Environmental evaluation of proposed alternative roads to the Mohale Dam

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Dissertation submitted in partial fulfillment of the requirements for the degree Master of Philosophy in Environmental Science

June 1993

Acknowledgements

I would like to thank the following people who have helped me with this dissertation:

Richard Hill, my supervisor, for very thorough advice and countless proofreadings during a very busy schedule.

Lara Dunwell, my flatmate, for proofreading and an objective viewpoint on environmental impact assessments.

My classmates, for making the coursework and the fieldwork in Lesotho, the foundations of this dissertation, very enjoyable.

Most importantly, my parents for making it possible for me to come to Cape Town and do the Environmental Science Masters course.

Executive summary

Purpose of the report

This is an academic report submitted in partial fulfilment of the degree Master of Environmental Science. It is written to demonstrate the competence of the writer in undertaking work in the field of Environmental Impact Assessment. The main purpose of the report is the comparative evaluation of two proposed alternative roads, the "Western Access Route" (WAR) and the "Least Cost Alternative Route" (LCAR). Since this is an academic report, it will not be used as a decision-making document and it will not be submitted to the proponent of the alternative roads.

Background

The LCAR and WAR are proposed as alternative roads for the transport of materials and labour from the Lesotho/South Africa border to the site of the proposed Mohale Dam. The Mohale Dam forms part of Phase 1B of the Lesotho Highlands Water Project. The proponent of the access road to the Mohale Dam is the Lesotho Highlands Development Authority, which is also the proponent of the Mohale Dam. The environmental impacts of the LCAR and WAR have already been examined in impact assessments completed by the Environmental Science Masters students between January and April 1993. This report synthesises the information contained in these reports, in order to recommend one of the routes on the basis of their nett benefit in bio-physical, socio-economic and financial terms.

Description of the alternatives

The WAR and LCAR both end near the site of the proposed Mohale Dam, but the they have different starting points on the Lesotho/South Africa border. The WAR follows the existing "Mountain Road" from Maseru on the border to the dam site. The use of this road would necessitate the upgrading of 60.4 km of the existing road, from the village of St. Michael's near Maseru, to the village of Patiseng near the dam site. The LCAR follows a route from the Ficksburg/Maputsoe border post to the dam site, where it joins the Mountain Road. The road from Ficksburg to the village

of Ha Mateka is an existing road, but the rest of the LCAR from Ha Mateka to the dam site would be a completely new road with a length of 55 km.

Methodology

Review of the assessment:

The impact assessments of the WAR and LCAR were reviewed in terms of the principles and methods of impact assessment theory. The impact assessments procedure compared to the Integrated Environmental Management (IEM) procedure to determine what deficiencies the impact assessments might have and what the implications of these deficiencies are for the study.

Comparative evaluation of routes:

The impacts that are documented in the impact assessments of the WAR and LCAR have been used as the basis for evaluation. The number of impacts that has been used for the decision has been reduced from more than 20 in the impact assessments to a total of 11. Impacts in terms of which either of the routes have a high significance without mitigation were used for evaluation. An impact by impact comparison of the alternative routes was undertaken. Each impact was presented in the following format:

General background: Where applicable, information that is relevant to both routes was provided to avoid repetition in the individual discussion of routes.

Alternative: the alternative under consideration.

Impact: Whether the impact is positive or negative.

Discussion of impact: An explanation of the causes of the impact, its magnitude (if possible) and the reasons why the impact is negative or positive.

Degree of confidence in prediction: The certainty with which the magnitude and/or significance of the impact can be predicted.

Interest group: The interest group(s) that will be affected by the impact.

Significance: The significance of the impact without mitigation and the criteria on which the significance rating is based.

Spatial context of significance: Whether the impact is significant on a international, national, regional, subregional or local scale.

The following criteria were be used to provide a motivation for the allocation of significance ratings to impacts:

- *Magnitude*: a quantification of the impact. No universal unit can be given as every impact is different, and it is not possible to quantify all impacts. In general, the higher the magnitude, the higher the significance.
- *Degree of effect on public health and safety*: the greater the effect, the higher the significance.
- *Reversibility of the impact*: the less reversible the impact, the higher its significance.
- *Degree of effect on environmental qualities, goods or services which are of special or unique character, in limited supply and/or essentially irreplaceable*: the greater the effect, the higher the significance.
- *Possibility of cumulative impacts*, i.e. the degree to which an action has little impact on its own but in combination with other actions could result in significant impacts: the greater the chance of cumulative impacts, the higher the significance.
- *Possibility of secondary impacts*, i.e. the possibility that the impact can give rise to secondary impacts that are not caused directly by the project actions: the higher the possibility the higher the significance.
- *The ability of the affected people to capitalise on positive impacts or overcome negative impacts*. This will be considered in the case of socio-economic impacts: the less the ability to capitalise on positive or overcome negative impacts, the higher the significance.
- *Duration of impact*: the longer the duration, the higher the significance. Duration will be stated as short term (a few days or months), temporary (a few months to a few years) or permanent (unlimited duration)

The evaluation for each impacts was summarised in a tabular format according to the Framework Method for evaluating road projects. In addition to the analysis of individual impacts, each route was evaluated, as a whole, according to the criteria of *equity* (whether the route would lead to a fair distribution of costs and benefits among the individuals and groups in society), *efficiency* (whether the benefits of the road outweigh its costs) and *sustainability* (whether the costs and benefits of the route are distributed fairly between generations).

Mitigation of impacts:

The mitigation measures to minimise negative impacts were prioritised by applying the following criteria to the impacts:

Significance: The higher the significance of a negative impact, the greater the priority for its mitigation.

Number of criteria that impact meets: Under each significance level, impacts are in the order of the number criteria (listed below) which they meet. The higher the number of criteria that the impact meets, the higher the priority of its mitigation:

- Does the impact impair the ability of people to meet their basic needs?
- Does the impact affect people's health and safety?
- Does the impact affect environmental goods, services or qualities which are special, unique or in limited supply?
- Does the impact affect the maintenance of essential ecological processes and life-support services?
- Does the impact affect the preservation of genetic diversity?

Findings

Review of the impact assessment:

The impact assessments of the WAR and LCAR accord with the broad principles of Integrated Environmental Management. Environmental input into the design of the roads has thus far progressed as far as Stage 1 of the IEM process. Environmental input should continue according to the guidelines for stages 2 and 3 of the IEM procedure.

The main deficiencies of the study are:

- The manner in which significance ratings have been assigned to impacts is not explicit.
- Certain important aspects of the roads have not yet been assessed and certain information regarding the road was unavailable due to the preliminary nature of the design. The most important outstanding information is the location of construction camps where road construction workers would be housed. This is relevant to determining the impact on social patterns of the local inhabitants along the routes. It will be necessary to determine where to locate construction camps with the minimum social disruption of the local population.
- The road designs that were assessed were preliminary. Some aspects of the road design may change after the impact assessments. It will be necessary to check whether the final design differs significantly from the preliminary design, and whether the original impact assessments are, therefore, still valid.

Comparative evaluation of routes:

It was found that the WAR is the preferred alternative. The reasons for recommending the WAR are:

- **Of the eleven factors which were selected for making the decision, nine are in favour of the WAR and two are in favour of the LCAR.** The decision factors have been summarised in the *Decision Framework* on page 87. A shortened version of the *Decision Framework* is given in the table on the next page.

Summary Table of Decision Factors

Interest Group	Decision factor	Alternative	
		LCAR	WAR
Transport, development and economic policies	Impact on National Planning Objectives		
	Impact on Lesotho Road Network		
Travellers	Impact on traffic flow in Maseru		
Occupiers	Impact on agricultural resources		
	Impact on local dagga-based economy		
Occupiers, and Users of facilities	Impact on houses, businesses and facilities		
	Impact on access to facilities, goods and services		
Policies for conserving and enhancing the area	Impact on wetlands		
	Impact on aquatic fauna		
	Impact on spiral aloes		
Financial implications	Finance		

Shading indicates preferred alternative for decision factor

- **The WAR is more equitable than the LCAR.** The major benefits of the LCAR are localised and distributed among about 2000 people in the Jorodane Valley. Most of the other interest groups are affected negatively by the LCAR. The WAR's benefits would accrue to the occupiers of the Jorodane Valley, the occupiers along the WAR, the inhabitants of Maseru and policy interests. Thus the WAR leads to a fairer distribution of costs and benefits than the LCAR.
- **The WAR is more efficient than the LCAR.** Using the compensation principle, the LCAR is inefficient, because the groups that obtain the most benefit from the LCAR (the inhabitants of the Jorodane Valley) are unlikely to be able to compensate those who bear the costs of the LCAR. Those who benefit from the WAR are more likely to be able to compensate those who lose than from the LCAR, and still be better off. This implies that the benefit : cost ratio of the WAR is higher than for the LCAR.

- **The WAR is more sustainable than the LCAR.** The LCAR would lead to several negative impacts which would affect future generations. The WAR would cause several positive impacts which would accrue to future generations.

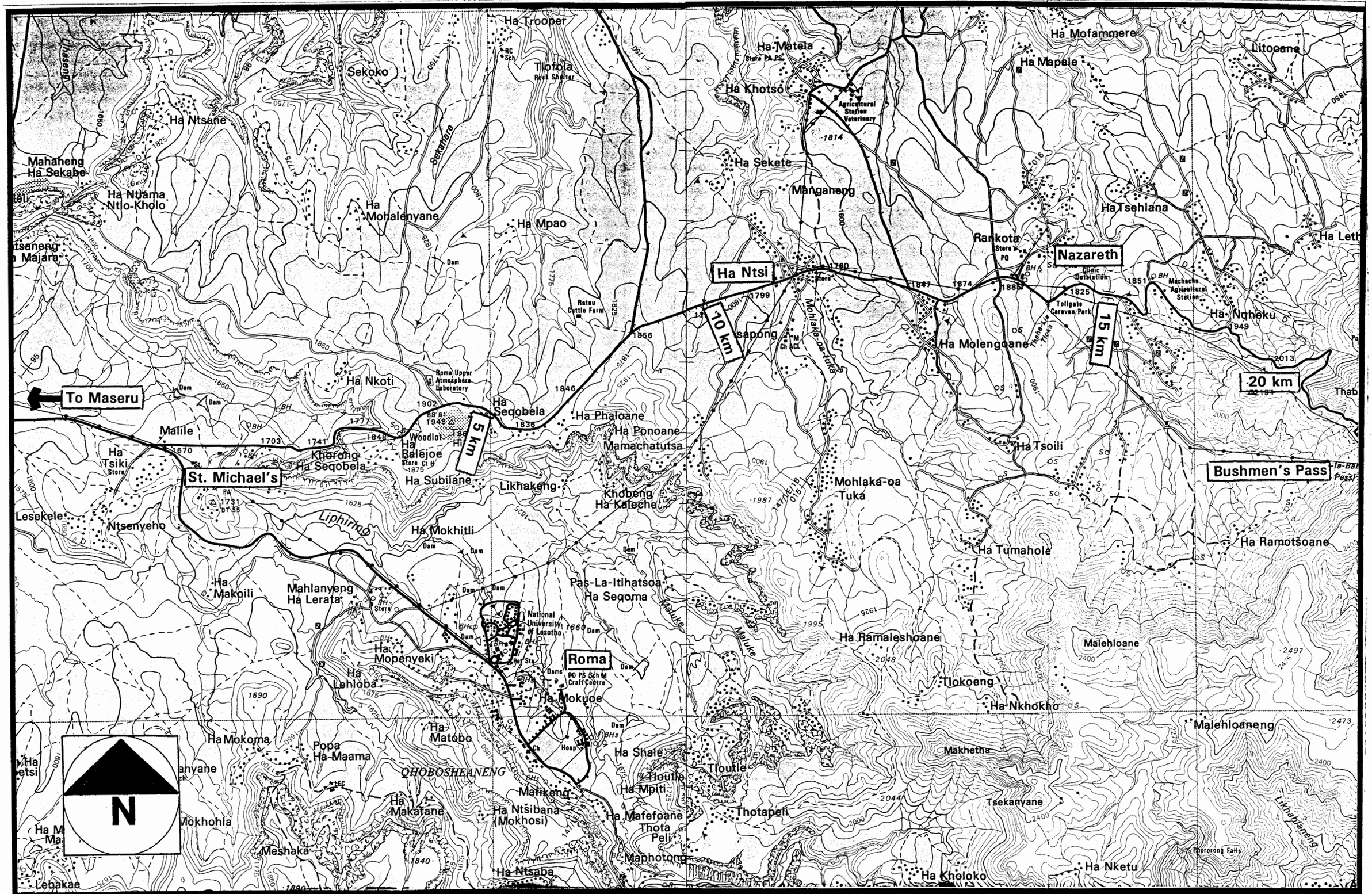
Mitigation of impacts:

It was determined that the following negative impacts are the most important impacts to mitigate:

- Impact on potable water supplies
- Impact on houses, businesses and facilities
- Impact on cultivated land
- Impact on spiral aloes
- Impact on social patterns
- Inconvenience and risk to people and livestock
- Impacts on wetlands
- Impact on *Leucosidea* shrubland

The mitigation measures for impacts should be formulated in an Environmental Management Plan, and be subjected to ongoing monitoring.

Table of contents



MAP 2b) ALIGNMENT OF WESTERN ACCESS ROUTE

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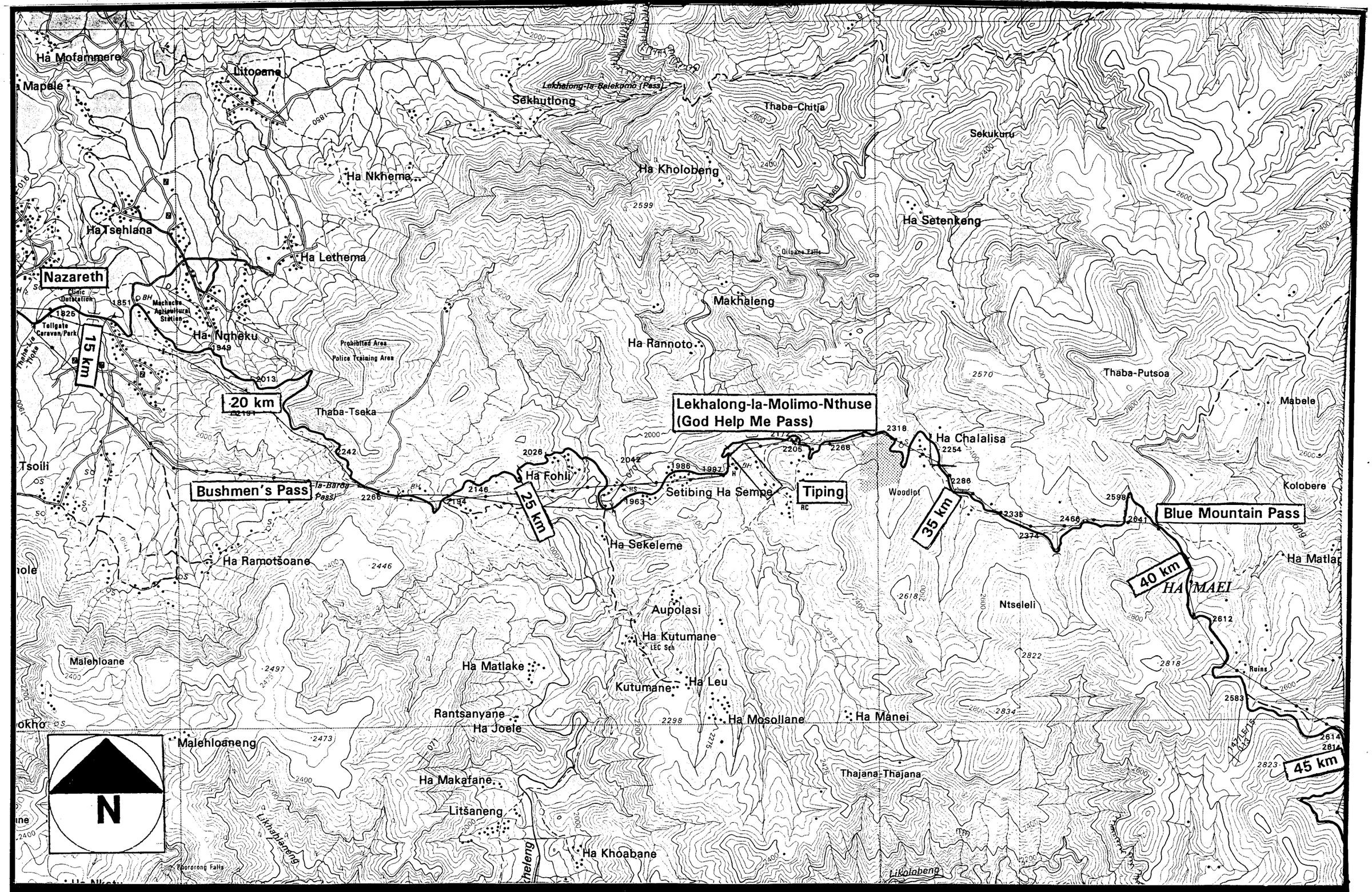

MAP 2c) ALIGNMENT OF WESTERN ACCESS ROUTE

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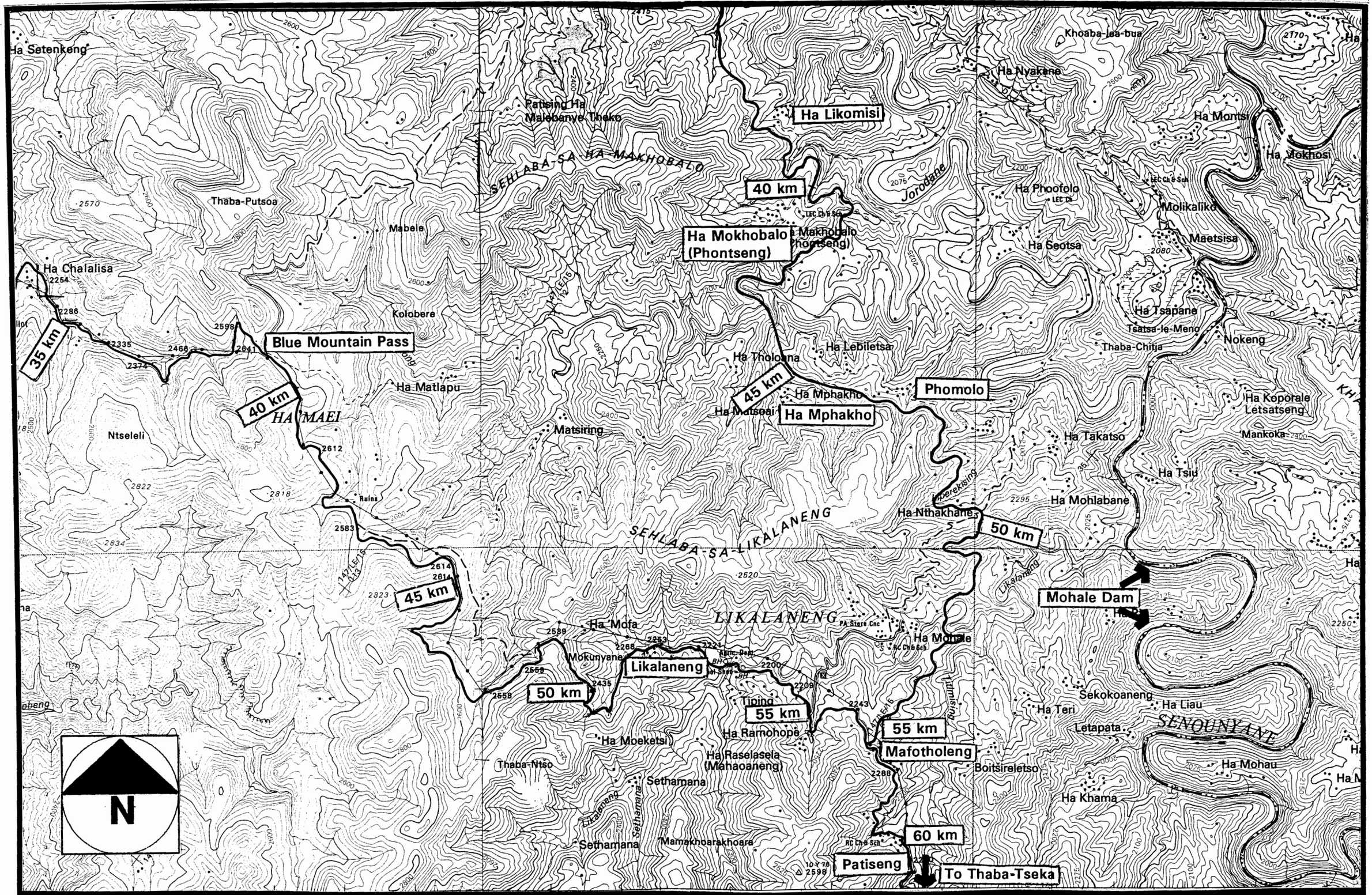

MAP 2d) ALIGNMENT OF WESTERN ACCESS RUOTE AND LEAST COST ALTERNATIVE ROUTE

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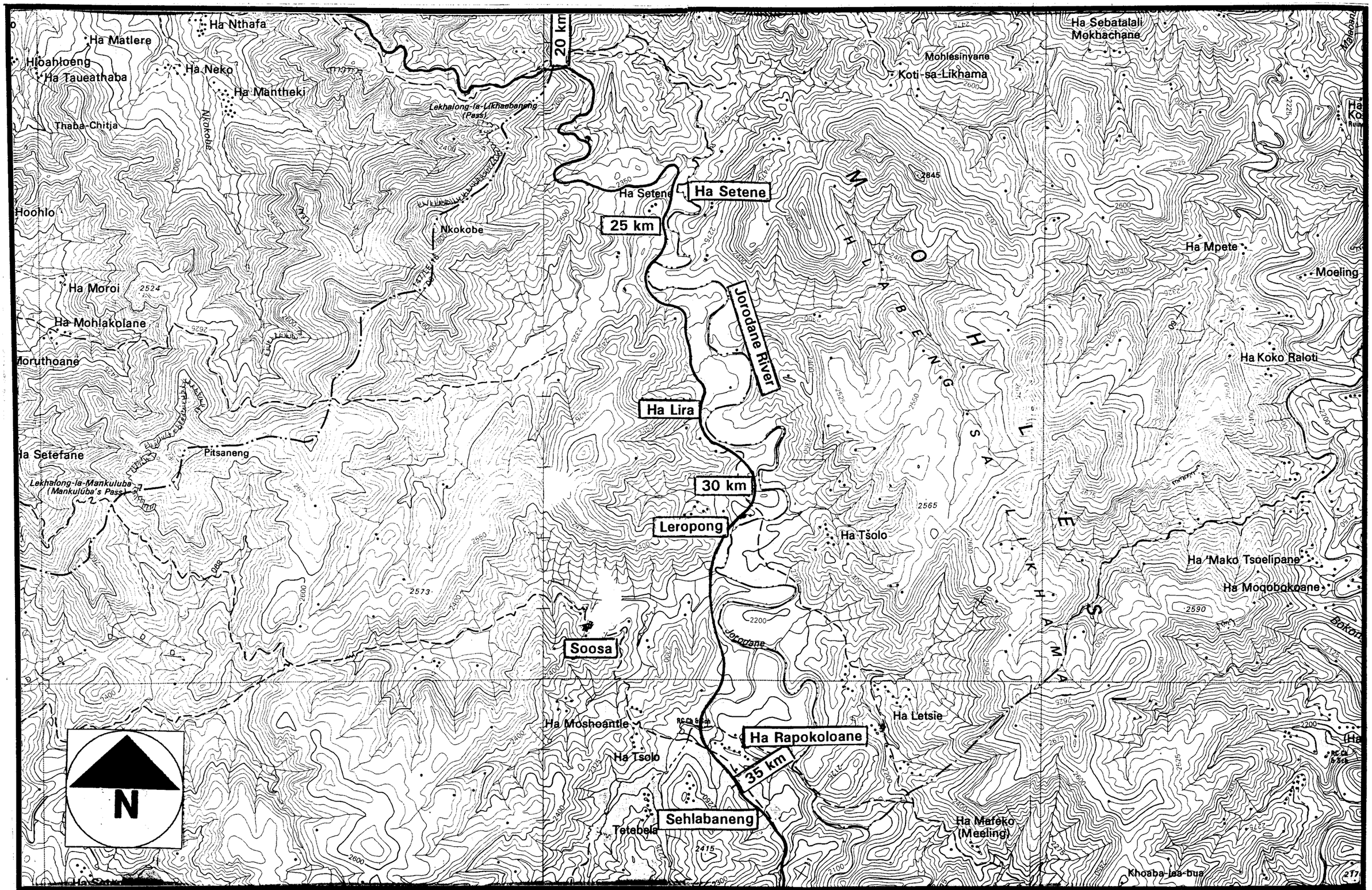

MAP 2e) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

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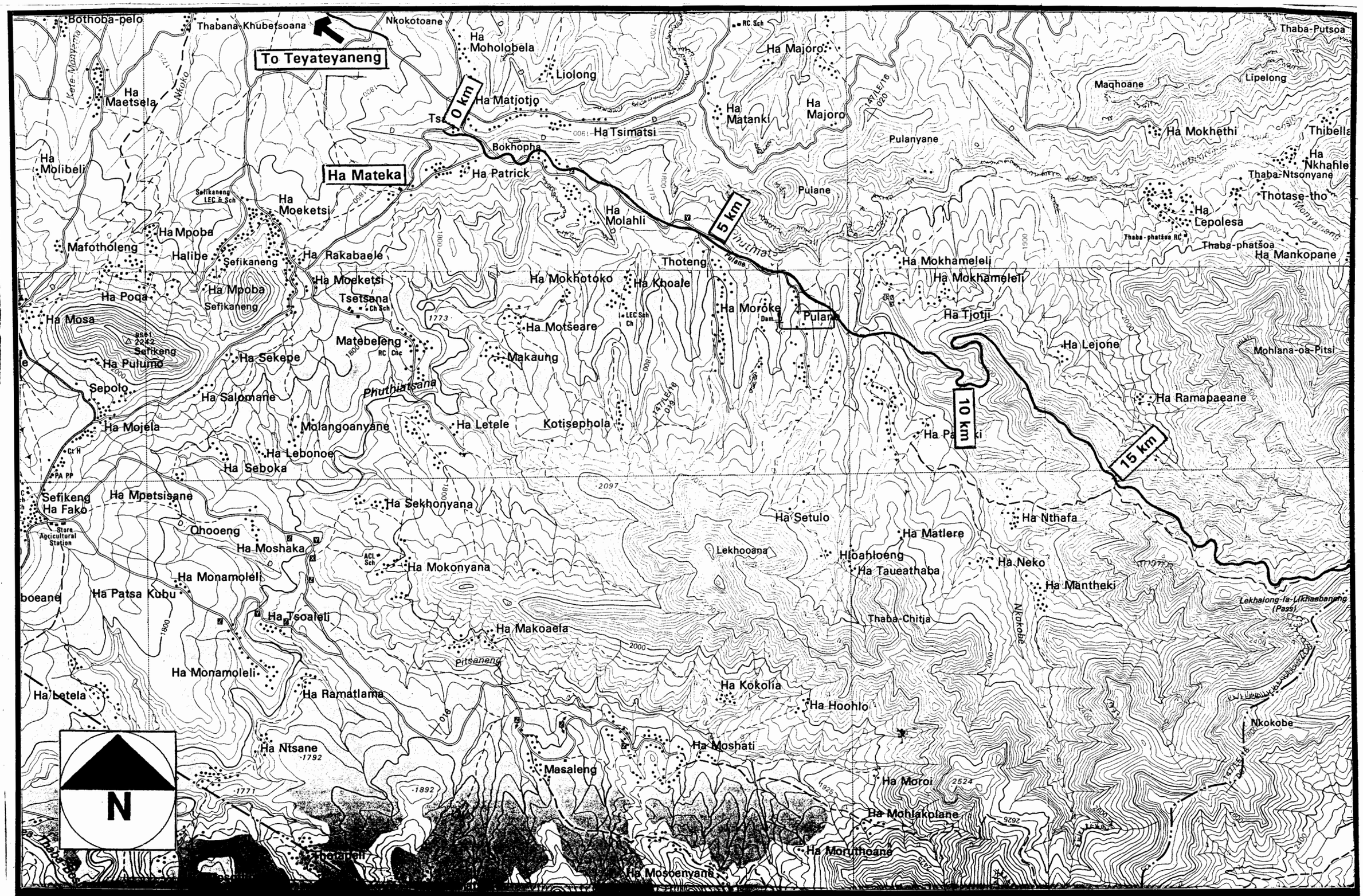


MAP 2f) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

CHAPTER 1.
INTRODUCTION

1.1 Purpose of this report:

This report has two main functions. Firstly, it is an academic report, written in partial fulfilment of the requirements for the degree Master of Philosophy in Environmental Science. The content of the report must demonstrate the competence of the writer in undertaking work in the field of environmental impact assessment. Secondly this report is an environmental evaluation that must draw on the information in the impact assessments of the Western Access Route (WAR) and the Least Cost Alternative Route (LCAR) to recommend which of these alternatives should be constructed as an access road to the Mohale Dam. The Mohale Dam is being built as part of Phase 1 of the Lesotho Highlands Water Project (LHWP).

This report will not be used as a decision-making tool as it will not be given to the proponent of the Mohale Dam access roads. It is, however, written according to the requirements for such a decision-making document.

In order to recommend one of the alternative routes, the impacts associated with the two routes will be compared and evaluated to determine which route provides the greatest nett benefit to society.

In the course of evaluation of alternative routes, the process followed in the impact assessments of the routes will be reviewed in the light of current environmental impact assessment theory. It will be determined whether the process that was followed is adequate, to the degree that it accords with the principles of this theory. Deficiencies in the assessments will be highlighted and the implications of this for the study will be discussed. Any additional studies that should be carried out before the implementation of the project will be identified and recommendations will be made

about measures to mitigate negative impacts and optimise positive impacts of the chosen route.

This report will be written as a stand-alone document that can be read and understood on its own without the necessity for constant reference to the contents of the impact assessments of the WAR and LCAR.

1.2 Background to the report:

The Mohale Dam is situated in the interior of Lesotho on the Senqunyane River (see Map 1). It is expected that the construction of the dam will commence in mid-1997. The proponent, the Lesotho Highlands Development Authority (LHDA), needs a road for the transport of construction materials and labour to the dam site from the Lesotho-South Africa border. The objective of the road is not only to provide access to the dam site, but also to enhance the existing road network within Lesotho (LHDA, 1986).

There are two proposed alternative routes for the access road to the dam. One of these is the existing "Mountain Road" or Western Access Route (WAR) which runs from Maseru on the western border of Lesotho, past the dam site to Thaba-Tseka in the interior of Lesotho (see Map 2). The use of this route would necessitate upgrading of the existing road from the village of St. Michael's to the village of Patiseng near the dam site, a distance of 60.4 km. A bypass would also be constructed around Maseru in order to carry construction traffic to the Mohale Dam if this route goes ahead.

The other proposed route, the Least Cost Alternative Route (LCAR), runs from the Ficksburg/Maputsoe border post and joins the Mountain Road at the village of Mafotholeng near the dam site (see Map 2). The section of this route from Maputsoe through Teyateyaneng to the village of Ha Mateka already exists and requires no upgrading, but there is currently no road through the Jorodane Valley

List of Maps

List of figures

List of tables

Impact Summary Tables:

List of appendices

Glossary and Abbreviations

Chainage The position along a route, measured in kilometres, from its starting point. In the case of the Western Access Route, the starting point is St. Michael's. In the case of the Least Cost Alternative Route, the starting point is Ha Mateka.

EEU Environmental Evaluation Unit

EIA Environmental Impact Assessment, the process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.

GBJV Gibbs Bergman Joint Venture, the joint engineering consultancy responsible for the design of the LCAR and WAR.

ha Hectares. One hectare is equal to 10000 m^2, an area equivalent to 100 m by 100 m.

IEM Integrated Environmental Management, the procedure of the Department of Environment Affairs which is designed to ensure that environmental considerations are integrated into all stages of the development process in order to achieve a balance between conservation and development.

I&AP's Interested and affected parties, meaning anyone who has an interest in the development proposal or who could be affected by it.

IUCN International Union for the Conservation of Nature and Natural Resources

LCAR Least Cost Alternative Route

LHDA Lesotho Highlands Development Authority

LHWP Lesotho Highlands Water Project

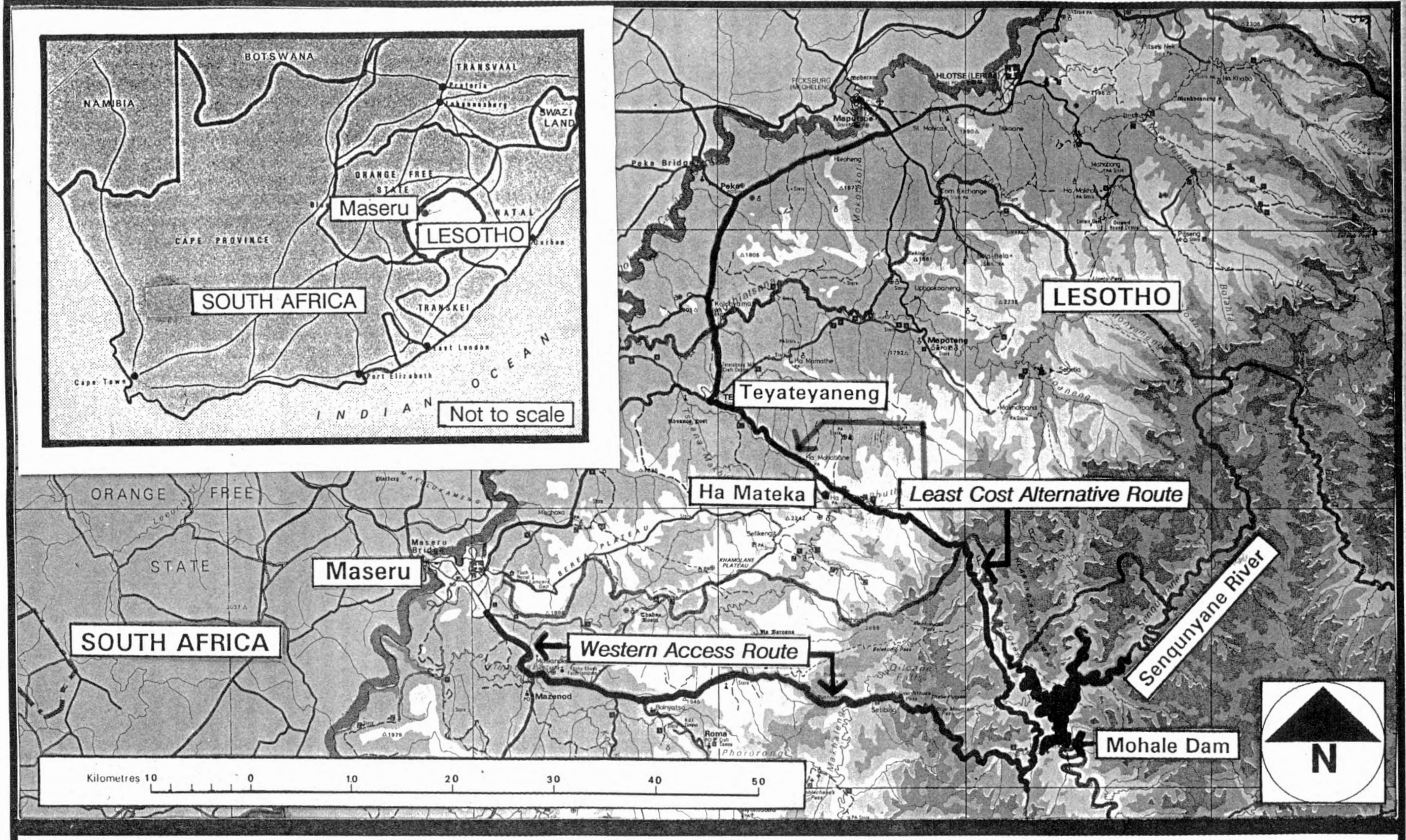
m Metres

Potable Suitable for drinking

SIA Social Impact Assessment

Sidespoil Excavated, unusable rock material (spoil) that is generated by excavations for road construction, and is dumped down the slope below the road.

WAR Western Access Route



MAP 1. LOCALITY MAP

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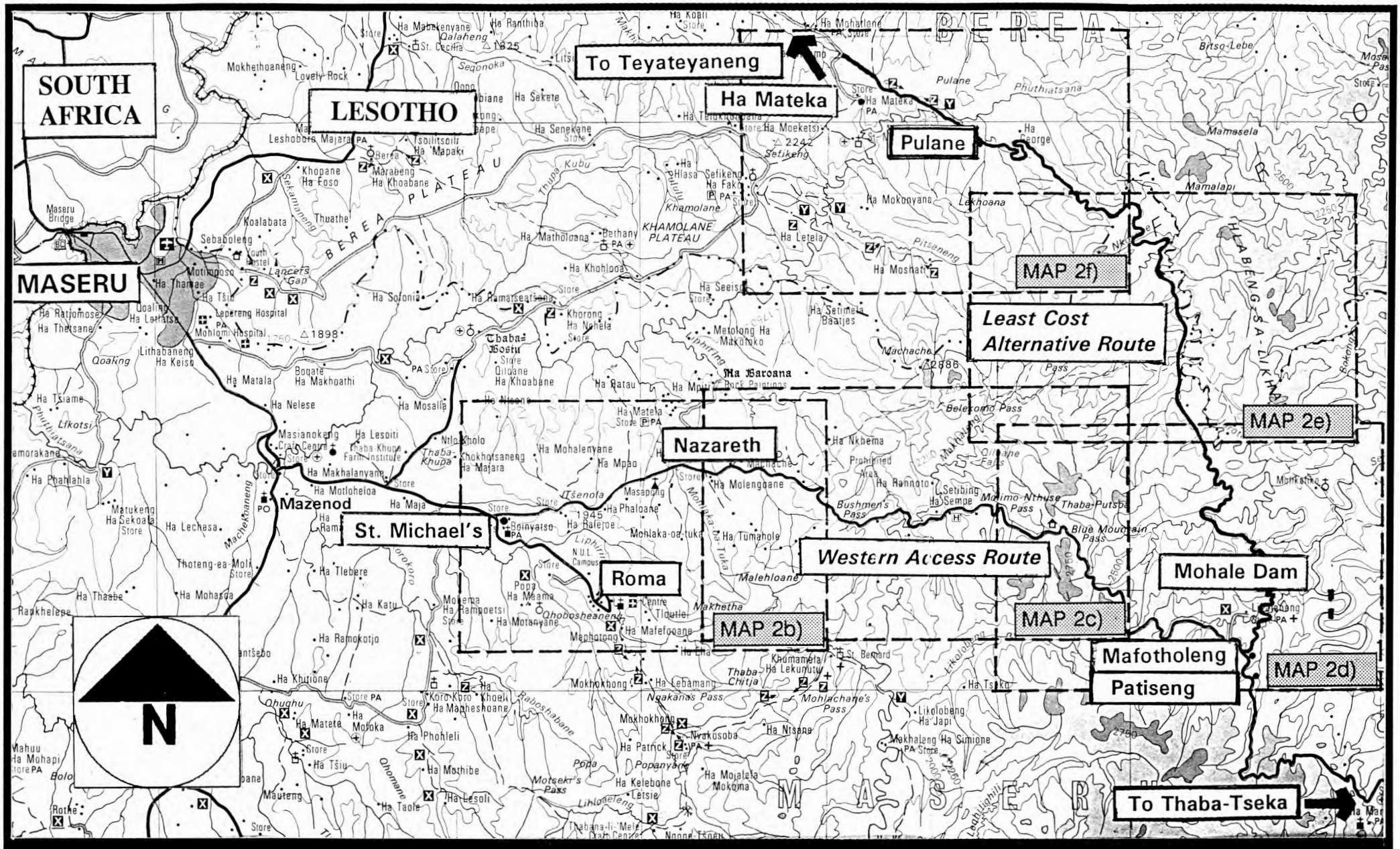

MAP 2a) POSITIONS OF ROUTES

from Ha Mateka to Mafotholeng. This latter section of the route would therefore entail the construction of a completely new road with a length of 55 km.

The impact assessment team of the Environmental Evaluation Unit (EEU), which conducted the assessments of these routes, consisted of nine Environmental Science Masters students, and included the author of this report. The masters students did the impact assessments as part of the requirements for their degree.

1.3 Terms of reference:

The contract for the design of the access road to the Mohale Dam (Contract LHDA 1000) was awarded to consulting engineers Gibbs-Bergman Joint Venture (GBJV) by the proponent, the LHDA. GBJV consists in equal proportion of Sir Alexander Gibb & Partners of Lesotho and B. S. Bergman & Partners of South Africa. The EEU was appointed in January 1993 by GBJV to conduct impact assessments of the WAR and the LCAR.

The terms of reference agreed between GBJV and the EEU (EEU, 1993a: 3) state that the following tasks should be carried out as part of the impact assessments of the WAR and LCAR:

- prediction of all negative and positive impacts on the biophysical and socio-economic environments along the LCAR and WAR;
- identification of and consultation with people who are likely to be affected by the road, to obtain their views and concerns regarding the roads;
- assessment of each of the identified impacts for their overall significance;
- recommendation of compensation requirements and mitigation for significant negative impacts;
- recommendation of optimisation measures for significant positive impacts.

1.4 Relationship of this report to other reports:

The first study by the EEU was done to determine which of eight alternative corridors for the LCAR was to be compared with the WAR. This was carried out as an initial desk-top study (EEU, 1993b) over a period of two weeks. Both the proponent and the impact assessment team were of the opinion that the corridor from Ficksburg/Maputsoe and through the Jorodane Valley was the preferred route for the LCAR.

This desktop study was followed by separate impact assessments of the WAR (EEU, 1993a) and LCAR (EEU, 1993c), which were completed at the end of April 1993. These assessments involved assessment of the biophysical and socio-economic impacts of the proposed roads. Social surveys were conducted along the WAR, LCAR and along the existing road to the Katse Dam to identify social impacts. It should be noted that the impact assessment of the LCAR only covers the section from Ha Mateka to Mafotholeng as this is the only section of the route that would require construction work. The rest of the route already exists and requires no upgrading. The environmental impact assessments of the LCAR and WAR form the foundations of this report.

This report will synthesise and evaluate the information presented in the impact assessments of the WAR and LCAR to determine which of these two routes should be recommended for detailed design and construction (see Figure 1, page 5).

The study team involved in the WAR and LCAR assessments also conducted impact assessments of the Resident Engineer's Camp and access roads 1 and 2 to the dam site (EEU, 1993d). These assessments will be ignored for the purposes of this report as the resident engineer's camp and access roads 1 and 2 will be constructed regardless of the which of the two main routes (WAR or LCAR) is chosen.

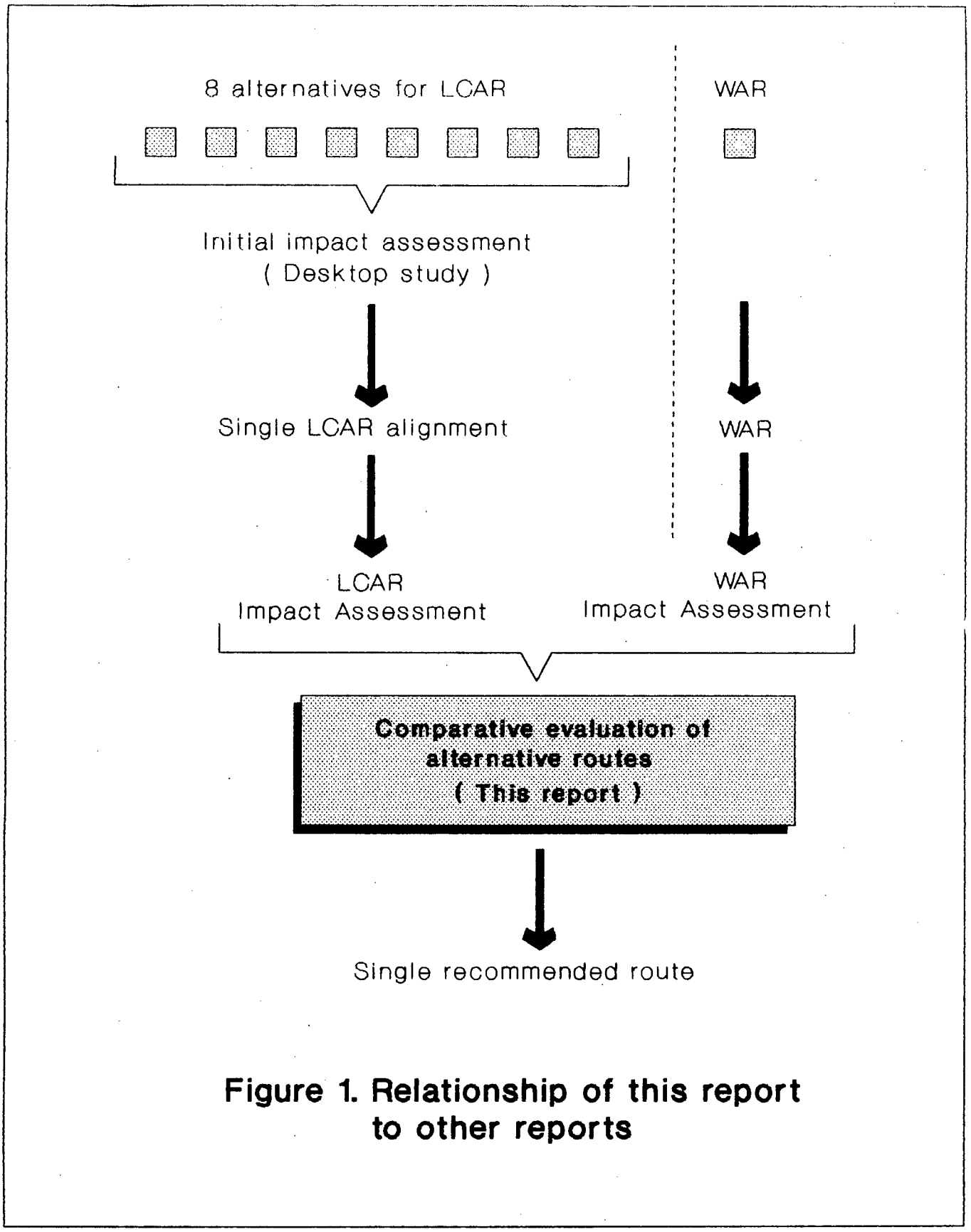

Figure 1. Relationship of this report to other reports

1.5 Approach to the study

The main objective of the evaluation process is to make a recommendation about whether the WAR or the LCAR should be constructed as an access route to the Mohale Dam. The impacts of the alternative routes, as set out in the individual impact assessments of these routes, are to be used to compare the routes and evaluate which route has the greatest nett benefit. Evaluation is based on the information on socio-economic and bio-physical impacts in the impact assessment reports. The cost of road construction and operation will also be a decision criterion. If the recommended route is more expensive than the rejected one, it will be considered whether the saving in environmental costs outweighs the extra financial costs of the recommended route.

The method of comparing and evaluating the routes will be non-quantitative. A framework method of assessment, in which the main impacts of alternatives are listed in a tabular format, will be used. The framework will then be used in an evaluation procedure. The evaluation procedure will test the compliance of the alternatives with three evaluation criteria of efficiency, equity and sustainability.

The adequacy of the impact assessment process will also be judged with reference to impact assessment theory. The content of the impact assessments will be changed only if identified deficiencies are considered important enough to have an influence on the outcome of the decision.

1.6 Report structure:

This report is divided into five chapters:

Chapter 1 describes the purpose of the report and provides a general background to the study. This section also includes the terms of reference for the impact assessments of the LCAR and WAR.

Chapter 2 is a description of the affected environment of the routes.

Chapter 3 is a review of the impact assessment process that was carried out for the WAR and LCAR in terms of theoretical literature about impact assessments.

In chapter 4 the LCAR and WAR are evaluated. The methodology of the evaluation is described and the impacts of the routes are compared to one another. A recommendation is made indicating which of the two alternative routes should be constructed.

Chapter 5 concerns mitigation of negative impacts and optimisation of positive impacts. The impacts which are most important to mitigate or optimise are identified in this chapter.

Chapter 6 includes the most important conclusions and recommendations arising from the preceding chapters. An assessment is given of the adequacy of the studies that have been done, and recommendations are made about further studies that may be necessary to supplement the existing reports. It is also recommended which impacts are most important to mitigate.

CHAPTER 2.
DESCRIPTION OF THE AFFECTED ENVIRONMENT

In accordance with the way in which impacts are structured in the impact assessments of the LCAR and WAR, the affected environment is divided into bio-physical, socio-economic and policy and planning aspects.

2.1 Bio-physical environment:

Geology and terrain: Lesotho can generally be divided into two zones on the basis of topography. There is a relatively flat lowland zone in the western part of the country and a very mountainous highland zone in the eastern part of the country. The boundary between the lowland and highland zones is approximately 1800 m above sea level, and the highlands can reach heights up to 3480 m. The lowlands are underlain by soft mudstones and shales of the Elliot formation with many flat-topped hills, the crests of which are composed of relatively hard sandstones of the Clarens Formation. The highlands are underlain by basalt of the Lesotho Formation.

Rainfall and hydrology: Precipitation in the study area occurs throughout the year, but is mostly in the form of intense summer thunderstorms of short duration. The mountainous zone can also receive considerable amounts of snowfall in winter. The mountains in the study area receive an average of 900 mm or more precipitation per annum, and the lowlands receive in the region of 700-800 mm. Most of the highland streams in the study area are fed by wetlands occurring at high altitudes in the mountains. Due to the intense nature of summer rain, rain is usually followed by short and intense flood events that are also marked by a considerable increase in the silt loading of rivers.

Biotic Environment: The natural vegetation of the area is short grassland with a few small isolated patches of scrub forest in mountainous areas. Most of the natural vegetation is under severe threat. Due to cultivation little of the natural vegetation in the lowlands remains, and the grassland in the mountainous regions is also extremely

degraded due to heavy overgrazing. The theoretical carrying capacity of the veld is estimated to be exceeded by as much as 200 percent. Another major source of degradation is the autumn burning of Broom grass (*Merxmuellera macowanii*) in wetlands for the provision of more palatable grazing.

Overgrazing, in combination with cultivation and hunting, has also severely depleted the indigenous fauna of Lesotho, and very few large mammals remain. Many large birds of prey such as bearded vulture, cape vulture and black eagle are under severe threat because of poaching.

Land use: The lowlands are intensively cultivated with maize and sorghum due to the favourable flat topography. Human population density is relatively high in the lowlands. The highland areas are less cultivated because of the steeply sloping nature of the terrain, with limited cultivation in the valley floors and on the sides of the valleys. Most of the highland areas are used for extensive grazing, which involves transhumance to the highest-lying areas in summer and to lower-lying areas in winter. The highlands are sparsely populated, with small isolated rural villages occurring mostly on north-facing valley slopes.

2.2 Socio-economic environment:

General: Lesotho has a very weak economy which can be considered peripheral to and dependent on the economy of South Africa. Thirty six percent of the population is employed, representing 65 percent of the total potential labour force. Migrant labour makes up 15 percent of the labour force, indicating the dependence of the Lesotho economy on South Africa. The majority of the population of Lesotho (80 percent) are still rural. Almost all the people along the WAR and LCAR lead a rural lifestyle.

One of the greatest problems of the Basotho people is poverty. Lesotho has a great inequality of resource distribution, with the result that those who are unemployed have become even poorer over the past ten years (Sechaba, 1991). This poverty is

least discernable in Maseru and the rest of the western lowland areas of Lesotho. Poverty becomes greater as one moves eastward and is most severe in the highlands (Setplan, 1990), which includes the area of the Mohale Dam and a significant part of the routes of the LCAR and WAR. People in the highlands also more unequal access to development opportunities compared to people in the lowlands.

According to Sechaba (1991), a socio-economic consultancy, other significant problems in Basotho society, in order of importance, are :

- lack of food;
- lack of good water supply;
- unemployment;
- lack of roads and transport;
- lack of money;
- lack of medical facilities;
- lack of household and personal possessions;
- lack of latrines;
- lack of good housing and building materials;
- lack of livestock;
- lack of fields.

The Least Cost Alternative Route:

The catchment area of the Jorodane River through which the LCAR passes contains 15 villages of more than 100 inhabitants and 33 villages of less than 100 inhabitants (EEU, 1993c: 21). The lowland section of the route from Ha Mateka to the Lekhalong-la-Likhaebaneng Pass is relatively densely settled and intensively cultivated. The section from the top of the pass and down the length of the Jorodane Valley is more sparsely populated. Villages are small and isolated, with small scale cultivation of crops.

The economy is rural, with the one of the most important sources of income being migrant labour (70 percent of those employed are migrant labourers) which provides

an income to 33.1 percent of the surveyed population. The sale of informal cash crops (dagga) is also very important as 64.9 percent of the population are dependent on it for income. In total 14.8 percent of the adults in the area are formally employed (EEU, 1993c: 21). Most households in the valley cultivate maize and wheat to meet their subsistence needs.

The major problems experienced by households, in order of decreasing importance are hunger, lack of clothing and lack of employment. The major problems facing villages, in the same order, are poor access to clinics, lack of transport, poor water quality and lack of standpipes, poor access to shops and lack of food (EEU, 1993c: 20-21).

Stock theft was mentioned as a problem by 92 percent of respondents to the social survey. Another major source of conflict related to stock concerns areas of seasonally reserved grazing (*maboelleng*) in the valley that are used by outsiders from the lowland area around Pulane who bring their cattle to the valley for summer grazing. This causes clashes between locals and outsiders and sometimes even results in death.

There is presently no road in the Jorodane Valley, and transport is mainly on foot, by donkey or on horseback.

The Western Access Route:

The total population in a 2 km wide corridor on both sides of the WAR that may be affected by the road consists of 13 villages of more than 100 inhabitants and 20 villages of less than 100 inhabitants. The highland section of the route from Bushmen's Pass (Lekhalong-la-Baroa) to Patiseng is relatively sparsely populated in comparison to the lowland section. Villages in the lowland section such as Ha Ntsi and Nazareth are also more semi-urban in appearance than villages along the highland section of the route.

The villages along the WAR generally suffer from inadequate services, economic underdevelopment and a lack of higher order services such as high schools, post offices, banks and petrol stations. This is reflected in the major problems affecting households, the most important being, in order of decreasing importance: hunger, lack of clothing and unemployment. The most important problems facing villages along the WAR are stock theft and shortage of potable water (EEU, 1993a: 20).

The major source of employment in the area is migrant labour. Migrant labour provides 13.9 percent of surveyed households along the WAR with an income. Most of the migrant labourers are employed in South Africa (EEU, 1993a: 20). A very small number of people own small businesses in the villages next to the road. Others maintain themselves through subsistence farming.

The existing WAR is an important transport route for locals to and from Maseru, but the available public transport is inadequate. There are only four buses per day that do not operate at night. Taxis only operate as far as Nazareth.

2.3 Policies and planning:

National planning objectives:

The primary objectives of the Fifth Five Year Development Plan (Ministry of Planning, 1993) are:

- The alleviation of poverty;
- The promotion of equity and justice;
- The generation of more productive job opportunities;
- Achieving an adequate level of sustainable economic growth, with emphasis on economic management.

Lesotho road network:

The quality of roads in the lowlands is generally much higher than the quality of roads in the highlands. Other problems of the road network are that many of the roads in are still unpaved and impassable during the wet season, and that many rural

areas are inaccessible to vehicles because of the absence of roads. This situation is exacerbated by the fact that the Lesotho Roads Department is only allocated a fraction of its financial needs, with the result that many roads fall into disrepair from lack of maintenance.

The Fifth Five Year Development Plan has prioritised the upgrading and reconstruction of a number of roads in Lesotho, one of which is the road from St. Michael's to Thaba-Tseka, a distance of 150 km. The 60.4 km of the WAR form part of this road.

Settlement Planning:

The main aim of the government settlement planning is to promote balanced settlement development and protect natural resources affected by settlement development (Ministry of the Interior, Land Surveys and Physical Planning, 1990). The present settlement pattern of Lesotho is unbalanced because of the contrast between the rapid growth of Maseru in the Lowlands and the very limited development of highland settlements. The settlement policy calls for the promotion of settlement development in underserviced areas in the highlands. This can only be achieved by harmonising road plans with the settlement policy proposals.

CHAPTER 3.
REVIEW OF THE IMPACT ASSESSMENT

3.1 Aims of review:

The main aims of reviewing the process and contents of the impact assessments are:

- to determine whether the impact assessment that was carried out accords with the theory and principles of environmental impact assessment theory;
- to determine the adequacy of the study and implications of deficiencies in the study, so that, if necessary, the assessment can be reapplied at a later date with the necessary improvements.

The impact assessments that were carried out will firstly be compared to the principles and procedure of Integrated Environmental Management (IEM).

3.2 Comparison of study with IEM procedure:

3.2.1 IEM procedure

Integrated Environmental Management is a procedure to ensure that environmental considerations are incorporated into the decision-making process of development proposals. The purpose of IEM is to mitigate negative impacts and enhance positive impacts of development proposals (Department of Environment Affairs, 1992).

IEM is a procedure developed specifically for development proposals in South Africa. No similar procedure exists in Lesotho, and there are no legal mechanisms to ensure that major development proposals in Lesotho are subject to environmental impact assessments as is required by IEM. It is therefore appropriate to compare the study with the South African IEM procedure.

The basic principles of IEM are (Preston, Fuggle & Robins, 1992: 749):

- Informed decision-making;
- Accountability for decisions and the information on which they are based;
- An open, democratic and participatory approach, with consultation with all interested and affected parties (I&AP's);
- A broad understanding of the term "environment" to include physical, biotic, social, economic and political components;
- An attempt to mitigate negative impacts and enhance positive impacts of development proposals;
- Pro-active and positive planning.

The IEM procedure consists of 3 stages (see Figure 2, page 17):

- Stage 1: Plan and assess proposal
- Stage 2: Decision
- Stage 3: Implementation

The impact assessments of the LCAR and the WAR would form part of stage 1 in the IEM procedure. The project has not yet been subjected to stage 2 or 3 in the procedure.

Stage 1: Plan and assess proposal

During Stage 1 of IEM a development proposal is put forward by the developer and the proposal is assessed to determine whether it is likely to have significant impacts on the environment. A key principle of stage 1 is that there should be environmental input to the proposal from the time of its inception and that environmental considerations should not be an addition to the project after design of the proposal is complete.

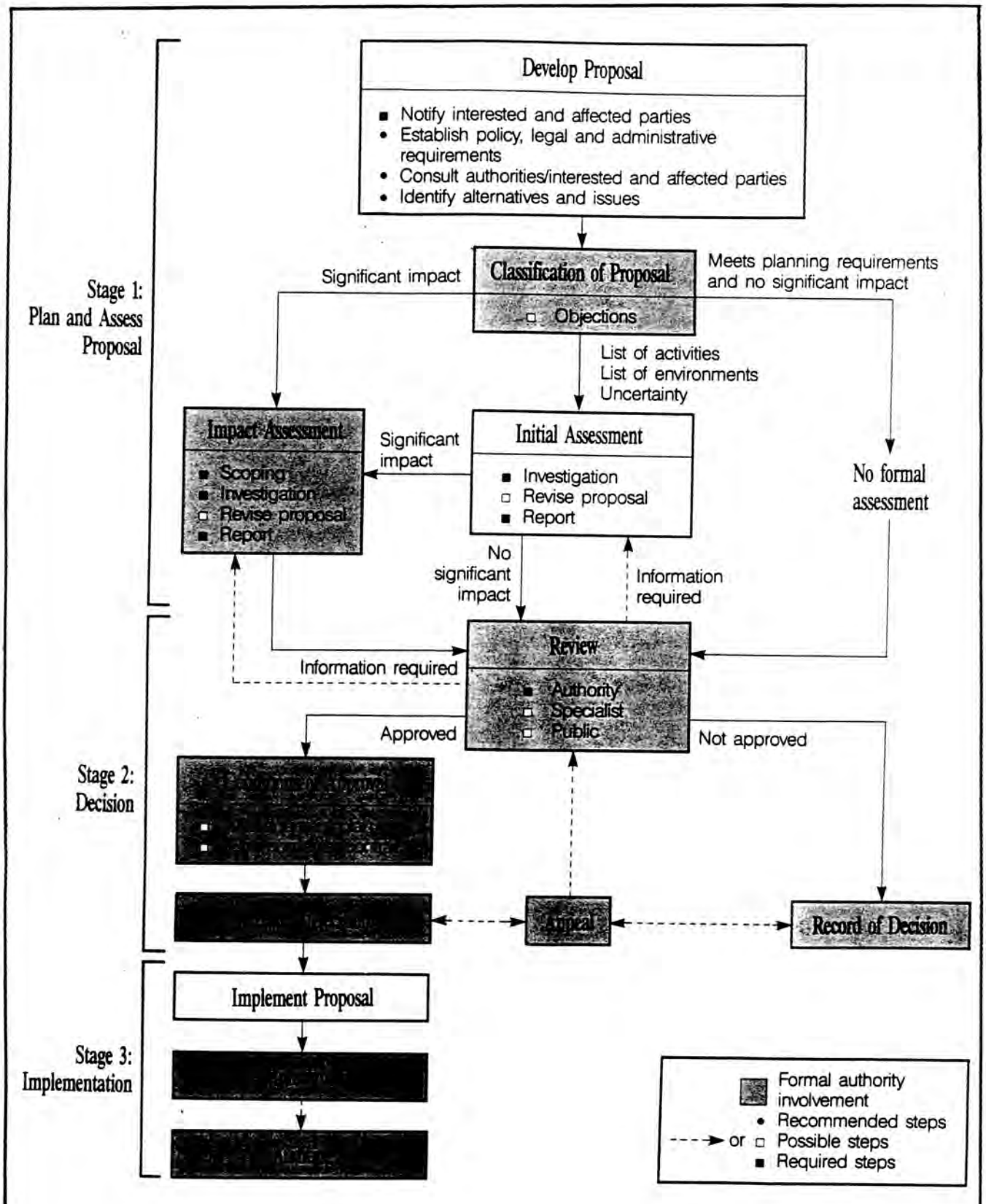

Figure 2. The Integrated Environmental Management procedure
(From: Department of Environment Affairs, 1992)

The recommended steps in stage 1 are:

- Establishing policy, legal and administrative requirements for the proposal;
- Notify I&AP's and discussing the proposal with I&AP's and relevant authorities;
- Identifying and considering environmental issues and possible alternatives;
- Identifying actions to optimise and mitigate impacts.

During stage 1 the proposal is classified into one of three possible routes of assessment depending on the nature of the proposal and the environmental attributes it is likely to affect. The proposal can go the route of "No formal assessment" if it will clearly not result in significant adverse impacts. The proposal can be subjected to an "Initial assessment" if there is uncertainty over the nature of impacts and to a full "Impact assessment" if it is clear that the project will cause significant impacts (Preston *et al*, 1992).

Stage 2: Decision

During stage 2 a decision is made by the relevant decision-making authority as to the desirability of the proposal. The authority has to be satisfied that the proposal complies with legal requirements and that, if necessary, an assessment of appropriate depth and adequacy has taken place. The decision-maker may set certain conditions for the approval of the proposal, such as the nature of mitigatory actions and the content of an environmental management plan. A publicly accessible record of the decision should be kept. IEM also makes provision for appeal against the decision by the proponents or other I&AP's (Preston *et al*, 1992).

Stage 3: Implementation

The project is implemented after a decision has been made. Implementation may be subject to conditions of approval such as an environmental management plan and an environmental contract that are stipulated by the decision-maker. To ensure that the project is implemented according to the agreement and to check the accuracy of predictions, monitoring of all approved projects is required. Implementation can also include periodic audits to reassess the project in the light of new developments since its implementation and to test the efficacy of the application of IEM (Preston *et al*, 1992).

The conduction of the impact assessments of the LCAR and WAR will now be compared to the principles and methods of IEM theory.

3.2.2 Agreement of the study with IEM procedure:

Stage 1: Plan and assess proposal

The project was carried out according to the principle that environmental input should start as early as possible in the project cycle. The assessment team were involved in the project from the stage of selection of alternative road corridors and also during the preliminary design of road alignments.

Policy requirements were assessed through reference to official government transportation policies such as those contained in the Five Year Development Plan (Ministry of Planning, Economics and Manpower Development, 1993) and in the National Settlement Policy (Ministry of the Interior, Land Surveys and Physical Planning, 1990). Administrative requirements were not included in the assessment since the proponent (LHDA) is also the government body responsible for the administration of the project.

The assessments were undertaken in accordance with the requirements for an "Initial Assessment" in the IEM procedure because of the preliminary nature of

the design and the high possibility of subsequent change in the design. The assessments of the alternative routes were done as separate reports on request of the client instead of a single document as preferred by the impact assessment team.

It was not possible to notify I&AP's of the proposal during the initial desk-top study of two weeks (EEU, 1993b) because of time constraints. This means that I&AP's were not in a position to suggest alternative corridors to the eight alternatives that had been narrowed down to a single "LCAR". I&AP's were contacted hereafter during the impact assessments of the LCAR and WAR and contributed to the assessment by highlighting those issues which they felt important for the impact assessments of the WAR and LCAR. Social impacts were identified through social surveys among the affected people along the two routes. These surveys consisted of structured questionnaires and informal interviews. Bio-physical impacts were identified during 4 days of field trip along the WAR and 5 days of field trip along the LCAR.

All impacts were assigned ratings of magnitude and significance. Mitigation for negative impacts and optimisation for positive impacts were identified during the assessments and recommended in the assessment reports where the specific impacts are discussed.

Stage 2: Decision and Stage 3: Implementation

The decision and implementation stages of the IEM procedure have not yet taken place. The decision will be partially based on the impact assessments of the WAR and LCAR, but will also probably be heavily influenced by the financial costs of construction of the roads and transportation costs for the roads. These costs were not included in the impact assessments of the routes. The decision will be made by the Joint Permanent Technical Commission (JPTC), which consists of equal proportions of Lesotho and South African members. Road construction is expected to start in the middle of 1994.

3.3 Investigation and assessment of impacts:

In this section the method of investigation and assessment of impacts will be appraised. The ideal requirements for the investigation and assessments of impacts put forward by Fuggle (1992: 767) will be used for this appraisal. These requirements are, *inter alia*:

a) assessment of the significance of measured or postulated impacts;
b) explicit statement of the criteria and assumptions employed to assess significance;
c) indication of the degree of confidence in the prediction of impacts;
d) identification of areas of potential risk or hazard, i.e. impacts with high significance but low probability of occurrence;
e) allowance for the comparison of alternatives, including the no-project alternative;
f) clear and unambiguous indication of weighting systems that may be used to aggregate impacts or place them in a rank order.

The method according to which impacts were assessed in the study is as follows (EEU, 1993a: 31-32):

A rating of **magnitude** and **significance** was assigned to each impact. Magnitude is defined as a measure of the size and extent of the impact. Where possible, this was expressed in quantitative terms, e.g. m^2 of land affected or number of houses affected. Significance of the impact was considered to be its importance in the light of the values of society. The judgement of significance of each impacts was therefore acknowledged to be subjective. In order to limit the degree of subjectivity involved in significance ratings, the following criteria were used as a guide for the judgement of significance. Significance of an impact was defined to be affected by the degree to which the impact:

- affects public health and safety;
- affects the overall well-being of people, and the number of people affected;
- involves impacts which are irreversible;
- will have effects over long time periods;

- affects or furthers national goals or local interests;
- affects environmental qualities, goods or services which are of special or unique character, in limited supply and/or essentially irreplaceable;
- may establish a precedent for future action;
- results in cumulative or synergistic effects;
- has the potential for optimisation or mitigation.

One of three significance ratings, namely *low, moderate* or *high*, were assigned to each impact. The significance rating of the impact with and without mitigation or optimisation was stated were the impact was discussed in the report.

Significance was judged by the individual in the impact assessment team who was most involved with the assessment of the impact under consideration. There is, therefore, a measure of personal bias in the rating of significance.

The extent to which the methodology for assessment of impacts meets Fuggle's theoretical requirements for the investigation and assessment of impacts will now be considered.

Requirement a): Assessment of significance

It is obvious that requirement a), the assessment of significance, has been met.

Requirement b): Explicit statement of criteria and assumptions for assessment of significance

Requirement b) has been met only partially. Although an explicit list of criteria has been provided in the section on assessment methodology, the basis on which the significance rating of each individual impact has been determined is not stated where that impact is discussed. Thus, while the use of criteria in the determination of significance is **implicit**, it is not made **explicitly** clear which criteria were used to determine the significance rating of individual impacts. There is, therefore, a measure of subjectivity in the rating of significance.

It must be noted that subjectivity is an essential and unavoidable characteristic of any EIA. Beanlands (1983), for instance, makes it clear that social ("value-laden") inputs are more important than technical ("value-free") inputs during the evaluation of impacts (see Figure 3 below). However, the values that are used to evaluate impacts must be made as explicit as possible so that the conclusions of the study are replicable by another person using the same value judgements. This is not possible with the assessments of the LCAR and WAR because the criteria which have been used to judge the significance of each impact have not been stated.

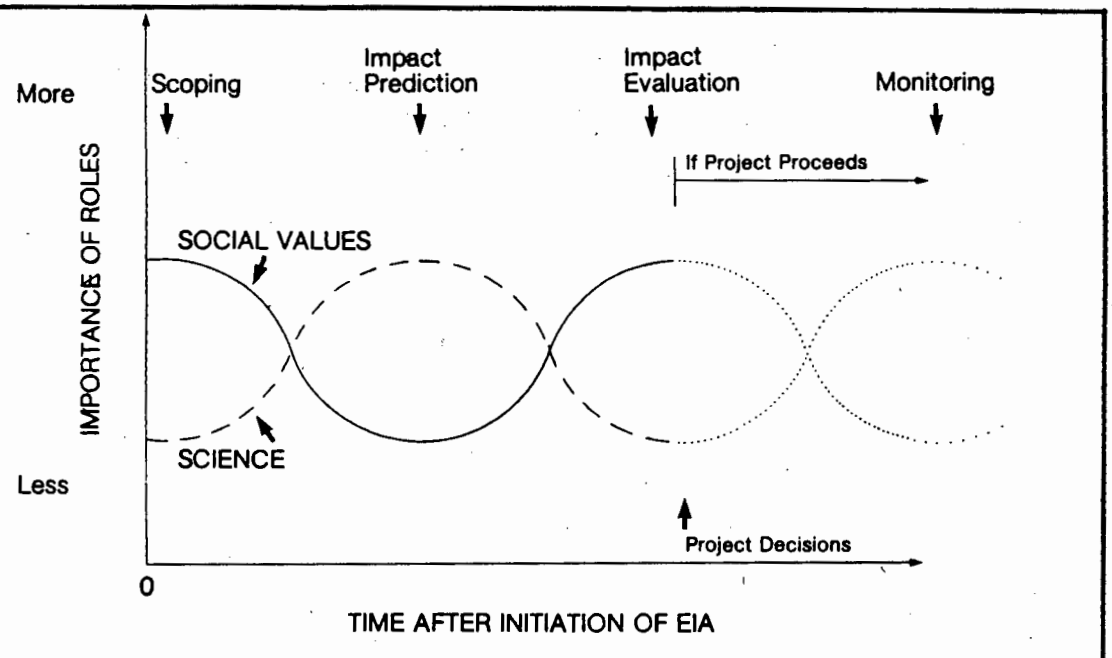

Figure 3. The relative importance of the roles of science and of social values in EIA
(From: Beanlands, 1983)

Another problematic aspect of the significance ratings is the scale or extent of impacts. Certain impacts that occur at widely differing scales have the same significance. In the WAR report for example, the impacts *Reinforcement of national road network plans* and *Interference with potable water supplies* have both been rated highly significant. Yet the first impact is at a national scale and the latter one at the level of local villages and households. The rating of impacts without stating the scale at which they are significant is problematic because readers might infer that equal significance implies equal scale.

The issue of significance rating is considered to be particularly important to the adequacy of the study since impacts of highest significance are likely to be used for decision-making.

Requirement c): Statement of degree of confidence in prediction

The method of assessment of impacts fails with regard to requirement c). The degree of confidence in the prediction is important for certain impacts such as river siltation along the LCAR. The degree of confidence in the prediction of this impact must be low because the location of borrow pits and quarries for this route has not yet been decided. If they are located near the Jorodane River, the degree of siltation in the river could be much higher than expected (this impact is discussed in more detail in section 3.5.4 below).

Requirement d): Identification of areas of potential risk or hazard

Although the impact assessment team was alert to impacts of high risk or hazard, no such impacts were identified during the study.

Requirement e): Comparison of alternatives, including the no-project alternative

The assessment meets requirement e). Two possible alternatives were assessed. In the case of this project the no-go alternative was not an option because a road to the dam site is absolutely essential for the transport of materials to the dam, and because existing roads to the dam are in too bad a condition to carry the extra traffic load of construction vehicles to the Mohale Dam.

Requirement f): Indication of weighting systems

Requirement f) does not apply to this study since the terms of reference for the assessments did not require weighting.

3.4 Scoping

Scoping is defined as the procedure for determining the extent of and approach to an impact assessment. Scoping should focus the assessment on reasonable alternatives and relevant issues (Department of Environment Affairs, 1992). The most important principles of scoping are the following:

- involvement of relevant authorities and I&AP's;
- identification and selection of alternatives;
- identification of significant issues to be examined in the impact assessment;
- determination of specific guidelines or terms of reference for the impact assessment.

It will now be considered whether and to what extent these principles were adhered to in the impact assessments of the LCAR and WAR.

3.4.1 Involvement of relevant authorities and I&AP's:

Due to time constraints during the initial desktop study of the eight alternatives for the LCAR corridor, it was not possible to involve I&AP's during this stage of the study. As many I&AP's as time allowed were consulted during the impact assessments of the LCAR and WAR. Most I&AP's were consulted through personal interviews or through telephonic interviews where the former were impossible. Further I&AP's were identified through a chain referral system.

3.4.2 Identification and selection of alternatives:

Because of the fact that I&AP's were not consulted during the initial desktop study of alternatives for the LCAR, it was not possible for I&AP's to suggest alternative routes. All the alternatives that were assessed during this initial study were proposed by the proponent. However, this is not a major problem for the assessments because of the difficult nature of the terrain through which a road to the Mohale Dam has to pass. The terrain is extremely mountainous, with the result that the number of technically feasible routes to the Mohale

Dam is limited. The number of existing roads to the area of the Mohale Dam is also severely limited. Thus, the alternatives suggested by the proponent probably represent the full range of feasible alternatives, and the fact that no alternatives were identified by I&AP's is not a limiting factor for the study.

3.4.3 Identification of significant issues to be examined in the impact assessment:

The significant issues in the assessment were identified through consultation with I&AP's and relevant experts. The social surveys along the road to the Katse Dam, the LCAR and WAR served to identify the issues of main concern to the local inhabitants along the routes. Because the road to the Katse Dam already exists, the survey along this road helped to identify which of the concerns of local inhabitants along the other routes were well-founded. This helped in focusing the impact assessment on those issues which could be realistically expected to occur.

3.4.4 Determination of specific guidelines or terms of reference for the impact assessment:

No specific guidelines or terms of reference were identified by I&AP's who were consulted during the impact assessment process.

3.5 General factors which potentially limit the findings of the assessments

This section deals with specific problems of the impact assessment which may influence its adequacy.

3.5.1 Scope of the study:

The impacts caused by the construction and presence of the Mohale Dam were not included in the terms of reference for the impact assessments of the access roads to the dam. No impact assessment of the dam has been done to date. This causes a problem for the study because the significance of some impacts caused by the roads will diminish when considered in the context of the dam

and its related infrastructure such as the dam engineer's construction offices and dam construction labourer's villages. Thus, impacts of the road that have been assigned a high significance might have a low significance when considered in the context of the dam and its related infrastructure.

It was also not possible to consider the combined and synergistic impacts of the road and dam. For instance, the combined loss of agricultural land in the Jorodane Valley due to the Mohale Dam and the LCAR would be very large.

This does not invalidate any of the findings of the impact assessments of the LCAR and WAR. However, it means that if significance levels are assigned to impacts in the EIA of the Mohale Dam, these should not be equated with significance levels of the impacts of the Mohale Dam access road.

3.5.2 Preliminary nature of the design:

The impact assessment team was involved in assessments at an early stage in the design of the roads. The assessment started during the selection of route corridors at a 1:50000 scale and continued during preliminary design at a 1:5000 scale. Because of the earliness of environmental input, changes to the alignment were suggested before the preliminary design had been completed. This ensured that the project would not have been delayed if major changes had to be made to the alignment for environmental reasons at a later stage. The final assessments of the WAR and LCAR were based on the alignments on a 1:5000 scale.

However, the involvement of the impact assessment at this early stage in design also has major drawbacks. Much information that was requested by the assessment team was either not available or subject to later change because of the preliminary nature of the design. For example, the location of construction camps for both routes, the location of borrow pits and quarries for the LCAR and the schedules for blasting had not been finalised at the time of the

assessment. Many other aspect of the road design and methods of construction may be changed at a later stage during final design.

Because of the high probability of change in the road design subsequent to the conduction of impact assessments, the assessments of the WAR and LCAR should not be considered as final impact assessments but only as preliminary assessments. The chosen route will have to be reassessed at a later stage to determine whether the present assessment is still valid and to update it with respect to those aspects in the final design which were not assessed originally. This would be especially important for such aspects as the siting of construction camps and quarries. This later assessment would also have to focus on mitigation of site-specific negative impacts of the final design at a very detailed scale.

The fact that much data on which the assessments were based are subject to change does not fundamentally affect their suitability as documents for decision-making at this stage. Although the WAR and LCAR assessments are preliminary, they do contain sufficient comparative information to be used as a basis for evaluating the routes. The choice between the **routes as a whole** can be made with the information at hand, but the exact nature of site-specific impacts and their mitigation must be based on a more detailed assessment at a later stage.

3.5.3 Practical problems:

Lack of aerial photographs:

Up to date aerial photographs of routes were not available for the impact assessments. Although new photographs were to have been takrn just prior to the study, this was not done due to unfavourable weather conditions. The most recent available aerial photographs date from 1978-1980. The unavailability of photographs caused delays and inefficiencies in the assessment process. For instance, major changes in village layout and the location of huts

had taken place in the previous 13 years since the available photographs were taken. It was, therefore, not always possible to identify where the LCAR passed through huts and villages. The loss of huts was only identified late in the assessment process when the alignments were walked. If recent photographs had been available, these impacts could have been identified at an earlier stage in the assessment, or the impacts could have been avoided, and the time spent assessing these impacts in the field might have been better used on other issues.

This problem does not fundamentally affect the findings of the study, but the study would have been expedited, had recent photographs been available.

Lack of precise alignment in the field:

The alignment of the LCAR was not pegged in the field and had to be followed using alignment maps on a scale of 1:5000. It was, therefore not always possible to determine the position of the LCAR road alignment in the field to the same degree of accuracy as for the WAR. For instance, there was not always absolute certainty whether the road would lead to the destruction of certain houses.

This results in a slightly greater degree of uncertainty in the assessment of physical impacts for the LCAR than for the WAR.

Lack of scientific data:

Lesotho is an underdeveloped country and lacks the resources for the gathering of data about its environment. There is thus a general lack of scientific data about the environment of Lesotho. For instance, there was no information about aspects such as stream flow in the affected rivers and streams. Certain data, such as average annual rainfall, were very difficult to obtain or had to be estimated through extrapolation from other similar studies for Phase 1A of the LHWP.

3.5.4 Problems in the assessment of specific impacts:

Clogging of stream courses

Information on the siting of borrow pits and quarries was available for the WAR, but not for the LCAR. The magnitude of the impact "Clogging of stream courses with rockfall from side spoiling, blasting or earthworks at quarry sites and borrow pits" (EEU, 1993c: 69) along the LCAR is thus uncertain and difficult to assess accurately. Borrow pits and quarries could have significant impacts on river siltation, and therefore on two rare and endangered species found in the Jorodane River, the Maluti Minnow (*Pseudobarbus quathlambae* - Status: endangered) and the Aquatic River Frog (*Rana vertebralis* - Status: Restricted), especially when considered in combination with the impacts of the road itself. The original alignment proposed by GBJV has been realigned at two places at the request of the impact assessment team, specifically because of its proximity to the river and the danger of spoilage into the river and resultant siltation.

This causes two problems with regards to assessment of the impact:

- If borrow pits or quarries are sited close to the river, the mitigation of impact provided by the realignment of the road might well be negated. The significance of the above-mentioned impact could therefore be higher than indicated in the impact assessment.
- As a result of the above, the degree of confidence in the prediction of the impact must be low.

Social impacts

The social impacts *Increased crime* and *Social disruption of local communities*, which are caused by the influx of foreign road construction workers contractors are difficult to assess, because it has not yet been determined where construction camps will be located.

It was stated in the impact assessments that villages closest to construction camps will suffer the most severe social disruption. Without knowledge of the location of the construction camps, it is impossible to know the location of the impact or to pinpoint the places where mitigation should be delivered. It is also difficult to predict the significance of the degree of social disruption. Social disruption is likely to be greater in isolated rural villages, than in easily accessible villages which have already have been exposed to outsiders.

It is recommended that the location of construction camps should receive attention in the impact assessment of the finalised route.

Impacts on the aquatic environment

In the impact assessments of the LCAR and WAR, impacts on the aquatic environment have been presented as several separate impacts. These impacts are:

- "Increased sediment loading of rivers and streams resulting from construction activities in water courses and/or from erosion of unconsolidated road spoil, cutfaces and stream banks denuded of vegetation" (EEU, 1993c: 64)
- "Clogging of stream courses with rockfall from side spoiling, blasting or earthworks at quarry sites and borrow pits" (EEU, 1993c: 68)
- "Impacts on two South African Red Data Book species of aquatic fauna, the Maluti minnow, *Pseudobarbus quathlambae* and the Aquatic River frog, *Rana vertebralis* occurring in the Jorodane River" (EEU, 1993c: 72)

There is no major difference between the nature or effect of the different impacts listed above. The essence of all these impacts is that they cause **harm to aquatic organisms because of the increased silt loading of rivers** that can be expected to be caused by road construction activities. However, because of the way in which these impacts have been defined, it appears as if there are three different negative impacts on the aquatic environment, when in reality there need be only one. This single impact could possibly be called "Impact on

aquatic fauna due to increased siltation". The division into three impacts could influence the outcome of the decision. In the words of Ministerie van Volksgezondheid en Milieuhygiëne & Ministerie van Cultuur, Recreatie en Maatschaplijke Werk (1981: 52):

> ".. if an alternative is giving rise to 9 'good' impacts and one 'bad' impact the outcome can be changed by regrouping the 9 'good' impacts into one impact category and *sub-dividing the one 'bad' impact into 9 categories*". [my italics]

In Chapter 4 of this report, *Comparative evaluation of routes*, the above three impacts on the aquatic environment have been consolidated into a single impact called "Impact on aquatic fauna".

CHAPTER 4.
COMPARATIVE EVALUATION OF ROUTES

4.1 Aim of evaluation:

In this chapter the routes will be evaluated to decide which route is the most desirable. Evaluation is defined as weighing of the available information to determine which alternative is in the best interests of the community at large (Department of Environment Affairs, 1992). The route which is found to have the greatest nett benefit in environmental (socio-economic and bio-physical) and financial terms will be chosen as the preferred option.

4.2 Principles of evaluation:

The method of evaluation will be non-quantitative. The choice of a non-quantitative method for the evaluation of alternatives is mainly due to the greatly varying nature of the impacts along the alternative routes. There are highly significant impacts along the LCAR, such as the possible local extinction of rare and endangered species, which are very difficult to compare quantitatively to other impacts such as economic impacts.

The other general disadvantages of quantitative methods which have resulted in the choice of a non-quantitative method are:

- the use of numbers in quantitative methods tends to hide the value judgements that are implicit in any evaluation (Hollick, 1981);
- quantitative methods fail to acknowledge the importance of the different value systems of different interest groups (Ministerie van Volksgezondheid en Milieuhygiëne *et al*, 1981);
- quantitative methods fail to present the trade-offs between alternatives (Ministerie van Volksgezondheid en Milieuhygiëne *et al*, 1981);

- numbers used in quantitative methods tend to give a false impression of accuracy and objectivity (Ministerie van Volksgezondheid en Milieuhygiëne *et al*, 1981).

The "no-go" alternative in which no action is taken will not be evaluated since the presence of an access road to the Mohale Dam is essential to facilitate the transport of construction materials and labour to the dam.

4.3 Method of comparison:

Choice of impacts to be considered in comparison:

Impacts of high significance will be used for comparison. An impact will be used in the evaluation process if that impact has a high significance for either one or both of the alternatives. Impacts where both alternatives are rated as having a moderate or low significance will not be considered. Reasons for this are given below.

- Impacts of high significance have, by definition, the greatest degree of effect on the environment. They are, therefore, more important to the decision than impacts of moderate to low significance.
- It is necessary to reduce the number of decision factors to a manageable level, especially for the purposes of a non-quantitative evaluation. Research indicates that a person can consistently compare options on the basis of only about 7 attributes (Miller, 1956). Although the number of decision factors in this dissertation is not as low as seven, the number of decision factors has been reduced from a possible total of 27 to 13, and the number of decision factors that involve significant trade-offs in the final evaluation is likely to be even smaller. The reduction of decision factors thus makes the evaluation more lucid.
- The impacts which are highly significant for either one or the other of the alternatives are representative of the full range of impacts, i.e. they include a balanced range of impacts on the bio-physical, socio-economic and policy environments. The omission of impacts of moderate to low significance thus does not exclude any major category of impacts. Were this the case, then

impacts of moderate to low significance would necessarily have been included in evaluation.

Therefore, it is assumed that the extra input of considering impacts of moderate and low significance would not lead to a different conclusion from a decision based on impacts of high significance.

The evaluation will be based on impacts that have a high significance without mitigation or optimisation. Comparison will therefore be based on "worst case scenarios" for each of the routes. An impact will be used for comparison if that impact has a high significance without mitigation/optimisation for either one or both of the alternatives. The reasons for using worst case scenarios for comparison are given below.

- Experience from Phase 1A of the LHWP indicates that mitigation was, in many cases, either not applied, applied too late or applied inadequately (Thoahlane, 1991 & Makuta, 1991). It is important that this report makes recommendations on the basis of what can realistically be expected to happen in the execution of the project.
- There are some potentially harmful impacts that have a moderate significance with mitigation and a high significance without mitigation. Comparison of worst case scenarios will ensure that these potentially highly significant impacts are included in the comparison.

Impacts on national planning objectives will be considered even though neither of the routes has a highly significant impact on these objectives. These impacts will be considered because of the national importance of the planning objectives to Lesotho.

Sequence of comparison:

The following sequence will be followed in the process of evaluating the alternatives.

Step 1. **Discussion of impacts:**

Impacts that have been chosen for comparison will be discussed, impact by impact, for each alternative. The reasons for the allocation of significance ratings to impacts will be explained more systematically than in the impact assessments of the WAR and LCAR, in order to facilitate comparison. The way in which this is done is explained in more detail in section 4.4 below.

Step 2. **Summary Framework:**

All the selected impacts which have been discussed in step 1 will be summarised in a Summary Framework table with impacts on one axis and alternatives on the other axis.

Step 3. **Elimination of impacts for which alternatives do not differ:**

If there are any impacts which have the same level of magnitude and significance for both alternatives, these will be eliminated from the evaluation process if they are not relevant to evaluation. Impacts which differ only in very small degrees will also be eliminated. However, some impacts that do not differ between alternatives may be important to the decision if trade-offs have to be made between impacts. If there are such impacts, they will be considered in the decision.

Step 4. **Decision Framework Table:**

The remaining impacts will be presented in a Decision Framework Table. This table will be used to inform a choice between the alternatives. For each impact, the alternative which is most acceptable with respect to that impact will be highlighted.

Step 5. **Decision:**

The trade-offs between the alternatives will be discussed. Assumptions on which the recommended route is chosen will be described. The final route selection will then be made and reasons will be given for the choice.

4.4 Step 1. Discussion of impacts:

The reasons for the allocation of significance levels to impacts will be explicitly stated, to rectify the deficiencies in the method of significance rating that were discussed in the previous chapter and to aid comparison of alternatives.

Criteria for assigning significance ratings:

In terms of IEM requirements, significance is influenced by context and intensity of the impact. "Context" refers to the spatial and temporal dimensions of an impact and "Intensity" refers to the severity of an impact based on a judgement by the affected people or a knowledgeable authority (Department of Environment Affairs, 1992).

To satisfy the consideration of intensity, the following criteria will be used to provide a motivation for the allocation of significance ratings:

- *Magnitude*: a quantification of the impact. No universal unit can be given as every impact is different, and it is not possible to quantify all impacts. In general, the higher the magnitude, the higher the significance.
- *Degree of effect on public health and safety*: the greater the effect, the higher the significance.
- *Reversibility of the impact*: the less reversible the impact, the higher its significance.
- *Degree of effect on environmental qualities, goods or services which are of special or unique character, in limited supply and/or essentially irreplaceable*: the greater the effect, the higher the significance.
- *Possibility of cumulative impacts*, i.e. the degree to which an action has little impact on its own but in combination with other actions could result in

significant impacts: the greater the chance of cumulative impacts, the higher the significance.

- *Possibility of secondary impacts*, i.e. the possibility that the impact can give rise to secondary impacts that are not caused directly by the project actions: the higher the possibility the higher the significance.
- *The ability of the affected people to capitalise on positive impacts or overcome negative impacts*. This will be considered in the case of socio-economic impacts: the less the ability to capitalise on positive or overcome negative impacts, the higher the significance.

To satisfy the consideration of the temporal aspect of context, the duration of the impact will also be a criterion for significance ratings.

- *Duration of impact*: the longer the duration, the higher the significance. Duration will be stated as short term (a few days or months), temporary (a few months to a few years) or permanent (unlimited duration)

Not all of the above criteria are necessarily relevant to each impact. Where the significance of an impact is discussed it will be stated which criteria influenced the significance rating.

To satisfy the spatial element of context the *spatial context of significance* of an impact will be stated. The statement of spatial context is to prevent the reader from inferring that different impacts with the same significance rating occur at the same spatial scale. Spatial context of significance will be stated as international, national, regional, subregional or local.

The *degree of confidence in the prediction* will be specified and factors which could decrease the confidence in the prediction will be noted.

Indication of interest groups:

The procedure of the Framework Method (Standing Advisory Committee on Trunk Road Assessment, 1979) of structuring the affected parties into six interest groups will be followed. These interest groups are:

- **Travellers** (people who use the road)
- **Occupiers** (people who live near the road and will be affected by it)
- **Users of facilities** (people who make use of facilities that will be affected by the road)
- Those concerned with **Financial implications**
- Those concerned with or responsible for implementing **Policies for conserving or enhancing the area**
- Those concerned with or responsible for implementing **Transport, development and economic policies**

The last two interest groups are used where the affected parties are diffuse and cannot easily be grouped together under a single title.

Layout of impacts:

An impact by impact comparison of alternatives will be undertaken. Each impact will be presented in the following format:

General background: Where applicable, information that is relevant to both routes will be provided to avoid repetition in the individual discussion of routes.

Alternative: the alternative under consideration.

Impact: Whether the impact is positive or negative.

Discussion of impact: An explanation of the causes of the impact, its magnitude (if possible) and the reasons why the impact is negative or positive.

Degree of confidence in prediction: The certainty with which the magnitude and/or significance of the impact can be predicted.

Interest group: The interest group(s) that will be affected by the impact.

Significance: The significance of the impact without mitigation and the criteria on which the significance rating is based.

Spatial context of significance: Whether the impact is significant on a international, national, regional, subregional or local scale.

After the discussion of an impact, the alternative which is most preferable in terms of that impact will be identified with the aid of an *Impact Summary Table*, a tabular comparison of the alternatives for that impact. The preferred alternative will be indicated with shading. The Impact Summary Tables will eventually be used as the horizontal rows of the Summary Framework table.

Impact on National Planning Objectives

Least Cost Alternative Route

Impact: Positive

Discussion of impact: The LCAR will promote the national planning objectives of **economic growth, employment creation** and **democratisation** of the Fifth Five Year Plan (Ministry of Planning, Economics and Manpower Development, 1993).

a) **Economic growth:** Insofar as the LCAR will serve to provide access to the Mohale Dam, which is an important component of the planned LHWP, the road will facilitate the exploitation of Lesotho's water resource base and the establishment of hydro-electric power schemes. Thus the road will reinforce the objective of economic growth.

b) **Employment creation:** The construction of the LCAR is predicted to provide employment opportunities for up to 500 people for 30-36 months. Thus the road will serve to reinforce the objective of job creation. However, judging from Phase 1A of the LHWP most of the construction labourers are likely to be South Africans and few jobs will go to local inhabitants (Thoahlane, 1991).

c) **Democratisation:** About 33 villages of less than 100 inhabitants and 15 villages of more than 100 inhabitants (approximately 2000 individuals) will benefit from having improved access to regional and national centres of government administration. Improved access to these centres could facilitate the goal of democratisation.

Degree of confidence in prediction: The degree of confidence is high since it is certain that the road will be built.

Interest group: Transport, Development and Economic Policies

Significance: Low, because:

- The duration of the provision of job opportunities is temporary.
- The number of Basotho likely to get jobs on the project is low.
- Many local people are unlikely be able to capitalise on job opportunities because of lack of road construction skills.

Spatial context of significance: National

Western Access Route

Impact: Positive

Discussion of impact: The WAR will promote the national planning objectives of **economic growth, employment creation** and **democratisation** of the Fifth Five Year Plan (Ministry of Planning, Economics and Manpower Development, 1993).

a) **Economic growth:** Insofar as the WAR will serve to provide access to the Mohale Dam which is an important component of the planned LHWP, the road will facilitate the exploitation of Lesotho's water resource base and the establishment of hydro-electric power schemes. Thus the road will serve to reinforce the objective of economic growth.

b) **Employment creation:** The upgrading of the WAR will provide employment for up to 500 people for 30-36 months. Further jobs would be created by the construction of a bypass around Maseru and upgrading of the railhead facilities in Maseru, both of which are contingent on upgrading of the WAR. Thus the road will serve to reinforce the Five Year Plan's objective of job creation. However, judging from Phase 1A of the LHWP most of the construction labourers on the roads are likely to be South Africans and few jobs will go to local people (Thoahlane, 1991).

c) **Democratisation:** Upgrading of the WAR will provide improved access to regional and national centres of government administration to about 30 villages. Thus the WAR could also facilitate the objective of democratisation.

Degree of confidence in prediction: The degree of confidence is high since it is certain that the road will be built.

Interest group: Transport, Development and Economic Policies

Significance: Moderate, because:

- The number of Basotho likely to get jobs on the road project is low, but more Basothos will get jobs from the WAR than from the LCAR because of the upgrading of the Maseru railhead and the construction of the Maseru bypass.
- Many local people are unlikely be able to capitalise on job opportunities because of lack of road construction skills.

- The duration of the provision of job opportunities associated with the WAR and the Maseru bypass is temporary but the duration of job opportunities associated with the upgrading of the Maseru railhead are permanent.

Spatial context of significance: National.

Impact Summary Table 1: Impact on national planning objectives

	Alternative	
Interest Group:	**LCAR**	**WAR**
Transport, development & economic policies	*Impact*: Positive • Supports the national planning objectives • Provides temporary jobs on the road. No upgrading of Maseru railhead or construction of Maseru bypass. *Significance*: Low	*Impact*: Positive • Supports the national planning objectives • Provides temporary jobs on WAR and Maseru bypass and also permanent jobs associated with the upgraded Maseru railhead facility. Provides more jobs than LCAR. *Significance*: Moderate

Shading indicates preferred alternative.

Both routes have a positive impact on the national planning objectives. The WAR provides more jobs than the LCAR because of the upgrading of the Maseru railhead facility and the construction of the Maseru bypass which are associated with the WAR. The impact of the WAR is moderately significant while the impact of the LCAR is of low significance. Therefore, with respect to impacts on national planning objectives, the preferred alternative is the Western Access Route.

Preferred Alternative: **Western Access Route**

Impact on Lesotho Road Network

General background

The upgrading of the following roads is identified as a priority by the Fifth Five Year Development Plan (Ministry of Planning, Economics and Manpower Development, 1993):

* St. Michael's - Thaba-Tseka (150 km) (part of which is the Western Access Route);
* Thaba-Tseka - Taung - Mpiti (140 km);
* Maseru bridge.
* Taung - Mokhotlong - Sani Pass (120 km)

The budget of the Lesotho Roads Department is extremely limited. Any savings in construction or maintenance costs of the above roads that would accrue to the Roads Department, due to the proposed road to the Mohale Dam, would be very beneficial.

Least Cost Alternative Route

Impact: Negative

Discussion of impact: The LCAR would have a negative impact on the Lesotho Road Network because it **conflicts with existing road plans** and because it will place an **additional burden on the road maintenance budget.**

a) **Contrast with existing road plans:** The LCAR is not in line with upgrading plans for the Lesotho Road Network as set out in the Fifth Five Year Plan. The upgrading of the Mountain Road (the first 61.4 km of the road from St. Michael's to Thaba-Tseka), instead of the construction of the LCAR, will increase the likelihood that the Lesotho Government will complete the entire stretch of road upgrading to Thaba-Tseka. This would result in a saving of approximately 10 Million Maloti to the Lesotho Government. The implementation of the LCAR could jeopardize planning objectives by detracting from the possibility of upgrading the entire Mountain Road from St Michael's to Thaba-Tseka.

b) **Additional burden on maintenance budget:** The LCAR will involve the construction of approximately 55 km of new road. The LHDA would be responsible for maintenance of this road during the first five years after construction. Based of the theoretical allowance per kilometre for maintenance of bitumen roads in Lesotho, the estimated maintenance costs for the stretch of new road would be M154 000 per year for routine maintenance and M1 760 000 every eight years for re-sealing. Assuming no resealing takes place in the five years after the LHDA's maintenance responsibility has lapsed, and not taking account of inflation, the road will cost M770 000 to maintain in this period. Thus the road would be a significant additional burden on Lesotho's already overtaxed maintenance programme after the LHDA's responsibility for maintenance has ended[1].

Degree of confidence in prediction: High

Interest group: Transport, Development and Economic Policies

Significance: High, because:

- The road will be permanent and the extra burden on the road maintenance budget will therefore be permanent.

Spatial context of significance: National

Western Access Route

Impact: Positive

Discussion of impact: The WAR will have a positive impact on the Lesotho road network because it **accords with existing road plans** and would result in **savings to the road maintenance budget** of at least M10 million.

a) **Accordance with existing road plans:** The upgrading of the WAR would contribute to realising the objective of the Fifth Five Year Plan, of upgrading the road from St. Michael's to Thaba-Tseka. The WAR consists of the first 61.4 km of this road.

[1] See Appendix 1 for assumptions on which this is based.

b) **Savings to the road maintenance budget:** The Lesotho Government estimates the reconstruction of the road between St. Michael's and Thaba-Tseka would cost M20 million. As a rough estimate, upgrading from St. Michael's to the Mohale Dam turnoff might save Lesotho about half of this, i.e. a saving of approximately M10 million. Upgrading of the Mountain Road does not involve construction of a new road and therefore places no additional burden on Lesotho's already overtaxed maintenance programme. In the five years after upgrading, maintenance expenditure by the Lesotho Department of Roads will be reduced as the road will be maintained by the LHDA during this period. Based on the theoretical allowance per kilometre for maintenance of bitumen roads in Lesotho, the estimated maintenance costs for the WAR should be M179 000 per year for routine maintenance and M897 000 every eighth year for resealing. The LHDA will be responsible for road maintenance for five years after upgrading. Assuming no resealing takes place in the five years after upgrading and not taking account of inflation, this would result in a saving of about M900 000 in maintenance costs during this period[2].

Degree of confidence in prediction: High

Interest group: Transport, Development and Economic Policies

Significance: High, because:

- The savings in maintenance costs because of the upgrading of the WAR as opposed to the building of the LCAR will be of permanent duration.
- There is a very high degree of correlation between the upgrading plans for the WAR and the national road plans.

Spatial context of significance: National

[2] See Appendix 1 for assumptions on which this is based.

Impact Summary Table 2: Impact on Lesotho road network

	Alternative	
Interest Group:	**LCAR**	**WAR**
Transport, development and economic policies	*Impact:* Negative • LCAR is not in accordance with existing road plans. • LCAR is completely new road - places additional burden of M154 000 per year on road maintenance budget after LHDA responsibility for maintenance is over. *Significance*: High	*Impact:* Positive • WAR accords with existing plans for upgrading of road from St. Michael's to Thaba-Tseka. • Upgrading of WAR results in saving of M10 million to Roads Department. • M179 000 per year maintenance saving to Roads Department over five years while LHDA maintians road. *Significance*: High

Shading indicates preferred alternative

The LCAR has a negative impact of high significance on the Lesotho road network and the WAR has a positive impact of high significance. Therefore, with respect to the Lesotho Road Network, the preferred alternative is the Western Access Route.

Preferred Alternative: **Western Access Route**

Impact on agricultural resources

General background

a) Cultivated land

The amount of cultivated land that would be lost is based on the assumption that everything inside the 20 m wide road reserve will be lost. In addition to the permanent loss of cultivated land, some land will be lost temporarily due to the siting of temporary access roads and/or temporary crusher sites on these lands. Compaction of the soil resulting from this could lead to permanent loss of agricultural lands. Further land may be damaged or lost as a result of erosion caused by water runoff from the road, road fill, and rocks from cuts and sidespoil falling into lands. The loss of cultivated land, whether permanent or temporary, will decrease the ability of affected communities to produce surplus produce for sale, or, in drought years, even to provide subsistence requirements. This results in lowered self-sufficiency and resilience of the affected community. The loss of cultivated land would lead to more severe impacts than the loss of grazing land.

b) Trees

Fruit trees, usually peach and apple trees, are probably the main source of fruit for families. In many areas near roads they serve as a source of income through fruit sale on roadsides. Other trees provide a source of shade, while species such as the willow are used for baskets, whips, and fodder; the poplar for building kraals and fences; and *Leucosidea sericea* and *Robinia* sp. for firewood.

c) Winnowing areas

Winnowing areas for separating the wheat from the chaff usually occur on smooth rocky areas near wheat fields.

d) Livestock facilities

Livestock facilities such as kraals are used to prevent stock theft and they are also important sources of fuel (cattle dung) to local villagers. Dip tanks in the area are communal and used by people from many surrounding villages.

Least Cost Alternative Route

Impact Negative

Discussion of impact:

The magnitude of the loss of agricultural resources due to the construction of the LCAR can be seen in Table 1 below.

Table 1: Agricultural resources lost due to the construction of the LCAR

Resource	Minimum lost
Cultivated fields	148 600 m^2
Vegetable gardens	3 320 m^2
Total cultivated land	151 920 m^2
Fruit trees	87
Non-fruit trees	20
Winnowing areas	6
Kraals	9
Stables	4

a) Loss of cultivated land

The amount of cultivated land and vegetable garden land likely to be lost due to the construction of the LCAR is 152 000 m^2 or just more than 15 hectares. This amount is a minimum estimate since no information is available regarding the siting of construction camps, quarries and borrow pits. The loss of cultivated land might be easily mitigated as several chiefs indicate that there is alternative land available in the Jorodane Valley, and that this land could be allocated to individuals who lose cultivated land to the road.

b) Loss of trees

Eighty seven fruit trees and 20 non-fruit trees will be lost to the LCAR.

c) Loss of winnowing areas

There are six winnowing areas along the LCAR that might be lost as a result of the road. Four of these occur between km 34.8 and km 35.4 and the others occur at km 37.2 and km 38.5.

d) Loss of livestock facilities

Nine kraals and four stables might be lost to the LCAR. Stock theft is a major problem in the Jorodane Valley area, and kraaling of cattle is essential at night. The loss of kraals could therefore lead to an increase in the theft of stock.

Degree of confidence in prediction: Moderate, because the alignment of the LCAR was not pegged in the field and the location of borrow pits, construction camps and temporary crusher sites (all of which could be located on agricultural resources) is not yet known. The magnitude of the impact could thus be larger than indicated here.

Interest group: Occupiers

Significance: High[3], because:

- The magnitude of the loss of agricultural land to the LCAR is more than 20 times higher than for the WAR (151 920 m^2 land lost along the LCAR as opposed to 6655 m^2 along the WAR).
- The loss of cultivated land has a high degree of effect on public health since people rely on cultivated land for most of their food requirements.
- The loss of cultivated land to the road is irreversible.
- There is a possibility of secondary impacts since the loss of kraals could cause an increase in the theft of cattle.
- There is a high possibility of cumulative impacts. The area of cultivated land lost to the Mohale Dam in the lower part of the Jorodane Valley is approximately 2 500 000 m^2, or 250 ha. Many of the people who lose land

[3] Note: The significance rating in the original assessment for this impact was moderate for the LCAR and high for the WAR. Because the magnitude of the impact for the LCAR is a fraction of that for the WAR, the significance ratings have been changed in this document.

here are likely to move into the upper part of the valley, where the topography is better suited to agriculture and thus compete for agricultural land with those people who lose land to the LCAR.

Spatial context of significance: Regional

Western Access Route

Impact: Negative

Discussion of impact:

The magnitude of the loss of agricultural resources due the upgrading of the WAR is shown in Table 2 below.

Table 2. Agricultural resources lost due to the upgrading of the WAR

Resource	Minimum lost
Cultivated fields	4 790 m^2
Fallow land	940 m^2
Vegetable gardens	925 m^2
Total cultivated land	6 655 m^2
Fruit trees	73
Non-fruit trees	104
Winnowing areas	1
Kraals	4
Stock pens	1
Dip tanks	1

a) Loss of cultivated land

The amount of cultivated land, vegetable gardens and fallow land that is likely to be lost to a wider road reserve is 6 654 m^2 or about 0.66 ha.

c) Loss of trees

Seventy three fruit trees and 104 non-fruit trees will be lost to the WAR.

c) Loss of winnowing areas

One winnowing area situated on a cut face at km 55.9 may be lost.

d) Loss of Livestock facilities

Four kraals (at km 52.2, 53.5, 54.7, 59.2), and a stock pen with associated dip-tank (at km 31) adjacent to the road may be lost.

Degree of confidence in prediction: Moderate to High. The position of temporary crusher sites, which might be sited on agricultural resources, is not yet known.

Interest group: Occupiers

Significance: Moderate, because:

- The magnitude of the loss of cultivated land is more than 20 times smaller for the WAR than for the LCAR (6 655 m^2 of land will be lost along the WAR as opposed to 151 920 m^2 along the LCAR).
- The loss of cultivated land has a high degree of effect on public health since people rely on cultivated land for most of their food requirements.
- The loss of cultivated land to the road is irreversible.

Spatial context of significance: Regional

Impact Summary Table 4: Impact on agricultural resources

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers & Users of facilities	*Impact*: Negative Losses: • **151 920 m² of cultivated land** • 87 fruit trees • 20 non-fruit trees • 6 winnowing areas • 9 kraals • 4 stables *Significance*: High	*Impact*: Negative Losses: • **6 655 m² of cultivated land** • 73 fruit trees • 104 non-fruit trees • 1 winnowing area • 4 kraals • 1 stock pen • 1 dip tank *Significance*: Moderate

Shading indicates preferred alternative

The construction of the LCAR would cause the loss of at least 20 times as much cultivated land as the WAR. The significance of the loss of agricultural resources is high along the LCAR and moderate along the WAR. Therefore, with respect to impact on loss of agricultural resources, the preferred alternative is the Western Access Route.

Preferred alternative: **Western Access Route**

Impact on the local dagga-based economy

Least Cost Alternative Route

Impact: Negative

Discussion of impact: The local economy of the Jorodane Valley is very strongly rooted in the sale of dagga which is grown here. For 64.9% of households in the valley (about 1300 people) the sale of dagga is a major source of cash income. Potential loss of income to the Jorodane Valley as a result of the LCAR is estimated at between M200 000 and M500 000 per annum. This will be a long-term impact with far reaching consequences for this remote community, who have limited access to the mainstream cash economy. A cash income is essential to this community in order to send their children to school, as well as to buy food, clothes and seed. Alternative sources of income would have to be developed in order to maintain the current standard of living. However, it will be difficult for inhabitants of the Jorodane Valley to match the level of income generated by the sale of dagga.

Degree of confidence in prediction: High

Interest group: Occupiers

Significance: High, because:

- The magnitude of people dependent on the sale of dagga is very high.
- The duration of the impact is permanent.
- The ability of the local people to overcome this impact is very low. There are very few employment opportunities in the area with which people could substitute the income they receive from dagga. The affected people also have limited skills with which to earn money through other means.
- There is a high possibility of secondary impacts. People who used to grow dagga might try to substitute their dagga income by farming with more stock, thereby exacerbating the already overgrazed condition of the veld.

Spatial context of significance: Subregional

Western Access Route

Impact: Neutral

Discussion of impact: No dagga is grown near the WAR. The upgrading of the WAR will therefore not have any impact on the economic activities associated with the sale of dagga. The growth and sale of dagga in the Jorodane Valley would be able to continue if the WAR is upgraded.

Degree of confidence in prediction: High

Interest group: Occupiers

Significance: Not applicable, since impact is neutral.

Spatial context of significance: Subregional

Impact Summary Table 5: Impact on the local dagga-based economy

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers	*Impact*: Negative • Loss of income to 65% of households (about 1300 people) • Loss of income to Jorodane Valley between M200 000 and M500 000. *Significance*: High	*Impact*: Neutral • No impact - dagga economy will be able to continue. *Significance*: Not applicable since impact is neutral

Shading indicates preferred alternative.

The LCAR has a negative impact of high significance on the dagga economy of the Jorodane Valley. The loss of income to the inhabitants of the Jorodane Valley would be considerable if the LCAR is built. The WAR has no impact on the dagga economy since no dagga is grown along this route. Therefore, with respect to impact on the local dagga-based economy, the preferred alternative is the Western Access Route.

Preferred alternative: **Western Access Route**

Impact on potable water supplies

General background

Most villages along the LCAR and WAR obtain their potable water from communal springs near the villages. Water in nearby rivers and streams is generally of poor quality as a result of contamination from human and livestock excrement, and washing of clothes. The issue of existing potable water supplies is therefore one of critical concern for villagers. Springs could either be destroyed directly by the road, or the effect could be delayed: springs could be damaged by later rockfall or the spring water could be made undrinkable due to siltation caused by increased runoff.

Least Cost Alternative Route

Impact: Negative

Discussion of impact: There are two springs along the LCAR, one at km 2.0 and one at km 46.8, which may be affected by the road.

Degree of confidence in prediction: High

Interest group: Occupiers

Significance: High, because:

- The loss of springs could have a very high degree of effect on public health.
- The loss of springs is irreversible.
- The availability of potable water from springs can be regarded as an environmental service which is in limited supply and essentially irreplaceable.
- There is a high possibility of secondary impacts in the form of an increase in sickness. The loss of springs could lead to the use of water from other sources such as streams which have usually been contaminated by humans and livestock.

Spatial context of significance: Local

Western Access Route

Impact: Negative

Discussion of impact: Forty three percent of respondents to the social survey along the WAR said that availability of water was a problem for their villages (EEU, 1993c). The Village Water Project, which is operative along the WAR, aims to address this problem but has not yet reached any of the villages surveyed between the Molimo Nthuse Pass and Patiseng, and it has been slow to implement proposals in the Nazareth area. There are seven water collection points along the WAR (of which two are disused) that are at risk of direct or indirect interference by road upgrading. These occur at the following chainages: km 15.7 (disused), km 18.1 (below road), km 27.9 (piped water outlet), km 30.6 (below road), km 32.9 (next to road), km 34.5 (disused), and km 54.7 (next to road).

Degree of confidence in prediction: High

Interest group: Occupiers

Significance: High, because:

- The loss of springs could have a very high degree of effect on public health.
- The loss of springs is irreversible.
- The availability of potable water from springs can be regarded as an environmental service which is in limited supply and essentially irreplaceable.
- There is a high possibility of secondary impacts in the form of an increase in sickness. The loss of springs could lead to the use of water from other sources such as streams which have usually been contaminated by humans and livestock.

Spatial context of significance: Local

Impact Summary Table 6: Impact on potable water supplies

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers	*Impact*: Negative • 2 springs could be affected. *Significance*: High	*Impact*: Negative • 7 water sources (two of which are disused) could be affected. *Significance*: High

No preferred alternative

The LCAR and the WAR both have a negative impact of high significance on potable water supplies. The LCAR could affect two springs and the WAR could affect five springs which are still in use. Because there is no difference between the impacts or their significance, and very little difference between the number of springs affected, there is no preferred alternative with respect to impact on potable water supplies.

Preferred alternative: **None**

Impact on social patterns

General background

There will be an influx of up to 500, mostly foreign, construction workers for a period of three years (1994 - 1997) while the chosen route to the Mohale Dam is under construction. These workers could disrupt the communities along the routes in the following ways:

* by exerting pressure on limited resources such as water and toilet facilities;
* by increasing the prevalence of alcoholism;
* by introducing prostitution and associated sexually transmitted diseases;
* by increasing the prevalence of petty and serious crimes.

These social disruptions and antisocial behaviour have been well documented for the Katse Dam in various reports, including Setplan (1991) and Makuta (1991). It is expected that villages closest to the road or to construction camps housing the construction workers will suffer the most severe social disruption.

Least Cost Alternative Route

Impact: Negative

Discussion of impact: Local residents expressed concern that a road may increase crime and introduce new crimes into the area. The major crime in the Jorodane valley is stock theft. This is reported by 92% of respondents and is reported to occur between 2 and 20 times a year. It often involves theft of large numbers of animals at a time, and the stock thieves are usually armed, either with sticks or guns. Residents have expressed the fear that a road will increase stock theft, with thieves being able to gain access to the valley more easily, and use vehicles to remove the animals. The reality of this fear is borne out by the social survey conducted on the Katse road, where 37.6% of respondents reported an increase in stock theft since the road had been built, as well as the use of vehicles for stock theft.

Only 17% of respondents mentioned crime other than stock theft. Other crimes mentioned include house-breaking (6.4%), fighting (7.5%), rape, murder and theft of

crops (3%). However, some residents expressed a fear that new problems such as housebreaking and prostitution would be brought into the area with the building of the road. The Katse road survey suggests that rape and fights have become more common since the construction of the road. However, it is not certain whether these crimes have been brought into the area by outsiders. It is also not clear whether these crimes will decrease in the post-construction phase when many of the outsiders leave the area, or whether these crimes have now become a permanent part of the local culture.

Degree of confidence in prediction: Although it is relatively certain that changes in current social patterns would occur, it is not possible to predict where these impacts would be most severe or how many people are would be affected. This is due to the fact that the location of construction camps is not yet known.

Interest group: Occupiers

Significance: High, because:

- An increase in crime could have a very high degree of effect on public health and safety.
- There is a high chance of cumulative impacts due to the presence of the construction workers for the Mohale Dam (from 1996 to 2000) during and after road construction.

Spatial context of significance: Subregional

Western Access Route

Impact: Negative

Discussion of impact: The local inhabitants fear that there will be an increase in the rate and scale of stock theft if the road is upgraded, because it would give easier access to stock thieves using large cattle trucks. 36% of respondents along the WAR derive income from their livestock, while 10% say that stock theft is already a serious problem. Results of the social survey conducted on the Katse Road show that 37.6% of respondents reported an increase in stock theft since the road was built, as well as the use of vehicles to transport the stolen animals out of the area.

Housebreaking, which was reported by several respondents in the survey area east of Bushman's Pass, could also be exacerbated by the easier access and egress that an upgraded road would afford burglars.

Degree of confidence in prediction: Although it is relatively certain that changes in current social patterns would occur, it is not possible to predict where these impacts would be most severe or how many people would be affected. This is due to the fact that the location of construction camps is not yet known.

Interest group: Occupiers

Significance: High, because:

- An increase in crime could have a very high degree of effect on public health and safety.
- There is a high chance of cumulative impacts due to the presence of the construction workers for the Mohale Dam (from 1996 to 2000) during and after road construction.

Spatial context of significance: Subregional

Impact Summary Table 7: Impact on social patterns

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers	*Impact*: Negative • Increase in crime. • Disruption of social patterns & lifestyles mainly due to: Increase in sexually transmitted diseases & increase in alcoholism. *Significance*: High	*Impact*: Negative • Increase in crime. • Stock theft already a major problem. • Disruption of social patterns & lifestyles mainly due to: Increase in sexually transmitted diseases & increase in alcoholism. *Significance*: High

No preferred alternative

The LCAR and the WAR both have negative impacts of high significance on social patterns. It is not possible to estimate how many people will be affected by the change in social patterns along the different routes, because the location of construction camps is not known. If the locations were known, it would have been possible to roughly estimate the number of affected people, on the basis of the population size of the villages closest to the construction camps. The only major factor that separates the LCAR from the WAR is the fact that the present extent of stock theft along the LCAR's affected environment is already high. However, the preferred route should be chosen on the basis of the change that can be expected along each route. It cannot be said with certainty that the change in stock theft along the LCAR would be significantly larger than along the WAR. Therefore, with respect to impact on social patterns, there is no preferred alternative.

Preferred alternative: **None**

Impact on houses, businesses and facilities

General background

The LHDA has provided compensation houses in the Katse Dam area but there are still some people who are waiting to be compensated for their lost houses or compounds (Makuta, 1991; Thoahlane 1991; EEU, 1993e). Where houses have already been provided, they have satisfied some residents, but others have complained that despite their high construction costs, the compensation houses are inferior to traditional houses in several respects: concrete floors are colder and less comfortable for people who have no furniture to sleep on, and zinc used for roofs on the new houses is a poorer insulator than thatch. According to the Compensation Division of LHDA, contractors, unlike traditional builders, have not allowed a 'settling period' with the result that the walls of some houses have cracked. Maintenance costs of the new houses are higher (and require cash, as opposed to the collection of local materials), and there are fewer people with the skills to repair the new houses compared with traditional ones. However, the compensation houses of block and zinc roofing are regarded as a status symbol by many of the local inhabitants.

Least Cost Alternative Route

Impact: Negative

Discussion of impact:

Table 3 below gives an indication of the number of structures which will be lost due to the construction of the LCAR.

Table 3. Houses, businesses and facilities which will be lost due to the construction of the LCAR.

Type of structures	Number affected
Residences	19
Businesses	2
Toilets	3

Degree of confidence in prediction: Moderate, because the alignment of the LCAR was not pegged in the field. The degree of confidence in the prediction is, therefore, not as high as for the WAR, because the Mountain Road already exists.

Interest group: Occupiers and Users of facilities

Significance: Moderate, because:

- The loss of structures is not irreversible because the road is not yet in existence and its alignment can be changed relatively easily to avoid structures.
- The magnitude of structures lost along the LCAR is almost half of that along the WAR (24 structures will be lost along the LCAR as opposed to 42 along the WAR).
- The duration of the loss of structures (without mitigation) is permanent.
- The loss of toilets could affect public health.

Spatial context of significance: Regional

Western Access Route

Impact: Negative

Discussion of impact:

Table 4 below shows the numbers of houses, shacks and businesses which will be lost due to upgrading of the WAR.

Table 4. Houses, businesses and facilities which will be lost due to the upgrading of the WAR.

Type of structures	Number affected
Residences	27
Shacks and other structures	2
Businesses	4
Toilets	9

Degree of confidence in prediction: High

Interest group: Occupiers

Significance: High, because:

- The duration of the loss of structures (without mitigation) is permanent.
- The magnitude of structures lost along the WAR is almost twice as high as that along the LCAR (42 structures will be lost along the WAR as opposed to 24 along the LCAR).
- The loss of structures is in many cases irreversible because the road is already in existence and many structures have located very close to the road. The alignment can therefore not easily be changed to avoid structures.
- The loss of toilets could affect public health.

Spatial context of significance: Regional

Impact Summary Table 8: Impact on houses, businesses and facilities

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers & Users of facilities	*Impact*: Negative • 19 residences • 2 businesses • 3 toilets *Significance*: Moderate	*Impact*: Negative • 27 residences • 4 businesses • 2 shacks and other structures • 9 toilets *Significance*: High

Shading indicates preferred alternative

Both the LCAR and the WAR have a negative impact on houses, businesses and facilities. The WAR would lead to the loss of almost twice as many structures as the LCAR. The significance of the impact on houses, businesses and facilities is moderate along the LCAR and high along the WAR. Therefore, with respect to impact on houses, businesses and facilities, the preferred alternative is the Least Cost Alternative Route.

Preferred alternative: **Least Cost Alternative Route**

Impact on access to facilities, goods and services

Least Cost Alternative Route

Impact: Positive

Discussion of impact: Because there is presently no road through the Jorodane Valley, the construction of the LCAR through this valley would provide access to facilities, goods and services which are not presently accessible by road. Local residents would benefit in the following ways from this improved access.

a) **Easier and faster access to clinics**: Most people in the Jorodane Valley attend Likalaneng Clinic, which is between 2 and 8 hours travel away on horseback. This travel time is often too long for critically injured patients.

b) **Transport for large items such as furniture, building materials, and bulk supplies**: Most of these items are bought in Maseru and brought on foot or horseback from the busstop at Thaba Putsoa.

c) **Transport to and from mortuaries**: Currently most corpses are taken to mortuaries in Maseru from the busstop at Thaba Putsoa. The LCAR will provide access to mortuaries in closer centres such as Teyateyaneng or at least cut the travelling time to and from Maseru.

d) **Transport for migrant workers**: Approximately 80 people in the Jorodane valley are employed in South Africa, which represents about 10% of adults in valley. Most of the migrant workers visit their villages one weekend a month. The journey on foot from the busstop at Thaba Putsoa to their villages and back takes at least 8 hours, with the result that many workers are able to spend only a few hours with their families.

e) **Improved social contacts**: A road would facilitate visits to residents in the Jorodane Valley by people from outside the valley.

f) **Improved access to agricultural requirements**: Based on the effects that have occured along the Katse Road, it is predicted the LCAR will improve access to seed distribution points and enable local farmers to obtain seeds for planting on time. The agricultural extension officer for the Jorodane Valley, who seldom visits isolated villages due to poor access, would be able to make more

visits to the area than before, and farmers would be able to transport their grain to the co-op for a better price than they used to receive from the local middlemen.

g) **Improved access to livestock facilities**: The LCAR would improve access to the shearing shed at Ha Rapokoloane, which is at present not fully utilised because of the problem of getting fleeces out of the Jorodane Valley without vehicular transport.

h) **Improved access to regional markets**: Fifty percent of the respondents to the Jorodane Valley social survey obtain an income from the sale of wool, mohair and crops. A road would facilitate the transport of these commodities to a wider market than is currently accessible to the farmers, with possible economic benefits. Similarly, there are individuals within the valley (such as traditional doctors) whose skills are in demand from a wide range of people and whose clientele is currently limited by the absence of vehicular transport out of the Jorodane Valley.

i) **Improved access for emergency services**: The LCAR would facilitate the access of ambulances and police to the Jorodane Valley. Police are frequently needed because of stock thievery, but are unable to apprehend thieves because of inadequate access.

j) **Improved access to schools**: The construction of bridges would improve access to schools in summer, when many schools cannot be reached because of flooded rivers. Children might also be able to travel to school quicker by taxi.

Degree of confidence in prediction: High

Interest group: Occupiers (in the Jorodane Valley)

Significance: High, because:

- The degree of change is very large since a new road would be constructed where none existed before.
- The provision of a road will have a high degree of effect on public health and safety since emergency services will be able to reach the valley and access to clinics will be improved.
- There is a good possibility of secondary impacts as improved access to markets might lead to the economic upliftment of people, and improved access to

agricultural advice and requirements might enable greater exploitation of the Jorodane Valley's high agricultural potential.

- The duration of improved access will be permanent.

Spatial context of significance: Subregional

Western Access Route

Impact: Positive

Discussion of impact: Although the WAR is an existing road and no new access routes would be created by upgrading it, the use of the road by more vehicles would lead to improved access for locals along the route. Local people frequently get lifts from passing private traffic or public transport. Improved transport is especially important in terms of health since many people use taxis to reach clinics. As an illustration, 73% of people along the Katse Road who went to clinics use taxis to reach the clinics, even though many complained that they were expensive. Even if many people cannot make full use of improved access because of financial constraints, the mere existence of opportunity to do so is important to people.

Degree of confidence in prediction: High

Interest group: Occupiers

Significance: Moderate[4], because:

- The improved access to clinics affects public health and safety.
- There is a possibility of secondary impacts in that higher order services such as banks, police stations and post offices might be attracted to the mountainous region of the WAR by the improved condition of the road and improved transport.

Spatial context of significance: Subregional

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[4] This has been changed from a rating of "high" in the original assessment.

Impact Summary Table 9: Impact on access to facilities, goods and services

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers, Users of facilities	*Impact*: Positive • LCAR provides road access where none existed before. • Improved access to: Clinics, mortuaries, friends & family, agricultural requirements, livestock facilities, regional markets and schools. • Improved access for: migrant workers, emergency services. • Facilitates easier transport of large items. *Significance*: High	*Impact*: Positive • WAR is an existing road, so it does not provide access to facilities, goods and services which were inaccessible by road before. • Improved (faster) access to clinics is major benefit. *Significance*: Moderate

Shading indicates preferred alternative.

Both the LCAR and the WAR have a positive impact on access to facilities, goods and services. The LCAR would provide improved access to a wide variety of facilities, goods and services that have no road access at present. The WAR, because it is an existing route, does not provide new road access, but would improve current access to clinics. The LCAR has a positive impact of high significance and the WAR has a positive impact of moderate significance on access to facilities, goods and services. Therefore, with respect to impact on facilities, goods and services, the preferred alternative is the Least Cost Alternative Route.

Preferred alternative: **Least Cost Alternative Route**

Impact on wetlands

General background

The greatest cause of the loss of wetlands would be the presence of a road. Additional loss of wetlands may occur due to erosion, which is caused by the increased velocity of runoff water from sidedrains, crossdrains and the road surface. The more extensive wetlands occur on gently sloping areas below the road, along streams and in gullies.

Wetlands are important in the ecological functioning of riverine systems as they store water and slowly release it into streams and rivers, thereby regulating the flow of the river. Disturbance or destruction of these wetlands may lead to a change in the flow regime of the rivers. The flow would become more irregular, with very high flows after rain and very low flows between rainstorms. The increase in water velocity during high flows could cause accelerated erosion, with a resultant increase in siltation. The disturbance of these wetlands is significant as many of the wetlands occur at high altitude. Once they have been disturbed, natural recovery of these wetlands is very slow because of the low temperatures at high altitudes. Although none of the wetlands in question are true alpine wetlands, in that they all occur below 3000 m, they are nevertheless very sensitive to disturbance.

Most of the wetlands along the LCAR are dominated by broom grass (*Merxmuellera macowanii*) which is the main source of thatching and broom-making material for local inhabitants. Broom grass is also used to make various articles such as hats which are sold to tourists. The loss of broom grass would thus also have a social impact as it would decrease the availability of an income-producing resource.

Least Cost Alternative Route

Impact: Negative

Discussion of impact: There are several wetlands that are crossed by the LCAR or occur adjacent to it. The most important wetlands that would be affected by the

LCAR occur in the upper reaches of the Jorodane River. These are crossed by the LCAR alignment between the chainages km 24.0 and km 24.5. The minimum total area of wetland that would be lost to the LCAR is 3860 m^2. It is conceivable that the presence of a road in the Jorodane Valley would lead to the sale of articles made from broom grass to passing tourists. The loss of wetlands along the LCAR would thus also have economic implications for local inhabitants.

Degree of confidence in prediction: High

Interest group: Occupiers, and Policies for conserving and enhancing the area

Significance: High, because:

- The magnitude of loss of wetlands is almost 4 times as high along the LCAR as along the WAR. The LCAR could lead to the destruction of 3860 m^2 of wetland in comparison to the 978 m^2 of the WAR.
- The loss of wetlands to the road is irreversible.
- The wetlands are very sensitive to disturbance.

Spatial context of significance: Subregional

Western Access Route

Impact: Negative

Discussion of impact: Several wetlands are crossed by or occur adjacent to the road in small gullies, especially along God Help Me Pass and Blue Mountain Pass. The most extensive wetland areas occur on gentle slopes below the road, along streams and in gullies, between the chainages km 27.5 and km 42.15. The total area of wetland which may be destroyed by upgrading of the WAR is 978 m^2. Broom grass is also used to make various articles such as hats, which are currently sold to passing tourists along the road. The loss of broom grass would thus also have a social impact.

Degree of confidence in prediction: High

Interest group: Occupiers, and Policies for conserving and enhancing the area.

Significance: Moderate, because:

- The magnitude of the loss of wetlands along the WAR is only one quarter of the loss along the LCAR. The WAR could lead to the destruction of 978 m^2 of wetland in comparison to the loss of 3860 m^2 along the LCAR.
- The loss of wetlands to the road is irreversible.

- The wetlands are very sensitive to disturbance.

Spatial context of significance: Subregional

Impact Summary Table 10: Impact on wetlands

	Alternative	
Interest Group:	**LCAR**	**WAR**
Occupiers, and Policies for conserving and enhancing the area.	*Impact*: Negative • 3860 m^2 of wetland lost. *Significance*: High	*Impact*: Negative • 978 m^2 of wetland lost. *Significance*: Moderate

Shading indicates preferred alternative.

The LCAR and WAR both have a negative impact on wetlands. The LCAR has an impact of high significance because of the large magnitude of wetland loss along this route. The WAR has an impact of moderate significance because of the relatively small loss of wetlands along this route. Therefore, with respect to impact on wetlands, the preferred alternative is the Western Access Route.

Preferred alternative: **Western Access Route**

Impact on aquatic fauna

General background

The construction of a road to the Mohale Dam is likely to lead to an increase in the sediment and pollution levels of the rivers and streams in proximity to it. The increased sediment and pollution loading would inhibit the existence of aquatic fauna in these streams.

The road could cause increased silt and pollution loads at two stages:

- **During construction** due to general clearing of vegetation, cutslopes, sidespoiling, creation of impermeable surfaces, and dumping of rubble and clay into river or stream courses to facilitate dry bed construction of bridge supports.
- **After construction** due to
  - the increased volume of runoff from impermeable surfaces, and the high velocity of runoff from through smooth-surfaced culverts;
  - increased inputs from altered agricultural and human practices (mechanized ploughing, fertilizers, pesticides, dip tanks, solid wastes and litter) caused by improved access to agricultural supplies.

Least Cost Alternative Route

Impact: Negative

Discussion of impact:

Impacts during construction: The magnitude of siltation caused by cutting and sidespoiling would be larger for the LCAR than for the WAR, because the LCAR is a new road. Cuts and sidespoil along the LCAR would be unstable because they would be newly formed and unvegetated. Erosion from these surfaces is thus likely to be larger than for the WAR.

Impacts after construction: The LCAR is likely to cause a greater magnitude of siltation after construction than the WAR. The water courses along the LCAR into which runoff water is released are not adjusted to the increased velocity of runoff.

They would require time to adjust, during which time erosion would occur from these water courses.

The two South African Red Data Book species of aquatic fauna, the Maluti minnow, *Pseudobarbus quathlambae* (status = endangered), and the Aquatic River frog, *Rana vertebralis* (status = restricted), occurring in the Jorodane River, may become locally extinct due to the increased siltation caused by the LCAR. Both Maluti minnow and Aquatic River frog have been shown to be sensitive to silt loading of their river environment (Rall, 1992 & Cambray & Meyer, 1987). Both species spawn during the late spring and summer months (October - February), during the rainfall season when siltation is most pronounced, and the reproduction of both species is very sensitive to high silt loads. Eighty six percent of the known habitat of the Maluti minnow in the Jorodane, the Bokong and Senqunyane Rivers will be flooded by the Mohale Dam. The further impact of the LCAR will probably reduce the occurence of the minnow to about 10% of its former habitat. A reduction of habitat of this magnitude would probably force the species to extinction within this locality.

Both the Maluti minnow and the Aquatic River frog populations occurring in the Jorodane-Senqunyane River system vary so significantly from other members of their species that they may be subspecies. The possibility of the genetic uniqueness of the Maluti minnow and the Aquatic River frog populations of the Jorodane River catchment emphasises the conservation status of these species.

Degree of confidence in prediction: Moderate. The location of borrow pits, quarries and temporary crusher sites along the LCAR are not yet known. If these are located close to the Jorodane River, the degree of siltation could be much higher than expected.

Interest group: Policies for conserving and enhancing the area

Significance: High, because:

- The duration of the effects of altered agricultural and human practices and increased velocity of runoff, due to the presence of impermeable surfaces and culverts, would be permanent.

- The LCAR is likely to cause a greater magnitude of siltation than the WAR during and after operation.
- The Jorodane River and the other affected streams along the LCAR are currently relatively free of silt (i.e. relatively "pristine") due to the absence of major development in the Jorodane Valley. The degree of change in silt loading in these water courses that would be imposed by the LCAR would thus be large.
- The Maluti minnow and the Aquatic River frog can be regarded as environmental goods which are unique and essentially irreplacable, due to their Red Data status and the possibility of their genetic uniqueness.

Spatial context of significance: National

Western Access Route

Impact: Negative

Discussion of impact:

Impacts during construction: The magnitude of siltation caused by the WAR is likely to be lower than that caused by the LCAR. The WAR is an existing route, and the cuts and sidespoil along the WAR have already stabilised and are mostly vegetated. Although some new cuts would be made and new sidespoiling would occur, the amount of material that is cut or spoiled would be much smaller than for the LCAR because the WAR is an existing route.

Impacts after construction: The WAR is likely to cause a smaller impact after construction than the LCAR. The WAR has been in existence for more than 20 years and the water courses along this road have already adapted to increased volume and speed of runoff. The amount of erosion from these water courses along the WAR is thus likely to be less than along the LCAR. Some of the stream fauna that is less tolerant to siltation can be expected to disappear from the affected streams. However, no rare or endangered aquatic species of fauna are known to occur in the streams and rivers that would be affected by the WAR.

Degree of confidence in prediction: High

Interest group: Policies for conserving and enhancing the area

Significance: Low, because:

- The duration of the effects of increased velocity of runoff, due to the presence of impermeable surfaces and culverts, would be permanent.
- The WAR is likely to cause a smaller magnitude of siltation than the LCAR during and after operation.
- No rare or endangered species of aquatic fauna are known to occur in the streams that would be affected by the WAR.

Spatial context of significance: Subregional

Impact Summary Table 11: Impact on aquatic fauna

	Alternative	
Interest Group:	**LCAR**	**WAR**
Policies for conserving and enhancing the area	*Impact*: Negative • Potential local extinction of two possibly genetically unique populations: Maluti minnow (*Pseudobarbus quathlambae*) and Aquatic River frog (*Rana vertebralis*). • Greater magnitude of siltation than WAR during and after construction • Possible increased impact due to borrow pits and quarries. *Significance*: High	*Impact*: Negative • No rare or endangered species known to occur in any streams or rivers affected by the WAR. • Smaller magnitude of siltation than LCAR during and after construction *Significance*: Low

Shading indicates preferred alternative

The LCAR could have a highly significant negative impact by causing the possible local extinction of two rare and endangered species, the Maluti minnow and the Aquatic River frog. Although the WAR would cause some loss of aquatic fauna, there are no known impacts on rare and endangered species along the WAR. Therefore, with respect to impacts on rare and endangered aquatic species, the preferred alternative is the Western Access Route.

Preferred alternative: **Western Access Route**

Impact on spiral aloes

General background

The spiral aloe, *Aloe polyphylla*, is classified as a Red Data species by the IUCN and is endemic to the mountain region of Lesotho. It is under severe threat due to illegal collection for sale and medicinal purposes. The collection of spiral aloes is most prevalent near major roads. The known distribution of the spiral aloe in Lesotho is believed to have shrunk by about a third due to collection (Donnay & Meyer, 1991).

Least Cost Alternative Route

Impact: Negative

Discussion of impact: Most of the spiral aloe populations along the LCAR alignment are undisturbed because of the absence of a road in the Jorodane Valley. A large and especially important spiral aloe population in the vicinity of the LCAR is situated near the village of Soosa, about 10 km to the west of the LCAR alignment. The social survey of the Jorodane Valley has also indicated spiral aloe sites near Ha Likomisi, Ha Makhobalo (Phontseng), Ha Mphakho and Ha Nthakhane. Improved access for greater numbers of people to these and other spiral aloe populations that would be provided by the LCAR, would probably cause intensive collection of aloes by local villagers for roadside selling. This could result in the local extinction of certain aloe sites, especially those close to the road. Even if measures were implemented to control aloe collection and sale, small scale collection for medicinal purposes is likely to continue.

Degree of confidence in prediction: High

Interest group: Policies for conserving and enhancing the area

Significance: High, because:

- The magnitude of collection of spiral aloes along the LCAR is likely to be much larger than along the WAR. The aloe populations along the LCAR are still relatively large as they have not yet been affected by collection for sale because of the absence of a road through the Jorodane Valley. Therefore, the number of aloes that is available for collection along the LCAR is larger than along the WAR.

- Spiral aloes can be regarded as environmental goods that are unique and in very limited supply due to their status as rare and endangered plants.
- The impact of removal of spiral aloes from their natural habitat is essentially irreversible.

Spatial context of significance: National

Western Access Route

Impact: Negative

Discussion of impact: There are several localities near the WAR where the spiral aloe is known to occur, one of which is fairly close to the road at approximately km 47.6 (28°00'E, 29°28'S). Most of the aloe populations along the WAR have already been severely depleted by collection. Collection of aloes by local inhabitants, for sale to tourists, has led to the extinction of many spiral aloe populations along the WAR. Improved access provided by the upgrading of the WAR may cause more tourists to enter the area, with the result that collection of aloes would increase. This could result in the local extinction of aloes at the remaining sites, and the total disappearance of all spiral aloes from the vicinity of the WAR. Even if measures were implemented to control aloe collection and sale, small scale collection for medicinal purposes is likely to continue.

Degree of confidence in prediction: High

Interest group: Policies for conserving and enhancing the area

Significance: Moderate, because:

- The magnitude of increased collection along the WAR is likely to be much smaller than along the LCAR. There has been collection of spiral aloes along the WAR since the Mountain Road was built, so the remaining number of aloes along the WAR which may be affected is relatively small.
- Spiral aloes can be regarded as environmental goods that are unique and in very limited supply due to their status as rare and endangered plants.
- The impact of removal of spiral aloes from their natural habitat is essentially irreversible.

Spatial context of significance: National

Impact Summary Table 12: Impact on spiral aloes

	Alternative	
Interest Group:	**LCAR**	**WAR**
Policies for conserving and enhancing the area	*Impact*: Negative • Large magnitude of impact because aloe populations have not been affected by collection in the past. • Large and important population at Soosa village and many other smaller populations near route. *Significance*: High	*Impact*: Negative • Small magnitude of impact since most aloe populations have already been reduced in size by collection. *Significance*: Moderate

Shading indicates preferred alternative

The LCAR would have a negative impact of high significance on spiral aloe populations because aloe populations along this route have not been affected by collection yet. The number of aloes that could be affected along the LCAR is thus larger than along the WAR. The WAR would have a negative impact of moderate significance on spiral aloes since most of the spiral aloe populations along the WAR have already been severely depleted or destroyed by collection. The number of aloe that could still be affected along the WAR is thus relatively small. Therefore, with respect to impact on spiral aloes, the preferred alternative is the Western Access Route.

Preferred alternative: **Western Access Route**

4.5 Step 2. Summary Framework

The impacts which have been discussed in Step 1 above have been consolidated into a single Summary Framework Table, which appears on the foldout page after this page. This table is composed of all the Impact Summary Tables for individual impacts, which appear after the discussion of each impact. The Impact Summary Tables make up the horizontal rows of the Summary Framework. In addition to socio-economic and bio-physical impacts, financial considerations have also been included as a decision-making factor.

The information in each cell of the table is necessarily brief owing to space constraints, and highlights only those aspects which are relevant to making a choice between the alternatives. The Summary Framework should be read horizontal row by horizontal row, because each row represents a different impact. Shading in a row indicates the alternative which is more preferable in terms of that impact. Where there is no shading in the row of an impact, it indicates that there was insufficient difference between the alternatives to make a choice between the alternatives for that impact.

Framework Table 1. Summary Framework

Shading indicates preferred alternative for specific impact.
No shading indicates no preferred alternative for specific impact.

		Alternative	
Interest Group	**Impact**	**Least Cost Alternative Route**	**Western Access Route**
Transport, development and economic policies	National Planning Objectives	Impact: Positive • Supports the national planning objectives • Provides temporary jobs on the road. No upgrading of Maseru railhead or construction of Maseru bypass. Provides less jobs than WAR. Significance: Moderate	Impact: Positive • Supports the national planning objectives • Provides temporary jobs on WAR and Maseru bypass and also permanent jobs associated with the upgraded Maseru railhead facility. Provides more jobs than LCAR. Significance: High
Transport, development and economic policies	Lesotho Road Network	Impact: Negative • LCAR is not in accordance with existing road plans. • LCAR is completely new road - places additional burden of M 154 000 per year on road maintenance budget after LHDA responsibility for maintenance is over. Significance: High	Impact: Positive • WAR accords with existing plans for upgrading of road from St. Michael's to Thaba-Tseka. • WAR results in saving of M10 million for upgrading. • M179 000 per year maintenance saving over five years while LHDA maintains road. Significance: High
Travellers	Traffic flow in Maseru	Impact: Neutral • Maseru bypass will not be constructed - LCAR will have no effect on traffic flow in Maseru. Significance: Not applicable since impact is neutral	Impact: Positive • Maseru bypass will be constructed. Bypass will alleviate traffic congestion in Maseru city centre. Significance: High
Occupiers	Agricultural resources	Impact: Negative Losses: • **151 920 m² of cultivated land** • 87 fruit trees • 20 non-fruit trees • 6 winnowing areas • 9 kraals • 4 stables Significance: High	Impact: Negative Losses: • **6 655 m² of cultivated land** • 73 fruit trees • 104 non-fruit trees • 1 winnowing area • 4 kraals • 1 stock pen • 1 dip tank Significance: Moderate
Occupiers	Local dagga-based economy	Impact: Negative • Loss of income to 64.9% of households (about 1300 people) • Loss of income to Jorodane Valley population between M200 000 and M500 000 per year. Significance: High	Impact: Neutral • No impact - dagga-based economy will not be affected because no dagga is grown along the WAR. Significance: Not applicable since impact is neutral
Occupiers	Potable water supplies	Impact: Negative • 2 springs could be affected. Significance: High	Impact: Negative • 7 water sources (two disused) could be affected. Significance: High
Occupiers	Social patterns	Impact: Negative • Increase in crime. • Disruption of social patterns & lifestyles mainly due to: Increase in sexually transmitted diseases & increase in alcoholism. Significance: High	Impact: Negative • Increase in crime. • Disruption of social patterns & lifestyles mainly due to: Increase in sexually transmitted diseases & increase in alcoholism. • Stock theft already a major problem. Significance: High
Occupiers & Users of facilities	Houses, businesses and facilities	Impact: Negative • 19 residences • 2 businesses • 3 toilets Significance: Moderate	Impact: Negative • 27 residences • 4 businesses • 2 shacks and other structures • 9 toilets Significance: High
Occupiers & Users of facilities	Access to facilities, goods and services	Impact: Positive • LCAR provides road access where none existed before. • Improved access to: Clinics, mortuaries, friends & family, agricultural requirements, livestock facilities, regional markets and schools. • Improved access for: migrant workers, emergency services. • Facilitates easier transport of large items. Significance: High	Impact: Positive • WAR is an existing road, so it does not provide access to facilities, goods and services which were inaccessible by road before. • Improved (faster) access to clinics is major benefit. Significance: Moderate
Policies for conserving and enhancing the area	Wetlands	Impact: Negative • 3860 m² of wetland lost. Significance: High	Impact: Negative • 978 m² of wetland lost. Significance: Moderate
Policies for conserving and enhancing the area	Aquatic fauna	Impact: Negative • Local extinction of two possibly genetically unique populations of rare & endangered species: Maluti minnow (Pseudobarbus quathlambae) and Aquatic River frog (Rana vertebralis). • Greater magnitude of siltation than WAR during and after construction • Possible increased impact due to borrow pits and quarries. Significance: High	Impact: Negative • No rare or endangered species known to occur in any streams or rivers affected by the WAR. • Smaller magnitude of siltation than LCAR during and after construction. Significance: Moderate
Policies for conserving and enhancing the area	Spiral aloes	Impact: Negative • Large magnitude of impact because aloe populations have not been affected by collection in the past. • Large undisturbed population at Soosa village and many other smaller populations near route. Significance: High	Impact: Negative • Small magnitude of impact since most aloe populations have already been reduced in size due to collection. Significance: Moderate
Financial implications		Capital Cost: M120 361 000 Upgrading Cost: M 5 004 770 Compensation Cost: M 654 775 Transportation Cost: M 98 517 000 Maintenance Cost: M 511 290 **Total Cost:** M225 048 835	Capital Cost: M 92 035 108 Upgrading Cost: M 7 584 970 Compensation Cost: M 1 572 935 Transportation Cost: M 76 645 000 Maintenance Cost: M 391 230 **Total Cost:** M178 229 243

4.6 Step 3. Elimination of impacts for which alternatives do not differ

Impacts for which the alternatives do not differ significantly will now be eliminated from the rest of the evaluation procedure.

There are two impacts for which the alternatives show very little or no difference. These are *Impacts on potable water supplies* and *Impacts on social patterns*.

a) Impacts on potable water supplies

Impacts on potable water supplies is eliminated because the difference in the magnitude of loss of potable water supplies for the alternative routes is very small. The LCAR might cause the destruction of 2 potable water supplies and the WAR might cause the destruction of 5 water supplies which are still in use. The significance of the impact is high for both alternatives.

b) Impacts on social patterns

Both routes would have a negative impact of high significance on existing social patterns. It is impossible to differentiate between the number of affected people for the alternatives. It is predicted that the greatest impact on social patterns would be caused by road construction workers. However, no information is available on the location of road construction worker's camps. Thus, it is impossible to estimate even roughly, the number of people in the immediate vicinity of the construction camps that might be affected. The only major difference between the two routes is that the magnitude of stock theft is already high along the LCAR route. However, the preferred route should be chosen on the basis of the change that it would cause. It is not certain that the LCAR would necessarily cause a greater change in stock theft than the WAR.

4.7 Step 4. Decision Framework

The impacts that remain after Step 3 have been presented in a Decision Framework Table on the foldout page opposite. This table will be used as the basis for the choice of the recommended route. The impacts in the Decision Framework have been grouped according to the interest groups which they affect. This is in order to facilitate comparison of the distribution of costs and benefits of the alternatives.

Framework Table 2. Decision Framework

Shading indicates preferred alternative for specific impact.

		Alternative	
Interest Group	**Impact**	**Least Cost Alternative Route**	**Western Access Route**
Transport, development and economic policies	National Planning Objectives	Impact: Positive • Supports the national planning objectives • Provides temporary jobs on the road. No upgrading of Maseru railhead or construction of Maseru bypass. Provides less jobs than WAR. Significance: Moderate	Impact: Positive • Supports the national planning objectives • Provides temporary jobs on WAR and Maseru bypass and also permanent jobs associated with the upgraded Maseru railhead facility. Provides more jobs than LCAR. Significance: High
	Lesotho Road Network	Impact: Negative • LCAR is not in accordance with existing road plans. • LCAR is completely new road - places additional burden of M 154 000 per year on road maintenance budget after LHDA responsibility for maintenance is over. Significance: High	Impact: Positive • WAR accords with existing plans for upgrading of road from St. Michael's to Thaba-Tseka. • WAR results in saving of M10 million for upgrading. • M179 000 per year maintenance saving over five years while LHDA maintains road. Significance: High
Travellers	Traffic flow in Maseru	Impact: Neutral • Maseru bypass will not be constructed - LCAR will have no effect on traffic flow in Maseru. Significance: Not applicable since impact is neutral	Impact: Positive • Maseru bypass will be constructed. Bypass will alleviate traffic congestion in Maseru city centre. Significance: High
Occupiers	Agricultural resources	Impact: Negative Losses: • 151 920 m^2 of cultivated land • 87 fruit trees • 20 non-fruit trees • 6 winnowing areas • 9 kraals • 4 stables Significance: Moderate	Impact: Negative Losses: • 6 655 m^2 of cultivated land • 73 fruit trees • 104 non-fruit trees • 1 winnowing area • 4 kraals • 1 stock pen • 1 dip tank Significance: Moderate
	Local dagga-based economy	Impact: Negative • Loss of income to 65% of households (about 1300 people) • Loss of income to Jorodane Valley population between M200 000 and M500 000 per year. Significance: High	Impact: Neutral • No impact - dagga-based economy will not be affected because no dagga is grown along the WAR. Significance: Not applicable since impact is neutral
Occupiers & Users of facilities	Houses, businesses and facilities	Impact: Negative • 19 residences • 2 businesses • 3 toilets Significance: Moderate	Impact: Negative • 27 residences • 4 businesses • 2 shacks and other structures • 9 toilets Significance: High
	Access to facilities, goods and services	Impact: Positive • LCAR provides road access where none existed before. • Improved access to: Clinics, mortuaries, friends & family, agricultural requirements, livestock facilities, regional markets and schools. • Improved access for: migrant workers, emergency services. • Facilitates easier transport of large items. Significance: High	Impact: Positive • WAR is an existing road, so it does not provide access to facilities, goods and services which were inaccessible by road before. • Improved (faster) access to clinics is major benefit. Significance: Moderate
Policies for conserving and enhancing the area	Wetlands	Impact: Negative • 3860 m^2 of wetland lost. Significance: High	Impact: Negative • 978 m^2 of wetland lost. Significance: Moderate
	Aquatic fauna	Impact: Negative • Local extinction of two possibly genetically unique populations of rare & endangered species: Maluti minnow (Pseudobarbus quathlambae) and Aquatic River frog (Rana vertebralis). • Greater magnitude of siltation than WAR during and after construction • Possible increased impact due to borrow pits and quarries. Significance: High	Impact: Negative • No rare or endangered species known to occur in any streams or rivers affected by the WAR. • Smaller magnitude of siltation than LCAR during and after construction. Significance: Low
	Spiral aloes	Impact: Negative • Large magnitude of impact because aloe populations have not been affected by collection in the past. • Large undisturbed population at Soosa village and many other smaller populations near route. Significance: High	Impact: Negative • Small magnitude of impact since most aloe populations have already been reduced in size due to collection. Significance: Moderate
Financial implications		Capital Cost: M120 361 000 Upgrading Cost: M 5 004 770 Compensation Cost: M 654 775 Transportation Cost: M 98 517 000 Maintenance Cost: M 511 290 **Total Cost:** M225 048 835	Capital Cost: M 92 035 108 Upgrading Cost: M 7 584 970 Compensation Cost: M 1 572 935 Transportation Cost: M 76 645 000 Maintenance Cost: M 391 230 **Total Cost:** M178 229 243

4.8 Step 5. Decision

As can be seen from the Decision Framework table, the WAR is the preferred alternative for 9 of the impacts that have been selected for the decision and the LCAR is the preferred alternative for 2 of the impacts. If it is assumed that all impacts are given equal weight in evaluation, then the WAR is, numerically speaking, clearly the preferred alternative.

A purely numerical analysis is, however, insufficient to recommend an alternative. The alternatives will be further evaluated according to Stauth's criteria of *equity, efficiency* and *sustainability* (Stauth, 1989) to determine which one is in the best overall interests of society. The definitions of equity, sustainability and efficiency are given below where these criteria are discussed.

4.8.1 Equity:

An action is equitable if its costs and benefits are distributed fairly among the individuals and groups constituting society.

LCAR: The benefits of those impacts in terms of which the LCAR is preferable affect the following two interest groups:

- Occupiers
- Users of facilities

The impacts relevant to these interest groups are *Impact on houses, businesses and facilities* and *Impact on access to facilities, goods and services*. The interest groups of these impacts comprise, almost exclusively, the population of the Jorodane Valley, which amounts to about 2000 people. Therefore, the benefits of those impacts in terms of which the LCAR is preferable, accrue to a very small sector of the Lesotho population.

WAR: The impacts in terms of which the WAR is preferable affect four interest groups. These interest groups are:

- Transport, development and economic policies
- Policies for conserving and enhancing the area
- Travellers

- Financial implications
- Occupiers

The affected parties making up the first two listed interest groups are diffuse, and in many cases would be affected only indirectly. However, the number of affected people in these groups is numerous because of the national policy nature of the impacts, and the wide spatial context of the impacts that affect these interest groups. The WAR is not only more beneficial to policy interest groups, but is also preferable to the LCAR in terms of *Impact on agricultural resources* and *Impact on the local economy*. These impacts respectively influence occupiers along the WAR and the occupiers of the Jorodane Valley. The WAR would also be beneficial to the travsellers in of Maseru because of the construction of the Maseru bypass. The benefits of the WAR would thus accrue to the inhabitants of the Jorodane Valley, the inhabitants along the WAR, the inhabitants of Maseru as well as a diffuse range of other affected parties that are represented by policies.

Therefore, the benefits of the WAR are spread amongst a greater number of people than the those of the LCAR. **The more equitable alternative is the Western Access Route.**

4.8.2 Efficiency: *An action is efficient if its benefits outweigh its costs.*

In Stauth's method of evaluation, the costs and benefits of alternative actions should ideally be expressed as monetary values (Stauth, 1989). Comparison on a monetary basis is inappropriate in this case because some of the impacts of the alternative roads are non-monetizable or very difficult to monetize. Examples are the possible local extinction of the Maluti minnow, Aquatic River frog and spiral aloes. In any case, monetization of the non-monetary decision factors would have to be done by an economist, and no such monetization has been carried out. It is, therefore, not possible to compare the efficiency of the alternatives in monetary terms.

To some extent the non-monetary efficiency of the alternative routes has already been addressed in the process leading up to the Decision Framework (*4.4 Step 1* to *4.8 Step 5* above). The nett benefit of the WAR outweighs the nett benefit of the LCAR in terms of 9 of the 11 decision criteria in the Decision Framework. On this basis it could be argued that the WAR is more efficient than the LCAR. However, this evaluation of efficiency does not take cognisance of the "Compensation principle". In terms of this principle, an action is efficient if those who bear costs could be compensated by those who receive benefits, with the result that the those who benefit still receive benefits, but those who lose are no worse off than before. Because the *Compensation principle* has not been taken into account in the evaluation process leading up to the Decision Framework, the *Compensation principle* will be considered here.

LCAR: The interest group that would receive the most significant benefits from the LCAR are *Occupiers* in the Jorodane Valley, because of the positive nature of the *Impact on access to facilities, goods and services* on the Jorodane Valley population. These people would also bear costs since their dagga economy would be destroyed and significant portions of their agricultural land would be lost. Almost all the other impacts in the Decision Framework, with the exception of the *Impact on National Planning objectives* and the *Impact on traffic flow in Maseru* would be negative in the case of the LCAR. All the interest groups other than the occupiers in the Jorodane Valley would, to varying degrees, bear costs. Thus, in order for the LCAR to be efficient in terms of the criterion of the *Compensation principle*, the inhabitants of the Jorodane Valley would need to compensate all the other interest groups. This cannot possibly be expected to happen. The Jorodane Valley inhabitants have very limited resources at their disposal. If the LCAR were to be constructed their resources would become even more limited through the destruction of the dagga-based economy. Therefore, the LCAR would be inefficient.

WAR: The interest groups that would gain from the WAR are: *Transport, development and economic policies, Travellers, Occupiers, Users of facilities* and *Financial implications*. The main groups who would lose are *Occupiers and Users of facilities* along the WAR, because of the loss of houses, businesses and facilities and the loss of agricultural land. The other interest group that would lose is *Policies for conserving and enhancing the area*, due to the negative impacts on wetlands, spiral aloe populations and aquatic fauna. These impacts are, however, relatively small and none of them is of high significance. The spiral aloe population is already depleted, no rare or endangered species of aquatic fauna would be affected, and the loss of wetlands is also relatively small. The most important cost-bearing interest groups that would need to be compensated are, therefore, *Occupiers and Users of facilities* along the WAR. It is theoretically possible that the people constituting these interest groups could be compensated. The saving of M47 million due to the choice of the WAR instead of the LCAR, could be used in part to compensate those who bear costs. The economic stimulus that the WAR would cause might lead to the generation of increased revenue for the Lesotho Government, which might be able to compensate the *Occupiers and Users of facilities* with the extra revenue. The WAR is thus, theoretically at least, relatively efficient.

Therefore, in terms of the *Compensation principle*, the WAR is more efficient than the LCAR. **The more efficient alternative is the Western Access Route.**

4.8.3 Sustainability: *An action is sustainable if its costs and benefits are distributed fairly between different generations.*

LCAR: The LCAR is unlikely to generate many jobs in the long term because the Maseru railhead would not be upgraded if the LCAR is built. The LCAR would also impose a significant and permanent additional burden on Lesotho's road maintenance budget because it entails the construction of 55 km of completely new road. This burden would have to be continued to be carried

by future generations. Future generations in the Jorodane Valley would be very negatively affected by the permanent loss of large areas of agricultural land and the permanent loss of the dagga-based economy in the Jorodane Valley. Both of these impacts would seriously impair the ability of the affected people to meet their subsistence requirements. It is also likely that the local extinction of two species of aquatic fauna and the destruction of endemic spiral aloes would be viewed negatively by future generations. Due to the probable continued loss of rare and endangered species, the protection of these species will gain even greater weight in future due to their increasing rarity. The presence of the LCAR would also lead to the loss of the future option of using the Jorodane Valley as a conservation area. Therefore, the LCAR would not lead to a fair distribution of costs and benefits between generations.

WAR: The WAR is likely to generate more jobs than the LCAR in the long term because of the upgrading of the Maseru railhead facilities. This may also indirectly promote the creation of future job opportunities due to increased ease of import and export of goods associated with the railhead upgrading. The upgrading of the WAR would result in savings to the Lesotho road maintenance budget, and these savings could be used in future for the upgrading or construction of other important infrastructure. The fact that the WAR does not go through the Jorodane Valley means that is does not foreclose the future option of building a road through the Jorodane Valley. The fact that the WAR would lead to the destruction of fewer spiral aloes and would not interfere with rare and endangered species of aquatic fauna is also likely to be highly valued by future generations.

Therefore, the WAR would lead to a fairer distribution of costs and benefits between generations. **The more sustainable alternative is the Western Access Route.**

In summary, the WAR is the preferred alternative on four counts:

- Of 11 decision factors (10 impacts plus financial implications), there are 9 in terms of which the WAR is preferable and 2 in terms of which the LCAR is preferable.
- The WAR is more equitable than the LCAR.
- The WAR is more efficient than the LCAR.
- The WAR is more sustainable than the LCAR.

Thus, the route which is recommended for construction is the Western Access Route.

4.8.4 Implications of giving greater weight to one type of impact than another:
A decision in favour of the WAR is based on the assumption that all impacts should be given equal consideration in evaluation of the alternatives. However, it can be seen that the impacts for which the LCAR is preferable are both of a socio-economic nature. If greater weight is given to socio-economic impacts, it can be asked whether the LCAR might have a better chance of emerging as the recommended alternative.

An analysis of the impacts proves that this is not so. Even though the LCAR does have positive socio-economic impacts, these impacts are at the same time negated by negative socio-economic impacts (e.g. the disruption of the local economy) of the LCAR on the same affected parties. It is also doubtful whether the positive socio-economic impacts of the LCAR, if expressed in monetary terms, would be able to outweigh the M47 million difference in financial cost in favour of the WAR. Also, the choice of the LCAR on the basis of socio-economic impacts would imply that the benefits of improved access to the 2000 people of the Jorodane Valley are valued more than the WAR's benefits which accrue to a much wider range and number of people.

Therefore, giving greater weight to socio-economic impacts than to other impacts would probably not lead to a different recommendation. It is

improbable that greater weight to any other type of impact would swing the decision in favour of the LCAR since the LCAR's major benefits are all socio-economic in nature.

CHAPTER 5.
MITIGATION OF IMPACTS

5.1 Aims of this chapter

This chapter is concerned with measures for mitigating the impacts of the preferred alternative. The most important mitigation measures will be prioritised. The identification of mitigation measures of highest priority should ensure that, even if all the negative impacts cannot be mitigated, at least the most important impacts would be addressed. The optimisation measures of positive impacts has not been included in prioritisation. It is more important to minimise the disadvantages of negative impacts, than to optimise positive impacts, because positive impacts will result in benefits to the affected parties regardless of optimisation.

No new mitigation measures will be suggested in this chapter as these measures have already been compiled in the impact assessment report of the WAR. A summary of recommended mitigation and optimisation measures for the WAR is given in Appendix 2 of this report.

5.2 Criteria for prioritisation

Impacts have been prioritised on the following basis:

Significance: The higher the significance of a negative impact, the greater the priority for its mitigation. Impacts are in the order of high significance to low significance.

Number of criteria that impact meets: Under each significance level, impacts are in the order of the number of the following criteria which the impact meets:

i) Does the impact impair the ability of people to meet their basic needs for nutrition, water and shelter.

ii) Does the impact affect people's health and safety?

iii) Does the impact affect environmental goods, qualities or services which are of special or unique nature, in limited supply or essentially irreplaceable?

iv) Does the impact affect the maintenance of essential ecological processes and life support systems? Examples of these processes are: soil generation and protection, the recycling of nutrients, and the cleansing of water (IUCN, 1980).

v) Does the impact affect the preservation of genetic diversity? Genetic diversity is defined as the range of genetic material found in the world's organisms (IUCN, 1980).

In the case of site-specific impacts, a tabular summary of chainages along the route, where the mitigation for the impact has to be applied, will be given. These tables will appear in *Appendix 2. Tables of chainages at which mitigation measures may have to be applied*. No tables have been done for impacts that are not site-specific.

5.3 Impacts for which mitigation has high priority

5.3.1 Impacts of high significance

a) Impact on potable water supplies

2 criteria:

i) Loss of springs impairs the ability of people to meet their **basic need** for potable water.

iii) Potable springs are environmental services which are in **limited supply** and essentially **irreplaceable.**

Mitigation: Wells and standpipes should be provided at points no further from the village than the existing water sources.

Table of chainages: See Table 5 in Appendix 3 for chainages at which mitigation should be applied.

b) Impact on houses, businesses and facilities

2 criteria:

i) Loss of houses impairs the ability of affected people to meet the **basic need** for shelter.

ii) Loss of toilets would lead to deteriorating sanitary conditions and thereby affect **public health.**

Mitigation: It should be ensured that compensation is paid timeously and houses are provided or compensated for before existing ones are destroyed. Business-owners should be compensated for loss of premises and loss of income during construction of a new premise in a suitable location, i.e. one that is near the road and conveniently situated to receive a similar number of customers. Supervision of contractors who build the compensation houses and training of local people in their maintenance is required. Inform people of the drawbacks of "modern" houses in contrast to traditional huts to facilitate informed choices. Inform residents well in advance of loss of toilet facilities, and replace with a new facility of comparable standard before the destruction of the old toilet. Residents should receive a replacement rather than monetary compensation. This is because some resident may not replace their toilets and choose to make use of nearby bushes and gullies with possible health hazards and pollution impacts on streams and springs.

Table of chainages: See Table 6 in Appendix 3 for chainages at which mitigation should be applied.

5.3.2 Impacts of moderate significance

a) Impact on cultivated land

2 criteria:

i) Loss of agricultural land impairs the ability of the affected people to meet their **basic need** of sufficient food.

ii) Agricultural land is essentially **irreplaceable.**

Mitigation:

Loss of cultivated land

Where possible, the side of the road not impinging on gardens and fields should be widened. The construction of temporary roads and other infrastructure on arable land should be avoided where possible. Temporary infrastructure should be located in old disused quarries, degraded land, or on other non-agricultural land. These decisions must be made in consultation with local residents. If land-owners cannot obtain fields on which to grow crops in the interim (through *seahlolo*), they should be given compensation for the time fields are out of production. All grazing or arable land that is affected by construction activities must be rehabilitated to previous condition. See Guidelines for Rehabilitation.

Table of mitigation: See Table 7 in Appendix 3 for chainages at which mitigation should be applied.

b) Impact on spiral aloes

2 criteria:

iii) Spiral aloes can be regarded as being **unique** due to their rarity and status as rare and endangered plants.

v) The loss of spiral aloes would negatively affect the **preservation of genetic diversity.**

Mitigation: Proclamation of strictly protected aloe reserves for the larger aloe sites near the Mountain Road. This could reduce collection but will probably not eliminate it. Local people who are currently involved in illegally selling aloes should be trained to cultivate aloes from seed, in order to sell them legally to passing tourists. This would avoid the negative economic impact of reduced income to locals if they could no longer sell aloes due to stricter protection. Small aloes are currently sold for between M10 and M20 and large ones for M50. Surveillance by conservation officials and police along tourist routes should be increased.

c) Impact on social patterns

1 criterion:

ii) The probable increase in violent crimes, theft and sexually transmitted diseases would affect **public health and safety.**

Mitigation: There is little that can be done to mitigate the problems of crime and anti-social behaviour. Villages should be encouraged to establish "neighbourhood watch" schemes. All employers should be responsible for ensuring that there are adequate facilities for their labourers. Where possible, these facilities could be located in existing villages to enable local residents to benefit from the worker population. The establishment of dispute resolution committees which comprise members of both the local affected villages and the immigrant workforce should be encouraged. However, the appropriateness of such measures should be discussed with local communities before decisions are taken. Employers of construction workers should be seen to support village authorities. The provision of compensation houses should be done in a sensitive and consultative manner. Opportunities should be provided for people to receive training in other skills, including those which would make them more employable during dam and road construction.

d) Impact on convenience and risk to people and livestock

1 criterion:

ii) Increased risk to people affects **public health and safety.**

Mitigation: Speed limits should be imposed along dangerous sections of the road, especially on mountain passes and in villages. Adequate road shoulders should be provided for the safe passage of pedestrians and livestock. Where bridges are built, sufficient space should be provided for pedestrians and livestock, particularly where there are no existing bridges that could serve as alternative crossing points. Road signage, zebra crossings, speed ripples, and reduced speed limits should be introduced at villages, schools and other crossing points to indicate pedestrian hazard. Traffic barriers should be provided in villages to limit access to the road to safe crossing sites. Effective,

appropriate road safety education programmes should be introduced, particularly in schools.

e) Impact on wetlands

1 criterion:

iv) The loss of wetlands negatively affects the maintenance of the **essential ecological processes** of cleansing water and maintaining constant stream flow.

Mitigation: Reduce damage to marshes by minimising the amount of cut and fill. Erect gabions or other mechanisms for breaking the velocity of water and allowing wide dispersal, rather than creating a narrow channel that would concentrate water flow. Experience with the Bokong wetlands along the Katse Road has shown that it is extremely difficult to rehabilitate wetlands, especially those at high altitudes (above 2800 m). Refer to Rehabilitation Guidelines.

Table of chainages: See Table 8 in Appendix 3 for chainages at which mitigation should be applied.

f) Impact on *Leucosidea* shrubland

1 criterion:

iii) *Leucosidea* shrubland is an environmental good which is in **limited supply** in Lesotho.

Mitigation: At km 21-22, minimise side cutting on the left and transport spoil to a designated spoiling area (see Rehabilitation Guidelines). At km 36.9, realign the road on the left of the existing bridge and minimise cutting on the right side after the bridge by following existing alignment from km 36.9-37.1.

Table of chainages: See Table 9 in Appendix 3 for chainages at which mitigation should be applied.

5.4 Rehabilitation

The *Rehabilitation Guidelines* which are included in the impact assessment reports are relevant to several impacts. Those impacts for which rehabilitation is a mitigation measure, and which have been identified as a priority here, are:

- Impact on cultivated land;
- Impact on wetlands;
- Impact on *Leucosidea* shrubland.

There are other impacts to which mitigation is relevant, but which have not been identified as a priority for mitigation. These impacts are:

- Impacts on aesthetics;
- Impact on aquatic fauna;
- Impact on grassland vegetation.

Due to the possible synergistic nature of these latter impacts, the necessity for mitigation of these impacts is important. For this reason rehabilitation measures, as specified in *Appendix 5. Guidelines for Rehabilitation* in the WAR Impact Assessment (EEU, 1993a), are also considered a mitigation measure of high priority.

5.5 An Environmental Management Plan

It has been recommended in the *Guidelines for Rehabilitation* (EEU, 1993a) that rehabilitation measures should be formulated in an Environmental Management Plan (EMP). In order to have a unified approach to mitigation, it is recommended that the EMP should be comprehensive, by also including all other mitigation measures. The mitigation measures of highest priority that have been identified in this chapter should be addressed in the EMP. The EMP should be reviewed during the course of the project to ensure it remains adequate. A full-time Environmental Monitor should be employed by the proponent to ensure that mitigation measures are carried out according to the recommendations. The recommendations of the Environmental Monitor should be enforceable on the road contractor.

CHAPTER 6.
CONCLUSIONS AND RECOMMENDATIONS

6.1 Adequacy of the impact assessments

The impact assessments of the LCAR and WAR accord with the broad principles of the Integrated Environmental Management (IEM) procedure. Environmental input into the design of the access road to the Mohale Dam has thus far progressed only as far as *Stage 1 (Plan and Assess Proposal)* of IEM procedure. It is recommended that any further actions by the proponent during the design, construction and continued existence of the road, should be undertaken according to the principles and procedures of *Stage 2 (Decision)* and *Stage 3 (Implementation)* of the IEM procedure. Continued transparency of the process through involvement of I&AP's is especially important to ensure that the public accepts the process and the decision.

The major deficiencies in the impact assessments are the method of assigning significance ratings to impacts and the preliminary nature of the design.

6.1.1 Significance ratings

Although criteria for assignment of significance were stated, and the use of criteria for assigning significance ratings was implicit, the way in which these criteria were used is not explicit. It is unclear how the criteria were applied to individual impacts. This could give the impression of personal bias in the assignment of significance ratings. The adequacy of the significance rating system is considered to be crucial, because in impact assessments, impacts of highest significance are most likely to be used as the basis for reaching a decision. Even if the significance ratings that were assigned are valid, it is important for the decision that they are also seen to have been reached in an objective and replicable manner. In this report an attempt has been made to make the assignment of significance ratings to individual impacts more explicit.

6.1.2 Preliminary nature of the design

The impact assessments of the LCAR and WAR were carried out at an early stage in the design of the roads. This resulted in the unavailability of information that is required for the prediction of some impacts. The most important of this unavailable information was the location of construction camps along both routes and the location of borrow pits and quarries along the LCAR. The location of construction camps is particularly important for the prediction of social disruption of the local inhabitants along the routes.

6.2 Additional studies necessary

Flowing from the above, it is recommended that additional studies should be done, and that they should focus on the following:

- Social disruption

  It is necessary to do an additional study focusing specifically on the social disruption of local inhabitants. The most severe social disruption of local communities is likely to be caused by the presence of road construction workers. Because the location of construction camps was not known at the time of the impact assessments of the LCAR and WAR, it was impossible to specify where social disruption would be most severe. This study should make recommendations about the location of construction camps and the management of construction labour, in order to minimise negative social impacts. Recommendations for location of construction camps must be enforceable on contractors.

- Changes in the design

  Because of the preliminary nature of the road alignments that have been assessed, it is necessary to check that the final alignment corresponds to the alignment that was assessed. If the final design differs significantly from the preliminary design, it will be necessary to check whether the original assessments are still valid. It may be necessary to re-assess the compensation and mitigation requirements of certain impacts.

6.3 Recommended route

It is recommended that the WAR should be upgraded to serve as an access road to the Mohale Dam. The reasons for recommending the WAR above the LCAR are:

- Of the eleven factors which were selected for making the decision, nine are in favour of the WAR and two are in favour of the LCAR. These decision factors are summarised in Table 7 below.

Table 5. Summary of Decision Factors

Decision factor	Alternative	
	LCAR	WAR
Impact on National Planning Objectives		
Impact on Lesotho Road Network		
Impact on traffic flow in Maseru		
Impact on agricultural resources		
Impact on local dagga-based economy		
Impact on houses, businesses and facilities		
Impact on access to facilities, goods and services		
Impact on wetlands		
Impact on aquatic fauna		
Impact on spiral aloes		
Finance		

Shading indicates preferred alternative

- The WAR is more equitable than the LCAR. The major benefits of the LCAR are localised and distributed among about 2000 people in the Jorodane Valley. Most of the other interest groups are affected negatively by the LCAR. The WAR's benefits would accrue to the occupiers of the Jorodane Valley, the occupiers along the WAR, the inhabitants of Maseru and policy interests. Thus the WAR leads to a fairer distribution of costs and benefits than the LCAR.

- The WAR is more efficient than the LCAR. Using the compensation principle, the main group that benefits from the LCAR (the inhabitants of the Jorodane Valley) are unlikely to be able to compensate the losers. The gainers of the WAR are more likely to be able to compensate the losers than for the LCAR, and still be better off. This implies that the benefit to cost ratio of the WAR is higher than for the LCAR.
- The WAR is more sustainable than the LCAR. The LCAR would lead to several negative impacts which would affect future generations. The WAR would cause several positive impacts which would accrue to future generations.

It can therefore be seen that all the tests which have been applied to the alternative routes indicate that the WAR is the recommended alternative.

6.4 Mitigation of impacts

6.4.1 Mitigation measures of highest priority

The mitigation of certain impacts is more important than the mitigation of other impacts. It is recommended that the mitigation of the following impacts is undertaken as a matter of priority. The mitigatory measures for these impacts should start during road construction. The mitigation of other impacts, although also important, do not carry as much priority as the impacts listed below.

Impacts of high significance

a) Impact on potable water supplies

b) Impact on houses, businesses and facilities

Impacts of moderate significance

a) Impact on cultivated land

b) Impact on spiral aloes

c) Impact on social patterns

d) Inconvenience and risk to people and livestock

e) Impacts on wetlands

f) Impact on *Leucosidea* shrubland

It is recommended that the mitigatory measures contained in the Rehabilitation Guidelines are also carried out as a matter of priority.

6.4.2 Environmental Management Plan

It is recommended that mitigation measures should be formulated in a comprehensive Environmental Management Plan (EMP). The prioritisation of mitigation measures, as suggested in chapter 5, should form part of the EMP. The EMP should cover mitigation both during and after construction. It is recommended than an Environmental Monitor be employed full-time to ensure that the mitigation is carried out according to the recommendations in the EMP. The Environmental Monitor should be on site during construction and his/her recommendations to the contractor should be enforceable.

6.5 Monitoring

It is recommended that ongoing monitoring, throughout the progress of the project, is carried out. The purposes of the monitoring programme should be:

- Checking whether and to what extent the predictions of the impact assessment reports have been realised.
- Ensuring that the project is carried out according to the recommendations and in compliance with the conditions of approval that may be laid down by the decision-maker.
- Reviewing the efficacy of the recommended mitigation measures and the EMP. Mitigatory measures should be reviewed during the time that they are applied, and afterwards. The recommended mitigation measures should not be regarded as immutable. If it is found that certain mitigatory measures are inadequate, they should be improved.

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Appendix 1. Maintenance costs for the WAR and LCAR

The theoretical cost of routine maintenance of tarred roads in Lesotho is M2800 per km per year. Routine maintenance excludes resealing, which takes place every eighth year and costs M32 000 per km (LHDA, 1992). The estimations of maintenance costs below excludes the costs of resealing.

Western Access Route:

Length of upgrading: 64.1 km

Maintenance per year	=	64.1 * M2 800
	=	M179 480
Miantenance over 5 years	=	5 * M179 480
	=	M897 400

Least Cost Alternative Route:

Length of new road: 55 km

Maintenance per year	=	55 * M2 800
	=	M154 000
Maintenance over 5 years	=	5 * 154 000
	=	M770 000

Appendix 2. Summary of mitigation and optimisation measures for the Western Access Route

Impact on National Planning Objectives

Significance without optimisation: **positive** impact of **moderate** significance.

Optimisation:

Improve and optimise economic management. Allocate a significant portion of the royalties generated by the LHWP, to regionally co-ordinated rural development projects.

Establish training programmes to teach local people appropriate skills associated with road construction/upgrading.

Complete planned infrastructural improvements (e.g. the proposed upgrading of the remainder of the Mountain Road to Tsaba-Tseka).

Impact on the Lesotho road network

Significance without optimisation: **positive** impact of **high** significance.

Optimisation:

Completion of proposed reconstruction plans as outlined in the Five Year Plan (particularly, the remainder of the route to Tsaba-Tseka), would ensure that the upgrading associated with the WAR would be of optimal benefit to Lesotho.

Continued effective maintenance of the road following its upgrading, and successful implementation of the Pavement Management and Maintenance System (PMMS) would further serve to optimise positive impacts.

Impact on traffic flow in Maseru

Significance without optimisation: **positive** impact of **high** significance

Mitigation:

The proposed Maseru bypass should be designed to reinforce urban and regional planning initiatives.

Impact on objectives of the national settlement policy

Significance without optimisation: **positive** impact of **low** significance.

Mitigation:

Upgrading of the Mountain Road should be co-ordinated with other efforts to promote settlement development, as recommended in the National Settlement Policy. These include decentralisation of public administration and the establishment of local authorities. Upgrading of the remaining link from Patiseng to Tsaba-Tseka should be completed.

Impact on tourism

Significance without optimisation: **positive** impact of **low** significance.

Optimisation:

Improvement in marketing Lesotho as a viable tourist destination (e.g. better provision of tourist brochures to South African and overseas travel agencies, production of marketing videos) as well as improvements in accommodation facilities, quality and range of services, security, car hire and vehicle servicing facilities. The successful implementation of tourism plans for Katse and Mohale Dams will also serve to optimise and reinforce potential benefits of the WAR, as would the reconstruction of the road from Patiseng to Tsaba-Tseka.

With regard to traffic control the tourist board, tourists and other road users should be informed of possible disruptions, by means of advertisements and notices detailing times and duration of road closure.

Impact on access to facilities, goods and services

Significance without optimisation: **positive** impact of **moderate** significance

Optimisation:

The benefits are to some extent dependent on the enterprise of taxi operators and the goodwill of passing motorists. However, appropriate siting of sufficient stopping and off-loading areas for taxis and buses should be provided.

Impact on employment and business opportunities

Significance without optimisation: **positive** impact of **moderate** significance

Optimisation:

Training programmes for local residents to assist them in marketing and business practices. Existing small businessesalong the road appear to have failed to incorporate transport costs into their goods prices.

Impact on dust and mud

Significance without optimisation: **positive** impact of **moderate** significance.

Optimisation:

Suitable design of road shoulders is required - they should have a firm, well drained surface, otherwise pedestrians are likely to walk on the road itself, especially in wet conditions.

Impact on road safety

Significance without optimisation: **positive** impact of **low** significance

Optimisation:

Speed limits should be imposed along dangerous sections of the road, especially on mountain passes and in villages. Adequate road shoulders should be provided for the safe passage of pedestrians and livestock. Where bridges are built, there should also be sufficient space for safe passage of pedestrians and livestock, particularly where there are no existing bridges that could serve as alternative crossing points.

Introduce road signage, zebra crossings, speed ripples, and reduced speed limits at villages, schools and other crossing points to indicate pedestrian hazard. Provide traffic barriers where appropriate in villages to limit access to the road to safe crossing sites.

Effective, appropriate road safety education programmes should be introduced, particularly in schools.

Impact on potable water supplies

Significance without mitigation: **negative** impact of **high** significance

Mitigation:

Wells and standpipes should be provided at points no further from the village than the existing water sources. Given the experience of villages along the Katse Road, and the slow implementation of the VWP's schemes, the replacement of water sources impacted by upgrading of the WAR should be a priority.

Impact on convenience and risk to people and livestock

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

Passage of vehicles and livestock during construction, should be assisted by personnel to ensure one-way traffic and increased safety.

Retain all bridges during construction of new ones.

Notify nearby residents when blasting will take place and place signs at the bottom of the pass on which blasting is to occur to inform motorists of blasting schedule.

Impact on agricultural resources

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

(a) Loss of arable land

Where possible, the side of the road not impinging on gardens and fields should be widened. The construction of temporary roads and other infrastructure on arable land should be avoided where possible. Temporary infrastructure should be located in old disused quarries, degraded land, or on other non-agricultural land. These decisions must be made in consultation with local residents.

If land-owners cannot obtain fields on which to grow crops in the interim (through *seahlolo*), they should be given compensation for the time fields are out of production. All grazing or arable land that is affected by construction activities must be rehabilitated to previous condition.

See Guidelines for Rehabilitation.

(b) Loss of winnowing areas

If no natural areas within an acceptable distance are found, new winnowing areas should be created.

(c) Loss of fruit and other trees

Where possible and without impinging on more important resources, the road should be widened on the side of the road opposite to the trees. Where this is impossible the owner should be compensated for the loss, according to the LHDA compensation plan and provided with young trees for replanting.

(d) Loss of Livestock facilities

Where destruction of kraals is unavoidable they should be dismantled before bulldozing or blasting takes place and the stones reused for rebuilding. At some locations the road could be widened on the opposite side to the kraal, which would avoid the necessity of relocating these facilities.

It may be possible to avoid destruction of the stock kraal at km 31 by raising the level of the road and erecting barriers. The stock pen, adjacent to the diptank, could be moved to the opposite side of the diptank and trees planted to provide shade for the animals.

Impact on cost of living

Significance without mitigation: **negative** impact of **moderate** significance.

Mitigation:

Little can be done, apart from introducing government subsidies and encouraging economic development plans for the area.

Impact on houses, businesses and facilities

Significance without mitigation: **negative** impact of **high** significance

Mitigation:

Ensure compensation is paid timeously and houses provided or compensated for before existing ones are destroyed. Business-owners should be compensated for loss of premise and loss of income during construction of a new premise in a suitable

location, i.e. one that is near the road and conveniently situated to receive a similar number of customers.

Improved supervision of contractors who build the compensation houses and training of local people in their maintenance.

Inform people of the drawbacks of "modern" houses in contrast to traditional huts to facilitate informed choices.

Inform residents well in advance of loss of toilet facilities, and replace with a new facility of comparable standard before the destruction of the old toilet. Residents should receive a replacement rather than monetary compensation. This is because some resident may not replace their toilets and choose to make use of nearby bushes and gullies with possible health hazards and pollution impacts on streams and springs.

Impact on social patterns

Significance without mitigation: **negative** impact of **high** significance

Mitigation:

There is little that can be done to mitigate the problems of crime and anti-social behaviour. Villages should be encouraged to establish "neighbourhood watch" schemes.

All employers should be responsible for ensuring that there are adequate facilities for their labour. Where possible, these facilities could be located in existing villages in order that local residents may benefit from the worker population. The establishment of dispute resolution committees which comprise members of both the local affected villages and the immigrant workforce should be encouraged. However, the appropriateness of such measures should be discussed with local communities before decisions are taken. Employers of construction workers should be seen to support village authorities.

The provision of compensation houses should be done in a sensitive and consultative manner.

Opportunities should be provided for people to receive training in other skills, including those which would make them more employable during dam and road construction.

Impacts on aesthetics

Significance without mitigation: **negative** impact of **moderate** significance.

Mitigation:

Wetting of dusty road surfaces.

Siting construction camp in developed or already disturbed areas.

Rehabilitation of all disturbed areas according to Rehabilitation Guidelines.

Impacts on aesthetics due to change in architectural style

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

Encourage residents receiving compensation houses to consider traditional houses by informing them of the disadvantages of modern houses in Lesotho's highly variable climate.

Impact on aquatic fauna

Significance without mitigation: **negative** impact of **moderate** signifance

Mitigation:

See Rehabilitation Guidelines for erosion control and rehabilitation.

The dumping of spoil material in stream or river courses should not be permitted.

Avoid siting of borrow pits or quarries along stream/river courses.

Stream courses disturbed or blocked by rockfall arising from construction of the road should be cleared and rehabilitated prior to completion of the contract.

Impact on wetlands

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

Reduce damage to marshes by minimising the amount of cut and fill;

Construct sufficient culverts to ensure adequate drainage;

Erect gabions or other mechanisms for breaking the velocity of water and allowing wide dispersal, rather than creating a narrow channel that would concentrate water flow. Experience with the Bokong wetlands along the Katse Road has shown that it

is extremely difficult to rehabilitate wetlands, especially those at high altitudes (above 2800m), and refer to Rehabilitation Guidelines.

Impact on spiral aloes

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

Proclamation of strictly protected aloe reserves for the larger aloe sites near the Mountain Road. This could reduce collection but will probably not eliminate it.

Training of local people who are currently involved in illegally selling aloes, to cultivate aloes from seed in order to sell them legally to passing tourists. This would avoid the negative economic impact of reduced income to locals if they could no longer sell aloes due to stricter protection. Small aloes are currently sold for between M10 and M20 and large ones for M50.

Increase surveillance by conservation officials and police along tourist routes

Impact on fauna

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

Education of construction workers as to the importance of maintaining populations of remaining faunal elements.

Location of construction camps in already degraded areas preferably where some infrastructure exists. Camps should not be located near cliffs which provide nesting sites for threatened species of birds.

Erection of signs alerting people to the importance and conservation status of rare and endangered fauna.

Increased surveillance by conservation officials and police along roads.

Impact on *Leucosidea* shrubland

Significance without mitigation: **negative** impact of **moderate** significance

Mitigation:

At km 21-22, minimise side cutting on left and transport spoil to a designated spoiling area (See Rehabilitation Guidelines). At km 36.9, realign the road on the left of the existing bridge and minimise cutting on the right side after the bridge by following existing alignment from km 36.9-37.1.

Impact on *Erica alopecurus*

Significance without mitigation: **negative** impact of **low** significance

Mitigation:

Minimise cutting and side spoiling in areas of *Erica alopecurus*.

Where possible, avoid the location of temporary haul roads or other temporary infrastructure on *Erica* habitat.

Impact on grassland vegetation

Significance without mitigation: **negative** impact of **low** significance

Mitigation:

All spoil should as a rule to be transported to designated spoil dumps that will be at most 2 km apart. This will prevent the coverage of large areas below the road due to spoil rolling down the slope. This measure will also concentrate the impact in already disturbed areas such as quarry sites or in other less sensitive areas.

See Rehabilitation Guidelines.

Impact on archaeological material

Significance without mitigation: **negative** impact of **very low** significance

Mitigation:

Collect stone tool scatters and house significant items in a local museum.

Impacts on palaeontological remains

Significance without mitigation: **negative** impact of **very low** significance

Mitigation:

Survey lowland sedimentary rock areas adjoining the road before construction of the road.

Appendix 3. Tables of chainages at which mitigation measures may have to be applied.

Table 1. Chainages at which mitigation for loss of potable water supplies may have to be applied.

Type of water source	**Chainage (km)** (St. Michael's = 0 km)	**Roadside**
Spring	18.1	Left
Pipe	27.9	Right
Spring	30.63	Left
Spring	32.9	Right
Spring	54.71	Right

Table 2. Chainages at which mitigation for loss of houses, businesses and facilites may have to be applied.

Type of structure	Number	Chainage (km) (St. Michael's = 0 km)	Roadside	Distance from centre line (m)
Houses	1	10.35	Left	9
	1	10.4	Right	10
	1	10.42	Left	8.6
	2	10.43 - 10.45	Right	6.9 & 10
	2	10.47 - 10.49	Left	8.6 & 9
	1	10.5	Right	9.5
	1	10.55	Left	6.7
	1	10.6	Right	7.6
	3	32.95	Left	6.2 - 8.4
	1	53.4	Right	7
	1	53.4	Left	9
	1	53.55	Right	9
Toilets	1	1.25	Right	8.5
	1	1.65	Right	9.9
	1	10.25	Left	10
	1	14.7	Right	14
	1	28.21	Right	11
	1	28.6	Right	?
	1	28.7	Right	6.2
Businesses	1	10.4	Left	7.4
	1	31	Right	6.2
	1	53.55	Right	8

Table 3. Chainages at which mitigation for loss of cultivated land may have to be applied.

Type of cultivation	Chainage	Roadside	Possible area lost
Sorghum	1.95 - 2.1	Left	300 m^2
Maize	4.4	Right	10 m^2
Maize	6.65 - 6.75	Right	50 m^2
Maize	8.1 - 8.15	Right	35 m^2
Maize	8.8 - 8.9	Right	50 m^2
Sorghum	9.85 - 9.9	Right	50 m^2
Maize	10.1 - 10.2	Right	?
Maize	10.83	Left	2 m^2
Sorghum	13.55	Right	125 m^2
Vegetables	13.65	Right	10 m^2
Sorghum	13.8 - 13.9	Right	50 m^2
Maize	14.65 - 14.7	Right	50 m^2
Maize	14.75 - 14.8	Right	50 m^2
Maize	16.0	Right	15 m^2
Maize	16.2	Right	?
Maize	16.5 - 16.55	Right	150 m^2
Sorghum	16.65	Left	95 m^2
Maize	17.42	Left	150 m^2
Maize	26.2 - 26.3	Right	320 m^2
Maize	26.59 - 26.6	Left	196 m^2
Fallow	26.6 - 26.8	Left	80 m^2
Vegetables	27.28 - 27.45	Right	15 m^2
Maize	27.28 - 27.45	Right	170 m^2
Maize	27.28	Left	30 m^2
Vegetables	27.3	Left	35 m^2
Maize	27.47	Right	120 m^2
Maize	27.55 - 27.8	Right	250 m^2
Vegetables	27.65	Left	13 m^2
Vegetables	28.0	Right	?
Vegetables	28.45	Right	20 m^2
Maize	28.5	Right	40 m^2

Vegetables	28.6	Right	3 m^2
Vegetables	28.72	Right	25 m^2
Vegetables	30.6	Right	207 m^2
Vegetables	30.65	Right	45 m^2
Fallow land	30.65 - 30.7	Left	460 m^2
Wheat	51.05	Right	288 m^2
Wheat	51.4	Right	75 m^2
Vegetables	52.0	Left	15 m^2
Wheat	52.0	Left	24 m^2
Vegetables	52.9	Right	9 m^2
Wheat	53.0	Right	200 m^2
Maize	53.0	Right	150 m^2
Vegetables	53.35	Right	210 m^2
Vegetables	54.55	Left	15 m^2
Maize	55.55	Right	140 m^2
Fallow	55.91	Right	?
Maize	55.95	Right	60 m^2
Vegetables	56.85	Right	90 m^2
Oats	56.85	Right	90 m^2

Table 4. Chainages at which mitigation for loss of wetlands may have to be applied.

Chainage (km) (St. Michael's = 0 km)	**Roadside**	**Area lost**
22.7	Left	150 m^2
27.5	Right	50 m^2
30.5	Right	75 m^2
31.2	Left & Right	300 m^2
33.55	Right	10 m^2
33.6 - 34.5	Left	?
34.6 - 34.7	Right	30 m^2
35.0	Right	10 m^2
35.1	Right	10 m^2
35.15	Right	21 m^2
39.7	Left & Right	20 m^2
40.55	Left	25 m^2
42.15	Left	45 m^2

Table 5. Chainages at which mitigation for loss of *Leucosidea* shrubland may have to be applied.

Chainage (km) (St. Michael's = 0 km)	**Roadside**	**Area lost**
20 - 21	Right	3000 m^2
36.9	Right	700 m^2