A Comparative Evaluation of Two Alternative Access Routes, the Least Cost Alternative Route (LCAR) and the Western Access Route (WAR), for the Mohale Dam Construction, Phase 1B, the Lesotho Highlands Water Project

Proponent: The Lesotho Highlands Development Authority

Prepared by: Marlene T. Laros

July 1993

Submitted in partial fulfillment of the requirements for the degree Master of Philosophy in the Department of Environmental and Geographical Science, University of Cape Town.

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SUMMARY

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1 Introduction

1.1 Contract LHDA 1000

Contract No. LHDA (Lesotho Highlands Development Authority) 1000 is the design and construction of the supporting infrastructure for the Mohale Dam, Phase 1B of the Lesotho Highlands Water Project (LHWP). The Environmental Evaluation Unit (EEU) of the University of Cape Town (UCT) was employed by GBJV (Gibbs-Bergman Joint Venture), consulting engineers, to conduct the environmental impact assessments for contract No. LHDA 1000. The impact assessments were:

* an initial EIA of the Maseru bypass alternatives;
* an EIA of two site access roads at the Mohale Dam construction site;
* an EIA of the Resident Engineers Camp, and

* **an EIA of the Least Cost Alternative Route (LCAR) and the Western Access Route (WAR) for the transport of construction materials to the Mohale Dam site.**

1.2 The EIA of the LCAR and the WAR proposals

The WAR, which forms part of the existing Mountain Road, was identified as a viable option for the transport of construction materials to the Mohale Dam site. The LCAR was identified from eight alternatives, excluding the WAR, in an initial desk-top study, as a viable route.

The WAR proposal involves the upgrading part of existing Mountain Road, which runs in an easterly direction from Maseru, over the Thaba-Putsoa Mountain Range to Thaba-Tseka. The WAR proposal would upgrade 60 km of this presently degraded road between St. Michael's and Patiseng.

The LCAR runs from Maputsoe to Ha Mateka via Teyateyaneng along existing roads. 55 km of new road will be built through the Jorodane Valley from Ha Mateka to Mafotholeng (refer to Map 1).

Two separate baseline EIA reports were produced for the LCAR and the WAR proposals.

2 Purpose of the dissertation

The purpose of this dissertation is:

1) to satisfy the academic requirements for the Master of Philosophy in Environmental and Geographical Science degree;

2) to provide a comparative assessment and evaluation of the environmental considerations of two alternative routes, the Least Cost Alternative Route (LCAR) and the Western Access Route (WAR), to transport building materials for the construction of the Mohale Dam during phase 1B of the Lesotho Highlands Water Project, and

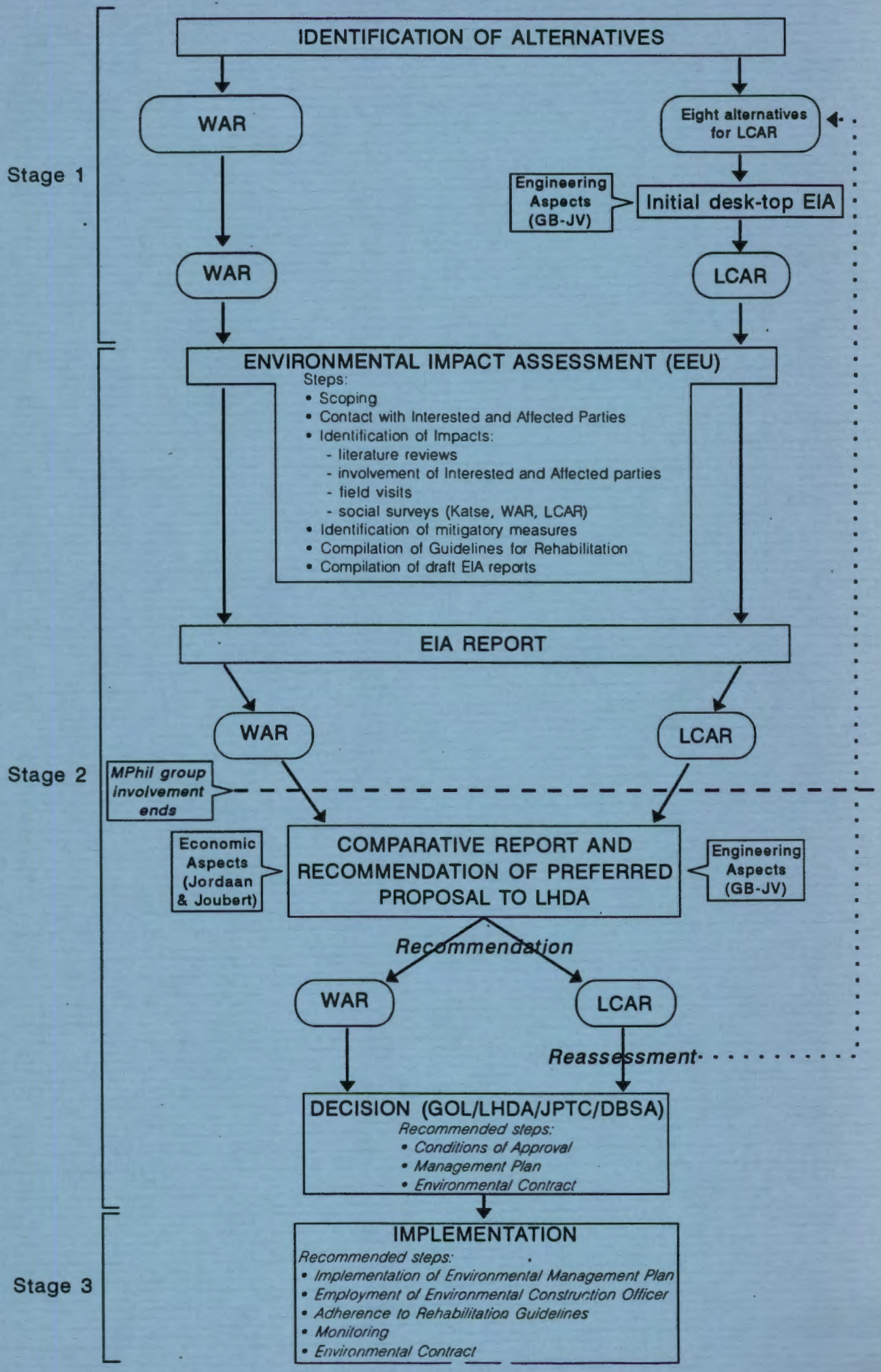
3) to recommend:

   a) a preferred route, and

   b) actions which will aid the LHDA in the effective consideration and management of the affected environments of the preferred option.

SUMMARY IMPACT TABLE (continued)			
LCAR		**WAR**	
Impact	*Significance*	*Impact*	*Significance*
BIOPHYSICAL IMPACTS			
▪ Potential local extinction of two IUCN Red Data Species (Maluti minnow and Aquatic river frog)	**High**		
▪ Increased sediment loading of rivers and streams	**Moderate**	▪ Increased sediment loading of rivers and streams	**Low**
▪ Destruction and local extinction of the Spiral aloe	**Moderate**	▪ Destruction and local extinction of the Spiral aloe	**Low**
▪ Impacts on wetlands	**Moderate/ Low**	▪ Impacts on wetlands	**Low**
▪ Loss of future landuse options for the Jorodane River Valley	**Low**		
▪ Clogging of water courses with rockfall	**Low**	▪ Clogging of water courses with rockfall	**Low**
▪ Alteration of water courses by drainage through ARMCO culverts	**Low**		
▪ Disturbance and death of faunal elements	**Low**	▪ Disturbance and death of faunal elements	**Low**
▪ Destruction of *Leucosidea* shrubland	**Low**	▪ Distruction of *Leucosidea* shrubland	**Low**
▪ Loss of vegetation	**Low**	▪ Loss of vegetation	**Low**
		▪ Destruction of *Erica alopecurus* habitat	**Low**

Figure 1: Procedure for environmental consideration: Mohale Dam access route.



3 Approach to the study

3.1 The baseline study

The environmental impact assessments were conducted according to the broad principles of Integrated Environmental Management (IEM), using an open, participatory approach, and including consultation with interested and affected parties (I&AP's).

The flow chart, Figure 1, illustrates the planning process and the approach used in the impact assessments of the LCAR and the WAR proposals.

3.2 The dissertation

The approach taken in this dissertation is not specifically a critique of the completed study. It focuses, rather, on the advantages of monitoring in EIAs of development projects such as the LHWP and more specifically, the EIA of the alternative access routes (the LCAR and the WAR). However, emphasis is placed on the shortcomings of EIA and social impact assessment (SIA) in the development context so as to illuminate the benefits of monitoring.

A comparative assessment and evaluation of the two routes, the LCAR and the WAR are presented. Although the Maseru bypass is considered as an important factor of the WAR, bypass route alternatives are not evaluated. It is the authors opinion that a bypass will be necessary when the construction of the Mohale Dam commences and that a detailed assessment of the bypass alternatives, which is based on public participation, will ensure that an environmentally rational choice is made.

4 Summary of the impacts for the LCAR and the WAR proposals

Table 1 presents a summary of the impacts identified for the two proposals

5 Summary of evaluation

5.1 National and regional considerations

National and regional planning will benefit to a greater extent through the upgrading of the WAR because:

1) Although the LCAR accords with the Fifth Five-Year Development Plan to a greater extent by servicing presently undeveloped areas, the potential for economic growth and a multiplier effect will be greater for the WAR proposal.

Table 1 Summary impact table

* Significance with mitigation

SUMMARY IMPACT TABLE			
LCAR		**WAR**	
Impact	*Significance*	*Impact*	*Significance*
NATIONAL AND REGIONAL IMPACTS			
▪ The LCAR could negatively affect pony trekking, but promote new types of tourism activities	Moderate	▪ Construction of the Maseru bypass would alleviate traffic congestion	High
		▪ Potential to provide net benefit to tourism and economic growth	Moderate
SOCIO ECONOMIC NEGATIVE IMPACTS			
▪ Social disruption	Moderate	▪ Social disruption	Moderate
▪ Loss of houses and business facilities	Moderate	▪ Loss of houses and business facilities	Moderate
▪ Disruption of local economy	Moderate	▪ Interference with potable water supplies	Moderate
▪ Loss of agricultural resources	Moderate	▪ Loss of agricultural resources	Moderate
		▪ Increased cost of living	Moderate
		▪ Inconvenience and increase risk to people and livestock	Moderate
▪ Increased risk/ danger to people and livestock	Low		
▪ Interference with potable water supplies	Low		
▪ Aesthetic impacts	Low	▪ Aesthetic impacts	Low
▪ Noise and disturbance from blasting	Low		
▪ Disturbance of burial sites	Low		
▪ Increased traffic flow between Maputsoe and Ha Mateka	Low		
SOCIO ECONOMIC POSITIVE IMPACTS			
▪ Improved access to goods and services	High	▪ Improved access to goods and services	High
		▪ Increased employment and business opportunities	Moderate
		▪ Improved road safety	Moderate
		▪ Reduced dust and mud	Moderate
▪ Increased opportunity to market goods	Low		
▪ Increased employment opportunities	Low		
ARCHAEOLOGICAL AND PALAEONTOLOGICAL IMPACTS			
▪ Archaelogical and palaeontological sites	Low	▪ Archaeological and palaeontological sites	Low

2) The WAR accords with the National Settlement Policy to a greater extent than the LCAR as it would strengthen present planned growth points such as Thaba-Tseka and Mantsonyane. Although the LCAR will reinforce planned development in the Leribe and Berea districts as well as that of Teyateyaneng, the Jorodane Valley lacks the institutional capacity to cater for development.

3) The upgrading of the WAR will reinforce to a greater extent, the Lesotho road network plans by contributing to the upgrading of the existing Maseru - Thaba-Tseka link.

5.2 National and regional impacts

The construction of the Maseru bypass makes the WAR the preferred option from a national and regional impact perspective. The Maseru bypass will benefit the residents of Maseru by alleviating traffic congestion in the city.

The pony-trekking activities in the Jorodane Valley will be negatively affected by the construction of the LCAR due to the loss of wilderness character of the area. The reinforcement of current tourist activities along the WAR and the conservation of the wilderness character of the Jorodane Valley will provide greater long-term benefits to the region than the LCAR proposal.

5.3 Socio-economic impacts

5.3.1 Negative impacts

The negative social impacts on the residents of the LCAR will be more pronounced than the WAR for the following reasons:

1) No road exists and the construction of the road will necessitate the penetration of a road reserve through the valley involving land-take and altered landuse patterns. Agricultural resources and burial sites will also be affected to a greater extent.

2) Although the levels of risk to people and livestock will be increased due to increased traffic on the WAR, the potential impact to safety in the Jorodane Valley will be marked as people living here are not accustomed to living with traffic.

3) The construction of the LCAR involves the reduction of income from the illegal cultivation and sale of dagga (*Cannabis sativa*) which will affect the welfare of those dependent on this 'informal' trade.

4) Social disruption and the loss of rural character will be more marked for the LCAR as the Jorodane Valley has no road, has fewer urban influences, as well as fewer modern houses. (This impact may be insignificant when compared to the effects on the Jorodane Valley during the construction and filling of the Mohale Dam.)

5.3.2 Positive impacts

Greater social benefits will accrue to the people along the LCAR in the Jorodane Valley by the provision of access to vehicular transport.

Although households along both routes may increase their income through selling beer, washing clothes and providing accommodation to the people associated with the construction of the road and the dam, the WAR has greater potential to increase employment levels in the area. This can be attributed to the existing higher order services such as tourist attractions (Basotho Pony Centre), shops and accommodation (Molimo Nthuse and Marakabei Lodges). Residents along the WAR therefore have a greater chance of benefiting through increased employment opportunities than those in the Jorodane Valley.

The total social benefits which will accrue to the people of Lesotho are greater for the WAR, whereas the social benefits from the LCAR proposal are localised in nature.

5.4 Biophysical impacts

The biophysical impacts on for the LCAR will be greater than for the WAR proposal for the following reasons:

1) The relative impacts of the LCAR on aquatic fauna (the Maluti minnow, *Pseudobarbus quathlambae* and the Aquatic River frog, *Rana vertebralis*), good water quality and the Jorodane Valley as an ecological system, will be greater than those of the WAR. This is attributable to the fact that a greater amount of earthworks will be necessary for the LCAR and because the LCAR alignment runs close to the Jorodane River for 20 km.

2) The construction of the LCAR and the associated traffic will result in the collection of Spiral aloes for sale to a newly available clientele. The sale of the Spiral aloe already occurs on the Mountain Road and would increase with increased vehicular volumes. The opening up of a new area of exploitation of the Spiral aloe should is seen as having greater implications for the survival of the species.

3) Hydrological impacts are expected to be of more importance on the LCAR and particularly in the Jorodane Valley where the water quality is high and the river flow unmodified.

4) The Jorodane Valley is considered deserving of high conservation status as is the river catchment. Two proposals have also been put forward which involve

the protection of this system. The construction of the LCAR may foreclose the option to incorporate the Jorodane valley into the Maluti Mountains-Jorodane Valley-Bokong River reserve system.

The provision of a road in the Jorodane Valley will increase access to the area and will increase pressures on available resources due to the influx of people associated with the building of the road and the Mohale dam. As the LCAR will be constructed close to and in proximity of the Jorodane River, any activities which aim to take advantages of the newly available passing clientele, will have the potential of negatively affecting the ecological functioning of the system.

6 Conclusion

The benefits associated with the WAR proposal are of a regional and national nature whereas those associated with the LCAR are mainly localised. The potential negative impacts to the social and the biophysical environments are greater for the construction of the LCAR than for the upgrading of the WAR. It is therefore recommended that the Western Access Route (WAR) is used as the access route to the Mohale Dam for Phase 1B of the Lesotho Highlands Water Project as it will result in greater environmental and the least environmental costs.

7 Recommendations

The following recommendations to the LHDA are considered essential if the Mohale Dam and associated infrastructure are to be developed in an environmentally responsible manner.

7.2 An holistic approach

An integrated approach to the environmental consideration in contract no. LHDA 1000 and the Mohale Dam developments is necessary to facilitate the effective consideration of the affected environment. It is not possible to view long-term impacts of the WAR proposal without the consideration of the Mohale Dam development and other associated infrastructure such as the construction camps and quarry sites.

It is necessary that the long-term environmental effects of Phase 1B of the LHWP are viewed holistically and that contractual constraints do not impede the effective consideration of the affected environment.

7.3 Public participation

Public participation in the decision and implementation phases should move beyond consultation. The involvement of local people and the use of existing community

organisations is essential during the upgrading of the WAR particularly with respect to relocation of people, land-take and compensation. The implementation of mitigation and optimisation measures should be a participative process. For example, the position of bus and taxi stops should be decided by the affected village.

Public participation will also benefit the success of monitoring and regional development programmes.

7.4 Monitoring

The accuracy of predicting social and biophysical changes caused by projects through EIA may be limited by the compartmentalisation of change into discrete impacts. Instituting a monitoring programme for the WAR and the Mohale Dam construction will not only aid the LHDA in the application of their compensation plan, but will also provide information about environmental changes which can be used in other phases of the LHWP.

The involvement of local people in the monitoring programme will be central to its success. Local teachers or clinic employees and other respected community members for example, could be employed by the LHDA on a part-time basis, to monitor chosen aspects of the environment. Monitoring need not necessarily be quantitative and can involve the qualitative description of social changes in the community.

7.5 The Environmental Management Plan

An Environmental Management Plan (EMP) should be drawn up for phase 1B of the LHWP. The EMP should be designed to incorporate the various phases of the Mohale Dam developments. It should be anticipatory to the development actions.

7.6 Employment of an Environmental Construction Officer

The employment of an Environmental Construction Officer (ECO) is strongly recommended in the Rehabilitation Guidelines of the Baseline Documents.

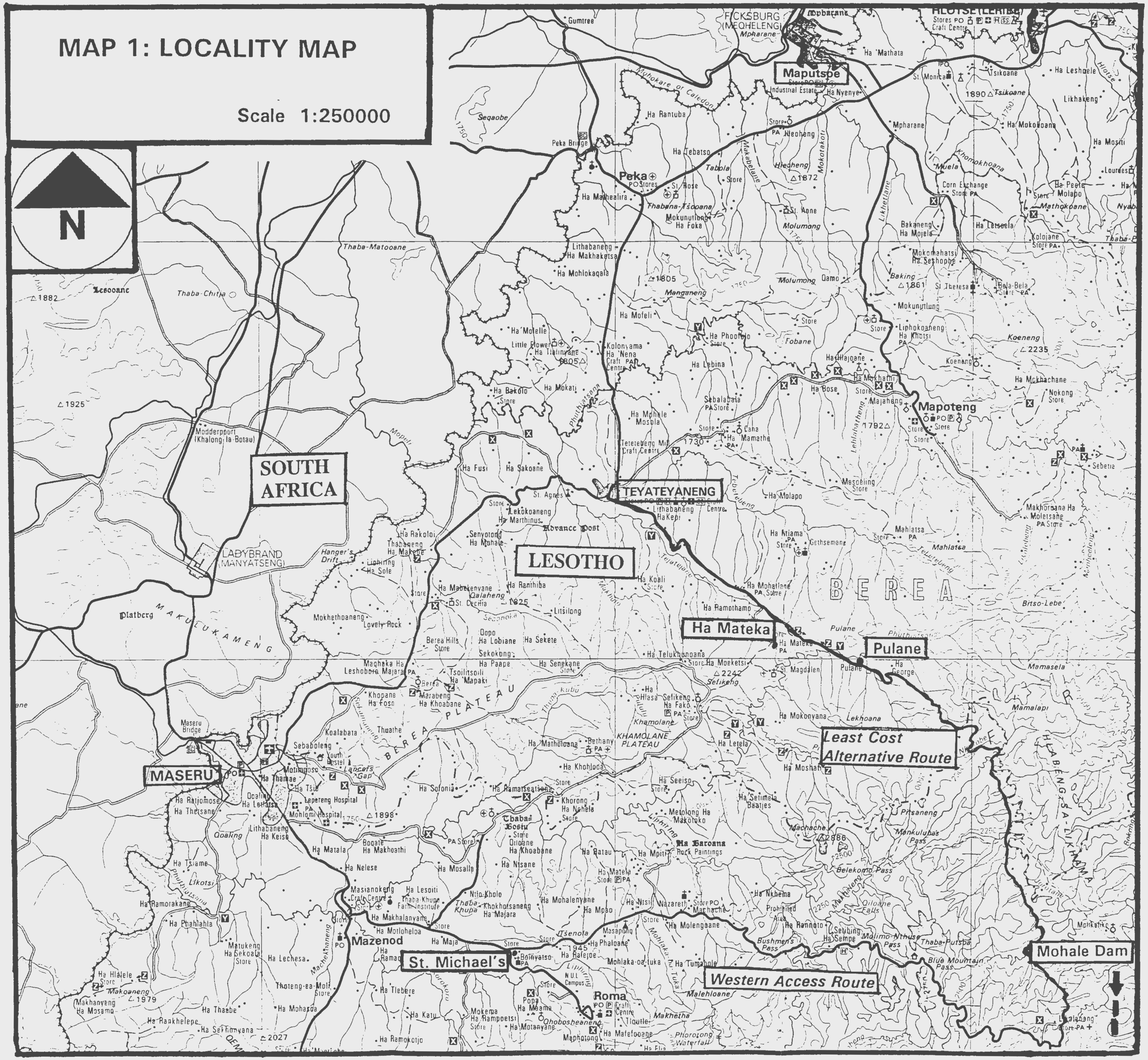
An ECO, trained in environmental monitoring should be on site at all times during construction in order to monitor activities and ensure that the requirements of the Environmental Management Plan are adhered to. The ECO should report directly to the Site Engineer so as to avoid unnecessary delays in construction.

7.7 Regional development programme

The LHDA has a commitment to rural development. The institution of a rural development programme, therefore, should be a priority. The uneven development at the Katse Dam site however, is a blatant reminder of the effect of these development initiatives in the absence of funding.

MAP 1: LOCALITY MAP

Scale 1:250000



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EEU/2/93/104b - Environmental Impact Assessment of the Western Access Route (WAR)

EEU/2/93/104c - Environmental Impact Assessment of the Least Cost Alternative Route (LCAR)

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GLOSSARY/ABBREVIATIONS

EEU	Environmental Evaluation Unit, UCT
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GBJV	Gibbs-Bergman Joint Venture
GDP	Gross Domestic Product
GNP	Gross National Product
GOL	Government of Lesotho
I&APs	Interested and Affected Parties
IEM	Integrated Environmental Management
IUCN	International Union for the Conservation of Nature
LCAR	Least Cost Alternative Route
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LSPP	Land, Survey and Physical Planning
km	kilometres
km/h	kilometre per hour
m	metres
m^2	square metres
M	Maloti (Lesotho currency equivalent to rands)
NGO	Non-Government Organisation
NSP	National Settlement Policy
SIA	Social Impact Assessment
STD	Sexually Transmitted Disease
UCT	University of Cape Town
WAR	Western Access Road

SECTION A:

INTRODUCTION AND

THEORETICAL CONSIDERATIONS

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THE DISSERTATION

The purpose of this dissertation is:

1) to satisfy the academic requirements for the Master of Philosophy degree in the Department of Environmental and Geographical Science;

2) to provide a comparative assessment and evaluation of the environmental considerations of two alternative routes, the Least Cost Alternative Route (LCAR) and the Western Access Route (WAR), to transport building materials for the construction of the Mohale Dam during phase 1B of the Lesotho Highlands Water Project, and

3) to recommend:

   a) a preferred route, and

   b) actions which will aid the LHDA in the effective consideration and management of the affected environments of the preferred option.

1.2 STRUCTURE OF THE DISSERTATION

The dissertation is presented in the following sections

Section A: The introduction provides the context in which to view the dissertation. It provides the background to the study, a description of the affected environment and the theoretical context in which the study is seated.

Section B: The assessment and the evaluation of the Least Cost Alternative Route (LCAR) and the Western Access Route (WAR) are presented in two chapters.

Section C: The conclusions of the evaluation of the LCAR and the WAR are presented and recommended actions for the preferred alternative and Phase 1B of the Lesotho Highlands Water Project are put forward.

Section D: The reference material used in the dissertation is listed.

Section E: Appendices.

1.3 BACKGROUND TO THE STUDY

1.3.1 The Lesotho Highlands Water Project

In 1986 a treaty was signed by the Government of Lesotho and the Government of the Republic of South Africa (LHDA, 1986a). The building of a number of dams and pipelines for the impoundment and extraction of a portion of Lesotho's water resources, in order to supply water demands in the transvaal, was agreed to. The Lesotho Highlands Water Project (LHWP) was set in motion by the establishment of a quasi-government authority, the Lesotho Highlands Development Authority (LHDA).

1.3.2 Contract No. LHDA 1000

Phase 1A of the LHWP is the construction of the Katse Dam and supporting infrastructure. Phase 1B is the construction of the Mohale Dam on the Senqunyane River, and supporting infrastructure. Contract No. LHDA 1000 includes the design and construction of some of the supporting infrastructure for the Mohale Dam:

- **The access route for the transport of materials from the Lesotho-South Africa border;**
- **The Maseru bypass;**
- The resident engineers camp, and
- The dam-site access road.

Contract No. LHDA 1000 was awarded by the LHDA to the Gibbs-Bergman Joint Venture (GBJV) on 18 December 1992. The Venture comprises a 50% Lesotho partner (Sir Alexander Gibbs & Associates, Maseru) and a 50% South African partner (BS Bergman & Partners, Pretoria). The Environmental Evaluation Unit (EEU) of the University of Cape Town (UCT) was appointed by Bergman and Partners (consulting engineers) to conduct an Environmental Impact Assessment (EIA) of *inter alia* the upgrading and operation of the Western Access Road and the construction operation of an alternative route, the LCAR, which was identified from a selection of eight alternative routes in an initial desk-top assessment.

The second year Master of Philosophy students of the Department of Environmental and Geographical Science at UCT constituted the environmental evaluation team of the EEU under the direction of Dr J. Raimondo (Project manager) and Ms S Grindley (Project leader).

1.3.3 The access routes: LCAR and WAR

One of the proposed alternative access routes is the existing "Mountain Road" or Western Access Road (WAR) which runs in an easterly direction from Maseru over the Thaba Putsoa Mountain Range to Patiseng village near the site of the Mohale Dam (Map 1). A second route was identified from a selection of eight alternative routes as the Least Cost Alternative Route (LCAR) during the first stage of the study (GBJV, 1993). The report on the environmental considerations applied in the selection of the LCAR is given in Appendix 1 of the Baseline Documents.

The Western Access Road begins at the St. Michael's turnoff from the Maseru-Roma road and follows existing roadway for 60.4 km until the turn-off to the proposed Mohale Dam at Patiseng. It forms part of the Lesotho trunk road system linking Maseru and Thaba-Tseka (see Map 1). It was proposed that a Maseru bypass would be constructed should the WAR be chosen as the preferred option to provide access to the Mohale Dam.

The LCAR runs from Maputsoe to Ha Mateka via Teyateyaneng along existing roads, and from here along a proposed new route down the Jorodane valley to Mafotholeng on the Mountain Road (see Map 1).

A detailed description of the LCAR and the WAR and the specific project actions for each are included in Appendix 1.

1.3.4 The initial EIA of the Maseru bypass alternatives

Alternatives for the Maseru bypass, which would be constructed as a part of the WAR, were assessed with respect to the social and biophysical costs and benefits they would cause. The report submitted to GB-JV stressed that the bypass should maximise social benefits and minimise the social and biophysical costs (EEU/2/93/104a).

1.3.5 The EIAs of the LCAR and the WAR

The environmental evaluation team compiled two separate impact assessment reports for the LCAR and the WAR:

- Environmental impact assessment of the Western Access Route (WAR) (EEU/2/93/104b)
- Environmental impact assessment of the Least Cost Alternative Route (LCAR) (EEU/ 2/93/104c)

The EEU compiled and presented the final evaluation report of the two alternatives to GB-JV. The members of the Masters of Philosophy class were to compile individual dissertations presenting a comparative assessment and evaluation of the two alternative access routes to fulfill the requirements of the degree.

1.4 OUTLINE OF THE PROJECT PROPOSAL

1.4.1 General

The proposal for the provision of an access route for the transport of building materials to the Mohale Dam site would involve either the construction of the LCAR from Maputsoe to Mafotholeng through the Jorodane Valley or the upgrading of the existing Mountain Road from St. Michael's to Patiseng (WAR).

The expected increase in average daily traffic for the routes is 200 vehicles per day during peak construction activities, a maximum of 16% of which will be heavy vehicle traffic.

A brief description of the proposals for the alternative routes is given below. A full description of the routes and the specific project actions is included in Appendix 1.

1.4.2 The LCAR proposal

The route under consideration would provide access to the Mohale Dam through the Maluti Mountains, via the Jorodane Valley. A preliminary alignment for the proposed road was submitted to the EEU for assessment of biophysical and socio-economic impacts. Guidelines addressing biophysical and socio-economic concerns were submitted to the Engineer for consideration during the preliminary design of the alignment (Appendix 2 of the Baseline Document). The alignment is subject to alteration, should the Engineer consider suggested re-alignments viable.

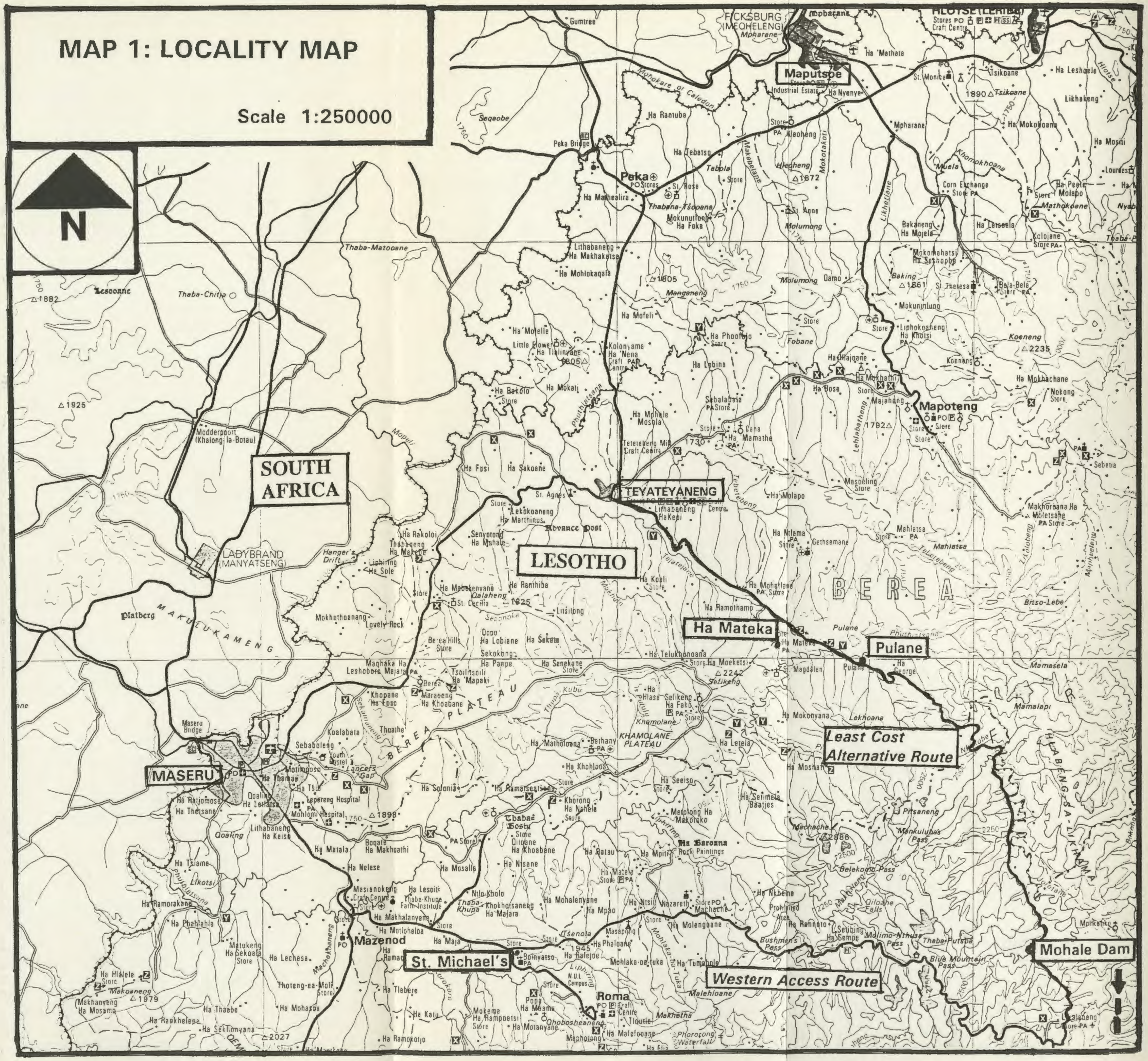
Existing roads will be used between Maputsoe to Teyateyaneng, where a bypass option will be considered, and then to Ha Mateka. 55 km of new road will be built from Ha Mateka to the Mohale Dam site (see Map 1).

1.4.3 The WAR proposal

The upgrading of the Mountain Road i.e. the WAR proposal, will involve the construction of a Maseru bypass (see Baseline Document: EEU/2/93/104a) so that

MAP 1: LOCALITY MAP

Scale 1:250000



traffic congestion occurring in the city will not be exacerbated during the construction of the Mohale Dam.

The section of the WAR from Maseru to St. Michael's does not currently need upgrading, but the section from St. Michael's to Patiseng will need upgrading to deal with the increased traffic load (see Map 1).

The proposal is to upgrade the WAR from St. Michael's to Patiseng to form a paved road. Upgrading will follow the existing road alignment, with small exceptions where widening of selected curves is required for safety or operational reasons. The road will be widened to a surfaced width of 8 m (total road width more than 9 m) except on portions which have a low traffic volume or are very difficult to widen. In the latter areas the road will have a minimum surfaced width of 7 m.

1.5 TERMS OF REFERENCE

1.5.1 The Initial EIA of the Maseru bypass

The EEU was responsible for providing an initial EIA of the potential biophysical and socio-economic impacts as well as the compensation requirements associated with the Maseru bypass alternatives identified by Jordaan and Joubert (traffic engineers).

1.5.2 The EIAs of the LCAR and the WAR

The role of the EIAs was to:

* **predict** all the negative and positive **impacts** on the biophysical and socio-economic environments along the LCAR and the WAR, taking into account LHDA's overall policy objectives as well as the regional and national context of the project;

* **identify** and **consult** with the people who are likely to be affected by the road to obtain their views and concerns regarding the proposals;

* **assess** each of the identified impacts for their overall **significance**;

* recommend **mitigation** for potentially significant negative impacts as well as compensation requirements, and

* suggest **optimisation** measures for potentially significant positive impacts.

1.5.2 The comparative assessment and evaluation of the LCAR and the WAR

The brief for this dissertation is to provide a comparative assessment of the LCAR and the WAR. The individual is given the latitude to focus on any relevant aspect of the study while satisfying the specific requirements of a good impact assessment report.

1.6 APPROACH TO THE STUDY

1.6.1 General

The environmental impact studies for the Maseru bypass and the access route alternatives, the LCAR and the WAR, were conducted according to the broad principles of Integrated Environmental Management (IEM), using an open, participatory approach, and including consultation with interested and affected parties (I&AP's).

1.6.2 The approach used in the EIAs of the LCAR and the WAR

Significant negative impacts, both socio-economic and bio-physical, were identified for the LCAR and the WAR, and actions necessary to minimise or mitigate these impacts were recommended. The study also included a consideration of the optimisation of positive aspects of the routing alternatives, in accordance with LHDA's stated policy of development of the sub-region (LHDA, 1986b).

The following tasks were carried out during the project cycle:

(i) **Initial contact with interested and affected parties:** This was undertaken by means of meetings with as many identified interested and affected parties (I&AP's) as possible. A listing of the I&AP's contacted and the issues raised during meetings is given in the Appendices of the Baseline Documents. A chain referral system was used to identify further I&AP's.

(ii) **Regular discussions with the client (LHDA) regarding the scope of and approach to the project**, this was an iterative process whereby information was gathered, collated and summarized.

(iii) **Identification of impacts** by means of:

* literature reviews;
* further contact with I&AP's and input by specialists in the fields of rehabilitation, hydrology, road engineering, and archaeology;
* field visits;

* a social survey conducted among 315 respondents from 16 villages along the WAR, and 265 respondents from 19 villages in the Jorodane River valley (8-15 March 1993), and

* reference to information obtained from a survey conducted along the Katse Road.

(iv) **Identification of appropriate measures to mitigate negative impacts and enhance positive impacts** through reference to the LHDA's Compensation Plan (1990), and from consultation with specialists. Suggested mitigation and optimisation measures as relevant to the identified impacts is given in the Appendices of the Baseline Documents.

(v) **Compilation of guidelines regarding rehabilitation, erosion control and other environmental concerns** to be included in contractor tender documents for contract LHDA 1000. The Rehabilitation Guidelines are provided in the Appendices of the Baseline Documents.

(vi) **Compilation of Environment Impact Assessment (EIA) report.**

1.6.3 Approach used in this dissertation

The approach taken in this dissertation is not specifically a critique of the completed study. It focuses, rather, on the advantages of monitoring in EIAs of development projects such as the LHWP and more specifically, the EIA of the alternative access routes (the LCAR and the WAR). However, emphasis is placed on the shortcomings of EIA and SIA in the development context so as to illuminate the benefits of monitoring.

A comparative assessment and evaluation of the two routes, the LCAR and the WAR are presented. Although the Maseru bypass is considered as an important factor of the WAR, the bypass route alternatives are not evaluated. It is the authors opinion that a bypass will be necessary when the construction of the Mohale Dam commences and that a detailed assessment of the bypass alternatives, which is based on public participation, will ensure that an environmentally rational choice is made.

1.7 ASSUMPTIONS AND LIMITATIONS

1.7.1 Assumptions

* Any construction of a road to the Mohale Dam should serve the interests of the local people, regional development, and of the national economy. This will

require that the road will link with other major transport networks (the Mountain Road), and not only provide access to the Mohale Dam site.

* A Maseru bypass will be built if the Western Access Route is chosen as the preferred alternative to serve the Mohale Dam. The initial environmental impact assessment will be followed by a detailed assessments including a social survey, should the WAR upgrading proposal be the preferred option.

* Should the LCAR be selected as the preferred alternative, further environmental investigations will be carried out regarding the most suitable alternative route.

1.7.2 Limitations

* Although independent studies exist (Thoahlane, 1991; Makuta, 1991), no monitoring of social change over time has been attempted along the Katse Road. Therefore predictions of social change during the project phases for the WAR and the LCAR may be unsubstantiated.

* No recent aerial photographs of the study areas were available.

* Details of the siting of construction camps, quarries and borrow pits were not available at the time of the study.

* The road construction camps, and the infrastructure required for the construction of the Mohale Dam were not included in the terms of reference, except for the siting of the Resident Engineer's Camp. This has created a gap in the study where predicted impacts might be outweighed by those caused by the actions of the dam construction.

* There is no integrated development plan for the Phase 1B area which indicates how the various component projects are inter-related. The component projects include the dam itself, access roads and developments such as resettlement villages, tourist facilities and feeder roads. As all planning for Phase 1B is still in its early stages, this information is not yet available from LHDA.

1.8 DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.8.1 Introduction

A detailed description of the affected environments is presented in the Baseline documents for the LCAR and the WAR and associated Maseru bypass. A condensed version of the description of the affected environment is presented here so as to provide

the context in which to view the assessment and evaluation of the alternative routes. Repeating information presented in the Baseline Document is unavoidable.

1.8.2 General

a) National and regional planning and development

Three important components of the national and regional planning and development environment are the national planning objectives, the Lesotho road network and Settlement planning. Their central objectives and deficiencies are outlined below.

i) National planning and development objectives

The primary development objectives outlined in the Fifth Five Year Plan (Ministry of Planning, Economics and Manpower Development, 1993) are:

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

In 1991 a study initiated to determine the extent and cause of poverty in Lesotho (Sechaba, 1991), identified the following main concerns:

* wealth in Lesotho is distributed in grossly unequal ways, leading to extensive relative poverty, and
* poverty is much more common in the mountain and other remote rural areas than in urban areas, district headquarters and lowland villages.

ii) Lesotho road network and maintenance

A contrast exists between the quality of the road network in the western lowlands and that in the east and the mountainous regions of Lesotho. Shortcomings in the existing road network include the following:

* Despite efforts to improve the road network, the majority of roads including strategic routes, are still unpaved, low quality roads, frequently impassable during the wet season.
* Many areas are without access for motor vehicles, particularly in the mountain areas.

* Linkages to the mountain areas are poor.

* Maintenance of existing roads is inadequate.

iii) The National settlement policy

The aim of the National Settlement Policy (NSP) (Ministry of the Interior, 1990) is to promote balanced settlement development and to protect natural resources and the environment affected by settlement development.

The present settlement pattern in Lesotho is viewed as unbalanced because, while the national capital is growing rapidly in an uncontrolled manner, settlement development in the mountain districts has been very limited.

The NSP calls for the unbalanced settlement to be influenced so that:

* the growth of Maseru is kept under control;

* at least one viable centre is developed in each district and some district centres are developed into regional centres, and

* settlement development is promoted in presently under-serviced areas particularly in the mountain districts.

These goals should be achieved, *inter alia,* by harmonizing road plans with NSP proposals and promoting the decentralisation of public administration and the establishment of local authorities in all centres.

iv) Tourism

Tourism in Lesotho has generally been limited by poor infrastructure and minimal advertising of Lesotho's attractions abroad. Since the decline of the attraction of the gambling casino in Maseru, the strategy for tourism has shifted in emphasis to developing the natural attractions in the interior of Lesotho (ERL, 1990). This would include historical and archaeological sites, pony trekking and other scenic recreational sports in the mountainous areas.

Estimates for revenue from tourism in Lesotho were M33.8 million in 1989, which constituted 3.1% of Gross Domestic Product (GDP) and 1.7% of GNP. While direct employment by the tourism sector is relatively low (2112 jobs in 1989), the indirect role it plays (i.e. secondary effects such as stimulation of trade) cannot be ignored (Ministry of Planning, Economics and Manpower Development, 1993).

b) Socio-economic environment

Lesotho's two major resources are water and the western grasslands (Trollip, 1981). Lesotho's economy can be seen as being dependent on the core economy of South

African industrialisation (Trollip, 1981). 65% of the potential labour force is employed (i.e.. 36% of total population), with migrant labour making up 15% of the labour force (Setplan, 1991).

The rural sector, comprising 80% of the population, plays a major role in the domestic economy, producing 45% of the Gross National Product GNP (Trollip, 1981). The rural economy though, is supported by the of the high level of migrant wage labour in South African mines.

Migrant labour has wreaked havoc on family life (Murray, 1981, in Sechaba, 1991) with many men leaving Lesotho to work in South Africa, mainly on the mines. The long absence of traditional household heads has created a high proportion (60-70%) of *de facto* women-headed households (Wilkinson, 1987). Approximately half of these women have migrant worker husbands and receive remittances; the rest are widows. The high number of widows may is attributable to the high mortality rates associated with mining in South Africa and to the fact that rural husbands are usually much older than their wives (Wilkinson, 1987).

The relatively high wages from mine labour undermine the desire for high agricultural productivity, which is further undermined by the soil becoming increasingly 'tired' because of mono-cropping, erosion and lack of organic matter due to the collection of dung for fuel (Sechaba, 1991).

Lesotho has a great inequality of resource distribution. (Sechaba 1991). This inequality has become greater over the past ten years, with the vast majority of those who do not have access to salaries or wages "sunk deeper into poverty" (Cobbe, 1988 in Sechaba, 1991). Poverty levels have a geographical component: "Generally poverty is less evident in Maseru, greater in the Lowland district centres, greater still in the peri-urban Lowlands, greater still in the Foothills and mountain district centres, and greatest in the Highlands" (Setplan, 1991).

* 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, and
* lack of fields.

Livestock are an important cultural and economic resource in the rural areas, providing "security in the form of wealth; draught power to assist agricultural production; food in the form of meat and milk; an annual income from the sale of wool and mohair; fuel from the dung; and in the case of horses and donkeys, transport" (ERL, 1989).

1.8.3 The affected environment of the LCAR

a) Socio-economic environment

i) Maputsoe to Ha Mateka

Maputsoe is a generally busy town, accustomed to the increased traffic and passage of construction vehicles brought by the Katse Dam activities.

The road between Ha Nyenye and Teyateyaneng is well used, both for local transport and as a link between northern Lesotho and the capital, Maseru. The area is characterised by medium to high density settlements.

The area between Teyateyaneng and Ha Mateka has a more rural setting and the road is less intensively used. Villages are frequent but small, and generally situated on hills with the settlements spread out along the road.

Ha Mateka and Pulane are linked by a poorly maintained 4X4 track which is often impassable at the crossing of the Phuthiatsana-ea-Thaba-Bosiu River because of flooding. Villages in the area are rural in character with agriculture being the primary activity.

ii) Ha Mateka to Mafotholeng

Local environment

The area from Pulane, over the Maluti Mountains into the Jorodane River valley is a rugged sparsely populated landscape, most of the small villages being located in valleys at the foot of the pass. Other solitary dwellings with stone wall kraals are used as cattle posts during the summer grazing months.

Settlement in the Jorodane valley is characterised by small villages scattered along both sides of the river catchment area. It is essentially a rural economy, although linked into the national and cross-border cash economy by migrant labour and sale of cash crops.

Poor quality gravel roads give vehicle access into valley from Thaba Putsoa towards Sehlabaneng, and from the Mountain Road to Ha Mohale. Apart from this there is no vehicle access to the valley and transport is by horse, donkey or on foot.

The isolation of the valley from services and markets has resulted in a marginalised community, whose major needs and problems, as expressed in the social survey, are outlined in Tables 1 and 2.

Table 1: The major problems facing households in the Jorodane Valley	
Problem	**% Respondents**
Hunger	80.5%
Lack of Clothing	59.2%
Lack of Employment	28.8%

Table 2 : The major problems facing villages in the Jorodane Valley	
Problem	**% Respondents**
Poor access to clinics	60%
No transport or roads	59.5%
Poor water quality and no stand pipes	34%
Poor access to shops	33%
Lack of food	19.5%

Socio-demographic characteristics and trends

The catchment area of the Jorodane River contains 15 villages of more than 100 inhabitants, and 33 villages of fewer than 100 inhabitants, giving an approximate population of between two and three thousand.

14.8% of adults in the area are employed. Respondents indicated that 70.9% of these were employed as migrant workers in South Africa, and 23.2% elsewhere in Lesotho.

62% of households surveyed have school-going children. Although several primary schools exist in the sub-region, not all the children attend school. Problems experienced in educating children includes lack of money and poor access to schools due to the absence of roads.

Landuse and settlement patterns

The fertile land of the Jorodane Valley is used extensively for the cultivation of crops and as grazing areas.

Social patterns and lifestyles

The villages are relatively isolated from outsiders, except for occasional tourists.

While stock theft was recorded by 92% of respondents, virtually no other crime was reported. However, grazing of lowland cattle in *maboelleng* (grazing land set aside between October and April to regenerate) is a major source of conflict in the area, leading to fights between villagers and lowland cattle herders, and on occasion resulting in death.

Fire wood and paraffin are scarce commodities in this area and the major sources of cooking fuel are cattle dung (*liso*) 62%, and woody shrubs (*sehalahala, kikitlela, lekhapu*). The shrubs are collected from the mountains around the villages.

Economic activities

Cash income is generated mainly from remittances from South Africa and the illegal cultivation of a narcotic plant, *Cannabis sativa* (dagga). Other economic activities include the sale of crops and livestock and renting of accommodation to tourists.

b) Archaeology and palaeontology

The Pulane basin is expected to be particularly rich in archaeological remains and rock paintings due to the nature of the Clarens Sandstone Formation and cave overhangs. One rock painting, reported to be one of the ten best in Lesotho exists at Mokhemeleli. The proposed alignment of the LCAR will pass within 1.5 km from the site.

c) Biophysical environment

i) The Pulane basin and the Lekhalong-la-Likhaebaneng Pass

The Pulane basin is a broad flat basin situated between the Khamolane Plateau to the west and the Maluti Mountain range to the east. The geology of the region is predominantly Clarens Sandstone Formation, capped by Lesotho Basalt Formation. The Pulane basin is drained by the upper reaches and source tributaries of the Phuthiatsana-ea-Thaba-Bosui River. Rainfall is estimated at 900 mm per annum.

The Lekhalong-la-Lekhaebaneng Pass traverses extremely mountainous and rugged terrain over the Maluti Mountains, reaching a maximum altitude of 2 600 m. At present, a poorly maintained track exists for the passage of livestock and individuals on foot or on horseback over the mountains into the Jorodane valley. The pass is impassable during bad weather in summer months (December - April).

The intensive use of the available arable and grazing land in the Pulane Basin would suggest that little natural fauna and flora still remains in this area. The natural vegetation is generally in a very degraded state due to overgrazing and fire, especially along the pass area.

No large bird-of-prey (e.g. vulture or black eagle) nesting sites were identified during the field trip in the mountainous regions of the Pass but their presence should not be ruled out.

ii) The Jorodane River valley

Physical terrain and geology

The Jorodane River valley is bounded to the north and west by the Maluti Mountain Range (highest point 2 875 m), to the east by the Molesi (Hlabeng sa Likhama) Mountain Range (highest point 2 900 m), and to the south by the Thaba-Putsoa Mountain Range (highest point 2 900 m). The valley bottom slopes from an altitude of 2 250 m in the upper reaches to 2 000 m at the confluence with the Senqunyane River.

The Jorodane valley is broad (1-1.5 km) in the upper and mid reaches. The Jorodane River flows in large regular meanders spaced approximately 300 m apart. The river is incised into the valley floor to depths ranging between 10 to 80 m. Towards the lower reaches of the river, up to the confluence with the Senqunyane River, the valley floor narrows and the topography becomes a steeply incised valley. Tributary river valleys of the Jorodane valley enter mainly from the west and are deeply incised. The eastern slopes of the Jorodane valley are steep and the eastern tributaries generally short.

The geology of the region is almost entirely basalts of the Lesotho Formation.

Climate and hydrology

The Jorodane valley receives summer rainfall and snow in winter. The mountainous regions typically receive more than 1000 mm per annum (Chutter *et al*, 1988).

The Jorodane River is a perennial river. It is generally very clear and fast flowing, only becoming turbid for short periods (1-2 days) during storm events. The water quality of the Jorodane River is high, particularly in the upper and mid reaches. The only source of chemical pollution input comes from the sheep dip tank at Soosa and from phosphates in soap used by the local people for washing (Rall, 1993).

Vegetation

The vegetation of the Jorodane valley is almost exclusively short grassland. In places, especially on steep high-lying slopes, it is characterised by overgrazing indicator species, although small areas of relatively undisturbed climax grassland with *Themeda triandra* can also be found.

The wetlands in the valley are mostly small patches that occur below points where there is surface seepage out of the slope. Wetlands are dominated by broom grass (*Merxmuellera macowanii*). Many of these wetlands have been reduced in size and degraded due to autumn burning of the broom grass.

An endangered plant species known to occur in the valley is the spiral aloe, *Aloe polyphylla.* It occurs in isolated colonies on steep mountain slopes at altitudes higher than 2 150 m. There are several localities in the valley where it occurs, the most important one being near the village of Soosa.

Fauna

A description of the aquatic and terrestrial fauna occurring or likely to occur in the study area as well as their protection status, is given in the Appendices of the Baseline document. Two IUCN Red Data rare and endangered species which may be directly or indirectly impacted by construction of the road through the Jorodane River valley are:

- *Pseudobarbus quathlambae* (Maluti minnow): listed as an endangered IUCN Red Data Species and occurs between the waterfall at Pampiri, in the mid-upper reaches of the Jorodane River below Leropong, and the Semongkoaneng waterfall on the Senqunyane River approximately 4 km downstream of the Mohale Dam wall site.

- *Rana vertebralis* (Aquatic River frog): listed as a rare IUCN Red Data Species and occurs throughout the length of the Jorodane River from source to confluence with the Senqunyane River (Rall, 1993).

1.8.4 The affected environment of the WAR

a) Socio-economic environment of the WAR

i) St. Michael's to Patiseng

Local environment

The Mountain Road was built more than forty years ago. In spite of this, the villages along the road still suffer from a dearth of services; the region as a whole suffers from economic stagnation and a lack of higher order services (such as high schools, post offices, banks, petrol stations and supermarkets). The lack of development of the region is reflected in the articulation of needs and problems by participants in the social survey (Table 3 and 4).

Table 3: The major problems facing households along the WAR

Problem	% Respondents
Hunger	77%
Lack of clothing	56%
Unemployment	43%

Other problems included the absence of spur roads leading into the villages from the Mountain Road, lack of money for school fees, and lack of toilets.

Table 4: The major problems facing the villages along the WAR

Problem	% Respondents
Stock theft	57%
Shortage of potable water	43%

The road itself is narrow and has a poor surface in parts, particularly from St. Michael's eastward to Thaba-Tseka. Public transport along the road is largely limited to four buses per day, which do not operate after dark. Service from Kombi taxis is erratic.

Socio-demographic characteristics and trends

The 13 villages of more than 100 inhabitants and 20 smaller villages will be directly affected by the WAR proposal. These households are characteristically comprised of 2.8 adults and up to seven children. At least 14% of absent working age people are employed as migrant workers.

Landuse and settlement patterns

The highland section of the LCAR is more sparsely settled than the lowland areas. Although the landuse patterns and the character of the settlements differ along sections of the WAR, villages have developed spontaneously without physical planning on both sides of the road. A graduation of semi-urban to rural may be seen with increasing distance from Maseru.

Social pattens and lifestyles

Settlements in the lowlands and highlands usually comprise clusters of stone and thatch, unpartitioned huts, often situated on raised hills. Water, for drinking and cooking purposes, is usually collected from a communal spring or tap, while washing is carried out in nearby streams and rivers.

The control of village chiefs varies but is usually stronger in more rural villages.

Economic activities

Major sources of income in the area are remittances from South Africa (almost exclusively miners) (10.6%) and remittances from Lesotho (3.3%).

Cash incomes are also derived by owners of small businesses in the area (shops, petrol station, motor mechanics, home builders), and sales of crafts to tourists. More than forty people hawk peaches daily for the duration of the season along the roadside where the buses stop.

Tourism

A number of tourist attractions exist on the Western Access Road from Maseru to Marakabei:

* pony trekking at Molimo-Nthuse Pass and Marakabei;
* hotels/lodges in Maseru and Molimo-Nthuse;
* the mountain fortress at Thaba-Bosiu;
* rock paintings at Ha Baroana;
* handicraft/weaving centres;
* caravan Park at Toll Gate House, and
* the scenic Bushman's Pass.

Possible future tourist attractions along or near this route (LHDA, 1986b) include:

* activities planned for the Mohale Dam which include pony trekking, fishing, sailing and canoeing, and

* a proposed nature reserve at Roma.

ii) Maseru

Maseru has an annual growth rate of approximately 7% (Ministry of the Interior, LSPP, 1989) and an estimated population of 160 000. The city is characterised by recent unplanned developments such as informal housing and road-side businesses. These unplanned developments are due to the recent retrenchments in South African mines and rural-urban migration, and inadequate enforcement of planning regulations. The Maseru Development Plan has made anticipatory provisions for growth of the city by highlighting and planning for development priorities which include: a Maseru border bridge; the pedestrianisation of parts of the CBD; planned settlement areas with service sub-centres, and a Maseru bypass.

b) Archaeology and palaeontology

i) Archaeology

The majority of archaeological sites in Lesotho are located within the sedimentary geological formations, especially in the lowland areas. Rock paintings made by Late Stone Age San people are commonly found in rock shelters and caves in sandstone

cliffs, especially those of the Clarens Formation. The WAR passes over a sandstone escarpment (km 3) near St. Michael's after which it enters the basalt formations, typical of the rest of the alignment. A few rock paintings are known from the lowland section of the WAR, but none are located close to the road.

ii) Palaeontology

No palaeontological remains are known from these formations along the WAR. However, the best known assemblages of terrestrial reptile fossils have been found in the Stormberg Group of rock formations comprising the Clarens, Elliot and Molteno Formations. These Formations contain important fossils which represent the transition between reptiles and mammals, the earliest mammals and the early radiation of dinosaurs, crocodiles, and possibly even birds.

c) *Biophysical environment*

i) St. Michael's to Patiseng

Geology and terrain

The lowland section of the WAR between St. Michael's (km 0) and Nazareth (km 14) lies at the foot of the mountainous eastern zone of Lesotho. Altitudes vary between 1650 m at St. Michael's on the western side to 1825 m at Nazareth further east. Topography is gently undulating except where the existing road ascends the sandstone escarpment. Between 0-3 km the area is underlain by shales and mudstones of the Elliot Formation ("Red Beds") which yield extremely erodible soils which have, in places, eroded to form several large (more than 4 m deep) active dongas. At km 3 the road negotiates a sandstone escarpment after which, from km 3.5-60.4 at Patiseng the area is underlain by basalt of the Lesotho Formation.

The highland section of the WAR between Nazareth and Patiseng is typified by mountainous terrain and the road travels over three passes: Bushman's Pass (2268 m), God Help Me Pass (2318 m) and Blue Mountain Pass (2650 m). Valleys between the passes are cut by rivers along which the land is more fertile.

Hydrology and Rainfall

Precipitation ranges from 540 mm per annum in the lowlands of Lesotho to more than 1000 mm per annum in the mountainous regions (Chutter *et al*, 1988). Rainfall occurs throughout the year, mostly in summer between December and March generally as a result of thunderstorm activity.

The length of the WAR falls within three major river catchments, the Phuthiatsana-ea-Thaba-Bosiu, the Makhaleng and the Senqunyane. Major tributary rivers of these rivers crossed by the WAR are the Mohlaka-oa-tuka, the Liphiring, the Makhaleng and the Likalaneng. Agricultural practices, settlements and road crossings within the catchments have altered river water quality.

Numerous tributary streams and source water wetlands are crossed by the WAR, particularly in the highlands between Molimo-Nthuse (km 29.5) and Ha Molapo (km 50). Most of the streams and wetlands are spanned by ARMCO culvert bridges or standard cross-flow culverts under the road.

Vegetation

The natural vegetation in the lowland is described by Acocks (1988) as *Cymbopogon-Themeda* grassland. Little of this natural vegetation remains as the area is highly cultivated and is subject to severe overgrazing by domestic livestock.

The highland area is typified by montane grassland, with alpine fynbos vegetation elements occurring at altitudes above 2500 m. Small patches of *Leucosidea sericea* woodland occur on steep, mainly south facing slopes. The vegetation is less disturbed than in the lowland areas as the steep slopes inhibit cultivation.

Fauna

Lowlands of Lesotho has little indigenous fauna as a result of extensive cultivation, overgrazing and hunting. All of the indigenous, diurnal large mammals, except rock hyrax, clawless otter and grey rhebok, have been hunted to local extinction, and large birds of prey, such as Cape vultures, bearded vultures and black eagle, are under severe threat of extinction.

CHAPTER 2

THEORETICAL CONSIDERATIONS

CHAPTER 2

THEORETICAL CONSIDERATIONS

2.1 INTRODUCTION

This chapter provides the theoretical context in which the environmental impact assessments for the WAR and the LCAR were researched, and in which the comparative evaluation of the two alternatives was approached in the dissertation. Only the major principles of the topics are explored, emphasis being placed on the limitations of some of the theories and methods both in their application generally, and in this study. Particular aspects of the theory are integrated into the other chapters of the document where necessary.

Monitoring in EIA and IEM is put forward as a solution to overcoming some of the methodological problems identified as well as limitations imposed by the time constraints within engineering project cycles. All too often, the perception prevails that once the EIA is complete, the mitigatory measures implemented and management plan instituted, our responsibility to the affected people and their environment is over. Increasingly, particularly in South Africa where the profession of environmental evaluation is becoming a fast growing and lucrative business, a need is being felt for some type of retrospective investigation regarding the extent to which IEM and EIA are achieving their stated goals. The following then, presents some theoretical aspects of environmental impact assessment; Integrated Environmental Management (IEM); biological impact prediction; social impact assessment; and finally, monitoring in EIA and IEM.

2.2 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

2.2.1 Some definitions

Environmental evaluation is defined by Munn (1979) as an activity designed to identify and predict the impact of legislative proposals, policies, programmes, projects and operational procedures on human health and well-being, and to interpret and communicate information about the impacts. Fuggle (1992) describes environmental impact assessment (EIA) as the administrative process whereby the environmental impact of a project, plan or policy is determined and environmental impact analysis as a process contained within an EIA through which the environmental effects of a project are analysed. Some confusion exists with respect to the use of these terms in the

literature (which spans almost three decades) but this document adopts the above definitions.

2.2.2 Origins and philosophical background

Environmental impact assessment has an undefinable origin but has been shaped by various influences such as rational planning theory, technology assessment, risk assessment and the policy goals of the environmental movement (Caldwell, 1988). The environmental movement of the 1960s and 1970s, however, may be seen as the most important factor, as it provided the moral and philosophical impetus for the development and institution of EIA. Influential publications of these times such as Rachel Carson's *Silent Spring*, and the more determinist or neo-malthusian writings of the late 1960s and early 1970s such as Hardin's *Tragedy of the Commons* and the Club of Rome Report entitled *Limits to Growth*, focussed on the carrying capacity of the earth and the emerging conflict between industrial growth and environmental well-being. World-wide, the consequences of the post-World War II explosive technological and economic growth brought increasing public apprehension and concern.

In the United States, one response to the growing social consciousness and disillusionment with the prevailing political powers' failure to attend to environmental crises was the inception of the National Environmental Policy Act (NEPA). NEPA (1970) made the consideration of environmental factors mandatory at all levels of decision making in federal agencies. Where major actions were contemplated, a detailed environmental impact statement was to be prepared and made available to the President, the Council for Environmental Quality and the public. Although the United States was the first country to incorporate environmental considerations of this nature into legislation, the 1960s saw "a search for operational tools to guide planning and decision-making having an impact upon the quality of environments and the health and safety of people (Caldwell, 1988:76)."

Environmental impact assessment may have provided the "tools" to inform and aid planning but, according to some environmentalist thought, does not facilitate the questioning of the types of planning or decisions that occur. Of the two main ideological stances in post-1970s environmentalism, the ecocentric and the technocentric modes, EIA is seated in the latter (O'Riordan, 1981; Pepper, 1984). The technocentrist attitude toward nature is that it can and should be managed so as to facilitate progress. Technocentrism as defined by O'Riordan (1981), accepts the status quo of political and economic power, and assumes the ability of humans to control and understand events to suit their purposes. Control and understanding is sought through the application of theories and models to predict changes in behaviour and value systems and the use of science to manage nature. Ecocentrism, on the other hand, is characterised by a lack of faith in modern technology and associated elitist expertise, and materialism for its own sake. Ecocentrism seeks to defy the status quo, politically

and economically, and would argue that EIA reinforces, rather than challenges present social disharmonies.

While the philosophical debate within environmentalism continues, environmental impact assessment remains one of the few *means* to enable the conservation of natural resources and perhaps the self-determination of people, albeit within prevailing social structures.

2.2.3 EIA procedure

Although EIA has developed substantially since the early years with respect to available methodologies and the extent to which they are integrated into the planning process, it is generally accepted that an EIA should:

a) describe the proposed action, as well as alternatives;

b) estimate the nature and magnitude of the likely environmental changes (including action-induced effects)

c) identify the relevant human concerns;

d) define the criteria to be used in measuring the significance of environmental changes, including the relative weighting to be assigned in comparing different kinds of changes;

e) estimate the significance of the predicted environmental changes i.e. estimate the impacts of the proposed action;

f) make recommendations for one of the following:

   (1) acceptance of the project

   (2) remedial action

   (3) acceptance of one or more alternatives

   (4) rejection

g) make recommendations for inspection procedures to be followed after the action has been completed (Munn, 1979).

2.2.4 EIA in developing countries

The application of EIA procedures in developing countries has been criticised as inappropriate for a number of reasons:

1) The use of EIA procedures in developing countries imposes western, developed countries' environmental and development perceptions on developing nations (Fuggle, 1990).

2) EIA imposes a democratic means to make inherently political processes ecologically and socially rational (Boggs, 1991) in a context where democratic participation in a decision may not be possible.

3) EIA may be ineffective as there are usually no legal requirements in most developing countries to ensure that the recommendations of an assessment are implemented (Fuggle, 1990).

4) Impact assessments for large projects funded by multinationals or development agencies are known to have had the following important shortcomings:

   a) Methods used are usually devised in developed countries and may not suit the specific biophysical and social context in which they are applied. As a whole the process may suffer from a lack of indigenous skills (Adams, 1990).

   b) Consultants used are usually not nationals but expatriates with the result that problems associated with cross-cultural communication and perceptual differences are common (Carpenter, 1985; Adams, 1990; Burge, 1990; Fuggle, 1990).

   c) These assessments are generally characterised by a low input of social expertise (Adams, 1990).

EIAs have been characterised as finite and reactive instead of proactive in the decision and planning processes (Adams, 1990). However, the extent to which they may be proactive in planning is determined by the institutional capacities and greater planning context in which they are used. In South Africa, Integrated Environmental Management, which is essentially a process of integrating environmental considerations into the project planning process, is seen to provide an African alternative to EIA in environmental evaluation. IEM's most important attribute is its potential to provide an iterative and adaptive approach to environmental planning.

2.3 INTEGRATED ENVIRONMENTAL MANAGEMENT (IEM)

2.3.1 Rationale and principles of IEM

"Integrated Environmental Management (IEM) is a systematic approach developed for ensuring the structured inclusion of environmental considerations in decision-making at

all stages of the development process. The objective of IEM is not to impede development, but to provide an effective approach, using interactive and iterative evaluation techniques, to improve a proposal, or suggest more environmentally acceptable ways of meeting the purpose and need of a development proposal. This enables the responsible authority to identify those actions which are in the best overall interests of society without jeopardising the project as a whole" (Fuggle, 1990:38).

"The basic principles underpinning IEM are that there should be:

* informed decision-making;
* accountability for information on which decisions are taken
* accountability for decisions taken;
* a broad meaning to the term *environment* (i.e., one that includes physical, biological, social, economic, cultural, historical and political components);
* an open, participatory approach in the planning of proposals;
* consultation with interested and affected parties;
* due consideration of alternative options;
* an attempt to mitigate negative impacts and enhance positive aspects of proposals;
* an attempt to ensure that the 'social costs' of development proposals (those borne by society, rather than the developers) be outweighed by the 'social benefits' (benefits to society as a result of the actions of the developers);
* democratic regard for individual rights and obligations;
* **compliance with these principles during all stages of the planning, implementation and decommissioning of proposals (i.e., from 'cradle to grave'), and**
* the opportunity for public and specialist input in the decision-making process" (DEA, 1992: 5).

2.3.2 The IEM procedure

IEM can be applied to all actions which fall into one of three main categories i.e. policies, programmes and projects. The flow diagram Figure 1 and Figure 2 present the IEM procedure.

FIGURE 1: THE INTEGRATED MANAGEMENT PROCEDURE

Stage 1: Plan and Assess Proposal

Proponents of development projects are encouraged to give early consideration to environmental issues by:

- notifying and consulting with authorities and members of the public likely to be interested in, or affected by, the proposal;
- identifying proposal alternatives, and issues associated with these alternatives;
- ensuring that proposals meet with policy, legal and administrative requirements, and
- considering possible mitigatory measures and management plan options.

The *Classification of Proposal* involves an authority decision on the type of environmental consideration necessary i.e., *No Formal Assessment*, *Initial Assessment* or *Impact Assessment*.

No Formal Assessment: The proposal meets planning requirements, the consultant is confident that it will not result in significant impacts and it is therefore submitted for review.

Initial Assessment: There is uncertainty whether the proposal will result in significant impacts, or the proposal is on the *List of Activities* or will occur in an area classified in the *List of Environments*

Impact Assessment: The implementation of the proposal will result in significant impacts. This may be identified through an initial impacts assessment.

Stage 2: Decision

The responsible authority either grants or refuses to grant approval for the proposal. If the information provided is inadequate for a decision to be taken, further information must be furnished before the proposal is granted or refused approval. Conditions of Approval may involve the preparation of a Management Plan and/or Environmental Contract or the commitment to the suggested mitigatory and rehabilitation requirements.

Stage 3: Implementation

During the implementation of the proposal, adherence to the *Management Plan* or *Environmental Contract* will be ensured through *Monitoring* or periodic *Audits*.

2.3.3 IEM and the planning procedure of contract No. LHDA 1000

It is important to note that while the LHDA does not, in policy, subscribe to the IEM procedure, it must fulfill the planning requirements of the funding agency, the Development Bank of South Africa and the World Bank. Two LHDA personnel, including the head of the Environment Division, have attended IEM short courses and claim to subscribe to the procedure (Pers. comm. Nkali; Mateka).

FIGURE 1: THE IEM PROCEDURE

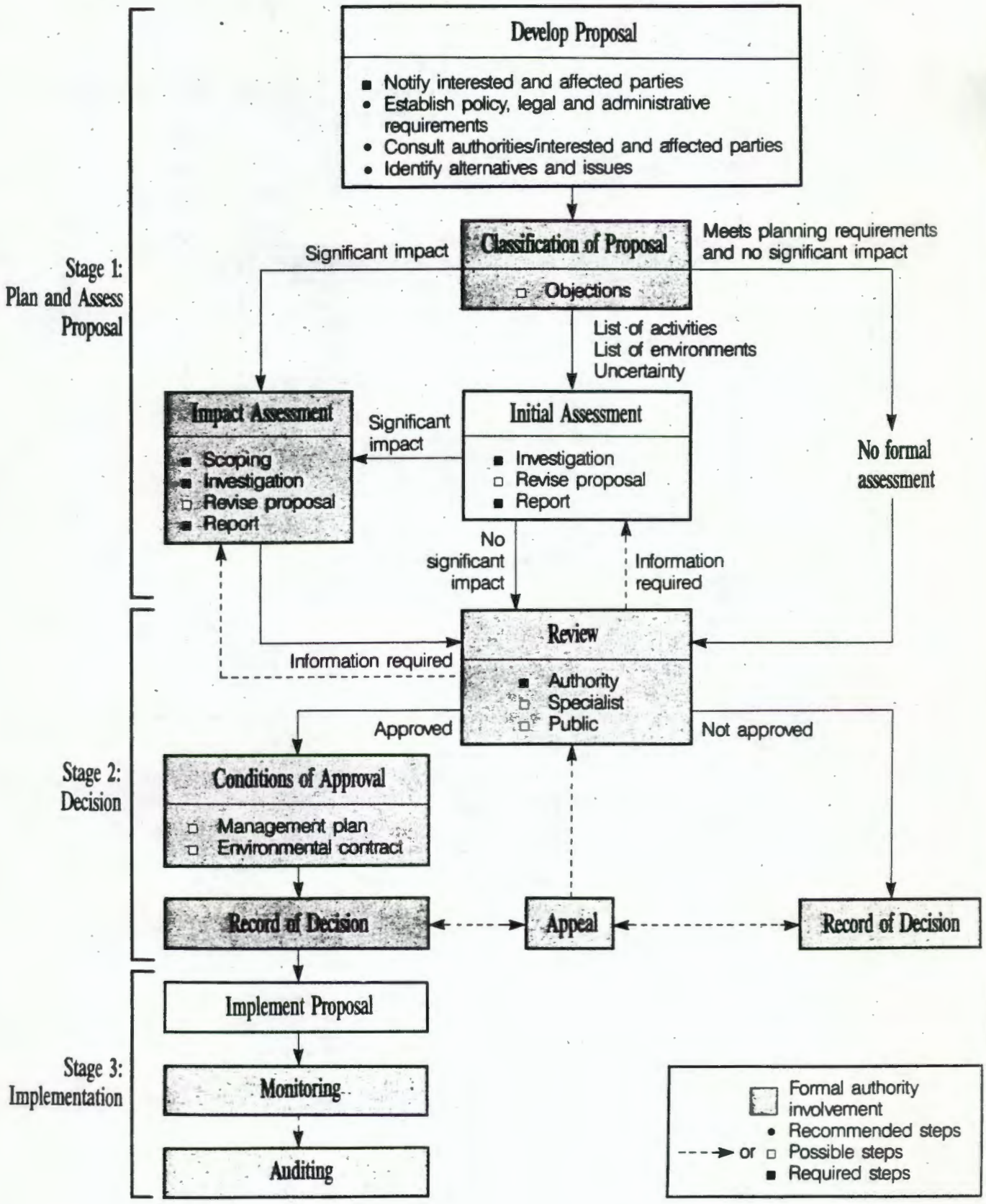
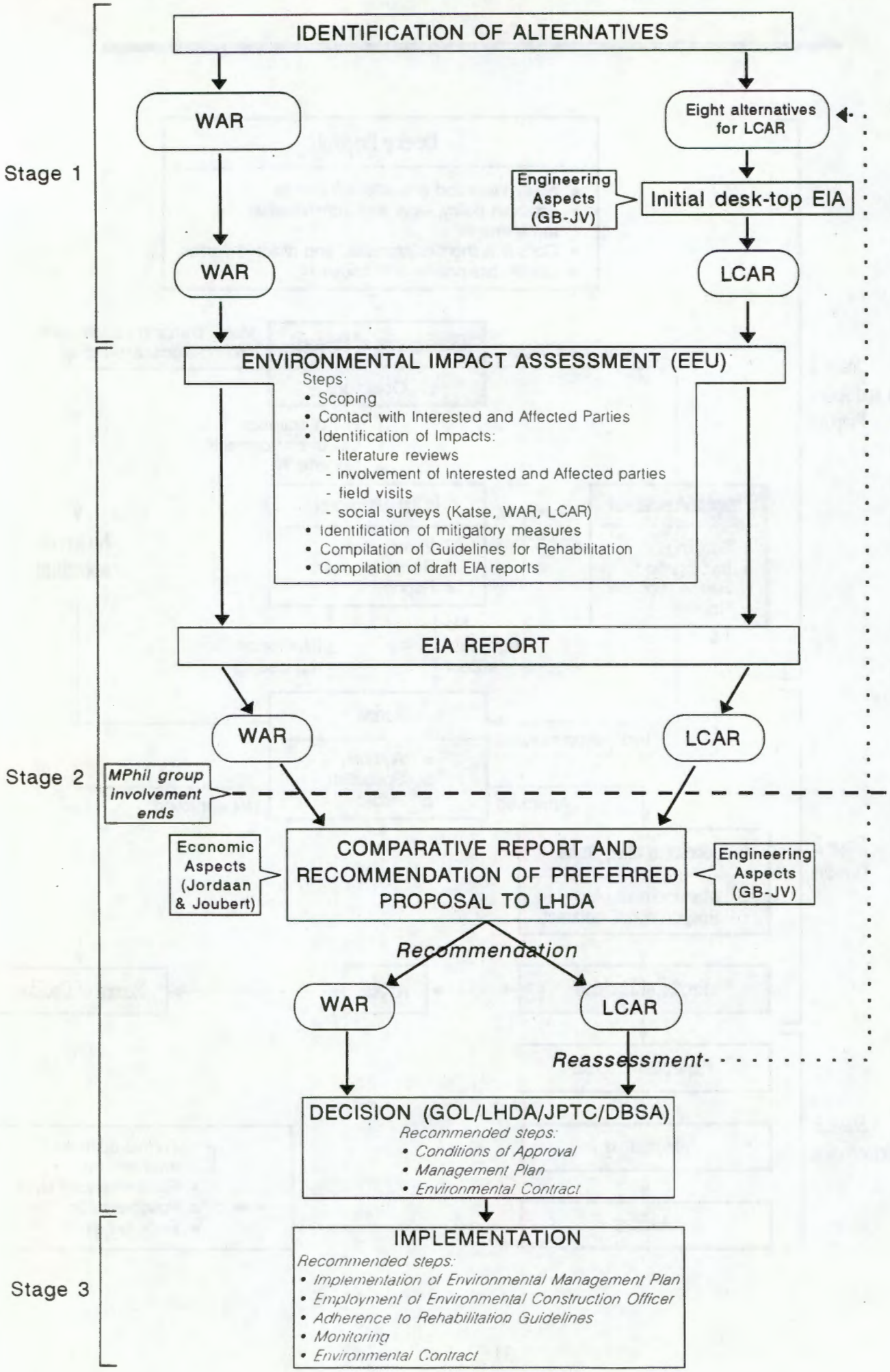


Figure 3: Procedure for environmental consideration: Mohale Dam access route.



Procedural considerations

Alternatives for the major access route to the Mohale Dam were identified by GBJV. The EEU was involved in conducting initial *desk-top* assessment of the eight proposed alternative routes, excluding the Western Access Route (WAR). The WAR was to be compared to the Least Cost Alternative Route (LCAR) which would be identified through the initial assessment. Screening out of the Eastern Access Routes resulted in five northern alternatives being put forward as the LCAR.

The initial desk-top assessment indicated that the five northern alternatives would result in very similar impacts. One route was chosen which satisfied engineering and environmental criteria and which would be compared to the WAR (GBJV, 1993) in the EIA process. The second stage of involvement of the environmental evaluation team was in conducting an impact assessment for the LCAR and the WAR.

If the LCAR is chosen over the WAR, a reassessment of all of the alternative routes identified in Stage 1 as well as others which may have been identified as viable options, is to be undertaken. Figure 3 indicates the project planning process used to consider environmental aspects in Contract LHDA 1000.

2.3.4 IEM, the impact assessment and contract LHDA 1000

The detailed assessments undertaken by the environmental evaluation team followed the guidelines for impact assessment (DEA, 1992) and involved scoping, detailed investigations and the production of two separate assessment reports, as well as a short comparative report which was submitted to the LHDA together with the findings of the design engineers, the traffic engineers and the consultant economist.

Contractual constraints

The greatest limitation to an holistic approach to the environmental consideration in contract LHDA 1000 was the compartmentalisation of different parts of the project. The two alternative routes were to be assessed in isolation of the site access roads, the resident engineer's camp, the Maseru Bypass and all of the other activities which will occur when dam construction commences. The environmental considerations were forced into project compartments, when in fact, the long-term impacts of Phase 1B of the LHWP should have been assessed as a whole. This is vital when viewing the social disruption which will be caused during the building of the Mohale Dam and eventual flooding of presently used land.

The potential of the multi-disciplinary team

The employment of a multi-disciplinary team is often negated by the division of a project into sub-projects. The result is usually the production of separate reports which then have to be integrated for the impact assessment report (Quinlain and Zingel,

1991). The extent to which a multi-disciplinary team can facilitate an interdisciplinary impact assessment instead of a multi-disciplinary study, depends on the amount of time and effort spent on organising effective communication between the experts.

Social welfare issues and environmental quality are neither socially nor politically separable. Social and technical scientists must learn to work together without the luxury of common theory and methodology (Rickson and Rickson, 1990).

EIA methods in IEM procedure

Although the IEM procedure may integrate environmental input into the early stages of project planning, the procedure of EIA and its methods remain unchanged in their application to projects. The impact assessment in IEM forces the expert into defining discrete impacts for systems which never have definable boundaries. Although the IEM guidelines were followed in the impact assessments of the alternative, the methodological problems of EIA still prevail.

2.4 PREDICTING BIOLOGICAL IMPACTS

The first problem faced by the ecologist is that of delimiting a boundary for an ecosystem, temporally and geographically. By defining specific boundaries for an impact assessment, we may determine the result of the investigation (Beanlands and Duinker, 1983). The definition of ecosystem boundaries further complicates the ability of the biological impact assessor to predict cumulative, synergistic and delayed impacts.

There are two extremes of biological impact prediction and assessment: those that consider single species and those that consider ecosystems as a whole. The intricacy of ecosystems remain a challenge to biologists and the prediction of impacts in the future. In developing countries, where information on ecosystem functioning is at best scant, "fly by night" biological assessments should be questioned.

Although the ecologically "correct" approach would be to view species as a part of a system, the use of "keystone" species and indicator species must be acknowledged as a shortcut to provide information on ecosystem well-being (Westman, 1985) in the face of financial and time constraints.

Effective monitoring programmes could enhance the predictive ability in biological assessments by providing information which could be applicable in similar situations. The Lesotho Highlands Water Project could, through the effective monitoring of biological impacts, facilitate more accurate prediction in subsequent development phases.

2.5 SOCIAL IMPACT ASSESSMENT

"The *human environment*, not the water, nor the air, nor the trees, is the core of any environmental impact assessment (Uriarte, 1985 quoted in Brown, 1990:136)."

2.5.1 Introduction

Social impact assessment (SIA) studies are based on two premises. They are concerned with understanding change to the society and the environment and how this change can be managed. Techniques used have ranged from those that stress the system regularities in communities and have been based on "social indicators" and their quantification, to those which pay attention to the views, feelings and hopes of those affected by a proposal. The latter, which has become more popular, may obtain data through participant observation, ethnographic fieldwork, interviews and questionnaires (Khan, 1990).

2.5.2 SIA in developing countries: Burge's suggestions

Burge's (1990) suggestions for SIA in developing countries and the authors assessment of the extent to which the social study in the assessments of the WAR and the LCAR achieved these goals is presented below:

Use of existing organisations

The community organisations approached were the Lesotho Council for Non-Government Organisations and the Highlands Church Action Group. Although these organisations were not used directly in the social survey, they provided information on important issues to be addressed through scoping (see Appendices of Baseline documents for the record of scoping).

Flexibility in the choice of methods used

A social survey was conducted by means of administering a questionnaire, informal interviews and observation. Where the questionnaire was found limiting it could be complemented by the interviews and general observations.

Use of Nationals to decrease perceptual gap

Although the three interviewing teams for the Katse Road, LCAR and WAR surveys were Basothos, the survey co-ordinators and the questionnaire compilers and analysers were not.

Use of appropriate methods

A combination of a questionnaire, interviews and observation were used, partly due to time constraint. It is recognised that community meetings would have generated more discussion and ideas.

Quantification of social characteristics and impacts

Although the questionnaires generated much quantifiable data, the importance of quantification of all social characteristics is questioned by the author and others (see below in criticisms of SIA methods).

Allow indigenous populations to express their opinions traditionally

Pitsos or community meetings are the manner in which most village conflicts are resolved. *Pitsos* were not used as a means to gather information.

Consult anthropological literature

Anthropological literature was not used in the SIA.

Selection of SIA variables through scoping

Scoping identified the potential social impacts. Questions pertaining to these potential impacts were included in the questionnaire.

Avoid repetitive data collection

Although studies have already been conducted in the Katse area, information pertaining specifically to the effect of the road on the communities was unavailable. As no monitoring programme is in operation on the Katse Road, a separate survey had to be conducted there.

Never use SIA as a justification for a decision already made

The researchers were unaware that a decision on which road would finally be used had already been made. The WAR was however favoured in the planning process.

Includes specific recommendations for mitigation

Mitigatory measures were suggested for all identified effects for the affected parties.

2.5.3 Problems in SIA identified in the literature

i) Empowerment

The extent to which SIA is a catalyst for community change through participation is often forgotten by those involved in the studies. Development is a political process and in that process rationality may not necessarily be based on the data collected in a SIA. SIA practitioners are always faced with the constraints of dominant political and economic ideologies, bureaucratic resistance as well as time and funding limitations (Huggins and Boersema, 1990).

Community empowerment should be affected not only through the process of addressing issues identified as concerns, but also by treating the "assessed subjects" as clients (Huggins and Boersema, 1990; Rickson *et al*, 1990; Henry, 1990). The information provided by SIAs should be available to the public and especially those affected by the proposal (Harding and Livesay, 1984). The only way in which the communities of the Jorodane Valley and the WAR areas may be empowered to affect the decision made, is for the information from the SIA and the EIA to be disseminated in an appropriate manner. Although this is a recommendation of the final report to the LHDA, it is an unlikely occurrence as it is not politically rational.

ii) Perceptions of development and progress

The rating of an impact as positive or negative depends to a large extent on the what the researchers believe to constitute "development" or "progress" (Huggins and Boersema, 1990; Henry, 1990; Quinlain and Zingel, 1991). Quinlain and Zingel (1991) illustrate this consideration by using the example of land tenure in rural African communities. A change in land-tenure systems may have a negative effect on the tribal authority in a rural African community, but the diminution of tribal authority may be a positive indication of development.

Social input from the communities should however, indicate what the people believe to constitute progress. This was achieved through the social surveys, interviews and observation.

iii) Lack of a theoretical base

The theoretically informed body of evidence necessary to provide the basis for predicting potential impacts resulting from a project is usually lacking in SIAs. Not only does SIA lack its own theoretical base, but it fails to incorporate existing

theoretical frameworks into its analysis (Murdock *et al*, 1986). The extent to which existing theoretical frameworks can be adapted is limited by the need to compartmentalise the effects of the project into discrete impacts.

iv) SIA procedures

Quinlain and Zingel (1991) highlight concerns of the social scientist with respect to SIA procedures. These concerns are based on experience of being employed in SIA.

1) The separation of social and biophysical concerns is a major concern as the altered biophysical environment may result in a new human impact being caused. "The opportunity to describe the interconnectedness of human practices and the natural environment, and to integrate development with conservation, is lost the moment the specialists begin to conduct their studies independently of each other (Quinlain and Zingel, 1991:2)." Multi-disciplinary research is seen to supplant the quest for integrated research.

2) By identifying discrete impacts and ascribing degrees or intensities of change, and suggesting equally specific mitigatory measures, the process of change is incorrectly compartmentalised. A cause and effect relationship is assumed which is usually difficult to prove.

3) Significance ratings of high or low can only be justified in the observable outcome of projects. Monitoring, the only means for validation of these predictions, is seldom carried out.

4) Mitigation is used to solve, minimise or avoid negative impacts and optimise beneficial impacts, where it may be more appropriately seen as promoting equity between the development proponent and the affected community.

Change is a process and cannot be compartmentalised (Huggins and Boersema, 1990; Quinlain and Zingel, 1991). SIA should be designed to understand change, but as a process rather than an effect, as SIA is part of a wider political process and not just an objective scientific instrument.

"It is unfortunate that SIA is seldom utilised for the assessment of the distributional effects and differential impacts of development projects during and after implementation. There is a clear need for an "experimental" approach to gain an understanding of the relationships involved in socio-economic impacts, as well as to systematically observe and assess actual impacts over time Hyggins and Boersema, 1990:7)."

2.6 MONITORING

2.6.1 Introduction

Monitoring in environmental impact assessment is often referred to as 'continuous assessment' but it is important to emphasise the distinction between impact assessment and monitoring. While impact assessment involves the predicting of anticipated impacts by using information gathered from similar situations or the transformation of primary data into information, monitoring is the observation or reporting of actual measured events (Bisset, 1984a; Carley and Bustelo, 1984).

Monitoring is be defined as: "the systematic collection and organisation of information, which is to be used in improving the decision-making process; either indirectly by informing the public, or directly as a feedback tool designed for the purposes of project management, program evaluation or policy development (Carley and Bustelo, 1984)."

Although monitoring has a short history in environmental sciences, it may be seen as a logical development of environmental impact assessment (EIA). The important role that monitoring can play in EIA however, is probably still not recognised. Monitoring is necessary not only for projects for which assessments were carried out in the planning stages but also for vast numbers of already existing development projects which received little environmental and even less social input during their implementation phases (Biswas and Geping, 1987).

2.6.2 The rationale for monitoring in EIA

The rationale for monitoring in the EIA of developments of the LHWP and more specifically for contract LHDA 1000 is presented below:

1) Monitoring may be used to recognise unforeseen impacts which the impact prediction failed to identify. It enables appropriate action to be taken to mitigate impacts before they have irreversible effects on the social and biophysical systems (Armour, 1988). Changes in the social realm are often difficult to recognise without an instituted monitoring programme (Bisset, 1984a).

2) Monitoring can be used to improve accuracy and verify impact predictions and thereby improve and refine the process (Armour, 1988; Bisset, 1984a). Data gathered in monitoring programmes may be used for descriptive accounts of the impacts of a project and thus aid other impact assessments.

3) The effectiveness of mitigatory measures may be assessed through monitoring (Armour, 1988; Bisset, 1984a; Department of Environmental Affairs, 1992).

4) Information obtained from monitoring may refute or ratify claims for compensation (Armour, 1988).

5) The interested and affected parties (I&APs) may have peace of mind by seeing a monitoring programme instituted in a development, especially when there is concern that latent or unforeseen secondary or cumulative impacts may occur.

6) Monitoring programmes are often strongly advocated by potentially affected parties and may form an integral part of public participation (Armour, 1988).

2.6.3 Types of monitoring applicable for the LHWP

The following outlines various monitoring options which may be seen as applying at different geographic scales (Carley and Bustelo, 1984) or at different phases in EIA (Bisset, 1984a). Although the monitoring types are presented separately, an integrated monitoring programme for the LHWP may contain a combination of these.

1) *Baseline monitoring* (Bisset, 1984a) or monitoring of ambient environmental quality (Carley and Bustelo, 1984), is the monitoring of specific biophysical and social factors so that a change to the quality of the environment (brought on by the construction of the LCAR, for example) may be distinguished from those caused by natural variability (prevailing drought conditions in Lesotho). Baseline monitoring is usually related to a specific project and can contribute to the evaluation of impact assessments and their mitigatory measures.

   The selection of target variables to be monitored at the post-approval stage of projects is perhaps the most important step in setting up a monitoring programme. The detail at which baseline monitoring surveys have to be carried out depends largely on the project type. The extent to which baseline monitoring programmes have to be implemented depends on the availability of information of environmental components in an area (Bisset, 1984a).

2) *Monitoring for project impact management* is the regular assessment of a wide range of biophysical, social and economic impacts relating to a specific project and is usually closely linked to mitigation schemes. It has as its primary aims the detection of impacts and their magnitude. The objective most difficult to achieve is proving that the impacts are directly related to the project, and not to other factors such as the natural variation of the system (Bisset, 1984b).

   It is envisaged that both the LHDA and the affected communities will benefit through the institution of project impact monitoring especially with respect to monitoring the efficiency of the compensation plan. Many social changes are

expected during the compensation period of 15 years. It will be important to identify changes which result from the application of the compensation plan i.e., impacts of mitigatory measures (Quinlain and Zingel, 1991).

3) *Experimental environmental monitoring* is an academic and often scientific process which has as its aim the testing of specific hypotheses, and predictions of the cause and expression of environmental impacts. Over time the activity contributes to improving the reliability and validity of impact assessment. Although some experimental social monitoring has been attempted, most work in this field relates to biophysical impacts (Carley and Bustelo, 1984).

4) *Programme evaluation monitoring*, which may also be called productivity measurement or performance auditing, is usually carried out by government departments or evaluation teams to measure the efficiency (ratio of organisational inputs to outputs) or effectiveness (satisfaction of goals and objectives) of policies and programmes (Carley and Bustelo, 1984).

The LHDA has agreed to institute development programmes in affected areas. Research into these directions has included community forestry, mountain horticulture, fisheries (LHDA, 1990). None of these plans have been instituted yet, but when they are, monitoring of their effects by an independent body should be carried out.

5) *Monitoring of socio-economic agreements* or *contractual arrangements*. "This is the monitoring of the voluntary, or contractual agreements between industry and government. Such monitoring focuses on the performances of industry in terms of provision of benefits, mitigation of negative impacts, social and cultural expenditure, and *public consultation*" (Carley and Bustelo, 1984:70). The individual phases of the LHWP and the project as a whole should be assessed with respect to the benefits it has provided to the people of Lesotho.

6) *Cumulative impact monitoring*. Such monitoring activities are not limited to a single project and may be carried out in regions where rapid development is occurring. An important aspect of this type of monitoring is that impacts may be directly or indirectly related to the developments. Emphasis is placed on all critical issues and changing patterns in the region, be they independent of the projects. Cumulative impact monitoring "is characterised by a regional, rather than site-specific, perspective; attention to overlapping impacts of different projects and policies; and a time-perspective stressing the long term, incremental and dynamic nature of social change" (Carley and Bustelo, 1984:71). Cumulative impact monitoring should be part of the regional planning process but few examples of such programmes exist.

Though not considered as part of the brief for contract LHDA 1000 the effects of the construction of the Mohale Dam and the associated construction camps and the influx of foreign workers on the people of the WAR and the LCAR

cannot be ignored. A regional perspective is necessary in order to achieve the effective monitoring identification of cumulative impacts.

2.6.4 Obstacles to effective social monitoring

Monitoring, according to the literature, should meet the following basic requirements: the identification of key factors or variables to be monitored; the establishment of a baseline condition; the development of a means of demonstrating cause and effect relationships (i.e. project induced changes must be separated from those occurring in the absence of the project); and the specification of measures of 'significant' change (Bisset, 1984a; Armour, 1988). As these monitoring requirements are based on biophysical monitoring, they are ill-equipped to provide an effective framework for social monitoring, the primary reason being that discrete impacts are researched instead of the process of change.

To demonstrate the difficulty of fulfilling the specified requirements of monitoring for social impacts an example from the study is used. Social disruption must be measured through some kind of quantifiable means. If we are to accept that some measurable indicators of social disruption will be reduced community cohesion, increased alcoholism and prostitution. Increased alcoholism and prostitution may be easily measured through survey methods. Community cohesion is more difficult to measure directly.

i) The identification of key factors or variables to be monitored.

The task of identifying key factors to be monitored with respect to community cohesion is not too difficult as it is an area relatively well-researched in the discipline of social science (Finsterbusch, 1985; Armour, 1988). Community cohesion according to many social scientists is dependent on 'high levels of commitment on the part of residents in the community, intensity of social interaction, shared values, and a certain degree of homogeneity regarding socioeconomic characteristics (Armour, 1988).' The level of commitment to an area and the intensity of social interaction and shared values could be investigated by using indicators such as kinship ties, friendship ties, interaction with neighbours, resident involvement in community groups, and reliance on local services.

ii) The establishment of a baseline condition.

Complications arise immediately when considering the task of measuring the absolute condition of a variable e.g. community cohesion. How can the above variables be

measured accurately and how can we define what measured values would constitute cohesion for any community? Public participation and the SIA often cause the community to become more organised and therefore increase cohesion. Time and financial constraints prevent the gathering of baseline information (in the absence of external influences such as project approval and construction) which is suitable for monitoring purposes.

iii) The development of a means of demonstrating cause and effect relationships and the specification of measures of significant change.

A social impact cannot be attributed to any one cause. It may not be a direct impact but be the result of a combination of other impacts. It is usually in attempting to meet this requirement that SIA monitoring fails, with the crucial factor being an ill-fated attempt to compartmentalise social change.

The impact, 'loss of community cohesion', cannot be attributed to any one cause. It is therefore not a direct impact but is a result of a combination of other impacts. Examples given are: impact on services (destruction of a spring), displacement of residents (compensation houses may be located far away from neighbours with which the relocated people shared strong social ties) and loss of resident satisfaction with place (which could result from an increase in alcoholism or prostitution). Even if most of the direct impacts affecting community cohesion could be identified, how are they related to each other and what role do each of them play in causing the loss of community cohesion.

The bias in most monitoring programmes has been towards the biophysical. Armour (1988) suggests that even where social monitoring is given equal emphasis, the socio-economic thrust of it always overshadows the socio-cultural and socio-psychological concerns.

The audience of any monitoring programme should be considered carefully. Access to the information gathered should be given to the concerned public as well as the decision makers. Information should be made available to the public in an appropriate medium so that they too may have a better understanding of the social, economic or structural changes that may be occurring in an area. It is through such types of information flows that public participation is encouraged, and a democratic (or pluralist) process helps strengthen local control (Carley and Bustelo, 1984; Reilly, 1985; Boggs, 1991).

Monitoring can contribute to the public participation process in EIA in other ways. Involving local people in gathering information is not only more appropriate when language or cultural barriers are present, but also increases public support and confidence in the monitoring programmes (especially if they are related to mitigation methods and compensation).

2.7 CONCLUSION

Straddling two theoretically disparate groups of sciences, environmental impact practitioners find themselves in ever compromising positions in the quest to provide integrated environmental evaluations. The need to make the issues and the predicted impacts on the social and biophysical environments comparable, so that 'trade-offs' can be made, has resulted in the compartmentalising of issues into 'discrete' impacts. Social scientists, in particular, have expressed their discomfort with the idea that it is possible to separate the effects of a project on societal functioning and individual behaviour.

Unfortunately, environmental consideration in EIAs have usually followed engineering project cycles. The result of the imposed project cycle is often a 'snap shot' view of the environment.

Given the constraints imposed on the consideration of environmental matters in the project cycle time scale, EIA and the integrated management procedure will only be effective if adequate provision is made to monitor the social and biophysical environment from the pre-planning phase up to and including the implementation phase. By discussing the various shortcomings of EIA, IEM, biological impact prediction and social impact assessment, with reference to the difficulties experienced in the impact assessment of the alternative access routes for the transport of materials for the construction of the Mohale Dam, monitoring has been shown to be a symptomatic solution to the time constraints which the project cycle imposes on the effective consideration the environment in development projects.

SECTION B

IMPACT ASSESSMENT AND COMPARATIVE EVALUATION OF THE ALTERNATIVES

The preceding two chapters have outlined the environmental impact assessment and integrated environmental management principles and processes as well as a rationale for monitoring in EIA. The first chapter of this section assesses the impacts identified in the study. A comparative evaluation of the LCAR and the WAR is presented in the second chapter.

The term "assessment" refers to the process of collecting, organising, analysing, interpreting, and communicating data while the term "evaluation" implies to some extent, the act of making value judgements or ascribing subjective values to data so that their relative importance may be determined (Stauth *et al*, 1993). According to integrated environmental management guidelines, evaluation means "to weigh the information available and determine which alternative is in the best interest of the community at large" (DEA, 1992).

The assessment stage does involve a certain amount of value judgement in assigning significance to impacts. Even though significance is assigned to a specific impact, usually within a disciplinary boundary, the context in which it is viewed (i.e. the environment) is perceived differently by different individuals (Quinlain and Zingel, 1991).

CHAPTER 3

COMPARATIVE ASSESSMENT OF THE LCAR AND THE WAR

CHAPTER 3

COMPARATIVE IMPACT ASSESSMENT OF THE LCAR AND THE WAR

3.1 INTRODUCTION

This chapter outlines the methodology in the identification and assessment of impacts and presents all the impacts identified for the LCAR and the WAR.

The *Guidelines for Report Requirements* for Integrated Environmental Management (DEA, 1992) suggest that certain information be provided for each impact identified.

"The following points should be included for each impact:

* Statement of impact or effect
* Brief description of impact
* Landowner(s) / interest groups(s) affected
* Statement of criteria for determining significance which could include magnitude, geographic extent, duration, frequency, risk or uncertainty, size of group affected)
* Significance of impact or effect without mitigation
* Suggested measures for mitigation or optimisation
* Significance of impact with mitigation or optimisation measures
* Degree of confidence in prediction" (DEA, 1992 *Guidelines for Report Requirements*:13).

3.2 ASSESSMENT METHODOLOGY

3.2.1 What is an impact?

An impact is an "effect" or "influence" (Oxford English Dictionary). In the EIA process, an attempt is made to recognise the causes and the effects of particular project actions within the environment, both social and biophysical. Impacts may be

categorised as primary (first-order) or secondary. Primary impacts are those directly caused by the project e.g. "loss of arable land", while secondary impacts result indirectly from the project and are a result of the existing interlinkages or interdependencies within the system. An example of a second order impact may be the "loss of income" which may be caused indirectly by a project action that involves an impact on the resource base of a community. Induced secondary impacts occur when a project causes new linkages to be formed in the system. The construction of the LCAR, for example, may induce economic benefits to local residents if they are able to sell crafts to a newly accessible market brought by tourist activities.

3.2.2 Identification of impacts

Impacts were identified through the methods described below.

A preliminary checklist of impacts was drawn up during the early stages of the study to identify as wide a range of impacts as possible. These were obtained from the checklist of environmental characteristics in the Integrated Environmental Management Guidelines series (DEA, 1992).

Potential positive and negative impacts resulting from the upgrading of the WAR and the construction of the LCAR were identified during consultation with relevant authorities, and through conducting social surveys. During authority scoping, meetings were held with interested and affected parties (I&AP's) to discuss the project and identify specific concerns. Issues of concern identified during these meetings are recorded in the appendices of the baseline assessment documents of the WAR and the LCAR.

Social surveys based on questionnaires and informal discussions were held at villages along the WAR, Katse Road and in the Jorodane Valley. Information from these surveys identified issues of concern to the residents likely to be affected. Findings of the social surveys are recorded in a report held by the EEU (Report on the Social Survey EEU 2/93/104e).

Quantifiable impacts likely to result from upgrading of the WAR and the construction of the LCAR were identified during fieldtrips along the existing road (WAR) and the proposed alignment (LCAR). This involved the measurement and recording of affected physical features and resources falling within 10 m of the centre line of the road, and those which fell outside this distance but which would be affected by road widening and construction. These included resources requiring compensation, such as fields, gardens, houses, kraals, as well as ecological aspects, such as marsh areas and problematic erosion areas. Specific locations of these affected features and appropriate mitigation measures are provided in tabular form for the WAR and the LCAR, following successive chainage, in the appendices of the baseline documents.

Where existing information about impacts was scarce, or where impacts were uncertain or highly significant, the advice of experts assisted in assessment.

Fuggle (1992) lists a number of characteristics which impact identification methods should have. The following presents some of these characteristics as well as the difficulties experienced, during the impact identification and assessments of the WAR and the LCAR, in trying to meet these requirements.

The method of impact identification for any one project should be:

1) **Comprehensive**: facilitate the consideration of the full range of impacts caused directly or indirectly by the project.

Although time was a limitation to achieving this goal, an attempt was made through the scoping process, the use of a comprehensive checklist, the social survey and field visits, to identify all of the possible impacts resulting from the construction of the LCAR or the upgrading of the WAR. Even if an assessment team is certain that they have identified all the impacts which could possibly result from a project, it is still imperative that a monitoring programme is introduced so that predictions can be validated and other impacts, not identified in the impact assessment, can be recognised and be mitigated and/or compensated for.

2) **Precise**: the consideration of the impacts of specific project actions should be investigated and presented. The use of general categories should be avoided.

The impact assessments of the individual routes were able to identify and assess specific project actions and resulting impacts. The cause-effect relationship is not always possible to identify when dealing with induced social impacts. It is necessary to group impacts to a certain extent, so as to facilitate the evaluation of the alternatives.

3) **Project-specific**: changes resulting from other influences should be separated from those resulting from the actions of the project.

Some degree of difficulty is experienced here, as changes in the environment should be considered as the context in which to view impacts resulting from the project. The drought experienced in the Lesotho, for example, will affect the recovery rate of rehabilitated areas. The relocation of people associated with the construction of the Mohale Dam in the Jorodane Valley may well overshadow any such impacts caused by the construction of the LCAR. The loss of income from the cultivation and sale of *Cannabis sativa* in the Jorodane Valley will be exacerbated by retrenchment of migrant workers from the mines.

The construction of the LCAR or the upgrading of the WAR will commence in mid-1994. The transport of materials to the Mohale Dam site (implementation phase) will start in mid 1997. The context in which the predicted impacts will have effect may be altered by then.

The division between the context in which an impact is to be considered and impacts resulting from other projects or influences is not clear. A solution found in many impact assessments is to view and characterise such uncharted territory as constituting synergistic impacts.

4) **Accurate**: the location, time (phase of the project) and duration (period of time in which impacts will occur) of impacts.

Accurately predicting the length of time that an impact will affect the social or biophysical environment is not always possible, especially when the recovery or rehabilitation time of these environments is unknown or unpredictable. The duration of impacts like increased prevalence of certain social pathologies such as alcoholism, increased crime rate and prostitution cannot be accurately determined. Had a monitoring programme been instituted for the Katse Road, the environmental evaluation team would have had more confidence in the prediction of duration of effects.

5) **Consistent**: different analysts using the same method of impact identification should be able to make the same assessment. The method should therefore be free from analyst bias (Fuggle, 1992).

By considering all opinions during an iterative scoping process, and due to the fact that the assessment team was multidisciplinary and worked in consultation with each other, analyst bias was avoided. Impacts identified and the significance to be applied was reviewed by the team as well as experts and interested and affected parties.

3.2.3 Significance and its application to identified impacts

Significance is usually defined as "meaning" or "importance". In EIA, to class an impact as significant "is to suggest that it will have, or is likely to have, considerable influence or effect (either positive or negative) on some aspect of human well-being" (Preston *et al*, 1992). The judgement of significance is subjective and impact-specific as there is no standard, objective threshold beyond which an impact becomes socially significant (Preston *et al*, 1992).

Significance is considered in terms of magnitude, time, duration and geographical extent and whether it is likely to have socially and/or ecologically beneficial (positive) or detrimental (negative) consequences. For this purpose, the significance of predicted impacts is rated on a scale of low, moderate or high significance to reflect the relative ranking of impacts. Positive impacts will have to be managed to optimise their beneficial effects, and negative impacts to mitigate their negative effects. The significance ratings of impacts with and without mitigation or optimisation are presented.

Criteria have been applied to impacts identified in the study, to determine the significance of the impact in the context of *magnitude*, *time*, *duration* and *extent* of effect. Positive and negative impacts have then been assigned a significance rating of high, moderate or low, in consultation with appropriate specialists.

3.2.4 Magnitude

Magnitude is a measure of the size or extent of an impact. The magnitude of an impact is assessed where possible in quantitative measures, e.g. area of land disturbed or number of people affected by project action. This, considered in context, will be used to determine degree of significance.

3.2.5 Time and Duration

Time refers to the phase of the project in which an impact will be caused, while duration is the time period over which an impact will have an effect on the environment. The duration of an impact may be an important factor determining its significance. The duration of an impact as stated in this assessment is an estimate.

3.2.6 Extent

The extent of an impact is the geographical area within which it may have influence. For the purposes of this assessment, extent for each impact is categorised as one of the following: Localised (having an effect at a specific points or locations e.g. loss of a house due to land-take), local (affecting a village or village cluster e.g. loss of a spring or a winnowing site), sub-regional (affecting part of an administrative region of Lesotho), regional (affecting an administrative region), national and international.

3.2.7 Context

Context is the biophysical and socio-economic background or milieu in which an impact should be considered. As already stated, there is difficulty in defining a boundary between context and effects which should be attributed to other projects or influences. A brief description of the socioeconomic and biophysical environments is

presented in the introductory chapter but a more detailed account is given in the respective Baseline documents for the LCAR and the WAR.

3.2.8 Criteria for assessing significance

The following list of criteria for significance was adapted from the Scottish Transportation Environmental Appraisal Manual (1986), Draft Transportation Environmental Assessment Manual (1992), and Integrated Environmental Management (IEM) documents (DEA, 1992).

Significance of impact for each of the routes was determined by the degree to which the proposed action:

* affects public health or 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 the availability or functioning of key resources;
* 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 actions;
* results in cumulative or synergistic impacts, and/or
* has the potential to optimise existing conditions.

The above criteria were used during the baseline study to assess impacts. The significance ratings assigned to the impacts have remained the same except for the rating of "loss of agricultural resources" on the LCAR.

3.2.9 Layout of impact tables

Assessment should be carried out for each of the alternatives in a way that facilitates comparison between them (*Guidelines for Report Requirements* DEA, 1992).

All of the impacts are presented in tabular form so as to provide the reader access to the information and to avoid repeating the complete narrative presentation of the baseline documents. For each impact, the following information is provided:

1) the **impact type** which remain unaltered from the baseline documents;

2) **comments** which explain the cause and the implications of the impact;

3) **magnitude, time, duration,** and **extent** which explain to a degree the significance applied to the specific impact;

4) **interested and affected parties**

5) **mitigation** and **optimisation** measures

6) **significance, with mitigation** and **without mitigation**

The presentation of the impacts of the LCAR and the WAR in separate tables is not accidental. The reader will recognise that although the impact groupings are the same for the two alternatives, the specific impacts identified differ. The biophysical and social environments of the alternatives are not the same and it would be erroneous to try and formulate new impact "names" to accommodate for exact comparison in the assessment stage.

An error to be avoided in the comparative assessment of the alternatives is using a "divide and conquer" approach. The reader is encouraged from the outset to compare impacts in groups, rather than as separate entities. The comparison of the overall negative biophysical impacts resulting from the LCAR and the WAR is facilitated by placing the related tables on consecutive pages. The comparison of "loss of *Leucosidea* shrubland", for example may be meaningless as a consideration in the comparative assessment of the two alternatives. In other words, the whole is more than the sum of the parts.

Notwithstanding the above caution, there are specific impacts, which one could view as decision factors, that do warrant greater consideration and, perhaps, individual comparison. They are the impacts which have been identified as having high significance, with or without mitigation. These impacts are given emphasis in the comparative evaluation chapter.

3.3 ASSESSMENT OF IMPACTS IDENTIFIED FOR THE LCAR AND THE WAR

3.3.1 National and regional planning and policy considerations

The tables include a section titled, "National and regional planning and policy considerations". In the baseline documents these considerations are presented as impacts. It is the author's opinion that accordance or contradiction with the National Settlement Policy, the Lesotho Road Network Plans or the Five Year Development Plan, are better placed as a set of over-arching considerations which are not assigned significance values. The rationale for this categorisation is as follows:

1) The manner in which these plans and policies were researched and drawn up is not known. No evidence exists that these documents were the result of a participative process.

2) The fruition of these plans and adherence to these policies to date is unknown and therefore their relevance may be questionable.

3) It is not possible to judge the relevance of an impact on policy or planning if the tangible benefits which will accrue to the people of Lesotho, through their implementation, is unknown.

4) The actions necessary for the effective mitigation and /or optimisation of the impacts are sometimes not within the power of the project proponent, LHDA, to fulfill.

3.3.2 Changes to the significance ratings applied in the Baseline documents

In the baseline document (Environmental Impact Assessment of the Least Cost Alternative Route, EEU/93/104c) "the loss of agricultural resources" is assigned the significance of low significance with mitigation, and moderate without significance. These ratings have been changed to moderate significance and high significance respectively.

The reasons for the changes are as follows:

- the loss of agricultural resources without mitigation would affect seriously, the health and well-being of the affected land-owners and their dependants, and

- the impact would operate over a long period of time with or without mitigation.

Furthermore, the social survey conducted in the Jorodane Valley indicates that some people do not own the rights to arable land or own livestock. This may indicate that agricultural resources are poorly allocated in the first place, or that they are a scarce resource. The "loss of agricultural resources" is therefore rated as a highly significant impact without mitigation.

3.3.3 Sequence of the tables

Table 3.3.4 a) National and regional planning and policy considerations for the LCAR
b) National and regional impacts for the LCAR

Table 3.3.5 a) National and regional planning and policy considerations for the WAR
b) National and regional impacts for the WAR

Table 3.3.6 a) i) Socio-economic negative impacts for the LCAR
ii) Socio-economic negative impacts for the WAR
b) i) Socio-economic positive impacts for the LCAR
ii) Socio-economic positive impacts for the WAR

Table 3.3.7 a) Biophysical impacts for the LCAR
b) Biophysical impacts for the WAR

Table 3.3.8 Summary impact table

Table 3.3.4.a. National and regional planning and policy considerations for the LCAR.

NATIONAL AND REGIONAL PLANNING AND POLICY CONSIDERATIONS FOR LCAR.		
Consideration	*Comments*	*Mitigation and Optimisation*
The construction of theLCAR does not accord with the Lesotho Road Network plans	The building of the LCAR will place extra burden (approximately M130 000 per year and M1 500 000 every 8 years) on the maintenance budget of the Roads Department.	Continued effective maintenance of the LCAR.
The LCAR will promote national planning objectives	Economic growth, employment creation and democratisation. 33 small villages and 15 large villages (more than 100 inhabitants) will be better serviced, while a total of 500 people will be employed during construction.	Rural development projects. Train local workers so that they may be employed in the construction of the LCAR.
The construction of the LCAR contradicts the National Settlement Policy	The LCAR will not directly service the many existing potential growth nodes which already have secondary and tertiary services, but plans for the Leribe and Berea districts will be reinforced.	Optimisation through decentralising administrative functions through Teyateyaneng.

Table 3.3.4.b. National and regional impacts for the LCAR.

NATIONAL AND REGIONAL IMPACTS FOR LCAR.						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
The LCAR could negatively effect pony trekking, but promote new types of tourism activities	The wilderness character of parts of the Jorodane Valley will be lost and will affect pony trekking activities (Annual income = M200 000 plus that earned by villagers and guides). A new road will improve access to tourists.	**Magnitude:** Unknown **Time:** Construction and implementation. **Duration:** Continued **Extent:** Regional	Those employed in and who benefit through pony trekking.	Change pony trekking routes to avoid the intrusion of the road. Improve tourist facilities.	**POSITIVE MODERATE SIGNIFICANCE**	**NEGATIVE MODERATE SIGNIFICANCE**

Table 3.3.5.a. National and regional planning and policy considerations for the WAR.

NATIONAL AND REGIONAL PLANNING AND POLICY CONSIDERATIONS FOR WAR.		
Consideration	*Comments*	*Mitigation and optimisation*
Reinforcement of the national planning objectives	Economic growth, employment creation and democratisation. 20 small villages and 13 large villages (more than 100 inhabitants) will be better serviced, a total of 500 people will be employed for a maximum of 36 months.	Rural development projects. Train local workers so that they may be employed in the upgrading of the WAR. Upgrade the remainder of the -Mountain Road to Thaba - Tseka.
The upgrading of the WAR accords with the existing national road plans	The upgrading of the Mountain Road up to Patiseng would cost the Government of Lesotho approximately M10 million. The upgrading of the WAR does not constitute the building of a new road and will therefore not be an extra burden on the already 'over-taxed' budget of the Roads Department.	Continued effective maintenance of the WAR.
Reinforces the objectives of the National Settlement Policy	The NSP identifies the Mountain region as a development priority - to this end, the Maseru-Thaba Tseka link is vital. The WAR will provide decentralisation through reinforcing developments along the WAR. Growth will be promoted at Mantsonyane.	Decentralisation of state public administration and the establishment of local authorities. Upgrade remainder of Mountain Road to Thaba-Tseka.

Table 3.3.5.b. National and regional impacts for the WAR.

NATIONAL AND REGIONAL IMPACTS FOR WAR.						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Construction of the Maseru bypass would alleviate traffic congestion	The traffic congestion on major arterial routes will be exacerbated by increased volumes of traffic caused by the construction of the Mohale Dam. The bypass would alleviate present congestion as well as that which is forecast during the implementation phase of the WAR.	**Magnitude**:Residents of Maseru approximately 160 000 people and those passing through Maseru **Time:** Implementation **Duration:** Continued **Extent:** National	Road users and residents and LHDA.	Provision of supporting transport infrastructure such as bus and taxi stops as well as pedestrian walkways. (Follow the recommendations of the Initial Assessment of the Maseru Bypass).	POSITIVE HIGH SIGNIFICANCE	POSITIVE HIGH SIGNIFICANCE
Potential to provide net benefit to tourism and economic growth	Present tourist and other economic activities will be reinforced The multiplier effect will be marked compared to the LCAR and will promote growth as supporting infrastructure already exists	**Magnitude**: Unknown **Time:** Implementation **Duration**: Continued **Extent**: Regional	Those employed in the tourist trade or those who will benefit through growth ie, local entrepreneurs.	Improve tourist information and facilities in the region.	POSITIVE MODERATE SIGNIFICANCE	POSITIVE LOW SIGNIFICANCE

Table 3.3.6.a.i. Socio economic negative impacts for LCAR.

SOCIO ECONOMIC NEGATIVE IMPACTS FOR LCAR.						
MAPUTSOE TO HA MATEKA						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Increased traffic flow along between Maputsoe and Ha Mateka	Potential for increased road accidents due to heavy construction vehicles, particularly during the upgrading of the busy Teyateyaneng intersection.	**Magnitude**: Between 80 to 200 vehicles per day. **Time**: Implementation **Duration**: Implementation ie, transport of materials to the Mohale Dam site, and continued. **Extent**: Along 57 km road, sub-regional	Local businesses, residents, motorists, pedestrians.	Provision of road signage, zebra crossings, speed ripples. Enforce reduced speed limits at villages, schools and all other crossing points.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
HA MATEKA TO MAFOTHOLENG						
Disruption of local economy	The presence of a road would cause the loss of income from *Cannabis* production in the Jorodane Valley due to the improved access of law enforcement officials.	**Magnitude**: The present income from these illegal crops is estimated M200 000 to M500 000 per annum. **Time**: Construction and implementation. **Duration**: continued **Extent**: The sub-region (Jorodane Valley).	Local residents, regional traders.	Development of other viable sources of income which would include skills training and development of regional or national markets for commodities produced.	**MODERATE SIGNIFICANCE**	**HIGH SIGNIFICANCE**
Interference with access to or destruction of potable water supplies	Interference with potable water supplies has serious health implications for those affected. Indirect influences include polluted run-off from the road, altered drainage patterns and rockfalls.	**Magnitude**: 4 springs (possibly four villages) will be directly affected by the construction of the LCAR (see chainage description of the LCAR in the Appendices of the Baseline Document for their position along the alignment). **Time**: Construction and implementation. **Duration**: continued **Extent**: Localised for particular villages	Local residents, particularly women who are responsible for collecting water.	Replace water supply (ie, equivalent quality and similar distance away) and toilets before the construction commences.	**LOW SIGNIFICANCE**	**HIGH SIGNIFICANCE**

SOCIO ECONOMIC NEGATIVE IMPACTS FOR LCAR: HA MATEKA TO MAFOTHOLENG (continued)						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Increased risk / danger to people and livestock	Increased danger and risk to those uneducated in road safety is expected, especially in instances where people are severed from destinations by the road. Passages used for the movement of livestock between Summer and Winter grazing particularly the Lekhalong-la-Lekhaebaneng pass. Livestock fatality due to road accidents and animals falling into the drainage ditches or off steep cut-slopes is evident from the Katse experience.	**Magnitude:** Unknown. Katse experience shows livestock fatalities at 25 and injuries at 36 since the completion of the road. **Time:** Implementation **Duration:** Continued **Extent:** Localised for particular villages and where the road intercepts paths of movement of people and livestock.	Pedestrians, especially children, and livestock-owners.	Provision of adequate road signage, zebra crossings, speed bumps and enforced speed limits at villages and schools. Introduce road safety education programmes at schools and villages prior to road construction. Provision of wider livestock ramps at intervals determined through negotiation with the residents. Provision of area along the road for the passage of pedestrians and livestock and barriers along the upper edge of steep cuttings.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
Disturbance of burial sites	Burial sites adjacent to the school buildings at Ha Rapokoloane may be directly affected by the LCAR. Burial sites are of particular cultural and psychological significance.	**Magnitude:** One site. Unknown for burial sites of stillborn and miscarried children. **Time:** Construction **Duration:** Continued **Extent:** Unknown	Residents	Alignment should avoid grave site. Where this is not possible, exhumation and reburial or other compensation processes should be negotiated with the affected parties.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**

SOCIO ECONOMIC NEGATIVE IMPACTS FOR LCAR: HA MATEKA TO MAFOTHOLENG (continued)						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Social disruption of local communities	Increased crime: increased stock theft may be facilitated by the construction of the LCAR. Increase in other crimes associated with the influx of 'outsiders, such as house-braking, rape and murder, which is feared by the residents (and validated in the Katse survey). Effects on social patterns and life styles: Increased abuse of alcohol, fear of prostitution and rape may be induced by the presence of external labour. The provision of compensation houses may alter the existing social hierarchies.	**Magnitude:** Unknown. **Time:** Construction and implementation. **Duration:** Intensified during construction and continued during implementation. **Extent:** Sub-regional (Jorodane Valley) and localised in villages in close proximity to construction camps.	Local residents, villages located near construction camps and road works, individuals and communities facing relocation.	Provision of family housing and recreational facilities for construction workers. Adequate policing Negotiation of location of compensation housing.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Noise and disturbance from blasting	The effects of noise and vibration from blasting particularly at the Lekhalong-la-Likhaebaneng Pass which will require much earth works has potential will be a considerable intrusion to local communities.	**Magnitude:** Unknown. **Time:** Construction . **Duration:** construction phase only. **Extent:** Localised along alignment, particularly in mountainous terrain.	Local residents, domestic animals, tourists.	Inform residents of the dangers of blasting, when blasting will occur. Reduce magnitude of blasts by using several blasts where possible.	LOW SIGNIFICANCE	MODERATE SIGNIFICANCE
Loss of rural character of valley	The audio and visual intrusion of the road in this picturesque area will change its character. Induced effects such as change from vernacular architecture in the compensation houses will contribute to the loss of the rural character of the Valley.	**Magnitude:** 19 houses and 14 kraals will be rebuilt. **Time:** Construction and implementation. **Duration:** Continued. **Extent:** Sub-regional (Jorodane Valley).	Tourists, local residents.	Spoil dumping sites to be specified to contractors. Rehabilitation of cut and spoil sites according to the rehabilitation guidelines (Appendices of Baseline documents)	LOW SIGNIFICANCE	LOW SIGNIFICANCE

SOCIO ECONOMIC NEGATIVE IMPACTS FOR LCAR: HA MATEKA TO MAFOTHOLENG (continued)						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Loss of agricultural resources	Loss of arable land caused by permanent or temporary land-take for : the road, construction camps, quarries, borrow pits, side spoiling, road-fill, access roads, crusher sites. Loss of fruit and other trees which provide food , fuel, shade, fodder and materials to make whips, baskets and kraals. Loss of winnowing areas. Loss of livestock facilities such as kraals and stables.	**Magnitude:** Total of: Cultivated fields:148 600 m^2 Vegetable gardens: 3 320 m^2 Fruit trees: 87 Other trees: 20 at least Winnowing areas: Unknown Kraals: 9 Stables: 4 **Time:** Construction. **Duration:** Continued where replacement is not possible. **Extent:** Localised where landtake is necessary.	Residents who grow crops, possess fruit and other types of trees, owners of livestock.	Avoid damage to any agricultural resources. Compensate for land and trees lost with fields and seedling rather than by grain or cash only. Rehabilitate all temporary land-take areas according to the rehabilitation guidelines (Appendices of Baseline documents). Provide alternative winnowing sites, kraals and stables.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Loss of houses and business facilities	Compensation will be provided, however, the new structures provided are more expensive to maintain and relocation can be a traumatic experience.	**Magnitude:** Total of 19 houses and 2 businesses will be relocated. **Time:** Construction. **Duration:**Construction and continued. **Extent:** Local.	Residents who are affected by the loss of houses or businesses.	Timeous compensation for buildings lost must be ensured (ie, before demolition). Train local people in the maintenance of modern houses.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Cumulative and synergistic impacts resulting from the LHWP.	Impacts resulting from the construction of the LCAR will be exacerbated by those resulting from the construction of the Mohale Dam and supporting infrastructure: two construction camps, resident engineer's camp, supervisors office and local access roads 1 and 2. The effects of tourism that will occur due to the dam are also not investigated.	**Magnitude:** Unknown. **Time:** Construction and implementation and the filling of the Mohale Dam. **Duration:** Continued. **Extent:** Local, sub-regional, regional and national.	Residents, business owners, construction workers, people of Lesotho.	Avoid compartmentalisation of consideration of impact of contracts on the environment.	HIGH SIGNIFICANCE	HIGH SIGNIFICANCE

Table 3.3.6.a.ii. Socio economic negative impacts for the WAR.

SOCIO ECONOMIC NEGATIVE IMPACTS FOR WAR.						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Interference with potable water supplies	Water collecting points will be affected directly and indirectly by the upgrading of the WAR. Interference with potable water supplies have serious health implications. Indirect influences include polluted run-off from the road, altered drainage patterns and rockfalls.	**Magnitude:** 7 water collecting points (see chainage description for WAR in the Appendices of the Baseline Document for their position along the alignment). **Time:** Construction. **Duration:** Continued. **Extent:** Localised for particular villages.	Local residents, particularly women who are responsible for collecting water.	Replace water supply, (ie, equivalent quality and distance away) and toilets before construction commences.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Inconvenience and increased risk to people and livestock	The upgrading of the WAR will cause inconvenience to road users due to increased traffic congestion and delays related to construction activities. Increased vehicular traffic volumes on the road during the construction of the Mohale Dam will increase the risk of road accidents .	**Magnitude:** 80 to 200 vehicles per day will use the WAR to access the Mohale Dam construction site. **Time:** Construction and implementation. **Duration:** Continued but intensified during upgrading, 36 months of the WAR and the construction of the Mohale Dam. **Extent:** Local and sub-regional.	Road users and livestock-owners and livestock.	Regulation of the flow of traffic during construction should be administered by the construction contractor and adequate road signage to indicate, road closure hazard and reduced road width.	MODERATE SIGNIFICANCE	MODERATE SIGNIFICANCE
Loss of agricultural resources	Loss of arable land caused by permanent or temporary land-take for the upgrading of the road, construction camps, quarries, borrow pits, side-spoiling, road-fill, access roads, crusher sites. Loss of fruit trees and other trees which provide food, fuel,shade, fodder and materials to make whips, baskets and kraals. Loss of winnowing areas. Loss of livestock facilities such as kraals and stables.	**Magnitude:** Total without mitigation 6 655 m^2 (with mitigation 4 654 m^2) Cultivated fields:4 790 m^2 (3 146 m^2) Vegetable gardens: 925 m^2 (568 m^2) Fallow land: 940 m^2 (940 m^2) One winnowing at km 55.9 Fruit trees: 73 (36) Other trees: 104 (81) Kraàls: 5 **Time:** Construction. **Duration:** Continued where replacement is not possible. **Extent:** Localised where land-take is necessary.	Residents dependent on crops, fruit, and livestock for their livelihood.	Avoid damage to any agricultural resources. Compensate for land and trees lost with fields and seedlings rather than by grain or cash only. Rehabilitate all temporary land-take areas according to the rehabilitation guidelines (Appendices of the Baseline Documents). Provide alternative winnowing sites, kraals.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE

SOCIO ECONOMIC NEGATIVE IMPACTS FOR WAR (continued).						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Increased cost of living	Caused by provision of taxi services rather than bus services, the presence of wage-earning construction workers.	**Magnitude**: Unknown. **Time**: Construction and implementation. **Duration**: Continued. **Extent**: Sub-regional.	Local residents.	Provision of a government subsidised bus service.	MODERATE SIGNIFICANCE	MODERATE SIGNIFICANCE
Loss of houses, businesses and facilities	Despite compensation being provided, these new structures are in some ways inferior to traditional buildings and are expensive to maintain.	**Magnitude**: Total number of buildings 33 (without mitigation) 18 (with mitigation). **Time**: Construction. **Duration**: Continued. **Extent**: Local.	Residents who lose houses, shacks and toilets, business premises	Ensure timeous compensation for buildings lost (ie, before demolition). Compensate businesses for lost income. Train local people in maintenance of modern houses.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Social disruption	Increased crime such as stock-theft and house-breaking is a concern of the residents. Effects on social patterns and lifestyles such as alcoholism and prostitution, the introduction of sexually transmitted diseases may be induced by the presence of external labour. Resettlement even where compensation is provided is often traumatic. Long-term demotivation of residents to work may be induced by the payment of compensation in the form of grain and cash.	**Magnitude**: Unknown. **Time**: Construction and implementation. **Duration**: Continued. **Extent**: Sub regional and localised in villages in close proximity to construction camps.	Residents of villages located near construction camps, individuals facing relocation.	Provision of family housing, recreational facilities for the construction workers. Adequate policing. Negotiation of location of compensation houses.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Aesthetic impacts arising from construction and existence of the upgraded WAR	Visual intrusion will result from dust in the dry months, areas where vegetation has been removed eg, temporary crusher sites and other road related infrastructure.	**Magnitude**: Unknown. **Time**: Construction and implementation. **Duration**: Intensified during upgrading until rehabilitation is complete. **Extent**: Sub-regional.	Road users including tourists.	Wet road surfaces to reduce wind erosion. Locate crusher sites etc, in already disturbed areas.	LOW SIGNIFICANCE	MODERATE SIGNIFICANCE

SOCIO ECONOMIC NEGATIVE IMPACTS FOR WAR (continued).						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Aesthetic impacts arising from change in architectural style	The change from vernacular architecture to modern forms which make use of concrete blocks and corrugated iron roofing will result from the provision of compensation buildings as well as the improved transport available for such construction materials.	**Magnitude**: Unknown **Time**: Construction and implementation **Duration**: Continued **Extent**: Sub-regional	All road users, especially road users	Offer modern and traditional architectural style houses to those receiving compensation	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**

Table 3.3.6.b.i. Socio economic positive impacts for the LCAR.

SOCIO ECONOMIC POSITIVE IMPACTS FOR LCAR.						
HA MATEKA TO MAFOTHOLENG						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Improved access to goods and services	Easier and faster access to clinics transport for migrant workers, large items, cadavers. Improved social contacts,access to agricultural requirements, livestock facilities, regional markets, emergency services and schools.	**Magnitude:** Improved access for 15 villages of more than 100 inhabitants and 33 villages of less than 100 inhabitants. **Time:** Implementation. **Duration:** Continued. **Extent:** Sub-regional (Jorodane Valley).	Local residents, migrant workers, school children, police.	Development of an efficient and affordable transport service. Provision of a wide road shoulder and bridges to accommodate pedestrians and livestock, and bus stops to serve all villages.	HIGH SIGNIFICANCE	HIGH SIGNIFICANCE
Increased employment opportunities	Although Katse experience indicates that jobs provided for local people in the road construction will be few, employment may be indirectly increased through activities such as selling food and beer, washing clothes, prostitution, building and renting accommodation for/to construction workers.	**Magnitude:** Unknown. **Time:** Construction and implementation. **Duration:** Construction and implementation and continued **Extent:** Localised at villages directly influenced by the road.	Local residents, South African and Basutho workers.	Use local builders to construct compensation houses. Train local people in road construction and maintenance skills and employ them . Ensure just treatment of workers. Implementation of a rural development programme.	LOW SIGNIFICANCE	LOW SIGNIFICANCE
increased opportunity to market goods	Potential exists through the presence of the road and associated travellers and construction personnel to market goods produced in the region.	**Magnitude:** Unknown. **Time:** Construction and implementation. **Duration:** Continued. **Extent:** Localised and sub-regional.	Local residents and tourists.	Provision of bus stops with sufficient space to provide small marketing venues.	LOW SIGNIFICANCE	LOW SIGNIFICANCE
IMPACTS ON ARCHAEOLOGICAL AND PALAEONTOLOGICAL REMAINS						
Archaeological and Palaeontological remains	Rock paintings and stone tool scatterings in the Pulane basin may be defaced or disturbed as a result of improved access to these areas.	**Magnitude:** Unknown **Time:** Construction and implementation **Duration:** Continued **Extent:** National / international	People of Lesotho, archaeologists, palaeontologists.	Alignment to be walked by an archaeologist to identify sites of importance.	POSITIVE LOW SIGNIFICANCE	NEGATIVE LOW SIGNIFICANCE

Table 3.3.6.b.ii. Socio economic positive impacts for the WAR.

SOCIO ECONOMIC POSITIVE IMPACTS FOR WAR.						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Improved transport and access to facilities, goods and services	Improved transport will result from the higher vehicular traffic volumes (particularly buses and taxis) associated with the upgraded WAR. Improved access to facilities will result from the upgrading of the WAR and the associated induced attraction of high order services eg,banks, post offices, filling stations.	**Magnitude**: Unknown, could affect 13 villages of more than 100 inhabitants and 20 smaller villages. **Time**: Implementation. **Duration**: Continued. **Extent**: Sub-regional.	All road users, tourists, residents especially school children, pregnant women and the sick.	Provision of sufficient stopping and off-loading areas for taxis and buses.	HIGH SIGNIFICANCE	HIGH SIGNIFICANCE
Increased employment and business opportunities	Temporary economic benefits will accrue to residents from the presence of workers through selling food, beer, washing clothes, renting accommodation and prostitution. Higher vehicular volumes on the WAR will provide more potential customers.	**Magnitude**: Unknown. **Time**: Construction and Implementation. **Duration**: Construction (intense, localised) and continued. **Extent**: Localised and sub-regional.	Residents offering services and those receiving them.	Provide training for local residents to assist them in marketing and business practices.	MODERATE SIGNIFICANCE	MODERATE SIGNIFICANCE
Reduced dust and mud	Improving the presently fragmented bitumen sealing of the road will benefit pedestrians and motorists who will not have the inconvenience of high dust levels and muddy conditions in the wet season.	**Magnitude**: The length of the WAR: 60.4 km. **Time**: Implementation. **Duration**:Continued provided the road is maintained. **Extent**: Local and Sub-regional.	Road users, particularly pedestrians and roadside residents.	Suitable design of road shoulders with firm, well drained surfaces.	MODERATE SIGNIFICANCE	MODERATE SIGNIFICANCE

SOCIO ECONOMIC POSITIVE IMPACTS FOR WAR (continued).						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Improved road safety	The existing road is dangerous as it has fragmented bitumen cover, potholes, a narrow road reserve and shoulder and has numerous curves with poor lines of sight.	**Magnitude:** The length of the WAR: 60.4 km. **Time:** Implementation. **Duration:** Continued provided the road is maintained. **Extent:** Sub-regional.	Road users, pedestrians and their livestock using the road shoulder.	Strict enforcement of reduced speed limits at villages and on dangerous sections of the road and the provision of adequate road signage pedestrian crossings and speed ripples where necessary. Provide a wide enough road shoulder for the safe passage of pedestrians and livestock. Introduce road safety education programmes in schools and villages.	**MODERATE SIGNIFICANCE**	**LOW SIGNIFICANCE**
IMPACTS ON ARCHAEOLOGICAL AND PALAEONTOLOGICAL REMAINS						
Archaeological and Palaeontological remains	Middle Stone Age stone tool scatterings may exist elong the Mountain Road. Fossils may be present in the Lowland section of the WAR (ie, St. Michael's to Nazereth) in Sandstone cliffs.	**Magnitude:** Unknown. **Time:** Construction and implementation. **Duration:** Continued. **Extent:** National / International.	People of Lesotho, archaeologists and palaeontologists.	Alignment to be walked by professionals in the field to identify sites.	**POSITIVE LOW SIGNIFICANCE**	**NEGATIVE LOW SIGNIFICANCE**

Table 3.3.7.a. Biophysical impacts for the LCAR.

BIOPHYSICAL IMPACTS FOR LCAR.						
HYDROLOGICAL IMPACTS						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Increased sediment loading of rivers and streams	Increased rates caused by the loss of vegetation cover, greater velocities of channelised water through culverts etc.increase sediment loading in rivers as do the dumping of materials to facilitate dry bed construction and movement of heavy machinery in the river beds. Prolonged periods of abnormally high sediment loading will impact on aquatic biological systems as well as limit the life span of the Mohale Dam.	**Magnitude**: Unknown **Time**: Construction **Duration**: Construction (36 months) and post construction of LCAR until rehabilitation is complete and streams have established new equilibria. **Extent**: The Jorodane River especially where the road runs close to or crosses the river or its tributaries.	Residents of the river catchment, people dependent on, and researchers interested in, the natural ecological functioning of the system	Enforcement of erosion control measures (see Appendices of Baseline documents for the rehabilitation guidelines) during construction. The employment of an Environmental Control Officer and implementation of an Environmental Management Plan. All run-off from road should be channelled into side drains prior to entering watercourses to allow for settling out of sediment.	**MODERATE SIGNIFICANCE**	**HIGH SIGNIFICANCE**
Clogging of water courses with rockfall	Stream clogging causes increased erosion around obstacles, changes in the hydrological equilibrium, alteration of the ecological functioning and loss of functional (potable water) and aesthetic qualities of the stream.	**Magnitude**: Unknown **Time**: Construction **Duration**: Construction (36 months) and post-construction until streams establish new equilibria **Extent**: The Jorodane River particularly points where dumping may occur.	Residents of the river catchment, people dependent on, and researchers interested in, the natural ecological functioning of the system	Avoid dumping of spoil material in stream courses or siting quarries or borrow pits along stream courses. Stream courses that are affected should be cleared and rehabilitated before completion of the contract.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
Alteration of water courses by enforced drainage through ARMCO culverts	Channel erosion will occur outwards and downwards of culverts, progressing upstream. Changes in stream velocity and increased erosion levels will impact on stream biota.	**Magnitude**: Unknown **Time**: Construction **Duration**: Post construction until streams establish new equilibria **Extent**:The Jorodane River, especially where the road crosses the river or its tributaries.	Residents of the river catchment, people dependent on, and researchers interested in, the natural ecological functioning of the system	Avoid the use of ARMCO bridges, except on small streams where they should accommodate more than the maximum streamflow volumes to prevent high velocity discharge of water.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**

BIOPHYSICAL IMPACTS FOR LCAR (continued): IMPACTS ON ECOLOGICALLY SENSITIVE AREAS						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Loss of future land use options of the Jorodane River and Valley	The Jorodane River is considered deserving of high conservation status. A conservation programme for the Maluti minnow has been proposed for the lower reaches of the river (above waterfall at Pampiri). Plans also exist to link this area and the Western Maluti mountain range to a Bokong river conservation area.	**Magnitude:** Undefined **Time:** Construction and implementation **Duration:** Continued **Extent:** Regional and national	People of Lesotho, conservationists, researchers and tourists.	Identify alternative sanctuary site for the Maluti minnow Strict adherence to the rehabilitation guidelines Employ an Environmental Control Officer and institute an Environmental Management Plan so that future options for conservation are not foreclosed by the construction of the LCAR	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
Impacts on wetlands and bogs	Wetlands and bogs act as water storage areas and as filters of sediment and excess nutrient. Their destruction changes river flow regimes resulting in increased erosion, sediment load and reduction of water quality as well as the destruction of broom grass *(Merxmuellera macowanii)* used for thatching and broom-making. A site of particular importance occurs between km 24 to km 25.5 of the LCAR alignment	**Magnitude:** 8 different wetland locations identified as being potentially impacted by the LCAR construction **Time:** Construction **Duration:** Construction and continued (mitigation has proven unsuccessful Katse Road) **Extent:** Localised direct impacts, sub-regional induced hydrological impact	Residents downstream of marshes, conservationists	Avoid construction activities near or in wetland areas. Where unavoidable minimise infilling, construct many small culverts rather than few large and erect gabions inorder to reduce river flow velocities Refer to rehabilitation guidelines (Appendices of Baseline documents)	**LOW TO MODERATE SIGNIFICANCE**	**MODERATE TO HIGH SIGNIFICANCE**

BIOPHYSICAL IMPACTS FOR LCAR (continued): IMPACTS ON RARE AND ENDANGERED SPECIES						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Destruction and local extinction of the spiral aloe *(Aloe polyphylla)* IUCN Red Data species	The spiral aloe is illegally collected and sold to tourists. The known distribution has shrunk by a third due to collection. It is expected that an increase of this activity will be induced by the presence of the LCAR. An important population exists 10 km west of the road alignment near Soosa. Other locations exist near Ha Likomisi, Ha Makhobalo, Ha Mphakho and Ha Nthakhane.	**Magnitude**: Undefined **Time**: Construction and implementation **Duration**: Continued **Extent**: National, international	Residents who want sustainable use of aloes, researchers, conservationists, people of Lesotho	Proclaim strictly protected aloe reserves Increased surveillance by conservation and other officials Train residents who wish to sell aloes to cultivate aloes from seed so as to maintain population numbers.	MODERATE SIGNIFICANCE	HIGH SIGNIFICANCE
Two species of aquatic fauna: the Maluti minnow *(Pseudobarbus quathlambae)* the aquatic river frog *(Rana vertibralis)*	The Maluti minnow (status = endangered) and the Aquatic River frog (status = restricted) (S.A. Red Data Book) that occur in the Jorodane-Senqunyane River system are possibly genetically unique. The survival of these species depends on the maintenance of high water quality as they will not survive in water with a high sediment load. Approx. 86% of the known habitat of the Maluti minnow in the Jorodane-Senqunyane-Bokong system will be flooded by the Mohale Dam.	**Magnitude**: Two species, magnitude of impact undefined **Time**: Construction **Duration**: continued **Extent**: National, international	Future generations, conservationists, researchers	Timing of construction in winter months to avoid impact on the reproductive success of aquatic fauna Continued research on the distribution of these threatened species.	HIGH SIGNIFICANCE	HIGH SIGNIFICANCE
Disturbance and death of faunal elements	Noise and vibration due to construction; the killing of animals for food or out of fear as well as the overall effect of introducing vehicular traffic.	**Magnitude**:Unknown **Time**: Construction and implementation **Duration**: Enhanced during construction and continued **Extent**: Localised in areas where construction camps are situated, sub-regional	Residents of the area, conservationists, researchers, people of Lesotho.	Erection of signs alerting people (including construction workers) conservation status of rare and endangered fauna.	LOW SIGNIFICANCE	MODERATE SIGNIFICANCE

BIOPHYSICAL IMPACTS FOR LCAR (continued): IMPACTS ON VEGETATION						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Destruction of *Leucosidea* shrubland	Side-spoiling between km 8 and km 16 on the alignment of the LCAR could result in the burial of parts of the community. Although the species *Leucosidea sericea* is not endangered, the extent of this type of shrubland is limited.	**Magnitude**: Unknown **Time**: Construction **Duration**: Construction, 36 months **Extent**: National	Residents who use wood for fuel, conservationists, researchers. People of Lesotho	No side-spoiling should be permitted between km 8 to 16 (Refer to Rehabilitation guidelines Appendices of Baseline documents)	LOW SIGNIFICANCE	MODERATE SIGNIFICANCE
Loss of vegetation	Vegetation lost by side-spoiling, and dumping and the creation of a road corridor will mainly be grass. The amount of grazing lost may be important especially in areas of valley bottoms (km 25 to 44) and areas degraded by erosion (km 17 to 25).	**Magnitude**: 110 ha of land used for the road corridor plus an unknown amount covered by side-spoiling **Time**: Construction **Duration**: Construction (36 months) and post-construction until rehabilitation is complete **Extent**: Localised between km 25 to 44 and 17 to 25 and where side spoiling occurs.	Stock-owners, tourists	Spoil to be transported to designated dumps.	NO SIGNIFICANCE	LOW SIGNIFICANCE

Table 3.3.7.b. Biophysical impacts for the WAR.

BIOPHYSICAL IMPACTS FOR WAR.						
HYDROLOGICAL IMPACTS						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Increased sediment loading of rivers and streams	Rivers in the lowlands are typically degraded due to intensive agriculture, and chemical inputs from washing. Increased sediment load in these areas will worsen the existing water quality. Rivers in the highlands are relatively less silt laden and more sensitive to new inputs.	**Magnitude**: Unknown **Time**: Construction **Duration**: During upgrading and afterwards until rehabilitation is complete and streams have established new equilibria **Extent**: Local and sub-regional where major tributaries are affected.	Residents of the river catchments, dependent on, and researchers interested in, the river systems.	Enforcement of erosion control measures (see Appendices of Baseline documents). The employment of an Environmental Control Officer and the implementation of an Environmental Management Plan. All run-off from the road to be channelled into side drains prior to entering water courses	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
Clogging of stream courses with rockfall	Stream clogging causes increased erosion around obstacles, changes in the hydrological equilibrium, alteration of the ecological functioning and loss of functional (potable water) and aesthetic qualities of the stream.	**Magnitude**: Unknown **Time**: Construction **Duration**: During upgrading and afterwards until streams establish new equilibria **Extent**: Localised and sub-regional catchment areas, particularly at points where dumping may occur	Residents of the catchment area, people dependent on, and researchers interested in, the river systems	Avoid dumping of spoil material in stream courses or siting quarries or borrow pits along stream courses. Stream courses that are affected should be cleared and rehabilitated before completion of the contract.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
IMPACTS ON ECOLOGICALLY SENSITIVE AREAS						
Loss of marsh area	Marshes are crossed or occur adjacent to the road on God Help Me Pass and Blue Mountain Pass and between km 27.5 and 42.15 in patches. Destruction of marsh areas will affect water quality and the availability of Broom grass *(Merxmuellera macowanii)* which is used for thatching and broom-making.	**Magnitude**: Potentially, 978 m^2 could be destroyed **Time**: Construction **Duration**: During upgrading and afterwards (rehabilitation of these wetland areas is not always successful) **Extent**: Localised direct impacts, sub-regional induced hydrological impacts	Residents downstream of marshes, conservationists	Minimise cut and fill in marsh areas Erect gabions or other structures to reduce water velocities through culverts Refer to rehabilitation guidelines (Appendices of Baseline documents)	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**

BIOPHYSICAL IMPACTS FOR WAR (continued): IMPACTS ON RARE AND ENDANGERED SPECIES						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Destruction and local extinction of the spiral aloe *(Aloe polyphylla)* IUCN Red Data species	The spiral aloe is illegally collected and sold to tourists. The known distribution has shrunk by a third due to collection. It is expected that an increase of this activity will be induced by the presence of the upgrading of the WAR due to an envisaged increased market due to increased traffic volumes.	**Magnitude**: Undefined **Time**: Construction and implementation **Duration**: Continued **Extent**: National	Residents who want sustainable use of aloes, researchers, conservationists, people of Lesotho	Proclaim strictly protected aloe reserves. Increased surveillance by conservation and other officials. Train residents who wish to sell aloes to cultivate aloes from seed so as to maintain population numbers.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
Disturbance and death of faunal elements	Noise and vibration due to construction; the killing of animals for food or out of fear as well as the overall effect of increased vehicular traffic.	**Magnitude**:Unknown but expected to be low as few faunal elements seem evident. **Time**: Construction and implementation. **Duration**: Enhanced during construction and continued. **Extent**: Localised in areas where construction camps are situated, sub-regional.	Residents of the area, conservationists, researchers, people of Lesotho	Erection of signs alerting people (including construction workers) conservation status of rare and endangered fauna.	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
IMPACTS ON VEGETATION.						
Destruction of *Leucosidea* shrubland	Two areas of *Leucosidea* shrubland may be affected by the upgrading of the WAR: km 21 to 22 which will be lost by cutting (already degraded) and km 36.9 which will be lost by realignment (good condition).	**Magnitude:** Total of 3 700 m^2 **Time**: Construction **Duration**:Construction, 36 months **Extent**: National	Residents who use wood for fuel, conservationists, researchers, people of Lesotho	Minimise side cutting at km 21 to 22 and transport spoil to designated dumping areas. Realign the WAR at km 36.9 to avoid destruction of the shrubland	**LOW SIGNIFICANCE**	**MODERATE SIGNIFICANCE**
Destruction of *Erica alopecurus* habitat	*Erica alpocurus* is endemic to areas of short grassland in the Afro-alpine biome of Lesotho and therefore has limited distribution. Impacts on habitats supporting this species should be avoided. Locations of affected areas are indicated in the information on the WAR chainage in the Baseline Document Apppendices	**Magnitude**: Approximately 100 m^2 of this habitat will be destroyed with the present alignments of the upgraded WAR **Time**: Construction **Duration**: Construction, 36 months **Extent**: National	Conservationists, researchers, all people of Lesotho	Minimise cutting and side spoiling and locating any temporary infrastructure in areas where *Erica alopecurus* occurs.	**LOW SIGNIFICANCE**	**LOW SIGNIFICANCE**

BIOPHYSICAL IMPACTS FOR WAR (continued): IMPACTS ON VEGETATION (continued).						
Type	*Comments*	*Magnitude, Time, Duration and Extent*	*Interested and affected parties*	*Mitigation and optimisation*	*Significance*	
					With mitigation	*Without mitigation*
Loss of vegetation	Side spoiling at sites with steep gradients will destroy vegetation at km 19 to 22, 29.4 to 30.5, 36.9 to 38.7 and 49.1 to 50.4	**Magnitude**: Unknown **Time**: Construction **Duration**: During upgrading and afterwards until rehabilitation is complete **Extent**: Localised, where side-spoiling and dumping occurs	Stock-owners, residents and tourists	Spoil to be dumped at designated sites	LOW SIGNIFICANCE	LOW SIGNIFICANCE

Table 3.3.8 Summary impact table

* Significance with mitigation

SUMMARY IMPACT TABLE			
LCAR		**WAR**	
Impact	*Significance*	*Impact*	*Significance*
NATIONAL AND REGIONAL IMPACTS			
▪ The LCAR could negatively affect pony trekking, but promote new types of tourism activities	**Moderate**	▪ Construction of the Maseru bypass would alleviate traffic congestion	**High**
		▪ Potential to provide net benefit to tourism and economic growth	**Moderate**
SOCIO ECONOMIC NEGATIVE IMPACTS			
▪ Social disruption	**Moderate**	▪ Social disruption	**Moderate**
▪ Loss of houses and business facilities	**Moderate**	▪ Loss of houses and business facilities	**Moderate**
▪ Disruption of local economy	**Moderate**	▪ Interference with potable water supplies	**Moderate**
▪ Loss of agricultural resources	**Moderate**	▪ Loss of agricultural resources	**Moderate**
		▪ Increased cost of living	**Moderate**
		▪ Inconvenience and increase risk to people and livestock	**Moderate**
▪ Increased risk/ danger to people and livestock	**Low**		
▪ Interference with potable water supplies	**Low**		
▪ Aesthetic impacts	**Low**	▪ Aesthetic impacts	**Low**
▪ Noise and disturbance from blasting	**Low**		
▪ Disturbance of burial sites	**Low**		
▪ Increased traffic flow between Maputsoe and Ha Mateka	**Low**		
SOCIO ECONOMIC POSITIVE IMPACTS			
▪ Improved access to goods and services	**High**	▪ Improved access to goods and services	**High**
		▪ Increased employment and business opportunities	**Moderate**
		▪ Improved road safety	**Moderate**
		▪ Reduced dust and mud	**Moderate**
▪ Increased opportunity to market goods	**Low**		
▪ Increased employment opportunities	**Low**		
ARCHAEOLOGICAL AND PALAEONTOLOGICAL IMPACTS			
▪ Archaelogical and palaeontological sites	**Low**	▪ Archaeological and palaeontological sites	**Low**

SUMMARY IMPACT TABLE (continued)

LCAR		WAR	
Impact	*Significance*	*Impact*	*Significance*
BIOPHYSICAL IMPACTS			
▪ Potential local extinction of two IUCN Red Data Species (Maluti minnow and Aquatic river frog)	**High**		
▪ Increased sediment loading of rivers and streams	**Moderate**	▪ Increased sediment loading of rivers and streams	**Low**
▪ Destruction and local extinction of the Spiral aloe	**Moderate**	▪ Destruction and local extinction of the Spiral aloe	**Low**
▪ Impacts on wetlands	**Moderate/ Low**	▪ Impacts on wetlands	**Low**
▪ Loss of future landuse options for the Jorodane River Valley	**Low**		
▪ Clogging of water courses with rockfall	**Low**	▪ Clogging of water courses with rockfall	**Low**
▪ Alteration of water courses by drainage through ARMCO culverts	**Low**		
▪ Disturbance and death of faunal elements	**Low**	▪ Disturbance and death of faunal elements	**Low**
▪ Destruction of *Leucosidea* shrubland	**Low**	▪ Distruction of *Leucosidea* shrubland	**Low**
▪ Loss of vegetation	**Low**	▪ Loss of vegetation	**Low**
		▪ Destruction of *Erica alopecurus* habitat	**Low**

CHAPTER 4

COMPARATIVE EVALUATION OF THE LCAR AND THE WAR

CHAPTER 4

COMPARATIVE EVALUATION OF THE LCAR AND THE WAR

4.1 INTRODUCTION

This chapter presents a comparative evaluation of the two alternative proposals. The description of the method used in this document is preceded by a brief discussion on the major differences between qualitative and quantitative evaluation methods.

4.2 METHOD OF EVALUATION

4.2.1 Evaluation: qualitative or quantitative

Quantitative or formal evaluation methods generally involve the application of commensurate units (often numerical) to value judgements. The types of transformations which are applied to data may range from panel ranking and weighting systems to ascribing shadow prices (i.e. Rands and Cents values) to potential impacts. An assumption made is that everything is tradeable (Lawrence, 1993). Once the trade-offs have been assigned values, it may be tempting to view the choice among the alternatives as purely a methodological problem. This is perhaps a reason why some quantitative evaluation methods are theoretically complex and inaccessible to the decision-maker and the public.

Another important assumption in the methodology of formal evaluation methods is that the magnitude and significance of an impact may be separated. Dwyer (in Lawrence, 1993) challenge this artificial compartmentalising of facts and values and questions the idea of value-free science. Almost any evaluation technique in EIA, however, requires this separation, as it is implicit to the definition of the word "evaluation".

Qualitative or informal evaluation techniques usually involve informed value judgements which may be expressed in a narrative form. The judgements should be systematically and clearly articulated so that the rationale behind the conclusions drawn may be understood by the decision-maker and the public.

It may be argued that all evaluation methods are inherently non-scientific and subjective to a certain extent (Lawrence, 1993). Perhaps the critical consideration in evaluation is not the technique, but who evaluates the impacts, and to what extent they understand the major trade-offs which are necessary in the choice of an alternative.

4.2.2 Method of evaluation used

The evaluation method chosen to weigh up the impacts of the WAR and the LCAR in this document is qualitative, drawing on the information in the baseline documents, the social survey and literature, and employing the informed judgement of the author. The evaluation is presented in two sections:

1) The first section evaluates the impacts of the alternatives under grouped impact headings or types, giving emphasis to significant impacts. Although an attempt is made to evaluate the significant impacts, the comparative evaluation of impact groups e.g. positive socio-economic impacts, is a more useful tool.

2) The second section evaluates the LCAR and the WAR according to the criteria of efficiency, equity and sustainability (Stauth, 1983; Stauth *et al*, 1992).

4.3 NATIONAL AND REGIONAL PLANNING AND POLICY CONSIDERATIONS

This section provides the planning and policy context in which the proposed alternatives can be viewed. Only the major aspects of these considerations are compared. A more detailed account for each of the routes is available in the baseline documents.

4.3.1 National planning objectives of the Fifth Five-Year Development Plan (1991/92 - 1995/96)

The major objectives of the Fifth Five-Year Development Plan (Ministry of Planning, Economics and *Man*power Development, 1993) also outlined in the description of the affected environment, are:

* the alleviation of poverty;

* the promotion of equity and social justice;

* the generation of more productive job opportunities, and

* an adequate level of sustainable economic growth, with the emphasis on economic management.

Poverty in the mountain regions of Lesotho is seen as a major problem (Sechaba Consultants, 1991; Report on the Social Survey EEU 2/93/104e). The Development Plan sees the Lesotho Highlands Water Project as an important contributor to economic growth and provider of jobs. The degree to which the construction of the LCAR and the upgrading of the WAR will meet these expectations, is uncertain. The construction

of the Katse Road provided few local people with jobs due to lack of skills (Thoahlane, 1991). 500 jobs will be created for a period of 36 months for both of the alternatives.

The provision of access to services to people in the mountain region will be met by both of the alternatives. However, LCAR would service villages (33 of less than 100 people and 15 larger villages) in the Jorodane Valley which are presently isolated, and may also open up new areas for development. The WAR, although degraded, exists and already provides a service to the local people. An improved service would be provided for 20 small villages and 13 large (i.e., more than 100 inhabitants) villages.

The potential for economic growth to occur after the construction of the access road to the Mohale Dam site is greater for the WAR. The potential for a multiplier effect for Lesotho is greater for the WAR as some secondary services already exist along the route. If Maseru is used as the point of break of bulk for dam construction materials, development of associated supporting services will occur in Lesotho. Spending associated with increased traffic through an urban area will also occur in Lesotho, whereas if the materials are brought through Ficksburg, spending will occur in South Africa.

The LCAR accords with the Development Plan to a greater extent in the servicing of undeveloped areas. The potential for economic growth and a multiplier effect will be satisfied by the upgrading of the WAR. The potential for income generation increased spending power will be encouraged through the upgrading of the existing WAR and therefore accord with the Development Plan.

4.3.2 The National Settlement Policy

The aim of the National Settlement Policy is to promote balanced settlement development (Land Surveys and Physical Planning, Ministry of the Interior, 1990). The major goals of the Policy as presented earlier are:

* decentralisation by reducing the primacy of Maseru;
* to provide at least one viable centre in each district as well as regional centres;
* to develop areas with unique or special qualities, and
* to promote settlement development in presently under-serviced areas, particularly the mountain districts.

The upgrading of the WAR reinforces the National Settlement policy to a greater extent than the LCAR as it would strengthen present planned growth points such as Thaba-Tseka and Mantsonyane. However, the use of Maseru as the port of entry and break of bulk for the dam construction materials, in the event that the WAR is upgraded, may encourage further unplanned growth of the city. The LCAR will reinforce planned development in the Leribe and Berea districts as well as that of Teyateyaneng. The

Jorodane Valley at present lacks the institutional capacity to cater for any development which might otherwise result due to the construction of the LCAR.

4.3.3 The Lesotho road network plans

The building of the LCAR will place an extra burden of M130 000 per year (routine maintenance) and M1 500 000 every 8 years (resealing) in the maintenance cost of 55 km of new road.

The upgrading of the Mountain Road to Patiseng would save the Government of Lesotho (Roads Department, Ministry of Works) approximately M10 million if undertaken by the LHDA. This alternative does not constitute the building of a new road and would therefore not place an extra burden on the maintenance budget of the Roads Department.

The proposed construction of the Mashai Dam in the future would necessitate a western access route between Maseru and Thaba-Tseka. Upgrading the WAR for the Mohale Dam construction would therefore efficiently support LHDA's longterm plans.

The upgrading of the WAR will reinforce to a greater extent, the Lesotho road network plans by contributing to the upgrading of the existing Maseru - Thaba-Tseka link.

4.3.4 Conclusion

The upgrading of the WAR reinforces and accords with national and regional plans and policies to a greater extent than the construction of the LCAR.

4.4 NATIONAL AND REGIONAL IMPACTS

4.4.1 Impacts of high significance

i) The construction of the Maseru bypass would alleviate congestion in Maseru

The major arterial roads in Maseru converge at Cathedral Circle in the central business district which causes traffic congestion. The major arterial routes of the city, namely Main South/Mafeteng Road and Main North/Teyateyaneng Roads are most congested

near the CBD due to the absence of regulated junctions, parking areas, passing lanes, and bus and taxi stops. The lack of these facilities results in travel on these roads being particularly dangerous. The Department of Roads has also indicated that the pavement structures of these major routes are reaching the end of their functional life-spans.

The construction of the bypass will benefit the people of Maseru (approximately 160 000 people) as well as the LHDA by providing improved and safer access to services and more efficient transport in the city. The potential benefits which could accrue to the people of Maseru should be maximised by following the recommendations of the Initial Environmental Impact Assessment of the Proposed Maseru Bypass (Contract No. LHDA 1 000) (EEU/2/93/104a).

Potential benefits accruing to the people of Maseru would be lost if the LCAR was built. The construction of the LCAR involves the provision of a bypass for Teyateyaneng but this would only benefit the LHDA in providing more efficient transport of materials. A bypass for Teyateyaneng may negatively affect the economy of the town which relies to a large extent on business brought by traffic between Maseru and Maputsoe.

4.4.2 Discussion

The WAR would encourage the growth of existing pony-trekking acivities, which has a gross income of M200 000 annually, by improving access to the region (moderate significance). Although other scenic, undeveloped valleys exist in which pony-trekking could take place, the construction of the LCAR would negatively impact pony-trekking by detracting from the wilderness character of the Jorodane Valley (moderate significance). The LCAR may promote the development of other tourist activities (moderate significance). The construction of Katse Road and the Mountain Road which traverse spectacular mountain areas have not induced noticable tourist development (personal observation). It is the author's opinion that without externally funded tourism development programmes, few short-term benefits will accrue to the region through tourism should the LCAR or the WAR be built.

The potential national and regional benefits which the WAR will provide through tourism are no greater than that of the LCAR. The construction of the Maseru bypass makes the WAR the preferred option from a national and regional perspective.

4.4.3 Conclusion

The overall potential for the upgrading of the WAR to provide an overall national and regional benefit to Lesotho is greater than that for the construction of the LCAR.

4.5 SOCIO-ECONOMIC IMPACTS

4.5.1 Significant negative socio-economic impacts

i) Interference with access to or destruction of potable water supplies (high significance without mitigation for LCAR and WAR)

The Sechaba (1991) survey on poverty in Lesotho lists the lack of good water supply as the second most important problem faced by the people. 34% and 43% of people from the Jorodane Valley and the Mountain road respectively, identified potable water supply as a major problem in villages. The number of springs which are at risk of direct and indirect distrurbance are 4 and 7 for the LCAR and the WAR respectively. The mitigatory measures for either of the alternatives includes the provision of alternative water supply, of an equivalent quality, for the potentially affected communities. However, the secondary effects of the disturbance of potable water supplies e.g. an increase incidence of diarrhoea, may be more serious in the Jorodane Valley which has limited access to health services.

ii) Social disruption of local communities (high significance without mitigation)

Crime along with other effects on social patterns and lifestyles are impacts which are evident in the Dam Katse development (Setplan, 1991; Makuta, 1991).

Stock theft in both the LCAR and the WAR areas was stated as a problem and validated by the Katse survey. 37% ? of people interviewed along the Katse Road attributed the increase in stock theft to the new road. A new road in the Jorodane Valley is more likely to increase stock theft occurrence, as this area, like the Katse area, does not have access to law enforcement. A road will also provide easier access for the stock-thieves. It is unlikely that the stock theft on the WAR will increase substantially after upgrading as the already road exists.

The influx of up to 500 construction workers will result in much business opportunity as well as considerable social disruption to the villages for either of the alternatives. It is likely that people searching for jobs will settle near the construction camps along the LCAR and the WAR in the hope of filling a newly available vacancy. Since the start of the Katse dam development, there has been an increase in crimes such as rape and assault. The social survey of villages along the Katse road supports this, but there is no evidence to suggest that these crimes were caused by outsiders. Other impacts on the social environment of the Katse Road area such as alcoholism (Makuta, 1991) and prostitution and associated sexually transmitted diseases have resulted from the influx of workers and female entrepreneurs (Nyaphisi, pers. comm.).

The long-term demotivation of community members to work or farm due to receiving cash and grain as compensation is an impact which could have serious implications for

those affected. The Katse survey has shown that there has been little non-agricultural development which could replace income lost due to the construction of the road. Little economic benefit in the form of passing trade accrues to the people on the Katse Road as development programmes promised by the LHDA are non-existent, partly because of the IMF review of the Government of Lesotho and the associated freezing of revenue brought in by the LHWP (Bonat and Abdullahi, 1991).

The compensation of land lost with other unused land by the LHDA is sometimes not a feasible option in the eyes of the villagers. Firstly, the rights to land are allocated by the chief; secondly, arable land is usually a scarce resource; and thirdly, allowing fields a fallow period is implicit to the agricultural sustainability of these areas.

Assessing and evaluating the social disruption of people on either of the proposed roads would have been more useful had a monitoring programme assessed societal changes along the Katse Road during construction and implementation. Although the social survey could establish to an extent the present social order of the area, adequate "baseline" information was not available. Whether impacts related to the influx of workers were transient or not, is also unknown. Even if this information were available, it is not possible to predict with any certainty how particular communities will react to the effect of the project. Demonstrating cause and effect relationships for social impacts, especially with respect to secondary and induced impacts is at best, difficult (Finsterbusch, 1985; Armour, 1988).

The social disruption of communities will be more marked in the Jorodane Valley where people are relatively isolated at present and where social pathologies such as crime and alcoholism are less prevalent. Nevertheless, to assume that the Jorodane Valley is free of the social pathologies usually related to an urban context, would be incorrect.

The social disruption which will result from the flooding of the lower reaches of the Jorodane Valley will overshadow impacts caused by the construction of the LCAR.

iii) Loss of agricultural resources (high significance without significance for both alternatives)

An impact on any agricultural resource in the absence of mitigation would seriously affect the communities in question as little other means to provide food and income exists. It is unlikely that loss of agricultural resources will remain uncompensated, but the inconvenience suffered by the affected communities cannot be disregarded. Although people along the Katse Road were compensated for land lost, delayed impacts such as damage to fields due to high velocity water flowing from culverts onto the adjacent fields, erosion and failure of cut-slopes, and rocks from fill-slopes rolling onto fields. The impact identification process in EIA usually takes place at one point in time and is therefore ill-equipped to accommodate delayed impacts (Adams, 1990). It is imperative, therefore, to devote more time to setting up a monitoring programme which will identify such impacts and allow for compensation. The mitigatory measures, then,

should also include the informing of the potentially affected parties of an appeal process which can be followed should indirect and latent impacts affect agricultural resources.

Table 5: A comparison of the agricultural resources lost for the LCAR and the WAR

Resource	LCAR	WAR
Arable land	148 600 m^2	3 146 m^2
Vegetable gardens	3 320 m^2	568 m^2.
Fruit trees	87	36
Other trees	20 (min)	81
Livestock structures:	5 kraals 9 stables	3 kraals 1 dip tank

The loss of fruit trees along the WAR is likely to have a greater impact on the income of people than that of the LCAR as peaches are sold to travellers along the Mountain Road at bus and taxi stops.

The impact on agricultural resources will probably manifest itself in the change of lifestyle due to cash or grain compensation as well as in a greater dependence on the cash economy in general. One could postulate that the LCAR will have a more pronounced affect due to the amount of land which will be taken in order to accommodate the road reserve. The effective compensation of resources should ensure that all affected parties are no worse off as a result of the project. The LHDA compensation officers will have to assess each affected party's needs individually in order to achieve this goal.

iv) Loss of houses and business facilities

Table 6:A comparison of the houses and business facilities lost for the LCAR and the WAR

Type of building	LCAR	WAR
Businesses	2	3
Houses	19	13

The direct impacts of the loss of houses and buildings will be effectively compensated for. Indirect impacts such as the social disruption and the loss of rural character will

result from relocation the provision of modern buildings. These effects could be greater for the LCAR where buildings are predominantly of a vernacular architectural form.

The relocation of people in the lower reaches of the Jorodane Valley during the construction of the Mohale dam will overshadow that caused by the construction of either of the roads. Impacts to the surrounding communities will include a greater demand on resources as well as social disruption.

v) Disruption of the local economy (high significance without mitigation)

The Jorodane Valley, the corridor of the proposed LCAR, is characterised by plantations of dagga (*Cannabis sativa*). Even where other crops are planted, dagga is frequently intercropped in a fashion which renders it concealed from view. Dagga is sold to the South African market at between M200 and M350 per 50 kg maize-meal bag. Although the returns from growing dagga are erratic, the social survey indicates that 69.4% of people in the Jorodane Valley rely on dagga as a major source of income. The potential loss of income from dagga which could be caused indirectly by the construction of the LCAR is between M200 000 and M500 000 per annum, a highly significant impact for these remote communities which have limited access to the mainstream cash economy.

The "informal economy" of the Jorodane Valley presents a moral dilemma to the decision maker. Helping to cause the demise of the drug economy is commendable while the welfare of all people still remains the major consideration. The creation of an alternative source of income for those involved in the cultivation and sale of dagga is an essential part of any development programme associated with the construction of the LCAR. Katse experience shows however, that even where an alternative activity for entrepreneurs is available, the growing and selling of dagga still proves more profitable. Many villagers along the Katse Road are still involved in the illegal "informal economy" and have simply moved their activities into another valley adjacent to the road (personal observation).

Notwithstanding the potential loss of income from dagga, most people interviewed in the Jorodane Valley indicated that they wanted the road (LCAR) to be built. The perception of those interviewed was that having a road in the Valley would provide access to other cash incomes. This, however, is not evident on the Katse Road.

4.5.2 Discussion and conclusion of negative socio-economic impacts

The negative social impacts on the residents of the LCAR will be more pronounced than the WAR for the following reasons:

1) No road exists in the Jorodane Valley and the construction of the LCAR will necessitate the penetration of a road reserve through the valley involving land-

take and altered landuse patterns. Agricultural resources and burial sites will be affected to a greater extent for the LCAR proposal.

2) Although the levels of risk to people and livestock will be increased due to increased traffic on the WAR, the potential impact to safety of people and livestock in the Jorodane Valley will be marked as people living here are not accustomed to living with traffic.

3) The construction of the LCAR involves the reduction of income from the illegal cultivation and sale of dagga (*Cannabis sativa*), which will affect the welfare of those dependent on this illegal trade.

4) Social disruption and the loss of rural character will be more marked as the Jorodane Valley has no road, has fewer urban influences as well as fewer modern houses. (This impact may be insignificant when compared to the effects on the Jorodane Valley during the construction and filling of the Mohale Dam.)

4.5.3 Significant positive socio-economic impacts

i) Improved access to goods and services (high significance with or without mitigation for both alternatives)

The impact of improved access to goods and services will be greater for the communities living in the Jorodane Valley as no road presently exists. Vehicular access to schools, clinics, emergency services and to larger centres where higher order goods are available, will be possible. Benefits perceived by the respondents of the survey of the Jorodane Valley include improved transport for migrant workers who commute weekly between South Africa and these isolated parts of Lesotho; improved social contacts; improved access to agricultural services, facilities and regional markets, and reduced travel time in transporting cadavers to and from mortuaries. The people near the WAR will enjoy an improved road service. The presence of labour in the area will also increase the amount of transport services operating in the area.

The extent to which either area will benefit from the construction of a new road or the upgrading of the existing road depends on the types of transport services which will be present and, more importantly, how expensive they are.

4.5.4 Discussion of positive socio-economic impacts

The most important difference between the two alternatives with respect to positive social impacts is the improved access to goods and services. Greater social benefits will accrue to the people along the LCAR in the Jorodane Valley by the provision of access to vehicular transport. The presence of construction workers in the area during the

building of the road and the dam will increase the number of buses and taxis serving the WAR or the LCAR.

The extent to which the upgrading of the WAR will improve road safety is unknown. Although upgrading will reduce the mud and dust on the road and road shoulder, improve the line of sight, provide passing lanes and taxi and bus stops, the road remains poorly designed with respect to safety (Schaap, personal communication).

Although households along both routes may increase their income through selling beer, washing clothes and providing accommodation to the people associated with the construction of the road and the dam, the WAR has greater potential to increase employment levels in the area. This can be attributed to the existing higher order services such as tourist attractions (Basotho Pony Centre), shops and accommodation (Molimo Nthuse and Marakabei Lodges). Residents along the WAR therefore have a greater chance of benefiting through increased employment opportunities than those in the Jorodane Valley in the short-term.

4.5.5 Conclusion

The negative social impacts resulting from the proposal would be more pronounced for the construction of the LCAR.

The positive impact of the LCAR providing access to goods and services makes this option preferable when viewing the social benefits of the alternatives, however, these benefits are largely localised.

4.6 BIOPHYSICAL IMPACTS

4.6.1 Significant biophysical impacts

i) Increased sediment loading of rivers and streams

The impacts resulting from increased sediment loading of watercourses is expected to be greater for the construction of the LCAR. The amount of earthworks necessary for the construction of the new road will cause more areas to be cleared of vegetation and thus the potential for larger amounts of soil to be eroded is greater. The LCAR runs close to a major river, the Jorodane River, for approximately 20 km, from the Lekhalong-la-Likhaebaneng Pass to Ha Mokhobalo (Phontseng).

The construction of the LCAR and associated erosion may decrease the lifespan of the Mohale Dam if erosion rates increase in the future. Other related effects will be a reduction of water quality for the residents of the Jorodane Valley.

The streams in the highlands along the WAR are less degraded than those in the lowlands (which are silt-laden under normal conditions) and will be more sensitive to increased sediment input. The relative impacts of the LCAR on aquatic fauna, good water quality and the Jorodane Valley as an ecological system, however, are deemed greater than those of the WAR in its surrounding catchment.

ii) Impacts on rare and endangered species

Two species of endangered aquatic fauna, the Maluti minnow (*Pseudobarbus quathlambae*) and the Aquatic River frog (*Rana vertebralis*), will be affected and perhaps be driven to local extinction should the conditions of increased silt pollution loading prevail for extended periods during the construction of the LCAR. This impact was assigned a high significance rating, with and without mitigation.

The Aquatic River frog (status = restricted) and the Maluti minnow (status = endangered) (South African Red Data Book, 1988) occurring in the Lesotho highlands are believed to be genetically unique. Both species are known to be sensitive to the sediment loading of their aquatic environment (Rall *et al*, 1993; Cambray and Meyer, 1987). Despite all efforts to mitigate silt-laden run-off from areas denuded of vegetation, it is unlikely that the LCAR can be built without changing the water quality of the Jorodane River. The Maluti minnow, however, is presently known only to exist in the lower reaches of the Jorodane River, which at the completion of the Mohale dam, will be inundated with water. A conservation programme has been proposed for the minnow in the Jorodane Valley, above the waterfall at Pampiri where the conditions for the survival of the species exist.

The potential impact on the Maluti minnow is twofold. The construction of the LCAR may contribute to its local extinction in its current habitat or may cause its demise in the proposed conservation area.

There are no known rare or endangered aquatic faunal species in the rivers impacted by the WAR.

The spiral aloe, *Aloe polyphylla*, is endemic to the mountains of Lesotho and is classified as rare by the IUCN (Talukdar, 1983). The impact "destruction and local extinction of spiral aloe as a result of increased collection" was given high significance rating without mitigation (moderate significance with mitigation) for the LCAR and moderate significance rating without (low significance with mitigation). The construction of the LCAR and the associated traffic will result in the collection of spiral aloes for sale to a newly available clientele. The sale of the spiral aloe already occurs on the Mountain Road and would increase with increased vehicular volumes. It is not possible to identify one population of spiral aloes over another as the genetic diversity of each of these different populations is probably unique. The opening up of a new area

of exploitation of the spiral aloe should be seen as more serious to the survival of the species.

4.6.2 Discussion

Hydrological impacts are expected to be of more importance on the LCAR and particularly in the Jorodane Valley where the water quality is high and the river flow unmodified. Potential changes to the hydrology of the streams and rivers of the Jorodane Valley also include the alteration of morphology by enforced drainage through culverts, the clogging of water courses with rockfall during construction and resultant increased sediment loading. The secondary impacts on the local residents and the aquatic fauna of the Jorodane Valley are major concerns.

Detailed studies for the particular rivers along the WAR alignment have not been attempted and there is therefore no assurance that the upgrading of the WAR will not have profound effects on river functioning. The rivers along the WAR seem relatively degraded but there is no reason why one should not attempt to improve their ecological functioning.

Impacts on ecologically sensitive areas include impacts to the whole of the Jorodane River Valley as well as particular wetland areas along the LCAR and the WAR which play an essential part in the maintenance of water quality in the Lesotho mountain region.

The Jorodane Valley is considered deserving of high conservation status as the river catchment processes have been little modified; the input of pollutants into the system is negligible; endangered and vulnerable endemic species are present in the river, and no exotic fish species are present for the length of the river (MacMillan, 1986). Two proposals have also been put forward which involve the protection of this system. These proposals are:

* to incorporate the upper reaches of the Jorodane River Valley and the Western Maluti Mountain range in a conservation area to be linked to the Bokong River catchment conservation area, and

* to introduce the Maluti minnow into the upper reaches of the Jorodane River, above the Pampiri waterfall, where it can be preserved after the lower reaches of the valley have been flooded post construction of the Mohale dam.

The proclamation of the Maluti Mountains-Jorodane Valley-Bokong reserve system are not necessarily precluded by the building of the LCAR. The survival of Maluti minnow under increased silt loading of the Jorodane River is unlikely should the species be introduced into the proposed conservation area.

Wetland areas provide water storage and filters for rivers. Any impact on these areas could result in the change in velocity of flow of the water and increased erosion and silt levels as well as the change in water quality with respect to water nutrient levels. Impacts on these areas will also reduce the amount of broom grass, *Merxmuellera macowanii* available to local residents for thatching and making brooms. The preservation of wetland areas is important for the LCAR and the WAR, but the effects on the relatively undisturbed Jorodane River will be more marked. Rehabilitation of wetland areas along the Katse Road has not been as successful as expected.

Impacts on vegetation for the LCAR will generally be greater in magnitude than that of the WAR due to land-take necessary for the road reserve. The impacts on particular plant communities like *Leucosidea* shrubland and *Erica alpecurus* populations may differ. *E. alpecurus* populations at risk of being destroyed along have been identified along the alignment of the WAR. Although not rare, this species is restricted to the areas of short grassland in the Afro-alpine biome of Lesotho and therefore should be preserved.

Leucosidea shrubland, a rare community type of Lesotho, will be potentially affected by both alternatives. The loss of these communities will also affect local residents who harvest the wood as a source of fuel. Although the *Leucosidea* stands may be more degraded along the WAR alignment, they are no less useful to the people who depend on this resource for fuel.

4.6.3 Conclusion

An assumption made throughout the preceding section is that because the Jorodane Valley is relatively undisturbed when compared to the biophysical environment along the Mountain Road, impacts on the system will be more important.

The biophysical impacts are judged to be greater for the LCAR than for the WAR proposal, with and without mitigatory measures. The provision of a road in the Jorodane Valley will increase access to the area and will increase pressures on available resources due to the influx of people associated with the building of the road and the Mohale dam. As the LCAR will be constructed close to and in proximity of the Jorodane River, any activities which aim to take advantages of the newly available passing clientele, will have the potential of negatively affecting the ecological functioning of the system. These affects could include the sale of spiral aloes as well as increased inputs into the Jorodane River i.e. pollution and sediment. In conclusion, the potential which exists within the Jorodane Valley to conserve Lesotho's natural heritage may be lost if the LCAR is constructed.

4.7 EVALUATION OF THE LCAR AND THE WAR ACCORDING TO THE CRITERIA OF EQUITY, EFFICIENCY AND SUSTAINABILITY

4.7.1 Introduction

Evaluation according to the criteria of efficiency, equity and sustainability is widely used as an acceptable way to test whether in a proposal will benefit society.

4.7.2 Equity

In the environmental evaluation context, an equitable proposal will ensure that the costs and benefits of the development are fairly distributed over society and that those who bear the costs directly are adequately compensated.

The LCAR it provides a road and transport as well as associated infrastructure to those who presently have access to neither. The LCAR also provides opportunities to people to cope better in the cash economy of which they are already a part. These benefits, however will only accrue to the people of the Jorodane Valley (less than 3000 people).

The upgrading of WAR will benefit more people due to the greater potential that exists for regional and national economic growth. The existing infrastructure in the area, as well as established tourist attractions, will accommodate a multiplier effect which will cause the growth of existing economic activities and the development of new economic activities. The regional multiplier effect will also be accentuated by Maseru acting as a point of break of bulk for the construction materials for the Mohale Dam. The potential economic growth will be enhanced by the construction of a Maseru bypass, according to the recommendations of the initial assessment (EEU/2/93/104a), and the upgrading of the railhead facilities in the city.

The WAR proposal promotes equity to a greater extent by providing national and regional benefits.

4.7.3 Efficiency

In an environmental evaluation context, the efficiency of a proposal is measured by comparing the total benefits and the total costs. In an efficient proposal, the total

benefits outweigh the total costs. Benefits and costs are viewed in biophysical and socio-economic terms.

The WAR proposal is considered more efficient for the following reasons:

1) The social costs for the WAR will be less in terms of social disruption and effects on agricultural resources.

2) The WAR forms part of the presently well-used Maseru-Thaba-Tseka link which requires upgrading. Upgrading of this route will benefit transport facilities for the people of Lesotho. External funds will pay for the upgrading of the road and not the already over-burdened budget of the Roads Department, whereas the construction of the LCAR will create an extra burden in terms of road maintenance.

3) The upgrading of the existing link, will contribute to the infrastructure needed for the construction of the of the Mashai Dam in the future phases of the LHWP.

4.7.4 Sustainability or intergenerational equity

The sustainability or intergenerational equity which a proposal promotes may be may be judged according to the effect that it could have on the well-being of future generations.

The WAR proposal is considered as promoting sustainability to a greater extent for the following reasons:

1) The WAR can provide greater economic benefits nationally and regionally and has the potential therefore, to influence the socio-economic status of present and future generations.

2) The WAR proposal involves less land-take and therefore does not prejudice the future generations. The land-take in the Jorodane Valley will potentially disadvantage future generations who will not inherit rights to the land lost through the construction of the LCAR. Compensation for resources lost, usually received in the form of grain or cash, will terminate after 15 years.

3) The potential local extinction the aquatic river frog and the Maluti minnow in the Jorodane Valley, predisposes the LCAR proposal as unsustainable.

4) The construction of the LCAR may foreclose the option to proclaim a nature reserve and sanctuary for minnow and frog in the upper reaches of the Jorodane Valley. The conservation of a wilderness area such as the Jorodane Valley will be in the interests of future generations when viewing the changing face of the Lesotho Highlands.

SECTION C:
CONCLUSION AND RECOMMENDATIONS

CHAPTER 5
CONCLUSION

CHAPTER 5

CONCLUSION

5.1 INTRODUCTION

The conclusions are presented for each aspect of the affected environment. The major trade-offs which are involved in choosing either of the alternative proposals are discussed in a final, general conclusion, section.

5.2 NATIONAL AND REGIONAL CONSIDERATIONS

National and regional planning will benefit to a greater extent through the upgrading of the WAR for the following reasons:

1) Although the LCAR accords with the Fifth Five-Year Development Plan to a greater extent by servicing presently undeveloped areas, the potential for economic growth and a multiplier effect will be greater for the WAR proposal. The existence of some services and established tourist destinations as well as the construction of the Maseru bypass and the upgrading of the railhead facilities in Maseru associated with the WAR, provide greater development impetus.

2) The WAR accords with the National Settlement Policy to a greater extent than the LCAR as it would strengthen present planned growth points such as Thaba-Tseka and Mantsonyane. Although the LCAR will reinforce planned development in the Leribe and Berea districts as well as that of Teyateyaneng, the Jorodane Valley lacks the institutional capacity to cater for development.

3) The upgrading of the WAR will reinforce to a greater extent, the Lesotho road network plans by contributing to the upgrading of the existing Maseru - Thaba-Tseka link.

5.3 NATIONAL AND REGIONAL IMPACTS

The use of Maseru as the port of entry for the building materials for the Mohale Dam and construction of the Maseru bypass makes the WAR the preferred option from a national and regional impact perspective. The Maseru bypass will benefit the residents

of Maseru by alleviating traffic congestion in the city and ensure that spending associated with break of bulk services occur in Lesotho.

The pony-trekking activities in the Jorodane Valley will be negatively affected by the construction of the LCAR due to the loss of wilderness character of the area. The reinforcement of current tourist activities along the WAR and the conservation of the wilderness character of the Jorodane Valley will provide greater long-term economic benefits to the region than that expected for the LCAR proposal.

5.4 SOCIO-ECONOMIC IMPACTS

5.4.1 Negative impacts

The negative social impacts on the residents of the LCAR will be more pronounced than the WAR for the following reasons:

1) No road exists and the construction of the road will necessitate the penetration of a road reserve through the valley involving land-take and altered landuse patterns. Agricultural resources and burial sites will also be affected to a greater extent.

2) Although the levels of risk to people and livestock will be increased due to increased traffic on the WAR, the potential impact to safety of people and livestock in the Jorodane Valley will be marked as people living here are not accustomed to living with traffic.

3) The construction of the LCAR involves the reduction of income from the illegal cultivation and sale of dagga (*Cannabis sativa*) which will affect the welfare of those dependent on this illegal trade.

4) Social disruption and the loss of rural character will be more marked as the Jorodane Valley has no road, has fewer urban influences as well as fewer modern houses. (This impact may be insignificant when compared to the effects on the Jorodane Valley during the construction and filling of the Mohale Dam.)

5.4.2 Positive impacts

Greater social benefits will accrue to the people along the LCAR in the Jorodane Valley by the provision of access to vehicular transport.

Although households along both routes may increase their income through selling beer, washing clothes and providing accommodation to the people associated with the construction of the road and the dam, the WAR has greater potential to increase employment levels in the area. This can be attributed to the existing higher order services such as tourist attractions (Basotho Pony Centre), shops and accommodation (Molimo Nthuse and Marakabei Lodges). Residents along the WAR therefore have a greater chance of benefiting through increased employment opportunities than those in the Jorodane Valley.

The total social benefits which will accrue to the people of Lesotho is greater for the WAR whereas the social benefits from the LCAR proposal are localised in nature.

5.5 BIOPHYSICAL IMPACTS

The biophysical impacts on for the LCAR will be greater than for the WAR proposal for the following reasons:

1) The relative impacts of the LCAR on aquatic fauna (the Maluti minnow, *Pseudobarbus quathlambae* and the Aquatic River frog, *Rana vertebralis*), good water quality and the Jorodane Valley as an ecological system will be greater than those of the WAR. This is attributable to the fact that a greater amount of earthworks will be necessary for the LCAR and because the alignment of the LCAR runs close to the Jorodane River for 20 km.

2) The construction of the LCAR and the associated traffic will result in the collection of spiral aloes for sale to a newly available clientele. The sale of the spiral aloe already occurs on the Mountain Road and would increase with increased vehicular volumes. The opening up of a new area of exploitation of the spiral aloe should is seen as having greater implications for the survival of the species.

3) Hydrological impacts are expected to be of more importance on the LCAR and particularly in the Jorodane Valley where the water quality is high and the river flow unmodified.

4) The Jorodane Valley is considered deserving of high conservation status as the river catchment. Two proposals have also been put forward which involve the protection of this system. The construction of the LCAR may foreclose the option to incorporate the Jorodane valley into the Maluti Mountains-Jorodane Valley-Bokong River reserve system.

The provision of a road in the Jorodane Valley will increase access to the area and will increase pressures on available resources due to the influx of people associated with the building of the road and the Mohale dam. As the LCAR will be constructed close to

and in proximity of the Jorodane River, any activities which aim to take advantages of the newly available passing clientele, will have the potential of negatively affecting the ecological functioning of the system.

5.6 GENERAL CONCLUSION

The major benefit associated with the LCAR proposal is the provision of access to goods and services for the people of the Jorodane Valley. The major costs involved are the potential local extinction of the Maluti minnow and the Aquatic River frog and the degradation of the ecological functioning of the Jorodane Valley system which is ascribed high conservation status.

The major benefits for the WAR are the construction of the Maseru bypass and improved access to goods and services. There are no major costs involved in the upgrading of the WAR.

The benefits associated with the WAR proposal are of a regional and national nature whereas those associated with the LCAR are mainly localised. The potential negative impacts to the social and the biophysical environments are greater for the construction of the LCAR than for the upgrading of the WAR. It is therefore recommended that the Western Access Route (WAR) is used as the access route to the Mohale Dam for phase 1B of the Lesotho Highlands Water Project as it will result in greater environmental benefits and the least environmental costs.

CHAPTER 6
RECOMMENDATIONS

CHAPTER 6
RECOMMENDATIONS

6.1 INTRODUCTION

Although the environmental impact assessment for the WAR has been rigorous, indirect, cumulative and synergistic impacts which were not identified during the study, may occur. The following recommendations to the LHDA are considered essential if the Mohale Dam and associated infrastructure are to be developed in an environmentally responsible manner.

6.2 AN HOLISTIC APPROACH

An integrated approach to the environmental consideration in contract no. LHDA 1000 and the Mohale Dam developments is necessary to facilitate the effective consideration of the affected environment. It is not possible to view long-term impacts of the WAR proposal without the consideration of the Mohale Dam development and other associated infrastructure, such as the construction camps and quarry sites.

It is necessary that the long-term environmental effects of phase 1B of the LHWP are viewed holistically and that contractual constraints do not impede the effective consideration of the affected environment.

6.3 PUBLIC PARTICIPATION

Public participation in the decision and implementation phases should move beyond consultation. The involvement of local people and the use of existing community organisations is essential during the upgrading of the WAR particularly with respect to relocation of people, land-take and compensation. The implementation of mitigation and optimisation measures should be a participative process. For example, the position of bus and taxi stops should be decided by the affected village.

Public participation will also benefit the success of monitoring and regional development programmes.

6.4 MONITORING

The accuracy of predicting social and biophysical changes, caused by projects, through EIA may be limited by the compartmentalisation of change into discrete impacts. Instituting a monitoring programme for the WAR and the Mohale Dam construction will not only aid the LHDA in the application of their compensation plan, but will also provide information about environmental changes which can be used in other phases of the LHWP.

The involvement of local people in the monitoring programme will be central to its success. Local teachers or clinic employees and other respected community members for example, could be employed by the LHDA on a part-time basis, to monitor chosen aspects of the environment. Monitoring need not necessarily be quantitative and can involve the qualitative description of social changes in the community.

6.5 THE ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) should be drawn up for phase 1B of the LHWP. The EMP should be designed to incorporate the various phases of the Mohale Dam developments. It should be anticipatory to the development actions.

6.6 EMPLOYMENT OF AN ENVIRONMENTAL CONSTRUCTION OFFICER

The employment of an Environmental Construction Officer (ECO) is strongly recommended in the Rehabilitation Guidelines of the Baseline documents.

An ECO, trained in environmental monitoring should be on site at all times during construction in order to monitor activities and ensure that the requirements of the Environmental Management Plan are adhered to. The ECO should report directly to the Site Engineer so as to avoid unnecessary delays in construction.

6.7 REGIONAL DEVELOPMENT PROGRAMME

The LHDA has a commitment to rural development (LHDA, 1986). The institution of a rural development programme, therefore, should be a priority. The uneven development at the Katse Dam site however, is a blatant reminder of the effect of these development initiatives in the absence of funding.

SECTION D:

REFERENCES

Acocks, J. P. H. 1988. Veld Types of South Africa. *Memoirs of the Botanical Survey of South Africa* 57. Department of Agriculture, Pretoria, Third Edition.

Adams, W. M. 1990. *Green Development: Environment and Sustainability in the Third World*, Routledge, London.

Armour, A. 1988. Methodological Problems in Social Impact Monitoring. *Environ. Impact Assess. Rev.* 8:249-265.

Beanlands, G. E. and Duinker, P. N. 1983. *An ecological Framework for EIA in Canada*. Dalhouse University Press.

Bisset, R. 1984a. *Role of Monitoring and Auditing in EIA. International Seminar on Environmental Impact Assessment,* University of Aberdeen. World Health Organisation.

Bisset, R. 1984b. *Assessment of Social/Behavioural Impacts. International Seminar on Environmental Impact Assessment,* University of Aberdeen. World Health Organisation.

Biswas, A. K. and Geping, Q. 1987. *Environmental impact assessment for developing countries*. Tycooly International, London.

Boggs, J. P. 1991. EIA within Democratic Politics: Contradiction in Terms or Emerging Paradigm? *Impact Assessment Bulletin* 9(3):1-11.

Bonat, Z. A. and Abdullahi, Y. A. 1991. The World Bank, IMF and Nigeria's Agricultural and Rural Economy. In: Onimode, B. (ed.) *The IMF, the World Bamk and the African Debt Volume 2: The Social and Political Impact*. The Institute for African Alternatives, London, pp 153-176.

Brown, L. 1990. Environmental Impact Assessment in a Development Context. *Environ. Impact. Assess. Rev.* 10: 135-143.

Burge, R. J. 1990. The benefits of social impact assessment in third world development. *Environ. Impact Assess. Rev.* 10, 1 & 2.

Caldwell, L. K. 1988. Environmental Impact Analysis (EIA): Origins, Evolution, and Future Directions. *Impact Assessment Bulletin* 6 (3/4):76-83.

Cambray, J. A. and Meyer, K. 1988. Early ontogeny of an endangered, relict, cold-water cyprinid from Lesotho. *Revue d'Hydrobiologie Tropicale* 21 (4): 309-333.

Carley, M. J. and Bustelo, E. S. 1984. Social Impact Assessment and Monitoring: a guide to the literature. *Social Impact Assessment Series* 7. Westview Press.

Carpenter, R. A. 1985. Collaboration among American and Third World environmental professionals: Constraints and opportunities. *The Environmental Professional* 7:285-288.

Chutter, F. M., Ashton, P. J. and Hely-Hutchinson, J. R. 1988. *Predicted limnological in the Phase 1A of the Lesotho Highlands Development Scheme.* Confidential Report for the Lesotho Highlands Development Authority, Maseru.

DEA (Department of Environmental Affairs) 1992. Documents 1, 2, 3, 4, 5 and 6. *Integrated Environmental Management Guideline Series*, DEA.

ERL, 1989. Rural Enterprises. *Lesotho Highlands Water Project Environmental Study (Draft Final Report).* Report for the LHDA, Environmental Resources Limited.

ERL, 1990. Tourism. *Lesotho Highlands Water Project Environmental Study (Draft Final Report).* Report for the LHDA. Environmental Resources Limited.

Finsterbusch, K. 1985. State of the art in impact assessment. *Environment and Behaviour* 1 (2):193-221.

Fuggle, R. F. 1990. Integrated Environmental Management: An Appropriate Approach to Environmental concerns in Developing Countries. *Impact Assessment Bulletin*, 8(1&2):31-46.

Fuggle, R. F. 1992. Environmental Evaluation. In: Fuggle, R. F. and Rabie, M. A. (eds.) *Environmental Management in South Africa.* Juta & Co. Ltd, Cape Town.

GBJV (Gibbs-Bergman Joint Venture), 1993. *Report on the Least Cost Alternative corridors: Contract No. LHDA 1000.* Report for the Lesotho Highlands Development Authority, Maseru.

Harding, J. and Livesay, M. 1984. Social Impact Assessment: Conceptual Frameworks and Their Implications for Planners. In: Millsap, W. (ed.) *Applied Social Science for Environmental Planning Social Impact Assessment Series No 10*, Westview Press, pp. 22-35.

Henry, R. 1990. Implementing Social Impact Assessment in Developing Countries: A comparative Approach to the Structural Problems. *Environ. Impact. Assess. Rev.* 10:91101.

Huggins, G. and Boersema, N. 1990. *Social Impact Assessment: the 'new' postivism?* Human Sciences Research Council, South Africa.

Khan, F. 1990. *Issues to be addressed in social impact assessments.* Environmental Evaluation Unit, University of Cape Town.

Lawrence, D. P. 1993. Quantitative versus qualitative evaluation: afalse dichotomy? *Environ. Impact Assess. Rev.* 13: 3-11.

LHDA, 1986a. Order No. 23 of 1986

LHDA 1986b. *Lesotho Highlands Water Project Feasibility Study: Supporting Report G.* LHDA, Maseru

LHDA, 1990. *Lesotho Highlands Water Project Rural Development Plan Phase 1A.* LHDA, Maseru Vol. 1-8.

MacMillan, L. A. 1986. Criteria for evaluating streams for protection. In: Campbell, I. C. (ed.) *The management of rivers for instream users.* Water Studies Centre, Institute of Technology, Chisholm, Australia.

Makuta, A. M. 1991. *An assessment of the socio-economic impacts associated with the LHWP on the village of Ha Mensel -Katse, Lesotho.* Unpublished Honours Thesis. Department. of Environmental and Geographical Science, UCT.

Ministry of the Interior, Land Surveys and Physical Planning. 1989. *Maseru Development Plan.* LSPP, Maseru.

Ministry of the Interior, Land Surveys and Physical Planning, 1990. *National Settlement Policy (Final Draft).* LSPP, Maseru.

Ministry of Planning, Economics and Manpower Development, 1993. *Fifth Five-year Development Plan (Final Draft).* Maseru.

Munn, E. E. 1979. *Environmental Impact Assessment: principles and procedures,* SCOPE 5, Second Edition, John Wiley and Sons.

Murdock, S. H., Leistritz, F. L. and Hamm, R. R. 1986. The state of socio-economic impact analysis in the United States: an examination of existing evidence, limitations and opportunities for alternative futures. *Environ. Impact. Asess. Rev.* 4 (3/4): 101-132.

O'Riordan, T. 1981. *Environmentalism.* Pion, London.

Pepper, D. 1984. *The roots of modern environmentalism.* Croom Helm, Beckenham.

Preston, G. R., Robins, N. and Fuggle, R. F. 1992. Integrated Environmental Management. In: Fuggle, R. F. and Rabie, M. A. (eds.) *Environmental Management in South Africa.* Juta and Co., Cape Town, pp 762-780.

Quinlain, T. and Zingel, J. 1991. *Social Impact Assessment projects within EIA studies in rural African settings: a reassessment and development of an alternative approach.* Institute for Social and Economic Research, University of Durban-Wstville.

Rall, J. L., Steyn, G. du Preez, H. H., Haarmse, J. T. and Maema, M. 1993. *Proposal for the development of a conservation programme on Pseudobarbus quathlambae in the catchment area of phase 1B of the Lesotho Highlands Water Project.* Department of Zoology, Rand Afrikaans University, Johannesburg.

Reilly, C. A. 1985. Who Learns What, When, How? Development Agencies and Project Monitoring. In: Derman, W. and Whiteford, S. (eds) Social Impact Analysis and Development Planning in the Third World. *Social Impact Assessment Series,* No. 12, pp. 32-49. Westview Press, Colorado.

Rickson, R. E. and Rickson, S. T. 1990. Assessing rural development: the role of the social scientist. *Environ. Impact Assess. Rev.* 10:103-112.

Rickson, R. E., Burge, R. J., Hundloe, T. and McDonald, G. T. 1990. Institutional Constraints to Adoption of Social Impact Assessment as a Decision-making and Planning Tool. *Environ. Impact. Assess. Rev.* 10:233-243.

Scottish Transportation Board, 1986. *Scottish Transportation Environmental Appraisal Manual.*

Sechaba Consultants, 1991, *Poverty in Lesotho - A Mapping Exercise,* Maseru.

Setplan, Vol III, 1991. Lower Bokong-Katse Development Plan. *Lesotho Highlands Water Project Contract 62: Lower Bokong, Ha Lejone, Butha-Buthe Planning Study* Volume III Setplan 1991.

South African Red Data Book: Reptiles and Amphibians,1988. Branch, W. R. (ed.) South African National Scientific Programmes 151. CSIR, Pretoria.

South African Roads Board 1992. *Transportation Assessment Manual (Draft).* Research and Development Advisory Committee, South African Roads Board.

Stauth, R. 1983. *Environmental Evaluation Manual,* Research Report No. 51. School of Environmental Studies, University of Cape Town.

Stauth, R., Sowman, M. and Grindley, S. 1993. The Panel Evaluation Method: an approach to evaluating controversial resource allocation proposals. *Environ. Impact Assess. Rev.* 13: 13-35.

Talukdar, S. 1983. The conservation of Aloe Polyphylla endemic to Lesotho. *Bothalia* 14: 985-989.

Taylor, C. N., Hobson, B. C. and Goodrich, C. G. 1990. *Social assessment: theory, process and techniques.* Centre for Resource Management, New Zealand.

Thoahlane, T. 1991. *The missing link in developing Phase 1A for the Lesotho Highlands Water Project.* Unpublished PhD Thesis. Graduate School of Arts and Sciences, Columbia University, New York.

Trollip, J. 1981. *Rural Development in Lesotho.* Saldru Working Paper 33, University of Cape Town.

Westman, W. E. 1985. *Ecology, impact assessment and environmental planning.* John Wiley & Sons.

Wilkinson, C. 1987. Women, migration and work in Lesotho. In: Momsen, J. H. and Townsend, J. (eds.) Geography of Gender in the Third World. Hutchinson, London, pp. 225-239.

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SECTION E:

APPENDICES

APPENDIX 1: ROUTE ALIGNMENT AND PROJECT ACTIONS FOR LCAR AND THE WAR

1 ROUTE ALIGNEMENT AND PROJECT ACTIONS FOR THE LCAR

1.1 Proposed alignment of the LCAR

The proposed alignment of the LCAR is shown on Map 2.

The LCAR begins at Maputsoe and travels south-west along the A1 from Ha Nyenye via Peka to the turnoff to Ha Mateka in Teyateyaneng. The LCAR would need to pass through Teyateyaneng for a minimum of one kilometre. The alternative to passing through the centre of Teyateyaneng would be an eastern bypass around Teyateyaneng, at a cost of 9 Million Maloti (GBJV, 1993).

From Teyateyaneng the proposed route heads east to Ha Mateka along an existing good, paved road (the B203). This section of road has been recently upgraded by the Lesotho Roads Department and no further work will be required on it (GBJV, 1993).

A new road is proposed from the turnoff at Ha Mateka to Pulane. This would follow the present track to Pulane and continue over the Maluti Mountains via the Lekhalong-la-Likhaebaneng Pass into the Jorodane valley. A minimum of two bridges will be required on the present alignment. These river crossings are: the Phuthiatsana River near Pulane and the Bokoaneng river, a major tributary of the Jorodane River. The proposed new road will run north/south for the length of the western side of the Jorodane valley, to the Mohale Dam site.

The LCAR from Maputsoe to the Mohale Dam site is 112 km in length. Of this 55 km will be entirely new road. Approximately 4 km of the proposed new road lies above the given snow line (2 450 m). It is likely that this is an underestimate for the distance above the snow line, as reports from local people suggest the snow line to be much lower, closer to 2 200 m.

This route would utilise the existing railhead and border facilities at Ficksburg for the passage of construction traffic and materials. No upgrading of these facilities will be required. It is anticipated that the capital, Maseru, will carry much of the light administrative traffic.

The road crossing the Berea Plateau from Maseru to Ha Mateka is currently being upgraded by the Lesotho Roads Department. This link between Maseru and the LCAR would offer an alternative access route to the Mohale Dam site other than the existing Mountain Road.

Upgrading of the road infrastructure of Maseru is being considered to relieve traffic congestion in the city centre. It has been proposed that if the LCAR is chosen as the access road to the Mohale Dam, Maseru would only need to accommodate light vehicular traffic. Thus a minimum requirement of bypassing the Cathedral roundabout by upgrading of Airport and Rantsaba Roads would be necessary (GBJV, 1993). It is however currently envisaged by the Physical Planning Division of the Ministry of the Interior that a full bypass of the city be implemented, with an upgrading of the railhead facilities, at a cost of between 10 and 15 Million Maloti.

The Maseru bypass alternatives are considered in greater detail in the Initial Environmental Impact Assessment of the proposed Maseru Bypass (Report EEU\2\93\104A).

1.2 Design Standards

1.2.1 Design life and maintenance

The completed road is designed for a 20 year life span. LHDA will be responsible for overseeing road construction. Maintenance of the road becomes the responsibility of the Roads Department of the Lesotho Government after construction of the Mohale Dam is complete, estimated to take 5 years.

1.2.2 Corridor width

The LCAR will have a road reserve of 20 metres. The proposal is for a bitumen-surfaced road 6.5 m wide with a total shoulder width of 1.5 m, making a total road width of 8.0 m.

Where necessary the road will be widened on corners in accordance with standards agreed upon by LHDA and based on LHWP Feasibility Study: Supporting Report G: 1986.

1.2.3 Design Speed

The road is designed to ensure safety of vehicles travelling at speeds between 50 and 80 km/h.

1.2.4 Bridges

A minimum of 2 bridges and maximum of 6 bridges are required on the present alignment. The normal road width will be increased by 1.5 m to allow for pedestrian passage on bridges.

Where possible ARMCO structures will be used when smaller water ways are crossed.

1.2.5 Drainage structures

Drainage structures are designed according to standards approved by LHDA and based on LHWP Feasibility Study: Supporting Report G: 1986. On average 5 culverts per kilometer can be expected.

1.3 Construction materials and spoiling

Construction materials for the road will be obtained from borrow pits and quarries in the area. Several possible sites have been identified but the exact location of the chosen sites will be based on further geotechnical investigation. Material sources not required for road maintenance will be rehabilitated subsequent to completion of the road.

Soil and rock will be transported to spoil areas but the extent to which this is done depends on cost, distance to spoil areas, quantity of spoil, whether transport is up or downhill, and delay in road construction incurred. The principles on which spoiling takes place will be agreed with LHDA.

1.4 Predicted road usage

The Average Daily Traffic (ADT) flow projected for the road during construction of the dam ranges from 80-200 vehicles per day but the actual figure depends on whether the dam wall will be a rock fill or concrete arch. 16% of the total number of vehicles is predicted to be heavy vehicles.

1.5 Personnel requirements

No definite figures regarding the work force required for construction of the road are as yet available. The following figures are based upon past GBJV contracts and provide only a general guide to the work-force requirements of the project.

A maximum of 500 persons are expected to be employed in construction activities. Table 1 presents a breakdown of worker skill requirements. The percentages and total number employed will vary during the various stages of construction.

According to LHDA employment policy, where possible local Basutho workers will be hired.

Table 1: Breakdown of personnel skill requirements

Level of skill	Personnel requirements
Senior staff	10%
Skilled	25%
Semi-skilled	20%
Unskilled	45%
Total	**500 persons**

1.6 Construction camps

The location and size of construction camps are determined by the contractor.

Local labour may find housing in the area. Where necessary roadside construction camps will be built. Satellite construction camps in which vehicles are stored and maintained are generally built at 20 km intervals along the road.

1.7 Phases of development

The construction of the road will take place in various phases. The timing and the broad grouping of the actions involved in these various phases are indicated in Table 2.

If the LCAR is chosen as the preferred alternative for access to the Mohale Dam above the WAR then a re-negotiation of GBJV services is required. The project timing given below may be altered at that stage.

Table 2: Project timing

Phase	Year	Activities
Pre-construction	early 1993	Planning and surveying of the road alignment
Construction	mid 1994	Construction and ongoing rehabilitation activities
Implementation	Mid 1997	Transport materials to the Mohale Dam

2 ROUTE ALIGNMENT AND PROJECT ACTIONS FOR THE WAR

2.1 Route alignment for the WAR

The proposed route follows the existing Mountain road from St. Michael's to Patiseng via Nazareth (Map 2), with the exception of a few alterations for safety or operational reasons.

The section of road between St. Michael's and Nazareth falls within the lowland zone (<1800 m) and that between Nazareth and Patiseng falls within the highland zone (>1800 m). The topography of the area between St. Michael's and Nazareth (0-14 km) is characterised by gentle slopes, with the exception of the distance between km 3-3.5 near St. Michael's where the road negotiates a sandstone escarpment. From Nazareth (14 km) the road ascends up the western slopes of the mountainous region by way of Bushman's Pass (Lekhalong-la-Baroa) lying at an altitude of 2268 m at km 22.5. The road between km 22.5 and 24 is relatively level, whereafter the road slopes downwards into the valley of the Makhaleng River which it crosses at km 27.75. At km 29.4 the road ascends up Lekhalong-la-Molimo-Nthuse Pass (God Help Me Pass) to an altitude of 2318 m at km 32.5. Hereafter, the road passes through very mountainous terrain over the Lekhalong-la-Thaba-Putsoa (Blue Mountain pass) lying at 2650 m at a distance of km 39.

2.2 Design Standards

2.2.1 Design life and maintenance

The completed road is designed for a 20 year life span. The LHDA, as opposed to the Government of Lesotho (GOL), will be responsible for overseeing road construction and maintenance during the five years of dam construction. Thereafter, maintenance of the road becomes the responsibility of the Roads Department of the GOL.

2.2.2 Corridor width

The upgraded WAR will have a road reserve of 20 m metres. The proposal is for a bitumen-surfaced road 6.6 m wide (3.3 m per lane) with a total shoulder width of 3 m, making a total road width of 9.6 m). On low volume roads or where difficult terrain

constrains this width, the total shoulder width will be 1.7 m. A minimum total surfaced width of 7 m is proposed where construction of the normal cross section (9.6 m) will entail very high costs. The minimum surfaced shoulder width is 0.7 m. Shoulders will be continuous regardless of width. Where necessary the road will be widened on corners in accordance with standards agreed upon by LHDA. Most of the existing road will have to be widened to meet desired design standards.

2.2.3 Design Speed

The road section from St. Michael's to Nazareth allows a general design speed of 75 km/h. Speed restrictions will be applied in residential areas and in places where the horizontal alignment does not allow a speed of 75 km/h. Some lowering of vertical curves will be done to accommodate the design speed of 75 km/h.

The road section from Nazareth to Patiseng will have a general design speed of 30 km/h. The design speed along this section of road is limited by the existence of constricting vertical and horizontal alignments.

2.2.4 Bridges

All existing large drainage structures will, where possible, be replaced by large ARMCO bridges or culverts.

Where new bridges are required because of upgrading or road realignment, old bridges occurring downstream and hydraulically too small will be demolished once construction of the new crossing has been completed to prevent backwater affecting the hydraulics of the new bridge. Bridges located upstream of the new bridge will be retained to allow for continued movement of traffic, and the safe passage of people and livestock.

The normal road width on bridges will be increased by 1.5 m to allow for pedestrian passage.

2.2.5 Drainage structures

Drainage structures are designed according to standards agreed to by LHDA and based on the LHWP Feasibility Study (1986). On average 5 culverts per kilometer can be expected.

2.2.6 Required realignments of existing WAR

The following proposed realignments are deemed necessary by the design engineers (BS Bergman & Partners) to improve traffic and pedestrian safety.

Chainage	**Realignment**
km 7.61	Move access to Ratau Primary School 50 m west or 100 m west;
km 10.5	Raise road level over Ha Ntsi bridge to improve the sight distance;
km 12.5	Site a new bridge east of Ha Molengoane 10 m upstream (right) of existing one while retaining the existing one during construction to accommodate traffic;
km 15.1	Site a new bridge west of Nazareth 10 m upstream (right) of existing bridge while retaining the existing one during construction to accommodate traffic;
km 26.4	Site a new bridge east of Ha Fohli 15 m upstream (left) of existing bridge while retaining the existing one to accommodate traffic. Eliminate S curve;
km 27.2	Locate new bridge west of Ha Sekeleme 10 m downstream (right) of existing bridge while retaining the existing one to accommodate traffic. Save as many trees located adjacent to bridge as possible;
km 29.4	Site new bridge 10 m downstream of existing one opposite the Molimo Nthuse Lodge and provide new access across the existing culvert to the lodge to improve sight distance problem. Avoid sewerage works and power poles on left and relocate the sewerage pipe; OR Site new structure in approximately the present position while providing a temporary crossing to accommodate traffic. Relocate the sewerage pipe and improve the sight distance to lodge;
km 35.3	Temporary deviation to be built upstream of existing bridge. Work will be done during the dry season when risk of flooding is minimised;
km 36.9	Realign road upstream (right) to improve radius while accommodating traffic across the existing structure, and
km 53.5	Locate new bridge downstream of existing bridge east of Likalaneng while retaining existing one to accommodate traffic. Avoid houses near road and relocate kraal. Speed restriction required.

2.3 Construction materials and spoiling

Construction materials for the project will be obtained from borrow pits and quarries in the area. Several possible sites have been identified but the exact location of the chosen sites will be based on further geotechnical investigation. Material sources not required for road maintenance will be rehabilitated subsequent to completion of the road.

Three hard rock sites have been identified by the engineering geologist as crushing sites but these still require investigation for quality, etc. The chainages along the WAR where these occur are: km 36.9-37.6; km 41; and km 47.6-47.9.

Soil and rock will be transported to spoil areas but the extent to which this is done depends on cost, distance to spoil areas, quantity of spoil, whether transport is up or downhill, and the delay in road construction incurred as a result. The principles on which spoiling takes place will be agreed with LHDA. Specifications for spoil dumps are outlined in Appendix 5.

2.4 Predicted road usage

The Average Daily Traffic (ADT) flow projected for the road during construction of the dam ranges from 80-200 vehicles per day (GBJV), 16% of which are predicted to be heavy vehicles. The actual traffic volume will depend on whether the dam wall will be a rock fill or concrete arch.

Use of the road estimated at Nazareth and Marakabei in 1992 are shown in Table 3.

Table 3. Average Daily Traffic (ADT) at Nazareth, Marakabei and Thaba-Tseka with percentage of light, medium, buses and heavy traffic

Vehicle size	Nazareth	Marakabei	Thaba-Tseka
ADT	352	85	116
Light	204 (58%)	48 (57%)	75 (65%)
Medium	106 (30%)	12 (14%)	13 (11%)
Buses	14 (4%)	8 (9%)	5 (4%)
Heavy	28 (8%)	17 (20%)	23 (20%)

2.5 Personnel requirements

No definite figures regarding the work force required for construction of the road are, as yet, available. The following figures are based upon past Gibbs-Bergman Joint Venture (GBJV) contracts and provide only a general guide to the work-force requirements of the project.

A maximum of 500 persons are expected to be employed in construction activities. Table 4 presents a breakdown of worker skill requirements. The percentages and total number employed will vary during the different stages of construction.

According to LHDA employment policy, local Basotho workers will be hired where possible.

Table 4. Breakdown of personnel skill requirements

LEVEL OF SKILL	PERSONNEL REQUIREMENTS
Senior staff	10%
Skilled	25%
Semi-skilled	20%
Unskilled	45
TOTAL LABOUR	500 PERSONS

2.6 Construction camps

The location and size of construction camps are determined by the contractor. It is envisaged that only one or two construction camps will be necessary and suitable locations for construction camps are suggested (Appendix 9).

Local labour may find accomodation in the area. Where necessary roadside construction camps will be built. Satellite construction camps in which vehicles are stored and maintained are generally built at 20 km intervals along the road.

2.7 Phases of development

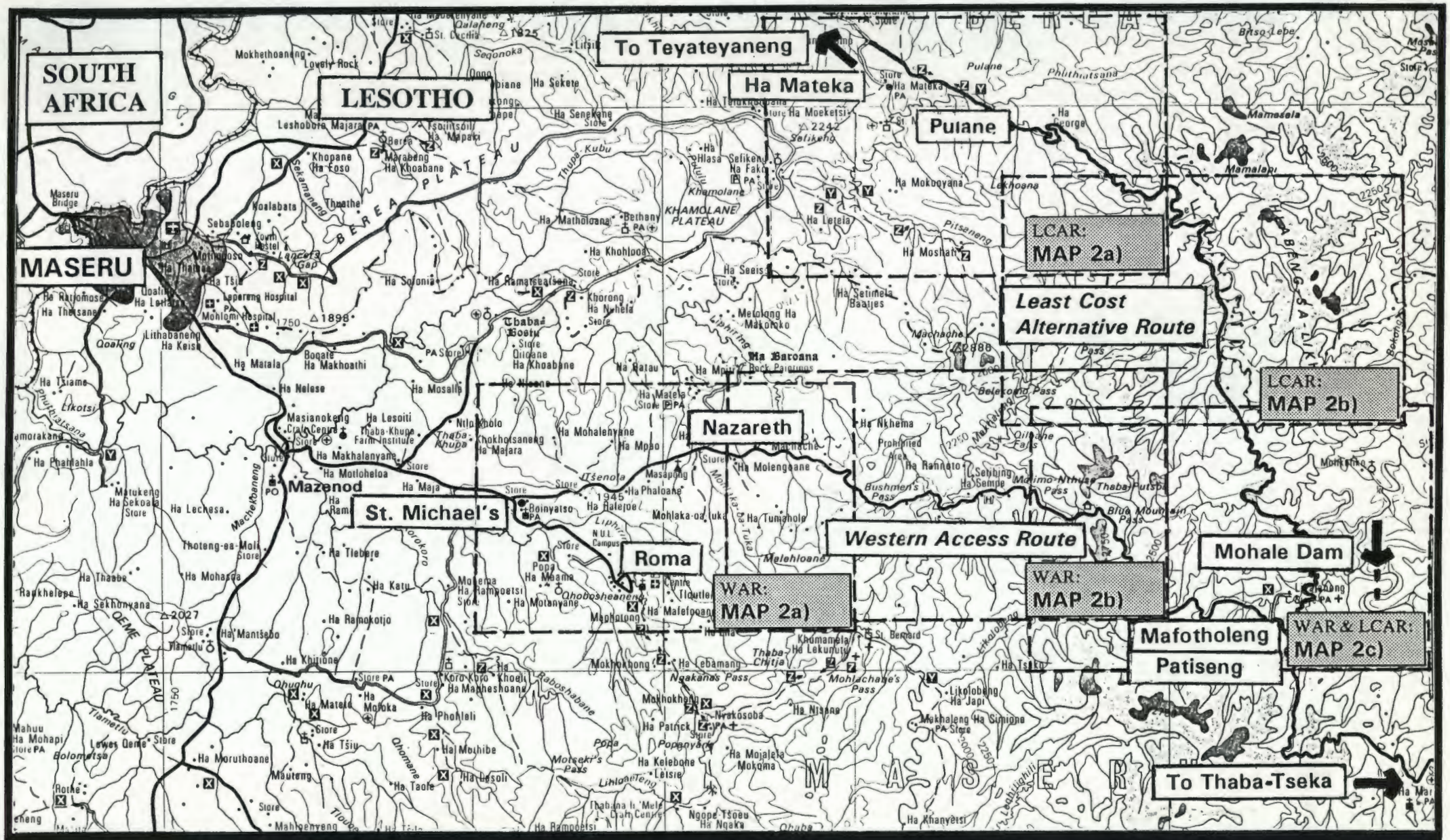
The construction of the road will take place in various phases. The timing and broad grouping of the actions involved in these various phases are indicated in Table 5.

Table 5. Project timing

PHASE	YEAR	ACTIVITIES
Pre-construction	Early 1993	Planning and surveying of the road alignment
Construction	Mid 1994	Construction and ongoing rehabilitation
Implementation	Mid 1997	Transport materials to the Mohale Dam

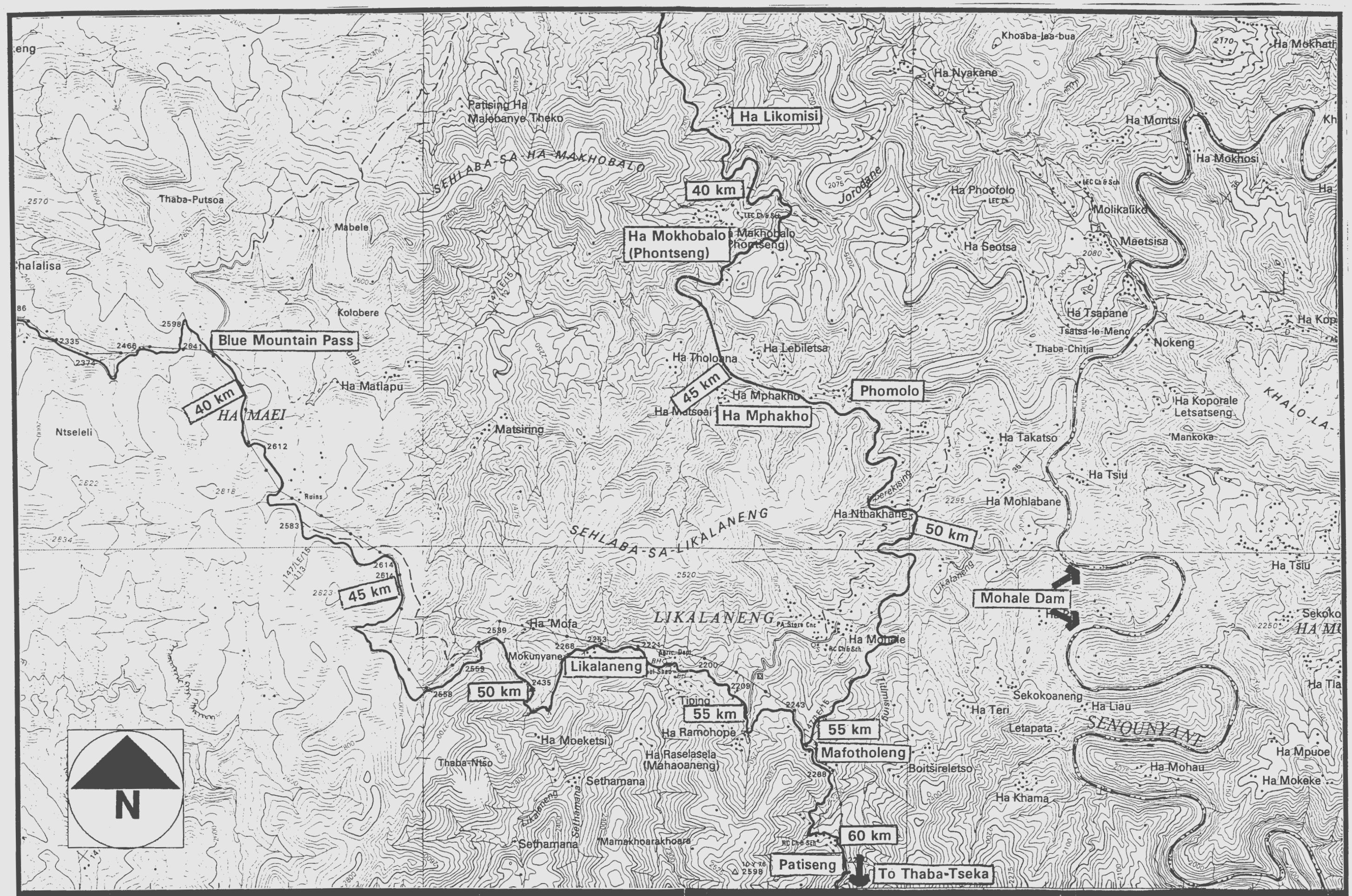
The length of road to be upgraded at any one time has not yet been investigated as such lengths are to be specified in contract documents and will depend on a variety of features such as topography, location of residential areas, bridges, and passing opportunities.

In flat/rolling terrain, temporary gravel surfaced deviations will be considered from St. Michael's to Nazareth (km 14) with a feasible upgrading length of 5-10 km. In mountainous terrain, road construction will occur simultaneous with passage of traffic as deviations are not feasible. The road will have to be closed during certain periods of day to allow cutting, spreading and mixing of layers, etc. Possible length of road construction will be 3-5 km.



MAP 2: POSITION OF 1:50000 MAPS

Scale 1:250000

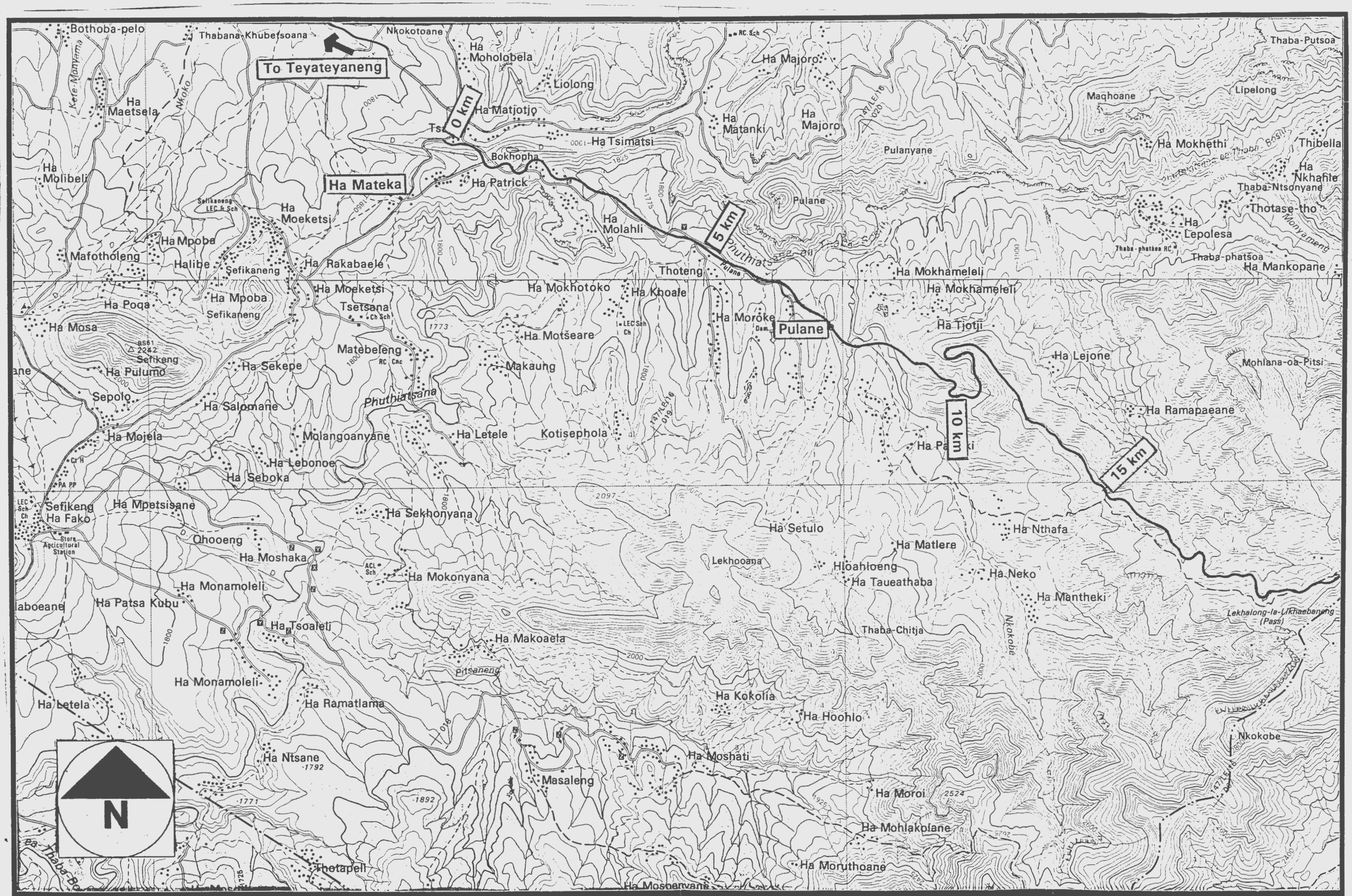


MAP 2c) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

Scale 1:50000

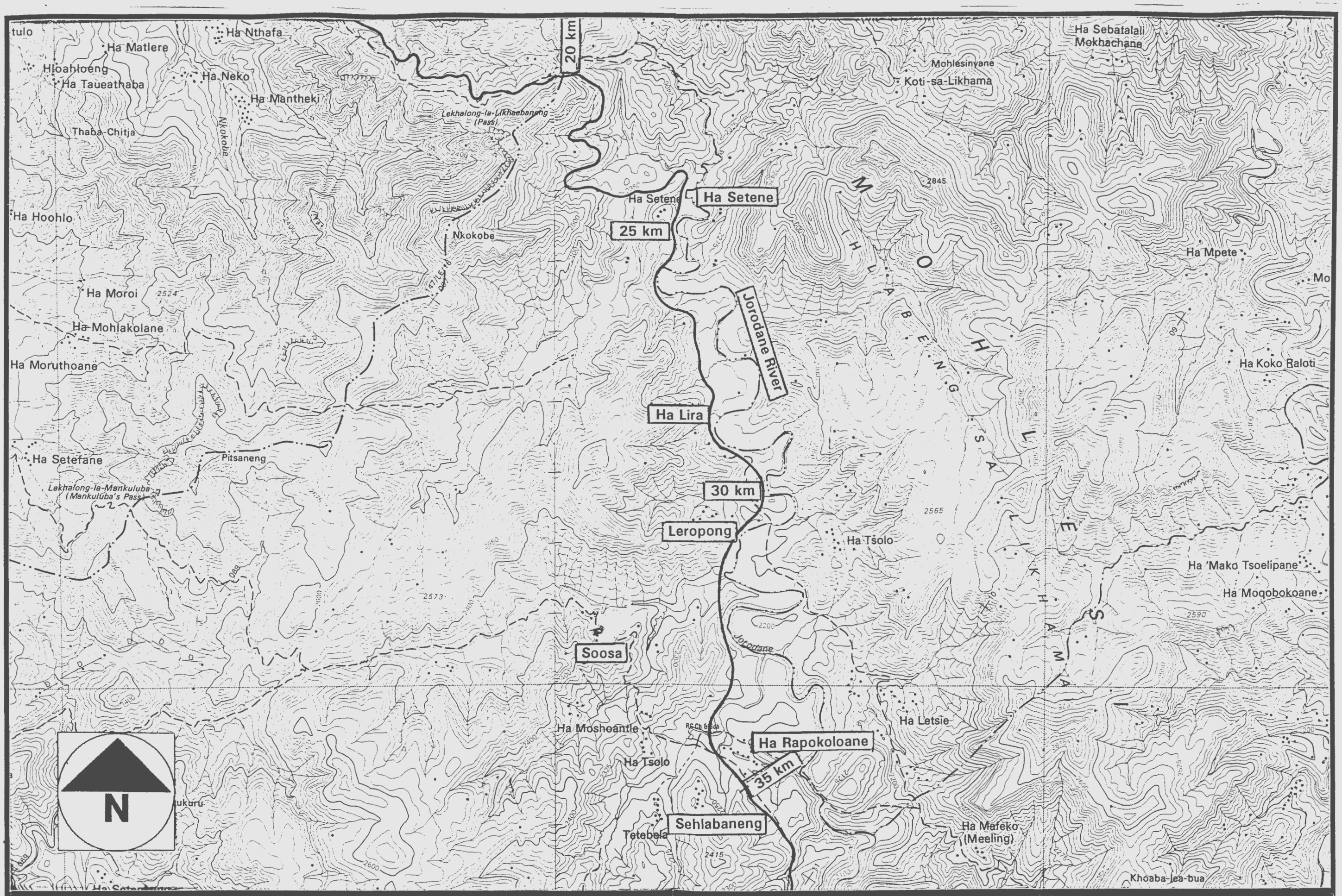
MAP 2a) ALIGNMENT OF WESTERN ACCESS ROUTE

Scale 1:50000



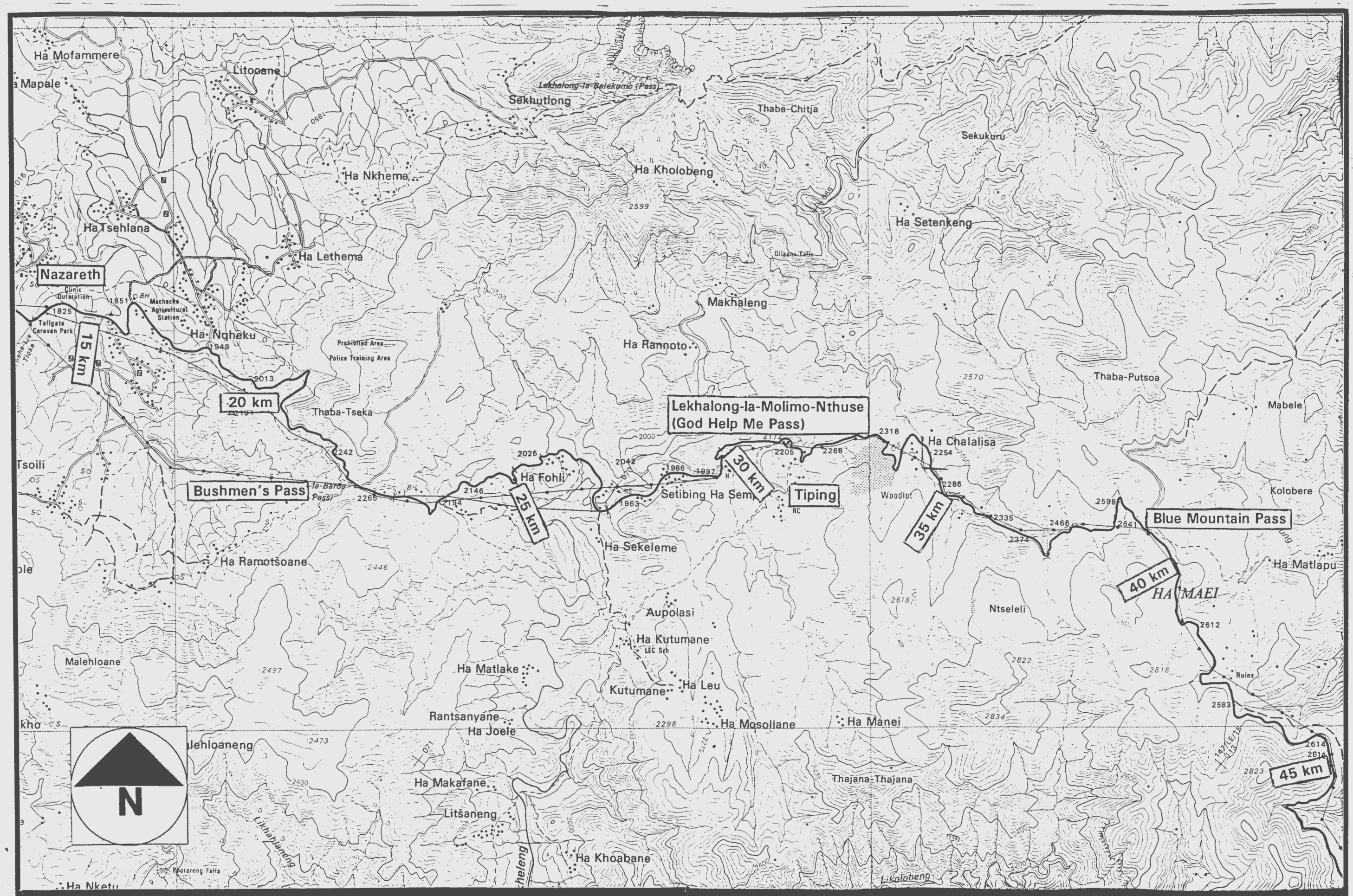
MAP 2a) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

Scale 1:50000



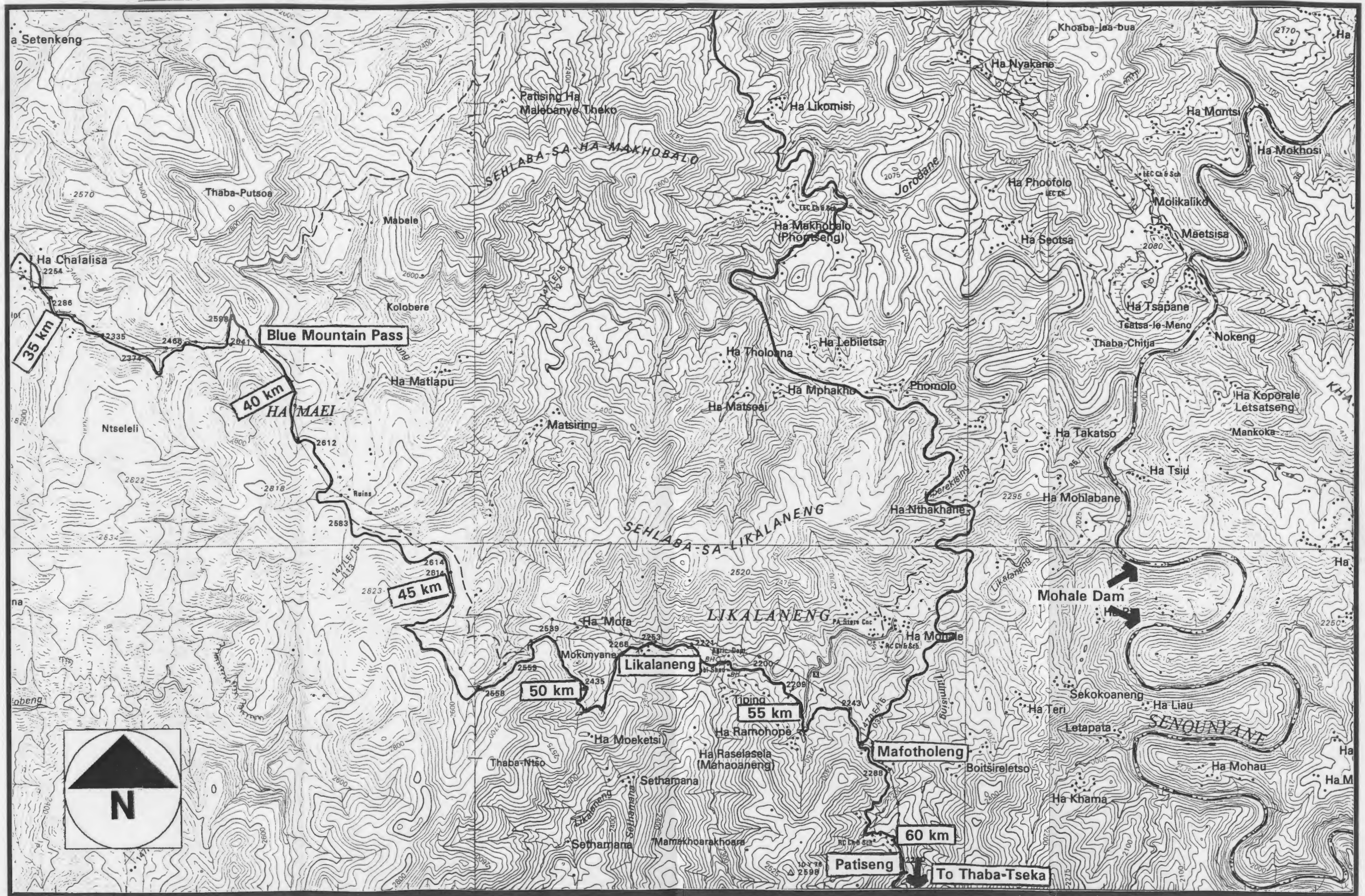
MAP 2b) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

Scale 1:50000



MAP 2b) ALIGNMENT OF WESTERN ACCESS ROUTE

Scale 1:50000



MAP 2c) ALIGNMENT OF WESTERN ACCESS ROUTE

Scale 1:50000