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ROADS DEPARTMENT

Ministry of Works, Transport
and Communications



Planning and Environmental Impact Assessment of Road Infrastructure

Guideline no 5

September 2001

Planning and Environmental Impact Assessment of Road Infrastructure

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ROADS DEPARTMENT

Under the policy direction of the Ministry of Works, Transport and Communications, Roads Department exists to provide and maintain adequate, safe, cost effective and efficient road infrastructure for Botswana and our neighbours in order to facilitate national development and intra regional communications in an environmentally sustainable manner. Implied in these far-ranging responsibilities is the obligation to:

- ensure that existing roads are adequately maintained in an environmentally friendly way in order to provide appropriate level of service for road users
- improve existing roads to required standards to enable them to carry prevailing levels of traffic with regard to the required degree of safety and environmental standard
- provide environmentally friendly new roads to the required geometric, pavement design and safety standards

The Department has been vested with the strategic responsibility for the overall management of the Public Highway Network (PHN) of approximately 18,300 kilometres (km) of roads. This confers authority for setting national specifications and standards and shared responsibility with the District Councils and Department of Wildlife and National Parks for co-ordinated planning of the PHN.

Roads Department is also responsible for administering the relevant sections of the Public Roads Act, assisting local authorities on technical matters and providing assistance in the national effort to promote citizen contractors in the road construction industry by giving technical advice wherever possible. This task has been facilitated by the publication of a series of Technical Guidelines dealing with standards, general procedures and best practice on a variety of aspects of the planning, design, construction and maintenance of roads in Botswana that take account of local conditions.

In its endeavour to provide uniformity of practice in the provision of efficient and effective road infrastructure, Roads Department has embarked on the preparation and publication of a number of Technical Guidelines. The main objective of these Guidelines is to document best practice and to preserve local knowledge on a variety of aspects of road planning, design construction and maintenance that have evolved over many years.

Guideline No. 1: The Design, Construction and Maintenance of Otta seals (1999)

**Workshop Proceedings, September 2000, Addendum with reference to
Guideline No. 1 The Design, Construction and Maintenance of Otta Seals (1999)**

Guideline No. 2: Pavement testing, Analysis and Interpretation of Test Data (2000)

Guideline No. 3: Methods and Procedures for Prospecting for Road Construction Materials (2000)

Guideline No. 4: Axle Load Surveys (2000)

Guideline No. 5: Planning and Environmental Impact Assessment of Road Infrastructure (2001)

FOREWORD

The guideline for Planning and Environmental Impact Assessment of Road Infrastructure has been produced at a time when Government is calling more and more for sustainable development. The National Development Plan 8 is the first of Botswana Development Plans to include a separate chapter on environmental conservation and land use.

The guideline provides a comprehensive technical basis for decision making through integrating Environmental Impact Assessment (EIA) into the planning process. It also provides transparent procedures that are followed when deciding on the choice of alignments. This is indeed a positive step as views of stakeholders and communities are taken into consideration in the planning process.

One of the value areas of the Roads Department relates to concern for public needs and consultation. This guideline covers this principle very well.

Planning and EIA of roads have been carried out in the past without the benefit of a national guideline. This has resulted in the production of environmental reports that varied in content, quality and coverage. This has made it difficult for road authorities and stakeholders to appreciate the basis for selecting alignments. It is possible that environmental issues of concern have been ignored or that necessary mitigating measures have not been implemented.

This guideline has not been written to be understood by technocrats only, but contains chapters that can easily be understood by the stakeholders at large. This has the benefit that stakeholders will at least understand the basis for selecting one alignment over the other.

Previous experience has shown that projects planned without proper consultation with stakeholders often lead to delays in construction due to late appeals for changes to the alignment.

It is my sincere hope that this guideline will be applied by parties for the benefit of the economy of the country.

Gaborone, September 2001



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Non - Governmental Organisations
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Community Representatives from the Palapye-Martins Drift road and the Mahalapye-Machaneng road

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SUMMARY

This guideline presents the methodology to be used for Planning and Environmental Impact Assessments of road projects.

The emphasis throughout is on the practical use of the methods. Full coverage of the theoretical or the philosophical basis of the methods is not presented.

The objective of the guideline is to achieve a comprehensive technical basis for decision-making through integrating Environmental Impact Assessments into the planning process.

Equally important is facilitating transparency for authorities and communities affected during the planning process.

The term environment in this guideline encompasses the economic, ecological and social surroundings of man.

Environmental Impact Assessment (EIA) is an evaluation of foreseeable impacts, both beneficial and adverse. It is intended to help reveal mitigating measures and alternatives to optimise positive impacts while reducing or limiting negative impacts. The end result of the EIA process should be a better understanding of the linkages between our society, our natural environment and the sustainable use of our inherited resources.

The EIA method described in this manual is a systematic evaluation of the relevant advantages (benefits) and disadvantages (costs) that alternative alignments for a new road project or improvements to an existing road will generate, regardless of the unit of measurement, i.e. whether measurable in monetary units or not.

The impacts that can be put into monetary terms e.g. time-savings, are handled in an ordinary Cost Benefit Analysis. The non-monetary impacts, for example impacts on archaeological relics, are handled in a systematic way describing the value of the asset and the magnitude of the impacts. Based on the value and the magnitude, the significance of the impacts are assessed.

EIA is also used as a basis for comparing different projects.

The normal steps of the planning process for road projects in Botswana are as follows:

- Pre-feasibility study - internal process to produce the ToR for the study and the EIA
- The Feasibility Study and the EIA- seeking and selecting a corridor as well as the alignments within the chosen corridor. Often there is only one corridor.
- Detailed planning of the selected alternative
- Construction
- Maintenance and monitoring

The guideline is divided into two parts as follows:

Part I: Chapters 1 - 5, describe the project cycle (planning - construction - maintenance).

Part II: Chapters 6 - 8, give technical guidance about consultation, the EIA and the comparison of alternatives.

The sections under 7.4, non-monetary impacts, can be read separately. Part of the text is therefore repeated throughout the chapter under each theme.

Appendices III and IV describe useful techniques when generating and analysing alignments, that is creative planning techniques and vulnerability mapping.

EIAs are normally carried out when planning new roads and are thus an important part of the planning process.

The extent of the EIA and whether or not there will be a comprehensive EIA can be settled through a screening process.

An EIA is to be carried out at different levels of detail at the pre-feasibility, feasibility and detailed planning stages. The most comprehensive EIA is normally carried out at the feasibility stage. Technical guidance for the level of detail of the EIA at each planning stage is given in Chapter 7.

Road projects often involve issues of conflicting interests. An EIA is, in this respect, a useful tool for documenting the various impacts and interests. An EIA also provides a transparent basis for comparing the alignments and recommending or deciding on alternative options.

Consultation with other public bodies and the local communities affected by the new roads is very important to enhance the benefits of the road project and to minimise any adverse effects. Transparency is important for creating the best possible basis for decision making. Transparency and accountability in the planning process are also important tools for reducing conflicts and avoiding set backs caused by decisions made without proper consultation.

The themes considered to be most relevant for road projects are covered in this guideline, namely:

Themes to be included in an EIA	Method of assessment :
Monetary themes: Time savings Savings in vehicle operating costs Benefit from generated traffic Savings in accident costs	Cost Benefit Analysis
Non-monetary themes: Geological resources Agriculture Surface water Archaeological and other historical assets Biophysics - wildlife and vegetation Aesthetic impacts Noise nuisance and local air pollution Social environment - effects on community life	Significances of impacts are assessed by combining the value of the asset and the magnitude of the impacts. Significance can range from four pluses to four minuses via zero + + + + 0 - - - - -
Short-term effects during construction	Check list

The guidelines also present advice on how to compare monetary and non-monetary impacts and how to discuss and substantiate the recommendation of an alignment.

Layout of the guideline

PART I - The Planning Process

- 1. Introduction**
- 2. The Pre-feasibility Study**
- 3. The Feasibility Study**
- 4. Detailed planning of the Selected Alternative**
- 5. Construction and maintenance**

PART II - Technical Guide to Consultation and EIA

- 6. Consultation**
- 7. The Environmental Impact Assessment at the feasibility stage**
- 8. Guide to the Comparison and Recommendation of alignments**

Appendices

Appendix I : Glossary of terms

Appendix II : Abbreviations

Appendix III: Creative planning techniques

Appendix IV: Vulnerability mapping - developing alignments

Appendix V : Reference list

PART I - The Planning Process

This covers chapters 1-5 and act as a general guideline to the planning process.

Chapter 1. Introduction

Chapter 2. The Pre-Feasibility Study - screening, initial assessment and scoping

Chapter 3. The Feasibility Study and the Environmental Impact Assessment - Corridor and Alignment Selection

Chapter 4. Detailed Planning of the Selected Alternative

Chapter 5. Construction and Maintenance

1. Introduction

1.1 Background

Road planning and construction are means of solving transport needs. Transport is important for achieving political objectives with respect to economic growth, rates of employment etc. Road planning is however complex and has both positive and negative impacts on the environment.

Botswana has several pieces of legislation on the protection of the environment, but no legislation exists that specifically requires an EIA to be undertaken prior to the implementation of major road policies, road programmes or road projects.

The approval of the National Policy on Natural Resource Conservation and Development in 1990 marked the beginning of a new approach to our development planning and implementation process. A comprehensive evaluation of environmental impacts before major projects are undertaken is now called for. The primary goal is to pursue policies and measures which will increase the effectiveness of the use and management of natural resources so that beneficial interactions are optimised and harmful environmental effects minimised.

The Roads Department of Botswana's Ministry of Works, Transport and Communications has been carrying out EIAs on all new road projects, partly as a donor requirement and partly as an internal policy that has no legal requirement. The Environmental Impact Report for non-monetary impacts has been produced as a stand-alone document which has not been used in an active way in the economic analysis of road projects. Hence, alignments have often been chosen with little emphasis put on the non-monetary environmental issues.

The National Development Plan 8 (1997-2002) is the first of Botswana's plans to include a separate chapter on Environmental Conservation and Land Use in recognition of the importance of the environment and land for development. Land is a finite resource, while the natural resources it supports can vary over time and according to management conditions and uses. Rapid increases in both population and prosperity have placed a tremendous strain upon Botswana's fragile natural environment, creating competition and conflicts and not always resulting in the optimal use of land and land resources.

The Roads Department has responded to the call for sustainable development proactively by producing these guidelines.

1.2 The purpose and scope of the guideline

The guideline is to be used as a guide in the planning and EIA of linear developments, with particular reference to roads. All impacts are to be included in the assessments, both monetary and non-monetary. All significant impacts must be described and discussed in order to optimise the benefits of the roads and minimise the adverse effects.

Sustainable development:
"A process of change aimed at meeting the needs of the present generation without jeopardising the ability to meet the needs of future generations"

Quote from "Our Common Future" by UN World Commission on Environment and Development. April 1987

The guidelines' objective is to facilitate transparency for affected authorities and communities as well as serving as a comprehensive technical basis for decision-making through every step in the planning process.

The target group of this guideline is the staff in the Roads Department, other public authorities and consultants involved in road planning.

It is intended that by using the procedures outlined in the guideline:

- Project evaluation will be presented in a consistent format
- The costs and benefits, both monetary and non-monetary, of project options and their relative magnitude will become clear
- Assumptions made will as far as possible be standardised between the projects through the method introduced for monetary and non-monetary impacts
- The appropriate level of data collection and analysis of projects will be undertaken depending on their nature and costs, and the scale of their likely impacts

1.3 The structure of the guideline

The guideline is structured in three main sections:

Part I: General guideline to the planning process

Part II: Technical guideline for consultation and EIA

Appendices: Explain terms and provide guidance on the techniques which can be applied when generating and analysing alignments.

The process described in this guideline is summarised in the project cycle in figure 1.8.3.

1.4 Framework for the selection of possible new road projects

The current planning process in Botswana is aimed at satisfying the national objectives of sustainable development and economic growth through the provision of a basic infrastructure of which roads form a major part. The Ministry of Works, Transport and Communications through the Roads Department, the Ministry of Local Government and the District and Urban Authorities are charged with the responsibility of providing road infrastructure in the country.

The planning and construction of roads is guided by a 6 year National Development Plan (NDP), outlining projects that are to be undertaken during the period of the Plan. All road projects intended for construction to bitumen standard or rehabilitation are included in this document and no project can be constructed without the express approval of Parliament. It follows therefore that the proper screening of projects has to be carried out before this National Plan is produced to ensure that candidate projects included are ranked the highest within a limited budget.

The selection of possible new road projects to be included in an NDP for subsequent construction is undertaken by means of a consultative process. Firstly the Roads Department in conjunction with the respective District Authorities draws up a list of possible new projects. The prioritisation of these projects is

made taking account of various factors such as the population to be served, traffic density and the industrial or tourist potential in the area. The overriding factor for the number of projects to be included is the financial ceiling set by the Ministry of Finance and Development Planning in the overall Government Budget.

The proposal of roads for construction is then presented for the Ministry of Works, Transport and Communications and subsequently included in the National Development Plan for approval by Parliament. Following approval, the process of planning the construction programme then commences. The National Development Plan is reviewed yearly with progress measured against the programme, and where necessary amendments are made to projects as circumstances dictate at that time. This includes both the deletion of projects or the addition of new ones.

1.5 Road Planning Authorities

The responsibility for the provision and maintenance of the Public Highway Network is currently divided as follows:

- Primary and Secondary roads are the responsibility of the Roads Department
- Tertiary and Access roads are the responsibility of District and Urban Authorities

The criteria adopted for classifying roads have been based on their relative importance and functions. Primary roads provide links to cities, towns and regional centres and other major centres of population larger than 10,000 and to important border crossings. Secondary roads link villages with a population of 2,000 people or more and established border posts, as well as sites of international or national interest. Tertiary roads link settlements with a population of 500 people or more. Access roads include the additional roads not contained in the foregoing categories, normally determined by District Councils. Roads and streets within a city or a village are the responsibility of the local authorities. The table below summarises the responsibilities of the Roads Authorities.

Type of road	Main function	Responsible authority
Primary road	Links cities, towns and district centres and other centres with 10.000 people or more and to border crossings	Roads Department
Secondary road	Links villages with a population of 2.000 people or more and established border posts, and sites of international or national interest	Roads Department
Tertiary Road	Settlements of 500 people or more	District and Urban Authorities
Access roads	Additional roads not contained in the foregoing categories	District and urban Authorities

Figure: 1.5.1 Overview of the road planning authorities

In addition to the above classes of roads, other public roads exist which serve local needs such as those found in National Parks etc.

1.6 Access Roads Policy

The Roads Department sometimes constructs access roads as part of primary or secondary roads to be handed over to District Authorities for future maintenance. The access road policy states that all settlements within a 10 km radius of the development project should be connected to the main road.



Figure 1.6.1: Map showing the most important national roads

1.7 Road Planning as an integral part of physical planning

The planning of any project is an activity aimed at making choices about future options in order to achieve certain goals. Planning for the development of road infrastructure is part of physical planning. The term physical planning also encompasses town planning, land use planning or other spatial planning which describes the land use and the relationships between different kinds of land use.

Definition of physical planning: "The art and science of ordering the use of land, siting of buildings and communication routes so as to secure the maximum practicable degree of economy, safety, convenience and beauty"
Physical Planning Handbook of Botswana DETR April 1997

Ideally road planning should:

- Enhance and protect assets important to the well-being of the people
- Handle the external impacts of developments
- Provide a comprehensive basis for decision-making

The role of the Road Planners encompasses being a:

- Facilitator - supply data and information to decision makers
- Co-ordinator - make sure everyone involved is well informed
- Negotiator - resolve conflicts
- Advocate - represent the different interests involved

Roads are an important prerequisite for other developments, and there is a strong relationship between the development of the road network and other land use. It is therefore important that road planning is done in co-ordination with and as an integrated part of other physical planning processes carried out by local planning authorities.

Physical planning can be approached in many ways. The dominant approach to planning to date is termed rational planning. Rational planning can be defined as a planning process where the planner will generate comprehensive solutions based on a systematic collection of important data, elaborated so that “the data dictate the solution”.

Critics claim that this is a way of allowing the collected data to dictate solutions with little room for creativity. Defenders claim that it is better to base solutions on knowledge and predictable science than on more flimsy politics.

Recent developments within the planning field have led to adjustments to the rational way of planning rather than a totally new approach. More emphasis has been put on participatory planning which means more consultation at an early stage both with the public, with other public stakeholders and with the private sector.

More weight is also put on multidisciplinary in planning, construction and maintenance. Teams consisting of engineers, landscape architects, architects, environmentalist, biologists etc. working together are considered the most cost-effective way of reaching optimal solutions.

Creativity and co-operation throughout the planning process are consequently stimulated. Examples of simple methods to stimulate creativity in teams working together are described in appendix III. These techniques are widely employed.

The term negotiative planning has also been introduced. This applies whenever an important part of the role of the planner is to negotiate between the developers and the political authorities.

1.8 The Project Planning Cycle and the Environment

The term environment is here used to describe the economic, ecological, and social aspects of the surroundings of man.

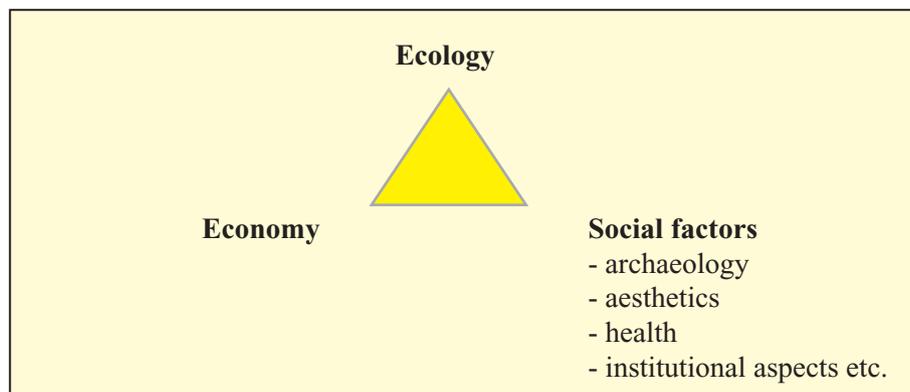


Figure 1.8.1: The three cornerstones of the term environment

An all-encompassing project assessment thus includes themes such as socio-economics, health, social conditions, traffic safety, ecology, cultural heritage and effects on community life.

The effectiveness and success of the EIA depends on the extent to which it is actively used and incorporated into the different stages of a normal project planning process, without causing much disruption to the flow of the process.

An important reason to carry out EIAs is to generate, eliminate and improve alternative alignments. Equally important is active integration of mitigating measures in the alignments. In this way an EIA will not only serve as a passive description of impacts, but actively contribute to better results from roads projects for society as a whole.

Figure 1.8.2 illustrates a general project planning cycle and how the EIA fits into the cycle. The illustration has been produced by the United Nations Environmental Program. When road planning conforms to the cycle it looks like figure 1.8.3.

The figure shows how EIAs are carried out in separate stages and at different levels of detail during the planning process.

Environment:

Environment includes the physical, ecological, archaeological, aesthetic, cultural, economic, institutional, human health and social aspects of the surroundings of man.

National Conservation Strategy Agency of Botswana 1999

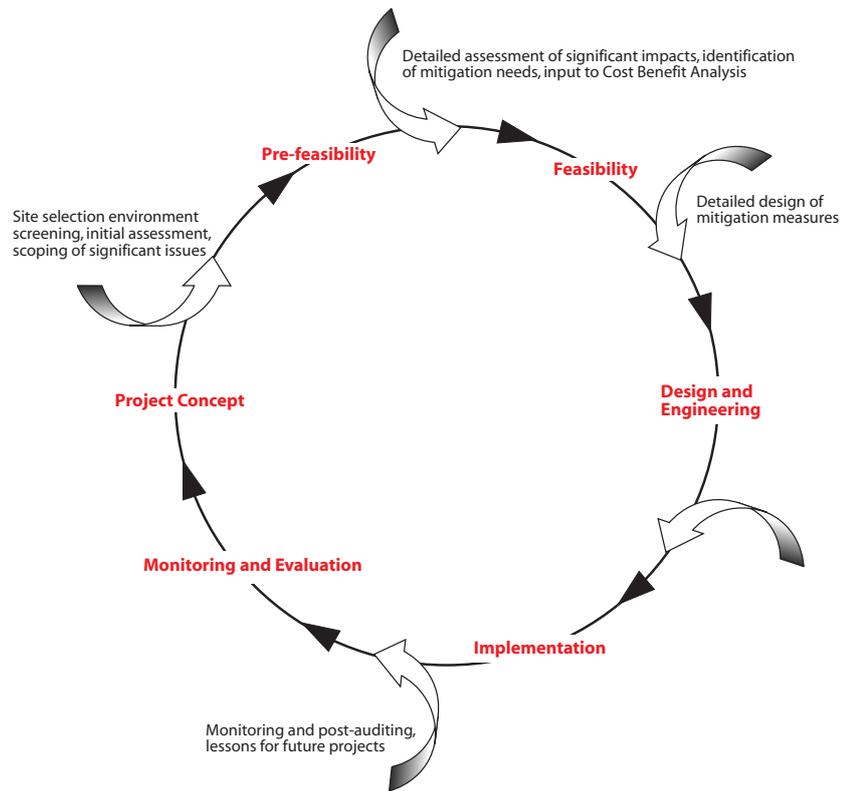


Figure 1.8.2: The EIA and the project cycle. Source: United Nations Environmental Program (UNEP) 1988. The diagram is an illustration of the project cycle showing how EIA can fit into the cycle.

If road planning were to conform to the cycle in figure 1.8.2 it would resemble the following sketch in figure 1.8.3.

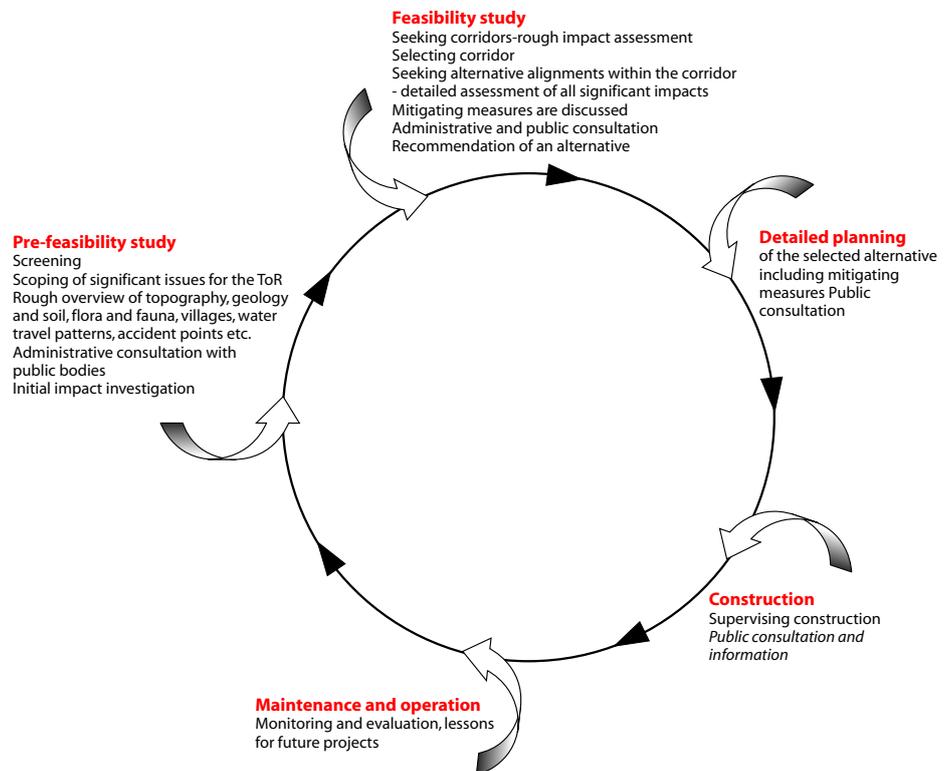


Figure 1.8.3: The Road Planning Process conforming to United Nations Environmental Program (UNEP)'s project cycle (figure 1.8.2)

The different stages in the road planning process as shown earlier are described in the chapters 2, 3, 4 and 5. Technical advice on issues such as the different themes of an EIA, report requirements, consultation procedures etc. is given in the chapters following chapter 5. Another way of illustrating the planning process is shown in figure 1.8.4.

Normally, the corridor selection stage at feasibility is not necessary. Different corridors might however be investigated when bypassing a town.

The impact assessment will be more or less the same when the rehabilitation or reconstruction of an existing road is the most feasible option. An EIA will be required in most cases.

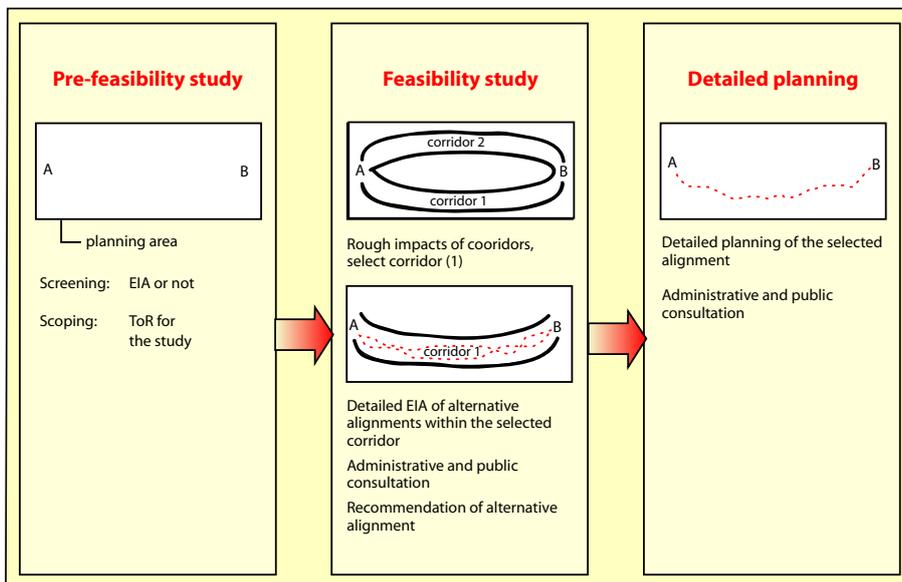


Figure 1.8.4: The planning process can also be illustrated like this.

1.9 Consultation

The need for consultation at the different planning stages of all major road projects cannot be over emphasised. The success of the overall planning and implementation processes will largely depend on the timely execution of this aspect by the planners. The extent to which consultations are required will of course vary from project to project depending on the size of the project, the area and the local conditions. These requirements should therefore be clearly laid out in the ToR and in addition be detailed in the proposed working programmes. Advice on consultation is given in chapter 6.0.

Consultation procedures should not be seen as a setback to progress but rather be appreciated as a means of facilitating an efficient assessment process that generally will save time and reduce costly delays to project implementation.

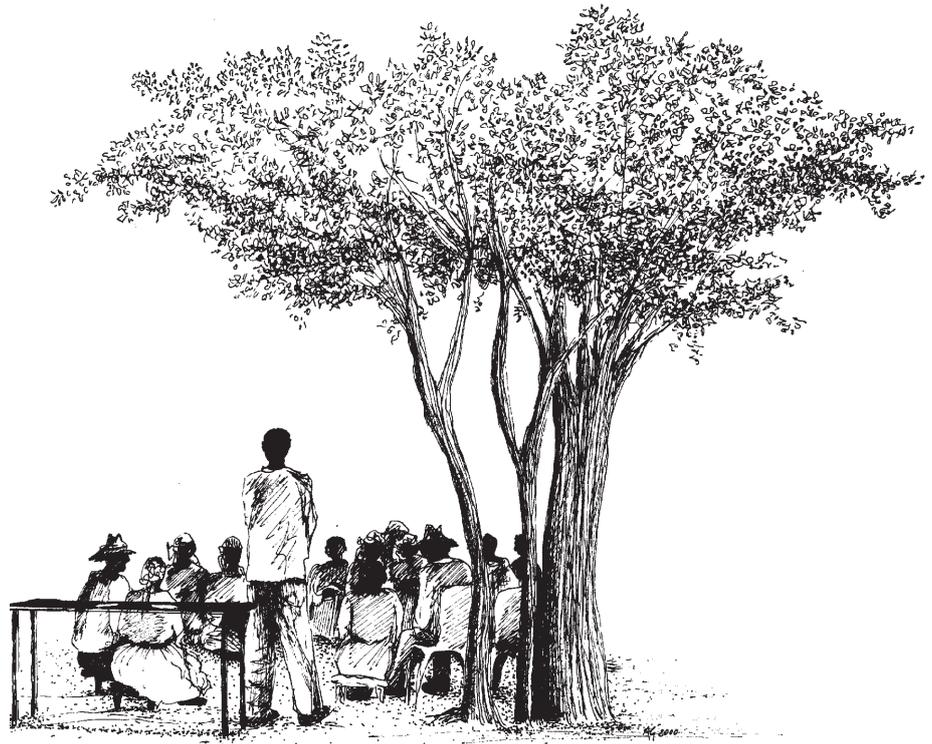


Figure 1.9.1: The need for consultation cannot be over emphasised

2. The Pre-feasibility Study - Screening, Initial Assessment and Scoping

2.1 Introduction

The pre-feasibility study is the process carried out to determine the scope and extent of the study. Screening will decide whether a comprehensive EIA should be carried out, while scoping will determine the ToR for the study.

2.2 Screening and Initial Assessment in the Pre-feasibility Study

The most important decisions concerning road projects are often taken at the pre-feasibility stage. Both screening and scoping are important as a basis for the planning of road projects.

A preliminary EIA has to be carried out at the pre-feasibility level in order to determine whether a comprehensive EIA is necessary. This is carried out through a process called screening. The check list below is to be used as a help.

For all major road and bridge projects an EIA is normally carried out as part of the planning process. This also applies to the rehabilitation or reconstruction of existing roads.

Screening, as a process to decide whether or not to carry out an EIA, is therefore necessary for small projects only.

The sensitivity of the area and the impact on the natural resources, the population and other social factors will determine whether an EIA has to be carried out.

For small projects such as improvements of intersections, adjustments of the alignment, increase of road width, small access roads in the districts etc., the screening of the project revealing the impacts will determine whether a comprehensive EIA should be carried out or not.

However, small projects which have adverse environmental effects on valuable and sensitive areas such as national parks, wetlands, archaeological sites etc. should undergo an EIA. The roads authorities will decide whether an EIA has to be carried out.

An EIA is normally carried out for all major road and bridge projects as well as for the reconstruction of existing roads.

Screening, as a process to decide whether or not to carry out an EIA, is necessary for small projects only.

The following is a proposal for an internal checklist that can be used for small projects. Large projects always require an EIA.

The checklist can therefore be used for small projects that do not automatically require an EIA.

If the answer to any of these questions is yes, scoping should be carried out for an EIA. The list consists of examples and is not exhaustive.

- *Does the project have an impact on agricultural areas of high productivity, such as arable land, good grazing land or important forests?*
- *Does the project have an impact on areas important for community life such as play grounds, kindergartens, open public spaces, Kgotla or landscape features of symbolic cultural value?*
- *Does the project have an impact on the habitats of endangered species locally or internationally?*
- *Does the project have an impact on important water systems?*
- *Does the project have an impact on automatically protected cultural relics (relics dating from earlier than 1902 according to the Monuments and Relics Act.) or on areas or objects that have been declared a national monument.*
- *Does the project have an impact on national parks, nature reserves or designated Wildlife Management Areas?*
- *Does the project have an impact on areas identified as landscape assets either related to nature or connected to objects of historical value in land zoning plans?*
- *Does the project have an impact on areas widely recognised for their scenic beauty?*
- *Does the project seriously increase the noise nuisance or local air pollution in a residential area, or for an institution such as a school, kindergarten or a hospital?*
- *Do several small roads have significant cumulative impacts?*

2.3 Scoping of significant issues as a basis for the ToR for the EIA and the Study

2.3.1 Definition and objectives of scoping

Scoping is defined as a procedure for determining the extent and approach of the EIA and the study. The extent and approach of the EIA is described in what is referred to as the terms of reference (ToR) specifically for the EIA.

The main objective of scoping is to focus the planning process and the EIA on reasonable alternative corridors and on the most significant impacts for the current project.

The Roads Department carries out consultation with public bodies and others in order to determine the ToR for the EIA and the feasibility study. Scoping involves the participation of relevant authorities and interested parties including district representatives in the area.

It is also important to ensure that all relevant stakeholders have an opportunity to influence the project at an early planning stage before the corridors

Scoping in this guideline is a procedure to determine the extent and approach of the EIA and the study

are selected for further assessment. Scoping will contribute to making the planning process and the project implementation itself cost effective.

The Roads Department is usually responsible for the scoping process.

2.3.2 The Pre-feasibility study - information as a basis for screening and scoping

Investigations to find the most important prerequisites for corridor selection should be carried out at the pre-feasibility stage in all projects. The collection of existing knowledge is necessary to obtain a preliminary overview of the important factors influencing corridor selection within the planning area.

Even if maps, aerial photos and statistical data are available, it may be necessary to carry out field investigations primarily for the purpose of identifying the latest developments in terms of infrastructure, the growth of settlements etc. This is specifically necessary where the 10-km access policy is to apply. Most of the smaller existing access routes to villages are not mapped, and in some cases some of the settlements are not developed enough to qualify for the 10 km access policy.

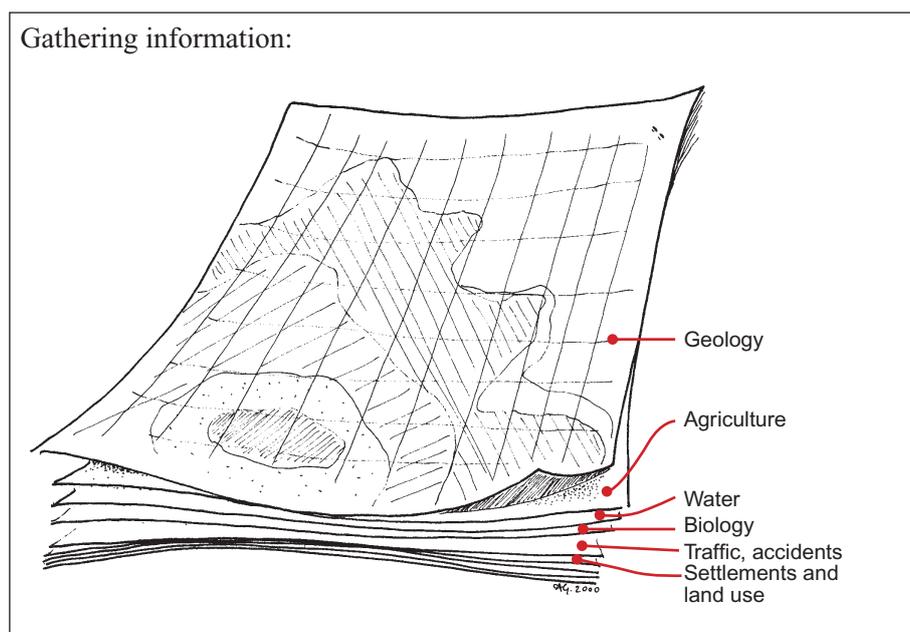


Figure 2.3.2.1: Knowledge of local conditions, creativity and consultation are important for coming up with viable alignments

As a minimum basis for the ToR for the study, information has to be obtained on the following issues, based on desk studies of existing data:

- Policy decisions, for example on road standards
- Village gazettement
- Existing land use plans
- Preliminary engineering investigations, e.g. topographical surveys, available data on road building material
- Traffic conditions, both existing and expected Average Annual Daily Traffic(AADT), the function of the road, accident points along the existing road, the need for access roads etc.
- Weather, e.g. climate - rainfall, temperature, wind erosion etc.

- Existing road links and their residual value as a foundation or source of construction materials
- Existing settlements, their population size, land use and existing infrastructure
- The natural environment - sensitive and valuable areas should be preliminarily mapped according to existing knowledge of the area (water, wildlife etc.)
- Registered archaeological sites and other valuable historical sites
- Sensitive areas, for example areas of scenic beauty and sites of specific scientific interest
- Good arable land and good grazing land

The ToR for the study is the base document for the Road Authorities and serves as a guide to supervise the consultants' work. The ToR must therefore provide a relatively detailed description of the project requirements and the project report requirements.

3 The Feasibility Study and Environmental Impact Assessment - Corridor and Alignment Selection

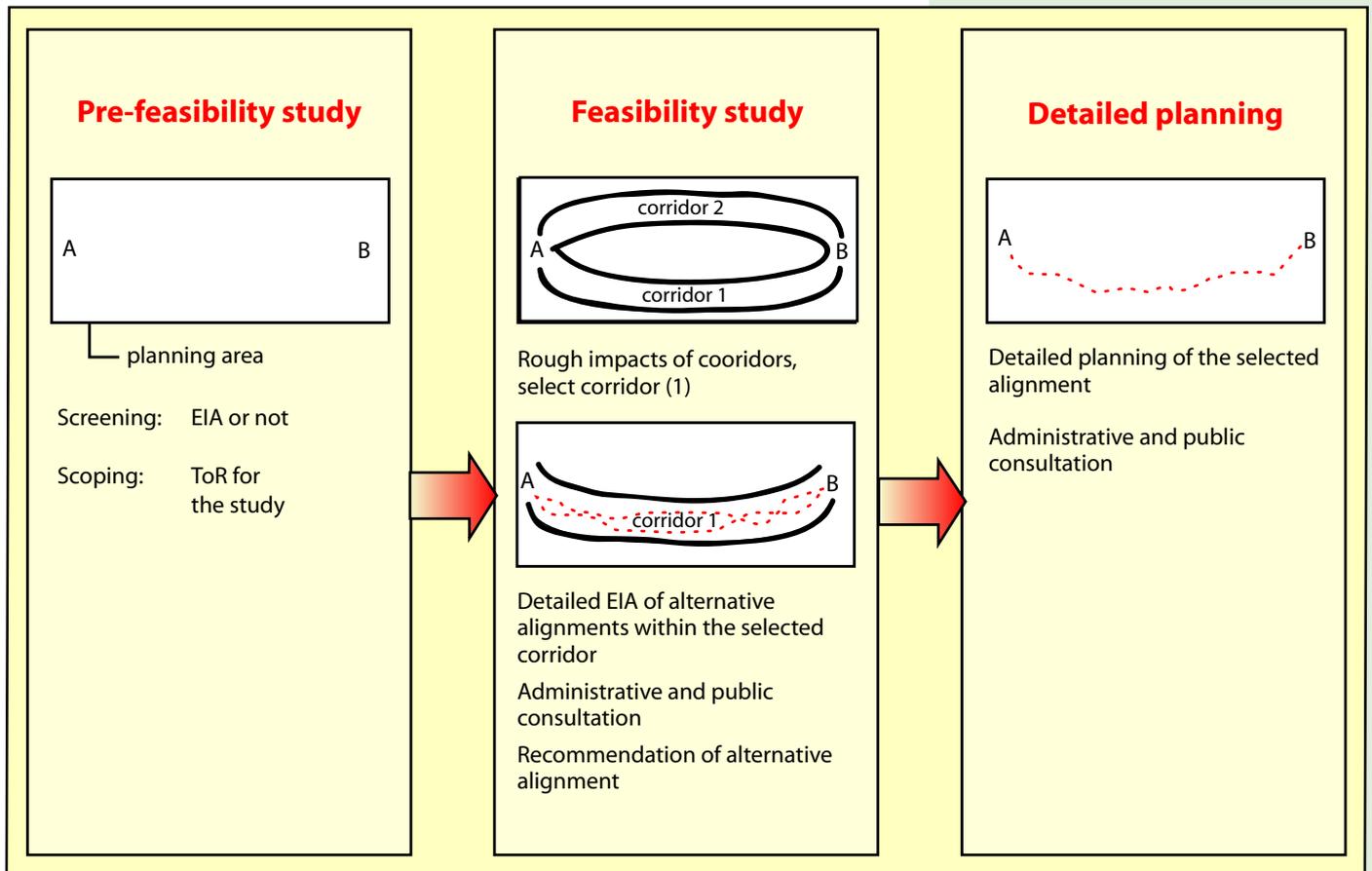


Figure 3.1: The different steps of the feasibility study and the EIA.

3.1 Introduction

A feasibility study is a study undertaken to investigate alternative options for a project, to find out whether the project should be carried out, and which option is the most viable.

A feasibility study is sometimes carried out in two stages, namely the corridor stage and the alignment stage. For example when bypassing a town, two different corridors might have to be investigated and evaluated.

In most cases, however, the feasibility study can be narrowed down to studying the viability of alignments within one corridor. The feasibility study is also used to determine the viability of reconstructing and rehabilitating an old road.

The study should take account of social factors, and economic and ecological considerations.

A feasibility study is undertaken to investigate alternative options for a project, to find out whether the project should be carried out, and which option is the most viable.

Feasibility studies may also be carried out to compare different road projects serving different populations as a means of ranking them in order of priority.

3.2 Corridor Investigation

The corridor investigation starts with gathering and reviewing existing data on aerial photographs, existing traffic counts, site reconnaissance, initial field surveys of settlements and other developments, terrain assessment, analysis of road building materials availability, wildlife migration patterns and other environmental aspects.

Following the determination of the corridors, a preliminary environmental impact assessment is to be carried out for each corridor in order to select the most feasible one. The environmental impact assessment carried out at this stage should generally not be detailed, but adequate for making an informed decision. The level of detail depends on the scale and magnitude of the project and will not be described in detail in this guideline.

Informal discussions may be held with inhabitants of the study area to determine if there are any features that are not obviously visible which should influence the choice of the corridor. It is also important to give the local community an opportunity to express their opinion on the choice of corridor.

3.3 Alignment Investigation

The first stage in the alignment investigation involves data collection. Data collection at this stage will be more detailed than at the corridor selection stage, and a complete 'walk over' the alignments is required to ensure that no significant details are left out. In instances where adequate mapping is unavailable, the recommended corridor will be mapped out on a reasonable scale to allow all ground features to be depicted. Consultation will be more extensive at this stage than at the corridor stage.

Various alignments are studied taking account of socio-political, ecological and economic impacts as well as engineering considerations in order to arrive at the pros and cons of each alignment and propose the best alignments for a detailed EIA.

Sometimes there is only one relevant alignment, for example when rehabilitating an existing road. The assessment of alternative standards will then be the main objective of the study.

Mitigation is defined as the implementation of practical measures to reduce adverse impacts on the environment, or enhance the beneficial aspects of an action. Mitigating measures will also be as drawn up for inclusion in the final EIA and in the plan at the detailed planning stage.

If the existing road is going to be decommissioned, the assessment must cover different options, for instance removing the tarmac for nature to take over gradually or handing the road over to the local communities for continued use.

Mitigation is defined as the implementation of practical measures to reduce adverse impacts on the environment, or enhance the beneficial aspects of an action. These measures will be drawn up for inclusion and in the plan at the detailed planning stage and in the final environmental impact statement.

At the feasibility stage a detailed EIA is carried out on the best alternative options, and the options are then compared with each other following the procedures described in Chapters 7 and 8.

The team of planners recommends the most viable of these alternatives in a detailed feasibility report. As part of the feasibility report an EIA report must be produced. This is the main basis for the Roads Authorities decision on the alignment, approval of the report and approval of the planning procedures carried out.

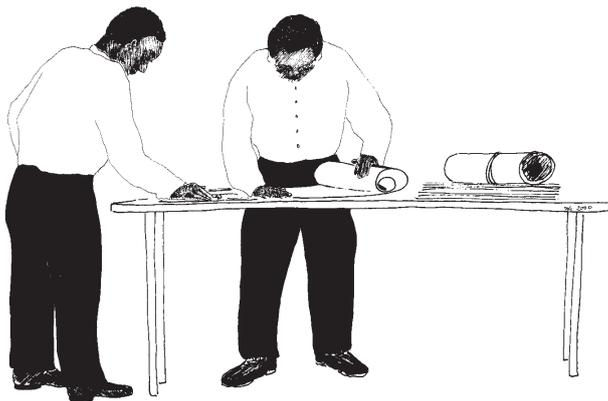


Figure 3.3.1: Teamwork is necessary for proposing reasonable alignments for further investigation

4. Detailed Planning of the Selected Alternative

4.1 Introduction

Upon approval of the recommended alternative alignment, the Roads Department will instruct the planners to proceed with further investigations and finalise the detailed planning.

The investigations at the detailed planning stage can be conveniently divided into the following main issues:

- Detailed topographic survey
- Detailed materials investigations
- Incorporation of the mitigating recommendation of the EIS
- Traffic and transportation studies
- Hydrological studies and construction water investigations
- Design of bridges and culverts
- Geometric design
- Pavement design
- Preparation of tender documents

Technically, the main objectives of the detailed planning will be met by the above. However, the level and detail of the investigations will depend on the complexity of the project.

Tender documents will be produced at this stage.

4.2 Design requirements

It is the responsibility of the planners to design a safe, efficient, environmentally friendly, attractive and cost effective road in accordance with accepted standards. The scope of the work will generally be described in the ToR requirements for the detailed planning stage.

The detailed planning will take account of accepted recommendations from the EIA, as such necessitating maximum interaction between the designer and other relevant disciplines.

Mitigating measures to reduce adverse environmental impacts, which have been recommended and found viable in the EIA, must be considered and will be planned in greater depth during the detailed planning stage.

Examples are:

- Landscaping of the area used for the road, the cut and fill sections
- Design of culverts and bridges
- Vegetation - what to remove, what to keep and what to plant etc.
- Fencing policy
- Design of rest areas
- Rehabilitation of borrow pits
- Decommissioning of the old road

During the detailed planning stage the project plan and the tender documents are produced.

4.3 Environmental Report at the Detailed Planning Stage

The environmental report as part of the detailed planning should be compiled concurrently with the final design report and as one of its integral parts, or as specified in the ToR. This report will detail the construction and the mitigating measures that are to be carried out.

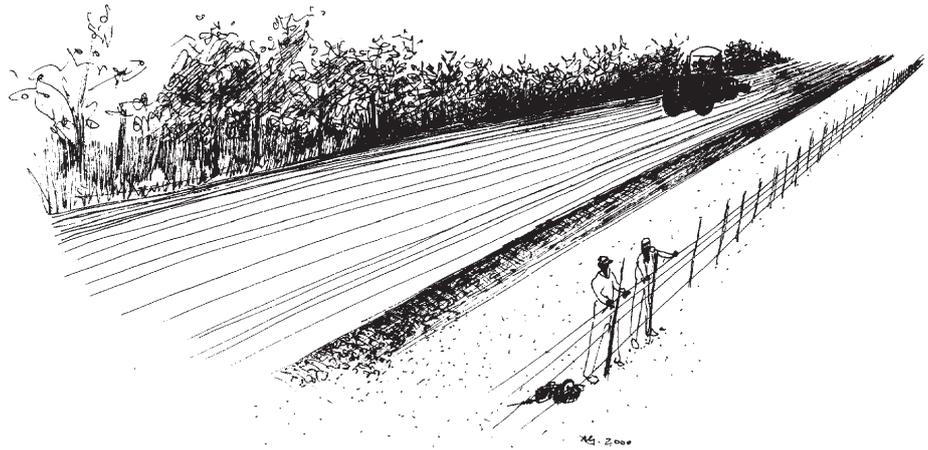
The final design report should also include a proposal for an Environmental Code of Conduct for inclusion in the tender documents in order to further reduce the negative impacts of construction and to enhance the positive ones.

4.4 Consultation during Detailed Planning

Detailed planning requires continuous interaction between the consultants and the Roads Authorities as well as consultation with other stakeholders such as the local and district authorities and representatives of the people living in the area.

Consultation during detailed planning is more localised from community to community or more directed at affected parties than at the feasibility stage. After compilation of the encroached properties within the 61 metre road reserve, the planners will submit the detailed topographic map for assessment at the early stages or as scheduled by the ToR. These maps are thereafter forwarded to the Land Board which evaluates and assesses the extent of the encroachment on the properties to determine the compensation. The Roads Authorities and the affected parties attend the assessment meeting to assist with the confirmation of property boundaries. This process should be completed well ahead of construction.

5. Construction and maintenance



5.1 Construction

Impacts related to construction, operation and maintenance should be clearly defined such that all parties to the contract are aware of their respective responsibilities.

Mitigating measures should be incorporated in the tender and in contract documents for implementation during the construction phase. The type of each mitigating measure and when it is to be implemented during construction should be stated for both adverse and beneficial impacts.

The Roads Department should organise a committee involving community leaders and other local authorities for the duration of the project in order to effectively communicate locally and with Roads Department representatives.

An Environmental Code of Conduct should be included in any contract covering the following themes as a minimum:

- The erection of camp site offices must be carried out in accordance with permission given, and the campsite rehabilitated on completion of the works
- Respect for people's properties and local customs
- Information to workers and the local community about the risk of spreading sexually transmitted diseases
- Permission for the establishment of borrow pits and their rehabilitation after use

A monitoring plan should be in place to ensure that the Environmental Code of Conduct is adhered to.

For more details see chapter 7.4.10, 'Short-term Effects during Construction'

An Environmental Code of Conduct should be included in any contract.

5.2 Operation and maintenance

The effectiveness of mitigating measures implemented during the construction phase requires monitoring and evaluation during the operation and maintenance phases of a road project. Those impacts that can be assessed during the twelve month maintenance period should be evaluated so that any shortcomings resulting from the improper execution of recommended measures can be corrected. An evaluation report should be produced assessing the effectiveness of these measures and, if necessary, recommending correcting measures. Monitoring is the responsibility of the Roads Authorities.

Part II - Technical guide to Consultation and Environmental Impact Assessment

Part II covers chapter 6-8 and act as a guide to consultation and the Environmental Impact Assessment :

Chapter 6. Consultation

Chapter 7. The Environmental Impact Assessment at the Feasibility Stage

Chapter 8. Guide to the Comparison and Recommendation of Alignments

6. Consultation



6.1 The Objectives of Consultation.

The objective of consultation is to ensure that the road network is planned and implemented in an accountable and transparent manner. This is important for the overall benefit of the affected communities and for the country at large. This should be achieved through a process, which allows for the full participation of the authorities and the public.

The aims to be achieved are as follows:

- To establish full background information to the project from all possible sources
- To identify viable alternatives for the project
- To take on board the views of the people at all stages of the project
- To reach a consensus

The development of consultative strategies and a systematic scheduling of deadlines are important in order to curb delays. This may call for monitoring checklists to be drawn up for the individual stages. The Roads Authorities can use such tools as a benchmark in their monitoring.

6.2 Different Levels of Consultation

Consultation should be carried out throughout all the five stages of the project cycle, namely:

- Pre-feasibility
- Feasibility
- Detailed Planning
- Construction
- Operation and maintenance

The level and frequency of consultation will vary from stage to stage depending on the decision-making requirements of each stage.

Besides internally within the Roads Department and the Ministry of Works, Transport and Communication, consultation will also take place at two other levels during the planning period, namely at Inter-ministerial, District and Community levels.

6.3 Inter-Ministerial Level

Departments, Ministries and Agencies, which have been identified as having inter-linked planning operations with road planning are as follows:

Department of Town and Regional Planning Department of Lands Department of Surveys and Mapping National Conservation Strategy Agency	Ministry of Lands, Housing and Environment
Department of Mines Department of Water Affairs Department of Geological Surveys	Ministry of Minerals, Energy and Water Affairs
National Museum, Monuments and Art Galleries	Ministry of Labour and Home Affairs
Departments of Crop Production Department of Animal Health and Production	Ministry of Agriculture
Department of Meteorology	Ministry of Works, Transport and Communication
Department of Wildlife and National Parks Department of Tourism	Ministry of Commerce and Industry

At Inter-Ministerial level officers involved will have direct planning links with the proposed road project. Invitations should be extended to such departments who will in turn appoint representatives to a reference group, which will monitor and regularly discuss the project till completion.

6.4 District and Community Level

Consultation will be done at two levels:

- District level
- Community level

Upon finalisation of alternatives consultation will be taken up with the above bodies to seek their views before proceeding to the detailed planning stage. Notification of the consultation meeting shall be made by a letter addressed to both the District Commissioner and the Council Secretary. The two shall also be requested to make arrangements for meetings.

All correspondence shall be copied to the Member of Parliament for the area.

Notifications and invitations to the meetings will be made through the Radio. Other more effective means maybe used where available.

6.5 Process of consultation at different planning stages.

6.5.1 Consultation at the Pre-feasibility Stage

Consultation in this phase will mainly be internal within Government departments unless the screening process imply involvement of other authorities or organisations. Where field investigations are to be carried out, the Roads Department may consult informally during the investigation for clarification purposes.

After production and internal approval, the Draft ToR shall be distributed for comments to the identified stakeholder Departments and Ministries whose policies and programmes may be affected. The covering letter accompanying the draft ToR will contain the whole background of the project and set the initial working programme.

The ToR will be finalised after incorporation of the comments.

The following figure illustrates the main steps of the consultation process at the pre-feasibility stage:

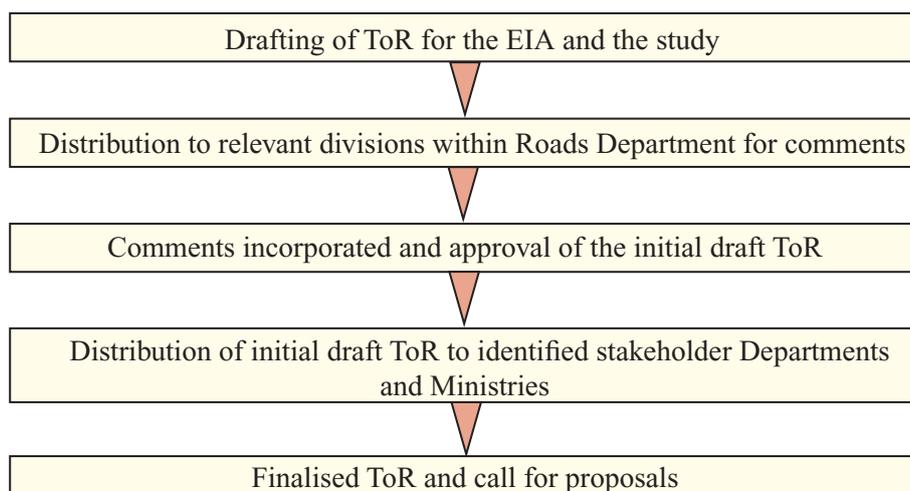


Fig. 6.5.1.1: The consultation procedure during the pre-feasibility stage.

6.5.2 Consultation at the Feasibility Stage

Generally speaking extensive investigations will be undertaken at this stage. However, the scope will vary from project to project as detailed in the ToR.

The EIA and the feasibility study will encompass the following two main procedures;

- Corridor selection and recommendation
- Alignment studies and recommendation

At the corridor selection stage, the impact assessment will be very preliminary, however extensive consultation will be required.

A more detailed EIA will be carried out during the alignment selection stage. Extensive consultation will be required also at this stage.

The following figure illustrates the main steps of the consultation process at the feasibility stage:

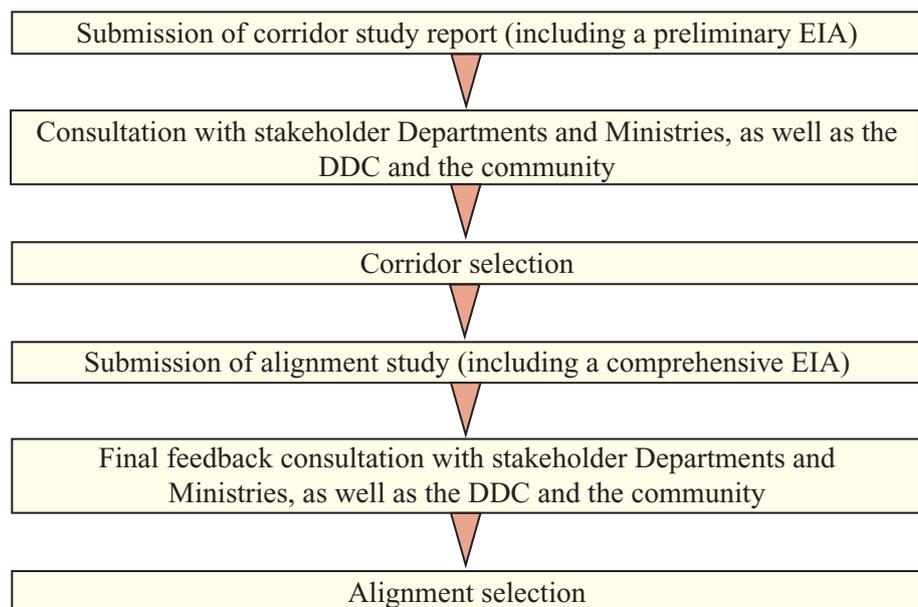


Figure 6.5.2.1: Consultation procedures at the feasibility stage

6.5.3 Consultation at the Detailed Planning Stage

The Roads Department will issue an instruction to proceed after approval. More extensive consultation will be done in the process of refining the alignment.

The following figure illustrates the main steps of the planning and consultation process at the detailed planning stage:

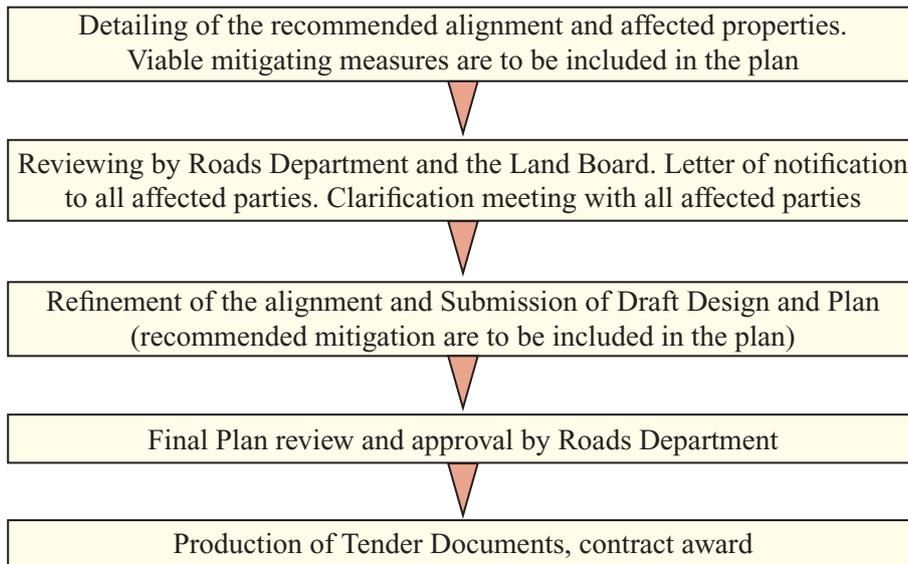


Figure 6.5.3.1: Consultation procedures at the detailed planning stage

7. The Environmental Impact Assessment at the Feasibility Stage

7.1 Introduction to Environmental Impact Assessment

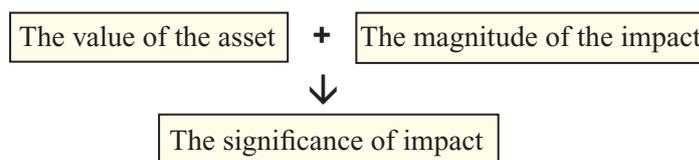
Environmental Impact Assessment (EIA) is an evaluation of foreseeable impacts, both beneficial and adverse. It is intended to help reveal mitigating measures and alternatives so as to optimise positive impacts while reducing or limiting negative ones. The end result of the EIA process should be a better understanding of the linkages between our society, our natural environment and the sustainable use of our endowed resources.

EIA is a systematic evaluation of the advantages (benefits) and disadvantages (costs) that a new road project or the improvement of an existing road will generate irrespective of whether they are measured in monetary units or not. The impacts that can be put into monetary terms, e.g. time savings, are dealt with in an ordinary Cost Benefit Analysis (CBA).

There is a method that can be used to assess the costs of noise nuisance and local air pollution to society. It is called the “Stated Preference” or “Willingness to pay” method and can be used to transfer non-monetary impacts into monetary impacts. However currently, these impacts are treated as non-monetary.

The non-monetary impacts, for example impacts on archaeology, are handled in a systematic way by describing the value of the asset and the magnitude of the impacts. Based on this the significance of the impacts is determined.

The non-monetary impacts are assessed by combining:



This is parallel to the logic of the CBA:

$$\text{Unit Cost} * \text{Quantity} \Rightarrow \text{Costs}$$

EIAs form the technical basis for decision-making concerning the choice of alignment and the standards for road projects and are carried out at different levels of detail at each stage of the planning process. EIAs are also used as a basis for comparing projects. The monetary and the non-monetary impacts are compared and weighed in a systematic way for different alignments as a basis for recommending a specific alignment.

Road projects often involve issues of conflicting interests. An EIA is, in this respect, a useful tool for documenting the various impacts and interests and forms a basis for weighing them against each other in a transparent and accountable manner.

An EIA is a systematic evaluation of advantages and disadvantages of a project.

EIA is normally carried out both when planning new roads and when rehabilitating an existing road.

The guideline describes the monetary and the non-monetary themes considered the most important in an EIA for road projects as presented below:

Themes to be included in an EIA	Method of assessment :
Monetised themes: Time savings Savings in vehicle operating costs Benefit from generated traffic Savings in accident costs	Cost Benefit Analysis
Non-monetary themes: Geological resources Agriculture Surface water Archaeological and other historical assets Biophysics - wildlife and vegetation Aesthetic impacts Noise nuisance and local air pollution Social environment - effects on community life	Significances of impacts are assessed by combining the value of the asset and the magnitude of the impacts. Significance can range from four pluses to four minuses via zero + + + + 0 - - - -
Short-term effects during construction	Check list

It is sometimes not relevant to look into all the themes. However, it is also difficult to draw the line between some of the themes. Nevertheless it is important to be systematic and only describe each effect once to avoid double counting.

Report requirements for an EIA at the feasibility stage will be described in the ToR. The entire study of both monetary and non-monetary impacts should be summarised in one report.

7.2 The reference alternative - alternative 0

When carrying out the EIA for monetary and non-monetary impacts for alternative alignments a base alternative should be established for comparison purpose. This is either called the reference alternative, alternative 0 or the “do nothing” alternative. The reference alternative should reflect the realistic circumstances if the project is not carried out. This will in general be the existing situation and its continuation through the evaluation period. Preserving the existing conditions will require maintenance and perhaps small amounts of investment in the future. The existing road and its traffic might also have environmental impacts that have to be taken into account when describing the non-monetary impacts of the reference alternative.

A correct description of the reference alternative is often a difficult task in the EIA. There will be uncertainties about the future maintenance budget, traffic growth or decline, and the effect of development elsewhere in the network. It is essential to think carefully about the reference alternative because it has a significant bearing on the outcome of the EIA process. The following example illustrates this point:

The EIA at the feasibility stage should be summarised in one report both for monetary and non-monetary impacts.

Example:

A project will replace an existing road. The calculated maintenance costs for the reference alternative are 300 mill. Pula and for the new project 280 mill. Pula. The benefit of the new project in relation to the reference alternative will then be 20 mill. Pula. In the case that the required maintenance costs for the existing road have been predicted too low and should have been 310 mill. Pula instead of 300 mill. Pula, the benefit from reduced maintenance costs would have increased from 20 mill. Pula to 30 mill. Pula. A more correct prediction of the maintenance costs for the reference alternative would have made the project economically more viable. The same situation could arise for the non-monetary impacts as one would have to refer to the impacts of the reference alternative to obtain the change of impact.

7.3 Monetary Impacts

7.3.1 The Cost Benefit Analysis Process

Cost Benefit Analysis (CBA) is a technique for assessing the economic efficiency of resource allocation. It allows one to compare alternative approaches to individual projects and to prioritise among competing projects on a monetary basis. It is based on all costs and benefits to society that can be quantified in monetary terms. The Cost Benefit Analysis forms an important input to the EIA.

The efficient use of resources by the Roads Authorities and road transport in general can have a significant impact on the overall performance of the economy and on the welfare of every member of society. It is therefore desirable that the economic aspect should be a key input in the decision making process.

However, there are always costs and benefits of road investments that cannot be put into monetary terms. These will be designated non-monetary impacts and are related, for example, to landscape encroachments as described in Chapter 7.4.

Changes in road conditions or service standards usually lead to changes in capital and maintenance costs. They also cause changes in user costs, and sometimes in non-user costs. The principle of CBA is to compare the change in Roads Authority costs with the change in user costs, and sometimes in non-user costs. One example of user costs is time savings. The first step of the analysis is to define the existing service standard, i.e. the geometrical standard, bearing capacity, roughness, speed, average annual daily traffic (AADT) etc. Based on this, the life cycle costs of the road will be calculated. These costs include Roads Authority costs and user costs, as well as other costs for each year over a period of, say, 20 years. Life cycle costs are then calculated for the project alternative, for example a new road. The difference in costs between the two options is the costs for the Roads Authorities and the benefits for the road users if the project is carried out.

It should be noted that in socio-economic evaluations all road user costs, such as fuel repairs and time are valued in what is termed resource costs. Resource costs equal market prices plus subsidies but without taxes.

Cost Benefit Analysis is a systematic procedure for measuring and weighing up all monetary benefits and costs associated with a public road.

Required competence: The CBA should be carried out by a transport economist or similar.

Required competence: The CBA should be carried out by a transport economist or similar.

7.3.2 Roads Authority Costs and Community Benefits

Public spending on road transport represents a demand on economic resources from the government. Resources used in road construction and maintenance could also have been used to satisfy other community requirements, for example public health services or educational services. Resource allocation to roads will only be economically efficient if greater benefits cannot be obtained from other investments.

Examples of Roads Authority costs are:

- Design, construction, maintenance and management of the road
- Land acquisitions and compensation
- Mitigation measures such as fencing, landscaping, noise barriers.

These costs should be entered in the CBA in constant base year prices, and no adjustments should be made for inflation to costs incurred in future years.

Benefits represent the community's valuation of the increased satisfaction that arises from the project. The community's valuation represents the sum of all individuals' valuation of the increase in their satisfaction. Benefits may be positive (when welfare is enhanced) or negative (when welfare is reduced). Positive benefits arise when, as a result of road improvement, individuals are able to consume more of a preferred good at a lower price.

When the quality of a preferred good is reduced or the price increased, individuals experience a negative benefit.

Community costs to be calculated are:

- Vehicle operating costs
- Travel time costs
- Accident costs

Vehicle operating costs should include fuel, service, repair and depreciation costs. The values used should be in resource cost terms. To calculate this a computer program should normally be used, for example the World Bank HDM-4 model (Highway Development Management).

It is generally accepted that people place a value on time both at work and in their spare time. The values of travel time savings for various classes of road users are a key input to the economic evaluation of road projects. This can be calculated in the HDM-4 model or similar.

7.3.3 Traffic Accident Costs

Although it is difficult and in a way unacceptable to place a monetary value on human life, an estimation of the loss of human health due to road accidents can be made. Accident costs can then be included in the CBA. However, this requires unit prices for road accidents and also requires traffic accident data in order to calculate the accident rate which can in turn be calculated for the existing road and used to make a forecast for the new road.

One approach to determine the unit costs of road accidents is to base it on surveys that show that the socio-economic costs of road accidents usually can be estimated at 1% - 3% of a country's Gross Domestic Product (GDP). With knowledge of the total number of accidents and their allocation to one of the categories 'Fatal', 'Injury' or 'Damage Only', accident costs may be derived. A variation of this approach is to determine the average national gross earnings and assume that they equal the loss to the economy if an individual dies or becomes unemployed because of an accident.

Although the Police and the Department of Road Transport and Safety maintain comprehensive road accident statistics, these have so far not been suitable as input for the EIA of road improvements. The reason is that the exact location on the road where an accident has taken place is not recorded in the Road Data Bank. Such information is a prerequisite so as to be able to calculate the accident rate for an existing road. The accident rate should be calculated as the number of accidents per million vehicle kilometres travelled. Expected accident rates for different types of new roads should be established based on available data in order to be able to predict accident rates for an improved or new road.

Once the Road Authorities have compiled unit prices for road accidents, and accident rates for existing roads and forecasts for the new ones, the calculation of the change in accident costs could be handled manually or within the HDM-4 model or similar.

7.3.4 Diverted and Generated Traffic

Diverted traffic means traffic which switches from one route to another as a result of improved accessibility. The origin and destination of this traffic are supposed to be exactly the same. To evaluate projects where a significant diversion of traffic is expected to occur, the whole network of affected roads must be analysed. Such effects are, however, most prevalent in urban areas, but may also occur in rural areas.

Generated traffic means traffic that would not otherwise travel between origins and destinations served by the improved route if the improvement itself had not taken place, i.e. traffic generated by the improvement. Generated traffic may comprise combinations of more frequent journeys made by existing users as a result of the improvement or of new journeys made by new users. The composition of the generated traffic does not, however, affect the measurement of the benefit.

The "rule of half" can be used to approximate the community benefits from generated traffic. Because of the assumption about consumer surplus and the shape of the demand curve, the community benefit of traffic so generated is equal to half the change in the resource costs of travel multiplied by the additional travel that occurs. This can be calculated by the following equation:

$$\frac{(P_0 - P_1) * (V_1 - V_0)}{2}$$

Where:

P_0 = User cost per trip before the improvement (reference alternative)

P_1 = User cost per trip after the improvement (project alternative)

V_0 = Volume of traffic before the improvement (reference alternative)

V_1 = Volume of traffic after the improvement (project alternative)

In figure 7.3.4.1 the generated traffic benefits are represented by the shaded triangle in the figure.

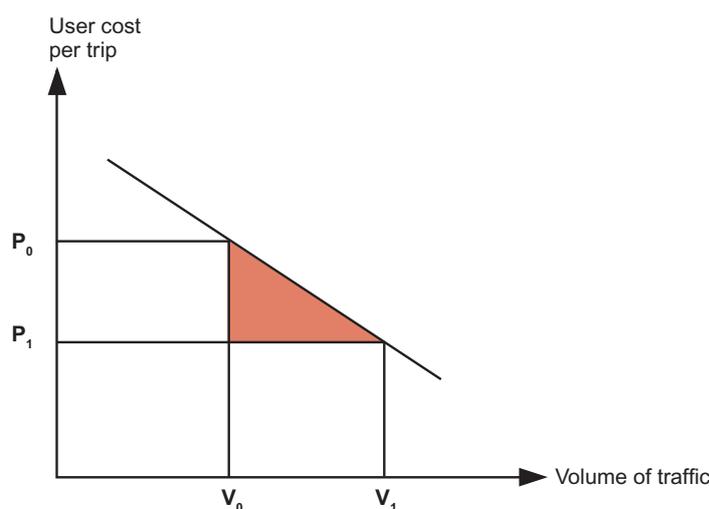


Figure: 7.3.4.1 User benefits from traffic are indicated by the shaded triangle

The estimation of generated traffic benefits also reflects some of the developmental benefits.

7.3.5 Evaluation Period and Economic life

The evaluation period should be long enough to capture all the significant costs and benefits needed to produce a valid full life cycle cost comparison. As a general rule, the evaluation period should be based on the economic life of the major asset in the project. In view of the uncertainties of forecasting costs and benefits over long periods, caution should be exercised in adopting a period longer than 20 years. However, discounting does reduce the present value of costs and benefits beyond 20 years. For example, 100 Pula in year 20 at a discount rate of 6% has a present day value of only 31 Pula. The evaluation period should be the same for all alternatives within a project to enable equal comparison of costs and benefits over the period.

7.3.6 Discounting Future Costs to Present Value, Price year

Individuals (and organisations) typically prefer to experience benefits as early as possible and to defer costs for as long as possible. This tendency is described by the term “time preference”. CBA takes account of time preference through discounting. Benefits are discounted over time so that the further away they occur in the future, the less they are worth now. Costs are similarly discounted.

The discount rate is the rate that would make it just worthwhile for people to spend their money in a year's time rather than now.

The discount rate is the rate that would make it just worthwhile for people to spend their money in a year's time rather than now. It is also the rate by which future income would need to be discounted (i.e. reduced) to its present value. People would then be indifferent to having the lesser discounted amount now rather than the higher value in a future year. An example below illustrates this.

We assume a discount rate of 6%.
 Say we can get 100 Pula in 10 years.
 Today that amount will equal : $\frac{100 \text{ Pula}}{1,06^{10}} = 56 \text{ Pula}$

At 6% discount rate the benefits from receiving 56 Pula today equals the benefits of receiving 100 Pula in 10 years.

The discount rate is not the inflation rate. Discounting for time preference is quite different from allowing for price inflation. The discount rate is expressed in real terms, i.e. it excludes inflation. This is necessary in order to be consistent with the valuation of costs and benefits in a CBA in constant base year prices.

To determine a correct discount rate one has to consult the Ministry of Finance and Development Planning.

The price year is the year in which the prevailing prices are used in a CBA for the evaluation of the costs and benefits over the life of the project. It is usually the same as base year. The costs of past years can be updated to the base year by using appropriate price indices.

7.3.7 Evaluation Factors

Basic factors need to be established before the costs and benefits of alternative solutions can be identified. Recommendation values/ advice are given below:

Factor:	Recommendation:
Evaluation Period	20 years
Economic life of the project	20 years
Price Year	Usually the current year; the year to which all valuations relate. Also called Base or Reference Year.
Discount Rate	Consultation should be done with Ministry of Finance and Development Planning to get the appropriate rate

7.3.8 Economic Assessment Criteria

There are a number of alternative criteria for the assessment of the economic value of projects.

Economic assessment criteria such as Net Present Value, Benefit Cost Ratio and Internal Rate of Return should be calculated.

Net present value (NPV) is an absolute measure and is equal to:

$$NVP = B - C$$

Where:

B = Discounted benefits (user + non-user) over the life of the project

C = Discounted Roads Authorities costs (project costs and change in maintenance costs) over the life of the project.

Benefit Cost Ratio (BCR) is a relative measure of profitability. It can be calculated as:

$$BCR = \frac{B}{C}$$

Where B and C stand for the same values as B and C in the equation above.

BCR has the advantage over NPV in that it reflects the rate of return and the intensity of benefit potential per unit of Road Authority cost.

Internal rate of return (IRR) is expressed as a percentage per annum, and is the rate by which benefits would need to be discounted in each year of the project's life so that the total discounted benefits equalled discounted costs. IRR is therefore the discount rate for which the NPV is zero.

First Year Rate of Return (FYRR) can be calculated as:

$$FYRR = \frac{B_1}{C}$$

Where:

B₁ = Discounting benefits in the first operating year

C = Discounted project costs and first year change in maintenance costs

FYRR is a criterion that can be used for assessing the optimal timing of a project. Normally the project should be delayed until the FYRR rises to the discount rate. If the FYRR is greater than the discount rate, the project should be brought forward for implementation.

Below is shown the final step in calculating the assessment criteria.

Example:

A: Sum monetary benefits (discounted)	77 mill. Pula
<u>B: Change in Road Authority costs (discounted)</u>	<u>70 mill. Pula</u>
C: Net Present Value (A - B)	7 mill Pula
D: Benefit Cost Ratio (A/B)	1,1
E: Economic Internal Rate of Return	8 %

When conducting the feasibility study of a road project NPV and BCR should always be calculated. In the evaluating process one has to compare the NPV to the non-monetary impacts to be able to state whether the project is worthwhile

or not with respect to both monetary and non-monetary impacts. The BCR is used to rank alternatives within a project as well as projects with respect to monetary impacts.

7.3.9 Sensitivity Analysis

Cost Benefit Analyses involve making estimates of many factors that are subject to uncertainty such as traffic growth rates, traffic speeds, and construction costs. Using single value estimates for such factors does not provide useful information as to the extent of the uncertainty about the Benefit Cost Ratio or of the probability of the BCR exceeding a certain value.

As a minimum, variation in project construction costs, traffic growth rates and discount rate should be tested. The table below identifies variables to which evaluation results are generally sensitive. The table also suggests percentages that can be applied in the test.

Variable	Suggested minimum value	Suggested maximum value
Construction costs:		
- at feasibility	- 25 % of estimate	+ 25 % of estimate
- at detailed planning	- 10 % of estimate	+ 10 % of estimate
Traffic level	- 25 % of estimate	+ 25 % of estimate
Traffic growth	- 2 % pa (absolute) of the forecast rate	+ 2 % pa (absolute) of the forecast rate
Discount rate	Increment of +/- 2% of the official discount rate	

7.4 Non-monetary Impacts

7.4.1 General principles of assessing non-monetary impacts

Unlike monetary impacts, non-monetary impacts cannot be calculated, assessed or compared with each other in a standardised fashion. It is, for example, not possible to draw direct comparisons between agriculture and archaeology. However, the EIA of non-monetary issues should be conducted systematically and, most importantly, in a transparent and accountable manner.

The EIA should be conducted in a transparent and accountable manner.

The themes described as non-monetary are:

Geological resources

Agriculture

Surface water

Archaeology and other historical assets

Biophysics - Wildlife and vegetation

Aesthetic impacts

Noise nuisance and local air pollution

Social environment - effects on community life

Short-term effects during construction

There is one sub chapter for each theme in the frame above. The sub chapters can be read individually, and part of the text is therefore repeated.

Assets may be affected by a road and the associated traffic due to:

- Change of land use
- Severance
- Change of terrain or land form
- Water, soil pollution or surface run-off water
- Noise and air pollution

Firstly, the geographical area affected by a road has to be determined for each of the themes above. This is called the influenced area. The size of the influenced area will vary from theme to theme and should be defined by the relevant specialist at the beginning of the EIA.

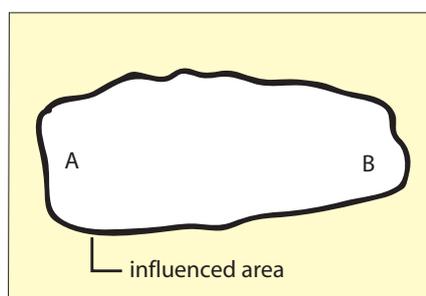


Figure 7.4.1.1: At the beginning of the planning process the influenced area has to be established

Under each sub chapter there is a recommendation for the type of competence needed for the impact assessment. In EIA's a chain of causes and effects will often be described where immediate effects result in different permanent long-term effects. This guideline place emphasis on permanent long-term effects.

This guideline place emphasis on permanent long-term effects.

Short-term effects occurring during construction or shortly afterwards, together with how to mitigate them, must be described in the Environmental Impact Assessment Report. This should also include an Environmental Code of Conduct. The short-term impacts should not be taken into account when assessing the significance of the permanent long-term impacts.

The EIA is carried out at different levels of detail at the pre-feasibility, feasibility and detailed planning stages. The comprehensive EIA that is subjected to extensive consultation and formal hearings is carried out at the alignment selection stage as part of the feasibility study. At the corridor selection stage, the principles below are also employed, although the assessment is rough in comparison with the alignment selection stage.

The methods described in the following chapters are based on evaluating each of the non-monetary impacts by employing the following steps:

1. An assessment of the value of the resources .

Valuable sites and areas must be identified and marked on maps as a basis for selecting alignment and for assessing the significance of the impacts of the selected alignment. The value must be seen in relation to national and international strategies for conservation and development. The value judgements must be substantiated and ranked according to their value as large, medium or low on a sliding scale.

Indicators of a large value are described for each asset and will serve as a guide in any value judgement as indicated below:

Large value	Areas protected by law or zoning, e.g. habitats of endangered species, areas or assets of national or great local importance such as national parks or Kgotla and areas of high vulnerability
Medium value	Regionally important areas or areas which are considered to be important locally and of medium vulnerability
Small/low value	Locally important areas and areas of low vulnerability

Protected areas such as archaeological sites, national monuments or national parks are as a rule considered to be of large value. The value judgement should be discussed with the public authorities responsible for resource management and must be substantiated.

Landscape analysis methodology can be used when assessing both value and vulnerability. The landscape assessment can also be used as a basis for selecting alignments and for impact assessment.

Vulnerability or sensitivity mapping is a widely used landscape analysis method for mapping valuable and vulnerable areas that have to be taken into account at the different stages of the planning process. A description of the main steps in this analysis method as detailed in Guideline on Strategic Environmental Assessment of Transport Infrastructure Plans 1999(European Commission DGVII Transport) are attached to this guideline in Appendix IV. A GIS - database, geographic information system, renders the analysis more effective and makes it easier to use the vulnerability analysis in the subsequent project EIA and in public hearings.

2. Assessing the nature and magnitude of impacts on the asset.

The following important impacts should be kept in mind as indicators of magnitude:

- Direct encroachments, change of area use, fill and cut sections, fences, bore holes, borrow pits etc.
- Barrier effect of the road and the traffic
- Water and soil pollution
- Surface run-off water
- Increase in traffic and in certain types of traffic, for instance trucks and tourist traffic
- Effects of traffic noise and local air pollution on residential areas, institutions, or recreation areas
- Long term health effects of the construction process
- Effects on local businesses that are either bypassed or given improved transport accessibility
- Short-term impacts during construction. Impacts caused by deposits, camp sites, erosion, noise etc. should be assessed and described separately and not included in the overall evaluation of the magnitude of the permanent impacts for each asset. A list of short-term effects, which may arise during construction for all assets, together with advice on mitigation can be found in section 7.4.10.

The magnitude of the impacts should be quantified as much as possible and marked on maps, i.e. the type of impact and the areas affected; a brief verbal description should also be given. The magnitude of both positive and negative impacts (see frame below) should be described ranging from 'small' to 'medium' to 'large'.

The magnitude of the impacts can be judged on a scale such as the following:

Large positive	Substantial positive effects
Medium positive	Condition noticeably improved
Small/none	Little or no change
Medium negative	Condition noticeably worsened
Large negative	Substantial adverse effects

3. Assessing the significance of impacts on assets

The significance of the various impacts is to be assessed by combining the value and the magnitude of impact. The general principle is that the larger the value and vulnerability of the asset, the more significant is the impact, whether positive or negative.

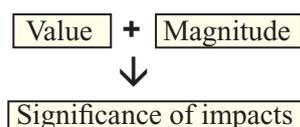


Figure 7.4.1.2: General principle of assessing non-monetary impacts

An assessment of an alternative will mean assessing the significance of impacts on various sites along the new road alignment. The alternative in its entirety must then in turn be given an overall assessment. A general scale is shown in figure 7.4.1.3.

The significance can range from very negative (----) to very positive (++++), see frame below.

The significance of the impact can be assessed on a scale as follows:

++++	Very large positive significance
+++	Large positive significance
++	Fairly positive significance
+	Small positive significance
0	Small/no significance
-	Small negative significance
--	Fairly negative significance
---	Large negative significance
----	Very large negative significance

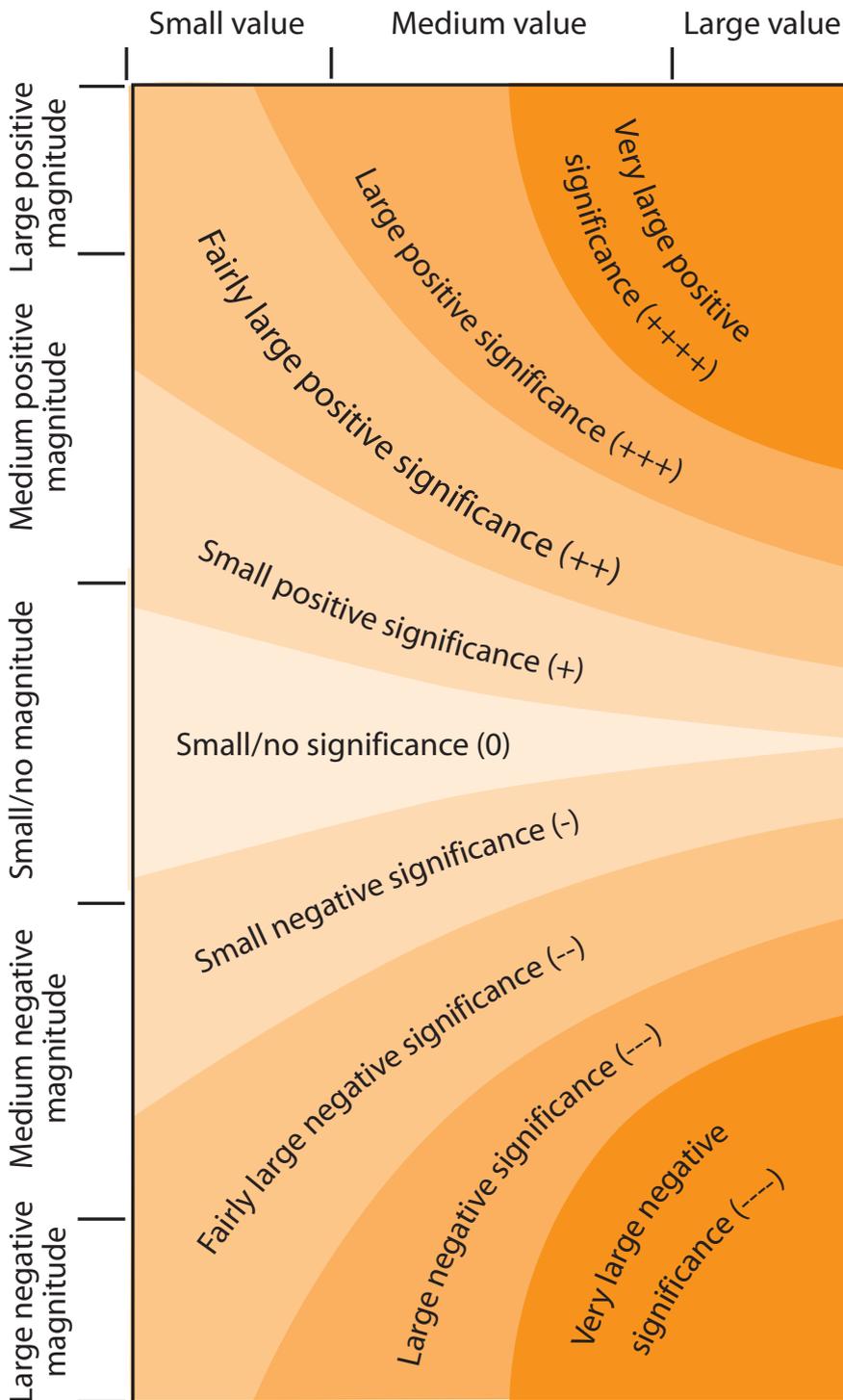


Figure 7.4.1.3 Value and magnitude can be combined to assess significance. It should not be used too enthusiastically. *Think for yourselves as well.*

The figure shows that the larger the value of the assets, the more serious are the adverse impacts. For example, if the value is large and the magnitude of the negative impact is large, the resulting significance will be ‘very large negative’(----).

Four minuses and four plusses should, however, be reserved for extreme impacts where assets of national importance are impacted on or will be

enhanced in a very significant way. The span from four minuses to four pluses should not be used to differentiate between alternatives whose impact significance does not greatly differ. Small differences should be described in writing.

It is important to bear in mind that the assessment will serve as a basis for ranking different alignments with respect to their total viability. The assessment must show clearly the important conflict points or conflict sections along alternative road alignments as well as the best alternative.

Items omitted from the EIA should be mentioned. This can encompass assets for which the impacts are judged to be negligible.

An example of the process of assessing the value of the natural environment, the magnitude of the impacts as well as the significance of the impacts are shown below:

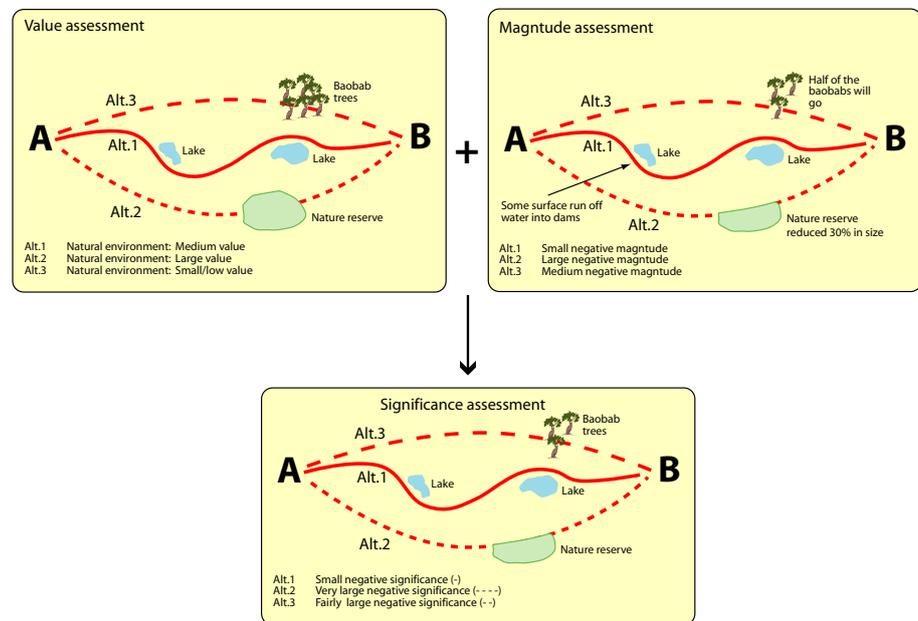


Figure 7.4.1.4: An example of assessing value, magnetude and significance

4. Mitigation

The assessment of the impacts should as a rule include a proposal for mitigating measures which should be carried out in order to reduce adverse effects or enhance positive effects. Examples are measures to protect trees, cattle fences, crossing points for cattle or wild life etc. Approved measures will form an integral part of the project.

Approved measures can be planned in further depth during the detailed planning stage. These measures should be included in the assessment of the impact's magnitude and significance. If a proposed mitigating measure improves or reduces the adverse effects, this will lead to another evaluation of the significance of the impact than would have been the case without it. This then must be included in the cost estimates for the project.

5. Monitoring

The technical staff responsible for each theme should propose any necessary monitoring of short and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for the resource management related to the different assets.

Monitoring and evaluation by the Roads Authorities are important in order to make adjustments to the project and to render future projects to be more cost effective and environmentally friendly.

6. Summary

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme:			
Value	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of pluses and minuses for each alignment	

7.4.2 Geological Resources



Geological resources comprise rock, soil and groundwater.

Definition:

Geological resources comprise rock, soil and groundwater.

The term “rock” covers units of the earth’s crust formed by certain geological processes. The term “soil” is used to describe materials produced by the disintegration of rocks. Arable soil is described in the subsection on agriculture. The term “groundwater” covers water within soil and rock, i.e. the subterranean part of the water’s hydro geological cycle.

Rocks can have different qualities as a source for crushed stone for construction purposes. In addition they can contain minerals and ores for commercial exploitation.

Soil possesses different qualities as a building material.

In Botswana groundwater can be essential for road construction and maintenance and is an important resource for human use.

Framework:

The Ministry of Minerals, Energy and Water Affairs (MMEWA) is responsible for overall policy and operational matters pertaining to the minerals sector.

Three departments within this Ministry have direct links with road planning. These are:

- The Department of Geological Surveys
- The Department of Mines
- The Department of Water Affairs

Among other things the Department of Geological Surveys is responsible for gathering, assessing and disseminating all data related to rocks, mineral deposits and groundwater resources.

The Department of Mines evaluates all mining lease applications and monitors the extraction and processing of minerals. The Department is also responsible for administering relevant portions of the Mines and Mineral Act and the Quarries, Works and Machinery Act.

The Department of Water Affairs supported by the Department of Geological Surveys is responsible for ground water investigations, protection and monitoring of resources.

According to the Mines and Minerals Act, all minerals are state-owned.

The impact assessment should be carried out by a geologist or similar.

The feasibility study - corridors:

A preliminary survey may be sufficient at this stage. The aim is to avoid areas containing existing quarries and mines, areas that are licensed for prospecting and areas with potential sources of valuable minerals. At this stage one should also carry out a map based survey for building materials for the road. This is necessary in order to avoid damaging the resource when locating corridors.

Available sources of information that should be referred to at this stage are:

- Geological maps
- Photo(aerial) maps
- Records at the Department of Geological Surveys and Department of Mines
- Literature review
- Geologists
- Land use plans
- Field visits - visual surveys

The survey should result in a map showing valuable areas of geological resources.

During this part of the feasibility study the best corridor will be selected.

The EIA and the feasibility study - alignments:

At this stage different alternative alignments within the selected corridor are investigated, and a comprehensive EIA is carried out.

1. A full resource inventory - assessing the value of the geological resources

The work to be undertaken is as follows:

- Further desk work on maps, records at the departments mentioned above
- Literature study and consultation with other geologists.
- Survey - fieldwork on foot.
- Laboratory analysis

The value and quality of the geological resources should, if possible, be quantified. Resources such as rock, soil and groundwater that are commercially exploited can be expressed in monetary terms. The criteria for determining value are commercially available volumes and quality. As an example; a large magazine of groundwater has large value. One should bear in mind the scarcity of the resources when estimating their value.

The value and vulnerability of the resources must be assessed within the influenced area for each alignment in accordance with national policy.

Required competence: The impact assessment should be carried out by a geologist or similar.

The value judgement must be substantiated.

The list of value indicators below consists of examples only and is not exhaustive.

Indicators of large value:

- Commercially exploitable resources
- Ground water of exploitable amounts and quality

The value judgement must be substantiated.

2. *Assessing the nature and magnitude of the impacts on the geological resources.*

Impacts to be considered are:

- Whether the new road will make it difficult to exploit the resources
- Pollution of groundwater from the construction camp
- Pollution of groundwater from the daily traffic on the road and from accidents involving tanker lorries

The magnitude of the impacts should be quantified as much as possible. Impacts, which can be expressed in monetary terms and will be compensated for, have to be included in the construction costs to the greatest possible extent. The consumption of gravel or rocks for road construction should be quantified and included in the construction costs. If not, it should be treated as a non-monetary impact on geological resources.

Short-term impacts only occurring during construction, and recommended mitigating measures should be documented. This should not be included in the overall description of permanent long-term effects on geological resources.

3. *Assessing the significance of the impacts on geological resources*

The significance of the different impacts will be assessed on the basis of the magnitude of the impacts related to the value of the geological resources. The general principle is that the larger the value of the geological resource, the more significant the impact, whether positive or negative.

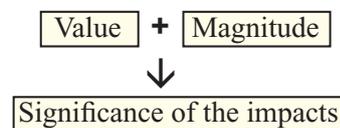


Figure 7.4.2.1 General principle of assessing non-monetary impacts

Assessing an alternative might involve evaluating the significance of impacts on various sites along the new road. The alternative in its entirety must in turn be subjected to a total assessment. The assessment must clearly illustrate the important conflict points or sections and what is, from the geologist's point of view, the best alignment. It is important to bear in mind that the assessment will form the basis for ranking different alignment locations with respect to their total viability.

Items omitted from the EIA because their impacts are considered negligible should also be mentioned.

4. *Mitigation*

The EIA of geological resources should include a proposal for mitigating measures. Examples are adjustments to the alignment to avoid damaging bore holes for ground water or the replacement of bore holes. Approved measures can be planned in further detail at the detailed planning stage. Mitigating measures included in the plan should also be included in the assessment of the significance of the impact. Proposed mitigating measures will improve or reduce the magnitude of the adverse effects. This will in turn lead to another assessment of the significance of the impacts than would have been the case without it. The approved measures must be included in the cost estimates for the project.

5. *Monitoring*

Technical staff from the Roads Authorities and others responsible for the assessment of geological resources should propose any necessary monitoring of both short- and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for the management of geological resources.

Monitoring and evaluation by the Roads Authorities are important when making adjustments to the project and designing future projects to be more cost effective and environmentally friendly.

6. *Summary*

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme: Geological resources			
Value	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of pluses and minuses for each alignment	

7.4.3 Agriculture



Agriculture, as defined in planning terms, refers to the economic exploitation of arable land, grazing land and forest.

Definition:

Agriculture, as defined in planning terms, refers to the economic exploitation of arable land, grazing land and forest. In a planning situation one should emphasise the agricultural resource for the country or the district rather than a single farm unit's economy. The loss in a farmer's income will be compensated for and should not be incorporated in the assessment of the significance of the impacts on agriculture. The cost of this compensation should be included in the construction costs and in the Cost Benefit Analysis.

Framework:

The Ministry of Agriculture is responsible for implementing agricultural policies. Two Departments within this Ministry have direct links with road planning. These are:

- The Department of Crop Production and Forestry
- The Department of Animal Health and Production

The following Acts should be referred to:

- The Agricultural Resources Act
- The Tribal Land Act
- The Forestry Act

There are three categories of land tenure:

- Communal or Tribal land
- State Land
- Freehold Land

The Feasibility study - corridors:

When assessing corridors the survey can be preliminary in nature. Due care should be taken to avoid areas of existing arable land and cattle posts.

Available sources of information at this stage are:

- Land use maps showing different categories of arable and grazing land
- The Soil Survey Section in the Department of Crop Production and Forestry
- Site visits - visual surveys

During this part of the feasibility study the best corridor will be selected.

The impact assessment should be carried out by an agronomist or similar

The EIA and the feasibility study - alignments:

At this stage different alternative alignments within the selected corridor are investigated, and an EIA is carried out.

1. *A full resource inventory - assessing the value of the agricultural resources*

The items to be studied are as follows:

- Further desk work on maps
- Maps showing farm boundaries
- Maps showing cattle posts and arable land
- Maps showing bore holes in relation to the connected pastures and cattle posts
- Vegetation maps
- Soil survey maps
- Records held at the Department of Crop Production and Forestry
- Fieldwork - surveys carried out on foot

The value and the vulnerability of agricultural land should be assessed within the influenced area for each alignment in accordance with national conservation policy. The list of value indicators below consists of examples only and is not exhaustive.

Indicators of large value are:

- Arable land in good condition
- Good grazing land
- Mopane or other forests belonging to woodlands associations
- Boreholes and cattle posts

The value judgement should be based on the productivity of the land and must be substantiated.

Required competence: The impact assessment should be carried out by an agronomist or similar.

The value judgement should be based on the productivity of the land and must be substantiated.

2. *Assessing the nature and magnitude of impacts on agricultural resources*

Impacts to be considered are:

- Reduction in arable and grazing land
- Reduction in forest areas
- Bad division of arable and grazing lands
- Possible flood hazard caused by changes to the terrain by the new road
- Possible erosion hazards caused by run-off water from the road

Impacts that can be put into monetary terms and are to be compensated for have to be included in the construction costs, for example compensation for the loss of arable land. Short-term effects only occurring during construction together with how to mitigate them should be mentioned in a comprehensive description of all short-term effects. However, they should not be included in the overall assessment of the permanent long-term impacts on agriculture.

3. *Assessing the significance of the impacts on agriculture*

The assessment of the significance of the different impacts is based on the magnitude of the impacts in relation to the value of the agricultural land. The general principle is that the larger the value of the agricultural resource, the more significant the impact, whether positive or negative.

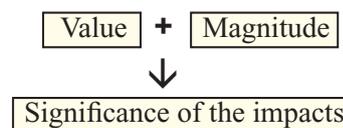


Figure 7.4.3.1 General principle of assessing non-monetary impacts

The assessment of an alternative means evaluating the significance of impacts on various sites along the new road. The alternative in its entirety must then be subjected to a total assessment. The assessment must illustrate the important conflict points or sections and what in the agronomist's point of view is the best alignment. It is important to bear in mind the assessment will form the basis for ranking different alignment locations with respect to their total viability.

Items omitted from the EIA because their impacts are considered negligible should also be mentioned.

4. *Mitigation*

The assessment of the impacts on agricultural resources should as a rule include a proposal for mitigating measures. Examples are; adjustments to the alignment to avoid splitting up fields, resettlement and relocation of fields, decommissioning of the existing road etc. Approved measures can be planned in further detail at the detailed planning stage.

Mitigating measures included in the plan should also be included in the assessment of the significance of the impact. A proposed mitigating measure will improve or reduce the magnitude of the adverse effects. This will in turn lead to another evaluation of the significance of the impacts compared to the

situation without it. Approved measures must also be included in the cost estimates for the project.

5. *Monitoring during construction*

Technical staff in the Roads Authorities and others responsible for the assessment of agriculture should propose any necessary monitoring of short- and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for the resource management of agricultural resources.

Evaluation and monitoring by the Roads Authorities is important in order to make adjustments to the project and designing future projects to be more cost effective and environmentally friendly.

6. *Summary*

Theme: Agricultural resources			
Value	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of plusses and minuses for each alignment	

7.4.4 Surface water



Surface water comprise all water, normally rivers, lakes, wetland, not defined as geological resources.

Definition:

Surface water comprise all water, normally rivers, lakes and wetland, not defined as geological resources in chapter 7.4.2.

Framework:

The Ministry of Minerals, Energy and Water Affairs (MMEWA) is responsible for overall policy in the water sector.

Important framework to be taken into consideration is:

- The Water Legislation
- The Water Master Plan
- Water Management Plans

Required competence: The impact assessment should be carried out by a hydrologist or similar.

The Water Apportionment Board grants water use licenses known as “water rights”. All water withdrawals have to be cleared by the Board.

The impact assessment should be carried out by a hydrologist or similar.

The Feasibility study - corridors

At this stage of the planning process a preliminary survey would be sufficient. The aim is to avoid severe impacts on surface water resources.

Available sources of information that should be referred to at this stage are:

- Bore hole data
- Hydrological Maps
- Field visits - visual surveys

During this part of the feasibility study the best corridor will be selected.

The EIA and the feasibility study - alignments

At this stage different alternative alignments within the selected corridor are investigated and a comprehensive EIA is carried out.

1. *A full resource inventory - assessing the value of the surface water resources*

The work to be undertaken is as follows:

- Further desk work on maps
- Field work - visual surveys
- Bore hole data compilation

The value or vulnerability of the water resource should be assessed within the influenced area for each alignment.

The list of value indicators below consists of examples only and is not exhaustive.

Indicators of large value :

- Generally most surface water in Botswana is of large value.
- Water sources which is reliable throughout the year
- Water which is a source of drinking water for people or cattle
- Polluted water if it can be utilised or purified

The value judgement must be substantiated.

The value judgement must be substantiated.

2. *Assessing the nature and magnitude of impacts on surface water*

Impacts to be considered are:

- Modifications to the water flow which could cause flooding, soil erosion, channel modification or silting
- Pollution of surface water both from construction camps and traffic after construction

To the greatest possible extent the magnitude of the impacts should be quantified. Short-term effects only occurring during construction as well as measures to mitigate them should be included in a comprehensive description of all short-term effects, but not included in the overall assessment of the permanent impacts on surface water.

3. *Assessing the significance of the impacts on surface water resources*

The assessment of the significance of the different impacts is based on the magnitude of the impacts related to the value of the surface water. The general principle is that the larger the value of the water resource, the more significant the impact, whether positive or negative.

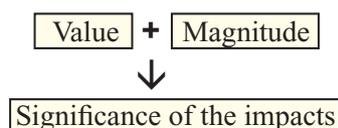


Figure 7.4.4.1 General principle for assessing non-monetary impacts

The assessment of an alternative means assessing the significance of impacts on various sites along the new road. The assessment must illustrate the important conflict points or sections and what in the hydrologist's point of view is the best alignment. The alternative in its entirety must then undergo a

total assessment. It is important to bear in mind that the assessment will form the basis for ranking different alignment locations with respect to their total viability.

Items omitted from the EIA because the impacts are considered negligible should be mentioned.

4. *Mitigation*

The assessment of the impacts on surface water resources should include a proposal concerning mitigating measures. An example is the extension of a planned bridge and the corresponding reduction in the embankment. Approved measures can be planned in further detail at the detailed planning stage. Mitigating measures which are included in the plan should also be included in the assessment of the significance of the impact. For example, if a proposed measure improves or reduces the magnitude of the adverse effects, this will lead to another evaluation of the significance of the impact compared to the situation without it. The approved measures must also be included in the cost estimates for the project.

5. *Monitoring*

Technical staff responsible for water resources should propose any necessary monitoring of the short and long-term effects. The Roads Authorities decides what should be implemented after consultation with other public bodies responsible for the management of water resources.

Evaluation and monitoring by the Roads Authorities are important in order to make adjustments to the project and to render future projects more cost effective and environmentally friendly.

6. *Summary*

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme: Surface Water			
Value	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of plusses and minuses for each alignment	

7.4.5 Archaeological and other historical assets



Definitions:

Archaeological and other historical assets are the physical evidence of human evolution and settlement, which in Botswana spans at least two million years.

Cultural heritage includes, among other things, places and objects of scientific and aesthetic value such as:

- An area of land with objects of archaeological and historical interest
- Any cave rock shelter, old structure or object (natural or man made) of scientific or aesthetic value or interest
- Any fossil, drawing, painting, petroglyph, carving or artefact of archaeological, historical, scientific, or aesthetic value
- Objects of present cultural value, Kgotla, shrines, sacred trees, grave sites or contemporary architecture

The historical manmade environment is a non-renewable resource. Cultural material is of value in terms of research into our past, education, recreation and tourism.

Aesthetic impacts not related to historical values should be described under aesthetic impacts and not under this theme.

Framework

The Ministry of Labour and Home Affairs are responsible for the cultural heritage.

The most important Acts concerning cultural heritage are:

- The Monuments and Relics Act
- The Town and Country Planning Act

Archaeological and other historical asset are the physical evidence of human evolution and settlement, which in Botswana spans at least two million

All archaeological or historical sites are protected by the Monuments and Relics Act, Chapter 59:03 (1970 as amended) of the laws of Botswana. This law automatically protects all relics predating 1902. In terms of Section 17, the law forbids any unauthorised person from altering, destroying or damaging any archaeological remains or removing materials from their site of discovery or deposition, whether they are known and registered by the National Museum, Monuments and Art Gallery (NMMAG) or have not yet been discovered.

Newer buildings, areas or objects of historical value can be protected under the terms of the Town and Country Planning Act or declared a National Monument by the Ministry of Labour and Home Affairs.

The Monuments and Relics Act gives the Minister of Labour and Home Affairs the power to issue written permission to alter, destroy or damage archaeological remains, or remove material from their site of deposition.

The Department of the National Museum, Monuments and Art Gallery (NMMAG) administers the Monuments and Relics Act on behalf of the Government .

It is a requirement in terms of the Monuments and Relics Act and Directive HA 6/4/31 of May 1986 from the Ministry of Labour and Home Affairs to carry out archaeological impact assessments and mitigation before road construction. No earthworks are allowed before the completion of archaeological impact assessment and mitigation work and the Ministry of Labour and Home Affairs has given written approval.

NMMAG assesses the outline of the archaeological work required in consultation with the Roads Department and the consulting archaeologist. The methodology and resulting study must be approved by NMMAG.

NMMAG will, on the basis of the impact study or mitigation work report, recommend to the Ministry of Labour and Home Affairs to either allow the proposed project to proceed or, if need be, advise the development agency to modify the project accordingly. This approval is only required for sites that are to be impacted.

The Roads Authorities are responsible for ensuring that the planners take archaeological considerations into account, and that the contractors and maintenance force are informed of their responsibilities

The assessment must be carried out by an archaeologist approved by the NMMAG.

The Feasibility study - corridors

The collection of information and data should be carried out at the beginning of the feasibility stage.

The main objective is to look for the best corridor, in order to minimise the impacts of human activity on archaeological and other historical resources.

As part of the screening process it is usually not possible to establish whether the road corridor may lead to serious adverse effects on heritage because of lack of data. Consequently the beginning of the feasibility study should include a preliminary survey of cultural heritage assets as a basis for selecting alternative corridors. The objective should be to locate major valuable and vulnerable areas in order to avoid planning new roads in these areas. The sur-

Required competence: The assessment must be carried out by an archaeologist approved by the NMMAG.

veys can be in the form of a probability study in which the archaeologist can predict which areas to expect findings based on registered relics, visual surveys in the area and professional experience.

Available sources of information that should be referred to are:

- Photo-maps
- Literature review
- Records at NMMAG
- Other archaeologists
- Field visits - visual surveys from a car and on foot
- The District Land Use Planning Unit

During this part of the feasibility stage the best corridor is selected.

The EIA and the feasibility study - alignments

At this stage different alternative alignments within the selected corridor are investigated and a comprehensive EIA is carried out.

1. A full resource inventory - assessing the value of the archaeological resources

The work to be undertaken is as follows:

- Further deskwork if necessary on maps, literature, records at NMMAG and consulting other archaeologists
- Fieldwork, surveys on foot, minimum surface collection (site description on NMMAG site register forms)
- Assessment of the occupation period, site types and state of preservation
- Laboratory analysis to assess site range, date and type
- Assessment of buildings and other historical assets newer than 1902

The archaeologist will probably need input from an historian or an architect on this last subject.

Valuable cultural heritage sites and areas must be identified and marked on maps as a basis for selecting the alignment. An assessment of value and vulnerability of the historical resources within the influenced area in relation to national and international strategies for heritage conservation should be carried out.

The list of value indicators below consists of examples only and is not exhaustive.

Indicators of large value are:

- Age: the older the relic, the more valuable it is. Any objects or sites older than 1902 are of high value
- Objects or areas can be of high value if declared a national monument by the Minister
- Rarity: the more rare in Botswana or in the world, the more valuable
- Whether the site/object is a representative relic or a typical relic in the history of Botswana
- The condition of the site, whether it is damaged or pristine

The value judgement must be substantiated.

The value judgement must be substantiated.

2. *Assessing the nature and magnitude of impacts on the cultural heritage*

Impacts to be considered are:

- Direct encroachments, borrow pits etc.
- The barrier effect of the road
- Effects of local air pollution from vehicles on rock art structures or buildings
- Effects of traffic noise on the perception/experience of heritage

To the greatest extent possible the magnitude of the impacts should be quantified, i.e. what sort of impact and the number of sites affected etc. Short-term impacts which occur during construction, are generally not very important for this asset.

3. *Assessing the significance of the impacts on cultural heritage*

The significance of the different impacts is assessed on the basis of the magnitude of the impacts in relation to the value of the cultural heritage. The general principle is that the larger the value of the cultural monument or site, the more significant the impact, whether positive or negative.

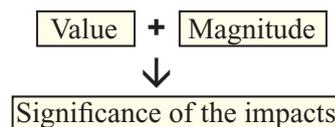


Figure 7.4.5.1 General principle for assessing non-monetary impacts

The assessment of an alignment means assessing the significance of impacts on various sites along the new road. The alignment in its entirety must then be given a total assessment. It is important to bear in mind that the assessment will act as a basis for ranking different alignments with respect to their total viability. The assessment must clearly illustrate the important conflict points or sections along the road and what from the archaeologist's and the historian's points of view is the best alternative.

Items omitted from the EIA because the impacts are considered negligible should also be mentioned.

4. *Mitigation*

The assessment of the impacts on cultural heritage should include a proposal for mitigating measures. The term 'mitigating measures' for this asset usually refers to a process for recovering information which might otherwise have been lost through development.

Mitigating measures can also include building bridges instead of embankments or adjustments to the alignment. Approved measures can be planned in further detail during the detailed planning stage if approved. Mitigating measures will improve or reduce the magnitude of the adverse effects. This will in turn lead to a different evaluation of the significance of the impacts than would have been the case without the measures. These measures must be included in the cost estimates of the project.

Important: The Ministry of Labour and Home Affairs must approve the archaeological assessment.

5. Monitoring

Technical staff responsible for archaeology and other historical values should propose any necessary monitoring of short and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for the resource management of cultural heritage.

Evaluation and monitoring by the Roads Department are important in order to make adjustments to the project and to render future projects more cost effective and environmentally friendly.

6. Summary

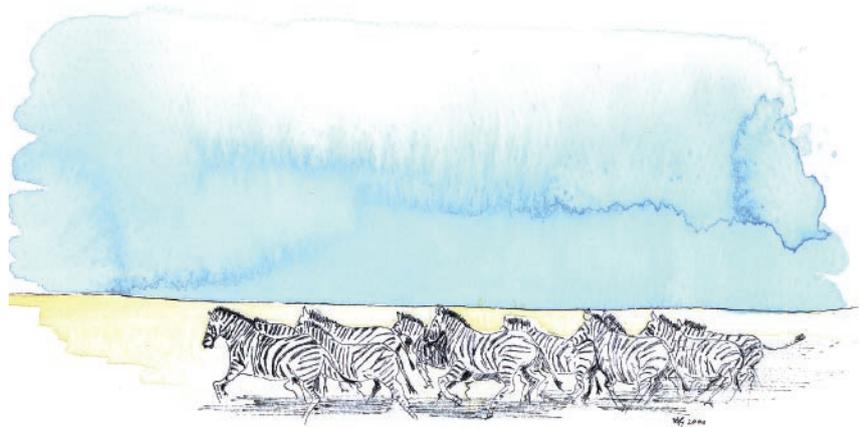
The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme: Archaeological and other historical assets			
Value	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reason for the number of pluses and minuses for each alignment.	



Figure 7.4.5.2 A Kgotla is an important part of the cultural heritage

7.4.6 Biophysics - Wildlife and Vegetation



The natural environment is by definition our physical surroundings with the emphasis placed on the natural conditions, the different factors as a basis for all life and the interaction between these factors.

Definitions

The natural environment is by definition our physical surroundings with the emphasis placed on the natural conditions, the different factors as a basis for all life and the interaction between these factors. This theme is limited to the value of nature on its own and biological functions. It does not include the topography as such or the economic use of natural or historical resources.

Framework

The Ministry of Trade, Industry, Wildlife and Tourism and the Ministry of Lands, Housing and Environment are responsible for the natural environment.

The following Departments are found to have direct links with road planning:

- The Department of Wildlife and National Parks
- NCSA

The most important framework concerning the management of the natural environment is:

- The Wildlife and National Parks Act
- The Forestry Act
- The Water Act
- The Fauna Conservation Act
- The Town and Country Planning Act
- The Tribal Land Act
- The Monuments and Relics Act
- The Agricultural Resources Conservation Act
- Botswana National Conservation Strategy and the National Policy on Natural Resources Conservation and Development of 1990.
- Ratified International Conventions and Treaties
- The National Development Plan

The National Conservation Strategy is described in the Nature Conservation Strategy of 1990 and in National Development Plan 8.

A biologist or similar should carry out the assessment of impacts on the natural environment.

Required competence: A biologist or similar should carry out the assessment of impacts on the natural environment.

The Feasibility stage - corridors

Information and data collection should, as a rule, be carried out at the beginning of the feasibility stage.

The main objective is to look for the best corridor in order to minimise the impacts of human activity on wildlife and vegetation.

The survey must cover the area within which the alternative corridors will be located. The objective should be to locate valuable and vulnerable areas in order to avoid major impacts in these areas. The surveys can be in the form of a desk study supplemented by visual surveys. A biologist can point out the ecologically most valuable and vulnerable areas based on registrations of soil, vegetation, climate and rainfall, water resources, geology, wildlife, topography, existing settlements, infrastructure and on visual surveys in the area.

Available sources of information that should be referred to at this stage are:

- Photo-maps
- Literature review
- Records at the Department of Wildlife and Forestry and at district level
- Other biologists and Non Governmental Organisations
- Field visits - visual surveys
- Existing data and maps on geology and soil, wildlife (migration pattern), vegetation, water resources, climate and topography
- Land use plans

Intensive fieldwork is usually not necessary at the corridor selection stage.

During this part of the feasibility stage the best corridor is selected.

The EIA and the feasibility study - alignments

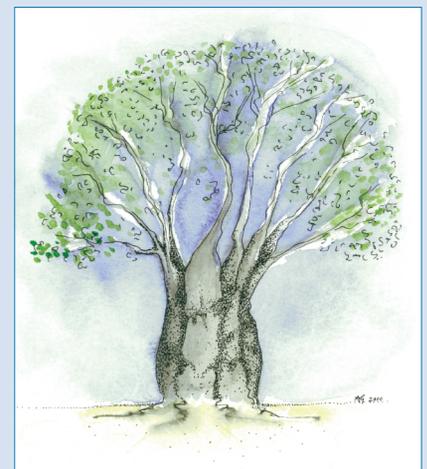
At this stage different alternative alignments within the selected corridor are investigated, and a comprehensive EIA is carried out.

1. A full resource inventory - assessing the value of the natural environment

The work to be undertaken is as follows::

- Further desk studies of maps and literature
- Records at the NCSA, and the Department of Wildlife and National Parks
- Fieldwork and surveys on foot
- Consultation with local and regional authorities, NGO's and community representatives

An assessment of the value and vulnerability of the natural environment in the influenced area in relation to national nature conservation strategies should be made for each alignment. Valuable and vulnerable areas should be marked on maps as a basis for selecting an alignment as well as for assessing the significance of the impacts for the alternative alignments.



The list below consists of examples only and is not exhaustive.

Indicators of large value are:

- Areas with a key-biological function for example areas of importance for endangered species or for migrating animals
- Areas of large bio-diversity
- Protected areas such as National Parks, Nature Reserves or Wildlife Management Areas
- Pans
- Areas with a large density of wildlife

The value judgement must be substantiated.

The value judgement must be substantiated.

2. *Assessing the nature and magnitude of impacts on the natural environment*

Important impacts to be considered are:

- Direct encroachments on the landscape, fill and cut sections, removal of large trees, borrow pits etc.
- Barrier effect of the road on wildlife, applies especially for migrating species and especially if the road is fenced
- Possible flood hazard which could damage the natural environment
- The effect on the natural environment of opening up new areas to human utilisation, for example when a new road and new bore holes enable people and cattle to be moved into new areas

To the greatest extent possible the magnitude of the impacts should be quantified, for example the type of impact, the size of the affected area etc. The affected areas should be marked on maps if possible. Vulnerability mapping as explained in appendix IV is a good tool for obtaining an overview of the biophysical resources and their vulnerability to encroachments.

Short-term effects that only occur during construction, such as erosion from run-off water, deposits, camp sites etc and how to mitigate them should be described separately and should not be incorporated in the overall evaluation of the permanent impacts on the natural environment.

3. *Assessing the significance of the impacts on the natural environment*

The significance of the different impacts is assessed on the basis of the magnitude of the impacts related to the value of the natural environment. The general principle is that the larger the value of the area, the more significant the impact, whether positive or negative.

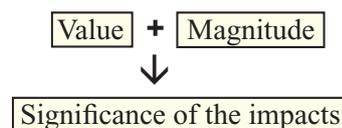


Figure 7.4.6.1 General principle of assessing non-monetary impacts

An assessment of an alternative means assessing the significance of various impacts on different areas along the new road. The alternative in its entirety must then in turn be given a total assessment. It is important to bear in mind

that the assessment will act as a basis for ranking different alignments with respect to their total viability. The assessment must clearly illustrate what the important conflict points or sections along the road are, and what in the biologist opinion is the best alternative. The impact assessment should be illustrated on maps, tables, figures etc. if possible.

For this theme regional effects on wildlife and vegetation are often an important issue. It is therefore important to establish whether the road should be fenced or not.

Items omitted from the EIA because the impacts are considered negligible should also be mentioned.

4. Mitigation

The assessment of the impacts on the natural environment should include a proposal for mitigating measures. This may include extending bridges to avoid blocking watercourses, adjustments to the alignment, fauna passages, decommissioning of the old road, re-vegetation etc. Approved measures can be planned in further detail during the detailed planning stage. Approved mitigating measures shall be included in the assessment of the significance of the impact. Mitigating measures will improve or reduce the magnitude of the adverse effects. This must in turn lead to a different evaluation of the importance of the impacts than would have been the case without them. The measures included in this assessment must also be included in the cost estimates of the project.

5. Monitoring during construction

Technical staff in the Roads Authorities and others responsible for the assessment of biophysics should propose any necessary monitoring of short and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for the resource management of wildlife and vegetation.

Evaluation and monitoring by the Roads Authorities is important in order to make adjustments to the project and to render future projects more cost effective and environmentally friendly.

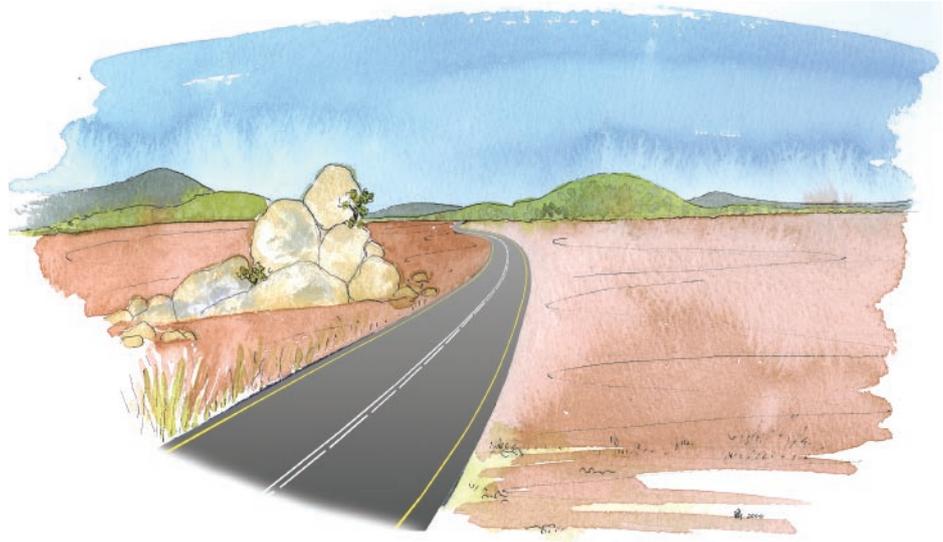
6. Summary

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme: Biophysics - wildlife and vegetation			
Value	Magnitude	Significance	Number of +/-
Large/medium/low and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of pluses and minuses for each alignment	



7.4.7 Aesthetic Impacts



The term aesthetics impacts describes the aesthetic qualities of the landscape both in the countryside and in built-up areas.

Definitions

The term aesthetic impacts describes the aesthetic qualities of the landscape both in the countryside and in built-up areas. The Road Authorities are primarily responsible for roads that traverse the countryside, but national roads also pass through built-up areas. The visual qualities of the landscape and the character of the landscape are a result of the topography and the geology, the water resources in the area, the climate, human influence, other land use, history etc. The aesthetic factors are not limited to the visual, but also include sounds and smells.

The aesthetic impact assessment cannot be carried out in isolation, but often forms part of a wider assessment of impacts on the landscape. Nevertheless, the aesthetic impact study should be a separate theme in the EIA.

Framework

The most important Acts concerning landscape management are:

- The Forestry Act
- The Wildlife and National Parks Act, Act No. 28 of 1992
- The Monuments and Relics Act, Chapter 59:03 (1970 as amended) of the laws of Botswana.

The Monument and Relics Act automatically protects all relics predating 1902. Under the terms of Section 17 the law forbids any unauthorised person from altering, destroying or damaging any archaeological remains or from removing materials from their site of discovery or deposit.

Newer buildings of historical value can be protected under the terms of the Town and Country Planning Act or declared a national monument by the Minister.

The Roads Authorities as a developer have a special responsibility to ensure that new roads do not cause serious visual disturbance to the landscape. Where possible, new roads should enhance the aesthetic qualities of the landscape.

The assessment of impacts on the aesthetics of the landscape should be carried out by especially trained experts such as landscape architects or similar, preferably in co-operation with representatives of the people living in the affected area.

Required competence: The assessment of impacts on the aesthetics of the landscape should be carried out by especially trained experts such as landscape architects or similar, preferably in co-operation with representatives of the people living in the affected area.

The Feasibility stage - corridors

Information and data collection should as a rule be carried out at the beginning of the feasibility stage.

The main objective is to look for the best corridor, in order to minimise the visual disturbance to the landscape and if possible enhance the aesthetic qualities of the area. Generally the landscape in Botswana has a scale and landform into which a road can quite easily blend if a good alignment is chosen.

The feasibility study should include a preliminary survey of the scenic qualities of the landscape, as a basis for corridor selection. The survey must cover the area within which the corridors will be located. The objective should be to locate valuable and vulnerable areas in the landscape in order to avoid building new roads in or too close to these areas. The survey can be performed as a desk study supplemented by visual surveys.

A landscape analysis, see Appendix IV on vulnerability mapping, is a tool often used to map and assess scenic qualities. Aesthetic considerations are important not only for landscapes of outstanding beauty, but also for what could be termed unexceptional or ordinary landscapes.

Available sources of information that should be referred to in a landscape analysis are:

- Photo-maps - topography
- Flora and geology
- Surface water - lakes, rivers and streams
- Cultivated areas
- Trees and shrubs
- Built-up areas
- Landscape features of symbolic or historical value
- Landmarks
- Scale and land form

The people living in the affected area should be consulted in order to check whether there are areas considered to be of aesthetic importance. During the corridor selection stage the character of the landscape should be described together with any special values connected to specific elements of the landscape.

The aesthetic values and the development envisaged by the road should be analysed and a conclusion drawn concerning the vulnerability of the landscape. The conclusions concerning vulnerability and constraints on development should be summarised in a map.

The assessment should be aimed at selecting and adjusting corridors. A more detailed assessment will be carried out in an EIA at the alignment selection stage.

During this part of the feasibility stage the best corridor is selected.

The EIA and the feasibility study - alignments

At this stage different alternative alignments within the selected corridor are investigated, and a comprehensive EIA is carried out.

1. A full resource inventory - assessing the value of the visual landscape

The work to be undertaken is as follows:

- Further desk studies, consulting maps, literature, public authorities at district level
- Fieldwork and surveys on foot
- Consultation with local authorities, Non Governmental Organisations and community representatives

The size of the areas influenced must be based on a judgement of the visibility of the road corridor. The visibility must be based on the viewpoint of drivers using the road, the inhabitants of the area and visiting tourists.

An assessment of the value and vulnerability of the scenic qualities and vulnerability of the landscape for each alignment in the influenced area should be carried out at a more detailed level. The same methods as employed at the corridor selection stage should be adopted. Valuable, sensitive areas should be marked on maps as a basis for selecting alignment as well as for assessing the significance of the impacts of the alternative alignments.

The list of value indicators consists of examples and is not exhaustive.

Indicators of large value are:

- Areas with surface water
- Hilly fertile areas
- Grandiose vistas
- Pans
- Spectacular vegetation or changes in vegetation

The value and vulnerability assessments must be substantiated.

2. Assessing the nature and magnitude of aesthetic impacts

Important impacts to be considered are:

- Direct encroachments on the landscape, fill and cut sections, borrow pits etc.
- Barrier effect of the road on vegetation and water caused by the road reserve, fencing, etc.
- Opening up spectacular views
- Creating a pleasant drive
- The function of the road, the types of traffic

To the greatest extent possible the magnitude of the impacts should be quantified. The affected areas and the visibility of the impacts should be marked on maps if possible. Any short-term effects which occur during construction and how to mitigate them should be described comprehensively. This however should not be taken into the overall assessment of the permanent impacts on the scenic qualities of the landscape.

The value and vulnerability assessments must be substantiated.

3. *Assessing the significance of the impacts on the aesthetic qualities of the landscape*

The significance of the different impacts is assessed according to the magnitude of the impacts related to the value of the scenery. The general principle is that the larger the value and the vulnerability of the area, the more significant the impact, whether positive or negative.

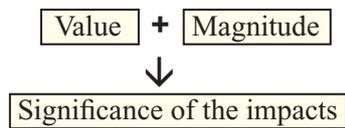


Figure 7.4.7.1 General principle of assessing non-monetary impacts

The assessment of an alternative means assessing the significance of various impacts on different areas along the new road. The alternative in its entirety must in turn undergo a total assessment. It is important to bear in mind that the assessment will be a basis for ranking different alignment locations with respect to their total viability. The assessment must clearly illustrate to the decision-makers what the important conflict points or sections along the road are and what in the aesthetics specialist's opinion is the best alternative. If there is a conflict of opinion between the local representatives and the specialist, this should be mentioned.

The illustration of impacts is especially important for this theme. A good illustration can communicate information much better than text. Illustrations are also important in substantiating the evaluation of the magnitude and significance of impacts. Visualisation on photo (50-mm lens), charts and tables, maps, perspectives etc. may be used.

Items omitted from the EIA because the impacts are considered to be negligible should also be mentioned.

4. *Mitigation*

The assessment of impacts on scenic qualities should as a rule include a proposal for any mitigating measures. These can range from adjustments to the alignment, adjustments to slopes and borrow pits, re-vegetation, decommissioning of the existing road and other measures. Approved measures can be planned in further detail during the design stage. Mitigating measures will improve or reduce the adverse effects. This must lead to a different evaluation of the significance of the impacts than would have been the case without them. Approved measures must be included in the cost estimates for the project.

5. *Monitoring*

Technical staff in the Roads Authorities and others responsible for assessment of aesthetic impacts should propose any necessary monitoring of short- and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for the resource management related to aesthetic values.

Evaluation and monitoring by the Roads Authorities are important in order to make adjustments to the project and to render future projects more cost effective and environmentally friendly.

6. Summary

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme: Aesthetic impacts			
Value	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in ranging from large words negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of plusses and minuses for each alignment	

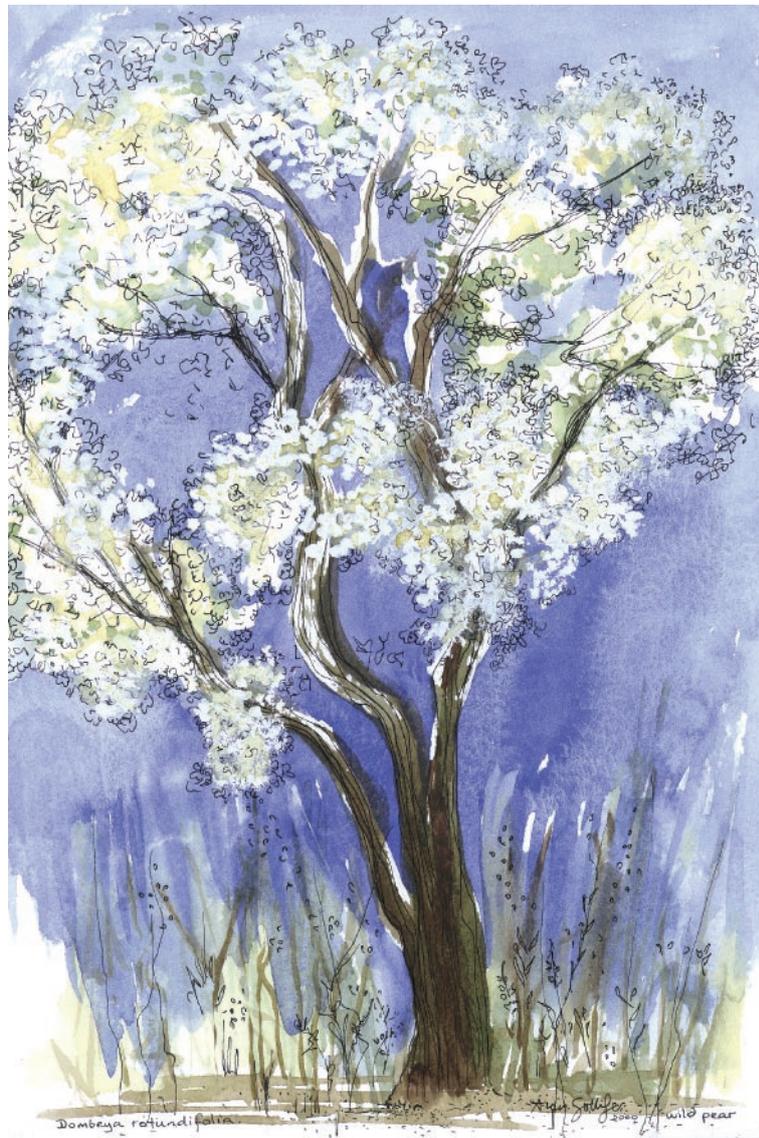


Figure 7.4.7.2 Large flowering trees are of aesthetic value.

7.4.8 Noise nuisance and local air pollution

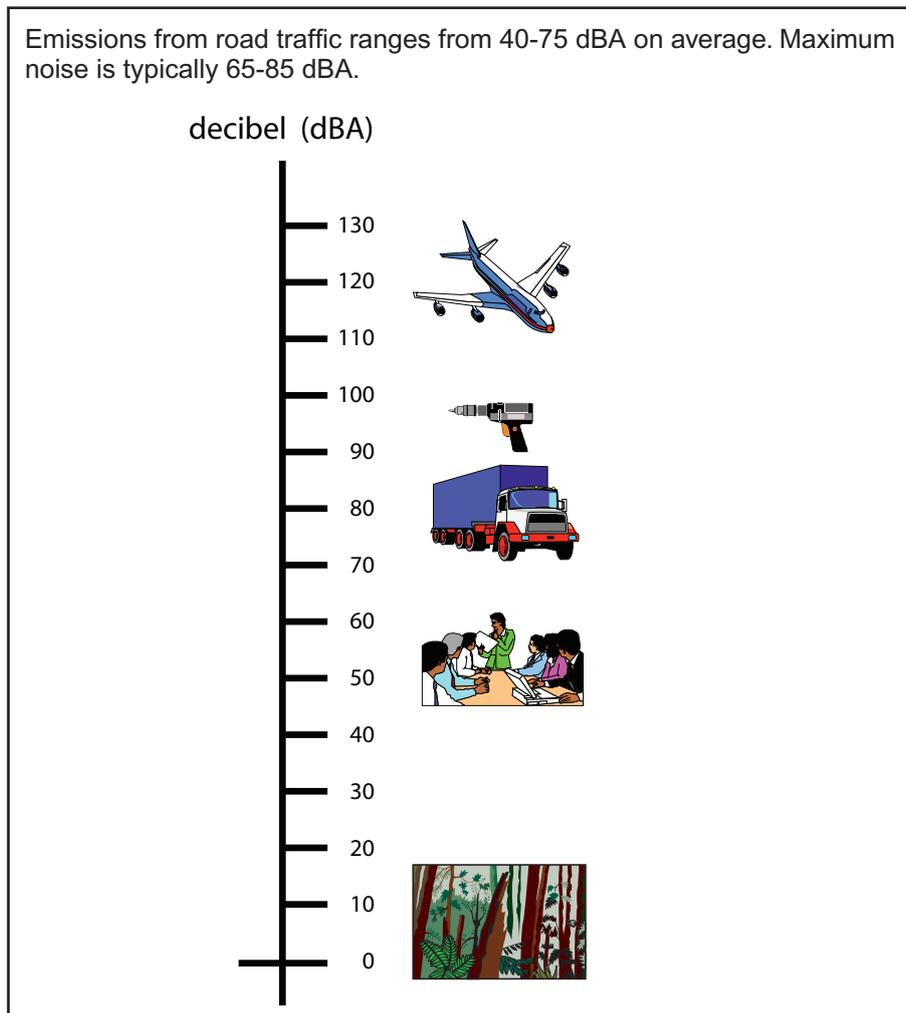


Figure 7.4.8.1 The figure shows typical noise levels from different sources.

Descriptions:

Noise nuisance and local air pollution caused by traffic on roads is covered under this theme. The emissions of pollutants by vehicles contribute greatly to total atmospheric pollution generated by human activities, the most important emissions from traffic being carbon dioxide (CO₂) and nitrogen oxides (NO_x). Carbon dioxide contributes to global warming, while nitrogen oxides contribute to acid rain and local air pollution.

The reduction of pollutants on a global scale requires measures on a national level and is beyond the scope of this guideline, which deals with local conditions in relation to specific road projects.

Too high levels of nitrogen dioxide (NO₂) or too high levels of particulate matter may cause a health problem locally along the roads. Nitrogen dioxide is mainly caused by vehicle emissions.

Particulate matter is caused by carbon nuclei on to which various compounds are adsorbed. Typical particulates are suspended airborne particles from diesel fuel combustion, materials produced by tyres, brake wear, road wear and dust.

Health effects are mainly damage to the respiratory functions, irritation of eyes and nose, and cancer.

Noise nuisance and local air pollution caused by traffic on roads is covered under this theme.

Botswana does not presently have a standard for local air quality, but the World Health Organisation has drawn up guidelines on air quality which can be used (WHO Guidelines for air quality). Reference should be made to Botswana Bureau of Standards.

Local air pollution problems arise along roads with high levels of traffic and where residential areas are situated close to the roads. This problem is prevalent in towns and cities. In the countryside dust is usually a problem on gravel roads and during road construction.

Vehicle engines and the friction between the tires and the road surface are the main sources of noise from road traffic. Driver behaviour and road maintenance activities are therefore important for noise emission. Heavy vehicles are major sources of noise. Noise can therefore be a problem even at low traffic levels.

Noise affects people through the disturbance of speech and sleep that in turn causes stress. The individual experience of nuisance is the best indicator of health risk. People who feel bothered by noise are those most probably in danger of suffering physical and psychological damage to their health.

Noise nuisance is usually a relevant theme when comparing alternative alignments. Botswana has not yet consolidated its national standard for noise. The World Health Organisation's guideline for community noise (Geneva, April 1999) states that an equivalent noise level of 55 dBA at the building facade of a dwelling is the maximum acceptable level. The guideline also states that 45 dBA should be the maximum noise level inside a dwelling during the night. People in hospitals, kindergartens and some other health institutions are especially vulnerable to noise.

For practical reasons the number of households, hospitals etc. affected by more than 55 dBA at the building facade is recommended as a basis for comparing alternative alignments in this guideline and figure 7.4.8.2 and 7.4.8.3 is to be used as advice to estimate the noise level.

Framework

The most important framework is the Public Health Act and Regulations.

The Act provides for matters related to the controlled abatement of nuisance in terms of pollution, unsuitable dwellings, etc.

Noise assessments and local air pollution assessments are usually carried out by civil engineers who have specialised in these issues.

The Feasibility stage - corridors

Information and data collection should be carried out at the beginning of the feasibility stage.

The main objective is to look for the best corridor in order to minimise noise nuisance and local air pollution. It is necessary to map settlements and to calculate future traffic amounts.

Local air pollution is normally not a problem when building new national roads. When rehabilitating gravel roads and during construction dust is a problem. Noise effects should however always be looked into. High traffic volumes on existing roads with residential areas close to the road can also be a problem.

Required competence: Noise assessments and local air pollution assessments are usually carried out by civil engineers who have specialised in these issues.

Available sources of information that should be referred to are:

- Photo maps for location of settlements
- Field visits

The assessment should be aimed at selecting and adjusting corridors. A more detailed assessment should be carried out at the alignment selection stage.

During this part of the feasibility stage the best corridor is selected.

The EIA and the Feasibility study - alignments

At this stage different alternative alignments within the selected corridor are investigated, and a comprehensive EIA is carried out.

1. A full mapping of affected households - assessing the value of the surroundings of the road.

The work to be undertaken is as follows:

- Desk studies on maps and field visits to establish the location of the households and institutions
- The number of households exposed to more than 55 dBA outside the building, must be mapped (see the figures on the next pages for advice). The extent of the mapping on both sides of the road depends on the traffic amounts
- Consultations with community representatives

The value of the influenced surroundings of the new road must be assessed for each alignment. Households which are inhabited part time should be mapped and accounted for in the same way as houses that are inhabited the whole year.

Generally speaking one should never consider designating areas where people live as a low quality environment because this in turn will mean that the negative impact from a new road has little significance.

The list of indicators below consists of examples only and is not exhaustive.

Indicators of large value are:

- Density of population along the road. Densely populated areas are more vulnerable than less densely populated ones and therefore of a larger value.
- Vulnerability of the settlements. Children and people who are ill are generally more sensitive to noise than the rest of the population. Hospitals, schools and kindergartens are therefore especially vulnerable to noise and local air pollution

The value judgement must be substantiated.

The value judgement must be substantiated.

2. Assessing the magnitude of the noise and local air pollution

Figure 7.4.8.2 and 7.4.8.3 is recommended as a basis for a rough assessment of noise exposure in order to compare alternative alignments. The impacts of the reference alternative as well as the effects of the alternative alignments should be assessed. The number of households exposed to more than 55 dBA at the building facade according to figure 7.4.8.2 and 7.4.8.3 should be calculated and used as a basis for comparing the alignments.

Households which are inhabited part of the year should be counted on an equal footing with those inhabited all the year round. The affected households should be marked on maps.

Local air pollution impacts have to be described and assessed on the basis of a sound evaluation. This is especially important when dealing with gravel roads or in cities with high traffic volumes.

Impacts only occurring during construction and how to mitigate them must be described in a separate chapter, and should not be taken into account in the evaluation of the permanent impacts of noise and local air pollution.

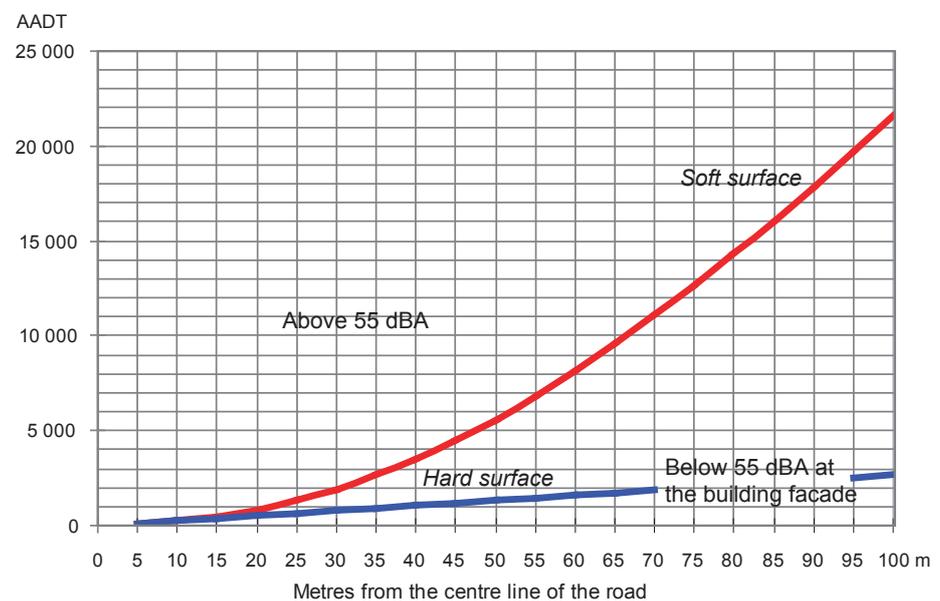


Figure 7.4.8.2: Distance from the centre line of a road to the facades with noise levels of more than 55 dBA at 60 km/h. The two tables are similar with the exception that the upper figure indicates a wider range of AADT (Average Annual Daily Traffic).

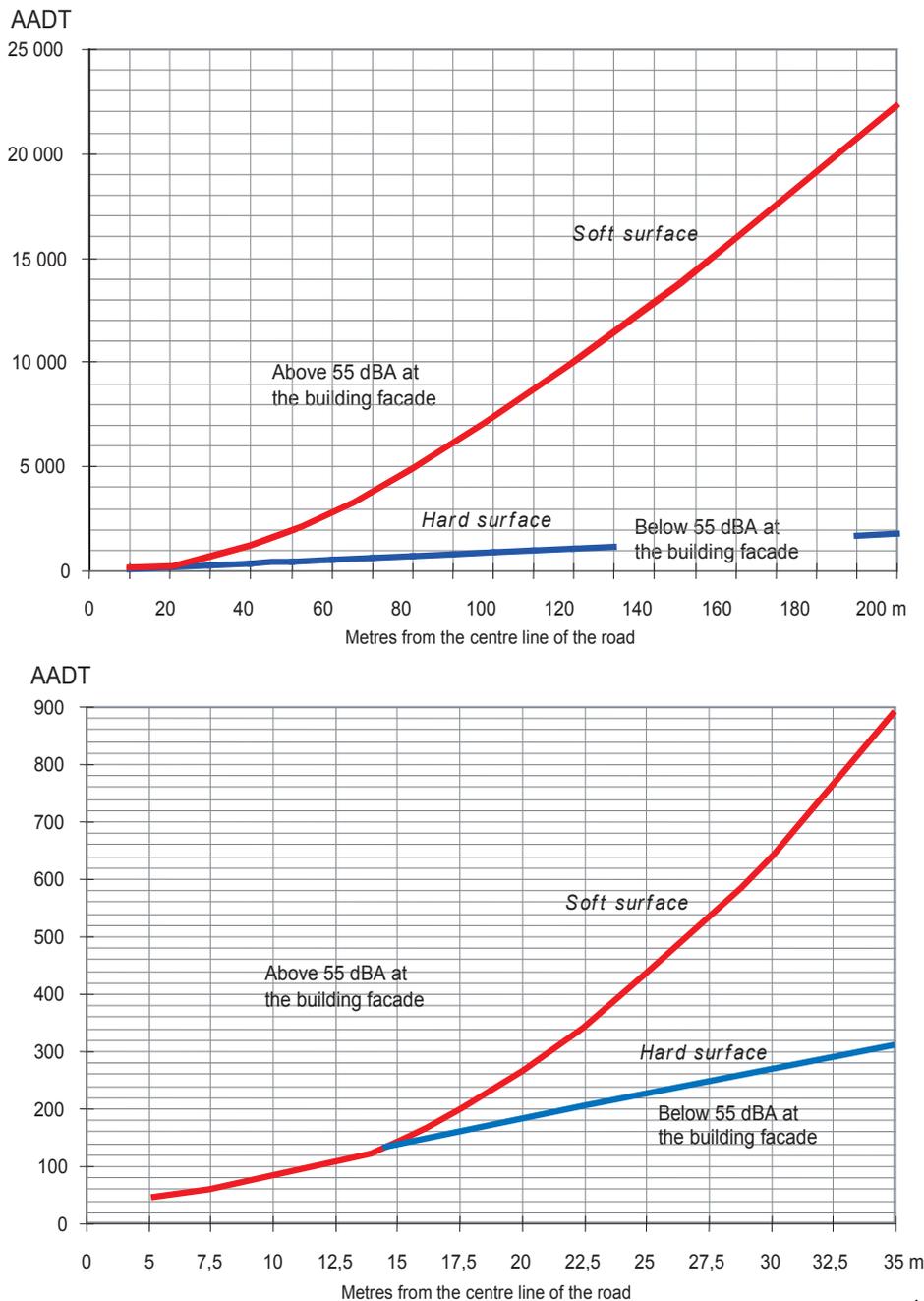


Figure 7.4.8.3: Distance from the centre line of a road to the facades with noise levels of more than 55 dBA at 90 km/h. The two tables are similar except that the upper figure indicates a wider range of AADT (Average Annual Daily Traffic).

3. Assessing the significance of local air pollution and noise impacts

The significance of the impacts should be seen in relation to the increase or reduction in the number of affected households. It is difficult to give advice on how to assess the significance of the impacts connected with this theme; it will depend on the absolute impacts seen in relation to the reference alternative as well as on the relative variations between alignments. First of all, it is important to clarify whether there has been a relative increase or decrease in exposure to noise and air pollution. The significance should be considered on the basis of the size of the project and on the absolute variation in noise

exposure. The vulnerability of the people exposed should also be considered. If there is a small variation in noise exposure for rather long alignments, say 40 km, the alignments can be considered the same with respect to noise. There has to be a significant difference in noise exposure seen in relationship to the size of the project to call for a different number of plusses and minuses for different alignments.

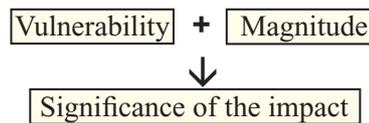


Figure: 7.4.8.4: General principle for assessing the significance of noise. The magnitude is the most important issue for this theme.

The assessment must clarify the important conflict areas or sections along the new road, and the alternative in its entirety must also be assessed.

The assessment must clearly illustrate what in the relevant specialists opinion is the best alternative.

It is important to bear in mind that the assessment will form the basis for ranking the different alternatives.

Impacts considered to be negligible that has been omitted should also be mentioned.

4. Mitigation

The assessment should as a rule include a proposal for viable mitigating measures, such as noise walls. The approved measures can be planned in greater detail during the detailed planning stage. Mitigating measures that will be carried out should be included both in the plan and in the assessment of the significance of the impacts. Mitigating measures will reduce the magnitude of any adverse effects. This will in turn lead to another evaluation of the significance of the impacts than would have been the case without it. The approved measures must be included in the cost estimates of the project.

5. Monitoring

Technical staff in the Roads Authorities and others responsible for the assessment of noise and local air pollution should propose any necessary monitoring of the short and long-term effects. The Roads Authorities decide what should be implemented after consultation with other public bodies responsible for noise and local air pollution.

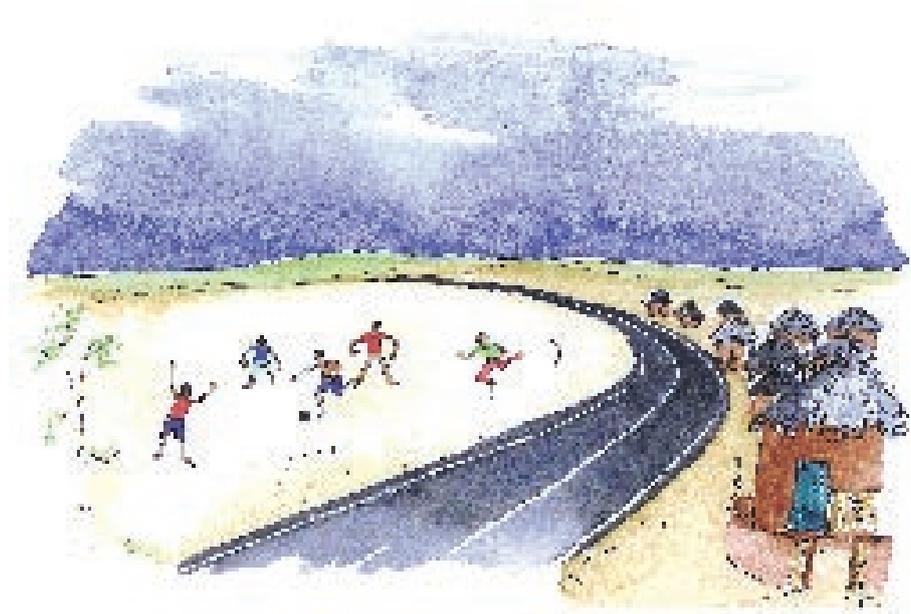
Evaluation and monitoring by the Roads Authorities are important in order to adjust the project and to make future projects more cost effective and environmentally friendly.

6. Summary

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme : Noise and local air pollution			
Vulnerability	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of pluses and minuses for each alignment	

7.4.9 Social Environment - Effects on Community Life



Definitions

The term social environment is used to describe the living conditions of people in the affected area with respect to issues such as sources of income, health and school facilities, services from the new road and the development of the community.

The term social environment is used to describe the living conditions of people in the affected area with respect to issues such as sources of income, health and school facilities, services from the new road and the development of the community. Social environment also includes the significance of the severance effect of the road for the population in the area, and of any increased or reduced feeling of insecurity resulting from a new road and the associated traffic.

The long-term local effects of the increased spread of diseases caused by the construction workers must also be taken into account.

The indirect effects of the new road on land use patterns are also included, i.e. expected new developments, either wanted or unwanted, resulting from the new road.

It does not include direct economic gains or losses caused by the road which will be covered by the Cost Benefit Analysis. Neither does the term social environment deal with traffic safety, which should be covered in the Cost Benefit Analysis.

Framework

The most important Acts concerning the social environment are:

- Town and Country Planning Act.
- The Public Health Act and Regulations
- The Tribal Land Act

The Public Health Act provides for matters related to the controlled abatement of nuisance in terms of pollution, unsuitable dwellings, etc.

A sociologist or similar should carry out the assessment of impacts on the social environment, preferably in co-operation with representatives of the people living in the affected area. Impacts on land use and the barrier effect should be assessed by a planner.

Required competence: A sociologist or similar should carry out the assessment of impacts on the social environment, preferably in co-operation with representatives of the people living in the affected area. Impacts on land use should be assessed by a planner.

The Feasibility stage - corridors

Information and data collection should, as a rule, be carried out at the beginning of the feasibility stage.

The main objective is to look for the best corridor, if there is more than one, in order to maximise the benefits to the communities influenced by the road while minimising the disadvantages.

The beginning of the feasibility study should include a survey of the population to be served by the road together with the location and size of settlements. The survey must cover the area within which the alternative corridors will be located. The objective is to find a corridor that will improve access in the most beneficial way to the population in the area and avoid disrupting traditional ways of everyday life and business.

Available sources of information that should be referred to are:

- Demographic data, population trends
- Sources of income in the area
- Location of cattle posts, lands and villages
- Social and economic links between and within the community
- Location of services like schools, health facilities etc

The assessment should be aimed at selecting corridors. A more detailed assessment will be carried out during the EIA at the alignment selection stage.

During this part of the feasibility stage the best corridor is selected.

The EIA and the feasibility study - Alignments

At this stage different alternative alignments within the selected corridor are investigated, and a comprehensive EIA is carried out.

1. A full social environmental inventory - assessing the value of the social environment

The work to be undertaken is as follows:

- Further desk studies, consulting maps, literature and public authorities at district and local level
- Fieldwork and surveys on foot
- Consultation with local authorities, Non Governmental Organisations and community representatives
- Interviews with local representatives

An assessment of the value of the social environment and its vulnerability to any changes envisaged by the new road should be carried out for each alignment. Settlements and areas interconnected with them should be marked on maps as a basis for selecting the alignment as well as for assessing the value, magnitude and significance of the impacts of the alternative alignments.

The value judgement must be substantiated.

The list below consists of examples only and is not exhaustive.

Indicators of large value are:

- The density of the population
- The vulnerability of the population; hospitals, schools and kindergartens are considered more vulnerable than the rest of a settlement

The value judgement must be substantiated. Generally speaking, one should never consider designating an area where people live as a low quality social environment because this in turn will mean that the negative impact from a new road have little significance.

2. Assessing the nature and magnitude of impacts on the social environment and on community life from a new road and the associated traffic.

Important impacts to be considered are:

- Direct encroachments on settlements
- Effects of both increased and faster traffic on access to the schools, play grounds, shops and other services etc. within a settlement
- Increased crime
- Improved or reduced accessibility for pedestrians and cyclists within the settlements
- Increased or reduced feeling of insecurity
- Better access to markets, health care, schools etc. outside settlements
- Reduced cost of living
- Possible flood hazard caused by changes to the terrain by the new road
- Disturbance of every day life, increased spread of diseases
- Possible negative effects of ribbon development along the new road if a settlement is bypassed or of other indirect impacts on the development of settlements

The magnitude of the impacts on settlements should be quantified to the greatest possible extent.

If there are positive effects for some people and adverse effects for others, these should be described separately due to their possible importance to the decision-makers. The overall impact should, however, be based on a complete assessment of all the effects.

Short-term effects occurring during construction along with how to mitigate them should be described separately (see chapter 7.4.10) and not included in the overall assessment of the permanent impacts.

3. Assessing the significance of the impacts on the social environment

The significance of the different impacts is assessed on the basis of the magnitude of the impacts related to value and the vulnerability of the social environment. The general principle is that the larger the value and the vulnerability of the area, the more significant is the impact, whether positive or negative

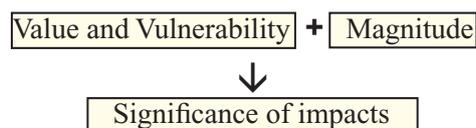


Figure 7.4.9.1: General principle for assessing impacts on the social environment

The assessment of an alternative means assessing the significance of various impacts on different settlements along the new road. The alternative in its entirety must then be subjected to a total assessment. It is important to bear in mind that the assessment will form the basis for ranking the different alignment locations with respect to their total viability. The assessment must clearly illustrate to the decision-makers the important conflict points or sections along the road and what is the best alternative in the opinion of the specialist on the social environment. If there is a conflict of opinion between the local representatives and the specialist, this should be mentioned.

The permanent effects can be positive for society as a whole even though some groups regard them as negative. Such negative effects should also be described, and possible mitigating measures to lessen the adverse effects should be sought.

Items omitted from the EIA because the impacts are considered to be negligible should also be mentioned.

4. *Mitigation*

The assessment of the impacts on the social environment should include a proposal for mitigating measures. Examples are; Code of conduct for the construction workers, information campaigns, adjustments to the alignment, carefully planned crossing points for people and cattle and zoning to prevent unwanted ribbon developments along the new road. Approved mitigating measures should be included in the assessment of the significance of the impact. Mitigating measure will improve or reduce the magnitude of the adverse effect. This in turn must lead to a different evaluation of the significance of the impacts than would have been the case without it. The approved measures must be included in the cost estimates for the project.

5. *Monitoring*

Technical staff responsible for the social environment should propose any necessary monitoring of short and long-term effects. The Roads Authorities decides what should be implemented after consultation with other public bodies responsible for the resource management related to the social environment.

Evaluation and monitoring by the Roads Authorities are important in order to make adjustments to the project and to render future projects more cost effective and environmentally friendly.

6. Summary

The assessment of the value, magnitude and significance of the impacts should be summarised in table form for each alternative alignment as shown below:

Theme: Social environment - Effects on Community Life			
Value and vulnerability	Magnitude	Significance	Number of +/-
Large/medium/low, and a brief description of why for each alignment	Quantified if possible, described in words ranging from large negative to large positive for each alignment	Ranging from very large positive to very large negative. Substantiation of the reasons for the number of plusses and minuses for each alignment	

7.4.10 Short-term Effects during Construction



Adverse or beneficial effects occurring mainly during construction should be described in the Environmental Impact Assessment Report, but should be kept separate from the rest of the impact assessment. Proposed mitigating measures to reduce negative environmental short-term effects and to enhance positive effects during construction should also be included in the report as a separate chapter. These impacts must also be dealt with in further detail at the detailed planning stage and in the tender documents for example in an Environmental Code of Conduct.

The affected communities and authorities will be informed in the EIA report of what effects to expect during construction and what mitigating measures are planned.

The Roads Department, usually represented by the Consultant Resident Engineer, is responsible for ensuring that mitigating measures are satisfactorily carried out. These must be included in the cost estimates for the project.

If the residual short-term effects, i.e. those remaining after mitigation, differ greatly from one alignment to another, they should be taken into consideration when choosing the alignment.

Checklist of short-term effects and applicable mitigating measures. The list is not complete, there may be other effects to consider:

Themes	Applicable mitigating/enhancing measures
Human relations:	
Short-term employment	Labour based methods are recommended when feasible. The labour force should be reasonably paid
Local communities	Community leaders and other local authorities should be encouraged to form a committee for the duration of the project, in order to communicate effectively with each other and with Roads Department representatives.
Private properties	Damage should be avoided by confining the contractors' activities to the road reserve. Damage to fences, wells, buildings, roads, fields, tracks etc. should be repaired as quickly as possible. Access roads must not transgress fields unless approved by the owner.
Traffic movement in the area	Provision for accommodation of traffic, re-routing etc
Health:	
Diseases	A Code of Conduct should be distributed to all workers, and health personnel should reinforce their efforts to combat diseases during the construction period.
Noise and air pollution	Construction work should not be done during the night. All machinery should be in good condition. Measures should be taken to control dust from the construction site.
Safety	High standards of safety should be adhered to. Construction vehicles should drive carefully, gravel should be watered to avoid dust, any blasting should be done carefully.
Work sites:	
Impacts of work sites	Work and campsites must be marked on maps in the EIA if possible. Permission must be obtained from the relevant authorities. After use the sites must be tidied up and no permanent structures must be erected. This includes the removal and safe disposal of waste oils, waste chemicals and mechanical waste to government designated dumping and recycling plants.
Reservoirs	All water, oil and chemical storage must be fenced. The remains of the reservoirs must be removed as soon as they are no longer needed. The retaining walls and fences must be removed and rehabilitation carried out as for the borrow pits.

.....to be continued

Checklist of short-term effects and applicable mitigating measures. The list is not complete, there may be other effects to consider:

Fuel wood	Fuel efficient cooking facilities should be provided where fuel wood is in shortage.
Incineration of waste	Incineration of waste by the contractor should be done at the camp or, if unavoidable on-site, and should take place within containers, i.e. old oil drums on bare ground. Incineration should not be carried out in windy weather.
Borrow pits:	
Borrow pits	Permission to open borrow pits must be obtained from the relevant Land Authorities and the Department of Mines. Topsoil should be carefully removed first and stored separately from the subsoil. After use the pit should be filled with the remaining subsoil first, followed by the topsoil, which should be evenly spread across the entire pit area to allow for revegetation.
Other themes:	
Disposal of surplus excavated material	The Roads Department and the local authorities have to approve areas for the disposal of surplus excavated material.
Soil erosion	Temporary drainage should prevent rapid runoff from disturbed surfaces.

8. Guide to the Comparison and Recommendation of Alignments

Alternative alignments are compared at the feasibility stage based on the monetary impacts and the assessment of non-monetary impacts. This is then used as a basis for recommending the best alignment.

The results of the assessments of the different themes in the EIA should be inserted into a table as shown in figure 8.1.2.

8.1 An example on ranking alternatives

Figure 8.1.1 below illustrates key figures and data for a road project. The reference alternative in this example is an existing gravel road with a length of 100 km. During the feasibility study two alternatives have been investigated: Alternative 1 with a length of 90 km and alternative 2 with a length of 110 km.

Item	Reference alternative (Existing)	Alternative 1 (Planned)	Alternative 2 (Planned)
Type of road	Gravel	Tarred	Tarred
Road length	100 km	90 km	110 km
Project costs		80 mill. Pula	90 mill. Pula
Traffic	600 AADT		
Generated traffic		Yes	Yes
Geological resources			Risk of pollution of the groundwater
Agriculture			Splitting up fields
Surface water		Great risk of soil erosion	Some risk of soil erosion
Archaeological and other Historical Assets		The road encroaches on a house built in 1940	
Biophysics - Wildlife and Vegetation		Fencing - a problem for the wildlife	
Aesthetic Impacts		3 deep cuts in hills 200.000 m ³	One huge fill 100.000 m ³
Social Environment - Community Life effects		Much better access to public services for 1200 people	Better access to public services for 500 people

Figure 8.1.1: An example of the magnitude of the main impacts of a project

The calculated monetary impacts and the assessed non-monetary impacts are summarised as shown below. The alignments are ranked separately both for monetary and for non-monetary impacts. The overall ranking is drawn upon this basis.

Impact	Alternative 1	Alternative 2
MONETARY IMPACTS (Discounted value in mill. Pula)		
- Time savings	20	15
- Saving in vehicle operating costs	50	40
- Benefit from generated traffic	10	15
- Saving in accidents costs	2	1
A: Total monetary benefits	82	71
- Project costs	80	90
- Change in maintenance costs	-10	-5
B: Total costs	70	85
C: Net Present Value (A - B)	12	-14
D: Benefit Cost Ratio (A/B)	1,2	0,8
E: Economic Internal Rate of Return	8%	5%
Ranking (monetary impacts)	1	2
NON-MONETARY IMPACTS:		
- Geological resources.....	0	-
- Agriculture.....	0	-
- Surface water.....	--	-
- Archaeological and other historical assets.....	-	0
- Biophysics - wildlife and vegetation.....	--	0
- Aesthetic Impacts.....	--	-
- Noise nuisance and local air pollution.....	0	0
- Social environment - community life effects.....	++	+
Ranking (non-monetary impacts)	2	1
Overall ranking	1	2

Figure 8.1.2: Example of a table showing the results of an EIA and the ranking of the alternatives

Ranking Alternative 1 as the best in this case implies that the 26 mill.Pula difference in Net Present Value is considered to be worth more to society than the more negative impacts of the non-monetary impacts. In order to understand the basis of the recommendation in a real situation one has to look more critically at the non-monetary impacts.

8.2 The ranking process

When analysing the results of the EIA the first factor one should look at is the Net Present Value. The question should then be whether all alternatives have a positive NPV? If they do, they are all worthwhile from a socio-economic point of view. Low traffic and large construction costs may sometimes cause a

negative NPV. In such cases there should be significant positive non-monetary impacts to justify realising the project. On the other hand the project could show a positive NPV but have very negative non-monetary impacts. In such cases one should consider not building that particular alternative and look for a better one.

One can easily rank the alternatives according to monetary impacts by looking at Benefit Cost Ratio (BCR) or the Economical Internal Rate of Return (EIRR) both of which are relative measures of economic benefit. This is shown in figure 8.1.2. Alternative 1 is ranked higher than alternative 2 because the former has the largest Benefit Cost Ratio.

During the EIA all the relevant non-monetary impacts for the different alternatives have been assessed and the conclusions are shown in figure 8.1.2. As explained earlier, a scale consisting of nine intervals is used ranging from very large positive (+ + + +) via zero to very large negative (- - - -) as follows:

++++	Very large positive significance
+++	Large positive significance
++	Fairly positive significance
+	Small positive significance
0	Little/no significance
-	Small negative significance
--	Fairly negative significance
---	Large negative significance
----	Very large negative significance

When ranking the alternatives with respect to the non-monetary impacts one should have in mind the fact that the significance factor expressed in figure 8.1.2 for different impacts should not be directly compared. For example, one minus for geological resources does not normally directly equal one minus for aesthetic impacts. However, one minus for geological resources for alternative 1 should roughly equal one minus for geological resources for alternative 2 within the same project. Based on the EIA for non-monetary impacts the different alternatives are compared and ranked according to the non-monetary impacts.

After ranking the alternatives based both on monetary and non-monetary impacts, the overall ranking is carried out. If the ranking of the alternatives both for monetary and for non-monetary impacts is the same, the overall ranking will also be the same.

In cases where one alternative is best with respect to monetary impacts, and another alternative best with respect to non-monetary, there is no way of calculating what the overall ranking should be. This will depend heavily on the weight we attach to the difference between the alternatives for the non-monetary impacts.

One approach will be to look at the difference in NPV for the two alternatives being compared. If we choose the alternative with the highest NPV the difference in NPV should at least be considered to be as important to society as the difference of the significance of the non-monetary impacts. What this really means is that the extra net present value for the alternative with the highest NPV must be considered as more important to society than the extra negative impacts on society from the non-monetary themes.

The reasoning above is explained in the following simplified example in figure 8.2.1.

Result from the Impact Assessment	Alternative 1	Alternative 2
Net Present Value	15 mill. Pula	5 Mill. Pula
Ranking based on Monetary Impacts	1	2
Agriculture (significance)	- - -	-
Ranking based on Monetary Impacts	2	1
Overall ranking	1	2

Figure 8.2.1 Example of comparing alternatives

In this simple example there is only one non-monetary impact, namely agriculture. Ranking according to monetary as well as non-monetary impact is very simple. However, arriving at the overall ranking is not so simple. We have to compare the difference between the alternatives for the monetary impacts with that between the alternatives for the non-monetary impacts. We then indirectly give a monetary value to the non-monetary impact. In the example in figure 8.2.1 the difference in Net Present Value is 10 mill. Pula. If we choose alternative 1, we indirectly say that we value the difference (2 minuses) between the alternatives for agricultural impacts as being worth less than 10 mill. Pula.

The results of the Sensitivity Analysis mentioned in Chapter 7.3.9 should be taken into account when comparing alternatives. Uncertainties in traffic forecast and construction costs should be explored because alternative estimates could lead to a different ranking. During such a process one will get to know the resilience of the ranking and the recommendation.

When ranking the alternatives based on non-monetary impacts and when doing the overall ranking based on all impacts, it is crucial to treat this as a multidisciplinary task. The multidisciplinary consulting team responsible for the environmental impact study should at this stage discuss the ranking of the alternatives. If the consultants do not agree, the objections to the recommendation should also be stated in their report. During the review of the recommendation the Roads Authorities may alter the consultants' conclusion as to which alternative to choose. The Roads Authorities should substantiate their conclusion for all projects.

During the process of comparing alternatives it is also important to bear in mind the objectives which the plan was supposed to achieve. Does the EIA indicate that these goals will be achieved?

During this process the financing of the project also has to be considered, and when funds are granted the construction can commence.

The multidisciplinary consulting team responsible for the environmental impact study should at this stage discuss the ranking of the alternatives.

APPENDICES

Appendix I - Glossary of terms

Alignment:

A geometrical fixed line describing a planned road which has been the subject of investigation, or an existing road.

Benefit Cost Ratio (BCR):

A relative measure of profitability. It could be calculated as discounted community benefits of the project divided by its discounted capital costs.

Corridor:

A bandwidth area within which one wants to investigate alternative alignments for a road.

Cost Benefit Analysis (CBA):

A technique for assessing the economic efficiency of resource allocation. It is based on all costs and benefits to society that can be quantified in monetary terms.

Economic Life:

The period over which the major assets in the project are supposed to function. (Often equal the Evaluation period).

Environment:

Includes all natural and social systems and their constituent parts, including people, communities and atmospheric, physical, ecological, aesthetic, cultural, economic, historic, institutional and social factors.

Environmental Impact Assessment:

Work undertaken in order to predict and assess the likely impacts of a proposed project or decision. Abbreviated to EIA.

Evaluation period:

The period over which the benefits and costs of a project are compared.

First Year Rate of Return (FYRR):

A criterion that can be used for assessing the optimal timing of the project. It could be calculated as the discounted community benefits in the first operating year divided by discounted capital costs.

Influenced area:

Geographical area within which the project will cause impacts, this may extend beyond the planning area.

Internal Rate of Return (IRR):

Is the rate by which benefits would need to be discounted in each year of the projects' life so that the total discounted benefits equalled discounted costs.

Mitigating measure:

Practical measures to reduce the adverse impacts or enhance the beneficial impacts of an action.

Monitoring:

Continuous or periodic surveillance of the physical implementation of a project to ensure that inputs, activities, outputs and external factors are proceeding according to plan.

Net Present Value (NPV):

An absolute measure of profitability. It could be calculated as discounted community benefits of the project less discounted capital costs.

Price Year:

The year to which all valuation relate.

Scoping:

A procedure for narrowing the scope of an assessment and ensuring that the assessment remains focused on the truly significant issues or impacts.

Screening:

The classification of proposals in terms of the requirements of an environmental assessment.

Sustainable development:

Development which satisfies the needs of the present generation without in any way putting in jeopardy the needs of future generations.

Terms of Reference:

Written requirements governing EIA implementation and its objectives, consultation to be held, data to be produced and form and contents of the Report. Often produced as an output from scoping. Abbreviated to ToR.

Appendix II - Abbreviations

AADT	Average Annual Daily Traffic
CBA	Cost Benefit Analysis
BCR	Benefit Cost Ratio
CPS	Creative Problem Solving
DDC	District Development Committee
DLUPU	District Land Use Planning Unit
GDP	Gross Domestic Product
GIS	Geographic Information System
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FYRR	First Year Rate of Return
HDM	Highway Development Management
IRR	Internal Rate of Return
MMEWA	Ministry of Minerals, Energy and Water Affairs
NCS	Nature Conservation Strategy
NCSA	National Conservation Strategy Agency
NDP	National Development Plan
NGO	Non Governmental Organisation
NMMAG	National Museum, Monuments and Art Gallery
NORAD	Norwegian Agency for Development Co-operation
NPV	Net Present Value
PHN	Public Highway Network
RD	Roads Department
ToR	Terms of Reference
UNEP	United Nations Environmental Program

Appendix III - Creative planning techniques

Introduction

Creativity is our ability to produce ideas, compositions, coherence and solutions, which were unknown to us. Creativity is a creating activity.

People who have the same education, experience and background often think in the same manner, but when people with different backgrounds mix, new thoughts and ideas will more easily emerge. Multidisciplinarity is therefore important for obtaining creativity.

As shown below creative thinking is quite different from rational thinking:

Rational:

Logical, analytic, systematic, focusing, step-by-step

Creative:

Intuitive, impulsive disconnected, spreading. When using creative planning techniques one needs to have a clear understanding of the problem that needs to be solved .

A creative planning process consists of one opening and one closing stage. In the former stage one is looking for as many ideas as possible, while in the latter one or a small number of ideas that have been chosen, require to be developed further.

In the following sections three creative planning techniques are briefly described:

Brainstorming

The session starts with a short briefing on the problem one wants to solve. Afterwards the participants can contribute their ideas which then have to be written down on a flipover chart in the order they have been produced.

At this stage the following rules are mandatory:

- Criticism is not allowed
- All ideas have to be looked upon as positive by the participants
- All ideas should be mentioned
- A large number of ideas are desirable

After this idea generating stage the person who runs the session sorts the ideas into groups. The most promising ideas are put in one group, and one then looks for combinations of ideas. Facts are gathered as a base for further development of the most promising ideas.

This brainstorming technique is suitable for solving simple tasks where the need for facts is low. The method works well with 6 - 12 participants.

Brain writing, "Method 635"

Method 635 is one of a number of brain writing methods. The numbers indicate a group of 6 persons, which note 3 ideas during a period of 5 minutes.

After an introduction to the problem, including a precise definition of the problem, each of the 6 participants gets a form similar to the one shown below. All the participants write down 3 ideas on the first line of the form. This should be done within 5 minutes and the form should then be passed to the persons to the right. All the 6 participants then write 3 new ideas within 5 minutes, attempting to:

- Supplement ideas above
- Associate and find related ideas to the ideas above
- Create new ideas

The process goes on until all the 6 forms have circulated the whole circle i.e. 30 minutes. Theoretically the result then will be $6 \times 3 \times 30 / 5 = 108$ ideas. One then has to sort out and choose the best ideas for further work.

Problem:			
Name of participant	Idea 1	Idea 2	Idea 3
Tom			
Dick			
Harriet			

Figure A III. 1: Example of form for a 635 process

The advantages of this method are:

- The method is simple
- Critical comments are rare during the process of creating ideas
- All participants are activated to the same extent

CPS Method

CPS means Creative Problem Solving. It is a systematic step by step method, which guides one from a problem to a solution, and further to a plan for implementation.

The method consists of 5 phases or stages as follows:

1. Seeking facts
2. Alternative problem definitions
3. Seek ideas
4. Criteria for selecting solutions
5. Acceptance of the solution

Each of these 5 phases consists of a diverging/opening/creating sequence and a converging/closing/assessing sequence. The same rules apply as for brainstorming i.e. no criticism, all ideas valuable etc. In the converging part of the process the person chairing the meeting will evaluate the ideas and interesting ideas, are gathered for further development in the next phase.

The method is in general more elaborate and time consuming than Brainstorming and Brain writing.

Appendix IV - Vulnerability mapping - developing alignments

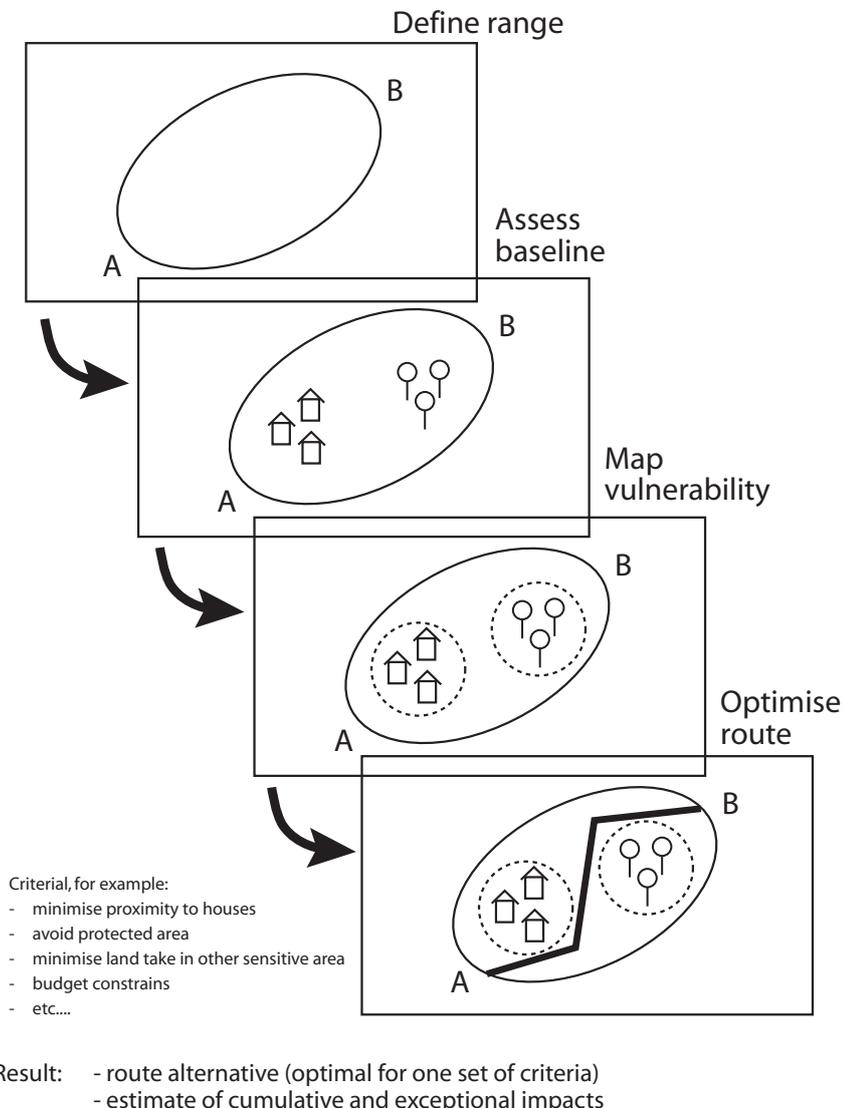


Figure A IV. 1: Vulnerability mapping

This is an example on how vulnerability mapping can be carried out at the feasibility stage.

The following steps should be taken:

1. **A range of possible alignments should be identified.** It is important that as much information as possible is known about the possible range of alternative alignments.
2. **Assess the baseline.** When the possible locations are known, the baseline (the existing situation and any developments that are not influenced by the infrastructure plan) can be assessed.

The first source of the value of a particular area is the formally approved policy. This may for example include nature conservation policy, recreation policy, spatial policy or any other environmental policy. Preferably this should be aggregated on an appropriate geographical scale, and indicated on thematic maps following the themes of the guideline. Other areas of value can be assessed by making use of other geographical information available at central or district level or at research institutes.

3. **Map vulnerable areas.** Defining which types of land use the route should avoid can narrow the range of possible transport infrastructure locations down. These are categories of land that are sensitive to severance, land take, noise etc. This results in a vulnerability map. The vulnerability map is then overlaid with possible infrastructure routes and designs, including the areas on both sides of the infrastructure where sensitive habitat or settlement could be at risk. If there are different views about the weight that certain impacts could have, different sets of criteria can be developed, resulting in different sets of vulnerability maps. The classical dilemma is the choice between crossing a rural area affecting biodiversity and agriculture or going through settlements affecting residents.

Such dilemmas cannot normally be solved in a technical analysis, because they are essentially political. In an EIA different alternatives have to be developed, minimising impacts from both perspectives. The choice is then made by the decision-makers and the basis of the EIA and other factors.

4. **Alignment optimisation.** Different alternative alignments can be generated. One way of doing this is to develop ecologically friendly alternative, the alternative most favourable for local communities and the alternative most favourable for transport economy. This can be done by using GIS (geographic information systems), or by hand. The sensitivity of the areas obviously depends on the mitigating measures that will be included in the plan (such as noise walls, speed bumps or fencing). If there are conflict points along alignments that are otherwise relatively less vulnerable, mitigating measures should be proposed at the alignment selection stage and included in the plan. This is especially important if this will make one alignment more feasible compared to other alignments.

The vulnerability mapping can easily be used as a basis for the EIA and in public hearings. If the analysis is supported by GIS it is much faster than when done by hand.

The text is an extract of Manual on Strategic Environmental Impact Assessment of Transport Infrastructure Plans from the European Commission.

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