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DEPARTMENT OF TRANSPORT

NATIONAL TRANSPORTATION MASTER PLAN STUDY

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ROAD PLANNING AND BUDGETING IN NAMIBIA

A guideline for road planning and budgeting procedures

FINAL REPORT

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and SweRoad

ROAD PLANNING AND BUDGETING IN NAMIBIA

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ABBREVIATIONS

AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
BMS	Bridge Management System
CEO	Chief Executive Officer
CSO	Central Statistics Office
DOT	Department of Transport
EAADT	Estimated Annual Average Daily Traffic
GIS	Geographic Information System
GDP	Gross Domestic Product
GRN	Government of the Republic of Namibia
HDM	Highway Design and Maintenance Standards Series
IRI	International Roughness Index
MWTC	Ministry of Works, Transport and Communication
NDP	National Development Plan
NTAB	Namibian Transport Advisory Board
NTMPS	National Transportation Master Plan Study (This Study)
NZ	New Zealand
PMS	Pavement Management System
PSC	Planning Steering Committee
RA	Roads Authority
RFA	Road Fund Administration
RMS	Road Management System
RSA	Republic of South Africa
SADC	Southern African Development Community
TRL	Transport Research Laboratory

TSS	Traffic Surveillance System
URMS	Unpaved Road Management System
VOC	Vehicle Operating Costs

ROAD PLANNING AND BUDGETING IN NAMIBIA

Preamble

The Government of the Republic of Namibia (GRN), through its Ministry of Works, Transport and Communication (MWTC) has commissioned the Swedish Consultants KM International AB to undertake a National Transportation Master Plan Study (NTMPS). The preparation of procedures and instruments to be used by the Roads Authority and MWTC for planning and budgeting of works are included in the Terms of Reference of the Study.

The new Roads Authority will be required by legislation (in draft at present) to annually prepare Estimates of Expenditure for a one year and a five year plan to be submitted to the Road Fund Administration for its approval.

Based on the needs and requirements of the Road Fund Administration Bill and the Roads Authority Bill, the Consultant has designed the procedures and instruments (tools) for road planning and budgeting required by the Roads Authority.

This guideline, which together with a separate Economic Evaluation Manual contains the tools for long term (strategic) and short term (five year) planning and budgeting, has been prepared for use by planners in the Roads Authority, as well as in the Ministry of Works, Transport and Communication and the Road Fund Administration.

Apart from providing an uncomplicated, transparent and systematic approach on the use of information to support road planning, the guideline is intended to also create an awareness of long term needs and a culture of pro-active planning. This should ultimately aim at a long term balancing and economically efficient use of resources available in the road sector in support of the new road user charging system and the national goals.

The guideline in short comprises the following:

The new legislative framework for road planning and budgeting in Namibia
Goals and objectives to be considered in the planning process;
Description of the road planning process;
Review of the most important available parameters and statistics presently relevant to the provision of roads in Namibia;
Description of the preparation of short, medium and long term plans;
Illustration of plans by means of practical examples

ROAD PLANNING AND BUDGETING IN NAMIBIA

General

Purpose of this guideline

This guideline has been prepared with the purpose to be a framework for the planning process in the new road sector environment. It is intended to be a support to those who are involved in the actual planning work, but could also be part of the procedures agreement between the Road Fund Administration and Roads Authority. However, the planning principles brought forward are also valid in a broader perspective and could be used independently of organisational arrangements.

The new legislation pertinent to the Roads Authority and the Road Fund Administration provides primarily for short and medium term planning and budgeting. This guideline in addition covers long term, strategic planning.

The purpose of the economic road planning process is basically to facilitate the fulfilment of certain goals, strategies and principles and meet the financial requirements. Ultimately, the aim is to create long term stability in respect of goals and funding levels for the road sector. With reference to funding of the road sector, the new legislation requires that the main objectives for the management of the national road network are economic efficiency and safety. This means that any project or strategy to be implemented through the road user charging system must reflect those objectives. The legislation however also provides for co-funding of projects and programmes which do not fully meet the requirements of economic efficiency.

Legislation requires that the new planning environment in Namibia shall cater for the involvement of road users and other stakeholders in the planning process and shall also promote transparency. It is hence considered appropriate to make use of understandable approaches and tools.

The general view and philosophy of this guideline is that economic road planning and budgeting should be seen as an interactive process including both a top-down and bottom-up approach. The top-down approach deals mainly with the 'strategic planning' part, *i.e.* what to do, goals and targets (to do the right things) and how to achieve it, while the bottom-up activities are geared towards and focused on the 'short term planning and budgeting' part of the process (when and where to do it).

Furthermore, the top-down exercise should be seen as a national network level discussion and screening in order to assess the global long term sustainable funding level, and the bottom-up exercise is mainly a project identification phase using condition assessment and economic evaluation tools for project justification and ranking.

The bottom-up approach will be the main approach for the annual exercise of calculating the funds to be included in the one-year and five-year estimates. It will however, in the absence of a full-fledged Road Management System, be augmented

by and calibrated with the top-down approach. This in addition takes cognisance of longer term effects and needs, such as backlog and peak requirements in the construction and maintenance of roads, and loan repayments. Eventually, the top-down and bottom-up approaches must converge.

It must also be emphasised that this guideline has no intention to cover all aspects as to assessing and recommending standards and targets, but rather concentrates on the principles and the elements of the process and recommends some unsophisticated but feasible tools. Proposed standards, targets and tools should of course be re-evaluated and refined step by step with time, keeping in mind that the more sophisticated the tools, the higher the demand on data capturing and updating. It is also worth mentioning that tools should support decision making and not make decisions.

Terms of Reference

The Consultants are required to carry out a number of tasks to be seen as part of the work to establish and implement a methodology of planning. The complete text of the Terms of Reference is included in Appendix A. The following specific tasks are pertaining to this guideline:

Task 16: Develop procedures and instruments to be used by NamRoad (Now Roads Authority) for the planning of road construction and maintenance, including budgeting techniques

The proposed NamRoad (= Roads Authority in the new legislation) will be responsible for operating the state road network, including planning for its development. This network will be run on a self-financing basis through a revolving fund approach. Also the maintenance of roads under the local authorities will be financed out of the road fund, and NamRoad would be expected to assist these authorities in developing their maintenance requirements, as required.
NamRoad will only invest in roads which are economically justified, but would also be responsible for implementation of other roads, i.e. roads justified on other grounds. It would also be responsible for maintaining these other roads. The basic planning for roads not justified on economic grounds, would be undertaken by the Ministry and the funding of these roads would come from the Central Revenue Fund or donor sources. The Ministry would in addition be able to set the standards for road construction and road maintenance for different types of roads.

Within this framework, the Consultant is expected to develop and prepare the detailed design of all the planning tools and procedures required by the NamRoad, essentially to allow it to achieve the aim of minimising the overall cost of the existing road network in the long-run, including road user costs. In doing this, the Consultant is expected to make maximum use of the tools already available within the Ministry, but also to develop appropriate and effective methods to serve that purpose.

Task 18: Implement procedures and instruments to be used by NamRoad for the planning of road construction and maintenance, including budgeting techniques

The Consultant would be responsible for actually implementing these systems and procedures, including the training of staff. The end result of this work would be the full completion of all the budgets, short term and long term plans required by NamRoad to initiate operation, and would be done together with staff envisaged to be employed by NamRoad.

Task 21: Develop procedures and instruments to be used by MWTC for short term and long term planning

Taking into account the new institutional arrangements in the transport sector, the Consultant shall develop the procedures and instruments to be used by the Ministry for short term and long term planning, including methods for project identification, prioritising and appraisal. He shall also identify the manpower required to undertake this work within the Ministry in the future and make recommendations in this regard, including of training needs.

The requirements in the second sentence of this paragraph have recently been transferred to the Consultant implementing the Road Fund Administration and the Roads Authority.

The planning process and political goals - introduction

Road planning should be seen as a process and not as a discrete event. In most countries there is a link between technical and political levels as well as a link between road administrators and road users. However, over the years a large number of countries, particularly in Sub-Saharan Africa, have experienced severe problems in their efforts to ensure timely and efficient funding of the road sector. Part of the problems are to be found in the bureaucracy problems inherent in the political process, constraining efficient planning and timely funding of road infrastructure. An increasing number of countries, one of them Namibia, are therefore shifting over to a new process whereby more direct links are established between the road users and the bodies responsible for the management and funding of the road infrastructure. Political influence is however still ensured through the new legislation which will form the framework for road planning and funding.

The Government of the Republic of Namibia has through its National Planning Commission produced a Development Planning Manual for Namibia (Volume I and II, July 1994). The Manual covers the general principles and techniques of economic planning and is recommended to be used as a general guide to development planning in Namibia.

The Manual will consequently be applicable and useful for the preparation of the strategic National Transportation Master Plan. It will also give input to the preparation of short and medium term road planning.

With reference to the Manual, planning can generally be defined as:

"a continuous process which involves decisions, or choices, about alternative ways of using available resources, with the aim of achieving particular goals at some time in future"

At certain stages e.g. during the assessment of quality and quantity standards, it is important to consult and inform various stakeholders, and regional and district levels in the Roads Authority, in order to seek acceptance for the proposed levels of services. This calls for a planning process and planning tools that are simple enough to be understood by stakeholders and thereby can accommodate accountability, acceptability and transparency.

In this guideline the road planning process is divided into three phases, strategic planning, programming and budgeting. Those phases are interacting to a large extent and should rather be seen as a continuous process. These three phases are intended to result in:

a long term plan - the National Transportation Master Plan - the strategic plan aiming at year 2012
a five-year plan - the medium term tactical plan (a five-year programme, to be revised annually) and
a one-year plan - the annual budget

Appendix B contains a list of relevant references reviewed in the preparation
of this guideline.

The new budgeting process

Sources of funds

There are two main sources of funds for the national road system of Namibia, namely:

revenues raised through the road user charging system and deposited in the Road Fund, and which will constitute the major source of funds for roads; and
Parliamentary appropriations which will be budgeted on the budget of the Ministry of Works, Transport and Communication and deposited in the Road Fund as a transfer payment.

The revenues raised through road user charges will be utilised to finance the so-called “economically justifiable” part of the national road network, *i.e.* the part with sufficient traffic to justify costs on the basis of the savings in the total vehicle operating costs which would result from expenditure on the road infrastructure. The above reflects the “user pay principle”, which in turn has the implication that the “ payer should benefit” from such payment. Road user revenues may therefore only be utilised if, and to the extent that, road users will benefit. The major share of the expenditure on the national road network will be spent on this part of the network.

The remaining part of the road network comprises those roads which have such low traffic volumes that they are “uneconomical” if the economic efficiency criterion is strictly applied. Where the provision of such roads is regarded as necessary in the national interest to improve accessibility to particular areas or regions they will be constructed using funds provided through Parliamentary appropriations, donations or other sources. This type of road is often called “social roads”. They will not be constructed out of road user revenues or only to the extent that they benefit road

users directly. The minimum maintenance standards of such roads, to ensure accessibility, will be determined by the Minister responsible for Transport.
The cost of such minimum maintenance will be financed from the Road Fund through revenues generated from road user charges since it is expected to represent only a very small portion of total expenditure on the national road network.

Other possible sources for funding of roads are grants or donations for road development. Such funds will likely only be received for the "social" type of roads mentioned above. They will generally be expected to be included in the Ministerial budget together with Parliamentary appropriations.

The funding and budgeting process

The funding and budgeting process to be followed by the Road Fund Administration (and the Roads Authority) is a two phase process. It is a "bottom-up" process initiated by actual needs for improvements or maintenance activities throughout the road network. Although legislation provides for allocation of an amount of funding, it does not imply that there is a certain annual amount of money available to be spent on the roads.

In the first phase individual projects or programmes are identified and screened for evaluation in terms of their economic viability. Costs and benefits related to the road users are taken into account. The actual evaluation of the projects and programmes will be done by consultants, the Roads Authority or sometimes MWTC staff in accordance an agreed and standardised methodology. The Road Fund Administration must scrutinise and approve such evaluation as a basis for decisions on the amount and manner of funding through the Road Fund. When all projects and programmes have been evaluated and an "amount of funding determination" has been made for each, the accumulative amount of funding required for economically justified projects or programmes is determined.

At this point the process of matching revenue and expenditure within a short, medium and long term planning scenario is started. This is referred to as determining the "manner of funding" and is the second of the two phases of the process being followed in terms of the new legislation. Typically the approach will be to first set aside funds for annual recurring expenditures such as road maintenance, expenditure on ongoing road projects commenced in earlier years and other contractual commitments such as repayment of long term loans. It should be noted that the annual road maintenance expenditure level is expected to be reasonably stable in real terms from one year to another (with some allowance for increased traffic and expansion of the network).

Since it might not be practicable to implement all economically viable projects immediately, the balance of the funds annually available from the existing levels of road user charges is then weighed against the funding required for the approved new road projects as determined in the first phase. Adjustment of the level of charges then needs to be considered.

It is clear that the whole funding process can only be effectively managed if a long term perspective is adopted. This will be done through a National Roads Master Plan which needs to be updated regularly in order to ensure that backlogs are eliminated and that funds for road projects are ensured in a longer term. Legislation also

requires adjustment in the level of charges to comply with a principle of stability, which may be impossible without such perspective.

The Road Fund Administration will, however, only provide annual project allocation details for the ensuing five year period in a “five year plan”. Amounts falling after the first five years will be shown as future expenditure in such a plan.

The first year of any five year plan will be known as a the annual budget or “one year plan” and will be distinguished from other years in a five year plan in that the amounts shown as allocated to particular projects and programmes are “approved” for expenditure in the relevant year. It is however evident that the expenditure on those projects during following years will also be secured since they will then be regarded as “ongoing projects”.

Road Sector Goals

The road sector goals contained in the policy and planning documents referred to hereunder need to be reviewed to reflect the requirements of new legislation concerning the provision and financing of roads. These national goals, however, are still applicable and of great importance when the need for “social roads” is being considered.

White Paper on Transport Policy

The White Paper on National and Sectoral Policies quoted in the White Paper on Transport Policy (DOT 1995) include *inter alia:*

> *”(i) sustained socio-economic development aimed at*
>
> a) *the eradication of poverty and the concomitant provision of better living standards for the people of Namibia*
> b) *narrowing the income gap*
> c) *facilitating agricultural and industrial development and other productive activities that will increase national income and reduce unemployment*
>
> *(ii) optimum utilisation of scarce resources”*

The White Paper considers the promotion of efficiency (optimum utilisation...) to be the primary goal to create the economic growth necessary for the secondary goals connected to equity (sustained socio-economic development).

The White Paper continues to advise that the means to achieve efficiency is by promoting competition in the transport sector. This is achieved by providing a regulatory framework which also takes into account environmental effects and safety.

Concerning the secondary goals of equity, the White Paper argues that these are primarily achieved outside the transport sector.

First National Development Plan (NDP1) - 1995/1996 - 1999/2000

The First National Development Plan (National Planning Commission 1995) lists four National Development Goals.

1 *Reviving and Sustaining Economic Growth*
2 *Creating Employment*
3 *Reducing Inequalities in Income Distribution*
4 *Reducing Poverty*

For each one of these goals a number of targets are set. For example the GDP growth target for the period 1995 to 2000 is set to 5% per year.

Of interest for the transport sector is the target to diversify export and import markets to reduce the share of trade with South Africa. No absolute target is however given.

The overall transport sector goal is to:

> *ensure the availability of safe, effective and efficient transport services in the different transport modes.*

This goal is broken down into:

> *ensure that transport infrastructure is provided effectively and efficiently.*
> *ensure that transport services are operated efficiently.*
> *ensure that quality standards in transport are achieved and maintained.*

Furthermore it is stated that

"*The Government is committed to redressing previous imbalances in the distribution of transport infrastructure and to giving high priority when considering new road projects to areas previously under-served."*

In chapter 20 (NDP1, pp 297-318) on Transport & Communication the Department of Transport policy on effectiveness is explained (Box 20:1 Balancing Infrastructure and Vehicle Operating Costs to Optimise Total Transport Costs):

> All road projects - new roads, upgrading from gravel to tar - should be analysed in respect of their costs and benefits
>
> The expected volume and type of traffic on a particular road is the major determinant of the level to which the road should be constructed and maintained. Local conditions which affect costs - such as the quality of construction materials, the distances to quarries, the efficiency of maintenance operations, the cost of equipment and labour and weather conditions - can influence decisions about roads in specific areas.

Corporate plan 1996, MWTC

A more recent policy paper is the Corporate Plan of the Ministry of Works Transport and Communication (MWTC 1996). The overall goal is formulated

> *"To ensure that the inhabitants of the country have access to a safe road infrastructure optimally constructed and maintained in accordance with the prevailing traffic volumes in any particular part of the country, and that safe, cost-effective and efficient road transport services are available for the conveyance of passengers and goods."*

The implications of the strategy are listed as a number of long term and short term activities. It is also mentioned that a road user charging system and a dedicated road fund is to be implemented. These activities are related to the restructuring of the Ministry under the MWTC2000 Project.
There are also policy statements by the Minister reiterating the need for involving the private sector in provision of services.

Of interest to the Ministry is, when

> *" developing long and short term strategies and plans of action, as well as when determining day-to -day routines, that these be determined keeping in mind the need to involve stakeholders and that such strategies, plans and routines should be client-oriented and transparent in their formulation".*

Relevance of existing goals to the Roads Authority

National goals are declared by democratic governments to confirm to the public its mandate in a transparent way. Such goals explain Government's long term vision and allows public auditing to assess how successful Government is in achieving these declared goals.

The activities of the Roads Authority (RA) are guided by the Roads Authority and Road Fund Administration (RFA) Acts (presently in draft format) which have been prepared in consideration of Government's national goals and policies in general. This new legislation focuses strongly on safety and economic efficiency at project and programme level. It also contains very specific processes which must be followed (See Section 1.4) and which inevitably have preference over declared general national goals. In order to conform to this legislation and to guide its management the RA will have to prepare its own corporate plan in which its core functions are formulated, based on commercially-driven principles. Projects currently listed in the NDP1, which have not been constructed yet, will hence have to be re-evaluated in terms of the requirements of the new legislation.

The new legislation, however, also provides for projects and strategies which will be initiated from a socio-economic or strategic point of view, the so called "social roads". The national goals will from part of the basis for the evaluation and funding of such projects or strategies. The construction of these roads will essentially be dependent on funding from other financial sources than the Road User Charging System but may be co-financed through that system to the extent which such roads would benefit road users. The Roads Authority, as official road agency of MWTC, will be responsible for the construction and maintenance of these roads.

The general public will in addition submit requests for projects through the Roads Boards or directly to the RA for proclamation, construction and maintenance of roads. The RA will have to determine the economic viability of such proposals and, when found not viable, assess their importance in terms of the national goals before submission thereof to the MWTC for rejection or acceptance.

Organisations involved - responsibilities and expected participation

Ministry of Works, Transport and Communication, the Roads Authority and the Road Fund Administration.

The three main bodies which are involved in the road planning process are;

Ministry of Works, Transport and Communication (MWTC), Department of Transport (DOT)
the Roads Authority (RA) and
the Road Fund Administration (RFA).

MWTC represents the owner of the national road network. The RA has the responsibility to manage the national road network and is also responsible for all planning activities within the road sector. The RFA is the financing body representing the road users. Legislation requires the RFA to employ sound economic principles when approving funds for the management of the national road network.

The RA will evaluate the long term objectives which can be derived from various goals and suggest strategies, standards and funding levels which may later be incorporated in e.g. a National Transportation Master Plan.
The RA shall annually submit one year and five year estimates of expenditure to the RFA for their approval and financing. Only projects or programmes which are found economically feasible will be fully financed by the RFA.

The Minister responsible for Transport may (Roads Authority Act, 1998, Article 21), after consultation with the RA, make regulations in relation to minimum standards for the construction and maintenance of the roads comprising the national roads network, including such standards which are necessary to ensure a safe road system. Minimum standards for the maintenance of roads which in the opinion of the Minister are reasonably necessary in the national interest in order to improve accessibility to any area in Namibia, will also be financed by the RFA, whether economically feasible or not.

Furthermore (Road Fund Administration Act, 1998, section 14 (3)), the Minister may enter into an agreement with the RFA about co-funding of any road project or programme. Such road projects will be referred to as “social roads” in this guideline (See also section 1.4 and sub-section 1.5.4).

Road user demands - the involvement of stakeholders

Road users are customers and should be treated as such. It remains however to be determined who the stakeholders are. In the NPD1 the stakeholders are other Ministries, the Association for Local Authorities in Namibia, various road user groups and the road transport industry. In addition, transport-dependent industries and chambers of commerce can be identified. The attention to stakeholders is also given in the MWTC Corporate Plan.

There are different levels at which these groups can be involved. It must be determined at what stages in the planning process the stakeholders will be involved.
The stakeholders should be consulted in terms of the new legislation and be given the opportunity to comment on the planning process. In particular, groups who may be worse off after the transition from the present planning system to the future system must be approached at an early stage. If there is no acceptance for the system of planning it will be difficult to get acceptance for the plans which are being produced within that planning system. Although the new legislation does not require approval or acceptance of the new planning system, the inclusion of the requirement to consult with stakeholders certainly emphasises an objective of transparency and to obtain advice. The envisaged new planning system should therefore at least be successfully explained and motivated to stakeholders.

There are in broad terms two categories of stakeholders in Namibia. The first group represented by the Roads Boards and the Namibian Transport Advisory Board (NTAB) is regulated by law and must be consulted as prescribed.

The following groups and organisations can also be considered as stakeholders:

Road Safety Council
Local Authorities
Namroad (=truck operators’ association)

Taxi Association
Other motorists, operators and transport buyers organisations
Chambers of Commerce
Automobile Association of Namibia (AA)

It may however be noted that the interests of most of those groups are already being taken care of through the Roads Boards and NTAB.

According to the RFA Bill, the "Minister responsible for Transport" shall determine which parties should be consulted. It is likely that NTAB would be the appropriate forum for consultations on central level. On regional level the Roads Boards would be an appropriate forum, however with some changes in the current representation. Such changes must be provided for in an amended Roads Ordinance.

There should also be a standard agenda in respect of road planning which could include e.g. the review and advice on proposed

- quality and quantity standards
- minimum maintenance standards
- traffic safety issues
- strategic development projects
- road user charges - value for money

Summary of recommendations in Section 1.6

It is recommended that the Minister responsible for Transport determines that the Namibian Transport Advisory Board be the appropriate forum for consultations with stakeholders on national level.
It is further recommended that the Minster determines that the roads Boards shall be consulted on regional level

The planning cycle - a tentative timetable

General

The Road Fund Administration Act, Section 15 "Manner of funding", states;

15.(1) The Administration shall, in determining the manner in which the amount of funding referred to in section 14(1) shall be made available, have regard to -

a) *the estimated income through the road user charging system;*

b) *the maintenance of a reasonable stability in the levels of road user charges, in real terms, in the short, medium and long term;*

c) any moneys accruing to the Roads Authority or any approved authority from any source other than under this Act and the estimated value of any asset, equipment, human resources and other relevant resources which are or will in all probability be at the disposal of the Roads Authority and which may effect the making of an allocation.

(2) The Roads Authority and every other body or authority entitled to an allocation from the Fund by virtue of section 19(1) shall, at least four months before the commencement of each financial year in such form as may be determined by the Administration, submit to the Administration estimates of income and expenditure duly prepared in accordance with the rules and principles, referred to in section 14(2), and which shall contain, in respect of the ensuing financial year and the ensuing five financial years, respectively, such particulars as may be required by the Administration relating to-

a) each project or programme which the Roads Authority and every approved authority proposes to undertake, including the estimated total cost of that project or programme and the cost of contingencies and administrative expenditure relating to such project or programme;

b) each project approved in any previous financial year and which is to be continued in the next financial year or in any of the five financial years;

c) the estimated administrative expenditure of the Roads Authority, including the cost of contingencies, to the extent that such expenditure was not included in the cost of a project or programme contemplated in paragraph (a); and

d) any factors, including environmental factors, which may affect the implementation of the one year and the five year plan concerned and the measures which will be taken to ensure execution of any such plan,

(3) The Roads Authority and every approved authority shall, before submission of each estimate contemplated in subsection (2), consult with such parties as the Minister responsible for Transport may determine.

(4) The Administration shall, after evaluation of every plan submitted to it in terms of subsection (2) and after consultation with the Roads Authority and every body or authority referred to in that subsection-

(a) approve, with or without amendments, or reject any proposed project or programme or administrative expenditure referred to in that subsection; and

(b) determine the amount of funding to be made available to the Roads Authority and every body or authority referred to in subsection (1), in respect of every project or programme or administrative expenditure approved in terms of paragraph (a) of this subsection,

and include the particulars of such approval and determination in a one year and a five year plan prepared in terms of section 16(1)

(4) The particulars of any project referred to in subsection (2) (b) shall, for the duration of the project, be included in every estimate of expenditure in respect of the ensuing financial year and funded in accordance with the terms on which it was originally included in the relevant estimate of expenditure and income in respect of the ensuing five financial years, unless the Administration and the Roads Authority or the body or authority concerned agree otherwise.

Section 16 "Plans" reads;

16. (1) The Administration shall at least two months before the commencement of every financial year prepare a one year and a five year plan which shall contain particulars and, where appropriate, a review and analysis of the following in respect of the ensuing financial year and the ensuing five financial years, respectively;

(a) the allocations in respect of expenditures referred to in section 19(1) and which shall include particulars of any project, programme or administrative expenditure contemplated in section 15(4);

(b) the estimated amounts of moneys accruing to the Fund in terms of section 18(1);

(c) the proposed levels of road user charges;

(d) any factors which may affect the implementation of the one year and the five year plan concerned and the measures which will be taken to ensure the effective execution of any such plan

(2) The Administration may from time to time during the course of a financial year, amend the one year and the five year plan referred to in subsection (1) in order to adapt any such plan to accommodate a change in circumstances or any new considerations.

(3) The Administration shall, immediately after finalization of every one year and five year plan or any amendment to that plan, forward the plan or the amendment to the Minister.

(4) Notwithstanding subsection (2), the Administration shall not amend an allocation in a one year plan or introduce a new allocation in such plan, without having regard to its implications for the Fund in the relevant financial year and unless the prescribed conditions and procedures have been complied with.

(5) The Administration shall, before the finalization of any one year or five year plan or any amendment to that plan, consult with such parties as the Minister, in consultation with the Minister responsible for Transport, may determine.

> *(6) A one year and a five year plan and any amendment to that plan shall be available for inspection at the office of the Administration and shall, subject to the directions of the Minister, be published, in such form as the Minister may determine, in at least two daily newspapers circulating nation-wide.*
>
> *(7) The failure of the Administration to comply with any provision of a one year or a five year plan or any amendment to that plan shall not affect the validity or enforceability of any act, agreement, right, obligation or liability performed, entered into, acquired or incurred by the Administration.*

The planning and budgeting process described in the new legislation is in principle a bottom-up exercise. Projects and programmes are generated on the basis of actual information on the road network and the traffic using it. However, unless and until the Road Management System is able to generate sufficient data to support long term decision-making, a top-down exercise will dominate strategic planning.

As an intermediate measure - in the absence of a full-fledged RMS -when introducing the new planning and budgeting process a combination of top-down and bottom-up however seems appropriate, as discussed under Section 1.1. The requirements of a RMS relevant to this guideline are commented on in Chapter 6, Further work.

The financial year commences in April each year. According to the RFA Act, the RA should submit to the RFA, estimates of expenditure not later than four months (which means end of November) before the commencement of the financial year.

In order to be able to go through all the steps that are required before the estimates can be submitted, the RA must therefore initiate the annual planning process at an earlier point. It is imperative to make clear to all parties involved that the planning process is not an annual event, but rather a continuous process with an annual cycle. A time schedule similar to the following should be established for each annual planning process (the activities are briefly explained in the subsections below):

Activity	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***
RA initiates planning	X											
Directives to RA regions	X	X	X									
Info. to stakeholders	X	X	X	X								
Feedback fr stakeholders			X	X	X							
RA data coll. /planning	X	X	X	X	X	X	X	X	X	X	X	X
MWTC requirem to RA				X	X	X	X					
RA regions need to RA				X								
RA Head Office estimates and budget preparations				X	X	X	X	X	X	X		
RA estimates to RFA						X						
Tentative alloc to regions							X					
RA regional budgeting							X	X	X	X		
RFA final alloc. to RA								X				
RA final alloc. to regions									X			
Evaluation previous year											X	X

Legend
Shaded boxes indicate RFA Act requirements

Initiation of the planning process

As can be seen in the schedule above, the RA ought to initiate the annual planning process not later than in June. Otherwise it will be difficult to be able to present to the RFA the estimates of expenditure for a one year and a five year plan before the end of November (Section 16, RFA Act).

It is recommended to establish a Planning Steering Committee (PSC) within the Roads Authority in order to facilitate the preparation of estimates to the RFA. The PSC should preferably include participation from not only the planning department/section but also from e.g. maintenance, construction, contracting, design and finance departments or sections.
The regional level of the Roads Authority should also be represented. The possibility to include a representative from the stakeholders at central level needs to be addressed.

Before the Chief Executive Officer (CEO) of the RA approves the final directives to the RA departments for the estimates of expenditure for the next one year and five year plan, the PSC shall assist the CEO by analysing and concluding the evaluation of previous year's follow up and then determine if the current goals, strategies and objectives are relevant for the next plan period or need to be re-assessed.

It is then recommended that the PSC compiles a preliminary estimate for the purpose of forming an indicative estimate for road maintenance for the network level. This estimate should as near as possible reflect the fund level required to satisfy the needs according to the established planning standards and targets for the various programmes.

Directives to the road maintenance regions - inventories and costing

Comprehensive directives for the estimates of expenditure should be issued by the 'Director of the Planning Department', or its equivalent after consultations in the PSC. The directives concerning the responsibilities of the road maintenance regions should be communicated not later than in August. These directives should include detailed instructions on the interpretation of objectives and targets for each programme, the required inventories and condition surveys for each of the various programmes, and the cost data to be collected and compiled.

This guideline together with the forms available in Appendix F could be used to support the exercise.

Information to stakeholders and feedback to roads authority

The stakeholders involved in the planning process should represent the road users and the transport industry in Namibia. It is therefore important to seek acceptance for existing road planning goals, strategies and objectives or any change thereof.

Before issuing the final directives, it is hence advisable to consult the Namibian Transport Advisory Board for their review and possible comments. The Roads Boards should also be given the opportunity to comment. Since time is rather restricted, this could possibly be done through a circular format.

MWTC's requirements

Any road project or maintenance programme for which the RFA has entered into a funding agreement with MWTC (funds to be appropriated by Parliament or donors) should be presented to the RA for inclusion in the estimates of expenditure for the one year and the five year plan. MWTC should be requested to submit such projects not later than in December.

Estimates from regions

In September, the RA regions should submit their estimates of expenditure based on the results from the inventories and the subsequent calculation of the

corresponding needs (optimum requirements). Any financial requirement for on-going projects should be included and provided for in the relevant programme proposal.

Roads authority (Head Office) estimates

With all necessary information available and summarised it will now be the responsibility of the PSC to organise the preparation of the compiled nation-wide estimates of expenditure for the one year and the five year plan. It is likely that the estimates representing the 'optimum needs' cannot always be met by the RFA, due to the requirements that the road user charges must be kept stable and that year-to-year budgets will have to be smoothened if necessary. Hence, it is important to have a strategy to handle fluctuations in funding in order to minimise the impact on the management of the national road network. This should preferably be done according to an in advance prepared prioritisation model. The model could also be used to analyse the consequences of different funding levels, if necessary. The nation-wide estimates shall be submitted to the RFA not later than end of November.

Road fund administration final allocations

It is expected that the RFA will allocate funds for the ensuing financial year and indicate the fund allocations for the ensuing five financial years in a one year and a five year plan respectively, not later than end of January.
Awaiting the final allocations, it is recommended that the RA works out tentative internal fund appropriations to the road maintenance regions, for those non-project related programmes which will be executed on regional levels.
The provisional appropriations should be based on the estimates submitted to the RFA and should be communicated to the road maintenance regions not later than December.

When the final allocation from the RFA is announced, the final regional appropriations can be made. The road maintenance regions are then expected to work out their detailed annual budgets before end of March.

Evaluation of follow-up information

It is very important to have access to a well functioning and reliable management system for follow-up (the current MMS follow-up system needs some adjustment to the new environment with all work being accomplished on a contract basis in future).

As soon as the compiled follow-up information from the previous year is available, it should be presented and discussed in the PSC. Based on the results from the evaluation, the PSC should recommend corrective measures to be considered for the next planning cycle. The evaluations and information should be adapted so as to facilitate the requirements of the annual report to be submitted to the Minister responsible for Transport.

Summary of recommendations in Section 1.7

- **Establish a time schedule for the annual planning process**

- **Establish a Planning Steering Committee in the Roads Authority**

The national road network

Road classification, road types and traffic volumes

Current road classification

In Namibia there is a distinction between proclaimed roads and unproclaimed roads, where only the former are part of the public road system. The four categories of proclaimed roads - trunk, main, district and farm roads - are defined in the existing Roads Ordinance (Ord. 17 of 1972); "The Minister may-

- declare a proclaimed road which is or will be part of the road system connecting Namibia as a whole with surrounding territories, to be a trunk road
- declare a proclaimed road which connects or will connect important centres within Namibia to be a main road
- declare a proclaimed road which carries or will carry a reasonable amount of traffic to be a district road
- declare a proclaimed road which it considers important enough to be a farm road."

The above definitions fit well into the current international practices, where trunk and main roads from a functional point of view would in general correspond to arterial roads, district roads would correspond to collector roads and farm roads would correspond to access roads (Some overlapping allowed within district and farm roads).

However, in the Roads Authority Act the "national road network", which should be managed by the Roads Authority, has been defined as the road network consisting of every trunk road, main road and district road proclaimed in terms of Chapter III of the Roads Ordinance, including any such road situated in a local authority area.

It is a road planning task to regularly reconsider the classification of those roads, the function or traffic pattern of which has changed to such an extent that they are not consistent with the classification system anymore.

Road lengths

The following tables explain the road lengths related to estimated traffic volumes (ADT)[1] 1997.

[1] On the issue of EAADT, AADT or ADT: When a traffic volume on a specific road is quoted, it should be indicated whether this is an EAADT, AADT or ADT (determined over any period less than a year). However, when using traffic volume as a criterion or a factor in determining an action to be taken, the general use of ADT should suffice. On some roads, the ADT will then be used; on other the EAADT or even AADT, depending on the sophistication of traffic counting performed on the roads involved. For planning purposes the ADT will be adequate.

Road class	ADT 1-200 km	ADT 201-1000 km	ADT 1001-2000 km	ADT >2000 km	Total km
TRUNK	484	2698	686	125	3993
MAIN	9198	360	35	2	9595
DISTRICT	27220	15	0	0	27235
TOTAL	36902	3073	721	127	40823

Table 2.1.1: All road types

Road class	ADT 1-200 km	ADT 201-1000 km	ADT 1001-2000 km	ADT >2000 km	Total km
TRUNK	400	2400	686	125	3611
MAIN	1036	188	35	2	1261
DISTRICT	73	15	0	0	88
TOTAL	1509	2603	721	127	4960

Table 2.1.2: Bitumen roads

Road class	ADT 1-20 km	ADT 21-50 km	ADT 51-100 km	ADT 101-200 km	ADT >200 km	Total km
TRUNK	0	0	67	17	298	382
MAIN	2076	4017	1524	545	172	8334
DISTRICT	23668	2077	1015	387	0	27147
TOTAL	25744	6094	2606	949	470	35863

Table 2.1.3: Gravel roads*) (incl. 172 km salt and 7898 km earth roads).

*) *N.B. The term 'gravel roads' used in this guideline also includes salt roads, non-engineered gravel roads and earth roads (tracks).*

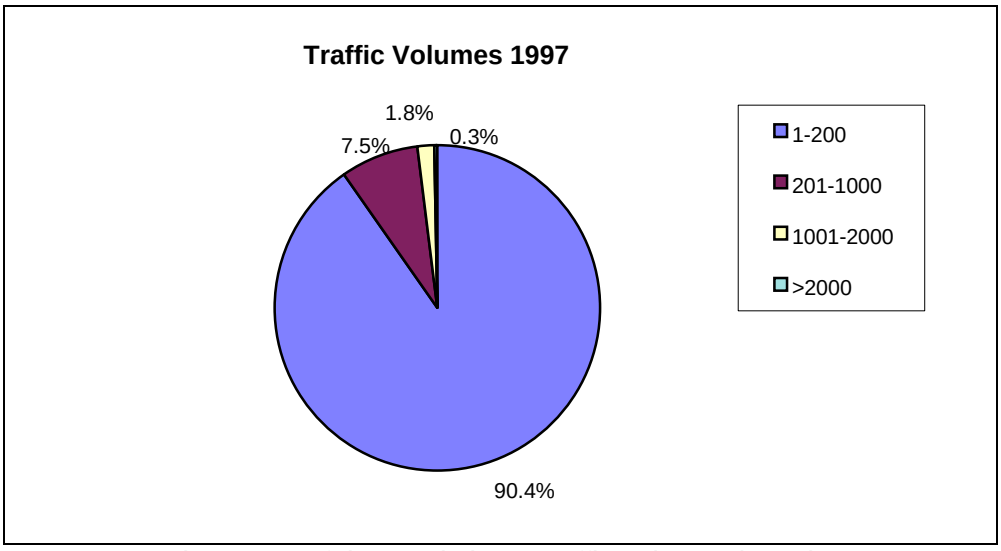


Figure 2.1.4: More than 90% of the roads have traffic volumes less than 200 vehicles per day.

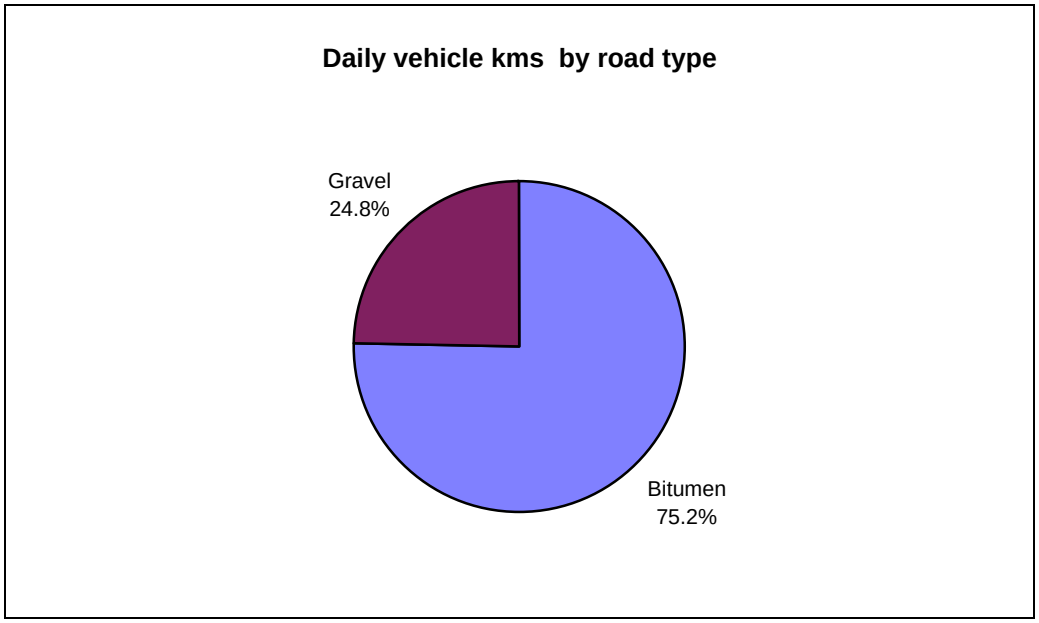


Figure 2.1.5: More than 75% of the driving is made on the bitumen roads, which constitute less than 15% of the entire road network.

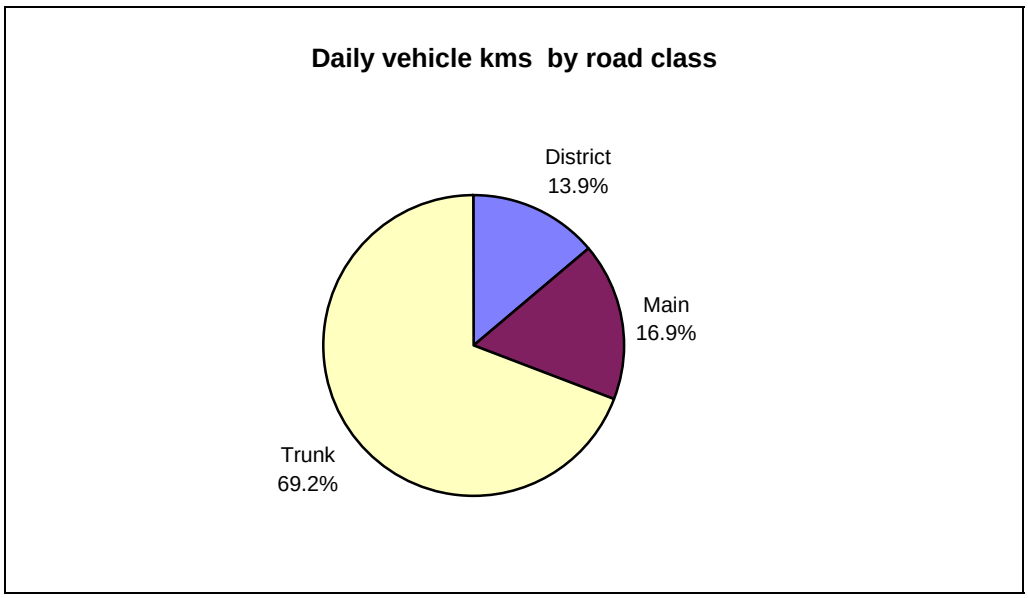


Figure 2.1.6: Less than 15% of the driving is made on the district roads.

Maintenance expenditure distributed on road types

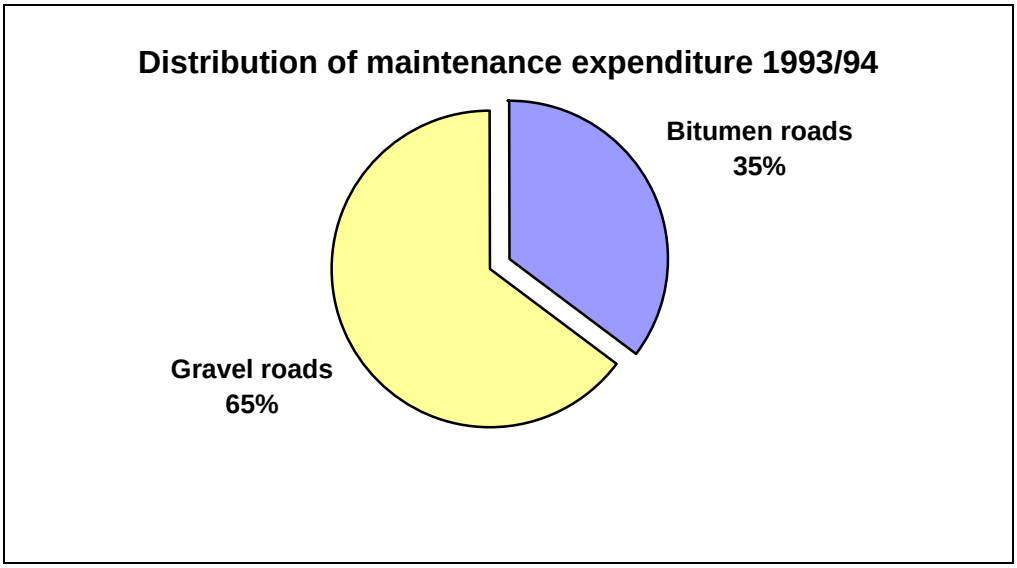


Figure 2.1.7: The gravel roads consume about 2/3 of the total annual maintenance fund, but only 25% of the driving is done on these roads. However, the gravel roads are by length more than 85% of the entire road network. A minimum standard reflecting minimum safety needs will have to be ascertained for the low-volume roads. Applying too ambitious maintenance standards on these roads could namely jeopardise the adequate funding of the more important bitumen maintenance.

Traffic forecasting

Road planning should focus on the future needs in the road transport system. It is therefore of great importance to try to forecast traffic growth and possible changes in traffic patterns. It is assumed that traffic growth will be faster than economic growth. Historically this is proven in Namibia as well as in other growing economies with comparatively low car ownership. Data from ten permanent traffic counting stations and 104 ad hoc stations indicate that the traffic growth has been about 6% annually during the period 1985-1995. A traffic forecast prepared by the NTMPS for the period up to the year 2012 indicates an increase between 6% and 8% annually, with the higher growth rate probably to be more significant for heavy vehicles. The consequences on wear and tear (routine and periodic maintenance) in general as well as upgrading of the design standard on certain links of the road network should be provided for in the estimates of expenditure for the one year and the five year plan.

This can be done by calculating the fund requirements for maintaining a road network corresponding to the forecast traffic volumes. The figure below illustrates the result of a 6% annual growth in traffic volume for ten years.
A more detailed traffic growth table is contained in Appendix C.

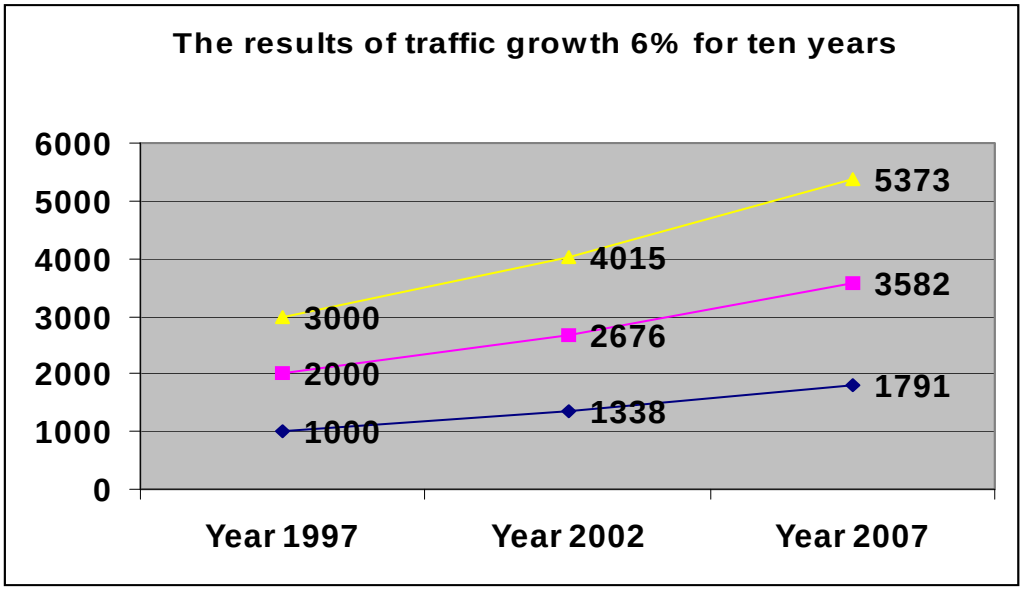


Figure 2.1.8: Traffic growth (compound) by 6% annually. Divide by ten for traffic volumes 100, 200 and 300 ADT.

Today 850 km of roads (all bitumen) have a traffic volume > 1000 ADT, of which only about 125 km >2000 ADT. In the year 2007 most of the 850 km will have a traffic volume>2000 ADT, that is almost seven times the 125 km of today.

The present standard of the national road network

The current standards of the road system in relation to the traffic volume it accommodates will be the major determinant for the assessment of needs in terms of routine maintenance, periodic maintenance and improvement of capacity in the road transport system. These standards will in terms of the new legislation, where possible, have to be determined based on the benefits it generates to road users. The following tables and graphs illustrate the actual situation and may be seen as indicators for tentative needs. Details on administrative and geographic aspects on road network statistics are given in Appendix D. In relation to the vehicle km travelled, it is understandable that the high level of service on most gravel roads which has been provided to date, has been questioned.

Road types and road classes in relation to traffic volume

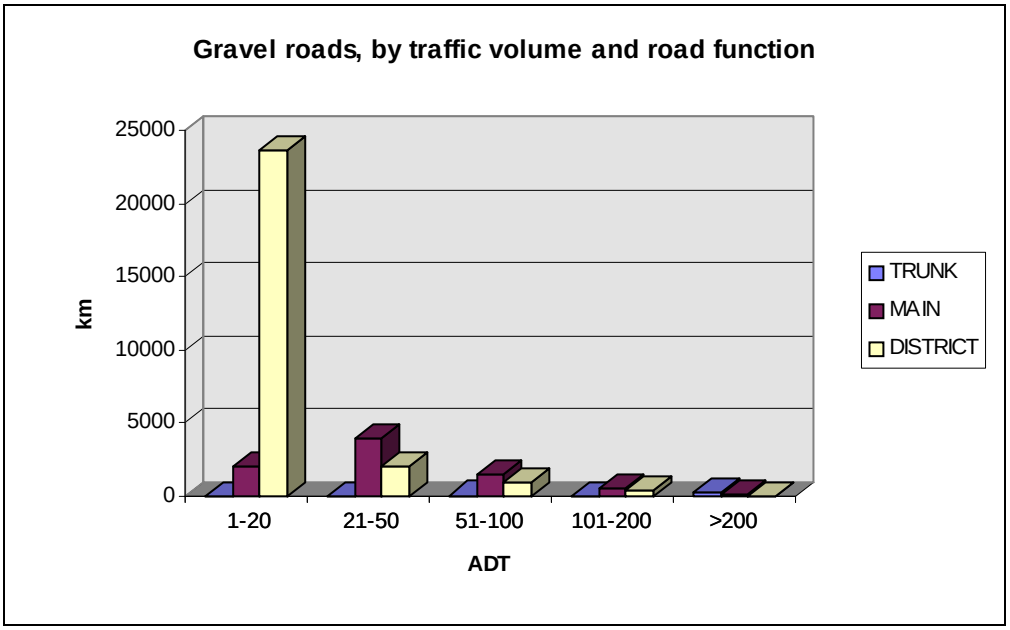


Figure 2.2.1: Almost 26,000 km (72%) of the gravel roads have a traffic volume less than 20 ADT. Very few gravel roads carry traffic volumes > 100 ADT

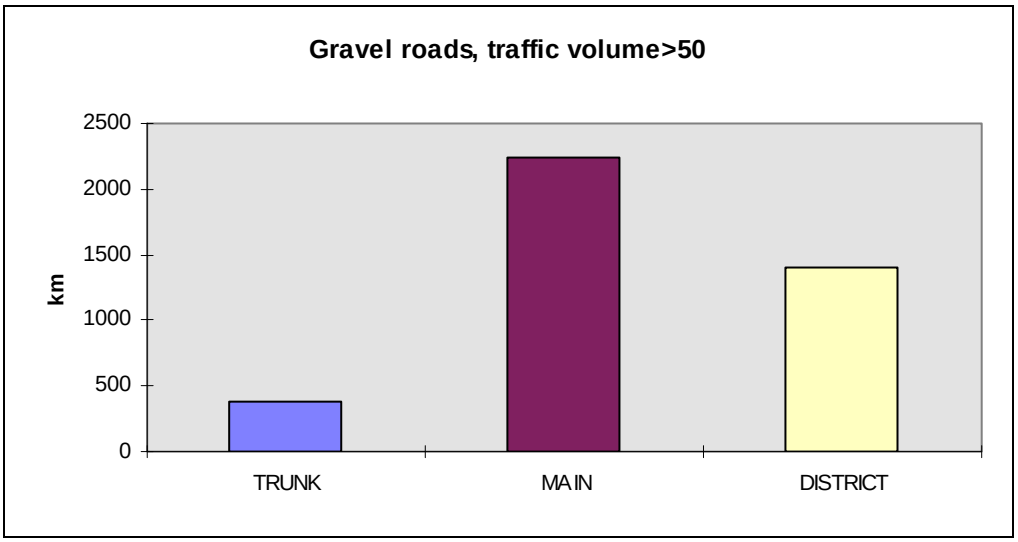


Figure 2.2.2: About 4000 km (11%) of the gravel roads have a traffic volume >50 ADT.

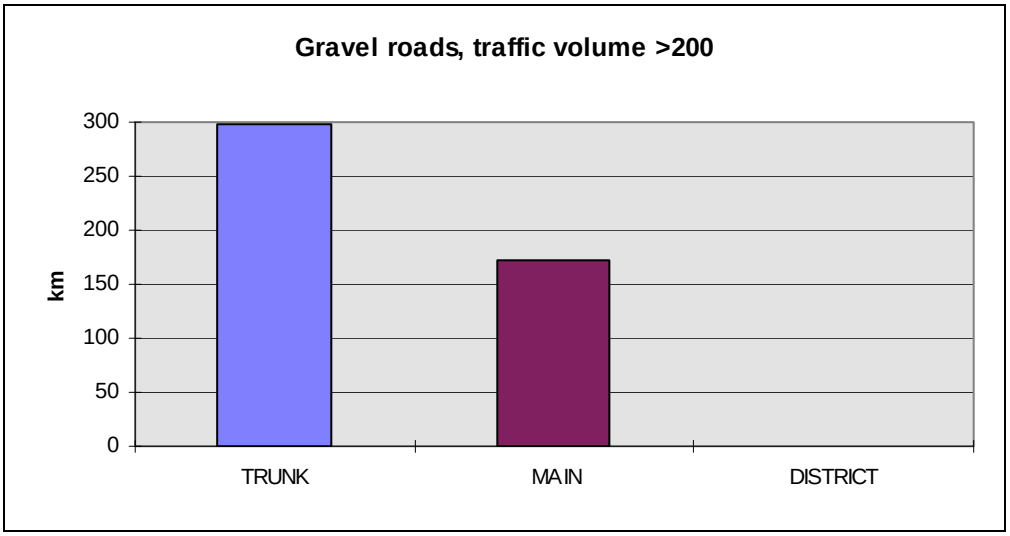


Figure 2.2.3: 470 km (1,3%) of the gravel roads have a traffic volume >200 ADT (Most of the gravel trunk roads will be surfaced as part of the Trans-Caprivi Highway project)

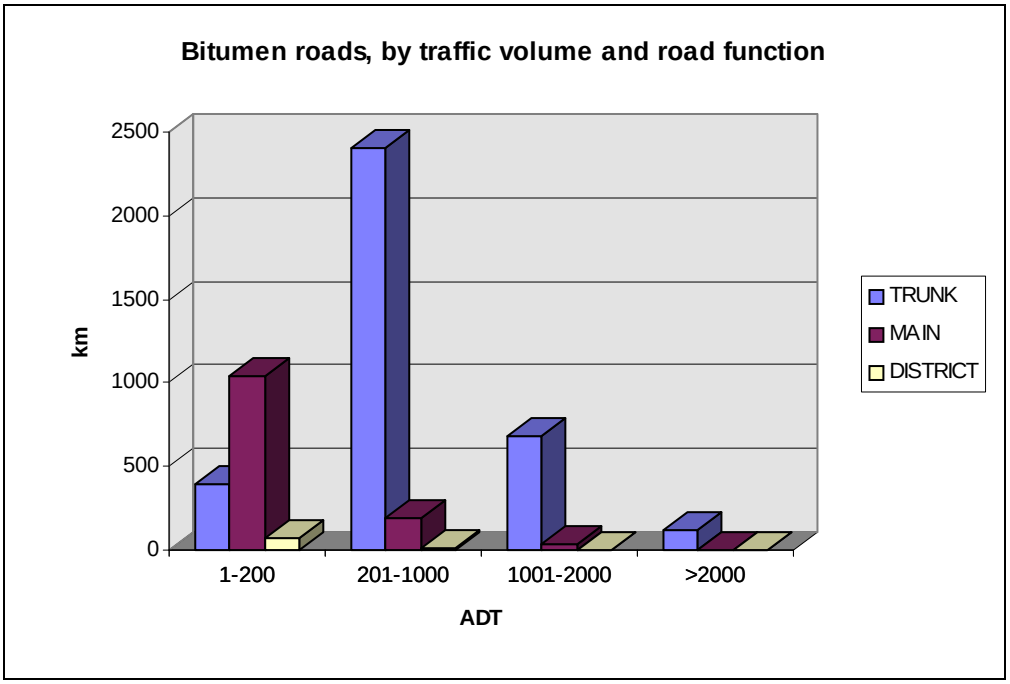


Figure 2.2.4: The average bitumen road has a traffic volume between 200-1000 ADT

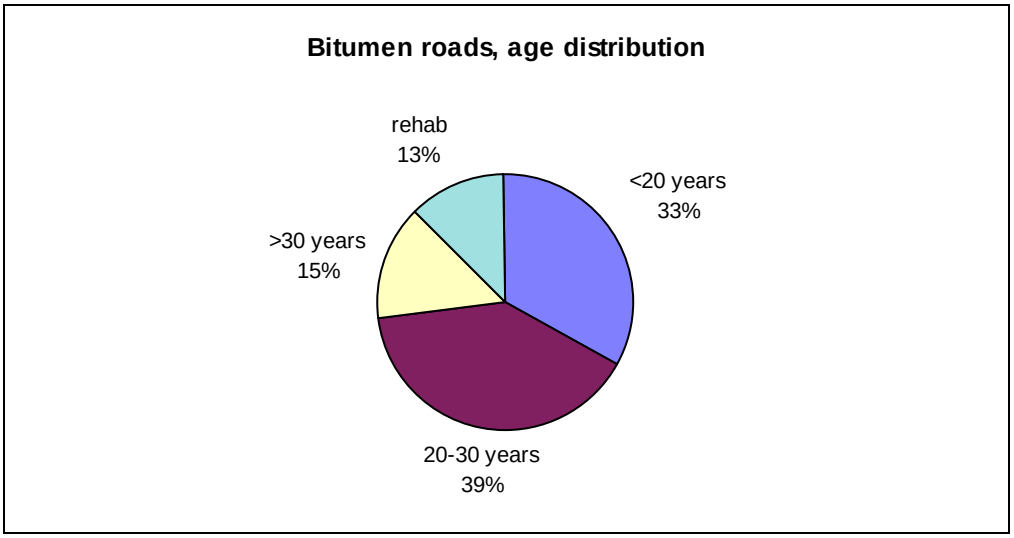


Figure 2.2.5: More than 50% of the bitumen roads are older than 20 years.

Of the roughly 5,000 km of bitumen roads in the country, 2,950 km were completed more than 20 years ago. About 1200 km of these are more than 30 years old. To date, about 650 km of road have been rehabilitated or have received a major overlay.

Provision of roads in the Administrative Regions - Accessibility

The distribution of roads over the country could be illustrated in many different ways, all depending on the purpose of the presentation - road lengths per square km, road lengths per capita, road lengths related to daily vehicle km per capita etc. The main interest with these kind of illustrations is to outline a sort of measurement of equity and accessibility in the road transport system. However, the information should be handled with care, since the reasons behind the differences in road availability in the various parts of the country are much more rational than from an equity point of view. In regions with a high population density it is also likely that the travel distances are shorter and the number of km per capita are less than in sparsely populated areas.

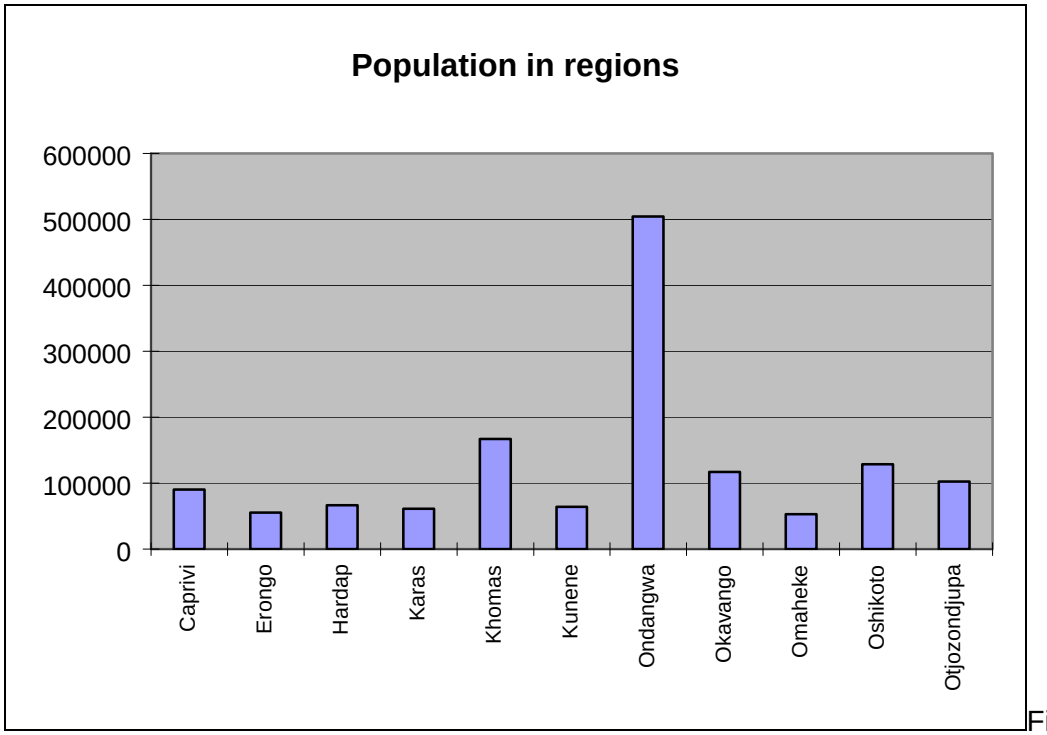


Figure 2.2.6: Population in the administrative regions according to 1996 census (The three regions Ohangwena, Omusati and Oshana are all included in the DOT Road Maintenance District of Ondangwa).

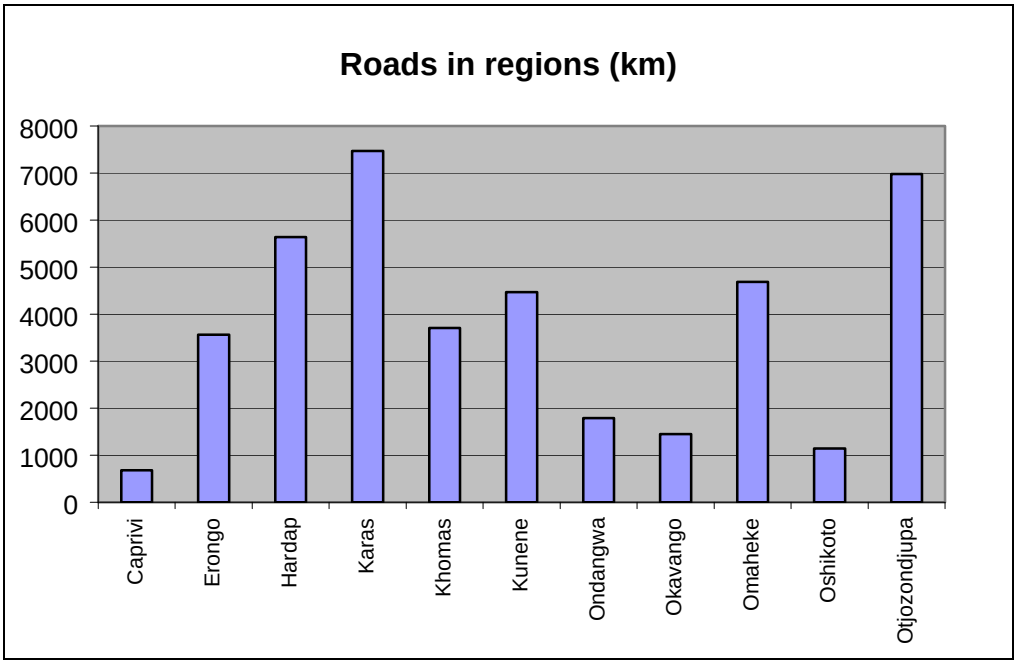


Figure 2.2.7: Proclaimed trunk, main and district roads by administrative regions (The three regions Ohangwena, Omusati and Oshana are all included in the DOT Road Maintenance District of Ondangwa).

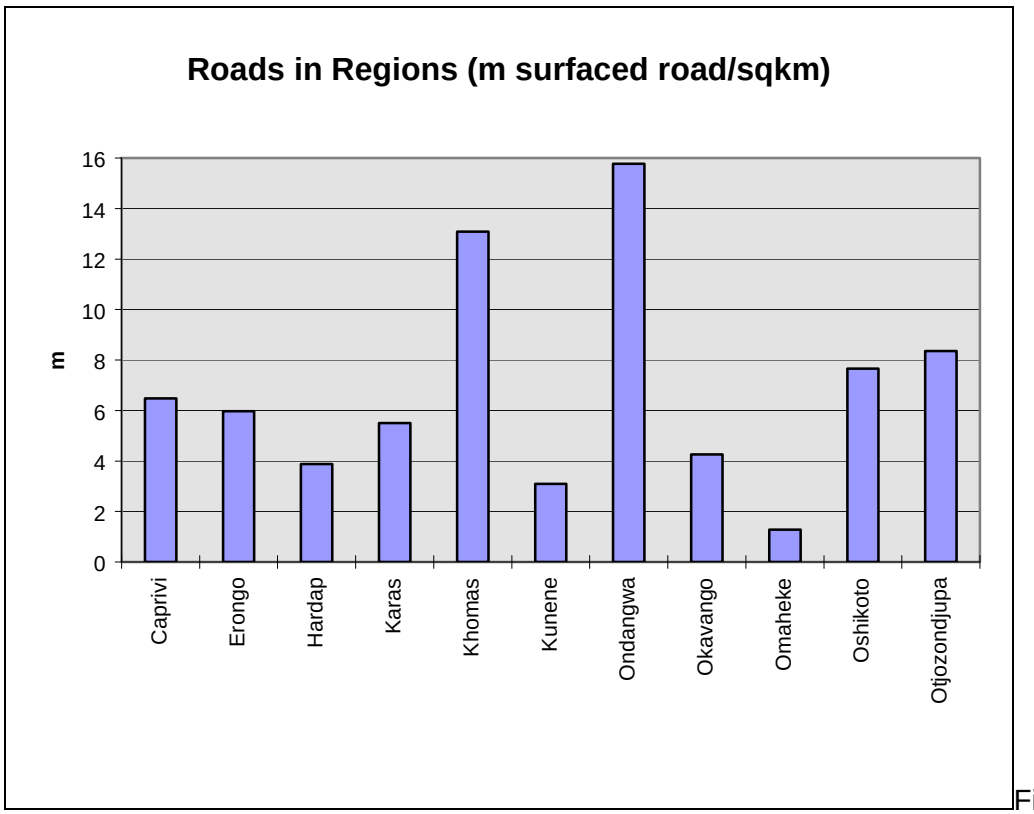


Figure 2.2.8: Distribution of bitumen roads (The three regions Ohangwena, Omusati and Oshana are all included in the DOT District of Ondangwa).

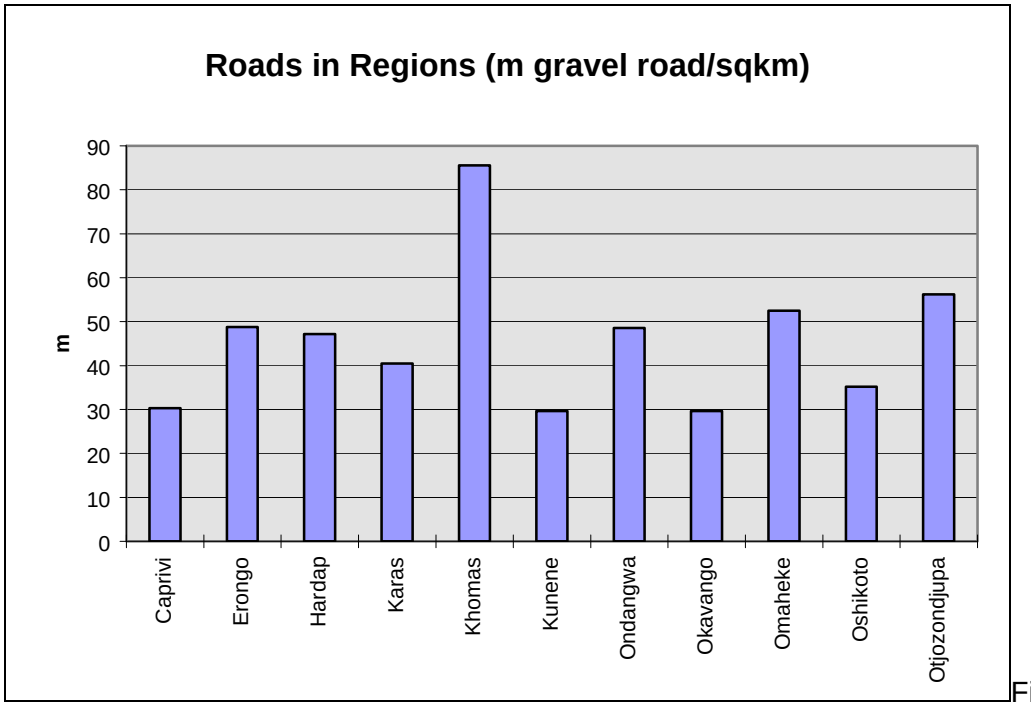


Figure 2.2.9: Distribution of gravel roads (The three regions Ohangwena, Omusati and Oshana are all included in the DOT District of Ondangwa).

The long term plan - strategic planning

Purpose

The main purpose of the strategic planning process is to review the national goals, including those enshrined in the new legislation on road user charging, and establish the objectives for the actual plan period. The long term plan should provide the framework in terms of policy and implementation strategy. The NDP1 and the National Transportation Master Plan 1998-2012 (NTMP) express the aims of Government. Some goals are general while others are more specific. However, the NTMP goals and the NDP1 goals will have to be evaluated and broken down into more operative objectives for the five year planning exercises. The requirements *of* the road users will be catered for through the new legislation.

Breaking down of the goals

The overall transport sector goal according to the current NDP1[2] is to;

> *"ensure the availability of safe, effective and efficient transport services in the different transport modes"*

This has also been elaborated on in the Corporate Plan 1996 of the Ministry of Works, Transport and Communications (MWTC 1996, see 1.5.3 above) which confirms and clarifies the NDP1 goal;

> *"To ensure that the inhabitants of the country have access to a safe road infrastructure optimally constructed and maintained in accordance with the prevailing traffic volumes in any particular part of the country, and that safe, cost-effective and efficient road transport services are available for the conveyance of passengers and goods."*

These goals, together with other goals mentioned in section 1.5 above, include long term requirements on accessibility, safety and efficiency. For the road sector the goals can be broken down into sub-goals such as the following:

Economic efficiency - all new road projects and major upgrading projects should be analysed in respect of their costs and benefits. In general only projects that are economically viable should be launched.
The maintenance standard levels for various road categories and traffic volumes should be set and applied considering traffic volume and type, and costs and benefits.

Safety - road safety should have a high priority (It is in the RFA Act Section 3 mentioned before economic efficiency and thus considered as more important) and the number of annually killed and seriously injured should be reduced. Minimum standards for the road construction and maintenance, which are necessary to ensure a safe road system, should be applied. Specific attention should be given to roads,

[2] A revised future NDP will also reflect the requirements of the new legislation concerning the provision and financing of roads

which have proven to be hazardous, and to road safety measures that will reduce the risk of accidentally being killed or seriously injured.

Accessibility and Equity - the accessibility to the trunk and main road network should be ensured all year around and throughout the country. Previously under-served areas should be given particular attention when considering new projects, to ensure that the needs are being addressed. A minimum standard for maintenance of low volume roads, related to road function, should be guaranteed.

The various sub-goals above may not coincide. For instance, economic viability, or road users' willingness to pay, has been emphasised to be applied when prioritising within and between goals. That means that any project or programme must be judged economically viable before other goals can be considered. Safety is to some extent already included in the economic evaluation through the accident cost savings. In order to be able to evaluate any interrelationship between the different goals, it could be of some help for decision-making to illustrate this in a table with the following contents:

Emphasis on	*Efficiency*	*Safety*	*Accessibility*	*Equity*
Economic viability	XXXXX	XXXXX	X	XXX
Traffic safety	XXXX	XXXXX	X	X
Minimum standard	XX	XXXX	XXX	XXX
"Social roads"	X	X	XXX	XXXXX
Preservation of capital investment	XXX	XXX	XX	XX
Comfort (riding quality)	XXX	XX	XXX	XXX

Table 3.2.1

X = very low contribution
XX = low contribution
XXX = contribution of importance
XXXX = significant contribution
XXXXX = high contribution

Two simple conclusions from the table 3.2.1 above would be that there is:

a synergy between economic efficiency and safety objectives and to some extent also with preservation of the capital investment
a relation between accessibility and equity

Evaluation of strategies/scenarios

Basis for evaluation

Long term strategies for road maintenance and development should as far as possible be based on data on each road link in the national road network. This will firstly entail the development of the framework for such as system. Secondly, it will require the collection and updating of a large quantity of data. A full-fledged Road Management System would consist of the following main components, some of which already exist in simplified and sometimes obsolete form:

Information Management and Control System
Traffic Surveillance System (TSS, exists)

Geographic Information System (GIS, under development)
Pavement Management System (PMS, exists)
Unpaved Road Management System (URMS)
Bridge Management System (BMS, exists in simple form)
Geometric Management System
Costing System

Currently there are obviously not enough tools or sufficient data available to make a comprehensive technical-economical evaluation of the long term effects of various strategic approaches on road maintenance in Namibia. The information contained in the existing TSS, PMS and BMS must however be utilised as far as possible. A number of the mentioned systems are expected to be modernised during the on-going development of a Road Management System (RMS). It will however take some years to develop these systems, collect all necessary data and calibrate models before they will be useful for prediction purposes. In the meantime a combination of empirical evaluation tools - to the extent possible based on the existing data, other information and local experience - and a simplified benefit-cost analyses is recommended. For details on economic evaluation see MWTC Economic Evaluation Manual, update September 1998.

International development

SATCC has developed a conceptual framework for the development of Road Management Systems. It has been prepared to serve as a blue-print for all SADC countries, thereby avoiding costly duplicative efforts and achieving a certain degree of harmonisation within the SADC region.

The World Bank's HDM-III has been adopted as the basic analytical tool. Currently, five provinces in RSA, Botswana Roads Department, Lesotho Roads Department and Swaziland are using a software package based on HDM-III (dTIMS - Deighton Total Infrastructure Management System). The software is essentially a powerful, user-friendly PMS and it provides high quality graphic presentations. Botswana Roads Department has used a locally calibrated version for four years now. However, with time and after appropriate data collection, their ambition is to develop deterioration relationships for every link on the road network. Namibia should be able take advantage of the on-going developments in the SADC region.

Another option will eventually be offered through the development of the
HDM-4, in which a number of specialists from Southern Africa have been involved. The new HDM version is however not expected to be available for general use until later in 1998 and consequently it can not be presented or recommended for use in Namibia at this stage. On the other hand, since the management of the HDM-4 project from now onwards will be incorporated as a special committee under PIARC (Permanent International Association of Road Conferences) the timely maintenance and updating of the HDM software is expected to be ensured in future. A use of the dTIMS as a presentation tool together with HDM-4 may also provide a suitable option.

Summary of recommendations in Section 3.3

	The Roads Authority must give high priority to the upgrading of the current RMS to generate accurate data required for long term road network appraisal **It is recommended that Namibia takes advantage of the ongoing development of RMS:s in the region, e.g. in Botswana** **It is further recommended to closely follow the development of and test the HDM-4 as soon as it is made available.**

Long term operational objectives

From the discussion on goals and goal fulfilment, the Roads Authority in liaison with MWTC, must derive and quantify its goals in operative objectives. The objectives must be concise and clear and based on sound economic grounds, but should rather not include any targets as to time.

Below follows a suggestion on a number of typical objectives for the Roads Authority to process further and later elaborate on in the five year plan:

All trunk roads should be considered for surfacing to a standard which corresponds to its function and expected traffic volume. This may also implicate alignment improvements, construction of new drainage facilities, widening of carriageways and surfacing of shoulders on existing roads.

All district centres should be connected to the trunk or main road network through an all-weather standard road.

All roads should meet a minimum maintenance standard in terms of riding quality and accessibility as outlined below:

I. Trunk roads (SADC "spec's")
   - A. Accessible all year for all approved motor vehicles
   - B. Road width, strength and surface quality to satisfy road user demands from economic and safety point of view
   - C. Width and height clearance in accordance with specifications
   - D. Sight distances to roadside vegetation to minimise collisions with animals
   - E. Apply standards for road furniture (signs, etc.)

II. Main Roads
   - A. Accessible all year - except during short periods of adverse weather conditions - for all approved motor vehicles. Exceptions may be made for roads where this requirement would cause excessive costs taking traffic volume into account
   - B. Road surface quality to satisfy road user demands from economic and safety point of view

C. Width and height clearance in accordance with normal traffic demand
D. Sight distances to roadside vegetation to minimise collisions with animals
E. Apply standards for road furniture (signs, etc.)

C. District Roads
F. Ungravelled
Accessible for four wheel drive vehicles all year except during periods of adverse weather conditions
G. Gravelled
Accessible all year - except during short periods of adverse weather conditions - for all approved motor vehicles.
Exceptions may be made for roads where this requirement would cause excessive costs
Riding quality to allow for safe driving at reduced speed

The objectives outlined above could form part of the business or corporate plan for the Roads Authority.

Summary of recommendations in Section 3.4

The Roads Authority must formulate a business plan for its activities. The business plan must contain objectives such as those formulated in this section.

Programming and fund estimation

Purpose

The necessity to maintain stability in the funding requirements of the road sector will be more pronounced after the establishment of the Road Fund Administration as the funding body. Since the Road Fund will be financed through the collection of Road User Charges, only minor fluctuations in consecutive fund requests will be acceptable. The purpose of the five year planning is to secure this stability.

It must also be kept in mind that too big fluctuations in the funding of the road sector will have unfavourable implications on the contracting industry.

Planning standards and targets - medium/short term objectives

General

Setting performance (quantity) and functional (quality) standards for especially road maintenance serves several purposes. The standards must:

ensure a minimum level of safety - based on research and what road users could reasonably expect;
ensure the target and optimum condition of the road network based on the goals and objectives derived from economic efficiency analyses;
indicate the minimum standard which is acceptable from equity, accessibility or preservation of capital investment point of view;
serve as the basis for calculating maintenance needs in terms of quantities of work to be performed; and
serve as the basis for describing the consequences of possible cuts or increases of the annual budget allocation.

The management of the road network of Namibia shall be based on economic efficiency principles. This implies that road conditions and thus road maintenance standards must, as far as possible, be subjected to economic analyses. For investments and major upgrading projects economic evaluation methods are already in place.

However, it is apparent that traffic volume is the major determinant of the economically viable standard levels even for road maintenance. Some activities will yet be justified on other grounds e.g. preservation of capital investment.
Without a full-fledged road management system (RMS) it is not possible to analyse or evaluate long term effects of different strategies as to maintenance standard assessments. Awaiting its development, routine maintenance, periodic maintenance, spot improvements, shoulder surfacings, climbing lanes, etc., can with convenience be evaluated through simplified evaluation tools based principally on traffic volume, and sound technical and economical judgements. Data in the existing TSS, PMS and BMS will nevertheless enhance this evaluation process.

Development projects and upgrading of existing roads must always be economically evaluated in terms of a benefit/cost analysis. The ‘optimum’ B/C ratio will indicate to

which standard the actual project can be constructed without violating the economic principles.

Gravel road maintenance

The main categories of gravel road maintenance in Namibia are:

- routine (roadside and road reserve) maintenance;
- blading of wearing courses; and
- regravellings.

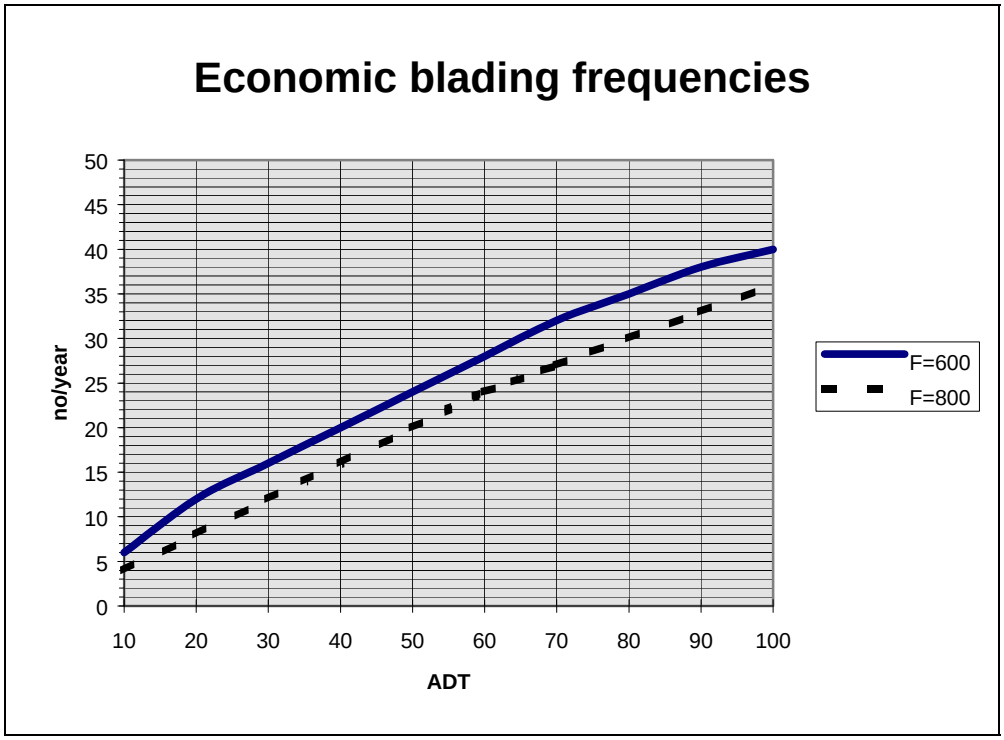
4.2.2.1 Routine maintenance

Routine maintenance activities on gravel roads could be characterised as roadside maintenance or road reserve maintenance, including culvert cleaning, bush clearing, grass cutting, signs, litter control etc. Standard requirements could be expressed as a quality or a quantity standard or a mixed quality and quantity standard. The standards will have to be assessed as part of the development of contracting models and will depend on which model for contracting should be used. Recommendations on standard requirements for 'roadside maintenance' for gravel roads can be found in the NTMPS, Volume 4, Contracting of Routine Maintenance, Draft Guideline, 3 December 1997.

4.2.2.2 Blading

Blading (grading) in Namibia is not a traditional grading operation where the grader-blade is cutting the gravel surface and redistributing the gravel wearing course. The technique of blading which has been developed through the years could be named "capping", indicating that a thin sand blanket (<1cm) is distributed over the gravel wearing course (sand or fine materials are picked up from the edges or slopes).The capping protects the wearing course from wearing off and the method has proved to work very well for low volume roads.
Even if the required blading frequency is much higher than by international practices, it appears to be economically viable as long as the traffic volume is low. The reasons behind are the higher grader capacity for this type of grading operation, the reduced gravel loss (the regravelling cycle is stretched out) and less need for gravel patching. It seems like the method is well adapted to the very dry conditions in Namibia.

The graph and the table below is intended to be a distinct tool to identify a maintenance standard for blading. The recommended blading frequencies are based on a an economic evaluation, using the model described in Appendix E. Graph 4.2.2.2 shows two envelopes for economic blading frequencies in relation to traffic volume. The value of F (= the average number of vehicle passes before accelerated deterioration will start) has been judged to be between 600 and 800 for the average Namibian gravel road. On roads in good condition, in areas with reasonable rainfall and in areas with good gravel, a *higher* value of F can be used. If sandy and dry condition a *lower* value may be more applicable. Also the vertical curvature will have an impact on the value of F.



Graph 4.2.2.2 Economic blading frequencies

When transforming the graph above into Table 4.2.2.2 the value of F=800 has been used on purpose, resulting in blading frequencies on the lower side. The frequencies have also been set having in mind that there are certain minimum standard requirements related to the functional road classification for low volume roads (<10 ADT). However, this is intended to be a planning and budgeting tool at network level, and the actual blading frequency for each road will have to be assessed individually, but should be justified if not within the recommended min-max boundaries.

Blading frequencies	ADT 1-10 no/year	ADT 11-20 no/year	ADT 21-50 no/year	ADT 51-100 no/year	ADT 101-200 no/year	ADT >200 no/year	
Min-Max	4	4-8	8-20	20-36	36-52	52	
Main	4	7	12	24	44	52	
District	4	5	12	24	44	52	
Gravel km	km	km	km	km	km	km	
Main	475	1601	4017	1524	545	172	
District	15197	5928	4620	1015	387	0	Total
Annual need	blkm	blkm	blkm	blkm	blkm	blkm	blkm
Main	9,500	56,035	241,020	182,880	119,900	44,720	654,055
District	243,152	118,560	221,760	97,440	68,112	0	749,024
TOTAL	252,652	174,595	462,780	280,320	188,012	44,720	1,403,079

Table 4.2.2.2 Recommended annual blading frequencies related to traffic volume and road class. Blade-km (blkm) has been calculated assuming 5 blades/km for main roads and 4 blades/km district roads.

Even if the blading frequency for the low volume roads (<50 ADT) is comparatively low, it is obvious that these roads will require the bulk of the total blading input (>63%). A modest increase of the blading frequency for these roads will result in a considerable increase of the total blading kms.

4.2.2.3 Regravelling

The need for regravelling a road depends on a large number of factors, where traffic volume is the most significant. On project level each road will have to be assessed individually, taking into account not only the traffic volume but also climate and wearing course material. A countrywide condition survey would give the actual need for regravelling. However, condition surveys are major events which consume substantial resources and are normally not performed on an annual basis. For network level planning and fund allocation purposes table 4.2.2.3 could serve as a simple guide for estimating a long term fund level for regravelling.

The proposed frequencies have been assessed using empirical formulas based on research by the Transport Research Laboratory (TRL 1984) in Kenya and by P. Paige-Green (PhD thesis May 1989) in South Africa and Namibia during 1984-1987 (See Appendix E). The suggested 50 year frequency for roads with ADT <50 indicates that most of the roads in this group with ADT< 20 will not receive any attention as to regravelling. There may, however, be a few exceptions in areas with more humid conditions than in general in Namibia, for instance in the

Caprivi region, where regravelling of low-volume roads (according to Paige-Green) should be made every 15-20 years.

Some low volume roads do not have a proper gravel wearing course today anyway, and will from economic point of view not be upgraded to real gravel roads in the foreseeable future. The lower frequencies for district roads are motivated from design speed point of view (lower speed leads to less gravel loss).

Regravelling frequencies	ADT 1-50 Years	ADT 51-100 Years	ADT 101-200 Years	ADT >200 Years	
Min-Max	11-50	9-40	7-13	5-9	
Main	50	15	8	5	
District	50	20	10	7	Total
Annual need	km	km	km	km	km
Main	122	106	70	94	392
District	515	51	39	0	604
TOTAL	637	157	109	94	997

Table 4.2.2.3 Regravelling frequencies (no of years in between regravelling) and corresponding annual need.

The approach indicates that about 1,000 km annually of the almost 36 000 km of gravel roads need attention as to regravelling.

4.2.2.4 Upgrading of earth roads to gravel road standard

The 7,898 km of earth roads (included in the total length of gravel roads) and the additional 2,533 km of proclaimed but not constructed and not maintained roads (not included) may need attention as to gravelling. A policy for the upgrading of these roads to gravel standard need to be established. The baseline for project appraisal should of course be economic viability.

4.2.2.5 Surfacing of gravel roads

There are about 4,000 km (see table 2.1.3) of a total of more than 35,000 km of gravel roads which have a traffic volume > 50 vehicles per day (ADT). Most of them are main roads (2,200 km) and district roads (1,400 km). About 400 km are trunk roads. As indicated earlier, most of the gravel trunk roads will be surfaced as part of the Trans-Caprivi Highway project within about two years. Excluding the trunk roads, 1,100 km of gravel roads have a traffic volume >100 ADT, and about 170 km have an estimated traffic volume >200 ADT.

An economic evaluation indicates that it generally would be economically justified to upgrade gravel roads to bitumen standard at traffic volumes as from about 100-200 ADT.

For district roads, and main roads with good alignment standard, a low-cost surfacing approach would probably be the most appropriate.

This range of traffic volume will of course change upwards or downwards depending on how much effort must be spent on vertical and horizontal alignment improvements, new structures, drainage facilities and quality and quantity of gravel available within economic hauling distances. However, improvements related to design speed must always be carefully considered and should be commensurate with the terrain as drivers normally adjust speed to the actual environment. In table 4.2.2.4 below only the likely economically warranted need is presented. From a functional point of view, some main roads <100 ADT, would also need to be attended to. However, the economic facts will call for other priorities and the target must be to surface the about 1,100 km of gravel roads >100 ADT first, starting with the main roads not forgetting the policy objective to reduce regional imbalances and economic viability.

Road class	ADT 101-200 km	ADT >200 km	Total >100 km
MAIN	545	172	717
DISTRICT	387	0	387
TOTAL	932	172	1104

Table 4.2.2.4 Surfacing of gravel roads

In order to maintain stability as to annual funding requirements, the upgrading of the 1,100 km of gravel roads to surfaced standard should be a task which obviously must be distributed over a reasonable period of time. Most of the 717 km of main roads should be considered as major upgrading projects and should be ranked according to actual B/C ratios together with the candidate development projects.

For the remaining 387 km of district roads due for surfacing, it is recommended to use a low cost[1] approach including spot improvements.

Bitumen road maintenance

4.2.3.1 Routine maintenance

The discussion on routine maintenance standards in section 4.2.2.1 above is also applicable for the bitumen roads and is referred to as Road Reserve Maintenance and Bitumen Road Maintenance in the NTMPS, Contracting of Routine Maintenance, Draft Guideline, 3 Dec 1997.

For bitumen roads the bushclearing is the dominant road reserve maintenance cost. It is carried out in the entire road reserve, normally 60 m wide. The returns of this costly operation must be questioned and also analysed in terms of economic viability or road users' willingness to pay, *i.e.* their perception of safety.

However, most importantly there should be quantity and quality standards regarding bitumen surface maintenance, shoulder maintenance, road signs/markings, structures, drainage etc. There is often a tendency from routine maintenance organisations to prioritise needs which are easily observed by anybody, rather than attending to the bitumen surface deterioration. The desired priority of timely bitumen maintenance, which must be considered to be one of the highest priority routine maintenance operations, can always be indicated by a quality standard for routine maintenance patching and crack sealing etc. Recommendations on standard requirements for bitumen surface maintenance can be found in the above mentioned guideline for contracting.

[1] The evaluation of the experimental trial sections, altogether 20 km, on dust prevention action, on road C31, 10km north Okahandja - Hochfeld, would possibly be of some interest with reference to low cost surfacing.

4.2.3.2 Maintenance seals - Reseals

In Namibia most bitumen roads have a single seal plus a slurry (Cape seal) or alternatively plus a thin asphalt mix ("Koffiemoer") in lieu of the slurry seal. There are only a few roads which have an asphalt concrete wearing course. The optimum time interval between reseals is difficult to establish on a network level. Project identification must be based on separate condition surveys. In general terms a reseal would be necessary every eight to twenty years, essentially depending on the following factors;

- condition of existing seal;
- pavement design (strength);
- traffic volume;
- vehicle axle loads; and
- climatic conditions.

Namibia is a very dry and hot country with generally low traffic volumes. Less than 850 km of the nearly 5,000 km of bitumen roads carry traffic volumes >1000 ADT. For the majority of the bitumen roads, ageing will be the determining factor for the reseal interval. Due to the hot and dry climate with extremely high ultra violet radiation, weathering of the bitumen results in a brittle wearing course that often leads to extensive temperature cracking (block and transverse cracking). Preventive maintenance measures like timely rejuvenation sprays are therefore highly recommended. However, routine maintenance cracksealing is normally very effective on this type of surface damages and should not be neglected.

For planning purposes the appropriate reseal intervals will be presumed to be related to traffic volume for volumes >1000 ADT. For roads carrying less traffic the estimate will be based on a 15-20 year reseal cycle on average. A maintenance strategy for sealed roads, including routine and periodic maintenance crack sealing, rejuvenating seals and reseals, would then be provided for according to the following table:

Action	ADT 1-200 Frequency	ADT 201-1000 Frequency	ADT 1001-2000 Frequency	ADT >2000 Frequency	Total (km)	Net total (km)
Rejuvenation spray	3 years	3 years	3 years	3 years		
Reseal or slurry seal	20 years	15 years	12 years	9 years		
Total km surf.road	1509	2603	721	127	4960	
Annual rejuvenation spray, km	503	868	240	42	1653	1331
Annual reseal, slurry seal, km	75	173	60	14	322	219

Table 4.2.3.2 Resealing intervals (years). The net totals are the result from deducting rehabilitations replacing reseals and reseals replacing rejuvenating sprays in the maintenance cycle.

Due to the present backlog in rejuvenating sprays, a three year cycle has been recommended. This interval may be changed into a five year cycle when the initial three year cycle has been completed, leading to a net total of 670 km rejuvenation sprays annually. The optimal frequencies should be determined through research projects.

Rehabilitation

"It is essential that a well-structured rehabilitation programme be followed ensuring that roads are rehabilitated before they deteriorate to such a level that traffic is adversely affected and complete reconstruction is required". This very true statement can be read in the NDP1 programme T&C 3: Infrastructure Rehabilitation.

Rehabilitation should be regarded as a heavy maintenance action meant to bring back the original capacity, riding quality and strength to the particular road section before it will fail completely and calls for an absolute reconstruction. While reconstruction means a total re-work of the pavement structure, i.e. a new road on the same location, a rehabilitation could be a bituminous overlay only. Sometimes it is difficult to distinguish between rehabilitation, reconstruction and upgrading projects.

It could, and normally does, make economic sense to also include in rehabilitation projects capacity and/or pavement strengthening in excess of the original to provide for future needs as well. Hence, it is here suggested to define a rehabilitation project as a project that allows for a rational increase in cost for additional improvement and/or upgrading work. If beyond this allowance the project should be defined as a major upgrading project (complete reconstruction) and be considered as a candidate development project.

More than 50% of the bitumen roads were completed over 20 years ago. Even though the dominant part of the present rehabilitation need will be caught by the year 2000, new

rehabilitation needs will develop continuously. The envisaged future fluctuations in the volume of rehabilitation will be dependant upon the age and design of each road link as well as traffic and climatic conditions. All this has to be closely monitored through a Pavement Management System.

The timing of rehabilitation on sections of roads also needs to be determined. One school of thought is to start rehabilitation of the entire road when some 50 % in length need to be rehabilitated. This approach would require abnormal routine maintenance (patching) for some period of time. Another option is to rehabilitate by sections not shorter than 40 to 50 km, to justify the high establishment costs pertaining to construction work. Remaining sections similarly should not be shorter than 40 to 50 km. The problem of timing is exacerbated when widening of a road with too narrow width is included in the project. This holds true for all the bitumen roads constructed during the 1960's in Namibia.

If the just engaged periodic maintenance strategy is followed promptly, including timely rejuvenation sprays, the following approach to the rehabilitation issue is proposed:

The majority of the low volume bitumen roads (ADT<200) will probably never reach a state when a full rehabilitation action will be needed. Many of these roads have not even had a reseal yet.

The design life for bitumen roads is generally twenty years. However, bitumen roads have shown to last well beyond that time depending on a number of factors which are linked to Namibian conditions. In combination with the periodic maintenance strategy the national average rehabilitation cycle for roads with ADT>200 is therefore recommended to be according to table 4.2.4 below.

A more detailed classification based on climate zones could improve rehabilitation interval prediction on a network basis. The high costs involved in rehabilitation however calls for detailed condition surveys at a project level. The new legislation also calls for detailed economic analyses before embarking on such large projects.

	ADT 201-1000	ADT 1001-2000	ADT >2000	Total (km)
Rehabilitation every	35 years	30 years	25 years	
Total km surf. road	2603	721	127	3451
Annual rehab. need	74	24	5	103

Table 4.2.4 Rehabilitation intervals

A sensitivity analysis indicates that the annual rehabilitation need would vary between 86 km and 138 km, if all roads with a traffic volume > 200 ADT will last between 40 years and 25 years respectively.

Further details on strategies for bitumen road rehabilitation are given in Section 5.5.

Improvement projects

A provision for improvement projects is often difficult to justify only on economic grounds. The magnitude of these projects is mostly "spot improvement size" and they are often considered too marginal to be included in the traditional development programmes. Nevertheless, there is a significant need for flexibility and rationality, when dealing with certain traffic safety and other isolated improvement issues. Typical improvement projects are;

Eliminating "black spots" (e.g. improving hazardous intersections, bends, superelevations, grades, sight distances etc.);
adding a climbing or passing lane;
widening of the carriageway;
shoulder surfacing; or
widening of bridges (could also eliminate a “black spot”);

The criteria for inventory of possible need and the related long term objectives could for example be expressed as follows;

Black spots with more than 3 annual accidents resulting in a fatality or serious injury should be eliminated.
Any road section with a traffic volume in the order of 2500 ADT, >10% heavy vehicles and having an equivalent gradient of 4% or more for at least 300 m should be considered for adding a climbing lane.
Passing lanes should be provided on roads in rolling terrain where the traffic volume is in the order of 3000 ADT and heavy vehicles >10%.
Any road section with a traffic volume in the order of 4000 ADT should be considered for shoulder surfacing.

It should be emphasised that these criteria and objectives are only tentative and need to be supported by economic evaluation of viability in each specific case.

Accordingly, the needs should be calculated and a five year objective established, e.g.;

- 50 black spot locations should be removed (10 annually)
- 100 km of the trunk roads will be equipped with surfaced shoulders (20 km annually)
- 100 locations will get improved drainage capacity and erosion protection (20 annually)

Development projects

4.2.6.1 General

The RFA has no intention to finance any road or bridge development project, except economically justified projects. No new road project or major upgrading project should be accepted or approved if not economically evaluated through an appropriate cost-benefit analysis. This is normally accomplished in the feasibility study. A feasibility study is often a major engagement carried out by consultants and its cost implications for the client can be substantial. The purpose of the feasibility study is

- to evaluate project alternatives;
- determine whether the project is economically viable or not; and
- study how the project would impact on the natural and social environments.

In order to avoid waste of resources a simple ("one-day exercise") study of the economic viability should be carried out for all potential development projects at a preliminary stage of planning. The methodology for economic evaluation contained in the Simple Procedures of the Economic Evaluation Manual, Draft September 1998 could serve as a model for such studies. On the basis of such a study it should be decided whether to proceed with a full feasibility study, put the project on hold or abandon it.

It should however be kept in mind that in cases where major changes in the traffic pattern, serious environmental implications, etc., can be expected this simplified method may not be sufficient even as a screening tool. Then a full feasibility study will be necessary.

Those projects which do not yield enough savings for the road users to qualify for full funding through the road user charging system may nevertheless be needed for "social" reasons.

The same simple methodology for project evaluation as mentioned above can therefore be used also for "social roads". The additional amount required for co-funding from other sources to make the project viable can then be established.

There is also another instrument available for ranking of social road projects, called the utility analysis. That type of analysis will in general be used for evaluation of potential low-volume roads where only tracks or no roads exist. It can be used for general screening before detailed

or simplified economic analyses are endeavoured. The methodology for utility analysis is described in the Economic Evaluation Manual.

4.2.6.2 New roads and bridges and major upgrading projects[2] - RFA-funded

All ongoing planning studies and development programmes including those under the NDP1 umbrella;

- T&C 2 Planning studies
- T&C 4 Labour-based Construction and Maintenance
- T&C 5 Walvis Bay Trans-Caprivi Transport Corridor
- T&C 7 Gobabis-Grootfontein Link Road
- T&C 8 Development of Roads in Regions

need to be reviewed. Planned projects, projects under study and new project initiatives should undergo the type of simple study of economic viability mentioned in sub-section 4.2.6.1 if no acceptable cost-benefit analysis was made previously. A ranking list strictly in accordance with the B/C-ratios can then be established.

Only from this stage should it be possible to discuss the prioritisation of tentative projects from other points of view e.g. functional aspects that must be considered (transport corridor link, missing link or bridge, accessibility to development areas, etc.), and input from stakeholders.

The final prioritised project list should only include economically viable projects if no other special project justification can be referred to. Such justifications should always be commented on.

Finally, it is recommended to exclude all tentative projects which will obviously not be executed within the next ten to fifteen years. Appendix F contains forms which can be used for listing and ranking of development projects.

4.2.6.3 "Social roads" (Government funded, donor funded, co-funded by RFA)

Road development projects which cannot prove economic viability, will normally not be financed by RFA from revenues generated by the Road User Charging System. They will consequently not fit into the prioritised project list mentioned above in section 4.2.6.2 .

However, some of these road projects may be motivated from a political (equity) or social point of view. The government has provided for a potential financing of this kind of road project from central revenue. The new legislation on funding of roads makes provision for partial funding of such projects through the road user charging system.

[2] A major upgrading of a road or a bridge, is here characterised as replacement of an existing facility that has been deemed to be substandard. The aim of upgrading a road or a bridge is to provide a new facility, which for all practical purposes is equivalent to constructing a new road or bridge.

A tentative prioritised list of such projects should be established taking into account the objectives mentioned in section 3.4 and the analysis methods mentioned in sub-section 4.2.6.1.

Summary of recommendations in Section 4.2

Determine or adjust, if necessary, existing maintenance standards to conform to safety and economic efficiency requirements. **Use standardised formulas and graphs for programming of blading of gravel roads and make adjustments for local conditions when budgeting blading activities. Compare also with blading results from previous years.** **Apply gravel loss survey results from the region or research results, such as those contained in Appendix E, when programming regravelling.** **Apply a low-cost approach to surfacing of district roads and main roads with good alignments.** **Apply a combination of rejuvenation sprays and reseals in the periodic maintenance of bitumen roads. Determine appropriate frequencies between treatments through research projects or condition surveys.** **Consider the long term needs for rehabilitation of bitumen roads by using the information contained in the PMS and TSS.** **Apply the criteria for identification of minor improvements and elimination of accident black spots** **Identify development projects by applying the simplified procedures or utility analysis (for "social roads") contained in the Economic Evaluation Manual**

Programming the needs and estimating optimum funding levels

General

The main purpose of programming is to compile and schedule the financial needs into logical packages as to financial year, type of work, type of road, road class and source of finance.

Another purpose is to provide for flexibility as to financial requirements within certain categories of work, but also to achieve some stability as to financial priorities between the various programmes and types of work. In this respect it is of some importance to define and distinguish between what is road network conservation and what is road network development. The programmes must also be easily understood in order to promote transparency.

This guideline proposes the following interpretation and definition of the programmes to be compiled;

i) Road network conservation - maintenance programmes
   - Routine maintenance programme
   - Periodic maintenance programme
   - Rehabilitation & improvement programme

ii) Road network development - investment programmes
   - Development programme

Routine maintenance programme

The routine maintenance programme will include provisions for

- maintenance of bitumen roads
  - bitumen maintenance
  - roadside maintenance
  - bridge maintenance

- maintenance of gravel roads
  - blading
- roadside maintenance
- bridge maintenance

Bitumen maintenance and blading are activities attending to the road pavement structure and the roughness of the surface. This kind of activities are ultimately affecting the vehicle operating cost (VOC) and should therefore be considered separately from a budgeting point of view. Roadside maintenance includes activities like bush clearing, grass cutting, signs, fences, guard-rails, culverts and drainage facilities etc. All these activities will have an influence on traffic safety.

It could be argued that the routines of cleaning bridge decks, painting ballustrades and removing vegetation and debris from bridges on a gravel road should form part of the routine maintenance of those roads. However, this would require additional training of staff maintaining the gravel roads and also affect the road maintenance negatively from an efficiency point of view. Bridge maintenance for gravel roads should therefore be co-ordinated within bridge maintenance activities for bitumen roads.

Periodic maintenance programme

The periodic maintenance provisions will also be divided into the maintenance of bitumen roads and the maintenance of gravel roads for the purpose of being able to calculate and follow up the total cost for gravel road and bitumen road maintenance separately:

- maintenance of bitumen roads
  - rejuvenating sprays
  - resealing
  - drainage repairs

- maintenance of gravel roads
  - regravelling
  - drainage repairs

Rehabilitation & improvement programme

Rehabilitation has been defined as a kind of "heavy" maintenance in section 4.2.4 above. For this reason it is essential that rehabilitation projects (within limits) are kept separate from any construction programme as to funding category. Hence it is suggested not to include rehabilitation projects in the development programme.

In addition, the provision for improvement works, which was argued for in section 4.2.5 above, is suggested to be part of the rehabilitation programme in order to increase flexibility as to funding. The reason behind this is the relationship between rehabilitation and spot improvements. Many rehabilitation projects require or include some spot improvements.

rehabilitation and improvement of bitumen roads
- rehabilitation (reworking, recycling and/or overlay)
- widening of the carriageway
- shoulder widening and surfacing
- widening of drainage structures and bridges

- rehabilitation and improvement of gravel roads
  - surfacing of gravel roads
  - upgrading of earth roads to gravel roads
  - widening of gravel roads

spot improvements
  - climbing/passing lanes/hazardous road sections/intersections
  - hazardous road sections
  - new drainage facilities and erosion protections

Development programme

The prioritised list of development projects that has been established according to the instructions in section 4.2.6.2 will constitute the tentative development programme to be funded by the RFA. Similarly the list of tentative projects for "social roads" will constitute the development programme funded by the government or any donor, most likely co-financed through the Road Fund. The RFA will be responsible for the financial co-ordination.

For the purpose of having the overall control of the development programme, the two lists just mentioned should be merged into one development programme. The possible components of the development programme will then be:

Development programme
- major upgrading projects
- new roads and bridges projects
-"social roads"
- "donor roads"
- labour-based construction projects

The one year and the five year plan - preparation of the estimates of expenditure

Costing and calculation of needs - proposed optimum funding levels

For each of the programmes mentioned above there will be an optimum funding level. Essentially, the optimum level corresponds to the needs emanating from the employment of the agreed criteria for economic viability that have been assessed by the RA.

For the purpose of obtaining an approximate estimate of the optimum fund level, which also could be used to determine the scope of work, the RA should first calculate the annual need for each programme on a network level. These calculations should be based on the theoretical long term needs according to standardised data tables, such as those in section 4.2.

When finally the actual needs in each road maintenance region have been identified and communicated to RA head office, the countrywide actual needs per programme should be

compiled, analysed and, if appropriate, adjusted to meet the scope of work indicated by the global approximate estimate.

The calculation of the actual needs must of course include the funding requirements for all on-going projects.

A set of forms/spreadsheets (Excel) which can be used for this activity are enclosed in Appendix F and contains forms for calculation of the following defined programmes;

Routine maintenance
Periodic maintenance
Rehabilitation & improvements
Development projects

Cost data to be used in the calculations must be based on actual contract rates collected from current contracts. These rates should be adjusted by a percentage[3] to also accommodate the Roads Authority's overhead costs for the planning and supervision that are, or could be linked to any maintenance or construction project or activity. However, it has not yet been decided how these costs are going to be budgeted.

At present the number of routine and periodic maintenance contracts is rather limited. The Government policy to eventually contract out all road maintenance and road construction will definitely increase the availability of more accurate and up-to-date cost data. Under the prevailing circumstances, it is advisable to assess some kind of average rates for the various activities to be costed for the fund estimate. Not only country wide average rates, but also regional average rates should be worked out. Once all contracts are in operation, rates per road link will be available.

In addition the administration costs of the Roads Authority and the Road Fund Administration must be determined. This estimate should be based on staffing, office, allowance, transport and accommodation requirements, etc., for the administrative personnel that cannot be linked to and charged to a specific project or group of projects. It is anticipated that all costs at district level can be charged directly to projects and will be provided for by the above proposed 7% percent overhead surcharge. The identification of the actual staff, office and other needs on central and regional levels will be possible only when the Roads Authority has been established. In the meantime the suggestion of the report on Road User Charges of N$ 7.5 million in 1996/97 prices is considered adequate.

It is sometimes necessary to forecast maintenance requirements for a five to ten year period. The Traffic Surveillance System (TSS), which is under development, will be able to provide traffic information on all road links. The traffic forecasting model, which also is under development, will be able to provide forecasts on traffic growth based on traffic information and annual employment data.

If using the forecast growth rate for a period of five or ten years applied on the TSS links it will be possible to produce traffic distribution tables for the fifth year. The fund requirement for year five can then be calculated in year one price level. The needs for the years in between can be interpolated.

[3] The number of staff for the RA establishment has been estimated at 220, including the administrative staff. A very rough estimate of the overhead percentage indicates a level less than 7%.

When all the fund requirements for the various programmes have been calculated and summarised, it is supposed to represent the optimum fund level that finally will be proposed to the RFA.

The consequences of any insufficiency in that estimate should be illustrated by indicating those standards and targets that cannot be met within the plan period. Yet, the optimum fund level concluded must be judged realistic and, if not, the adopted standards and targets should be reconsidered. Eventually, the RA estimates of expenditure, if found economically feasible, and the budget approved by the RFA, may harmonise.

Budget elasticity - prioritisation model

The most likely "scenarios" within a five year period that would need to be evaluated for the Roads Authority are linked to

- traffic growth and
- funding constraints

A sensitivity analysis on deviated traffic growth could easily be done by altering the assumed traffic growth by +/-5% annually, evaluate the corresponding traffic volume classes (using TSS) and finally calculate the needs according to the same procedure as above. This analysis should be part of the preparation of the estimates of expenditure for the five year plan.

The possible funding constraints would be linked to whether the RA will be able to justify all needs or not, or if the RFA will be in the position to accept the proposed funding level or not.

Hence, it is necessary to prepare a strategy to handle ‘temporary’ funding constraints in relation to the ‘optimum’ fund level. The strategy is also needed to describe the immediate consequences of insufficient funding. Long term effects of inadequate funding will have to be analysed using specially designed evaluation tools included in the PMS (see section 3.3) and will not be taken care of in the five year planning exercise.

The following two graphs illustrate a simple and educational tool that describes and quantifies the immediate effects of inadequate funding levels.
If worked out and decided on in advance, the tool is a useful support when plans must be adjusted to meet available funds. The percentages that are shown are based on a sample calculation and should only be seen as indicative.

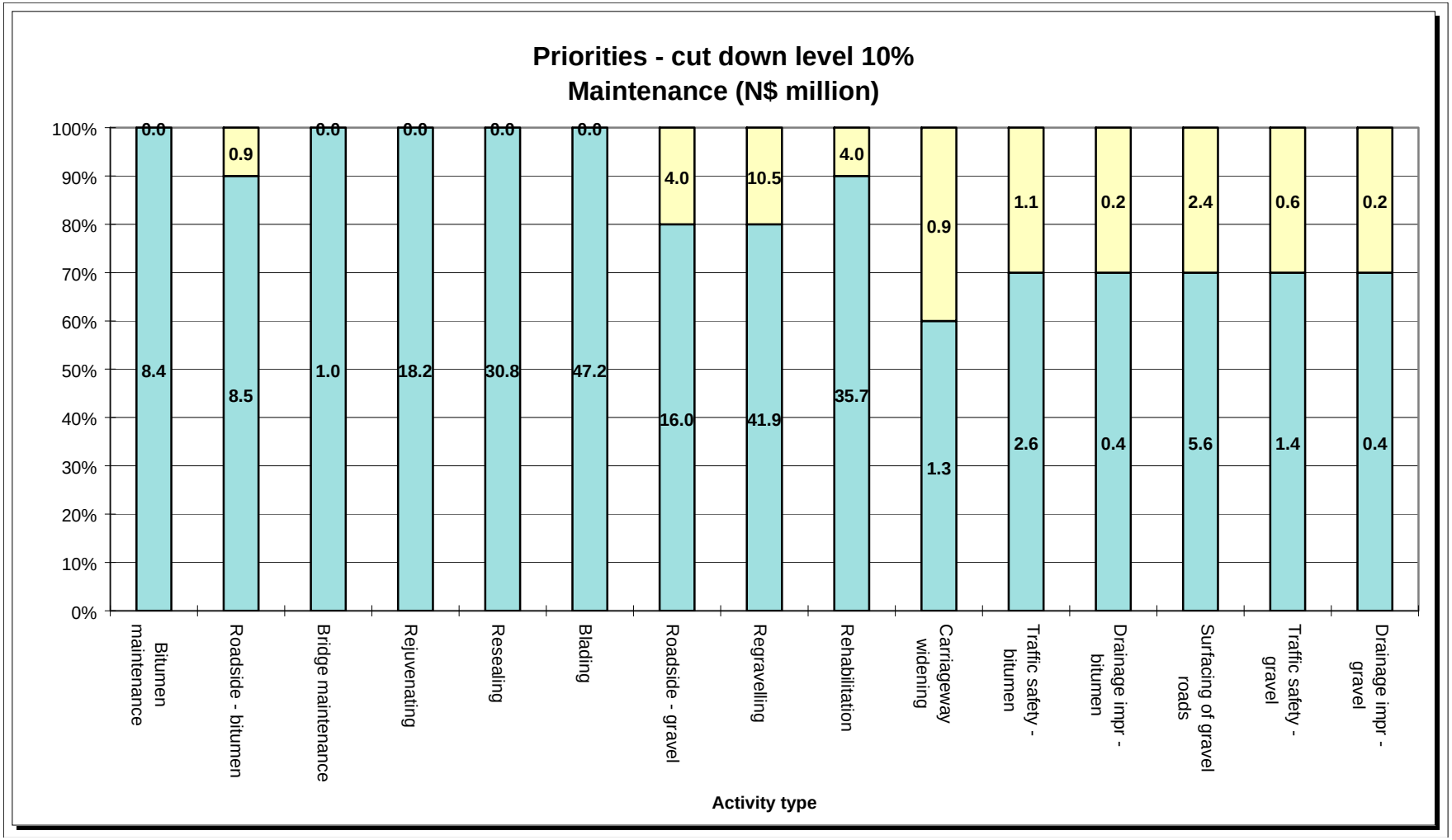
It is recommended that the RA decide on a strategy for prioritisation within and between the various programmes and work out similar prioritisation model charts, but only when the funding requirements (and the amounts of money involved) for the various activities are evident.

The charts should indicate the strategy chosen, on how to adjust and prioritise between the planned activities, step by step, in order to meet the actual budget allocation. Concluding this sample model, it suggests a lower priority to roadside maintenance and improvement works, while further reductions will affect even the other programmes (sample graphs for cut down levels 10%, 20% and 30% are presented in Appendix G). The purpose of the proposed

priorities is to emphasise direct road user needs (VOC) and preservation of capital investments.

Obviously, there must be a lower limit for some of the activities and others may not be reduced at all, since the amount of money involved is negligible.

If, even if unexpected, the budget allocation for some reason exceeds the ‘optimum’ level, priority should be given to any previous backlog in the reseal and rehabilitation programmes before backlogs in the regravelling and improvement works programmes are attended to.


Priorities - cut down level 10%
Maintenance (N$ million)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
8.4
0.9
8.5
0.0
1.0
0.0
18.2
0.0
30.8
0.0
47.2
4.0
16.0
10.5
41.9
4.0
35.7
0.9
1.3
1.1
2.6
0.2
0.4
2.4
5.6
0.6
1.4
0.2
0.4
Bitumen maintenance
Roadside - bitumen
Bridge maintenance
Rejuvenating
Reseaing
Blading
Roadside - gravel
Regravelling
Rehabilitation
Carriageway widening
Traffic safety - bitumen
Drainage impr - bitumen
Surfacing of gravel roads
Traffic safety - gravel
Drainage impr - gravel
Activity type

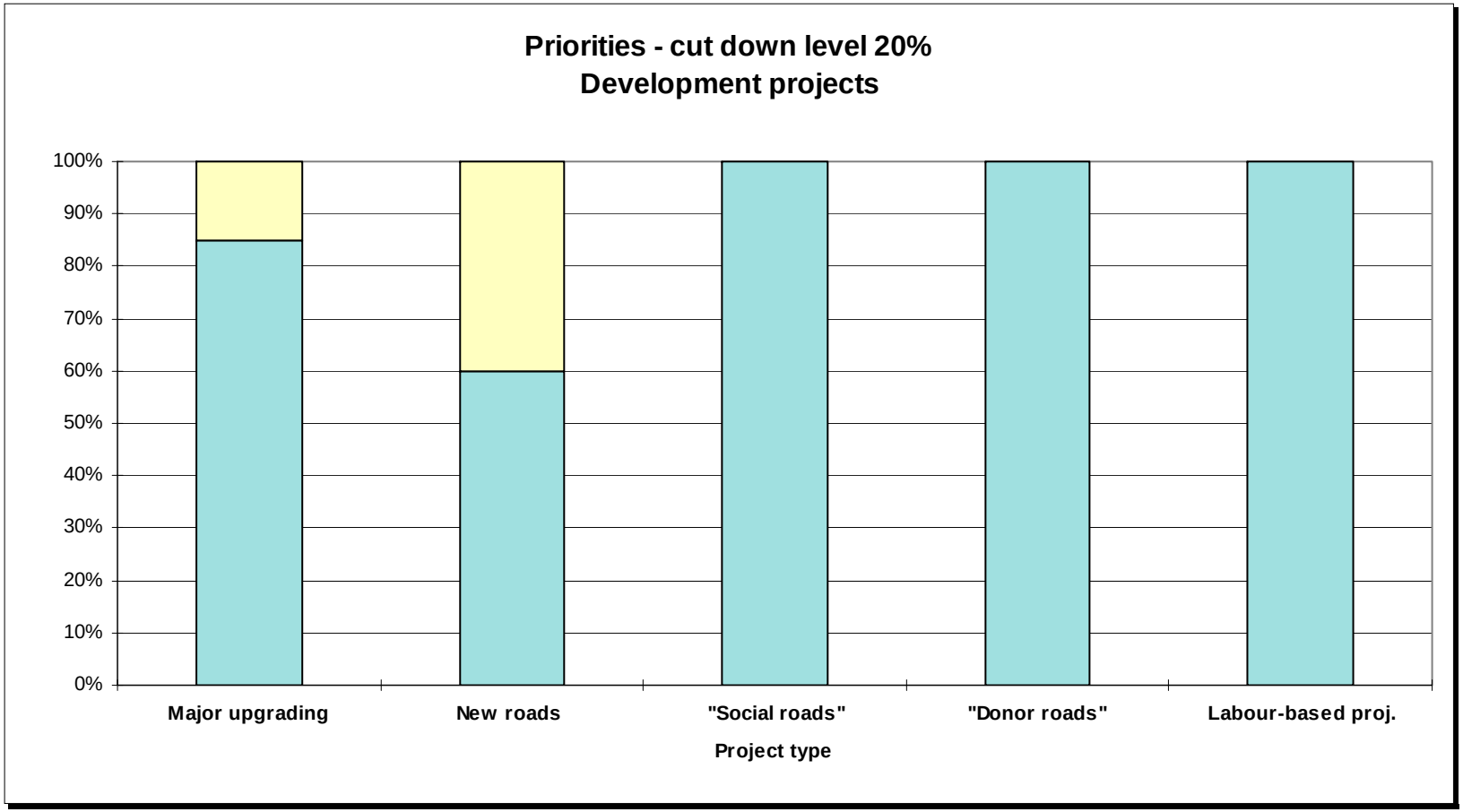

Priorities - cut down level 20%
Development projects
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Major upgrading
New roads
"Social roads"
"Donor roads"
Labour-based proj.
Project type

Figure 4.3.8.1: Consequences of a 20% cut of the development budget - sample chart (in this example it is envisaged that development projects financed by bodies other than the RFA, will not be affected by any funding constraint).

Current funding levels

Looking at the expenditure (figure 5.3.1) for the last four financial years and the approved budget for 1997/98, it appears that the construction programme has consumed 60-115 N$ million annually, while the maintenance programme has been more stable over time, 127-174 N$ million, with an increase corresponding well to current prices. It should also be noted that the construction programme includes not only new roads and major upgrading projects but also some rehabilitation projects, which are suggested to be considered as 'heavy maintenance'.

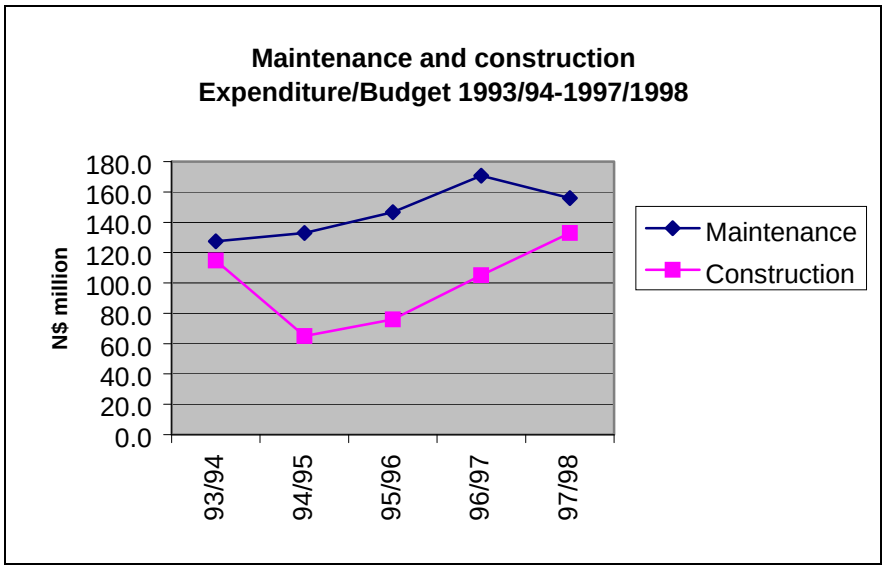


Figure 5.3.1 Road maintenance and construction expenditure in current prices

The future level of funding in the development programme will be a matter of finding a correlation to targets set in the various development plans. As a guide to which level may be selected, the estimate in the report on Road User Charges would be of some interest. It proposes a funding level for construction of between N$ 70-80 million in 1996/97 price levels for the next few years. The sum contains grants, loans and the proposed contribution from the Road Fund Administration which will be in the range of N$ 55-65 million. Another way to assess the optimum level of the construction programme is to analyse the capital investment in the road infrastructure and its depreciation (table 5.3.2 below).

The estimated value of the national road network				
Road class	**Road type**	**km total**	**Reinvestment cost, average cost/km N$**	**Total reinvest-ment value N$ million**
Trunk	Bitumen	3,611	850,000	3,069
	Gravel	382	250,000	96
Main	Bitumen	1,261	800,000	1,009
	Gravel	8,334	250,000	2,084
District	Bitumen	88	500,000	44
	Gravel	19,077	100,000	1,908
	Salt&Earth	8,070	50,000	404
TOTAL		40,823		8,612

Table 5.3.2: The reinvestment value of the national road network

If the theoretical depreciation is based on a 40-year service life and the average age of the road network is 20 years the net asset of the road capital would be N$ 4,300 millions. The annual investments and reinvestments in the road network should not be less than the annual depreciation which is about N$ 108 millions. This is of course a very rough estimate which could be refined. However, it gives an indication of the long term annual funding level needed for construction and rehabilitation.

Preliminary estimate of expenditure - network level

When standards and targets are agreed upon and judged economically feasible, a network level preliminary estimate of the "optimum" funding level will be possible to obtain. Table 5.4.1 below shows the presumptions made for the calculations which follow on next page. The rates used in the calculations are retrieved from various sources reviewed (see Appendix H, Summary of costs and rates) and would not be applicable for the project level estimates.

	PROGRAMME	Selected standard or target
A.	Routine maintenance	
	1.Gravel roads - blading - roadside & bridge maint	 blading according to table 4.2.2.2 =1,4milj blkm same level as previous year
	2. Bitumen roads - bitumen maintenance - roadside maintenance - bridge maintenance	 same level as previous year same level as previous year same level as previous year
B.	Periodic maintenance	
	1. Gravel roads - regravelling	 1000 km annually according to table 4.2.2.3
	2. Bitumen roads -regravelling of shoulders - rejuvenating sprays - resealing	 same level as previous year 1300 km annually according to table 4.2.3.2 220 km annually according to table 4.2.3.2
C.	Rehabilitation & Improvements	
	1. Gravel roads - upgrading to gravel road - low-cost surfacings - spot improvements	 same level as previous year 10 year programme - 40 km annually according to table 4.2.2.4 20 drainage improvements annually 10 black spots removed annually
	2. Bitumen roads	
	- rehabilitation - carriageway widenings - spot improvements	overlay & spot improvements - 100 km annually included in rehab projects + 20 km annually 10 black spots removed annually
D.	Development projects	
	- major upgrading projects - new roads & bridges	10 year programme - 70 km annually according to table 4.2.2.4 According to NTMP
E.	Administration	
	Head office & Regions District overheads	According to RUC report Included in rates (7%)

Table 5.4.1 Presumed standards or targets

Preliminary Estimates of Expenditure - network level - 1997 price level							
Programme		Activity	Unit	Quantity	Rate*) N$/unit	Activity cost N$1000	Cumu-lative N$1000
A.	**Routine maintenance**						
	1.Gravel roads						
		blading	blkm	1,400,000	*30*	*42,000*	
		roadside (bushclearing)	lumpsum			*3,600*	
						45,600	
	2. Bitumen roads						45,600
		bitumen maintenance incl roadside	lumpsum			*18,800*	
		sundry maintenance	lumpsum			*9,400*	
						28,200	
							73,800
B.	**Periodic maintenance**						
	1.Gravel roads						
		regravelling	km	1,000	90,000	90,000	
							163,800
	2.Bitumen roads						
		rejuvenating spray (incl. road marking)	km	1,300	12,000	15,600	
		resealing (incl. road marking)	km	220	95,000	20,900	
						36,500	
							200,300
C.	**Rehab & improvement**						
	1.Gravel roads						
		upgrading to gravel road	lumpsum			*5,400*	
		low-cost surfacings	km	40	350,000	14,000	
		spot improvements - traffic safety	no	5	100,000	500	
		spot improvements - drainage	no	20	50,000	1,000	
						20,900	
							221,200
	2.Bitumen roads						
		rehab.(asphalt overlay only)	km	50	265,000	13,250	
		spot improvements - traffic safety	no	5	500,000	2,500	
						15,750	
				TOTAL MAINTENANCE			**236,950**
D.	**Development**						
	1.Major upgrading proj.						
		surfacing of gravel main roads	km	70	700,000	49,000	
		widening+overlay+surf shl	km	50	1,000,000	50,000	
						99,000	
	2.New roads&bridges						99,000
		according to NTMP	km	50	1,000,000	50,000	
				TOTAL DEVELOPMENT			**149,000**
E.	**Administration**						
		according to RUC				7,500	
				TOTAL ADMINISTRATION			**7,500**
				GRAND TOTAL ROADS			**393,450**
	*) contract rates/*departmental cost follow up*						

Table 5.4.2

The five year plan - preparation of estimates of expenditures

General approach

The preliminary estimate above could serve as an indicative estimate of the total funding level required. However, the final estimates must of course be based on inventories, condition surveys and identification of projects. Projects have to be specified, costed, economically evaluated and ranked. Slight variations as to funding requirements and physical output will probably arise, especially within and between the maintenance programmes. Some flexibility for this kind of alterations, as long as within the global estimate, must be allowed.

The estimates of expenditure for the five year plan is recommended to start with the mentioned preliminary estimate for the network level. The preliminary estimate should be seen as a top-down exercise with the aim to determine the scope of work in general for the next five year period of time.

The five year planning activity will then be a product of the top-down employment of chosen quality and quantity standards and targets, and the following bottom-up inventories of actual needs. The identified projects under the programmes mentioned in section 4.3 must be produced. Listing and ranking of the projects must be based on inventories, condition surveys and the application of sound economic principles if not economically evaluated. Periodic maintenance projects and ordinary rehabilitation projects are recommended to be ranked according to condition while improvement and development projects should be ranked according to economic feasibility. Alternative periodic maintenance options could be compared in terms of effectiveness and also evaluated economically if adequate information is available.

Finally, the financial requirements for the projects must be distributed over the five year period, not necessarily exactly in accordance with the preliminary estimate for each programme, but generally in agreement with the five year global estimate. Those projects, for which financial requirements for any reason cannot be met within the plan period, could be 'waitlisted' by being indicated in the column 'later'. If the funding level for the five year period, represented by the preliminary estimate, seems to be inappropriate in relation to the inventories, standards and targets need to be reviewed and a new preliminary estimate be worked out. If economic inefficiency will result a case for increased road user charges must be motivated to the RFA.
The “stability principle” for funding in the new legislation will however limit the decision of the RFA in this regard. It might therefore be necessary to take a loan instead of increasing the road user charges.

Five year plan/estimate for the period 1999/2000 to 2003/2004

The NTMPS Study Team applied the planning methodology described in section 5.5.1 in order to prepare a realistic estimate as a basis for the implementation of the new Roads Authority operations in 1999. The result of the work is presented in detail in Appendix I. Summary sheets are shown on the next two pages. The price level of the financial year 1997/98 has been used throughout. The following comments to the main items are offered.

A: Routine maintenance

The annual amounts are the same as those represented by the average of the last five years including 1997/98. These amounts may be conservative and could be questioned on the grounds that future maintenance under contract must be cheaper for efficiency reasons. The amounts are nevertheless recommended as a point of departure for the new organisation. They however do not include the effects of increased traffic, which would counteract reduced costs due to improved efficiency, a factor obviously not yet available.

B: Periodic maintenance

The amounts for rejuvenating sprays and reseals are based on the top-down criteria proposed for the road network level in sub-section 4.2.3.

Allowance has been made for a phasing-in period of three years for both. This was done to reduce the burden of the high expenditure in the first two years due to the high continuation amounts for development and rehabilitation projects, and to allow time to conduct more condition surveys. In the case of rejuvenating sprays a three year cycle will commence as from year three. Practice during the phasing-in period might however prove that a five year cycle will be more cost effective.

The amounts for reseals must also be adjusted in future based on condition surveys and the appropriate type of seal must be decided on per road or road link. The need for reseals will very much be dependent on the success of the much less expensive rejuvenation sprays.

The amounts for regravelling are based on the long term needs identified by applying the criteria in Section 4.2.2 and the actual annual regravellings carried out in the past. It has been noted that the annual kilometres of regravelling have been substantially reduced during recent years. A backlog and loss of asset has undoubtedly been created.

This trend needs to be reversed to prevent a total depletion of gravel in the wearing course layer of gravel roads countrywide, and the creation of unacceptably rough roads.

Also here allowance is made for a phasing-in period; five years in this case due to the huge increase in overall expenditure. Annual condition surveys, with the emphasis on centre-line gravel thickness, but also information on the availability and quality of gravel and water, hauling distances, etc., on a project level will however be required to enhance decision-making from the bottom-up approach. The long term effects on transport in this case must not be taken lightly.

C: Rehabilitation and improvements

The point of departure for identification of the annual needs for rehabilitation of bitumen roads was the criteria proposed in Section 4.2.4. This top-down approach was however regarded as too inaccurate for the preparation of a program for rehabilitation in the medium term. Therefore, the information contained in the Pavement Management System of DOT was utilised. The Study Team prepared the following long term scenarios based on the PMS data for discussion of the five year estimates:

1. NTMPS Optimistic Strategy
2. NTMPS Conservative Strategy
3. DOT PMS Strategy

Tables and graphs showing the details on the various strategies are contained in Appendix J.

Some of the data in the PMS is somewhat outdated (1990) and the technical relationships used to predict the remaining life of the road pavements appear to be on the conservative side. The Study Team therefore recommends that the NTMPS Optimistic Scenario be accepted as basis for programming of rehabilitation for the five year plan. The relatively dry climate in most parts of Namibia as well as traffic data have been the major determinants in this recommendation. Future monitoring of the PMS must be done in such a way that the long term effects of the recommended strategy are controlled. New deflection tests have been conducted on bitumen roads countrywide, but remaining life predictions have not been modelled yet. This information will improve the assessment of rehabilitation needs significantly when available. The NTMPS Team believes that the recommended strategy does not involve any major risks in the medium term. The inclusion of the more obvious rehabilitation projects in the medium term, as well as the fact that rehabilitation actions can be delayed by the introduction of more intensive routine maintenance operations, if required, will allow room to manoeuvre. Such additional routine maintenance could however be less cost-efficient. One unknown factor which may have a major influence on the performance of the existing old pavements is the future rainfall in relation to previous years.

The rehabilitation programme indicates the number of km for each specific road due for rehabilitation during a specific period of time. As a rule the number of km in the programme does not cover every km of a certain road link, for instance TR 1/3 Keetmanshoop - Wasser, where 26 km out of total 52 km will need attention in the five year programme. The remaining 26 km must also be considered in the final process of deciding in detail how to carry out the work. This should be done on the basis of a feasibility study and road design. It may then be feasible to combine the rehabilitation of the road with widening of the carriageway within the existing formation width on the remaining 26 km. The five year budget provides for the inclusion of such widening. An economic analysis based on the few basic assumptions indicated that the existing six metre (6.0-6.3) wide bitumen roads can be widened when the traffic volume exceeds ± 1000 vehicles per day.

The Ministry has identified a number of so-called "suspect" bridges with deficiencies from a structural point of view. A priority list was prepared in 1995, covering eight bridges deemed to be due for rehabilitation. The six most urgent of these bridges are proposed for rehabilitation during the first two years of the five year plan whilst the remaining, which only need monitoring, can be deferred for the time being.

The rehabilitation programme also contains a number of bridges to be widened during the period. The viability of those projects has been studied using the Simple Procedure for Bridge Widening in the Economic Evaluation Manual.

Amounts for spot improvements on bitumen and gravel roads are just tentative and should be further developed by identification of projects through the RA regional staff.

The low cost surfacing of gravel roads have been identified on the basis of economic viability using the simplified procedures referred to in sub-section 4.2.6.1 (The sections which were surfaced on the Okahandja-Hochfeld and Tsumeb-Tsintsabis roads are examples of such low volume/low cost surfacing projects).

The programming has been made in order to allow for more detailed studies on actual and future traffic volume and costs, before final decision to go ahead with any of the projects. The programme will provide some 70 km of surfaced roads per year.

D: Development projects

During the fiscal years 1999/2000 and 2000/2001 the major part of the budget will be dedicated to the construction of:
TR8/7 Katima Mulilo - Ngoma;
MR110 Onuuno - Eenhana; and
labour-based bitumen and gravel roads in the North.

Due to these commitments, in the order of N$ 117 million during 1999/2000, only a minimum amount for one new project is proposed for that year. During the next four years the following bitumen road projects have been proposed to be included in the plan (ranked on the basis of B/C Ratio):

Rank	Road no.	Project name
1	MR44	Swakopmund - Henties Bay
2	MR56	Gobabis - Drimiopsis
3	New	Drimiopsis - Otjinene
4	DR3403	Bagani - Mohembo

Those projects which have not been evaluated through full feasibility studies as indicated in the plan were identified by the Study Team using the Simplified Procedures for Surfacing of Gravel Road or Road Widening. The plan also contains a number of potential projects which may become feasible at a later stage. Further detailed studies of these projects need to be made before final decision to go ahead.

The tentative amounts proposed for development of gravel roads are on the same level as the average for the last five years, except for the continuation amounts of ongoing projects during the first three years. Primarily labour-based projects are included under this programme.

The amount for planning of developments is slightly higher than in the previous five year period but the same as in 1997/98. The much higher figure in the current fiscal year is caused by the large number of planning activities in progress at the moment.

E: Administration and sundries

The main item in this programme is the costs of the RA Head Office. The amount has been based on the 1997/98 expenditures. The amount must be regarded as tentative until the final details on the organisation of the RA are available.

F: Other items

The amounts for repayment of loans have been calculated from the repayment conditions of current loan agreements.

The implementation of the Namibian Traffic Information System (NaTIS) will require close to N$ 17 million during 1999/2000 and the running of the system will require about N$ 9.2 million per year thereafter.

The amounts for planning are the same as for the approved budget 1998/99.

Grand Total

Two summaries of the five year plan are presented, one with and one without loans and grants. This is in order to show the requirements of funds from the Road Fund and to give the total volume to be handled the RA during the next five years. The total amount excluding loans and grants during 1999/2000 is close to the average during the last five years. After an increase by some 24 % in the second year the amounts required from the Road User Charging System will be fairly stable during the following years in the plan.

The one year plan - the Annual Budget

While the five year plan should be seen as an interim or tentative 'budget' for the foreseeable future, the one year plan is actually the Annual Budget. Being the first year of that five year plan it will automatically be an element of the estimates for the five year plan. Nevertheless, it will have to be detailed as per programme (see forms enclosed in Appendix F) and costs should be controlled and assured. The following project identification is suggested within each programme;

periodic maintenance programme
- regravelling
- regravelling of shoulders
- rejuvenating sprays
- resealing

rehabilitation and improvement programme
- rehabilitation of roads & bridges
- carriageway widening
- surfacing and widening of shoulders
- upgrading to gravel road
- surfacing of gravel roads

- spot improvements

development programme

- major upgrading projects
- new roads and bridges

Last but not least, the submission of the estimates of expenditure for the one year plan (the Annual Budget) as well as for the five year plan should always include a brief summary by the director of the RA, where he/she highlights and comments the most important issues related to the actual budget year.

The basis for the first annual budget of the Roads Authority including comments is contained in the five year plan in Section 5.5. The first year in the five year plan represents the annual budget for the fiscal year 1999/2000.

Further work

General

This guideline provides a framework for road planning and budgeting in Namibia and will serve as a tool in the process of establishing the working methods and procedures of the new Roads Authority. It will also guide the Ministry in its strategic planning and evaluation of social road projects and programmes. Some of the procedures contained herein or in other manuals referred to are ready to use whilst others need to be further developed.

The recommendations contained in sub-sections 1.6.3, 1.7.10, 3.3.3, 3.4.1 and 4.2.7 should be applied as soon as the Roads Authority has come into operation.

There is however an obvious need for further development of support systems without which there will be a limited efficiency in the application of some of the recommendations in the guideline and manuals. The next section therefore contains proposals for further work in this context in order to enhance and develop the performance of the Roads Authority and the value of this guideline.

Recommendations

Development of the road management system (RMS)

The RMS must constitute the firm basis for future road planning. The various components of the RMS were commented on in sub-section 3.3.1. The efforts during the next few years in developing the RMS must focus on

enhancing the existing Traffic Surveillance System (TSS) by expanding the system for permanent counting stations to - in a first step - 15 stations covering trunk and main roads in all the DOT maintenance regions.

completion of the ongoing project aiming at a user-friendly Geographic Information System (GIS) which will present the national road network in a reliable way and clarify the extent of responsibility of the Roads Authority;

Upgrading of the Pavement Management System in order to provide easily accessible and aggregated information on the current service level of the bitumen roads and also provide a better basis for prediction of future needs for periodic maintenance and rehabilitation. The present technical relationships inside the PMS appear to be too conservative since their indications of remaining service life appear to give too low values. In other cases the indications are the opposite. The reasons for these discrepancies must be found and remedied. The existing prediction models normally under-estimate the value of timely routine and periodic road maintenance.

The system for monitoring of the unpaved roads should not be too ambitious. An Unpaved Road Management System could contain detailed information on each road link of the gravel roads. This might however entail collection of an enormous amount of data which need to be updated regularly in order to be useful. The Consultant does not believe this is the right direction for the Roads Authority to take. Instead, a more simple and straightforward approach should be chosen, basically in the direction which this guideline points (See sub-section 4.2.2). For instance,

* the relationships between traffic and blading frequency presented in 4.2.2.2 should be further developed by identifying representative road links in each region, covering different climatic conditions, materials and traffic volumes. Test sections should be selected on those road links and a research programme should be formulated in order to cover the needs for calibration of graph 4.2.2.2 or developing a simple generic formula for roughness prediction. The number of test roads could probably be limited to 15 - 20 in the initial step, if necessary to be expanded in future. The data collected in the tests must be closely monitored, analysed and the results fed back into the planning system;
* the basis for prediction of regravelling contained in sub-section 4.2.2.3 should also be calibrated, possibly by collecting gravel loss data from the same road sections as those just mentioned. The basis in Namibia for the formula developed by Paige-Green was namely limited to test sections in the Windhoek and Gobabis areas. Annual digging of test holes in the centre lines of as many gravel roads as possible in order to measure the remaining gravel thickness will not be costly. It can be done in conjunction with other maintenance activities and will provide reliable data.

The Bridge Management System contains a lot of useful information but must also be developed further from a user's point of view so that it can serve as a tool for strategic planning and for monitoring of bridge maintenance and repair. The first step could possibly be to move the existing data into a modern data base software in order to get an easily available tool for activity planning based on certain selection criteria.

Later on, the system should be developed to provide prediction models for remaining life, etc.

The needs for a Geometric Management System seem to be less than the abovementioned systems. Data on bitumen surface and formation widths are already contained in the PMS and will suffice in the near future. Alignment geometry should be considered on a project basis and will not require a data bank. A number of "black spots" have already been identified by the DOT through the years (mainly based on reports on accidents) and should first be attended to.

A detailed Costing System which would have been very useful for the NTMPS will be less urgent in future since road works will be carried out on a contract basis. The Roads Contractor must develop his own costing system as a basis for tendering. For the Roads Authority it will be enough to create a project and activity related cost data base on an aggregated level to be used for planning and budgeting purposes. The tendering process will ensure cost-effective operations.

Development and application of tools for economic evaluation

The Economic Evaluation Manual is a framework for evaluation of projects and strategies in the road sector. The main text of the manual needs to be reviewed only every 5 years or so. However, there is a need for more frequent recalculation of the input data to be used in the evaluations.

The basis for vehicle operating costs used in the NTMPS is the HDM-III based HDM-VOC. The relationships between road roughness (IRI) and VOC contained in the HDM-VOC should be replaced with those new ones which will be part of the HDM-4. There will be a separate module in the HDM-4 for calculation of VOC which makes it easy to just use that facility instead of HDM-VOC and still retain the spreadsheets in the Simplified Procedures in the manual as the standard tool. The new set of VOC relationships should be implemented within the next two years, if not before. Calibration of these relationships by substituting default input values with Namibian cost data will be possible.

The time costs used in the NTMPS are based on data collected in the RSA and contained in the COSTDATA software. The particular set of data should be fairly representative for most of Namibia since it was developed for the region around Upington. It should be sufficient for economic evaluation on national network level.

For project evaluation it is recommended that further studies on the distribution of income related to vehicle passengers are carried out for the Northern part of Namibia. The Ministry of Labour or the Central Statistical Office of the National Planning Commission could be tasked to help with the required data surveys.

The accident costs in the NTMPS were also based on South African data which may not be true in Namibia. New data on accident costs should be evaluated on the basis of accident rates and actual costs caused by accidents which have occurred in Namibia. There is however not enough basis at the moment for such data collection. As a matter of priority, a study into those frequencies and costs should be carried out as soon as a proper accident information system is in place. In the meantime, the South African data will have to be applied.

Regarding appropriate software for economic evaluation the new HDM-4 seems promising and will likely be the future global standard tool. Namibia should follow this development and start using the HDM-4 as soon as it is made available on the market. Some of the technical relationships for road maintenance contained in the software are not directly applicable in Namibia. It will therefore be necessary to calibrate the HDM-4 models before recommending full scale use of the software. This should if possible be done within a year after release of the software. In the meantime the Simplified Procedures in the Economic Evaluation Manual will be sufficient in most cases of project evaluation. The dTIMS software is a shell programme which makes use of models, such as HDM-III or HDM-4, as a basis for high quality presentations, primarily for optimising maintenance strategies. It has not been designed for economic evaluations of options considered for design purposes. This software can be considered in future, after having established detailed data bases, to augment the HDM-4 software.

Needs for research

The new environment for road management and financing will likely provide a good basis for development of new methods in road construction and maintenance. Research into new techniques will be financed through the road user charging system to the extent that it will be economically viable and promote efficiency.

The Roads Authority must initiate such research and encourage the development of local consultants and institutions to take part in research projects, such as

optimal blading and regravelling frequencies on gravel roads;
optimal frequencies of rejuvenation sprays on bitumen roads;
use of local materials for low costs surfacing of gravel roads;
long term technical standards and performance of roads built by labour-based methods.

Training

During the development of this guideline a number of meetings with relevant staff in the DOT have been held. Although not designed as formal training these meetings have contributed to creating an awareness in strategic planning and methods for planning and budgeting. Some staff have also been given more detailed explanations of the proposed procedures and tools, and also an introduction of the HDM-4. It will however be necessary to conduct training courses in the detailed use of this guideline and the procedures and tools associated with it. This can only be done when the guideline has been formally approved and the Roads Authority is in place. It is also not yet known who will be the users of the procedures and tools.

The details of a training programme still has to be worked out. The main target groups and course contents could be the following:

<u>Executive group</u>

Two days course covering:

Framework (legal and practical) for road planning and budgeting
Approaches and basis for strategic planning
Overview of tools and procedures for economic evaluation of projects and strategies, and prioritisation
Demo of practical examples in planning and budgeting

<u>RA staff</u>

Five days course covering

Framework (legal and practical) for road planning and budgeting
Overview of tools and procedures for economic evaluation of projects and strategies
Practical training in the use of, incl. explanation of the background for,

* Simplified Procedures for economic evaluation of projects and strategies
* HDM-4 (when available)
* Traffic forecasting on low-volume roads

* Standard forms for five year plans and annual budgets
Updating and development of procedures and tools
Contract documentation.

Appendices

APPENDIX A

Terms of Reference

APPENDIX B

Reports and other documents reviewed

Appendix B

Reports and other material reviewed

1. Development Planning Manual for Namibia, July 1994
2. White Paper on Transport Policy, October 1995
3. First National Development Plan (NDP1) 1995/1996-1999/2000, Volume I and II
4. Corporate Plan of the Ministry of Works Transport and Communication (MWTC 1996)
5. Road Fund Administration Bill, 29 May 1998
6. Roads Authority Bill, 29 May 1998
7. National Transportation Master Plan Study, Final Report on Road User Charges, 28 May 1997
8. National Transportation Master Plan Study, Draft Issues Report on Road Project Evaluation, 25 June 1997.
9. Road Management System Master Plan, Final Draft, August 1997
10. National Transport Development Plan, Step 1, Final Report December 1996, SOGREAH/SYSTRA
11. Recommendations for the allocation of maintenance funds to the road authorities, Department of Transport, RSA.
12. National Accounts 1981-1996, Central Statistics Office, Windhoek
13. The Kenya Maintenance Study on Unpaved Roads: Optimum Maintenance Strategies, T.E. Jones, TRL, UK, 1984
14. The Influence of Geotechnical Properties on the Performance of Gravel Wearing Course Materials, P. Paige Green, PhD Thesis, Pretoria, 1989

APPENDIX C

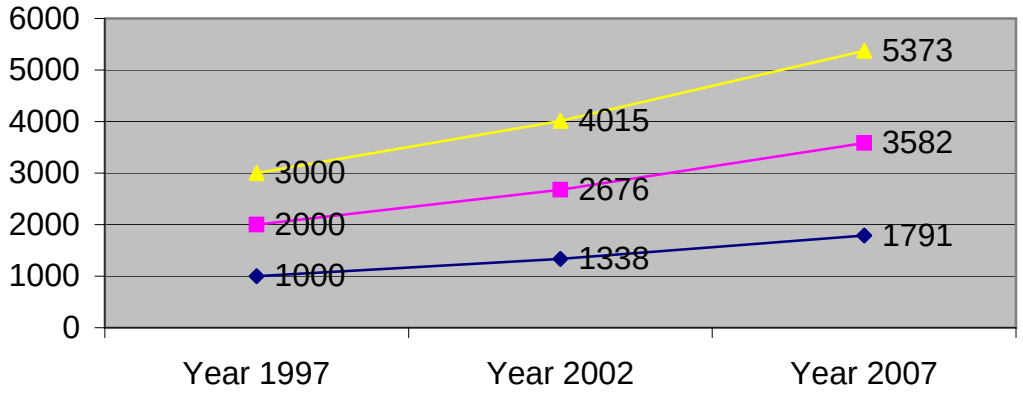
Illustrative traffic growth table

Traffic growth table*)

*) results from various growth rates after 5,10,15,and 20 years

Traffic volume Year 1997	Annual growth %	Traffic volume Year 2002	Traffic volume Year 2007	Traffic volume Year 2012	Traffic volume Year 2017
50	2%	55	61	67	74
100	2%	110	122	135	149
200	2%	221	244	269	297
500	2%	552	609	673	743
1000	2%	1104	1219	1346	1486
2000	2%	2208	2438	2692	2972
3000	2%	3312	3657	4038	4458
50	4%	61	74	90	110
100	4%	122	148	180	219
200	4%	243	296	360	438
500	4%	608	740	900	1096
1000	4%	1217	1480	1801	2191
2000	4%	2433	2960	3602	4382
3000	4%	3650	4441	5403	6573
50	6%	67	90	120	160
100	6%	134	179	240	321
200	6%	268	358	479	641
500	6%	669	895	1198	1604
1000	6%	1338	1791	2397	3207
2000	6%	2676	3582	4793	6414
3000	6%	4015	5373	7190	9621
50	8%	73	108	159	233
100	8%	147	216	317	466
200	8%	294	432	634	932
500	8%	735	1079	1586	2330
1000	8%	1469	2159	3172	4661
2000	8%	2939	4318	6344	9322
3000	8%	4408	6477	9517	13983

The results of traffic growth 6% for ten years



APPENDIX D

Administrative and geographical road network statistics

Administrative and geographical road network statistics

Administr. Region	Popu-lation 1991	Area sqkm	Pop./ sqkm	MWTC Road district	Gravel roads km 1992	Daily vehicle-km on gravel rds	Bitumen roads km 1992	Daily vehicle-km on bitum.rds	Total km	Daily total veh.km	Roads m/sqkm	Roads m/cap.	Gravel m/cap.	Bitumen m/cap.	Daily vehicle-km per cap.	Daily vehicle-km per km	Daily Veh.km/ gravelkm	Daily Veh.km/ surf. km
Caprivi	**90422**	**18530**	**4.9**	**Katima Mulilo**	**561**	**7454**	**120**	**6556**	**681**	**14010**	**36.8**	**7.5**	**6.2**	**1.3**	**0.2**	**20.6**	**13.3**	**54.6**
Erongo	**55470**	**65086**	**0.9**	**Usakos**	**3177**	**29887**	**389**	**39172**	**3566**	**69059**	**54.8**	**64.3**	**57.3**	**7.0**	**1.2**	**19.4**	**9.4**	**100.7**
				Mariental	3785	13252	394	42913	4179	56165								
				Maltahohe	1426	4989	34	445	1460	5434								
Hardap	**66495**	**110382**	**0.6**		**5211**	**18241**	**428**	**43358**	**5639**	**61599**	**51.1**	**84.8**	**78.4**	**6.4**	**0.9**	**10.9**	**3.5**	**101.3**
				Bethanien	1839	8941	214	4556	2053	13497								
				Karasburg	1876	6496	347	33794	2223	40290								
				Keetmanshoop	2862	9958	332	57694	3194	67652								
Karas	**61162**	**162384**	**0.4**		**6577**	**25395**	**893**	**96044**	**7470**	**121439**	**46.0**	**122.1**	**107.5**	**14.6**	**2.0**	**16.3**	**3.9**	**107.6**
				Windhoek	2309	10578	344	40587	2653	51165								
				Rehoboth	907	4594	148	29239	1055	33833								
Khomas	**167071**	**37590**	**4.4**		**3216**	**15172**	**492**	**69826**	**3708**	**84998**	**98.6**	**22.2**	**19.2**	**2.9**	**0.5**	**22.9**	**4.7**	**141.9**
				Opuwo	1669	27497	2	48	1671	27545								
				Outjo	2381	10561	420	8592	2801	19153								
Kunene	**64017**	**136549**	**0.5**		**4050**	**38058**	**422**	**8640**	**4472**	**46698**	**32.8**	**69.9**	**63.3**	**6.6**	**0.7**	**10.4**	**9.4**	**20.5**
Ohangwena	179634	10029	17.9	Ondangwa														
Oshana	134884	5180	26.0	Ondangwa														
Omusati	189919	12552	15.1	Ondangwa														
	504437	**27761**	**18.2**	**Ondangwa**	**1348**	**16346**	**438**	**48710**	**1786**	**65056**	**64.3**	**3.5**	**2.7**	**0.9**	**0.1**	**36.4**	**12.1**	**111.2**
Kavango	**116830**	**42771**	**2.7**	**Rondu**	**1269**	**14367**	**182**	**16356**	**1451**	**30723**	**33.9**	**12.4**	**10.9**	**1.6**	**0.3**	**21.2**	**11.3**	**89.9**
Omaheke	**52735**	**87202**	**0.6**	**Gobabis**	**4576**	**20781**	**112**	**5508**	**4688**	**26289**	**53.8**	**88.9**	**86.8**	**2.1**	**0.5**	**5.6**	**4.5**	**49.2**
Oshikoto	**128745**	**26765**	**4.8**	**Tsumeb**	**941**	**8988**	**205**	**29795**	**1146**	**38783**	**42.8**	**8.9**	**7.3**	**1.6**	**0.3**	**33.8**	**9.6**	**145.3**
				Grootfontein	2608	24295	359	50868	2967	75163								
				Okahandja	1360	7232	194	33423	1554	40655								
				Otjiwarongo	2108	12427	351	36755	2459	49182								
Otjozondjupa	**102536**	**108124**	**0.9**		**6076**	**43954**	**904**	**121046**	**6980**	**165000**	**64.6**	**68.1**	**59.3**	**8.8**	**1.6**	**23.6**	**7.2**	**133.9**
Total	**1409920**	**823144**	**1.7**		**37002**	**238643**	**4585**	**485011**	**41587**	**723654**	**50.5**	**29.5**	**26.2**	**3.3**	**0.5**	**17.4**	**6.4**	**105.8**

APPENDIX E

Gravel loss tables

Gravel loss table*)

Formula GL=4.33x(T^2)/(T^2+375)*(1.25+T/100+1.04R^2+0.56VC) for Laterite
Formula GL=5.07x(T^2)/(T^2+375)*(1.25+T/100+1.04R^2+0.56VC) for Quartzite

Where GL=annual Gravel Loss in mm
T=average daily Traffic in no of vehicles
R=annual Rainfall in m
VC=rise and fall (%), Vertical Curvature

Gravel loss (mm/year)								Theoretical regravelling frequencies (years)					
T Traffic AADT	R Rainfall m	Laterite VC=0 GL mm	Quartzite VC=0 GL mm	Laterite VC=2 GL mm	Quartzite VC=2 GL mm	Laterite VC=4 GL mm	Quartzite VC=4 GL mm	Laterite 150 mm VC=0	Quartzite 150 mm VC=0	Laterite 150 mm VC=2	Quartzite 150 mm VC=2	Laterite 150 mm VC=4	Quartzite 150 mm VC=4
20	0	3.2	3.8	5.7	6.7	8.2	9.7	46	40	26	22	18	16
50	0	6.6	7.7	10.8	12.7	15.0	17.6	23	19	14	12	10	9
100	0	9.4	11.0	14.1	16.5	18.7	21.9	16	14	11	9	8	7
150	0	11.7	13.7	16.5	19.3	21.3	24.9	13	11	9	8	7	6
200	0	13.9	16.3	18.7	22.0	23.6	27.6	11	9	8	7	6	5
250	0	16.1	18.9	21.0	24.5	25.8	30.2	9	8	7	6	6	5
300	0	18.3	21.5	23.2	27.1	28.0	32.8	8	7	6	6	5	5
20	0.3	3.4	4.0	6.0	7.0	8.5	9.9	43	37	25	22	18	15
50	0.3	6.9	8.1	11.2	13.1	15.4	18.0	22	18	13	11	10	8
100	0.3	9.8	11.5	14.5	16.9	19.1	22.4	15	13	10	9	8	7
150	0.3	12.1	14.2	16.9	19.8	21.7	25.4	12	11	9	8	7	6
200	0.3	14.3	16.8	19.1	22.4	24.0	28.0	10	9	8	7	6	5
250	0.3	16.5	19.4	21.4	25.0	26.2	30.7	9	8	7	6	6	5
300	0.3	18.7	21.9	23.6	27.6	28.4	33.2	8	7	6	5	5	5
20	0.8	4.7	5.5	7.2	8.5	9.7	11.4	32	27	21	18	15	13
50	0.8	9.1	10.6	13.3	15.6	17.5	20.5	16	14	11	10	9	7
100	0.8	12.2	14.2	16.8	19.7	21.5	25.2	12	11	9	8	7	6
150	0.8	14.5	17.0	19.3	22.6	24.1	28.2	10	9	8	7	6	5
200	0.8	16.8	19.7	21.6	25.3	26.4	30.9	9	8	7	6	6	5
250	0.8	19.0	22.3	23.8	27.9	28.6	33.5	8	7	6	5	5	4
300	0.8	21.2	24.8	26.0	30.5	30.9	36.1	7	6	6	5	5	4

*)according to TRL Kenya study (Report 1 111, 1984)

Gravel loss table (Paige-Green, 1989)

Formula GL=3.65x[ADT(0.059 + 0.0027xN - 0.0006xP26) - 0.367xN - 0.0014xPF + 0.0474xP26]

Where GL=annual Gravel Loss in mm
ADT=Average Daily Traffic in no of vehicles
N = Weinert value representing the climatic conditions
P26 = Percent of material passing the 26.5 mm sieve
PF = Plastic Limit x percent passing 0.075 mm sieve

		Gravel loss, GL (mm/year)									Theoretical regravelling frequencies (years). Nominal thickness 150 mm								
T Traffic ADT	N Weinert value	P26 value 70 PF value 200	P26 value 70 PF value 400	P26 value 70 PF value 600	P26 value 85 PF value 200	P26 value 85 PF value 400	P26 value 85 PF value 600	P26 value 100 PF value 200	P26 value 100 PF value 400	P26 value 100 PF value 600	P26 value 70 PF value 200	P26 value 70 PF value 400	P26 value 70 PF value 600	P26 value 85 PF value 200	P26 value 85 PF value 400	P26 value 85 PF value 600	P26 value 100 PF value 200	P26 value 100 PF value 400	P26 value 100 PF value 600
20	3	8.9	7.9	6.9	10.8	9.8	8.8	12.8	11.8	10.7	16.8	19.0	21.9	13.8	15.3	17.1	11.7	12.8	14.0
50	3	11.7	10.6	9.6	12.6	11.6	10.6	13.6	12.5	6.8	12.9	14.1	15.6	11.9	13.0	14.2	11.1	12.0	22.1
100	3	16.2	15.2	14.2	15.5	14.5	13.5	14.9	13.8	12.8	9.2	9.9	10.6	9.7	10.3	11.1	10.1	10.8	11.7
150	3	20.8	19.8	18.8	18.5	17.5	16.4	16.1	15.1	14.1	7.2	7.6	8.0	8.1	8.6	9.1	9.3	9.9	10.6
20	10	0.9	-0.1	-1.1	2.8	1.8	0.8	4.8	3.8	2.7	165.7	n.a	n.a.	52.8	n.a	n.a.	31.4	n.a	n.a.
50	10	5.7	4.7	3.7	6.7	5.7	4.6	7.6	6.6	5.6	26.2	31.9	40.8	22.5	26.5	32.4	19.7	22.7	26.9
100	10	13.8	12.7	11.7	13.1	12.0	11.0	12.4	11.4	10.3	10.9	11.8	12.8	11.5	12.5	13.6	12.1	13.2	14.5
150	10	21.8	20.8	19.7	19.7	18.4	17.4	17.1	16.1	15.1	6.9	7.2	7.6	7.6	8.1	8.6	8.8	9.3	10.0
20	30	-21.9	-23.0	-24.0	-20.0	-21.0	-22.0	-18.1	-19.1	-20.1	n.a	n.a	n.a.	n.a	n.a	n.a.	n.a	n.a	n.a.
50	30	-11.2	-12.2	-13.3	-10.3	-11.3	-12.3	-9.3	-10.3	-11.4	n.a	n.a	n.a.	n.a	n.a	n.a.	n.a	n.a	n.a.
100	30	6.7	5.7	7.7	6.0	5.0	3.9	5.3	4.3	3.2	22.5	26.5	19.5	25.1	30.2	38.1	28.3	35.1	46.2
150	30	24.6	23.5	22.5	22.2	21.2	20.2	19.9	18.9	17.8	6.1	6.4	6.7	6.7	7.1	7.4	7.5	7.9	8.4

APPENDIX F

Forms for Estimates of Expenditure

Date

ESTIMATES OF EXPENDITURE - SUMMARY OF FIVE YEAR PLAN

Nation-wide/ or Region

Financial years **From:** **To:**

Category	Road type	Activity	Approved budget year	Expenditures in Year	Year	Year	Year	prices Year
			N$ 1000	N$1000	N$1000	N$1000	N$1000	N$1000
A:Routine maintenance	Bitumen roads	Bitumen maintenance, incl.						
(Sundries + overhead costs		road reserve maintenance						
included)	Gravel roads	Gravel maintenance, incl.						
		road reserve maintenance						
	SUBTOTAL ROUTINE MAINTENANCE							
B:Periodic maintenance	Bitumen roads	Rejuvenating sprays						
(Sundries + overhead costs		Reseals, roadmarkings, edgings						
included)	Gravel roads	Regravelling, betterment, bushclearing						
	SUBTOTAL PERIODIC MAINTENANCE							
C:Rehabilitation	Bitumen roads	Rehabilitations (incl. overlays)						
and improvements		Bridge repairs and widenings						
		Carriageway widenings						
		Spot improvements						
	Gravel roads	Surfacing of gravel roads (low cost)						
		Spot improvements						
	SUBTOTAL REHAB&IMPROVEMENT							
	SUB TOTAL MAINTENANCE							
D:Development projects	Bitumen roads	New road constructions & major upgradings						
	Gravel roads	New road constructions & major upgradings						
	Bridges	New bridges						
		Planning of developments						
	SUB TOTAL DEVELOPMENT							
E:Administration and		Head office						
sundries (including com-								
pensation & fencing)								
	SUB TOTAL ADMINISTRATION							
F: Other items		Loan repayments						
		Planning (incl. NaTIS)						
	GRAND TOTAL							

Date

A:Routine maintenance estimates of expenditure (annual need)

Nation-wide/ or Region

Financial Year

Road class/type	Bitumen roads						Gravel roads						Sub Total
	Bitumen maintenance			Road Reserve Maint.			Gravel maintenance			Road Reserve Maint.			
	km	cost/km N$	Total N$ 1000	km	cost/km N$	Total N$ 1000	km	cost/km N$	Total N$ 1000	km	cost/km N$	Total N$ 1000	N$ 1000
Trunk roads													
Main roads													
District roads													
Grand Total													

Date

B:Periodic maintenance estimates of expenditure (annual need)

Nation-wide/ or Region

Financial Year

Road class/type	**Bitumen roads**									**Gravel roads**			**Sub Total**
	Annual rejuvenating sprays		Total	Annual resealing		Total	Annual regravelling of shoulders		Total	Annual regravelling		Total	
	km	cost/km, N$	N$ 1000	km	cost/km, N$	N$ 1000	km	cost/km, N$	N$ 1000	km	cost/km, N$	N$ 1000	**N$ 1000**
Trunk roads													
Main roads													
District roads													
Grand Total													

Date

C1:Rehabilitation and improvement; estimates of expenditure (annual need)

Bitumen roads

Nation-wide/ or Region

Financial year

Road class/type	**Bitumen roads - rehabilitation and spot improvements**									**Sub total**
	Rehabilitation, incl. overlays			Carriageway widening			Climbing/passing lanes			
	km	cost/km, N$	N$ 1000	km	cost/km, N$	N$ 1000	km	cost/km, N$	N$ 1000	**N$ 1000**
Trunk roads										
Main roads										
District roads										
Grand Total										

	New drainage facilities& erosion protections			**Bitumen roads - spot improvements**						**Sub total**
				Hazardous road sections			Dangerous intersections			
	no	cost/no, N$	N$ 1000	km	cost/km, N$	N$ 1000	no	cost/no, N$	N$ 1000	**N$ 1000**
Trunk roads										
Main roads										
District roads										
Grand Total										

Date

C2:Rehabilitation and improvement; estimates of expenditure (annual need)

Major repairs and widening of bridges

Nation-wide/ or Region

Financial year

Road class/type	Widening existing bridges			Replace with new bridges			Major repairs			**Sub total**
	No of spans	cost/span, N$	N$ 1000	No of spans	cost/span, N$	N$ 1000	No of spans	cost/span, N$	N$ 1000	**N$ 1000**
Trunk roads, need										
Main roads, need										
District roads, need										
Grand Total, need										

Date

C3:Rehabilitation and improvement; estimates of expenditure (annual need)

Gravel roads

Nation-wide/ or Region

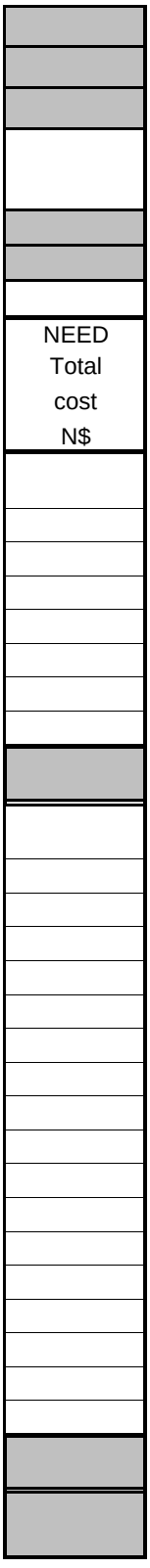
Financial year

Road class/type	**Gravel roads**									**Sub total**
	Surfacing of gravel roads			New drainage&erosion prot.			Hazardous road sections			
	km	cost/km, N$	N$ 1000	no	cost/no, N$	N$ 1000	km	cost/km, N$	N$ 1000	**N$ 1000**
Trunk roads, need										
Main roads, need										
District roads, need										
Grand Total, need										

Estimates of expenditure Date
Financial Years …… Region
Routine maintenance District
Gravel and Earth Roads

Rd no		**Road class**			**Road length**	
Road		**Surf.type**			**Traf.vol. ADT**	
name		**Surf.width**				

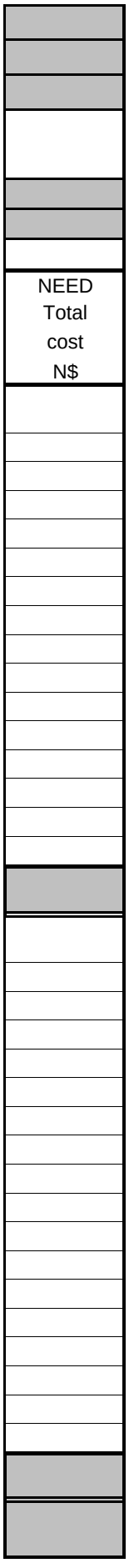
Act. code	Activity	From km	To km	Unit of measure-ment	Qty	Cost/ Qty N$
	Gravel Road Maintenance					
	Blading			blkm		
	Pot hole patching			m2		
	Spot gravelling			m3		
	Emergency maintenance			lumpsum		
	Miscellanous			lumpsum		
	Total Gravel Road Maintenance			km		
	Road Reserve Maintenance					
	Grass cutting			km		
	Bush clearing			km		
	Trimming and pruning of trees			no		
	Debris and litter clearing			km		
	Culvert cleaning			no		
	Drain clearing			km		
	Signs - repair,replacement			no		
	Culvert repairs			no		
	Culvert extensions			no		
	Bridge deck cleaning			no		
	Guardrail repair			m		
	Rest area/Lay-bye cleaning			no		
	Emergency maintenance			lumpsum		
	Miscellanous (rock clearing, wreck			lumpsum		
	removal, watering of trees, etc.)					
	Total Road Reserve Maintenance			km		
	Grand Total Routine Maintenance			km		


NEED
Total
cost
N$

Estimates of expenditure Date
Financial Years …….. Region
Routine maintenance District
Bitumen Roads

Rd no		**Road class**			**Road length**	
Road		**Surf.type**			**Traf.vol. ADT**	
name		**Surf.width**				

Act. code	Activity	From km	To km	Unit of measure-ment	Qty	Cost/ Qty N$
	Bitumen Road Maintenance					
	Base repair			m2		
	Crack sealing			km		
	Surface patching			m2		
	Surface sealing - spray and chip seal			m2		
	Surface sealing - spray and dust seal			m2		
	Bleeding removal			m2		
	Depression levelling			m2		
	Edge repair			m2		
	Shoulder blading			shlkm		
	Shoulder mowing			shlkm		
	Shoulder gravelling			shlkm		
	Road marking			km		
	Emergency maintenance			lumpsum		
	Miscellanous			lumpsum		
	Total Bitumen maintenance			km		
	Road Reserve Maintenance					
	Grass cutting			km		
	Bush clearing			km		
	Trimming and pruning of trees			no		
	Debris and litter clearing			km		
	Culvert cleaning			no		
	Drain clearing			km		
	Signs - repair,replacement			no		
	Culvert repairs			no		
	Culvert extensions			no		
	Bridge deck cleaning			no		
	Guardrail repair			m		
	Rest area/Lay-bye cleaning			no		
	Emergency maintenance			lumpsum		
	Miscellanous (rock clearing, wreck			lumpsum		
	removal, watering of trees, etc.)					
	Total Road Reserve Maintenance			km		
	Grand Total Routine Maintenance			km		

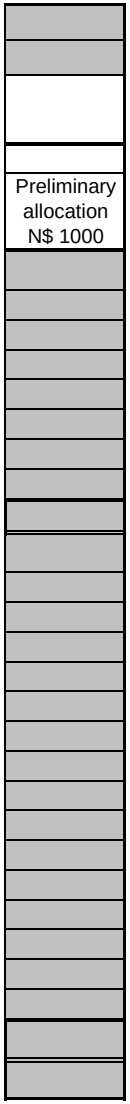

NEED
Total
cost
N$

Estimates of expenditure Date

Financial Years …….. Nation-wide/Region

Routine maintenance **Gravel and Earth Roads - All Roads**

Act. code	Activity	Unit of measure-ment	TRUNK ROADS			MAIN ROADS			DISTRICT ROADS			ALL ROADS			
			Qty	Cost/ Qty N$	Total cost N$ 1000	Qty	Cost/ Qty N$	Total cost N$ 1000	Qty	Cost/ Qty N$	Total cost N$ 1000	Qty	Cost/ Qty N$	Total cost N$ 1000	Est. exp. curr. year N$ 1000
	Gravel Road Maintenance														
	Blading	blkm													
	Pot hole patching	m2													
	Spot gravelling	m3													
	Emergency maintenance	lumpsum													
	Miscellanous	lumpsum													
	Total Gravel Road Maintenance	km													
	Road Reserve Maintenance														
	Grass cutting	km													
	Bush clearing	km													
	Trimming and pruning of trees	no													
	Debris and litter clearing	km													
	Culvert cleaning	no													
	Drain clearing	km													
	Signs - repair,replacement	no													
	Culvert repairs	no													
	Culvert extensions	no													
	Bridge deck cleaning	no													
	Guardrail repair	m													
	Rest area/Lay-bye cleaning	no													
	Emergency maintenance	lumpsum													
	Miscellanous	lumpsum													
	Total Road Reserve Maintenance	km													
	Grand Total Routine Maintenance	km													


Preliminary allocation N$ 1000

Estimates of expenditure Date

Financial Years …….. Nation-wide/Region

Routine maintenance **Bitumen Roads - All Roads**

Act. code	Activity	Unit of measure-ment	TRUNK ROADS			MAIN ROADS			DISTRICT ROADS			ALL ROADS			
			Qty	Cost/ Qty N$	Total cost N$ 1000	Qty	Cost/ Qty N$	Total cost N$ 1000	Qty	Cost/ Qty N$	Total cost N$ 1000	Qty	Cost/ Qty N$	Total cost N$ 1000	Est. exp. curr. year N$ 1000
	Bitumen Road Maintenance														
	Base repair	m2													
	Crack sealing	km													
	Surface patching	m2													
	Surface sealing - spray and chip seal	m2													
	Surface sealing - spray and dust seal	m2													
	Bleeding removal	m2													
	Depression levelling	m2													
	Edge repair	m2													
	Shoulder blading	shlkm													
	Shoulder mowing	shlkm													
	Shoulder gravelling	shlkm													
	Road marking	km													
	Emergency maintenance	lumpsum													
	Miscellanous	lumpsum													
	Total Bitumen maintenance	km													
	Road Reserve Maintenance														
	Grass cutting	km													
	Bush clearing	km													
	Trimming and pruning of trees	no													
	Debris and litter clearing	km													
	Culvert cleaning	no													
	Drain clearing	km													
	Signs - repair,replacement	no													
	Culvert repairs	no													
	Culvert extensions	no													
	Bridge deck cleaning	no													
	Guardrail repair	m													
	Rest area/Lay-bye cleaning	no													
	Emergency maintenance	lumpsum													
	Miscellanous	lumpsum													
	Total Road Reserve Maintenance	km													
	Grand Total Routine Maintenance	km													

Preliminary allocation N$ 1000

Estimates of expenditure Date

Financial Years …… Nation-wide/Region

Periodic maintenance **Five year plan - Regravelling**

Gravel Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000
Grand Total																	

Estimates of expenditure Date

Financial Years …… Nation-wide/Region

Periodic maintenance **Five year plan - Rejuvenating spray**

Bitumen Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000
Grand Total																	

Estimates of expenditure Date

Financial Years …… Nation-wide/Region

Periodic maintenance **Five year plan - Resealing**

Bitumen Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Type of seal	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000
Grand Total																		

Estimates of expenditure Date

Financial Years ……. Nation-wide/Region

Periodic maintenance **Five year plan - Regravelling of shoulders**

Bitumen Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000
Grand Total																	

Estimates of expenditure Date

Financial Years …….. Nation-wide/Region

Rehabilitation & improvement **Five year plan - Rehabilitation of Roads & Bridges**

Bitumen Roads

Rank	Road class T,M,D	Bridge or Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
Grand Total																				

Estimates of expenditure Date

Financial Years …… Nation-wide/Region

Rehabilitation & improvement **Five year plan - Widening of carriageways**

Bitumen Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation **/N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
Grand Total																				

Estimates of expenditure Date

Financial Years …… Nation-wide/Region

Rehabilitation & improvement

Bitumen Roads

Five year plan - Spot improvements

a) new drainage & erosion protections - b) hazardous road sections

c) dangerous intersections - d) climbing and passing lanes

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	Project type a,b,c,d	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
Grand Total																	

Estimates of expenditure Date

Financial Years …… Nation-wide/Region

Rehabilitation & improvement **Five year plan - Upgrading to gravel road**

Earth Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
Grand Total																				

Estimates of expenditure Date
Financial Years …… Nation-wide/Region
Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**
Gravel Roads

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	B/C Ratio	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
Grand Total																					

Estimates of expenditure Date

Financial Years …….. Nation-wide/Region

Rehabilitation & improvement **Five year plan - Spot improvements**

Gravel and Earth Roads **a) new drainage & erosion protections - b) hazardous road sections**

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation **/N**ew	Project type a,b,c,d	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
Grand Total																	

Estimates of expenditure
Financial Years ……
Development projects

Date
Nation-wide/Region

Five year plan - New Roads and Bridges and Major Upgrading Projects

Rank	Road class T,M,D	Bridge or Road no	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	ADT	B/C ratio	Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan**						Source of Finance			
																Year 1	Year 2	Year 3	Year 4	Year 5	Later	RFA	GVT	Donor	Other
																N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000
Grand Total																									

Estimates of expenditure
Financial Year ……
Development projects

Date
Nation-wide/Region

Annual budget - New Roads and Bridges and Major Upgrading Projects

Rank	NPC Project code	Bridge no Road no	Project name	Project No.	**C**onti-nuation /**N**ew	From km	To km	Total km	ADT	B/C ratio	Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No	Total Estim. cost N$1000	Total Exp before current year	Estim. Exp. current year	Estim. Proj. cost FY……. N$ 1000	Source of Finance				Cumulative Total		Estim. Exp. later N$ 1000
																		RFA N$ 1000	GVT N$ 1000	Donor Loan N$ 1000	Donor Grant N$ 1000	incl. Loans N$ 1000	excl. Loans N $1000	
Grand Total																								

Date Sheet no:

Regravelling projects
Annual budget for year
Project list

Rank	Region	Project name	Road class T,M,D	km	Cost/ km N$	Total cost N$	Prel. design Yes/No	Detail. design Yes/No	Budget Year 1 N$	Budget Later N$
Grand Total										

Date Sheet no:

Reseal projects
Annual budget for year
Project list

Rank	Region	Project name	Road class T,M,D	km	Cost/ km N$	Total cost N$	Prel. design Yes/No	Detail. design Yes/No	Budget Year 1 N$	Budget Later N$
Grand Total										

Date Sheet no:

Surfacing of gravel roads
Annual budget for year
Project list

Rank	Region	Project name	Road class T,M,D	km	Cost/ km N$	Total cost N$	Prel. design Yes/No	Detail. design Yes/No	Budget Year 1 N$	Budget Later N$
Grand Total										

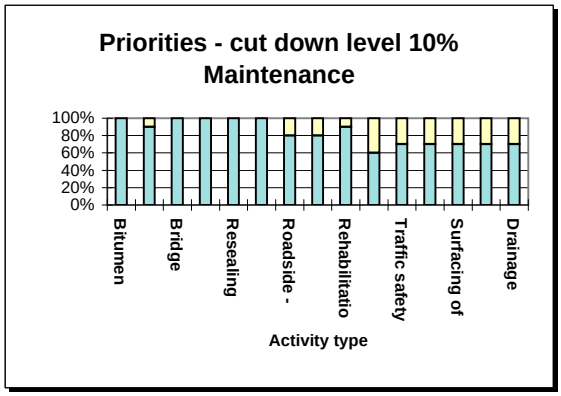
Date Sheet no:

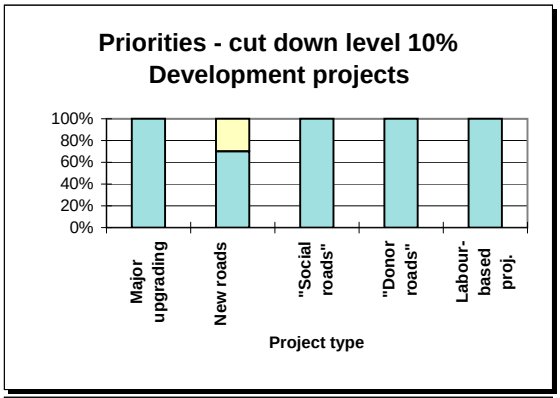
Rehabilitations and improvement works
Annual budget for year
Project list

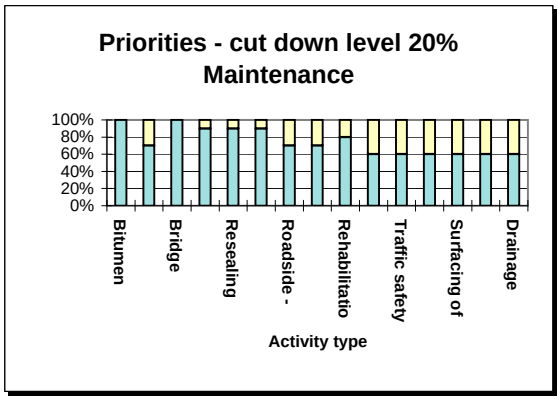
Rank	Region	Type of project	Project name	Road class T,M,D	km/no	Cost/ km/no N$	Total cost N$	Prel. design Yes/No	Detail. design Yes/No	Budget Year 1 N$	Budget Later N$
Grand Total											

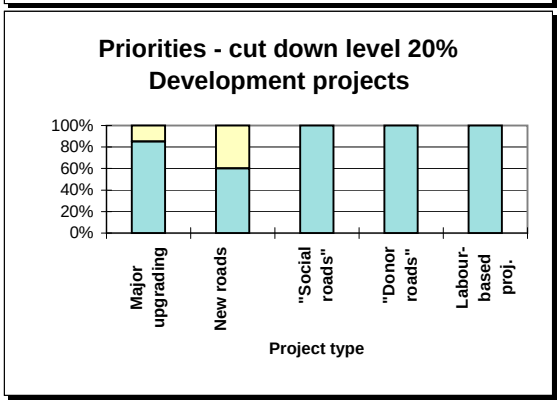
APPENDIX G

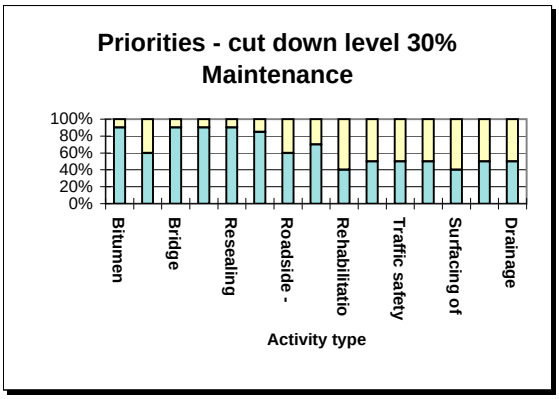
Prioritisation model - sample graphs

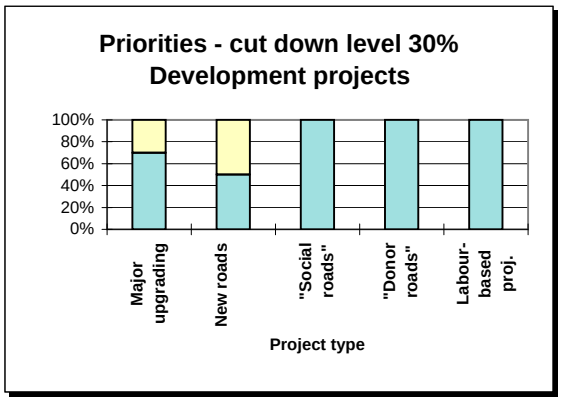

Priorities - cut down level 10% Maintenance
100%
80%
60%
40%
20%
0%
Bitumen
Bridge
Resealing
Roadside -
Rehabilitatio
Traffic safety
Surfacing of
Drainage
Activity type


Priorities - cut down level 10% Development projects
100%
80%
60%
40%
20%
0%
Major upgrading
New roads
"Social roads"
"Donor roads"
Labour-based proj.
Project type


Priorities - cut down level 20% Maintenance
100%
80%
60%
40%
20%
0%
Bitumen
Bridge
Resealing
Roadside -
Rehabilitatio
Traffic safety
Surfacing of
Drainage
Activity type


Priorities - cut down level 20% Development projects
100%
80%
60%
40%
20%
0%
Major upgrading
New roads
"Social roads"
"Donor roads"
Labour-based proj.
Project type


Priorities - cut down level 30% Maintenance
100%
80%
60%
40%
20%
0%
Bitumen
Bridge
Resealing
Roadside -
Rehabilitatio
Traffic safety
Surfacing of
Drainage
Activity type


Priorities - cut down level 30% Development projects
100%
80%
60%
40%
20%
0%
Major upgrading
New roads
"Social roads"
"Donor roads"
Labour-based proj.
Project type

APPENDIX H

Summary of costs and rates

Date
1998-09-23

ESTIMATES OF EXPENDITURE - SUMMARY OF FIVE YEAR PLAN
Excluding loans and grants

Nation-wide/ or Region
Nation-wide

Financial years From: 1999/2000 **To:** 2003/2004

Category	Road type	Activity	Average last five years N$ 1000	Actual year 1997/98 N$ 1000	Approved budget 1) 1998/99	Year 1999/2000 N$1000	Year 2000/2001 N$1000	Year 2001/2002 N$1000	Year 2002/2003 N$1000	Year 2003/2004 N$1000
			Expenditures in			1997/98	prices			
A:Routine maintenance	Bitumen roads	Bitumen maintenance, incl.	25 000.0	32 500.0	32 100.0	25 000.0	25 000.0	25 000.0	25 000.0	25 000.0
(Sundries + overhead costs		road reserve maintenance								
included)	Gravel roads	Gravel maintenance, incl.	57 300.0	56 400.0	55 800.0	57 300.0	57 300.0	57 300.0	57 300.0	57 300.0
		road reserve maintenance								
	SUBTOTAL ROUTINE MAINTENANCE		82 300.0	88 900.0	87 900.0	82 300.0	82 300.0	82 300.0	82 300.0	82 300.0
B:Periodic maintenance	Bitumenroads	Rejuvenating sprays	3 600.0	2 700.0	1 300.0	7 500.0	12 000.0	15 600.0	15 600.0	15 600.0
(Sundries + overhead costs		Reseals, roadmarkings, edgings	8 300.0	16 100.0	5 300.0	10 000.0	15 000.0	20 900.0	20 900.0	20 900.0
included)	Gravel roads	Regravelling, betterment, bushclearing	56 200.0	40 700.0	40 300.0	45 000.0	55 000.0	65 000.0	75 000.0	90 000.0
	SUBTOTAL PERIODIC MAINTENANCE		68 100.0	59 500.0	46 900.0	62 500.0	82 000.0	101 500.0	111 500.0	126 500.0
C:Rehabilitation	Bitumen roads	Rehabilitations (incl. overlays &	15 900.0	43 700.0	23 200.0	22 500.0	43 650.0	40 330.0	28 650.0	25 040.0
and improvements		bridge widenings)								
		Carriageway widenings	0.0	0.0	0.0	0.0	0.0	3 400.0	10 000.0	10 500.0
		Spot improvements	0.0	0.0	0.0	0.0	2 500.0	2 500.0	2 500.0	2 500.0
	Gravel roads	Surfacing of gravel roads (low cost)	0.0	0.0	0.0	3 200.0	25 000.0	25 000.0	25 000.0	25 000.0
		Spot improvements	0.0	0.0	0.0	0.0	1 500.0	1 500.0	1 500.0	1 500.0
	SUBTOTAL REHAB&IMPROVEMENT		15 900.0	43 700.0	23 200.0	25 700.0	72 650.0	72 730.0	67 650.0	64 540.0
	SUB TOTAL MAINTENANCE		166 300.0	192 100.0	158 000.0	170 500.0	236 950.0	256 530.0	261 450.0	273 340.0
D:Development projects	Bitumen Roads	New road constructions & major up-gradings	58 300.0	3 500.0	30 600.0	39 350.0	39 050.0	46 400.0	45 250.0	36 750.0
	Gravel Roads	New road constructions & major up-gradings	8 000.0	7 100.0	9 200.0	12 325.0	19 130.0	7 000.0	8 000.0	8 000.0
	Bridges	New bridges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Planning of Developments	1 600.0	2 500.0	7 700.0	2 500.0	2 500.0	2 500.0	2 500.0	2 500.0
	SUB TOTAL DEVELOPMENT		67 900.0	13 100.0	47 500.0	54 175.0	60 680.0	55 900.0	55 750.0	47 250.0
E:Administration and		Head office	20 400.0	9 800.0	9 400.0	9 800.0	9 800.0	9 800.0	9 800.0	9 800.0
sundries (including com-										
pensation and fencing)										
	SUB TOTAL ADMINISTRATION		20 400.0	9 800.0	9 400.0	9 800.0	9 800.0	9 800.0	9 800.0	9 800.0
F:Other items		Loan repayments	1 400.0	2 275.0	3 671.0	3 926.0	3 926.0	3 926.0	4 062.0	4 195.0
		NaTIS			7 884.0	16 797.0	9 213.0	9 213.0	9 213.0	9 213.0
		Planning (excl. NaTIS)	10 800.0	12 400.0	12 214.0	12 214.0	12 214.0	12 214.0	12 214.0	12 214.0
	SUB TOTAL OTHER ITEMS		12 200.0	14 675.0	23 769.0	32 937.0	25 353.0	25 353.0	25 489.0	25 622.0
	GRAND TOTAL		266 800.0	229 675.0	238 669.0	267 412.0	332 783.0	347 583.0	352 489.0	356 012.0
					1) Includes funds needed for ongoing projects under loan agreements					

Date
1998-09-23

ESTIMATES OF EXPENDITURE - SUMMARY OF FIVE YEAR PLAN
Including loans and grants

Nation-wide/ or Region
Nation-wide

Financial years From: 1999/2000 **To:** 2003/2004

Expenditures in 1997/98 prices

Category	Road type	Activity	Average last five years N$ 1000	Actual year 1997/98 N$ 1000	Approved budget 1998/99	Year 1999/2000 N$1000	Year 2000/2001 N$1000	Year 2001/2002 N$1000	Year 2002/2003 N$1000	Year 2003/2004 N$1000
A:Routine maintenance	Bitumen roads	Bitumen maintenance, incl.	25 000.0	32 500.0	32 100.0	25 000.0	25 000.0	25 000.0	25 000.0	25 000.0
(Sundries + overhead costs		road reserve maintenance								
included)	Gravel roads	Gravel maintenance, incl.	57 300.0	56 400.0	55 800.0	57 300.0	57 300.0	57 300.0	57 300.0	57 300.0
		road reserve maintenance								
	SUBTOTAL ROUTINE MAINTENANCE		82 300.0	88 900.0	87 900.0	82 300.0	82 300.0	82 300.0	82 300.0	82 300.0
B:Periodic maintenance	Bitumenroads	Rejuvenating sprays	3 600.0	2 700.0	1 300.0	7 500.0	12 000.0	15 600.0	15 600.0	15 600.0
(Sundries + overhead costs		Reseals, roadmarkings, edgings	8 300.0	16 100.0	5 300.0	10 000.0	15 000.0	20 900.0	20 900.0	20 900.0
included)	Gravel roads	Regravelling, betterment, bushclearing	56 200.0	40 700.0	40 300.0	45 000.0	55 000.0	65 000.0	75 000.0	90 000.0
	SUBTOTAL PERIODIC MAINTENANCE		68 100.0	59 500.0	46 900.0	62 500.0	82 000.0	101 500.0	111 500.0	126 500.0
C:Rehabilitation	Bitumen roads	Rehabilitations (incl. overlays &	15 900.0	55 000.0	85 800.0	92 500.0	83 650.0	62 480.0	28 900.0	25 040.0
and improvements		bridge widenings)								
		Carriageway widenings	0.0	0.0	0.0	0.0	0.0	3 400.0	10 000.0	10 500.0
		Spot improvements	0.0	0.0	0.0	0.0	2 500.0	2 500.0	2 500.0	2 500.0
	Gravel roads	Surfacing of gravel roads (low cost)	0.0	0.0	0.0	3 200.0	25 000.0	25 000.0	25 000.0	25 000.0
		Spot improvements	0.0	0.0	0.0	0.0	1 500.0	1 500.0	1 500.0	1 500.0
	SUBTOTAL REHAB&IMPROVEMENT		15 900.0	55 000.0	85 800.0	95 700.0	112 650.0	94 880.0	67 900.0	64 540.0
	SUB TOTAL MAINTENANCE		166 300.0	203 400.0	220 600.0	240 500.0	276 950.0	278 680.0	261 700.0	273 340.0
D:Development projects	Bitumen Roads	New road constructions & major up-gradings	85 300.0	61 800.0	66 900.0	94 400.0	48 250.0	47 020.0	45 250.0	36 750.0
	Gravel Roads	New road constructions & major up-gradings	8 000.0	15 900.0	22 000.0	24 600.0	30 260.0	12 000.0	8 000.0	8 000.0
	Bridges	New bridges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Planning of Developments	1 600.0	2 500.0	7 700.0	2 500.0	2 500.0	2 500.0	2 500.0	2 500.0
	SUB TOTAL DEVELOPMENT		94 900.0	80 200.0	96 600.0	121 500.0	81 010.0	61 520.0	55 750.0	47 250.0
E:Administration and		Head office	20 400.0	9 800.0	9 400.0	9 800.0	9 800.0	9 800.0	9 800.0	9 800.0
sundries (including com-										
pensation and fencing)										
	SUB TOTAL ADMINISTRATION		20 400.0	9 800.0	9 400.0	9 800.0	9 800.0	9 800.0	9 800.0	9 800.0
F:Other items		Loan repayments	1 400.0	2 275.0	3 671.0	3 926.0	3 926.0	3 926.0	4 062.0	4 195.0
		NaTIS			7 884.0	16 797.0	9 213.0	9 213.0	9 213.0	9 213.0
		Planning (excl. NaTIS)	10 800.0	12 400.0	12 214.0	12 214.0	12 214.0	12 214.0	12 214.0	12 214.0
	SUB TOTAL OTHER ITEMS		12 200.0	14 675.0	23 769.0	32 937.0	25 353.0	25 353.0	25 489.0	25 622.0
	GRAND TOTAL		293 800.0	308 075.0	350 369.0	404 737.0	393 113.0	375 353.0	352 739.0	356 012.0

Estimates of expenditure Date ######

Financial Years …1999-2003…… Nation-wide/Region Windhoek

Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**

Gravel Roads **Low Cost/5% Traffic Growth Alternative**

Rank	Road class T,M,D	Road no	1997 ADT	Project name	Conti-nuation /New	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan						If applicable		
												Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
	MR	32	80	Junction TR1/3 - MR 29	New			65.0												
	MR	33	50	Uhlenhorst - Dordabis	New			99.0									x			
	MR	34	65	Maltahöhe - Solitaire	New			214.0												
	MR	39	105	Aranos (MR40) - MR 61	New			7.0												
	MR	40	45	Aranos (MR41) - MR 91	New			63.0									x			
	MR	47	60	MR 31 - Rehoboth	New			134.0									x			
	MR	49	65	Windhoek - Gamsberg	New			80.0									x			
	MR	52	45	Daan Viljoen N.P. - Moria Farm	New			115.0									x			
	MR	94	45	Junction TR1/4 - Hardap Dam Rd	New			6.0									x			
Grand Total																				

Estimates of expenditure Date ######

Financial Years …1999-2003…… Nation-wide/Region Swakopmund

Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**

Gravel Roads **Low Cost/5% Traffic Growth Alternative**

Rank	Road class T,M,D	Road no	ADT	Project name	Conti-nuation /New	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
	MR	36	45	Naukluft N.P. - Walvis Bay	New			140.0									x			
	MR	63	45	Garfield Farm - Outjo	New			38.0									x			
	MR	64	55	Omaruru - Uis (MR76)	New			129.0									x			
	MR	67	65	Kamanjab - Otjovasandu	New			50.0									x			
	MR	67	60	Otjovasandu - Ruacana	New			201.0									x			
	MR	69	45	Outjo - Uib Farm	New			90.0									x			
	MR	76	55	Henties Bay - Uis	New			114.0									x			
	MR	76	115	Uis - Khorixas	New			119.0												
	MR	76	105	Khorixas - Kamanjab	New			101.0												
	MR	80	75	Wilhelmstal - Omaruru	New			67.0												
	MR	100	85	MR67 - Opuwo	New			60.0												
	DR	1 935	70	Usakos - Kudubis Farm	New			36.0									x			
	DR	2 301	100	Henties Bay - Junction DR2303	New			76.0												
Grand Total																				

Estimates of expenditure Date ######

Financial Years …1999-2003…… Nation-wide/Region Otjiwarongo

Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**

Gravel Roads **Low Cost/5% Traffic Growth Alternative**

Rank	Road class T,M,D	Road no	ADT	Project name	Conti-nuation /New	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
	MR	39	50	Esselen Farm - Gobabis	New			160.0									x			
	MR	59	155	Junction TR1/7 - Elisenore Farm	New			66.0												
	MR	59	150	Elisenore Farm - Otjosondu	New			59.0												
	MR	60	80	Elisenore Farm - Hochfeld	New			47.0												
	MR	71	65	Grootfontein - Otjituuo	New			57.0									x			
	MR	73	60	Grootfontein - Abenab	New			24.0									x			
	MR	91	50	W Aminuis - E Gobabis	New			177.0									x			
	MR	101	80	In Okakarara	New			5.0												
	DR	1692	50	Junction TR6/2 - Helena	New			88.0									x			
	DR	3802	45	Okangoho - Okamatapati	New			105.0									x			
Grand Total																				

Estimates of expenditure Date ######

Financial Years …1999-2003…… Nation-wide/Region Oshakati

Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**

Gravel Roads **Low Cost/5% Traffic Growth Alternative**

Rank	Road class T,M,D	Road no	ADT	Project name	Conti-nuation /New	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan						If applicable		
												Year 1	Year 2	Year 3	Year 4	Year 5	Later	Feasib. study	Prel. design	Detail. design
												N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	Yes/No	Yes/No	Yes/No
	MR	110	50	Okongo - Eenhana	New			98.0									x			
	MR	110	50	Eenhana - Ohangwena	New			47.0									x			
	DR	3403	180	Bagani (TR8/4) - Mohembo	New			25.0												
	DR	3511	80	Katima Mulilo - Linyandi	New			72.0												
	DR	3612	70	Okahao - Uutapi	New			57.0									x			
	DR	3620	75	Oshakati - Onuuno	New			16.0												
	DR	3622	60	SE Ondangwa - Eenhana	New			86.0									x			
Grand Total																				

Estimates of expenditure Date ######

Financial Years …1999-2003…… Nation-wide/Region Keetmanshoop

Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**

Gravel Roads **Low Cost/5% Traffic Growth Alternative**

Rank	Road class T,M,D	Road no	ADT	Project name	**C**onti-nuation /**N**ew	From km	To km	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	**Funding Requirements - 5 year plan** Year 1 N$ 1000	Year 2 N$ 1000	Year 3 N$ 1000	Year 4 N$ 1000	Year 5 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
																	x			
				No projects identified													x			
																	x			
																	x			
Grand Total																				

Estimates of expenditure Date ######

Financial Years …1999-2003…… Nation-wide/Region Nation-wide

Rehabilitation & improvement **Five year plan - Surfacing of gravel roads**

Gravel Roads

Rank	Road class T,M,D	Road no	1997 ADT	Project name	Conti-nuation /New	1997 B/C ratio	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan						If applicable		
											Year 1 1999/2000 N$ 1000	Year 2 2000/2001 N$ 1000	Year 3 2001/2002 N$ 1000	Year 4 2002/2003 N$ 1000	Year 5 2003/2004 N$ 1000	Later N$ 1000	Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
1	MR	76	115	Uis -Khorixas	New	1.4	119.0	300 000	35 700	0.0	3 200	20 000	12 500			0			
2	MR	76	105	Khorixas - Kamanjab	New	1.3	101.0	300 000	30 300	0.0		5 000	12 500	12 800		0			
3	MR	59	100	Junction TR1/7 - Otjosondu	New	1.2	125.0	300 000	37 500	0.0				12 200	19 000	6 300			
4	DR	2301	100	Henties Bay - Junction DR 2303	New	1.2 1)	76.0	300 000	22 800	0.0					6 000	16 800			
5	MR	100	85	MR67 - Opuwo	New	1.1	60.0	300 000	18 000	0.0						18 000			
6	DR	3511	80	Katima Mulilo - Linyanti	New	1.0	72.0	300 000	21 600	0.0						21 600			
Grand Total							**553.0**		**165 900.0**	**0.0**	**3 200.0**	**25 000.0**	**25 000.0**	**25 000.0**	**25 000.0**	**62 700.0**			

1) Feasibility Study by VWL Namibia Inc., July 1992

APPENDIX I

Five Year Plan 1999/2000 - 2003/2004

Estimates of expenditure Date ######

Financial Years 1999-2003…… Nation-wide/Region Nation-wide

Rehabilitation & improvement **Five year plan - Carriageway widenings**

Bitumen Roads

Rank	Road class T,M,D	Road no	1997 ADT	Project name	Conti-nuation /New	Total km	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan 1999/2000 N$ 1000	2000/2001 N$ 1000	2001/2002 N$ 1000	2002/2003 N$ 1000	2003/2004 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
1	TR	1/3	800	Wasser - Asab	New	38.0	300 000	11 400.0	0.0			3 400	8 000		0	No	No	No
2	TR	1/3	1090	Asab - Ebenerde	New	35.0	300 000	10 500.0	0.0				2 000	8 500	0	No	No	No
3	TR	1/4	800	Kalkrand - Rehoboth	New	69.0	300 000	20 700.0	0.0					2 000	18 700	No	No	No
4	TR	1/3	800	Keetmanshoop - Wasser	New	26.0	300 000	7 800.0	0.0						7 800	No	No	No
5	TR	1/4	800	Mariental - Kalkrand	New	54.0	300 000	16 200.0	0.0						16 200	No	No	No
Grand Total						**80.0**		**66 600.0**	**0.0**	**0.0**	**0.0**	**3 400.0**	**10 000.0**	**10 500.0**	**42 700.0**			

Estimates of expenditure Date ######

Financial Years 1999-2003…… Nation-wide/Region Nation-wide

Rehabilitation & improvement **Five year plan - Rehabilitation of Roads & Bridges**

Bitumen Roads **With and without loans and grants**

Rank	Road class T,M,D	Bridge or Road no	1997 ADT	Project name	Conti-nuation /New	Total km	Total km rehab prio 1	Width (m) exist bitumen/ bridge 1)	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan 1999/2000 N$ 1000	2000/2001 N$ 1000	2001/2002 N$ 1000	2002/2003 N$ 1000	2003/2004 N$ 1000	Later N$ 1000	If applicable Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No
	TR	1/7	1 200	Widening bridges Okahandja-																
				Otjiwarongo						6 000.0	4 800.0	1 200.0								Yes
	B	0125		Okonjoka River (6 spans)	Cont.															
	B	0185		Omatako River (4 spans)	Cont.															
	B	0187		? (4 spans)	Cont.															
	B	0188		Ovitua River (5 spans)	Cont.															
	B	0382		Okamita River (3 spans)	Cont.															
	TR	1/11	1 630	Oshivelo - Oshakati (*loan*)	Cont.	190	190			*107 000.0*	*34 500.0*	*60 000.0*	*12 000.0*	*500.0*			0.0			Yes
				Oshivelo - Oshakati (GRN)						17 000.0	5 000.0	12 000.0					0.0			
1	TR	8/6	460	Kongola - Katima Mulilo (part *grant, part loan)*	Cont/New	116	116	6.0		*95 000.0*	*35 100.0*	*10 000.0*	*28 000.0*	*21 650.0*	*250.0*		0.0			Yes
2	TR	8/3	260	Mururani - Rundu	New	131	85	8.0	480 000	40 800.0		4 000.0	30 000.0	6 550.0	250.0		0.0			
3	TR	1/11	350	Ondangwa - Oshikango	New	63	63	8.0	560 000	35 280.0		1 000.0	7 000.0	27 030.0	250.0		0.0			
				Rehabilitation of bridges	New															
4	TR	2/1		Swakop River in Swakopmund	New			8.5		3 000.0		3 000.0								
5	TR	1/1		Korabib and Gamkap Rivers	New			6.7-7.3		1 300.0		1 300.0								
6	TR	2/1		Arandis Road over Rail	New			11.0		1 500.0			1 500.0							
7	TR	1/6		Swakop River at Okahandja	New			8.6		1 300.0			1 300.0							
8	TR	2/1		Road over Road at Karibib	New			14.1		600.0			600.0							
9	TR	1/3	800	Wasser - Asab	New	78	40	6.3	560 000	22 400.0				2 000.0	20 150.0	250.0	0.0			
10	TR	1/3	1 090	Asab - Ebenerde	New	69	34	6.3	560 000	19 040.0					2 000.0	16 790.0	250.0			
11	TR	1/4	800	Kalkrand - Rehoboth	New	99	30	6.0-6.3	560 000	16 800.0						2 000.0	14 800.0			
12	TR	1/3	800	Keetmanshoop - Wasser	New	52	26	6.1	560 000	14 560.0							14 560.0			
13	TR	1/7	1 200	Okahandja - Sukses (selected reconstruction & overlay)	New	107	33	8.0	375 000	12 375.0							12 375.0			
14	TR	1/4	800	Mariental - Kalkrand	New	76	22	6.3	560 000	12 320.0							12 320.0			
15	TR	1/7	1 200	Sukses - Otjiwarongo (selected reconstruction & overlay)	New	69	21	8.0	375 000	7 875.0							7 875.0			
16	MR	72	460	Tsumeb - Grootfontein	New	56	17	7.3-7.4	480 000	8 160.0							8 160.0			
17	TR	8/2	300	Taranaki - Mururani	New	50	21	8.0	480 000	10 080.0							10 080.0			
18	TR	2/3	1 200	Usakos - Karibib	New	30	2	6.1-6.3	560 000	1 120.0							1 120.0			
19	TR	2/3	425	Karibib - Omaruru	New	65	10	6.7	480 000	4 800.0							4 800.0			
20	TR	1/3, 1/4	800 -	Widening of bridges																
			1 500	Keetmanshoop - Rehoboth																
				16 bridges (total 84 spans)	New			6.1-6.7		22 900.0			3 250.0	4 750.0	6 000.0	6 000.0	2 900.0			
Grand Total						**1 251**	**710**			**461 210.0**	**79 400.0**	**92 500.0**	**83 650.0**	**62 480.0**	**28 900.0**	**25 040.0**	**89 240.0**			
Grand Total (Excluding loans and grants)						**1 251**	**710**			**n.a.**	**9 800.0**	**22 500.0**	**43 650.0**	**40 330.0**	**28 650.0**	**25 040.0**	**89 240.0**			

1) Width between kerbs of bridges

Estimates of expenditure
Financial Years 1999-2003……..
Development projects

Date ######
Nation-wide/Region Nation-wide

Five year plan - New Roads and Bridges and Major Upgrading Projects Excluding loans and grants

Rank	Road class T,M,D	Bridge or Road no	Project name	New Road Section	Conti-nuation /New	Total km	1997 ADT	1997 B/C ratio	Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan 1999/2000 N$ 1000	2000/2001 N$ 1000	2001/2002 N$ 1000	2002/2003 N$ 1000	2003/2004 N$ 1000	Later N$ 1000	Source of Finance RFA N$ 1000	GVT N$ 1000	Donor N$ 1000	Other N$ 1000
			Commitments (excl. loans and grants)																					
			Gravel roads		Cont.										12 325	19 130	7 000.0	1 100.0			39 555.0			
			Bitumen roads		Cont.										38 600	250					38 850.0			
1	MR	44	Swakopmund - Henties Bay	7.4/12.4	New	74.0	450	5.4 1)	Yes			1 000 000	74 000			7 000	30 000	30 000	6 750	250	74 000.0			
2	MR	56	Gobabis - Drimiopsis	6.8/9.8	Cont.	29.0	130	1.7 2)	Yes			800 000	23 200			12 800	10 150	250		0	23 200.0			
3	TR	New	Drimiopsis - Otjinene	6.8/9.8	New	117.0	n.a.	1.2 2)	Yes			800 000	93 600				6 000	15 000	30 000	42 600	93 600.0			
4	DR	3403	Bagani - Mohembo	6.8/9.8	New	25.0	180	1.1	Yes	Yes		800 000	20 000		750	19 000	250			0	20 000.0			
	DR	3620	Okatana - Onuuno	6.8/9.8	New	11.0	75	0.9	?			300 000	3 300							3 300				
	MR	56	Maltahohe - Solitaire	6.8/9.8	New	214.0	65	0.8	No			300 000	64 200							64 200				
	TR	New	Otjinene - Grootfontein	6.8/9.8	New	173.0	n.a.	n.a	No			860 000	148 780							148 780				
	TR	1/6	Windhoek (Brakwater) - Okahandja	Dual CW	New	55.0	3 000	0.6	No			2 000 000	110 000							110 000				
	TR	2/1	Walvis Bay - Swakopmund	Dual CW	New	34.0	2 700	0.5	No			2 000 000	68 000							68 000				
	MR	92	Ondangwa - Oshakati	Dual CW	New	33.0	2 000	0.3	No			2 000 000	66 000							66 000				
	TR	New	Windhoek - Walvis Bay 3)	6.8/9.8	New	290.0	n.a.	n.a.	No			1 100 000	319 000							319 000				
	TR	6/1	Windhoek Southern Bypass	7.4/12.4	New			Negative 4)	Yes				0							0				
			New gravel roads															6 900	8 000	n.a.				
Total Bitumen Roads															**39 350**	**39 050**	**46 400**	**45 250**	**36 750**	**822 130**	**249 650**			
Grand Total						**1 055**							**990 080**	**0**	**51 675**	**58 180**	**53 400**	**53 250**	**44 750**	**822 130**	**289 205**	**0**	**0**	**0**

1) Feasibility Study by VWL Namibia Inc., July 1992
2) Feasibility Study by Stewart Scott Namibia, March 1996, alignment along MR56, DR1635, DR1612 and MR 70
3) Connects to MR49 West of Windhoek (end of existing tar, Length = 8.5 km)
4) Feasibility Study by VKE (Namibia) Inc., March 1998

Estimates of expenditure
Financial Years 1999-2003……..
Development projects

Date ######
Nation-wide/Region Nation-wide

Five year plan - New Roads and Bridges and Major Upgrading Projects Including loans and grants

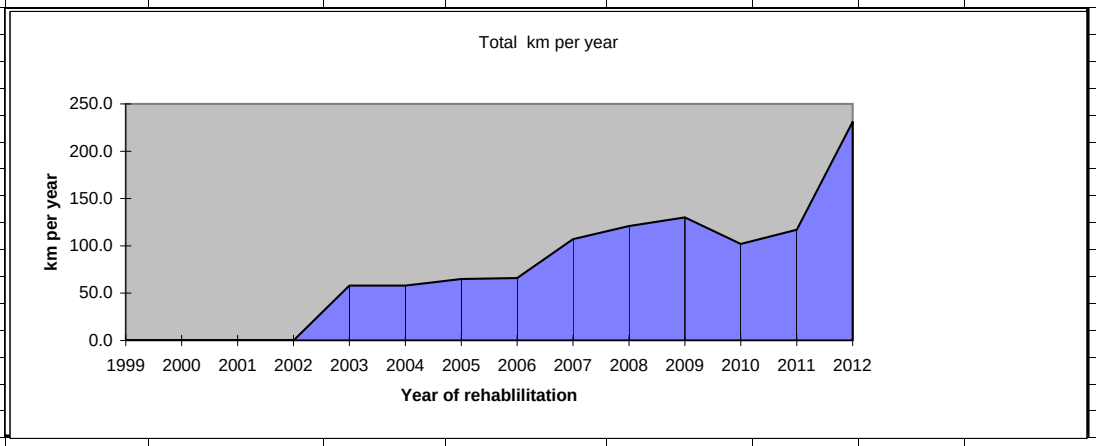
Rank	Road class T,M,D	Bridge or Road no	Project name	New Road Section	Conti-nuation /New	Total km	1997 ADT	1998 B/C ratio	Feasib. study Yes/No	Prel. design Yes/No	Detail. design Yes/No	Cost/ km N$	Total cost N$1000	Total exp. before Year 1	Funding Requirements - 5 year plan 1999/2000 N$ 1000	2000/2001 N$ 1000	2001/2002 N$ 1000	2002/2003 N$ 1000	2003/2004 N$ 1000	Later N$ 1000	Source of Finance RFA N$ 1000	GVT N$ 1000	Donor N$ 1000	Other N$ 1000
			Commitments (incl. loans and grants)																					
			Gravel roads		Cont.										24 600	30 260	12 000.0	1 100.0						
			Bitumen roads		Cont.										93 650	9 450	620.0							
1	MR	44	Swakopmund - Henties Bay	7.4/12.4	New	74.0	450	5.4 1)	Yes			1 000 000	74 000			7 000	30 000	30 000	6 750	250	74 000.0			
2	MR	56	Gobabis - Drimiopsis	6.8/9.8	Cont.	29.0	130	1.7 2)	Yes			800 000	23 200			12 800	10 150	250		0	23 200.0			
3	TR	New	Drimiopsis - Otjinene	6.8/9.8	New	117.0	n.a.	1.2 2)	Yes			860 000	100 620				6 000	15 000	30 000	49 620	93 600.0			
4	DR	3403	Bagani - Mohembo	6.8/9.8	New	25.0	180	1.1	Yes	Yes		800 000	20 000		750	19 000	250			0	20 000.0			
	DR	3620	Okatana - Onuuno	6.8/9.8	New	11.0	75	0.9	?			300 000	3 300							3 300				
	MR	56	Maltahohe - Solitaire	6.8/9.8	New	214.0	65	0.8	No			300 000	64 200							64 200				
	TR	New	Otjinene - Grootfontein	6.8/9.8	New	173.0	n.a.	n.a	No			860 000	148 780							148 780				
	TR	1/6	Windhoek (Brakwater) - Okahandja	Dual CW	New	55.0	3 000	0.6	No			2 000 000	110 000							110 000				
	TR	2/1	Walvis Bay - Swakopmund	Dual CW	New	34.0	2 700	0.5	No			2 000 000	68 000							68 000				
	MR	92	Ondangwa - Oshakati	Dual CW	New	33.0	2 000	0.3	No			2 000 000	66 000							66 000				
	TR	New	Windhoek - Walvis Bay 3)	6.8/9.8	New	290.0	n.a.	n.a.	No			1 100 000	319 000							319 000				
	TR	6/1	Windhoek Southern Bypass	7.4/12.4	New			Negative 4)	Yes				0							0				
			New gravel roads															6 900	8 000	n.a.				
Total Bitumen Roads															**94 400**	**48 250**	**47 020**	**45 250**	**36 750**	**829 150**	**210 800**			
Grand Total						**1 055**							**997 100**	**0**	**119 000**	**78 510**	**59 020**	**53 250**	**44 750**	**829 150**	**210 800**	**0**	**0**	**0**

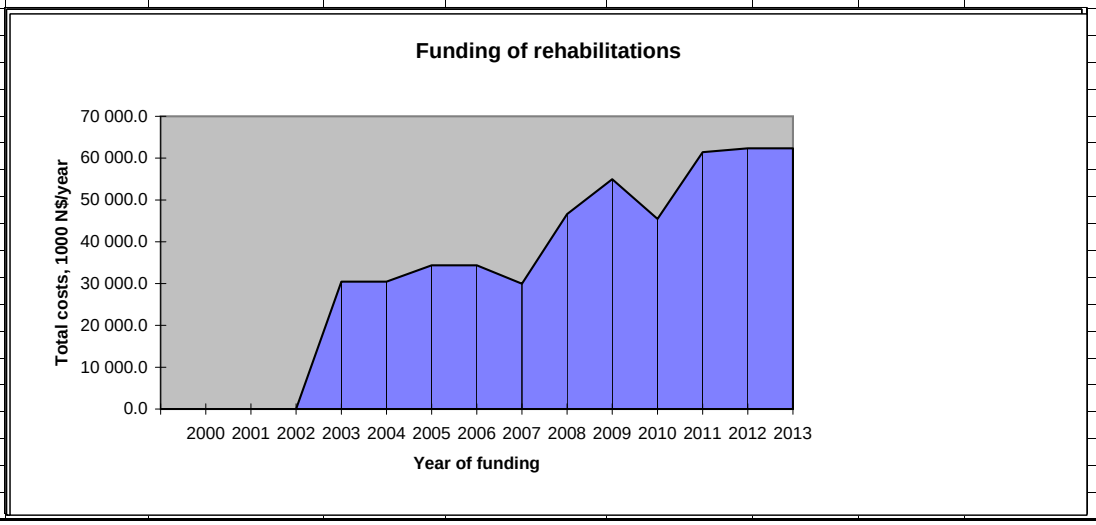
1) Feasibility Study by VWL Namibia Inc., July 1992
2) Feasibility Study by Stewart Scott Namibia, March 1996, alignment along MR56, DR1635, DR1612 and MR 70
3) Connects to MR49 West of Windhoek (end of existing tar, Length = 8.5 km)
4) Feasibility Study by VKE (Namibia) Inc., March 1998

APPENDIX J

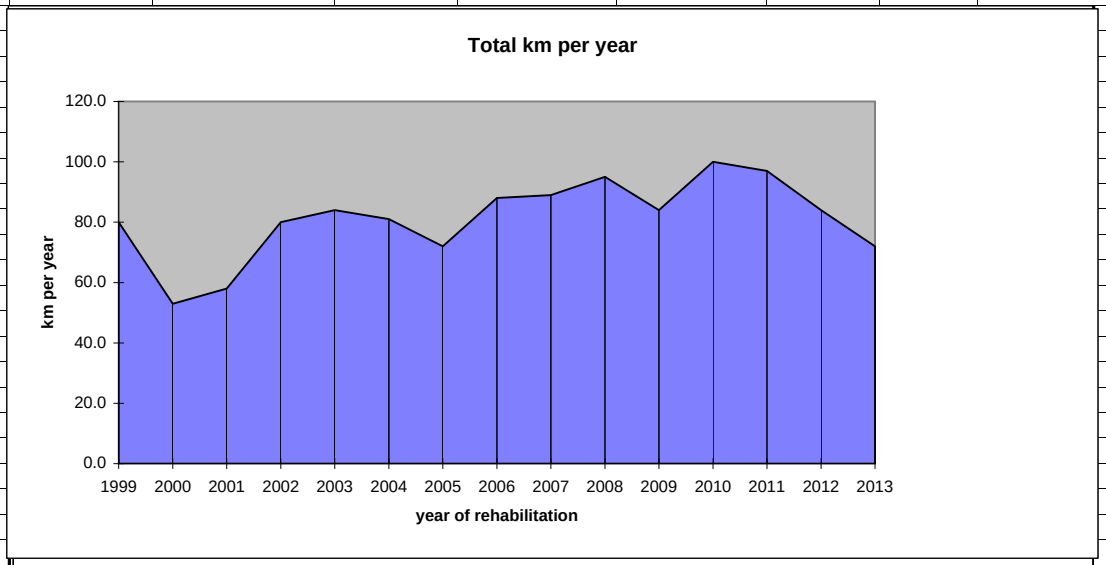
Evaluation of strategies for rehabilitation of bitumen roads

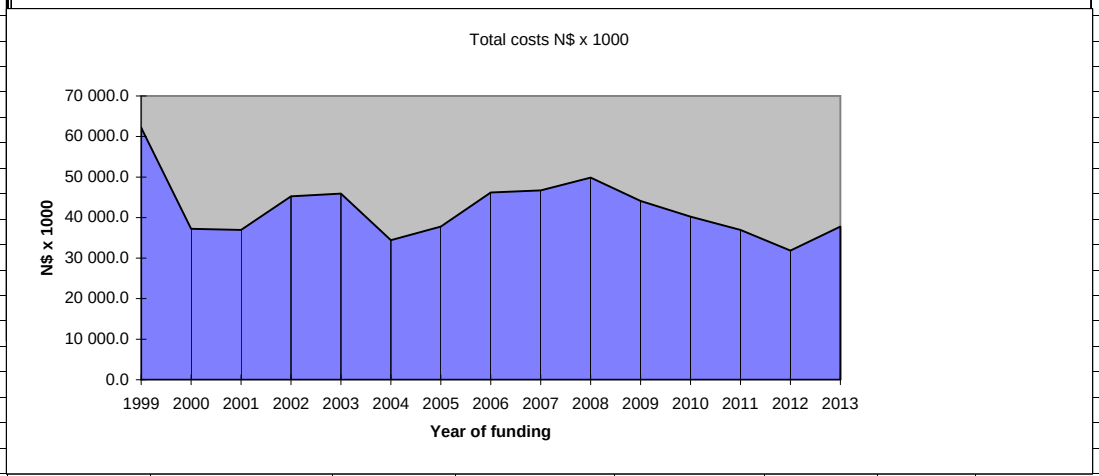
Year start rehabilitation	Total km per year	Keetmanshoop km	Windhoek km	Swakopmund km	Otjiwarongo km	Oshakati km	Year of funding	Total costs N$ 1000/year
1999	0.0							0.0
2000	0.0						**2000**	0.0
2001	0.0						**2001**	0.0
2002	0.0						**2002**	0.0
2003	58.0					58.0	**2003**	30 450.0
2004	58.0					58.0	**2004**	30 450.0
2005	65.0					65.0	**2005**	34 387.5
2006	66.0					66.0	**2006**	34 387.5
2007	107.0				107.0		**2007**	29 960.0
2008	121.0	52.0			69.0		**2008**	46 620.0
2009	130.0	78.0			52.0		**2009**	54 950.0
2010	102.0		69.0		33.0		**2010**	45 465.0
2011	117.0		99.0	18.0			**2011**	61 425.0
2012	231.0	79.0	76.0	30.0	46.0		**2012**	62 362.5
							2013	62 362.5
Total	**1 055.0**	**209.0**	**244.0**	**48.0**	**307.0**	**247.0**		**492 820.0**



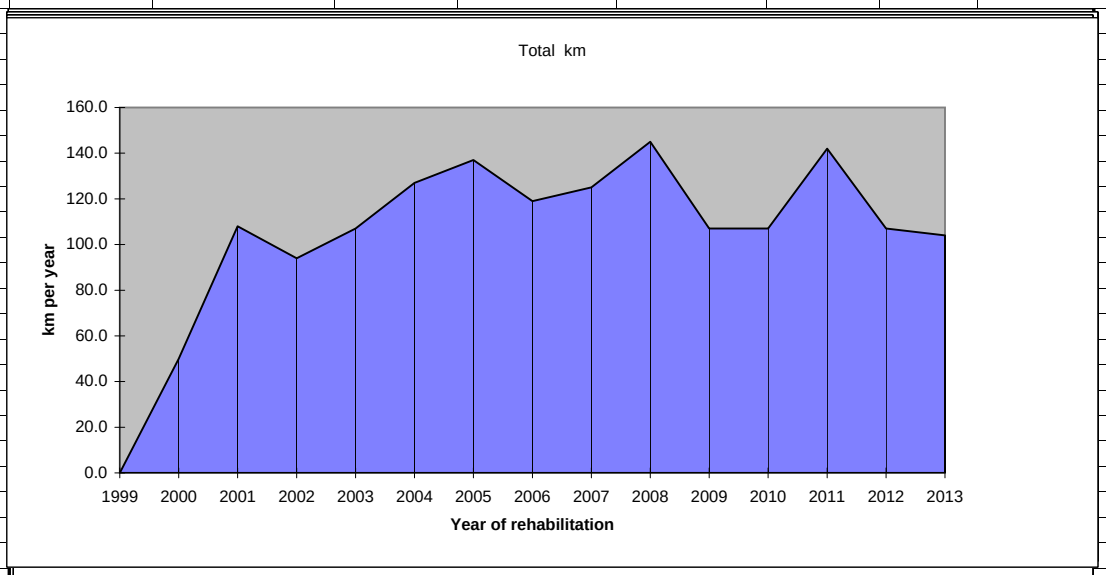


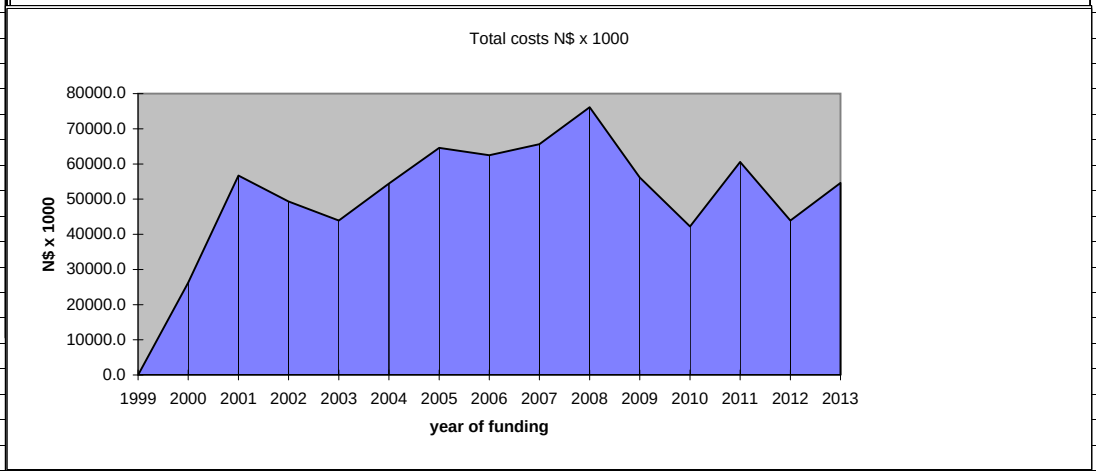
Year start rehabilitation	Total km	Keetmanshoop km	Windhoek km	Swakopmund km	Otjiwarongo km	Oshakati km	Year of funding	Total costs N$ x 1000
1999	80.0	0.0	0.0	0.0	0.0	80.0	**1999**	62 200.0
2000	53.0	0.0	0.0	0.0	0.0	53.0	**2000**	37 250.0
2001	58.0	0.0	0.0	0.0	0.0	58.0	**2001**	36 950.0
2002	80.0	40.0	0.0	0.0	0.0	40.0	**2002**	45 250.0
2003	84.0	0.0	39.0	0.0	0.0	45.0	**2003**	45 930.0
2004	81.0	26.0	22.0	0.0	33.0	0.0	**2004**	34 440.0
2005	72.0	0.0	0.0	12.0	30.0	30.0	**2005**	37 800.0
2006	88.0	24.0	0.0	26.0	0.0	38.0	**2006**	46 200.0
2007	89.0	40.0	49.0	0.0	0.0	0.0	**2007**	46 725.0
2008	95.0	0.0	50.0	0.0	45.0	0.0	**2008**	49 875.0
2009	84.0	40.0	44.0	0.0	0.0	0.0	**2009**	44 100.0
2010	100.0	0.0	0.0	0.0	50.0	50.0	**2010**	40 250.0
2011	97.0	40.0	0.0	0.0	57.0	0.0	**2011**	36 960.0
2012	84.0	34.0	0.0	0.0	50.0	0.0	**2012**	31 850.0
2013	72.0	0.0	0.0	72.0	0.0	0.0	**2013**	37 800.0
Grand total	**1 217.0**	**244.0**	**204.0**	**110.0**	**265.0**	**394.0**		**633 580.0**



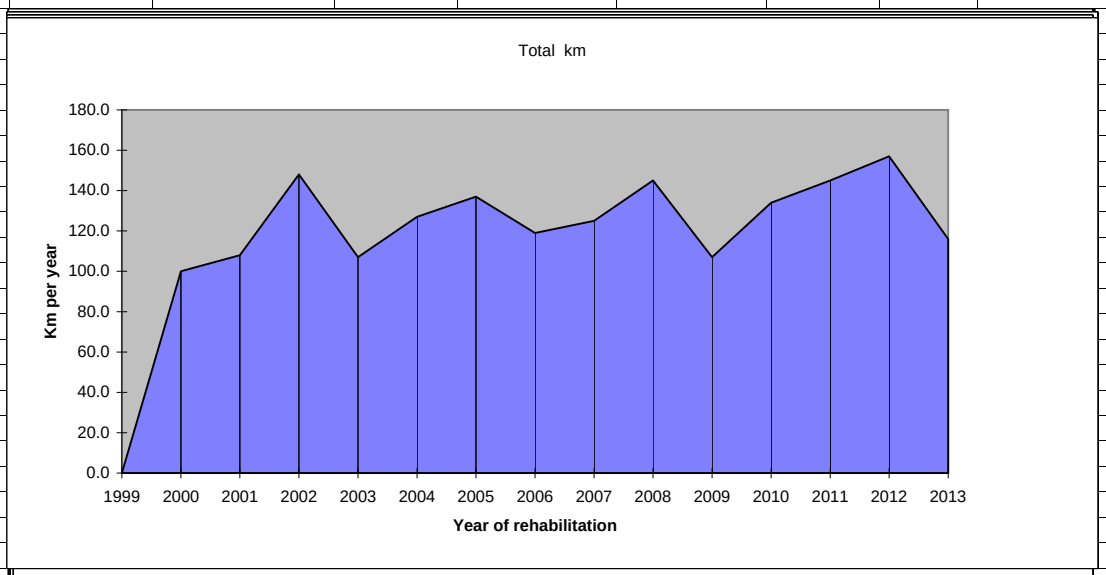


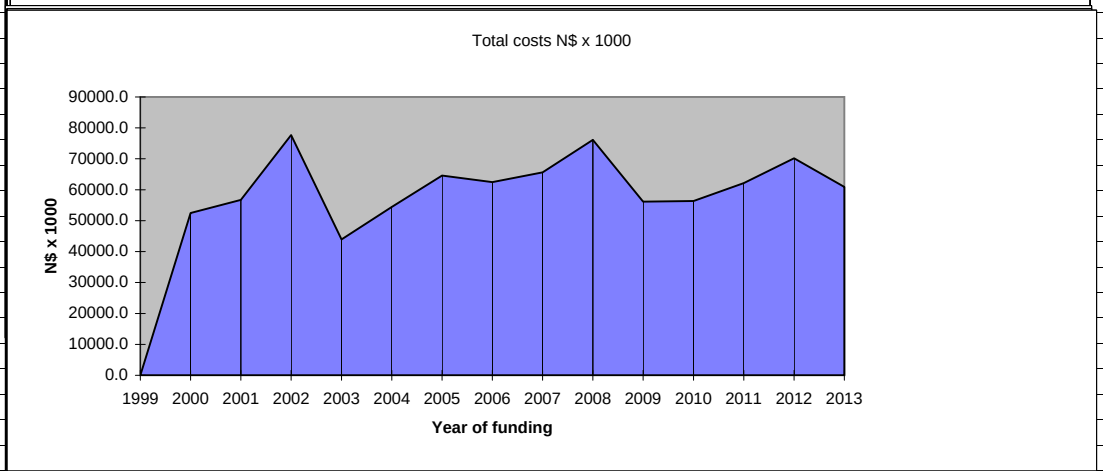
Year start rehabilitation	Total km	Keetmanshoop km	Windhoek km	Swakopmund km	Otjiwarongo km	Oshakati km	Year of funding	Total costs N$ x 1000
1999	0.0	0.0	0.0	0.0	0.0	0.0	**1999**	0.0
2000	50.0	0.0	0.0	0.0	0.0	50.0	**2000**	26 250.0
2001	108.0	0.0	0.0	55.0	0.0	53.0	**2001**	56 700.0
2002	94.0	0.0	51.0	0.0	43.0	0.0	**2002**	49 350.0
2003	107.0	57.0	0.0	0.0	50.0	0.0	**2003**	43 925.0
2004	127.0	57.0	20.0	0.0	50.0	0.0	**2004**	54 425.0
2005	137.0	56.0	51.0	0.0	30.0	0.0	**2005**	64 575.0
2006	119.0	0.0	45.0	24.0	0.0	50.0	**2006**	62 475.0
2007	125.0	0.0	49.0	26.0	0.0	50.0	**2007**	65 625.0
2008	145.0	0.0	70.0	25.0	0.0	50.0	**2008**	76 125.0
2009	107.0	57.0	0.0	0.0	0.0	50.0	**2009**	56 175.0
2010	107.0	0.0	0.0	0.0	57.0	50.0	**2010**	42 210.0
2011	142.0	57.0	0.0	0.0	57.0	28.0	**2011**	60 585.0
2012	107.0	57.0	0.0	0.0	50.0	0.0	**2012**	43 925.0
2013	104.0	0.0	25.0	79.0	0.0	0.0	**2013**	54 600.0
Grand total	**1 579.0**	**341.0**	**311.0**	**209.0**	**337.0**	**381.0**		**756 945.0**





Year start rehabilitation	Total km	Keetmanshoop km	Windhoek km	Swakopmund km	Otjiwarongo km	Oshakati km	Year of funding	Total costs N$ x 1000
1999	0.0	0.0	0.0	0.0	0.0	0.0	**1999**	0.0
2000	100.0	50.0	0.0	0.0	0.0	50.0	**2000**	52 500.0
2001	108.0	0.0	0.0	55.0	0.0	53.0	**2001**	56 700.0
2002	148.0	0.0	55.0	0.0	43.0	50.0	**2002**	77 700.0
2003	107.0	57.0	0.0	0.0	50.0	0.0	**2003**	43 925.0
2004	127.0	57.0	20.0	0.0	50.0	0.0	**2004**	54 425.0
2005	137.0	56.0	51.0	0.0	30.0	0.0	**2005**	64 575.0
2006	119.0	0.0	45.0	24.0	0.0	50.0	**2006**	62 475.0
2007	125.0	0.0	49.0	26.0	0.0	50.0	**2007**	65 625.0
2008	145.0	0.0	70.0	25.0	0.0	50.0	**2008**	76 125.0
2009	107.0	57.0	0.0	0.0	0.0	50.0	**2009**	56 175.0
2010	134.0	27.0	0.0	0.0	57.0	50.0	**2010**	56 385.0
2011	145.0	57.0	0.0	0.0	57.0	31.0	**2011**	62 160.0
2012	157.0	57.0	0.0	0.0	50.0	50.0	**2012**	70 175.0
2013	116.0	27.0	25.0	64.0	0.0	0.0	**2013**	60 900.0
Grand total	**1 775.0**	**445.0**	**315.0**	**194.0**	**337.0**	**484.0**		**859 845.0**





Estimates of expenditure Date 20/08/98

Financial Years 1999/2000 - 2003/2004 and later…… Nation-wide/Region Keetmanshoop

Bitumen Roads **Rehabilitation of Roads**

Projects to be investigated

Road class T,M,D	Road no	TSS 1997 ADT	Heavy traffic %	Project name	Total km	Year of constr/ rehab	Age index (%) = Actual age/Rainfall age			Rehabilitation needs, km						DOT/PMS estimated remaining life in kms			Cost/ km N$	Total cost N$1000	Deflect. Measurem. Yes/No	Rehab Index Yes/No
										NTMPS optimistic			NTMPS conservative									
							Actual age	Rainfall age	Age index	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	5 - 10 years	10+ years				
TR	1/3	800	25	Keetmanshoop - Wasser 4)	52	1960 1)	38/9 1)	40	95/23 1)	13	13	13	21	16	16	29	12	11	525 000	27 300.0	Yes	Yes
TR	1/3	800	25	Wasser - Asab 4)	78	1966	32	40	80	20	20	20	31	23	23	43	18	17	525 000	40 950.0	Yes	Yes
TR	3/1	300	35	Karasburg - Grunau	50	1966	32	40	80	0	3	8	0	3	13	7	8	35		0.0	Yes	Yes
TR	1/2	560	35	Grunau - Keetmanshoop 4)	158	1967	31	40	78	16	32	40	32	32	32	52	63	43	525 000	82 950.0	Yes	Yes
TR	3/1	270	35	Nakop - Karasburg	129	1968	30	40	75	0	6	19	0	6	32	18	21	90		0.0	Yes	Yes
TR	1/1	270	30	Noordoewer - Grunau	143	1970	28	40	70	0	7	14	7	14	21	13	10	120		0.0	Yes	Yes
TR	4/1	180	15	Keetmanshoop - Goageb	110	1973 2)	25	40	63	0	0	0	0	0	6	1	0	109		0.0	Yes	Yes
TR	4/2	180	15	Haalenberg - Luderitz	45	1975	23	40	58	0	0	0	0	0	5	n.a.	n.a.	n.a.		0.0	No	No
TR	4/2	180	15	Aus - Haalenberg	80	1977	21	40	53	0	0	0	0	0	8	n.a.	n.a.	n.a.		0.0	No	No
MR	88	35	10	Keetmanshoop - Airport	5	1967 3)	31	40	78	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
MR	31	80	15	Goageb - Bethanien	32	1972	26	40	65	0	0	0	0	0	0	0	0	32		0.0	Yes	Yes
					882					**49**	**81**	**114**	**91**	**94**	**156**	**163**	**132**	**457**		**151 200**		

1) 16 km rehabilitated in 1989

2) 125 mm crusher run base course

3) 125 mm crusher run base course

4) Sections between those rehabilitated should be considered for widening of the carriageway (C/W) to uniform width (See proposed 5-year plan for C/W widenings)

n.a. = no measurements done

Estimates of expenditure Date 20/08/98

Financial Years 1999/2000 - 2003/2004 and later…… Nation-wide/Region Windhoek

Bitumen Roads **Rehabilitation of Roads**

Projects to be investigated

Road class T,M,D	Road no	TSS 1997 ADT	Heavy traffic %	Project name	Total km	Year of constr/ rehab	Age index (%) = Actual age/Rainfall age			Rehabilitation needs, km						DOT/PMS estimated remaining life in kms			Cost/ km N$	Total cost N$1000	Deflect. Measurem. Yes/No	Rehab Index Yes/No
										NTMPS optimistic			NTMPS conservative									
							Actual age	Rainfall age	Age index	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	6 - 10 years	11+ years				
TR	1/5	1 650	12	Windhoek - Aris	64	1961/89	37/9	35	106/25	0	0	13	0	6	13	14	5	45		0.0	Yes	Yes
TR	1/5	1 650	12	Aris - Rehoboth	23	1961/89	37/9	35	106/25	0	0	5	0	2	5	5	2	16		0.0	Yes	Yes
TR	1/6	3 000	8	Windhoek W Bypass (to MR52)	9	1981	17	35	49	0	1	1	0	1	2	2	1	6		0.0	Yes	Yes
TR	1/6	3 000	8	Windhoek Western Bypass 1)	14	1981	17	35	49	0	1	2	0	1	3	3	1	10		0.0	Yes	Yes
TR	1/6	3 000	8	Brakwater - Teufelsbach	10	1960/78	38/20	35	109/57	0	1	2	0	1	2	2	1	7		0.0	Yes	Yes
TR	6/1	2 800	10	Windhoek - Kappsfarm	20	1961/78	37/20	35	106/57	0	0	1	0	0	2	1	1	18		0.0	Yes	Yes
TR	1/4	800	18	Mariental - Kalkrand 2)	76	1962	36	40	90	11	11	15	15	15	23	22	16	38	525 000	39 900.0	Yes	Yes
TR	1/4	800	18	Kalkrand - Rehoboth 2)	99	1963	35	40	88	15	15	20	20	20	30	29	21	49	525 000	51 975.0	Yes	Yes
TR	1/3	1 090	25	Asab - Ebenerde 2)	69	1963	35	40	88	17	17	17	28	21	21	38	15	15	525 000	36 225.0	Yes	Yes
TR	1/3	1 100	25	Ebenerde - Mariental	30	1963/83	35/15	40	88/38	8	8	8	12	9	9	17	7	6		0.0	Yes	Yes
TR	6/1	2 500	10	Kappsfarm - Ondekaremba	25	1964/78	34/20	35	97/57	0	0	1	0	0	2	2	1	22		0.0	Yes	Yes
TR	5/1	290	19	Hardap - Stampriet	53	1971	27	40	68	0	0	0	0	0	3	0	0	53		0.0	Yes	Yes
TR	6/1	600	15	Ondekaremba - Gobabis border	71	1973	25	35	71	0	0	7	0	0	14	5	4	62		0.0	Yes	Yes
MR	33	110	15	Voigtland - Dordabis	62	1978	20	35	57	0	0	0	0	0	12	n.a.	n.a.	n.a.		0.0	No	No
MR	34	125	10	Mariental - Maltahohe	111	1980	18	40	45	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
MR	47	90	15	Rehoboth - Rehoboth Station	40	1978	20	40	50	0	0	0	0	0	4	n.a.	n.a.	n.a.		0.0	No	No
MR	52	400	15	Windhoek - Daan Viljoen G.R.	19	1971	27	35	77	0	0	4	0	4	4	n.a.	n.a.	n.a.		0.0	No	No
MR	61	90	15	Stampriet - Aranos	81	1977	21	40	53	0	0	0	0	0	0	0	0	81		0.0	Yes	Yes
MR	70	80	14	TR6/1 - Omitara	15	1975	23	35	66	0	0	2	0	2	3	n.a.	n.a.	n.a.		0.0	No	No
MR	81	800	8	TR6/1 - Hosea Kutako Airport	1	1965/78	33/20	35	94/57	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
MR	93	200	15	TR1/4 - Hardap Dam	7	1971	27	40	68	0	0	1	0	0	2	n.a.	n.a.	n.a.		0.0	No	No
					899					**51**	**54**	**99**	**75**	**82**	**154**	**140**	**75**	**428**		**128 100**		

1) North of Independence Avenue

2) Sections between those rehabilitated should be considered for widening of the carriageway (C/W) to uniform width (See proposed 5-year plan for C/W widenings)

n.a. = no measurements done

Estimates of expenditure Date 20/08/98

Financial Years 1999/2000 - 2003/2004 and later…… Nation-wide/Region Swakopmund

Bitumen Roads **Rehabilitation of Roads**

Projects to be investigated

Road class T,M,D	Road no	TSS 1997 ADT	Heavy traffic %	Project name	Total km	Year of constr/ rehab	Age index (%) = Actual age/Rainfall age			Rehabilitation needs, km						DOT/PMS estimated remaining life in kms			Cost/ km N$	Total cost N$1000	Deflect. Measurem. Yes/No	Rehab Index Yes/No
										NTMPS optimistic			NTMPS conservative									
							Actual age	Rainfall age	Age index	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	6 - 10 years	11+ years				
TR	7/1	1 050	15	Okasise - Wilhelmstal 1)	18	1964	34	35	97	0	3	5	2	4	5	3	3	12	525 000	9 450.0	Yes	Yes
TR	7/1	1 200	15	Wilhelmstal - Karibib 1)	50	1964	34	35	97	0	8	8	5	10	10	8	9	33		0.0	Yes	Yes
TR	2/2	1 300	12	Swakopmund - Trekkopje	69	1966	32	40	80	0	0	14	0	14	14	n.a.	n.a.	n.a.		0.0	No	No
TR	2/2	1 300	12	Trekkopje - Usakos 1)	76	1965	33	40	83	0	0	15	0	15	15	n.a.	n.a.	n.a.		0.0	No	No
TR	2/3	1 200	15	Usakos - Karibib 1)	30	1966	32	35	91	2	8	10	4	12	10	18	8	4	525 000	15 750.0	Yes	Yes
TR	2/1	2 700	17	Walvis Bay - Swakopmund	34	1970	28	40	70	0	0	3	0	3	7	n.a.	n.a.	n.a.		0.0	No	No
TR	2/5	510	10	Outjo border - Outjo	30	1970	28	35	80	0	0	2	0	2	3	1	2	27		0.0	Yes	Yes
TR	2/4	300	20	Omaruru - Kalkfeld	70	1974	24	35	69	0	0	3	0	0	7	3	3	64		0.0	Yes	Yes
TR	2/4	280	20	Kalkfeld - Otjiwarongo	69	1973	25	35	71	0	0	3	0	0	7	3	3	63		0.0	Yes	Yes
TR	2/3	425	15	Karibib - Omaruru	65	1976	22	35	63	3	7	13	7	20	13	38	17	10		0.0	Yes	Yes
MR	36	?	?	Road to Walvis Bay Airport	15	1966	32	40	80	0	0	3	0	3	6	n.a.	n.a.	n.a.		0.0	No	No
MR	67	75	10	Outjo - MR 68	146	1980	18	35	51	0	0	0	0	0	15	n.a.	n.a.	n.a.		0.0	No	No
MR	68	80	10	MR 67 - Okaukuejo	104	1984	14	30	47	0	0	0	0	0	10	0	0	104		0.0	Yes	Yes
					776					**5**	**26**	**79**	**18**	**83**	**122**	**74**	**45**	**317**		**25 200**		

1) Sections between those rehabilitated should be considered for widening of the carriageway (C/W) to uniform width (See proposed 5-year plan for C/W widenings)

n.a. = no measurements done

Estimates of expenditure Date 20/08/98

Financial Years 1999/2000 - 2003/2004 and later…… Nation-wide/Region Otjiwarongo

Bitumen Roads **Rehabilitation of Roads**

Projects to be investigated

Road class T,M,D	Road no	TSS 1997 ADT	Heavy traffic %	Project name	Total km	Year of constr/ rehab	Age index (%) = Actual age/Rainfall age			Rehabilitation needs, km						DOT/PMS estimated remaining life in kms			Cost/ km N$	Total cost N$1000	Deflect. Measurem. Yes/No	Rehab Index Yes/No
										NTMPS optimistic			NTMPS conservative									
							Actual age	Rainfall age	Age index	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	6 - 10 years	11+ years				
TR	1/6	3 000	8	Teufelsbach - Okahandja	40	1960/78	38/20	35	109/57	0	2	6	0	4	8	7	2	31		0.0	Yes	Yes
TR	1/9	820	15	Otavi - Tsumeb 1)	62	1960	38	30	127	0	2	19	9	12	12	18	11	33		0.0	Yes	Yes
TR	1/7	1 200	15	Okahandja - Sukses	107	1964/90	34/8	35	97/23	11	22	33	22	33	16	54	19	34	280 000	29 960.0	Yes	Yes
TR	1/7	1 200	15	Sukses - Otjiwarongo	69	1964/91	34/7	35	97/20	7	14	21	14	21	10	35	12	22	280 000	19 320.0	Yes	Yes
TR	7/1	1 050	15	Okahandja - Okasise 1)	46	1964	34	35	97	0	7	12	5	9	14	7	8	31	600 000	27 600.0	Yes	Yes
TR	1/8	1 250	15	Otjiwarongo - Okaputa	61	1965/98	33/0	30	110/0	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
TR	1/8	1 250	15	Okaputa - Otavi	58	1965/98	33/0	30	110/0	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
TR	8/1	400	15	Otavi - Grootfontein	96	1970	28	30	93	0	10	14	5	14	14	22	18	56		0.0	Yes	Yes
TR	2/5	510	10	Otjiwarongo - Outjo border	40	1970	28	35	80	0	0	2	0	0	4	1	2	37		0.0	Yes	Yes
TR	8/2	300	15	Grootfontein - Berg Aukas 2)	19	1971	27	30	90	0	2	4	0	4	6	11	4	4		0.0	Yes	Yes
TR	8/2	300	15	Berg Aukas - Taranaki	62	1 982	16	30	53	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
TR	8/2	300	15	Taranaki - Mururani 3)	50	1979	19	30	63	5	16	16	16	11	5	30	12	10	280 000	14 000.0	Yes	Yes
TR	6/1	600	15	Gobabis border - Gobabis	94	1972	26	35	74	0	0	9	0	0	18	7	5	82		0.0	Yes	Yes
TR	6/2	450	20	Gobabis - Welkom	15	1972	26	35	74	0	0	0	0	0	1	0	0	15		0.0	Yes	Yes
TR	2/4	300	20	Kalkfeld - Otjiwarongo	69	1973	25	35	71	0	0	3	0	0	7	3	3	63		0.0	Yes	Yes
MR	72	470	10	Tsumeb border - Grootfontein	33	1971	27	30	90	7	3	7	10	7	8	21	4	8	280 000	9 240.0	Yes	Yes
MR	87	85	10	Okahandja - Gross Barmen	26	1981	17	35	49	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
MR	96	200	10	To Grootfontein Airport	4	1970	28	30	93	0	0	4	0	4	0	n.a.	n.a.	n.a.		0.0	No	No
MR	101	60	15	TR1/7 - Okakarara	72	1982	16	30	53	0	0	7	0	7	7	8	10	54		0.0	Yes	Yes
DR	2844	50	5	TR8/2 - Berg Aukas 2)	4	1971	27	30	90	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
					1 027					**30**	**78**	**157**	**81**	**126**	**130**	**224**	**110**	**480**		**100 120**		

1) Sections between those rehabilitated should be considered for widening of the carriageway (C/W) to uniform width (See proposed 5-year plan for C/W widenings)

2) 200 mm crushed rock base

3) Carbonation problem

n.a. = no measurements done

Estimates of expenditure Date 20/08/98

Financial Years 1999/2000 - 2003/2004 and later…… Nation-wide/Region Oshakati

Bitumen Roads **Rehabilitation of Roads**

Projects to be investigated

Road class T,M,D	Road no	TSS 1997 ADT	Heavy traffic %	Project name	Total km	Year of constr/ rehab	Age index (%) = Actual age/Rainfall age: Actual age	Rainfall age	Age index	Rehabilitation needs, km: NTMPS optimistic 0 - 5 years	NTMPS optimistic 5 - 10 years	NTMPS optimistic 10 -15 years	NTMPS conservative 0 - 5 years	NTMPS conservative 5 - 10 years	NTMPS conservative 10 -15 years	DOT/PMS estimated remaining life in kms: 0 - 5 years	6 - 10 years	11+ years	Cost/ km N$	Total cost N$1000	Deflect. Measurem. Yes/No	Rehab Index Yes/No
TR	1/10	600	21	Tsumeb - Oshivelo	95	1968/81	30/17	30	100/57	0	19	19	12	19	19	41	28	26		0.0	Yes	Yes
TR	1/11	1 630	23	Oshivelo - Ondangwa	152	1968/80/98	30/18/0	30	100/12/0	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
MR	84	120	15	S Oshivelo (TR1/10) - Namutoni	36	1968	30	30	100	0	0	0	0	0	2	0	0	36		0.0	Yes	Yes
MR	92	2 000	15	Ondangwa - Oshakati	35	1968/80/98	30/18/0	30	100/12/0	0	0	0	0	0	0	n.a.	n.a.	n.a.		0.0	No	No
MR	72	460	10	Tsumeb - Grootfontein border	23	1971	27	30	90	5	2	5	7	5	6	14	3	6		0.0	Yes	Yes
TR	8/3	260	15	Mururani - Rundu 1)	131	1979	19	30	63	40	26	19	53	29	19	94	16	21	525 000	68 775.0	Yes 3)	Yes 3)
TR	8/4	280	10	Rundu - Takwasa	53	1987	11	30	37	0	0	0	0	0	11	6	19	28			Yes	Yes
TR	8/4	280	10	Takwasa - Divundu	147	1992	6	30	20	0	0	0	0	0	29	18	53	76			Yes	Yes
TR	8/6	460	10	Kongola - Katima Mulilo	116	1979	19	30	63	58	46	12	58	58	0	9	107	0	525 000	60 900.0	Yes	Yes
TR	1/11	350	50	Ondangwa - Oshikango	63	1984	14	30	47	0	6	13	0	13	19	40	3	20		0.0	Yes 3)	Yes 3)
MR	92	30	15	Ruacana - Uutapi 2)	61	1981	17	30	57	0	6	9	0	6	15	12	3	46		0.0	Yes	Yes
MR	92	30	15	Uutapi - Ogongo 2)	57	1981	17	30	57	0	6	9	0	6	15	11	3	43		0.0	Yes	Yes
MR	92	30	15	Oshakati - Ongongo 2)	55	1984	14	30	47	0	6	8	0	6	14	11	3	41		0.0	Yes	Yes
MR	75	400	12	Tsumeb - Tsintsabis	12	1986	12	20	60	0	0	0	0	0	1	0	1	11		0.0	Yes	Yes
MR	111	180	14	Oshakati - Okahao	70	1993	5	30	17	0	0	0	0	0	7	n.a.	n.a.	n.a.		0.0	Yes	Yes
DR	3622	270	15	TR1/11 - Eenhana	4	1984	14	30	47	0	0	0	0	0	0	0	0	4		0.0	Yes	Yes
					1110					**103**	**117**	**94**	**130**	**142**	**157**	**256**	**239**	**358**		**129 675**		

1) Carbonation problem

2) Silcrete, salt

3) Studies in progress

n.a. = no measurements done

Estimates of expenditure Date 17/08/98

Financial Years 1999/2000 - 2003/2004 and later…… Nation-wide/Region Nation-wide

Rehabilitation & improvement

Bitumen Roads

Rank	Road class T,M,D	Bridge or Road no	TSS 1997 ADT	Project name	Total km	Rehabilitation needs, km						DOT/PMS estimated remaining life in kms			Total cost N$1000	Funding Requirements - 5 year plan					
						NTMPS optimistic			NTMPS conservative							1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	Later
						0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	5 - 10 years	10 -15 years	0 - 5 years	6 - 10 years	11+ years		N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000	N$ 1000
				Keetmanshoop	882	49	81	114	91	94	156	163	132	457							
				Windhoek	899	51	54	99	75	82	154	140	75	428							
				Swakopmund	776	5	26	79	18	83	122	74	45	317							
				Otjiwarongo	1027	30	78	157	81	126	130	224	110	480							
				Oshakati	1110	103	117	94	130	142	157	256	239	358							
Grand Total					**4694**	**238**	**356**	**543**	**395**	**527**	**719**	**857**	**601**	**2040**							
Annual average per 5 year period						**48**	**71**	**109**	**79**	**105**	**144**	**171**	**120**								

1) Carbonation problem

2) Silcrete, salt

3) Studies in progress