operating environment and maintenance regime. Table 13 includes recommended useful lives for road assets that may be used by rural road agencies. These recommendations must be reviewed by each RA for suitability to their circumstances.

**Table 13: Expected Useful Life of Road Assets**

Asset	Expected Useful Life (EUL) in Years
Right of Way – Earth Roads	30
Right of Way – Gravel Roads	50
Formation	25
Gravel Wearing Course	7
Bridges	50
Major culverts	25
Minor Culverts	15
Information Signs	3
Regulatory Signs	3
Bus Shelters	7
Kerbs and Channels	3
Guardrails	5

## ASSET VALUATION METHOD

Assigning a monetary value to the assets will demonstrate the cost of depreciation and replacement and the RA can ensure that adequate funding is set aside to maintain the networks in a usable state in the long term.

As with common practice, the Depreciated Replacement Cost (DRC) approach has been adopted as the most appropriate asset valuation method, as follows:

$$\text{Depreciated Replacement Cost (DRC)} = \frac{\text{RUL} \times \text{CRC}}{\text{EUL}}$$

where:

- RUL – Remaining Useful Life;
- CRC – Current Replacement Cost; and
- EUL – Expected Useful Life.

RUL is established following visual condition assessment of the asset and considering the knowledge of the maintenance regime to date.

EUL is the anticipated life of the asset from acquisition or new construction until failure assuming normal expected operating environment and maintenance regime.

CRC is an estimate of replacement of the asset with a modern equivalent of similar nature, based on current unit rates.

### DETERMINATION OF RUL – REMAINING USEFUL LIFE

As defined above RUL is usually determined from the visual condition assessment of the asset whilst considering the maintenance regime that the asset has been subjected to. The condition of the road network in this case will be used as proxy to determine the RUL according to a scale that is customised to the road type that is gravel or earth road.

The generic condition rating shown in Table 14 is adopted for the assets, with the RUL for each asset being determined after detailed consideration of all factors.

**Table 14: Generic Condition Rating**

Rating	Description	Detailed Description	RUL as % of EUL
5	Very Good	Sound structure, well maintained. Only normal maintenance required.	71-100
4	Good	Serves needs but minor deterioration (< 5%). Minor maintenance required.	46-70
3	Fair	Marginal, clearly evident deterioration (10-20%). Significant maintenance required.	26-45
2	Poor	Significant deterioration of structure and/or appearance. Significant impairment of functionality (20-40%). Significant renewal/upgrade required.	11-25
1	Very Poor	Unsound, failed needs reconstruction/ replacement (> 50% needs replacement).	0-10

*Adapted from MFMA Local Government Asset Management Guideline, RSA*

### ESTABLISHING UNIT RATES

To calculate the Current Replacement Cost, unit rates must be established for each asset that take into account all cost factors: overheads, design, construction, supervision, etc. These rates can be

built up from basic costs of inputs or can be obtained from historical costs, if available and reliable. Rates may also be obtained from the local construction industry organisations.

Whilst the ideal situation will call for a detailed calculation of the CRC for each asset on a road section, it may be prudent to establish generic rates per kilometre at network level at the beginning and this can be improved upon as the RA's develop more mature asset management systems.

An example of unit rates is shown in Table 15.

**Table 15: Typical Unit Rates**

Road Type	Current Replacement Unit Rate (\$/km)
Earth	10,000
Gravel	25,000
Surfaced – Chip & Seal	200,000
Asphalt	300,000

### EXAMPLE OF CALCULATION OF ASSET VALUE

Table 16 and include the results of simple asset valuation for a road network using the process described above. The methodology for valuation of road assets was refined as the GEM project progressed and was implemented in the project areas. The development of an appropriate method of asset valuation was part of the research project.

### REPORTING

The following reports are generated from the Condition Monitoring and Asset Valuation processes:

- Asset knowledge reports – extent of network, type of roads, bridge structures, etc.;
- Current Network Asset Value;
- Percent of Network in condition worse than threshold – by type;
- Trends in Asset Value over the last three years;
- Trends in condition of road network by type over the last three years;
- Projected trends in asset value and condition following planned improvements in asset management and funding;
- Expenditure split – capital, rehabilitation, periodic, maintenance, agency costs; and
- Road network mapping in various forms.

Table 16: Example of an asset valuation data template

ASSET VALUATION DATA				
<b>Expected Useful Life</b>				
Gravel Pavement		7	years	
Formation		50	yrs	
<b>Costs per Km</b>				
Total CRC/Km Gravel Road		30,000.00		
Formation	45%	13,500.00	US\$	
Gravel Pavement	55%	16,500.00	US\$	
Routine Maintenance		2,000.00	US\$	
Periodic Maintenance - Regravels		13,200.00	US\$	
Rehabilitation		19,800.00	US\$	
Upgrading		16,500.00	US\$	
<b>Min Threshold Conditions</b>				
Gravel Layer		Fair		
Formation		Fair		
<b>Road Maintenance and Development Needs Parameters</b>				
	<b>2016 Baseline</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
% of Network to Maintain	100%	100%	100%	100%
% of Fair for Periodic	100%	100%	100%	100%
% of Poor and V.Poor for Rehab	50%	50%	50%	50%
% of Earth Roads to Upgrade	20%	20%	20%	20%
<b>Costs per Km (Actual)</b>				
Routine Maintenance		85.00	US\$	
<b>Budget History (million US\$)</b>				
	<b>2016 Baseline</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
Routine Maintenance	-	0.07	-	-
Periodic Maintenance	-	-	-	-
Upgrading	-	-	-	-
Rehabilitation	-	-	-	-
<b>Total</b>	-	<b>0.07</b>	-	-
<b>Actual Expenditure (million US\$)</b>				
	<b>2016 Baseline</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
Routine Maintenance	-	-	-	-
Periodic Maintenance	-	-	-	-
Upgrading	-	-	-	-
Rehabilitation	-	-	-	-
<b>Total</b>	-	-	-	-



Table 17: Example of road asset valuation

ASSET VALUE CALCULATION

BASIC INFORMATION ON ROAD AND SECTIONS								CURRENT REPLACEMENT COST								EXPECTED THRESHOLD VALUE						CURRENT ASSET VALUE						ANALYSIS				
GEM Road No.	Road No.	Road Name	Road Type	Segment No.	Start Km	End Km	Length (km)	Expected Useful Life - EUL (Yrs)		Gravel Road CRC Cost/Km (\$)	CRC Cost/km: Formation (\$)	CRC Cost/Km: Pavement (\$)	Formation CRC Cost (\$)	Pavement CRC Cost (\$)	Current Replacement Cost (\$)	Min. Threshold Condition - Rating		Remaining Useful Life (RUL) at Threshold Condition (Yrs)		Depreciated Remaining Cost (DRC) at Threshold Condition (\$)		Asset Value at Threshold Condition (\$)	Current Condition Rating		Remaining Useful Life (RUL) at Current Condition (Yrs)		Depreciated Remaining Cost (DRC) at Current Condition (\$)		Current Asset Value (\$)	Current Asset Value as % of CRC	Current Asset Value as % of Min Threshold Value	Roads with Condition Less than Permissible (Kms)
								Formation	Pavement							Formation	Pavement	Formation	Pavement	Formation	Pavement		Formation	Pavement	Formation	Pavement	Formation	Pavement				
1	0	Mpemba - Mulenje	Gravel	1	+0	5+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
1	0	Mpemba - Mulenje	Gravel	2	5+000	10+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Good	47.5	6.0	64,125	70,125	134,250	90%	128%	-
1	0	Mpemba - Mulenje	Earth	3	10+000	15+200	5.20	50	n/a	30,000	13,500	16,500	70,200	0	70,200	Fair	n/a	35.0	-	49,140	-	49,140	Very Good	n/a	47.5	-	66,690	-	66,690	95%	136%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	1	+0	5+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	2	5+000	10+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	3	10+000	15+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	4	15+000	20+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	5	20+000	25+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	6	25+000	30+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Good	Fair	42.5	4.9	57,375	57,750	115,125	77%	110%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	7	30+000	35+000	5.00	50	7	30,000	13,500	16,500	67,500	82,500	150,000	Fair	Fair	35.0	4.9	47,250	57,750	105,000	Very Good	Fair	47.5	4.9	64,125	57,750	121,875	81%	116%	-
2	U1/U2	Mwalumina - Chongwe River	Gravel	8	35+000	40+200	5.20	50	7	30,000	13,500	16,500	70,200	85,800	156,000	Fair	Fair	35.0	4.9	49,140	60,060	109,200	Good	Fair	42.5	4.9	59,670	60,060	119,730	77%	110%	-
3	U16	Lukoshi - Nchute	Gravel	1	+0	5+000	5.00	50	7	45,000	20,250	24,750	101,250	123,750	225,000	Fair	Fair	35.0	4.9	70,875	86,625	157,500	Very Good	n/a	47.5	-	96,188	-	96,188	43%	61%	5.00



# ROAD MAINTENANCE MONTHLY REPORT

**MR2**

**MONTH:** ..... **FINANCIAL YEAR:** ..... **ROAD NUMBER:** ..... **UNIT NO. / NAME:** .....

**DISTRICT:** ..... **ROAD NAME:** .....

**Labour Intensive Maintenance :**

RESOURCE TYPE	ACTIVITY	DATE WORK DONE												TOTAL	UNIT COST	TOTAL INPUT COST
⊕	Major Crossing Mtce															
⊕	Culvert Maintenance															
W	Erosion & Drain Mtce															
O	Gravel Patching															
P	Sign Maintenance															
N	Verge Clearing															
A	Supervisor															
M	Clerk/MA/Tractor Driv.															
	TGO															
	Guards															
MATERIALS	Cement (Pockets)															
	Stone (m3)															
PROGRESS	Major Crossing (No.)															
	Culvert Maint. (No.)															
THIS	Erosion & Drains (Kms)															
	Gravel Patching (Kms)															
Month	Sign Maint. (Kms)															
	Verge Clearing (Kms)															
	Section Number															

Progress to date: Major Crossing No.      Culverts No.      Verge Cleared (Kms)      Signs Maintained No.      Erosion & Drains Kms:      Gravel Patching Kms

**Total Allocation:**                      **Expenditure this Month:**                      **Expenditure to Date:**                      **Balance:**

Compiled		Committed	
Date		Date	
Signature		Signature	
Unit Supervisor		DISTRICT	





## ROAD MAINTENANCE ANALYSIS

**DISTRICT**

EQUIPMENT INTENSIVE ACTIVITIES										LABOUR INTENSIVE ACTIVITIES									
District	LEN	P	Gravel Patching	Cost of tractor/Lorry	Grading.	Grading. Cost	Other Trans.	Supervision ve	Equip. Oper. Cost	P/A	Erosion & Drains	Verge Clear	Gravel Patch	Culvert Repair	Sign Maint	Major Struc	P/A	Cost of Labour	Total Maint. Oper. Cost
		A	(KM)	USD	(KM)	USD	USD	USD	TOTAL USD		(Km)	(Km)	(Km)	(No.)	(Km)	(NO.)			USD
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
		P								P							P		
		A								A							A		
<b>Network</b>		<b>P</b>								<b>P</b>							<b>P</b>		
<b>Totals</b>		<b>A</b>								<b>A</b>							<b>A</b>		

Prog - Programmed

P - Planned

A- Actual

Exp- Expenditure







## Annex H. A list of possible socio-economic indicators

	Indicator	Units
	<b>General</b>	
1.	Distance from nearest paved road	Km
2.	Distance from the District Centre (name of the centre):	Km
3.	Average travel time to the District Centre (by different modes of transport)	Min
4.	Name of the road serving the Trading Centre: How many days of the year is the road closed due to rains?	
5.	Road Condition Index	
	<b>Availability and cost of transport</b>	
6.	No. of private transport operators serving the Trading Centre <ul style="list-style-type: none"> <li>- Light vehicle</li> <li>- Bus/combi</li> <li>- Motorcycle (boda-boda)</li> <li>- Freight transport /trucks</li> </ul>	No.
7.	No. of available trips to the District Centre per day (on a normal day) <ul style="list-style-type: none"> <li>- Light vehicle</li> <li>- Bus/combi</li> <li>- Motorcycle (boda-bodas)</li> <li>- Freight transport /trucks</li> </ul>	No.
8.	No. of available trips to the District Centre per day (on a market day) <ul style="list-style-type: none"> <li>- Light vehicle</li> <li>- bus/combi</li> <li>- Motorcycle (boda-bodas)</li> <li>- Freight transport /trucks</li> </ul>	No.
9.	Fares on public transport to the District Centre (passenger-km) <ul style="list-style-type: none"> <li>- Light vehicle</li> <li>- Bus/combi</li> <li>- Motorcycle (boda-boda)</li> </ul>	Currency unit
10.	Cost of freight transport to the District Centre (ton-km) <ul style="list-style-type: none"> <li>- Truck (...tons)</li> <li>- Light vehicle (...tons)</li> <li>- Motorcycles/IMTs (...tons)</li> </ul>	Currency unit
	<b>Price of goods in the Trading Centre (TC)</b>	
11.	Prices of three items exported from the TC (e.g. potatoes, rice, maize, charcoal) <ul style="list-style-type: none"> <li>- Item 1 (name)- state units:</li> <li>- Item 2 (name)- state units:</li> <li>- Item 3 (name)- state units:</li> </ul>	Currency unit
12.	Prices of three items imported into the TC (e.g. petrol, soap, seed, fertiliser) <ul style="list-style-type: none"> <li>- Item 1 (name)- state units:</li> <li>- Item 2 (name)- state units:</li> <li>- Item 3 (name)- state units:</li> </ul>	Currency unit
	<b>Price of goods in the District Centre (same items as priced in the Trading Centre)</b>	
13.	Prices of three items exported from the Trading Centre <ul style="list-style-type: none"> <li>- Item 1 (name)- state units:</li> </ul>	Currency unit

	Indicator	Units
	- Item 2 (name)- state units: - Item 3 (name)- state units:	
14.	Prices of the three items imported into the Trading Center - Item 1 (name)- state units: - Item 2 (name)- state units: - Item 3 (name)- state units:	Currency unit
	<b>Road Safety</b>	
15.	Is road safety awareness taught to children at the school?	
16.	Are road safety awareness presentations made to adults in the village?	
17.	No. of accidents on the road serving the Trading Centre in the past year	No.
	<b>Education- nearest school to the TC - Name of school:</b>	
18.	Average time to reach the nearest school from the Trading Centre by different modes of transport (by gender and age)	Min
19.	No. of pupils enrolled at the nearest school (gender disaggregated)	No.
20.	Average monthly pupil attendance rate for the past year (gender disaggregated)	%
21.	No. of staff employed at the school (gender disaggregated)	No.
22.	Average monthly staff attendance rate for the past year (gender disaggregated)	%
	<b>Health - nearest health centre/clinic to the TC - Name of health centre/clinic:</b>	
23.	Average time to reach the nearest health centre from the TC by different modes of transport (by gender and age)	Min
24.	Average no. of health workers at clinic each month for the past year (gender disaggregated)	No.
25.	Average no. of patients treated each month for the past year (gender disaggregated)	No.
	Is there an ambulance service available from the clinic to the district hospital?	
	<b>Agriculture</b>	
26.	What is the average no. of visits per month by an extension worker to the TC village?	No.
27.	Price of main cash crop produce in the District Centre (per kg)	Currency unit
28.	Price of main cash crop produce in the Trading Centre (per kg)	Currency unit
29.	Farm-gate price of main cash crop produce in the TC village (per kg)	Currency unit
	<b>Economic activities - non-farm</b>	
30.	Factories, local /cottage industries in the Trading Centre or nearby area.	Type & No.
31.	No. of shops / kiosks in the Trading Centre	No.

## Annex I. Questionnaire on Social and Economic Impacts of Road Maintenance

Name of the Country: .....							
Name of the District: .....		Date of data entry: .....					
Name of Surveyor: .....		<b>Trading Centres</b>					
General		Units	1	2	3	4	5
1	Name of Trading Centre (TC)						
2	Population						
<b>Transport Infrastructure</b>							
3	Distance of TC from the nearest paved road	Km					
4	Distance from District Centre (DC)	Km					
5	<b>Average travel time to DC (by dominant mode of transport)</b>	Min					
6	Name of the road serving the Trading Centre						
7	<b>How many days of the year is the road closed due to rains?</b>	No.					
8	<b>No. of worker-days per km of road maintained (gender disaggregated)</b>	No.					
9	<b>Road Condition Index (RCI)</b>						
<b>Availability and cost of transport</b>							
10	<b>No. of private transport operators serving the Trading Centre</b>						
10.1	Light vehicle	No.					
10.2	Bus/Minibus	No.					
10.3	Motorcycle (boda-boda)	No.					
10.4	Freight transport /trucks	No.					
11	<b>No. of available trips to District Centre per day (normal day)</b>						
11.1	Light vehicle	No.					
11.2	Bus/Minibus	No.					
11.3	Freight transport /trucks	No.					
12	<b>No. of available trips to District Centre per day (market day) - Optional</b>						
12.1	Light vehicle	No.					
12.2	Bus/Minibus	No.					
12.3	Freight transport /trucks	No.					
13	<b>Fares on public transport to the District Centre</b>						

13.1	Light vehicle	\$					
13.2	Bus/Minibus	\$					
13.3	Motorcycle (boda-boda)	\$					
14	<b>Cost of freight transport to the District Centre</b>						
14.1	Truck (...tons)	\$					
14.2	Light vehicle (...tons)	\$					
14.3	IMTs /motorcycle (...tons)	\$					
<b>Road safety &amp; Security</b>							
15	<b>No. of accidents on the road serving the TC for the past year</b>	No.					
16	<b>No. of theft incidents in the TC for the past year</b>	No.					
<b>Price of goods in the District Center &amp; Trading Centre</b>							
17	<b>Price of main cash crop produce in the District Centre per kg</b>	\$					
18	<b>Price of main cash crop produce in the Trading Centre per kg</b>	\$					
19	<b>Price of two main food items in the TC (e.g. maize, rice) per kg</b>						
19.1	<i>Item 1 .....</i>	\$					
19.2	<i>Item 2 .....</i>	\$					
20	<b>Prices of two essential commodities in the TC (e.g. sugar, salt) per kg</b>						
20.1	<i>Item 1 .....</i>	\$					
20.2	<i>Item 2 .....</i>	\$					
<b>Economic activities - non-farm</b>							
21	<b>No. of factories / local industries in the Trading Centre</b>	No.					
22	<b>No. of shops/kiosks in the Trading Centre</b>	No.					
<b>Optional Indicators - Education &amp; Health facilities within 1 km radius from the Trading Center</b>							
<b>Education- nearest school to the TC: Name.....</b>							
23	Average monthly pupil attendance rate for past year ( <i>gender disaggregated</i> )	No.					
24	Average monthly staff attendance rate for past year ( <i>gender disaggregated</i> )	No.					
<b>Health - nearest health centre to the TC: Name.....</b>							
25	Average monthly workers attendance rate - past year ( <i>gender disaggregated</i> )						
26	Average monthly patient attendance rate - past year ( <i>gender disaggregated</i> )						

## Annex J. An example of data analysis template

### A comparison of Baseline 2016 and Second Survey 2017 Data

Indicators / Name of Trading Centre		Kanakant.	Mpango	Kapete	Chilyab	Nchute	Mulalika	Mwalum	Lwimba	Chiyota	Soko B.
Distance from district centre (DC)	(Km)	20	22	6.5	30	40	45	29	20	42	28
Average travel time to DC - 2017	(Min)	20	35	13	45	60	80	60	60	45	90
Average travel time to DC - 2016	(Min)	20	22	13	60	60	80	55	40	45	20
No. of private transport operators serving the TC - 2017	No.	216	25	216	175	160	168	168	166	159	161
No. of private transport operators serving the TC - 2016	No.	216	125	216	175	160	168	168	166	159	161
Fares on public transport (pass-km) 2017	ZMK	5	25	5	10	25	25	30	35	30	25
Fares on public transport (pass-km) 2016	ZMK	5	5	5	10	15	25	30	50	60	65
Cost of freight transport to the DC (ton-km) - 2017	ZMK	150	300	150	300	300	1700	1700	1800	1900	2300
Cost of freight transport to the DC (ton-km) - 2016	ZMK	150	300	150	300	300	1700	1700	1800	1900	2300

Source of Data: Chongwe Municipal, Zambia

### Presentation of Results on a Bar Chart

