An environmental impact assessment of the alternative access routes, the Western Access Route, and the Least Cost Alternative Route, to the proposed Mohale Dam, Lesotho.

by

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Submitted in partial fulfillment for the degree of Master of Philosophy, Environmental Science.

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July 1993

EXECUTIVE SUMMARY

An environmental impact assessment of the alternative access routes, the Western Access Route (WAR) and the Least Cost Alternative Route (LCAR), to the proposed Mohale Dam, Lesotho.

1. Purpose of the report

This report is concerned with the environmental impact assessment of two alternative access roads, the Western Access Route (WAR) and the Least Cost Alternative Route (LCAR), to the proposed Mohale Dam site, Lesotho. The procedure adopted by the Environmental Evaluation Unit (EEU) study team for the assessment of environmental impacts associated with the development of the two routes, is critically reviewed. A comparative evaluation of the alternative routes is undertaken. The preferred access route, which best satisfies the above environmental criteria, is recommended.

2. Background

In January 1993, the Environmental Evaluation Unit (EEU) of the University of Cape Town was appointed by Gibb-Bergman Joint Venture (GBJV), to assess the environmental impacts associated with the development of an access road from the Lesotho-South Africa border to the construction site of the proposed Mohale Dam (Phase 1B), Lesotho Highlands Water Project (LHWP), Lesotho.

An existing road, termed the Western Access Route (WAR), was identified as a possible access route. This route would require upgrading to a suitable standard for the passage of heavy construction vehicles, and, in addition, the construction of a bypass of the central business district of Maseru. At an early stage of the study, an alternative access route to the WAR was identified from eight possible alternative routes. This route has been termed the Least Cost Alternative Route (LCAR).

The EEU study team undertook a full assessment of the environmental impacts associated with upgrading the Mountain Road/Western Access Route (WAR) and the construction of the

LCAR. These detailed impact assessments are documented in Report **EEU/2/93/104a, EEU/2/93/104b** and **EEU/2/93/104c**, submitted with this report.

3. Route alignments

The proposed route alignments of the WAR and the LCAR are presented on Map 1.

The proposed upgrading of the WAR is between St. Michael's and Patiseng on the Mountain Road, which runs east from Maseru. The road passes over the Maluti mountains via the Bushman's Pass (2 268 m), the Molimo-Nthuse Pass (2 318 m) and the Blue Mountain Pass (2 650 m).

The proposed alignment of the LCAR, begins, on existing roads, from Ficksburg/Maputsoe in the north, west to Peka, south to Teyateyaneng and south-east to Ha Mateka. No upgrading is proposed for this stretch, except a possible widening of the T-junction at Teyateyaneng. From Ha Mateka the LCAR continues with a proposed new road, which would run eastwards past Pulane, over the Maluti mountain range via the Lekhalong-la-Likhaebaneng Pass (2 600 m) and into the Jorodane River valley. The proposed alignment runs for the length of the Jorodane River valley, along the western bank of the Jorodane River, to the Mountain Road in the south, joining it at Mafotholeng, 2 km north of Patiseng.

4. Terms of reference for this study

This study was required to:

* Critically review the procedure followed by the EEU study team in the assessment of environmental impacts associated with the two alternative routes, as detailed in the environmental impact assessment reports for the WAR and the LCAR, submitted with this study:
  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).

* To undertake the comparative evaluation of the two alternative routes in terms of environmental criteria, in order to recommend a preferred alternative access route to the Mohale dam site.

5. Methodology of this study

5.1 The identification of key impacts

For the purposes of the identification of key impacts associated with the WAR and the LCAR, the mitigation of impacts was not assumed, beyond the compensation required for damaged or lost resources. Key impacts were therefore identified as those impacts which have been assigned significance ratings of **high** or **moderate-high** without mitigation, by the study team. The remaining impacts which have been assigned significance ratings of **moderate** or **low**, without mitigation, are considered to be non-key impacts.

5.2 The comparative evaluation of the two alternative routes

The key impacts associated with each alternative were considered as key "benefits" or "costs", depending on whether the impact was rated positive or negative, respectively.

The benefits and costs were evaluated according to Stauth's (1989) three criteria of efficiency, equity and sustainability, defined as:

The **efficiency criterion**:
An action should be efficient i.e. total benefits resulting from the project action should exceed total costs, and those who benefit from the action could potentially compensate those who bear the costs, and still be better off.

The **equity criterion**:
An action should be equitable i.e. benefits and costs resulting from the project should be fairly distributed across the different groups of the present-day society affected by the development.If the gainers compensate the losers so that the distribution of costs and benefits remains the same or improves, the action is considered both efficient and equitable.

The **sustainability criterion**:
An action should be sustainable i.e. the proposed development action should be able to provide a net benefit to society over intergenerational time periods. Future generations should be able to enjoy the same level of welfare as enjoyed by members of the present-day society.
Sustainability also requires that long-term ecological productivity or carrying capacity of a natural system is not traded-off for short-term economic gain or project needs.

The trade-offs associated with the choice of either of the alternative routes above the other are listed and discussed.

6. Summary of the analysis of the environmental impact assessment process

The EEU is committed to the application of the Integrated Environmental Management (IEM) approach for the evaluation of alternatives and the assessment of environmental impacts associated with a proposed development. IEM was developed in South Africa in response to the need for a systematic procedure which would ensure the incorporation of environmental considerations into the planning, decision making and implementation of a development.

The primary objective of IEM is to generate environmentally and socially acceptable alternatives during the early planning stages of a development, through the interaction with interested and affected parties (I&APs) and the public in general. The process is intended to be iterative, with numerous opportunities for communication of environmental concerns to the decision makers, and with continuous feedback to the public and affected parties via workshops and public meetings, throughout the lifetime of a project.

The IEM process and EIA reports (**EEU/2/93/104b** and **EEU/2/93/104c**) emanating from the impact assessment of the WAR and LCAR have certain shortcomings.

1. The identification of the LCAR was done in a very short time, without involvement of I&APs.

2. The scoping process served only to assist in the identification of a wide range of issues, rather than the focussing of the study on a fey key issues.

3. The reports placed emphasis on the assessment of identified impacts, rather than on whether recommendations for mitigatory actions would be implemented or not, i.e the identification of residual impacts.

In certain respects, however, the IEM process adopted for the study was unusually effective, as there was considerable input of environmental concerns into the design stages of the alternative routes. There was active and ongoing interaction with the LHDA Technical, Infrastructure and Environment Divisions, and a large scale involvement of the affected parties during the social surveys in the affected areas.

7. The identification of key impacts

The key environmental impacts are presented together with recommended mitigatory actions, in Table S1. The significance rating assigned to each impact, without and following, mitigation/optimisation of the impact, is indicated.

Table S1: The key environmental impacts associated with the Western Access Route and the Least Cost Alternative Route

	Western Access Route	Least Cost Alternative Route
Promotion of national planning objectives	+ve Reinforces national road network plans High significance without mitigation. Optimisation: complete proposed reconstruction plans for Mountain Road. High significance following optimisation. +ve Maseru bypass will alleviate traffic congestion in Maseru High significance without mitigation. Optimisation: improve services of Maseru. High signficance following optimisation.	-ve Not in accordance with existing road plans and places additional burden on maintenance budget. High significance without mitigation. Mitigation: requires continuous, effective maintenance. High significance following mitigation
Socio-economic impacts	+ve Improved transport and access to facilities, goods and services High significance without optimisation. Optimisation: appropriate siting of stopping and off-loading areas. High significance following optimisation. -ve Social disruption: increased crime, resettlement of families, demotivation to farm High significance without mitigation. Mitigation: employers should be responsible for labour; sensitive, consultative approach to provision of compensation houses. Moderate significance following mitigation	+ve Improved access to facilities, goods and services. High significance without optimisation. Optimisation: Regular bus stops, wide shoulder for pedestrians and livestock, efficient and cheap, public transport system. High significance following optimisation. -ve Social disruption: increased crime, effects on social lifestyles. High significance without mitigation Mitigation: provision of recreational facilities for labourers, adequate policing. Moderate significance following mitigation. -ve Disruption of local economy. High significance without mitigation. Mitigation: Development of other source of income for local residents, rural development programmes. Moderate significance following mitigation.
Biophysical impacts	No impacts of high significance	-ve Increased sediment loading of rivers and streams High significance without mitigation. Mitigation: Strict enforcement of erosion control measures, the employment of an environmental control officer during construction to enforce environmental controls. Moderate to low significance following mitigation. -ve Clogging of stream course with rockfall from earthworks. High to moderate significance without mitigation. Mitigation: No dumping of spoil material in stream or river courses. No siting of quarries/borrow pits next to streams. Rockfall in streams and rivers should be cleared. Low significance with mitigation -ve Impacts on sensitive ecological areas: wetlands and bogs. High to moderate significance without mitigation. Mitigation: Avoid construction activities within wetland areas; rehabilitate areas which have been disturbed. Moderate to low significance following mitigation. -ve Possible local extinction of two endangered species, the Maluti minnow, *Pseudobarbus quathlambae*, and the spiral aloe, *Aloe polyphylla*. High significance without mitigation. Mitigation: A National Park and sanctuary area has been proposed for the conservation of the region and the endangered species. There is no mitigation other than avoidance.
Compensation for lost resources	-ve Loss of privately owned resources: total value WAR: M 654 775, WAR + bypass: M 1 572 935 -ve Interference with access to, or destruction of, potable water supplies. High significance without mitigation. Mitigation: wells and standpipes must be replaced at distances equal or closer to village than original well. Moderate significance following mitigation.	-ve Loss of privately owned resources: total value LCAR: M 973 761. -ve Interference with access to, or destruction of, potable water supplies. High significance without mitigation. Mitigation: Replacement of springs that will be destroyed with suitable water supply of equivalent quality. Low significance following mitigation.

8. The comparative evaluation of the alternative access routes

The efficiency test:

The development of the WAR would result in an overall benefit to the Lesotho society, on both national and local levels. The development of the LCAR, although of benefit to the local people of the Jorodane valley who are presently without a road, would result in an overall cost to the Lesotho society in the long-term.

The equity test:

The development of the WAR was found to be more equitable than the development of the LCAR for the following reasons:

* The WAR would benefit more people than the LCAR.

* The benefits of the WAR would be more widely distributed than those associated with the LCAR.

* The costs of the WAR would be more equitably carried by all road users, although social costs would be inequitably carried by certain communities in close proximity to labour camps. Such costs could be mitigated. The costs of the LCAR would be inequitably carried by the Lesotho Government, the biophysical environment, and those communities impacted by labour camps and the traffic of strangers for the first time, the Government of Lesotho, and the biophysical . Ecological costs would be inequitably carried by future generations.

The sustainability test:

The WAR would be a more sustainable alternative than the LCAR for the following reasons

* The WAR would provide for the present-day generation without jeopardising the ability of future generations to meet their needs. The LCAR would provide for present-day generations, but would involve national and ecological costs which would negatively effect future generations.

* Upgrading the WAR would be a long-term improvement of, and investment in, the existing national road network and social infrastructures. The LCAR would

be a new development in a natural and rural area. No other industrial developments presently exist in the remote mountainous regions, and the existing natural habitats and character of the area would be irreversibly altered.

* The upgrading of the WAR would not foreclose any future options for different land use or conservation of endangered species and undeveloped areas, as the road already exists. The LCAR could threaten an endangered species in the Jorodane River with possible local extinction and would foreclose the conservation options for a sanctuary stream and a National Park in the upper reaches of the Jorodane valley.

* The WAR would not result in any significant ecological impacts. The proposed alignment of the LCAR would significantly alter hydrological and ecological balances in the Jorodane valley, possibly reducing biological productivity in the long-term.

Trade-offs associated with the selection of either access route

In the choice of the WAR as the access route, three main trade-offs would be made.

1. The opportunity for the construction of a new, well engineered road in Lesotho, which would service remote people, presently without paved road access, would be lost.
2. The people of the Jorodane valley, in the absence of the existing track being upgraded, would be forced to continue living under their present difficult conditions, without access to improved services and opportunities.
3. Traffic congestion and some disturbance of local communities between St Michael's and Patiseng would be likely to occur during the period of road reconstruction.

In the choice of the LCAR as the access route, the trade-offs are numerous.

1. The national planning priorities of road networks and settlement planning would be contradicted, rather than enhanced.
2. The Government of Lesotho would lose the benefits of having the first 60 km of the Mountain Road upgraded at the expense of LHDA, and would have to carry the costs of maintaining the Mountain Road during dam construction, and both roads once dam construction is completed.
3. The presence of a new road which is poorly utilised by the general traffic, may prove to be more of a national burden in terms of long-term road maintenance costs, than of benefit.
4. The Maseru bypass would not be constructed. Thus the city of Maseru would not benefit by the construction of the bypass and railhead, with the associated economic benefits.

5. The WAR would not be upgraded. Thus the communities and existing facilities along the Mountain Road would not benefit by improved access and services associated with upgrading.
6. The affected area of the Jorodane River valley is a sensitive ecological area of national importance, in that it forms a primary catchment for the proposed Mohale dam. Biophysical impacts, both primary and secondary, resulting from construction and operation of the LCAR would increase siltation of the Jorodane River and reduce the water quality exiting from the system.
7. The siltation of the Jorodane River could threaten an endangered species (the Maluti minnow) with local extinction, and the presence of a road could cause the exploitation of an undisturbed spiral aloe population for roadside sale.
8. The presence of a road in the upper regions of the Jorodane valley would irreversibly change the nature of the regions, and foreclose future options for conservation and establishment of a national park, and the associated tourism opportunities.

9. Conclusions

In terms of environmental evaluation criteria and the analysis of trade-offs, the WAR is the preferred alternative route for access to the Mohale Dam.

The WAR would result in numerous long-term benefits which would accrue locally and nationally. The costs associated with the WAR would likely be minimal, as mosts negative impacts have already occurred due to the fact that the road already exists.

The benefits associated with the LCAR would accrue disproportionately to a few people in the Jorodane valley. A new road would result in long-term costs, both nationally and locally.

10. Recommendations

The following recommendations are made:

1. **Preferred alternative:** The Western Access Route is recommended as the preferred access road to the Mohale dam site, in terms of environmental criteria.

2. **Environmental management:** The actions for optimisation of positive impacts and mitigation of negative impacts associated with the upgrading of the WAR, as recommended in Report **EEU/2/93/104b**: Appendices 3, 4, 5 and 9, should be implemented <u>in full</u> during, and following, construction activities.

4. **Project planning:** Integrated Environmental Management and consultative planning should be continued throughout the construction period. This is particularly important with respect to the participation of affected communities, in order assess whether compensation for resources lost as a result of the development, is adequate. Project planning should consider tourism development with respect to the existing tourist facilities along the WAR, to Thaba-Tseka.

3. **Project alternatives:** In the event that the WAR is not selected by the Joint Permanent Technical Commission (JPTC) as the preferred alternative route, it is strongly recommended that the identification of alternatives be reconsidered. The results of this EIA clearly show that a major road running north-south through the Jorodane valley is not a viable option.

4. **Area Management Plan:** The development of the WAR should not be considered in isolation of the development plans for the entire Phase 1B area. It is recommended that the Area Management Plan (AMP) be developed for the Phase 1B region in conjunction with the planning process for the selected access route.

5. **Further studies:** The section of road between Maseru and St. Michael's should be assessed in similar detail to the EIA for the WAR, in terms of environmental impacts and compensation requirements.

6. **Provision for disadvantaged communities:** It should be recognised that the people of the Jorodane valley are in need of a road. It is recommended that a feeder road be provided by the LHDA from the Mohale dam site to communities in remote regions of the Jorodane valley. Alternatively, the track which presently exists between Thaba Putsoa on the Mountain Road, and Ha Rapokoloane in the Jorodane valley, should be upgraded to an all-weather road.

7. **Maseru bypass:** The Maseru bypass should be constructed prior to the commencement of construction of the Mohale Dam (1997), in order to avoid the passage of heavy construction vehicles through the central business district of Maseru.

8. **Selection of the LCAR:** In the event that the LCAR be selected by the JPTC as the preferred alternative, further planning of this route should not proceed without a more detailed environmental impact assessment of the affected area.

9. **Rural development:** It is recommended that rural development programmes be timeously implemented in the regions affected by the selected alternative. Such actions would be necessary for the affected communities to be able to realise fully the potential socio-economic benefits associated with the access road development.

Map 1: The alignments of the Western Access Route and the Least Cost Alternative Route

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ACKNOWLEDGEMENTS

A special thanks to my supervisor, Merle Sowman, for her helpful and friendly advice throughout the writing of this thesis.

I sincerely acknowledge the hard work of my colleagues in the EEU study team, who participated with great enthusiasm in the environmental impact assessment of the Mohale Dam access roads.

Finally, warm thanks to Barry Heydenrych, for proof-reading this thesis at the eleventh hour.

CHAPTER ONE

Introduction

1.1 Overview

This thesis is concerned with the environmental impact assessment of two alternative access roads, the Western Access Route and the Least Cost Alternative Route, to the Mohale Dam site, Lesotho. The procedure followed in the environmental impact assessment is critically reviewed. A comparative evaluation of the alternative routes according to three environmental evaluation criteria: efficiency, equity and sustainability, is undertaken. The preferred access route, which best satisfies the above environmental criteria, is recommended.

This chapter presents the background to the overall environmental impact study of the Contract no. LHDA 1 000, Lesotho Highlands Water Project, Phase 1B Access Road. The stages of the study and the reports emanating from the various aspects of the environmental impact study are briefly described. The chapters following this introductory chapter, are briefly outlined.

1.2 Background

1.2.1 The LHDA Contract no. 1000, Phase 1B Access Roads:

Contract no. LHDA 1000 - Phase 1B Access Roads, of the Lesotho Highlands Water Project (LHWP), was awarded by the Lesotho Highlands Development Agency (LHDA) to the Gibb-Bergman Joint Venture (GBJV) on 18 December 1992. In January 1993, the Environmental Evaluation Unit (EEU) of the University of Cape Town was appointed by GBJV, to assess the environmental impacts associated with the development of an access road from the Lesotho-South Africa border to the construction site of the proposed Mohale Dam (Phase 1B, LHWP), Lesotho.

An existing road, generally known as the "Mountain Road", leads eastwards from Maseru (capital city of Lesotho) over the Maluti Mountains, via Nazareth and Blue Mountain Pass. The Mountain Road is directly accessible from the Lesotho-South Africa border at Maseru, and passes within 7 km of the proposed Mohale Dam wall site. Due to the convenience of using the Mountain Road to gain access to the Mohale Dam site, it had been identified by LHDA as a possible Western Access Route (WAR) (Map 1) to the Mohale Dam (GBJV, 1992).

However, LHDA policy generally encourages that alternatives to a proposed development are investigated. Furthermore, the Mountain Road is a poorly engineered and tortuous, winding road, traversing several mountain passes. It would require considerable upgrading in order to improve it to the standard required for carrying an additional predicted daily traffic volume of 80 - 200 heavy construction vehicles, during the period of dam construction.

The use of the Mountain Road as an access route will also necessitate the passage of construction materials through the Maseru border and vehicles through Maseru's central business district, which presently suffers severe traffic congestion. In order for construction materials to be offloaded in Maseru, a new railhead will have to be built in Maseru, linking with Ladybrand or Ficksburg. Furthermore, the upgrading (with new extensions) of the existing road network of Maseru, or the construction of a full bypass of Maseru (see Report EEU/2/93/104a), will be required in order to accommodate any additional traffic burden, in particular, heavy vehicles associated with the construction of the Mohale Dam.

Due to: (i) the safety hazards in the mountainous sections; (ii) the financial costs associated with upgrading the Mountain Road and; (iii) the necessary extensions to Maseru's road and rail network, it was considered necessary that alternative routes to the dam wall site be identified. The routes which were feasible in terms of engineering criteria, would be assessed in terms of environmental and financial costs.

Eight alternative road corridors were identified by the consultant engineers. These alternatives satisfied the criteria that (a) the route led from the northern or western border of Lesotho to the dam site, and (b) the terrain was navigable by road. The eight routes were then examined during a desk-top survey on the basis of financial costs of construction (done by the consultant engineering study team) and environmental costs and benefits (done by the EEU study team). The purpose of the examination was the selection of one road corridor which satisfied the criteria of minimum financial costs and safety hazards, and maximum social benefits. One suitable route, or "Least Cost Alternative Route" (LCAR) (see Map 1), was identified as a possible alternative access route to the Mohale Dam site.

The EEU study team undertook a full assessment of the environmental impacts associated with upgrading the Mountain Road/Western Access Route (WAR) and the construction of the LCAR. These detailed impact assessments are documented in Report EEU/2/93/104b and EEU/2/93/104c, submitted with this report.

1.2.2 Location of the proposed WAR and LCAR alignments

The location of the proposed alignments of the WAR and the LCAR are presented on Map 1 (insert facing page). The alignments of the WAR and the LCAR are highlighted in bold coloured lines. The location of the proposed Mohale Dam site is indicated.

The proposed upgrading of the WAR will occur between St. Michael's and Patiseng on the Mountain Road, running east from Maseru. The road passes over the Maluti mountain via the Bushman's Pass (2 268 m), the Molimo-Nthuse Pass (2 318 m) and the Blue Mountain Pass (2 650 m).

The proposed alignment of the LCAR runs from Ficksburg/Maputsoe in the north, west to Peka, south to Teyateyaneng and south-east to Ha Mateka on existing road. No upgrading is proposed for this stretch, except a possible widening of the T-junction at Teyateyaneng. From Ha Mateka a new road is proposed, running east past Pulane, over the Maluti mountain range via the Lekhalong-la-Likhaebaneng Pass (2 600 m) into the Jorodane River valley. The proposed alignment runs for the length of the Jorodane River valley, along the western bank of the Jorodane River, to the Mountain Road in the south, joining the Mountain Road at Mafotholeng, just north of Patiseng.

A detailed description of the characteristics of the environments that will be affected by these proposals are given in the individual impact assessment reports for the WAR and LCAR (see below). The 1:50 000 scale maps indicating the alignments of the WAR and the section of proposed new road of the LCAR are given in Appendix 1.

1.2.3 Terms of reference of the overall environmental impact assessment contract

The environmental impact assessment of Contract no. LHDA 1000 was associated with various aspects, namely:

* a desktop selection of a "least cost alternative route" (LCAR) to the Western Access Route (WAR), from eight alternative routes. This was to be completed within one month of the appointing of the EEU;
* a detailed environmental impact assessment of the WAR (from St. Michael's to Patiseng), and the LCAR (the alignment as given by the engineers). This would include the determination of compensation costs associated with upgrading or construction, according to the LHDA Compensation Plan (1990). The individual impact assessments would facilitate the comparative evaluation of the two routes and enable a selection of a preferred alternative access route for development, based on environmental criteria;
* an initial environmental impact assessment, including the assessment of compensation costs, of six alternative Maseru bypass routes (as identified by the consultant engineers). This would facilitate the selection of a preferred Maseru bypass route for development based on environmental criteria of minimum social and biophysical disturbance and maximum socio-economic and regional planning benefit;
* an assessment of environmental impacts associated with the construction of two minor access roads from the Mountain Road to the proposed Mohale Dam wall, and;
* an assessment of environmental impacts associated with the construction of the resident engineers' camp near the proposed Mohale Dam wall site.

1.3 Overall approach to the Environmental Impact Assessment of LHDA Contract no. 1000.

1.3.1 Stages in the study process

The selection of the "least cost" alternative access route (minimum financial, social and ecological costs, maximum national and social benefit) and the investigation of the impacts associated with the development of the WAR and the LCAR took place in two stages:

Stage 1:

* The identification of an alternative road corridor from the Lesotho-South Africa border to the dam wall site, from eight proposed corridors, not including the WAR - the selected road corridor to be called the "Least Cost Alternative Route" (LCAR). This preliminary assessment incorporated both engineering and environmental concerns, and was completed by GBJV and EEU in mid February 1993. The findings presented in the **GBJV (1993) Report: "Report on the Least Cost Alternative corridors"**. See appendix 1 of EEU/2/93/104b or EEU/2/93/104c Reports.

Stage 2:

* The Bergman consultant engineers of GBJV prepared a detailed design of the alignment of the WAR. The EEU study team undertook a full environmental impact assessment of the environmental impacts and compensation costs associated with upgrading the WAR. The findings of the environmental impact assessment is presented in the **EEU/2/93/104b Report: "Environmental Impact Assessment of the Western Access Route (WAR)"**. Submitted with this report.

* The Alexander Gibb consultant engineers of GBJV were responsible for preparing a preliminary alignment of the LCAR. The EEU study team conducted an investigation of the environmental impacts associated with the construction and operation of the LCAR. Once the LCAR alignment was received from the GBJV, the route was assessed for compensation requirements. This was completed in May 1993. The findings of the environmental impact assessment is presented in the **EEU/2/93/104c Report: "Environmental Impact Assessment of the Least Cost Alternative Route (LCAR)"**. Submitted with this report.

* An initial assessment of the environmental impacts and compensation costs associated with the construction and operation of a Maseru Bypass, involving a comparison of six alternative bypass routes. The findings of this analysis are presented in the

EEU/2/93/104a Report: "Initial environmental impact assessment of the proposed Maseru bypass". Submitted with this report.

* An assessment of the environmental impacts and compensation costs associated with the construction of two minor access roads at the dam wall site and the siting of the resident engineer's camp. The alignment of the access roads were provided by Alexander Gibb consulting engineers of GBJV for impact assessment by the EEU study team. The survey is presented in **EEU/2/93/104d Report: Environmental impact assessments of Access 1 and Access 2 and the Resident Engineer's camp**. Not submitted with this report.

1.3.2 Approach and methodology of data collection in overall study

The environmental impact study was conducted according to the principles of Integrated Environmental Management (IEM) (DEA 1992), using an open, participatory approach, and including consultation with interested and affected parties (I&APs).

With respect to the WAR and the LCAR, significant negative impacts, both socio-economic and bio-physical, were identified for the alternative access routes, and actions necessary to minimise or mitigate these impacts were recommended. The impact assessments also incorporated a consideration of the optimisation of positive aspects, in accordance with LHDA's stated policy of development for the sub-region.

The following tasks were carried out in the process of data collection and the identification of impacts associated with the WAR and LCAR:

(i) Initial contact with interested and affected parties:
This was undertaken by means of personal interviews and meetings with as many identified I&APs as possible.

(ii) Regular discussions with the client (LHDA) and the GBJV engineers regarding the scope of and approach to the project:
This was an iterative process whereby information was obtained pertaining to engineering and environmental concerns. Environmental information was fed by the study team to the engineers during the planning and design process for the alignment of the LCAR.

(iii) Identification and assessment of impacts by means of:
* literature reviews;
* discussions with I&APs and specialists (specialist fields included rehabilitation, hydrology, ecology, road engineering, and archaeology);
* field visits;
* a social survey conducted among 315 households from 16 villages along the relevant section of the WAR, and 265 households from 19 villages along the relevant section of

the Jorodane River valley. (The results of the social survey are available in the Report on the social survey for LHDA Contract No. 1000, Report EEU/2/93/104E, available on request from the EEU);

* a social survey conducted along the recently constructed Katse Road;
* a round table discussion comprising the study team and an external environmental consultant for the assigning of impact significance.

(iv) Determination of appropriate measures to mitigate negative impacts and enhance positive impacts:

This was done by reference to information gathered during consultation with I&APs and with specialists, and by the compilation of guidelines for rehabilitation, erosion control and other environmental concerns.

(v) The compilation of the baseline environmental impact assessment reports (1.3.1 above).

1.4 Purpose of this study

The purpose of this study is twofold.

Firstly, the process followed by the EEU study team in the assessment of the environmental impacts associated with the WAR and the LCAR, is critically analysed. The Lesotho Highlands Water Project (LHWP) is briefly described in order to develop an understanding of how environmental considerations have been incorporated into project planning and development in Lesotho. The application of environmental impact assessments (EIAs) in developing countries, and the evolution of the Integrated Environmental Management (IEM) procedure is reviewed.

Secondly, the key environmental impacts associated with the alternative routes are identified, and compared according to the environmental criteria of efficiency, equity and sustainability (Stauth 1989). A preferred alternative of the two routes is recommended, based on environmental criteria.

1.5 Structure of this report

This report consists of five chapters and two appendices.

Chapter Two expands on the background to this study and provides an analysis of the process adopted in the environmental impact assessment of the WAR and the LCAR. The Contract no. LHDA 1000 is placed in context of the greater LHWP. The role of the Integrated Environmental Management (IEM) as a process for facilitating the identification of alternatives

and improving social involvement is discussed. The environmental impact assessment of the alternative access routes is assessed in terms of the following:

1. Procedurally, was it adequate?
2. Was it effective in achieving its objectives i.e. informing the decision makers of environmental concerns?

Chapter Three presents the key positive and negative environmental impacts associated with the WAR and the LCAR. The impacts are briefly described.

Chapter Four presents the comparative evaluation of the two alternative routes. The key environmental impacts identified in chapter three are evaluated as costs or benefits to the development. The evaluation is undertaken by applying the criteria of efficiency, equity and sustainability. Trade-offs associated with the choice of one alternative above the other are highlighted.

Chapter Five presents the conclusion of the comparison and recommends a preferred access route for development. Recommendations are made for mitigation of negative impacts and ongoing environmental monitoring and rural development programmes.

CHAPTER TWO

An analysis of the environmental impact assessment of the access routes to the proposed Mohale Dam, Lesotho

2.1 Overview

The purpose of this chapter is to critically assess the approach taken by the EEU study team in the selection of the "least cost alternative route" (LCAR), and for the identification and assessment of the environmental impacts associated with the Western Access Route (WAR) and the LCAR.

The overall larger Lesotho Highlands Water Project and the application of environmental impact assessments (EIAs) in a country such as Lesotho, where environmental conservation is just emerging, is discussed. The integrated environmental management (IEM) process, developed by South African environmental professionals in response to the problems encountered with EIAs in developing countries, is briefly described.

2.2 The Lesotho Highlands Water Project and environmental conservation in Lesotho.

2.2.1 Background to the Lesotho Highlands Water Project

Lesotho is a land-locked country, surrounded by the Republic of South Africa. It has a total population of approximately 1.6 million people, the majority being concentrated in the western lowlands of the country. The rural sector comprises 80% of the population, although only 13% of the country is arable (LHDA 1990a). Lesotho is in many ways economically dependent on the core economy of South Africa. Due to the high level of wage labour in South African mines, the rural economy is very dependent on the cash economy, and is not an entirely subsistence or self-sufficient system. Lesotho is a net importer of foods from South Africa.

Lesotho has no significant mineral resources, but has an abundance of water. In the 1950's, Ninham Shand proposed that the headwaters of the Orange (or Senqu) River in the Lesotho Highlands could provide sufficient water to meet the increasing demand for water by the growing industries and residential areas of the Johannesburg/Vaal Triangle region of South Africa (LHDA 1990a). Detailed feasibility studies were carried out between 1979 and 1986,

and in 1986 the "Treaty on the Lesotho Highlands Water Project between the Government of the Kingdom of Lesotho and the Government of the Republic of South Africa" was signed.

For Lesotho, the LHWP has three main objectives:

* to provide revenue to Lesotho, by transferring water from the Senqu catchment in Lesotho to South Africa - direct royalty payments will be received from the Government of South Africa for water transferred from Lesotho;
* to generate hydro-electric power for Lesotho, in conjunction with the water transfer, and;
* to promote the general development of the remote and underdeveloped mountain regions of Lesotho, while ensuring that comprehensive measures are taken to avoid any adverse effects which the project might have on the local population and their environments

(LHDA 1990a).

2.2.2 *The Lesotho Highlands Development Agency*

Under the 1986 Treaty, the Lesotho Highlands Development Agency (LHDA) was created by the Government of Lesotho to supervise that portion of the LHWP which falls within Lesotho. This represents about 90% of the project. The LHDA reports to the Joint Permanent Technical Commission (JPTC), which was established to ensure that obligations of the 1986 Treaty are fulfilled. Equal representation is provided in the JPTC from both the Government of South Africa and the Government of Lesotho. The JPTC ultimately makes all decisions concerning the numerous small projects associated with the LHWP. This, however, excludes decisions pertaining to the hydropower scheme.

The LHDA, since its establishment, has expanded into eleven Divisions: Technical, Infrastructure, Environment, Water resources, Capital Finances, Finance, Legal, Administrative, Computer services, Training, and Public Relations. Those Divisions relevant to this study are:

* The Technical Division - responsible for design, construction, and maintenance of the LHWP dams and water transfer tunnels.
* The Infrastructure Division - responsible for all additional infrastructure such as access roads, camps and towns.
* The Environment Division - responsible for the development and implementation of appropriate responses to the socio-economic and environmental aspects of the LHWP. These include the provision of:
  - compensation for affected individuals or parties;
  - the implementation of longer term rural development programmes for the affected areas, and;
  - mitigatory actions to protect and manage the physical, biological and cultural environment.

2.2.3 LHDA and environmental concerns

The 1986 Treaty deals briefly with socio-environmental concerns in Article 7 (18), where it is stated that:

> *The LHDA shall effect all measures to ensure that members of the local communities in the Kingdom of Lesotho, who will be affected by flooding, construction works or other similar Project related causes will be enabled to maintain a standard of living not inferior to that obtaining at the time of first disturbance.*

And also in Article 15:

> *The parties agree to take all reasonable measures to ensure that the implementation, operation and maintenance of the Project are compatible with the protection of the existing quality of the environment and in particular shall pay due regard to the maintenance of the welfare of persons and communities immediately affected by the Project.*

The rest of the 90 page Treaty deals with engineering standards, the legal binding for the provision of water to South Africa and the financial management duties of the Project. Such minimal provision for the incorporation of social and environmental considerations in the implementation of the Project is indicative of a strongly technocratic and engineering approach throughout the decision-making process. Furthermore, the focus of the legal requirements on the incorporation of environmental concerns during the implementation and operation stages of the project, fails to recognize the need for a focus on environmental concerns during the planning stages of the overall project.

As pointed out by McAuslan (1987), the probable reasons for such a disproportionate weighting of the duties and decision-making in the LHWP Treaty in favour of technical considerations are:

* the two principle groups of decision-makers involved are the engineers and the economists reporting to international financing agencies;
* it is a major engineering project and must be seen to be of international standard, and;
* it is only recently, since the 1987 Brundlandt Report (WCED 1987), that the principles of sustainable development are being seriously integrated into international development and financing programmes.

The sub-division of the LHDA into departments (e.g. technical, infrastructure, and environmental), has highlighted this biasing of the decision-making responsibilities in favour of engineering concerns. The Technical, Infrastructure and Finance divisions have considerably more involvement in Project activities and decisions than the Environment Division, which is typically marginalised in its activities. The Environment Division is considered to be

responsible for aspects of compensation and social welfare during the project implementation phase. However, at this stage, it should ideally be ensuring that environmental concerns are incorporated into the planning of projects, and that environmental standards are enforced during the decision-making process and during on-site construction activities.

This situation has resulted in the Environment Division taking a sub-optimal, reactive position rather than a proactive, up-front position in promoting environmental caution during planning and decision-making within the LHDA. Examples of serious environmental neglect exist on completed aspects of the LHWP, such as along the northern Katse Dam access road from Ficksburg to the Katse Dam site, and along the auxiliary southern access roads from Katse to Thaba-Tseka. Although these roads were completed three years ago, various residual environmental problems can be observed to date, and are as yet, poorly attended to:

* high altitude wetlands have been severely degraded and only minimally rehabilitated:
* large unsightly cut-face scars have not been rehabilitated and continue to show serious instability and erosion after four years of existence;
* poor cross-road drainage has resulted in bad erosion and damage to the tar surface;
* the number of accidents, deaths and injuries on the Katse road are catastrophically high;
* the implementation of social benefits such as rural development schemes and a regular and affordable public transport system has not been not forthcoming, and;
* village water points (springs) lost as a result of the construction of the Katse road have not yet been replaced

(Information from field trip 18/2/93, Report EEU/2/93/104e - Social survey, MRC Report 1992).

2.2.4 *Environmental concerns in a national and political context*

Economic development and the increase of the national income of Lesotho is a primary national objective (Lesotho Fifth Five Year Plan, 1993). The process whereby this is foreseen to happen is through industrialisation and investment in labour intensive national works, in which the LHWP will occupy the priority position. The technology, skills and workforce required for the technical and financial implementation of the LHWP have all been imported from South Africa and other international contract countries. Although some degree of environmental expertise has also been imported (such as for this study), no coincident formulation of enforceable environmental protection laws within Lesotho or timeous training of individuals in environmental and conservation disciplines, within Lesotho, has taken place.

Environmental law in Lesotho, as in most developing countries, is in its infancy and far from adequate (Witzsch and Ambrose 1992). At present, no mandatory or informal requirement exists in Lesotho for the incorporation of environmental concerns during planning and implementation of a development, or for monitoring and auditing once development has occurred. No overarching conservation or social welfare policy exists in Lesotho for the protection of the individual, society and natural ecosystems from the direct or indirect effects of environmental degradation resulting from the LHWP and economic development. Although a

national conservation act has recently been proposed which would fulfil this need (Witzsch and Ambrose 1992), it may be many years before it is legally endorsed by the Lesotho government.

2.3 The Environmental Impact Assessment process and the development of Integrated Environmental Management

2.3.1 "Building the boat"

In the case of major international engineering projects in a less developed country, such as the LHWP and associated developments in Lesotho, which are funded by international funding agencies (World Bank and Development Bank of South Africa), the recent policy of the international funding agencies is to demand an environmental impact assessment (EIA) of the proposed development (World Bank Technical paper, 1991, DBSA unpublished report). Accordingly, for a development such as LHDA Contract no. 1000, a foreign consultant (in this case, the EEU), was contracted to conduct the EIA due to the lack of appropriate expertise within Lesotho, in order to fulfill the externally enforced requirement.

Applying an environmental management process in a country where acute shortages of trained manpower, information and skills exist for the anticipation and solving of environmental problems, has been compared to "sailing a boat while building it" (Graybill 1985). However, the objectives of environmental management, and the assessment of environmental concerns surrounding a development and application of such concerns in decision making, has a relatively standard form internationally, and "sailing the boat" is the process of following through a number of tasks in a logical order (Table 1).

The primary goals and objectives of an EIA are given by Hollick (1986) as:

1. *To protect the environment from damage.* This incorporates the following objectives:
   - to ensure that adequate environmental information is available to decision makers;
   - to ensure that environmental factors have been taken into account in project planning and decision making;
   - to ensure adequate environmental management for the duration of the project.

2. *To improve public participation in government and corporate business decisions.* The process should strive to involve the public at all stages of the EIA.

3. *To promote economic efficiency.* The EIA should strive to minimise costs and maximise benefits to the proponents and the community.

In order to achieve the above three goals, a number of tasks must be completed in the EIA process. These tasks, outlined in Table 1 below, typically can be catagorised into the following

Table 1: The EIA process for project assessment

(modified from Lee 1982))

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1. *Description of proposed development*
   - Identify aspects and phases of the project (construction and operation) for which information is necessary.
   - Determine resources to be used, wastes created, and the physical form of the development.

2. *Identification of alternatives to the proposed development.* (This could occur at various stages of the development.)
   - Describe project alternatives.
   - Identify the feasible alternatives.

3. *Description of existing and projected environmental conditions.*
   - Identify aspects of environmental conditions for which information is sought.
   - Collate existing environmental data.
   - Summarize and present environmental data.

4. *Assessment of probable significant effects of the development on the environment.*
   - Identify impacts.
   - Assess magnitude of impacts on environment.
   - Assess the social significance of impacts by:
     specialist advice
     response of affected parties.

5. *Recommendations for possible mitigation measures.*
   - Identify potential mitigation measures for the negative impacts associated with the project.

6. *Compliance with other environmental plans, policies and controls.*
   - Assess likely compliance of development with existing and proposed environmental controls.

7. *Preparation of a report of the assessment.*

8. *Review of the reports by interested organisations.*

9. *Public involvement in any or all of the above stages.*
   - This may occur during the identification of issues, the assessment of significance, and the review of the report findings.

10. *A decision on the action to be taken and conditions to be applied by the responsible authority*
    - Where more than one report is prepared, the decision may be taken in stages.
    - The environmental conditions must be enforceable and monitored over time, with the view to reassessment of the project if needed.

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five components: (i) identification of appropriate information and data collection; (ii) the measurement and prediction of the magnitude of environmental impacts likely to result from the action, (iii) the assessing of the social significance of impacts for the purpose of decision making, (iv) recording and communicating the results of the assessment, with recommended mitigatory controls to the development, and (v) monitoring the actual changes (Lee 1982, Wathern 1986).

Many developing countries such as Lesotho, suffer the same constraints connected with the successful application of an EIA process, namely:

* the absence of a national environmental policy;
* the lack of sufficient, appropriately trained and experienced personnel in the day-to-day operation of the EIA process;
* the lack of public participation in the decision making process;
* the lack of public awareness of their ability to resist autocratic decisions;
* the lack of accountability of developers and decision-makers;
* a resistance by authorities to enforce environmental controls during construction due to the fear of loss of economic opportunities and foreign income through delays imposed by the EIA procedure;
* the lack of scientific data or information;
* the lack of finances to enforce environmental controls, and;
* EIAs are generally undertaken as a separate exercise to the planning process.

(Hill and Fuggle 1988, Kennedy 1986, Lee 1986, Lim 1985, Lowry and Carpenter 1985, Sowman 1993).

2.3.2 The Integrated Environmental Management process

Recognising the difficulties associated with implementing EIAs in developing countries such as South Africa and its neighbours, the Council for the Environment, an advisory council to the South African Minister of Environment Affairs, embarked on the development of the Integrated Environmental Management (IEM) procedure (Council for the Environment 1989).

IEM was developed in South Africa in response to need for a systematic procedure for incorporating environmental considerations into planning, decision making and implementation of development. It was considered that the use of the term EIA was inappropriate, as the EIA process was perceived by development proponents to be reactive, anti-development, separate from the planning process and typically resulting in costly delays to development or "stop-go" decisions (Council for the Environment 1989, Sowman 1993).

The term Integrated Environmental Management (IEM) was coined to distinguish IEM as a much broader concept than EIA, which embraces all aspects of environmental planning, assessment and management (Council for the Environment 1989). A formal, systematic IEM

procedure has been prepared by the Department of Environment Affairs, in consultation with members of the EEU (Department of Environment Affairs 1992).

The primary objective of IEM is to generate, during the early planning stages of a development, environmentally and socially acceptable alternatives to that development, through interaction with affected parties and the public in general (Fuggle and Hill 1988, DEA 1992). These alternatives and public concerns are communicated to decision makers throughout the planning, design and implementation phases of a development, to decommissioning of a development. The process is intended to be iterative, with numerous opportunities for feedback to the public and decision makers, via workshops and public meetings.

Thus emphasis of the IEM approach has shifted slightly relative to the EIA approach, in that environmental issues and public concerns are intended to be incorporated into decision making from the early planning phase of the development process through to decommissioning of the project. Furthermore, it requires an open and participatory approach with the interested and affected parties (I&APs) and the public, involved in the identification of key issues associated with the proposed development (Stauth 1989, DEA 1992). EIA has historically focussed less on the planning phase of the development and the identification of social issues, and more on the identification and assessment of negative biophysical impacts and mitigation measures to minimise the negative impacts of the development (Canter et al 1991, Htun 1986).

The key principles and objectives of IEM are:

* the term "environment" is to be considered in its broadest sense - physical, social, biological, economic, cultural, historical and political;
* decision-making will be informed of environmental and community/social concerns during all stages of the development - from planning to decommissioning;
* alternatives and social concerns identified by the involvement of all I&APs, should be seriously considered from the early planning phases of the development, and throughout the development process;
* to minimize negative environmental impacts by timeous identification of mitigation and/or adopting alternatives to the proposed project actions;
* to enhance positive aspects and social benefits by identifying affected parties' and workforce needs, and incorporating these into the planning design, and;
* open consultation with the public and affected parties to ensure a less technocratic, top-down approach to the planning and implementation of the project

(Council for the Environment 1989, Fuggle 1989, Sowman 1993).

The basic tasks of IEM differ very little from those required for EIAs, as given in Table 1. Certain tasks, such as the early identification of alternatives, the identification of social concerns, and the interaction between the environmental consultants, the decision makers, the public and I&APs, receive greater emphasis. Overall, however, sailing the boat of IEM is typically a process of applying all the tasks of Table 1, as for EIA.

2.4 The evaluation of the environmental impact assessment of the WAR and LCAR

The EEU is committed to the application of the Integrated Environmental Management (IEM) approach, for the process of evaluation of alternatives and the assessment of environmental impacts associated with a proposed development.

2.4.1 Methodology of assessment of EIAs

The environmental impact assessment reports (EIAs) of the alternative access roads for Contract no. LHDA 1000 are submitted with this study - **Reports: EEU/2/93/104b** (WAR) and **EEU/2/93/104c** (LCAR). The EIAs of the WAR and the LCAR will be assessed according to whether these EIAs performed the tasks required of an EIA. The overall process is evaluated in terms of the basic principles of the IEM process.

With reference to Table 1: This review considers tasks 2, 3, 4 and 5. The description of project action (task 1) is covered by task 2 and 3. Similarly, the compliance with environmental controls (task 6) is covered by task 5. Public involvement and I&AP scoping (task 9) occurred throughout task 2, 3, 4, and 5. Thus Task 1, 6 and 9 will not be discussed separately. This study should be considered as part of the preparation of the impact assessment report (task 7), as the individual EIA reports for the WAR and LCAR cannot be viewed as isolated from the comparative evaluation of the alternatives. The review of the reports (task 8) and the decision on the action (task 10) will only possible following the completion of this report.

2.4.2 Constraints to the effective implementation of IEM principles

The main technical constraints to the application of IEM to LHDA Contract no. 1000 were:

* major time constraints - only four months were scheduled for the environmental impact assessment;
* a general lack of baseline sociological and ecological information;
* the preliminary alignment of the LCAR was only completed and made available to the study team at an advanced stage of the study;
* accessibility to the LCAR study area was difficult, the only affordable means of transport on horseback. The LCAR study was thus restricted by time and weather, and;
* the EEU study team and the people in the affected rural areas speak different languages and have different value systems.

Other constraints of a more political nature were:

* no contact was made during the EIA with the ultimate decision makers of JPTC;
* the decision making in the LHDA is strongly influenced by the Technical and Infrastructure Divisions, and the Environment Division typically took a reactive position. This generally made the communication of environmental concerns difficult during the planning process, as engineering and financial concerns took priority;

* the brief for the study was to look at impacts associated with the two alternative alignments for the access road to the Mohale dam site, and not to assess in any detail secondary or cumulative impacts associated with the overall Phase 1B project.

Due to the multidisciplinary nature of the EEU study team and the size of the research group (9 persons), many of the technical constraints were overcome during the study. Throughout the project, the EEU study team worked in close co-operation with the consultant engineers, GBJV. The study team provided recommendations for environmental considerations to be implemented in the design of the LCAR (EEU/2/93/104c: Appendix 2), and recommended re-alignments for consideration, where given alignments were thought to be environmentally problematic. The principle that the "environment" be interpreted in its broadest sense, i.e. physical, social, economic, cultural, historical and political (DEA 1992), was rigorously pursued in the identification of environmental issues associated with the project.

The political constraints were, however, part of the LHWP system, and it was not possible to do more than conduct the EIA within the limits of the system.

2.4.3 The identification of alternatives

In accordance with IEM, the EEU Study Team was involved in the assessment of the environmental suitability of Phase 1B access roads from the early planning stages of the project. There was no requirement to examine the need for the project, as it formed part of the much larger LHWP, Phase 1B Project. It is self-evident that an access road of good standard is essential for the transport of construction materials from the South African border with Lesotho, to the proposed Mohale Dam wall site. It could not be assumed that the Western Access Route (Mountain Road), although a convenient choice as it already exists, was indeed the best route to take to the dam site. The terms of reference of the study were that a single alternative route would be identified for comparison with the WAR.

The initial stage required the identification of a "Least Cost Alternative Route" (LCAR) from eight alternative routes identified by the consulting engineers (GBJV 1993) as being technically feasible, excluding the Mountain Road or "Western Access Route" (WAR). This was an almost entirely desk-top survey with minimal contact with "interested and affected parties" (I&APs), and relying on secondary data such as a 1991 population census and topographical maps..

The following environmental decision criteria were used for the selection of the LCAR from the eight alternative routes:

* number and groups of people affected (a greater number was assumed to be positive due to the present paucity of roads in Lesotho);
* sub-regional development opportunities;
* agricultural potential of the region;

* the distance of the route above the snow line (greater length taken to be negative due to safety hazards), and;
* sensitive ecological areas or components in the areas affected.

Based on the above, an LCAR was selected which provided the greatest length of new road to the greatest number people and took the route with the shortest distance above the snow line. However, the selected LCAR passes along the length of the Jorodane valley, in close proximity to the Jorodane River valley, where an endangered species of fish, the Maluti minnow (*Pseudobarbus quathlambae*), is known to occur. It is also a region of great scenic beauty, presently under consideration for a national conservation area, for tourist recreation and to provide the Maluti minnow with a sanctuary area in perpetuity.

Although the ecological impacts associated with the LCAR were potentially severe and would require more detailed assessment in stage 2 of the study, the initial assessment indicated this route as the preferred option. It was considered that road safety and the provision of transport and economic opportunities to remote communities outweighed the uncertainty associated with the potential negative environmental impacts in the Jorodane valley, which could, theoretically, be mitigated for.

Two major constraints affected the identification of alternatives for the selection of the LCAR. Firstly, the contract required that the decision regarding the selected LCAR was made within four weeks of the acceptance of the contract. This placed a severe time limitation on the study. Secondly, the baseline information available for the comparison of the eight alternative routes was generally inadequate.

In many ways, the identification of the alternative route was poorly executed. No alternatives, other than those presented by the engineers for consideration, were generated. No identification of issues through contact with I&APs was conducted. Only maps of 1:50 000 or larger scale were available for the study, and no aerial photographs of the alternative corridors were available. Minimal baseline information on socio-demographic and ecological aspects exists for the study region, and only one field trip was undertaken.

Hollick (1986) has noted that the early dismissal of a wide range of options for a preferred alternative, rather than the detailed comparative evaluation of all options studied in similar depth, does little to help the decision maker. Hollick (1986) does, however, also note that "there is little to suggest that the outcome *(of keeping many options)* is any better than *(determining one alternative early)* provided that all relevant factors are included in the evaluation at each stage and that there is a willingness to reconsider earlier decisions if unexpected problems should emerge" (p. 163) (italicised text present author's inclusion). Furthermore, the costs of keeping many options open to an advanced stage of design can be very high. In the case of the selection of the LCAR, the brief for the study limited the analysis of alternatives to the rapid selection of one alternative for detailed assessment and comparison with the WAR. It was included in the contract that if the LCAR should, after the detailed

assessment, appear to be more suitable than the WAR, the discarded alternatives would again be re-evaluated.

In summary therefore, although the identification of the alternative access route had severe limitations, it was acceptable that, within the constraints of time and very limited primary data, a single LCAR should be rapidly decided upon. This would only be acceptable under the conditions that the process of the generation of alternative routes would be reconsidered if, during the more detailed environmental impact analysis, the LCAR was found to be the environmentally preferred option of the two alternative routes.

2.4.4 The identification of key issues and collecting baseline data

The EEU Study Team made considerable effort to provide all possible I&APs with the opportunity to express their concerns and individual needs regarding the Phase 1B access route development.

The identification of issues by contact with all I&APs and the public is termed scoping (DEA 1992). The process of scoping in IEM should provide the information needed to set the boundaries for the study and identify the key concerns which need to be addressed by the impact assessment, namely:

* the geographic and social boundaries which would define the extent of the project and associated impacts;
* the identification and selection of alternatives;
* the key resources of the region and their uses;
* the key activities and social needs of the affected parties, and;
* the key policies which would have direct implications for the project.

There are various methods of scoping: networking, public announcement (press/media), by written word, by telephone, interviews, questionnaires, workshops and public meetings (DEA - *Guidelines for Scoping* 1992). Choice of the methods employed for scoping is dependent on several factors, such as: the location of the project in relation to interested and affected parties, the resources (funds, time, manpower) available for scoping, and the nature and socio-economic status of the various groups affected by the project (DEA 1992). As the alternative route had already been selected in the first stage of the study, the main purpose of the scoping process was the identification of the national policies affected by the project and the key concerns of the I&APs. It was decided that the most effective method of contacting I&APs was through personal interviews. This involved meetings with government agencies and interested parties, and the administering of a questionnaire survey amongst those rural communities which would be affected by the project.

Scoping is typically problematic, largely due to the fact that social values change with time, locality and cultures (Beanlands 1986). It is, however, essential for identifying the components of the environment for which there is public and professional concern, and upon which the EIA

should focus. Various difficulties were experienced during the scoping process. The Lesotho Government officials were often found to be reluctant to divulge information. This is common in bureaucratic institutions where either confidential information is at stake, or a general lack of communication between government departments prevails (Graybill 1985). Some areas affected by the project are situated in the very remote mountainous regions of the country. The only access to the area of the proposed alignment of the LCAR was on foot or by Basuto pony, placing severe limitations on the time available for making contact with the affected communities.

A social survey, using personally administered questionnaires and informal interviews was conducted amongst the communities who would be affected by the WAR and the LCAR, in order to determine the communities' needs and existing social conditions and concerns regarding the proposed road development. A social survey was also conducted amongst communities living along the Katse road, which is a new road (3 years old) built for access to the Katse dam site through a previously entirely rural region, where people had had no access to services other than by foot or horseback. The observed changes along the Katse Road in terms of social disruption, access to services and economic opportunities, would be similar to changes which could be expected to occur in the Jorodane valley. The results of the three social surveys are presented in the **Report EEU/2/93/104e: Report on the Social Survey for LHDA Contract No. 1000** (available from the EEU).

The questionnaire technique is unfamiliar to the rural Basuto. However, the questionnaires were administered by Basuto numerators, whose services were hired for the project, and thus the numerous difficulties of language and culture could be overcome. The social survey successfully qualified issues of concern in the local communities, but was unable to provide a reliable quantification of issues.

Information generated for the Katse Dam (Phase 1) impact assessment (ERL 1990) was extensively referred to. Almost no recorded information existed the more remote regions of the LCAR, particularly with respect to biophysical data or surveys. With exception of the ecology of the Jorodane River, which has been researched in some detail (Rall 1992). The study is therefore mostly based on inference from studies done elsewhere in Lesotho or internationally, EEU field trips and the social survey undertaken by the EEU researchers and hired numerators. Additional input was given by a specialist in archaeology, following a 2-day field trip in the study area.

In order to avoid indiscriminate data gathering, a problem suffered by many EIAs in the past (Lee 1982), issues identified in the scoping process were focussed on, and checklists and matrices were used to select the additional information needed for the study. This approach generally promotes a more efficient assessment of those aspects of the project which are likely to be relevant in the decision making process (Lee 1982).

To summarise, the scoping exercise was of value in that it provided much of the baseline information used in the environmental impact assessment study. Communication with government agencies and I&APs enabled the identification of a wide range of environmental and social concerns for more detailed analysis. Thus, although the scoping process did not achieve a primary objective of assisting the study team to focus on a few key issues, it did enable the identification of numerous important issues within a short period of time, which could be investigated in greater detail by the study team.

2.4.5 Predicting impacts and assessing magnitude and significance

The procedure for predicting impacts and determining impact magnitude and significance adopted by the EEU study team will be analysed according to the nine evaluation criteria proposed by Elkin and Smith (1988), namely:

1. *Prediction methods*: Does the report indicate on what basis predictions are made?
2. *Assumptions*: Are the assumptions made in the methods clearly stated and justified?
3. *Validity*: Are the methods used in identifying and measuring impacts valid?
4. *Bias*: Is there undue emphasis placed on particular stages or aspects of the project?
5 *Nature of impacts*: Is each impact considered in terms of the factors (where relevant) of magnitude, duration, risk and uncertainty?
6. *Cumulative impacts*: Does the report consider cumulative impacts of the project with regards to other past, ongoing and potential projects in the general region?
7. *Project-caused impacts*: Has an attempt been made to isolate project-generated impacts form other changes resulting from natural variability and/or activities not associated with the proposed project?
8. *Identifying key impacts:* Does the report identify the major impacts and specify the rational, criteria, or other bases supporting these judgements?
9. *Magnitude vs importance*: Is there a clear distinction between the predicted size of the impacts (magnitude) and the importance (significance) of the impacts.

2.4.5.1 Prediction methodology and bias

The methodology for the identification of impacts is clearly stated in the EIAs for the WAR and the LCAR. Checklists, scoping, fieldwork, social surveys and the consulting of relevant literature are all valid methods for the identification of impacts. Two assumptions were made in the identification of impacts, and these were not clearly indicated. Firstly, it was assumed that the area affected by the road development was a 4 km wide corridor, the proposed alignment being the centre line of the corridor. This assumption is stated in the initial impact assessment for the identification of the LCAR (GBJV 1993).

The second assumption is inherent in the nature of the overall project. The EIA for the LCAR was intended as a preliminary impact assessment, whilst that for the WAR as a final, detailed impact assessment. This was done in the event that if LCAR was selected as the preferred alternative route, a detailed impact assessment would carried out along the alignment of the

LCAR, but if the WAR was selected, the Report: EEU/2/93/104b, would suffice. Thus, it was originally intended that the identification and analysis of impacts for the LCAR would be carried out at a more superficial level than for the WAR. This did not, in fact, occur, as both EIAs were conducted at a similar level of detail in order to be comparable for the final comparative evaluation (this report).

No undue bias was afforded to any individual aspects of the project, construction and operation phases of the roads being equally considered. Some bias may have occurred due to the fact that endangered fish species was identified to occur in the Jorodane River, and thus could potentially be threatened by the construction of the LCAR. As a result, the conservation status of this area may have been heightened above other less researched areas. However, the conservation of endangered species is increasingly being recognized by funding agencies as a major environmental concern (World Bank Technical Paper 1991).

2.4.5.2 The nature of impacts and magnitude and significance (5 - 9 above)
The EIA reports for the WAR and the LCAR provide a comprehensive assessment of the expected and high probability impacts associated with either alternative. Magnitude was assigned to impacts were appropriate and determinable, but for many of the impacts, no magnitude could be assigned due to inadequate baseline information or uncertainty of prediction. No attempts are made at predicting unexpected or low probability events, as such predictions would have been conjecture. The study brief limited the discussion of impacts to those directly associated with the alternative roads and, thereby limiting the discussion of cumulative impacts arising from the implementation of the Mohale Dam project.

Two main areas of uncertainty, as defined by De Jonge (1986), were associated with the identification and assessment of impacts:

* uncertainty of prediction, and
* uncertainty of values.

Uncertainty of prediction, although inherent in any prediction, can be reduced by research (De Jonge 1986). The identification of the full spectrum of issues resulted in the superficial description of as many impacts as possible. Thus accuracy of information with respect to a few key issues was forfeited for information pertaining to a large number of identified impacts.

The uncertainty of values is dealt with in the discussion on assigning of significance below.

In the determination of impact significance, the study team assigned each impact a significance rating of high, medium or low, according to the degree to which the development of either alternative route:

* would further national goals or local interests;
* would involve impacts which are irreversible;
* would have effects over long time periods;
* would affect public health or safety;
* would affect the overall well-being of people, and the number of people affected;

* would affect the availability or functioning of key resources;
* would affect 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;
* may result in cumulative or synergistic impacts, and/or
* may have the potential to optimise existing conditions.

As Thompson (1990) clearly states: "The focus of EIA, must be a judgement as to whether or not impacts are significant, based upon the value judgements of society, or groups of people chosen to represent the wishes of society... EIA methodologies should include a consideration of the value-judgements made, whose values they actually represent, and whether or not they can be taken as representative of the society as a whole. Unless a methodology contains specific provision for an element of public opinion, there is a danger that the views of study-team members may exert undue influence upon the result. Few would question the use of experts to define impact magnitude, but leaving them as the sole arbiters of significance is open to challenge." (p.241).

It is relatively easy to recognize basic human needs and attach high significance ratings accordingly. It can be assumed that local communities would be in full agreement with this. Society can also be expected to place a high value on species and ecosystems of commercial, recreational or aesthetic importance. A species, or area of natural beauty, of no utility value to the local people, albeit threatened with extinction, would be of no immediate importance to the society (Beanlands 1986). It therefore becomes increasingly difficult to apply significance ratings to the possible extinction of a species or to the decline of a natural area with no value to the local public.

Thus there is a need for a balance between academic opinion and society's needs, in weighing up the overall significance rating. The process of significance assignment for LHDA 1000 involved a discussion with members of the study team and an impartial external advisor (not from Lesotho). The baseline scientific information and the professional opinions of social, ecological and archaeological experts was weighed against the social information gathered during a series of meetings with LHDA Technical, Infrastructure and Environment Divisions, Government of Lesotho agencies and three separate social surveys of the affected local communities.

To summarise, the significance levels assigned to impacts were inevitably influenced by the values of the study team. The study team, did however, make considerable effort during the scoping process and social survey, to clarify the interests and values of the affected parties in both urban and rural environments. The final judgements of significance attempted, as best as possible, to reflect the public's acceptability and desirability of the identified impacts.

2.4.6 Recommending mitigation/optimisation activities

The planning and implementation of appropriate mitigation measures for adverse biophysical impacts, or the optimisation of positive aspects of the project by secondary activities such as rural development or improved services, represent important activities in the environmental impact assessment process (Canter *et al* 1991). In the United States, the Council on Environmental Quality recommends the following sequential consideration for impact mitigation: avoiding the impact altogether by not taking the action or parts of the action; minimising the impact by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action, and; compensating for the impact by replacing or providing substitute resources or environments (Council on Environmental Quality 1978, in Canter *et al* 1991).

Although the above considerations were not formally applied in the identification of mitigation actions for the environmental impacts associated with the WAR and LCAR, the recommended mitigation actions reflect these principles, where relevant to the impact. Mitigatory actions were identified by reviewing measures used for similar projects, and from information from relevant literature. Compensation requirements were assessed by surveying the WAR and new road section of the LCAR in terms of impacts on compensatable resources per kilometre of road. Although the EIAs for the WAR and LCAR did not clearly state the process adopted for identifying mitigatory measures, the application of required mitigation or optimisation measures was rigorous throughout.

The likely implementation of mitigatory actions was, however, not assessed in the reports. It could be assumed that compensation for damaged or lost buildings and resources would take place, as this is a legal requirement of LHDA, enforceable by Lesothan law (LHWP Compensation Regulation, 1990, Legal Notice No.50). The same is not true for the remainder of the recommended mitigation actions (ref. the Katse Road experience - 2.2.3 above). To quote from Graybill (1987) concerning the efficient implementation of environmental mitigatory measures in countries with severe constraints of budget, communication and skills for : *"If assessments are performed under circumstances which effectively preclude design changes, their value is significantly reduced. Emphasis on assessment alone may produce very fine, tidy and logical recommendations, but they will be recommendations which may be set aside for at least three reasons. Either they come at the wrong time, are not supported by budget, or they lack common ground with project or local government objectives and realities."* (p.345).

2.5 Summary

It is important to recognise that the individual EIA reports for the WAR and the LCAR are incomplete in isolation from the comparative evaluation report.

Overall, the IEM process and EIA reports resulting from the study are not without problems, namely:

* The identification of the LCAR was done in a very short time, without involvement of I&APs;
* The scoping process in reality only assisted in identifying a wide range of issues. The key issues were identified by the EEU study team by assigning ratings of high significance to impacts, and;
* The reports placed a great emphasis on the assessment of identified impacts, rather than on whether recommendations for mitigatory actions would or would not be implemented, i.e the identification of residual impacts.

In certain aspects, however, the IEM process adopted for the study was unusually effective, in that there was considerable input of environmental concerns into the design stages of the alternative routes. There was active and ongoing interaction with the LHDA Technical, Infrastructure and Environment Divisions, and a large scale involvement of the affected parties during the social surveys.

CHAPTER 3

The identification and discussion of key impacts associated with the WAR and the LCAR.

3.1 Overview

This chapter deals with the identification and discussion of the key environmental impacts associated with the alternative access routes, the Western Access Route (WAR) and the Least Cost Alternative Route (LCAR).

3.2 Introduction

The concise and logical presentation of the results of an environmental impact assessment (EIA) is critical in the success of communicating the environmental concerns to the decision makers. Historically, EIAs were generally done at an advanced stage in a development process, and typically assumed a reactive and anti-development position. The resulting environmental impact reports were unwieldy volumes of information, which communicated poorly with the decision makers (Lee 1982). Even recently, a review by Elkin and Smith (1987) of 14 EIA reports produced for the National Parks in Canada, found that the majority of the reports were poor at communicating the key issues to decision makers and the public, who were "forced to plough through documents that obscure the issues and gloss over gaps in information and knowledge" (p. 76).

The decision makers will ultimately be concerned only with those impacts assigned highest significance ratings. In order to prevent overloading the decision makers with information, the number of impacts or impact categories which need to be considered should be reduced to the key issues of concern (Lee 1982).

The purpose of this chapter is to identify and briefly discuss those impacts associated with the WAR and the LCAR, which were assigned the highest significance ratings by the study team. This is to allow for an informed comparative evaluation of only those impacts and issues which are critical in the final selection of the preferred access route to the Mohale Dam site.

The significance ratings assigned to impacts do, however, involve considerable uncertainty and inevitably reflect value judgements made by the study team performing the technical investigation (De Jonge 1986, Thompson 1990). The decision makers should be sufficiently well informed of all impacts to enable them to introduce their own value judgements and

significance assessment. Detailed information pertaining to all impacts and specialist's reports should be easily obtainable, either as an addendum to the decision makers document, or as a separate volume. The reports **EEU/2/93/104a, EEU/2/93/104b** and **EEU/2/93/104c,** submitted with this report, provide a detailed discussion of all the impacts identified and investigated by the study team.

3.3 Identification of key impacts

3.3.1 Methodology

Ratings of high, moderate-high, moderate and low significance were assigned to positive and negative impacts associated with the WAR and the LCAR (see Reports **EEU/2/93/104b** and **EEU/2/93/104c** Section C). Actions required for the mitigation of impacts were recommended, and a second significance rating following mitigation of the impact, was assigned to each impact.

Tables (i) and (ii) and Tables 6 and 7 of Reports **EEU/2/93/104b** and **EEU/2/93/104c**, present a summary of impacts and significance ratings, with and without mitigation respectively. These tables are presented, corrected for the printing errors given below, in Appendix 2 of this report.

Please note the following errors in Report **EEU/2/93/104c** (EIA of LCAR) on Table (ii) of Executive Summary and Table 7 (p. 37), where impacts were incorrectly rated on the tables:
Under socio-economic impacts: the impact *Social disruption of local communities* is rated as moderate. This rating should be high (see text p. 56, EIA of LCAR).
Under biophysical impacts: the impact *Loss of leucosidea woodland* is rated as high. This should be rated as moderate (see text p. 76, EIA of LCAR). And the impact *Loss of spiral aloe population* is rated as moderate, this should be rated as high (p. 74, EIA of LCAR).

For the purposes of the identification of key impacts associated with the WAR and the LCAR, the mitigation of impacts is not assumed, beyond the compensation required for damaged or lost resources. Key impacts are therefore identified as those impacts which have been assigned significance ratings of **high** or **moderate-high** <u>without mitigation</u>. The remaining impacts which have been assigned significance ratings of **moderate** or **low**, <u>without mitigation</u>, are considered to be non-key impacts.

3.3.2 Tabular presentation of key impacts

Table 2 presents the identified key positive (+ve) and negative (-ve) impacts assigned high and moderate-high significance, without mitigation, according to the four impact categories defined above. A point form summary of the recommended mitigatory action for each impact is also presented.

3.3.3 Impact categories

Four impact categories are defined for the tabular presentation of key impacts (Table 2):

* promotion of national planning and development;
* socio-economic impacts;
* biophysical impacts, and;
* loss of resources requiring compensation.

The fourth category of compensation is separated from general socio-economic impacts, as the LHDA is legally bound to compensate for any loss of buildings, fences, gardens, fruit and other trees, agricultural land and water points resulting from a development associated with the LHWP. The loss of compensatable resources can be financially quantified and it is expected that compensation will be applied according to the LHDA Compensation Plan (1990b). In the case of general socio-economic impacts, mitigation cannot be assumed.

3.3.4 Assumptions and limitations

The primary assumption is that the significance ratings assigned to impacts by the study team are accurate reflections of the real significance of the impact. The problems associated with assigning significance are discused is some detail in Chapter 2.

A limitation of presenting the decision makers with only the key impacts, is that the action nay be perceived as fragmented bits of the whole (Lahlou and Canter 1993). There is considerable value in being presented with detail of the full spectrum of predicted impacts, so as to be aware of the full implications of the development. The decision makers should be aware of their responsibility in considering the entire development, so as to be able to make their own value judgements and significance assessments.

Table 2: The key environmental impacts associated with the WAR and the LCAR

	Western Access Route	Least Cost Alternative Route
Promotion of national planning objectives	+ve Reinforces national road network plans High significance without mitigation. Optimisation: complete proposed reconstruction plans for Mountain Road. High significance following optimisation. +ve Maseru bypass will alleviate traffic congestion in Maseru High significance without mitigation. Optimisation: improve services of Maseru. High significance following optimisation.	-ve Not in accordance with existing road plans and places additional burden on maintenance budget. High significance without mitigation. Mitigation: requires continuous, effective maintenance. High significance following mitigation
Socio-economic impacts	+ve Improved transport and access to facilities, goods and services High significance without optimisation. Optimisation: appropriate siting of stopping and off-loading areas. High significance following optimisation. -ve Social disruption: increased crime, resettlement of families, demotivation to farm High significance without mitigation. Mitigation: employers should be responsible for labour; sensitive, consultative approach to provision of compensation houses. Moderate significance following mitigation	+ve Improved access to facilities, goods and services. High significance without optimisation. Optimisation: Regular bus stops, wide shoulder for pedestrians and livestock, efficient and cheap, public transport system. High significance following optimisation. -ve Social disruption: increased crime, effects on social lifestyles. High significance without mitigation Mitigation: provision of recreational facilities for labourers, adequate policing. Moderate significance following mitigation. -ve Disruption of local economy. High significance without mitigation. Mitigation: Development of other source of income for local residents, rural development programmes. Moderate significance following mitigation.
Biophysical impacts	No impacts of high significance	-ve Increased sediment loading of rivers and streams High significance without mitigation. Mitigation: Strict enforcement of erosion control measures, the employment of an environmental control officer during construction to enforce environmental controls. Moderate to low significance following mitigation. -ve Clogging of stream course with rockfall from earthworks. High to moderate significance without mitigation. Mitigation: No dumping of spoil material in stream or river courses. No siting of quarries/borrow pits next to streams. Rockfall in streams and rivers should be cleared. Low significance with mitigation -ve Impacts on sensitive ecological areas: wetlands and bogs. High to moderate significance without mitigation. Mitigation: Avoid construction activities within wetland areas; rehabilitate areas which have been disturbed. Moderate to low significance following mitigation. -ve Possible local extinction of two endangered species, the Maluti minnow, *Pseudobarbus quathlambae*, and the spiral aloe, *Aloe polyphylla*. High significance without mitigation. Mitigation: A National Park and sanctuary area has been proposed for the conservation of the region and the endangered species. There is no mitigation other than avoidance.
Compensation for lost resources	-ve Loss of privately owned resources: total value WAR: M 654 775, WAR + bypass: M 1 572 935 -ve Interference with access to, or destruction of, potable water supplies. High significance without mitigation. Mitigation: wells and standpipes must be replaced at distances equal or closer to village than original well. Moderate significance following mitigation.	-ve Loss of privately owned resources: total value LCAR: M 973 761. -ve Interference with access to, or destruction of, potable water supplies. High significance without mitigation. Mitigation: Replacement of springs that will be destroyed with suitable water supply of equivalent quality. Low significance following mitigation.

3.4 Discussion of key impacts

3.4.1 PROMOTES NATIONAL PLANNING AND DEVELOPMENT

The Western Access Route

(i) Positive impact on the Lesotho road network, largely because it accords with existing national road plans and would result in savings of M 12.7 million to the Lesotho Government.

The reconstruction of the 150 km of Mountain Road from St Michael's to Thaba-Tseka, of which the Western Access Route represents the first 60 km stretch, has already been identified as a priority by the Lesotho Department of Roads. The development of the WAR will further the road network priorities in Lesotho, as the money is not presently available to the Lesotho Department of Roads for upgrading this road as planned. The Lesotho Government has budgeted a total of M 20 million for the 150 km of Mountain Road, thus the selection of the WAR as the access road will "save" the Lesotho Government at least M 10 million.

The Mountain Road is regularly used by local travellers and tourists, and is in need of constant repair. An estimated M 2.7 million would be saved by the Roads Department on the maintenance costs of this section of road during the construction of the Mohale Dam. These costs will be carried by LHDA for the period of dam construction (scheduled for 5 years), only reverting to the Lesotho Roads Department after dam construction is completed.

(ii) Selection of the WAR with the associated construction of the Maseru bypass and railhead facilities would alleviate traffic congestion in Maseru and promote economic growth.

Selection of the WAR is associated with the construction of a paved bypass road of the Maseru central business district (CBD) and possibly a railhead facility, constructed by LHDA for the offloading of construction materials in Maseru. Traffic flow in Maseru is presently extremely congested along the arterial routes and in the CBD, and the surrounding suburbs are largely lacking in paved roads. The selected bypass route will consider the provision of a less congested through-route in Maseru for heavy vehicles, and the extension of the paved road network of the city of Maseru (see Report EEU/2/93/104a). The construction of an alternative route for vehicular flow through Maseru will greatly improve the local road environment of Maseru.

The construction of the bypass in Maseru will involve costs to individuals who may lose houses or land. Under LHDA policy, these costs will be compensated for by replacement of houses or remuneration.

The construction of the bypass and railhead facilities in Maseru could be of considerable local and national economic benefit. The economic activity associated with the location of railhead facilities in Maseru would be likely to promote employment opportunities, improved import-export trade and greater financial investment in Maseru. Economic activity and investment stimulated in such a manner is likely to continue long after the construction work on the dam has ended. The siting of the railhead within Maseru could also bring import revenue from goods and construction materials offloaded in Lesotho. These funds could be made available for the upgrading of domestic services in Maseru.

The improvement of facilities and infrastructure in Maseru could encourage further congestion of Lesotho's population. The growth of the city might not be sustainable, relative to the services offered. Focussing of development initiatives in Maseru could, in addition, detract from the development of urban centres elsewhere. Without a concentrated effort to stimulate development outside Maseru and to upgrade the services within Maseru.

Least Cost Alternative Route

(i) **Development of the LCAR contradicts national road networks planning objectives and places an additional burden on the maintenance budget.**

The LCAR will involve the construction of approximately 55 km of new road through an area with a low settlement density. Although the LCAR would provide a shorter route between Teyateyaneng and Likalaneng (Mountain Road), the national road network planning objectives do not include any priority planning for such a road. This could be seen to be indicative that there is no present national need for such a road, besides as an access road to the proposed Mohale Dam.

A 55 km stretch of new road would be a significant additional burden on Lesotho's road maintenance budget once road maintenance costs revert back to the Lesotho Roads Department (5 years after construction of the LCAR). The mountainous terrain traversed by the LCAR is exposed to extremes in weather conditions, having snowfall in winter and heavy thunderstorm activity in summer. Such conditions would suggest that maintenance will be continuous and problematic, the road being subject to rockfalls and wash-aways. A high input of human and financial resources into a potentially seldom-used road in Lesotho is unlikely to be maintained in the long-term, and the result may be the rapid deterioration of a high quality road once the dam is constructed. This situation is typical of less developed countries with limited financial resources.

3.4.2 SOCIO-ECONOMIC IMPACTS

Western Access Route

(i) Improved transport and access to facilities, goods and services.

The Mountain Road is the only west-east road from Maseru to Mantsonyane and Thaba-Tseka, regional centres of the central mountainous region of Lesotho. It is a well used transport route for local travellers, traders and tourists. Only the first 30 km to Molimo-Nthuse are tarred. Improved transport safety associated with the provision of a good quality tar road, would be of benefit to all persons presently using the WAR as a trade or transport route. Widening of the road, improved lines of sight at junction roads, clearly demarcated stopping places and bus stops, as well as signage and road furniture (railings, centre-line cats-eyes, warning signs) would greatly increase the safety factor along the WAR.

Twenty-two percent of the respondents participating in the questionnaire survey undertaken in villages along the WAR, believed that upgrading the road would attract better services and new development. The improvement of services along the WAR is not a definite outcome of upgrading the 60 km stretch of Mountain Road from St Michael's to Likalaneng. Development of the WAR would, however, reinforce existing national planning priorities for resettlement and rural development towards Thaba-Tseka. As businesses and tourist facilities are already located along the WAR, it is likely that these centres (e.g. Nazareth, Molimo-Nthuse, Marakabei) will develop further, benefitting from the presence of a better road.

(ii) Social disruption

The Mountain Road was built in the 1970s, thus the social effects associated with the presence of the road such as altered social expectations, increased crime, stock theft and ease of access to alcohol, paraffin and benzene, have already become part of the communities' way of life along the WAR. The social ills of crime and alcoholism were, in fact, found to be present in villages along the WAR at higher levels relative to villages in more remote, rural areas (Report EEU/2/93/104e - Results of the Social Survey). It is unlikely, despite the fears of local inhabitants, that such negative impacts should increase as a result of the presence of a better road, as the existing road is already well used.

Possible short-term negative impacts associated with the presence of construction workers and camps have been identified as:

* greater pressure on limited resources such as water and toilet facilities;
* increased prevalence of alcoholism;
* introduction of prostitution and sexually transmitted diseases.

Such impacts would most likely be problematic for the local inhabitants of the villages in the immediate vicinity of labour camps. The presence of such camps would, however, be associated

with increased opportunities for trade. Furthermore, the communities along the Mountain Road are already familiar with the passage of foreigners through their villages, due to the existance of the road.

The resettlement into new compensation houses of families whose houses will be demolished as a result of road widening, can cause conflict within villages (Thoahlane 1991). Compensation houses are perceived as status symbols and can result in altering village social heirachies. Such secondary impacts are complex, unavoidable and difficult to mitigate. In the past, LHDA has encouraged the idea that compensation houses are "better" than normal village dwellings, and that individuals receiving compensation houses are "favoured" above others. This exacerbates a potentially difficult social transition, rather than facilitating social acceptance by the whole community (Thoahlane 1991).

Least Cost Alternative Route

(i) Improved access to facilities, services and goods.

The only access road into the Jorodane valley is via a 4X4 vehicle track (in very poor state of repair) from Thaba Putsoa on the Mountain Road, to Ha Rapokoloane (village in the Jorodane valley) (see Map 2b, Appendix 1). People in the remote regions of the Jorodane valley have no other access to urban commodities and medical services than by foot or on horseback. The presence of a road would provide opportunities of transport, acquisition of domestic and agricultural materials, and improved access to medical care, schools and markets. The overwhelming response from communities in the Jorodane valley during the social survey was that they were adamant that they need a road.

The results of the social survey on the Katse Road (a new road constructed three years ago through a remote rural community) showed that although the new road was generally appreciated by communities living near it, the road was not always accessible to individuals as a transport route due to lack of money for buses or taxis (Report **EEU/2/93/104e**). The benefits associated with a new road, although perceived by all, may only be real for those who have cash resources. However, without a road, the opportunity for fast access to goods and services, in particular emergency services, does not exist at all.

(ii) Social disruption

The following elements of social disruption have been identified as likely to result from the construction of the LCAR through the rural environment of the Jorodane valley:

* increased crimes such as stock theft and housebreaking;
* increased incidences of alcoholism, rape and sexually transmitted diseases, and;
* resettlement of families to new compensation houses or the relocation of village facilities.

Information from the social survey on the Katse Road confirms the prediction that the above impacts would be associated with a new road in a rural area. Benefits of such a development are only available to a few, whilst the costs of social decline are borne by the entire society. It is unlikely that police presence would dissuade such decline, it could even cause the situation to become worse. Corruption of police authority was observed in some villages on the Mountain Road (H Mackinnon, EEU researcher, pers. comm.).

The communities of the Jorodane valley are not entirely isolated from contact with materialistic urban values, and individuals have considerable experience of the urban environment and western society through migrant labour and shopping trips to Maseru and Teyateyaneng. Indeed, battery operated hi-fi sets, lounge suites and glass cabinets are commonly seen in houses in the valley. They are, however, sufficiently removed from the mainstream economy that systems such as bartering are still dominant in the circulation of resources within and between villages. In the absence of a road, villages and individuals suffer equal hardships, and the divide between rich and poor, although it exists, is not emphasised. With the presence of a road, the remnants of bartering would likely be replaced with an urban buying and selling system, as shortages of consumer commodities are reduced by ease of access. The divide between rich and poor will be widened.

The presence of construction camps and construction labour would be likely to have the same short-term effects as described above for the WAR. The presence of a large number of male labour (approximately 250 men) in the rural villages close to the construction camps would presumably be socially disruptive. The rural villages of the Jorodane valley are typically small, with close-knit communities, and with little exposure to the movement of many foreigners through the village.

The resettlement of families losing houses into new compensation houses would have the same impacts on social heirachy in affected communities as described for the WAR above.

(iii) Disruption of local informal economy

The local informal economy provides the Jorodane valley community with between M 200 000 and M 500 000 per annum. The disruption of the local informal economy would be detrimental to the cash flow of numerous families in the valley, where communities are already marginalised, and have little access to the mainstream economy. A cash income is essential to these communities in order to send their children to school, as well as to buy food, clothes and seed. Residents in the Jorodane valley are aware of the possibility that the informal sector would be reduced by the presence of a road, but have repeatedly stated that they would find a substitute means of income (B Schreiner, EEU researcher, pers. comm.).

3.4.3 BIOPHYSICAL IMPACTS

Western Access Route

No key significant biophysical impacts associated with the upgrading of the Western Access Route were predicted by the study team.

Least Cost Alternative Route

(i) Increased siltation of water courses.

Hydrological impacts would be unavoidable in the event of the construction of the LCAR, in particular within the Jorodane valley. A new road would result in the interference of sheetflow of water down slopes, constriction of sheetflow into streamflow through culverts, erosion from surfaces denuded of vegetation on the cut and fill slopes, increased velocities of runoff from hardened surfaces and increased channel erosion where culverts discharge into stream beds.

Experience from the Katse road shows a very poor standard of environmental control in the protection of surfaces from erosion, and streams and rivers from silt-loading. This has resulted in bad erosion at numerous places along the road (pers. obs.), which inevitably ends up as silt in the streams and rivers of the area.

Siltation of the Jorodane River would result in an important secondary impact on the water quality flowing into the Mohale Dam. A long life-span of the Mohale Dam is dependent on good catchment control. The Jorodane River valley forms a primary catchment for the Mohale Dam. Silt that gets washed down in the river would settle out in the Mohale Dam.

(ii) Clogging of stream courses with rockfall from side spoiling, blasting or earthworks at quarry sites and borrow pits.

Examples of stream clogging with rockfall can be seen on the Katse Road and the Mountain Road. The impacts of stream clogging are:

* increased erosion at the disturbed site leading to siltation of the stream downstream of the obstruction;
* disturbance of the hydrological balances of the system, and;
* loss of the functional and aesthetic quality of the stream or river course.

The LCAR alignment passes in very close proximity to the Jorodane river, along the face of steep river incision slopes (see km 26, 28, 31 and 33 of Map 2b LCAR, Appendix 2). The potential for rockfall into the Jorodane River at these sites during cutface engineering for the road, is very high.

The locations where quarries and borrowpits would be sited for the construction of the LCAR was unknown at the time of the study.

(iii) Impacts on endangered species

Two endangered species, the Maluti minnow (*Pseudobarbus quathlambae*) and the spiral aloe (*Aloe polyphylla*), occur in the Jorodane valley.

The Maluti minnow, found to occur in the Jorodane River (Cambray and Meyer 1988, Rall 1992), is recognised internationally as an endangered species (IUCN 1986). The Maluti minnow is only known to occur in five other, high elevation, streams in the world, all within Lesotho. The construction of the Mohale Dam would destroy 86% of its presents habitat area in the Senqunyane, the Jorodane and the Bokong Rivers by flooding. Thus the remaining 14% of habitat is of very high conservation status.

The spiral aloe is endemic to the mountainous highland areas of Lesotho, a large presently undisturbed population (approximately 2 000 healthy adult plants) is located near Soosa in the Jorodane valley. The total population of remaining plants in Lesotho is estimated at between 12 000 and 14 000 individuals, believed to have shrunk about a third from its historical distribution due to illegal collection and selling (Donnay and Meyer 1991). Although listed as vulnerable (i.e. is believed that the species will move into the endangered category if the causal factors continue operating) in the IUCN Plant Red Data Book , it is considered endangered by the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

The continued local existence of both these species are potentially threatened by the construction of the LCAR. The local extinction of the Maluti minnow would be likely to result from the degradation of its habitat in the Jorodane River. This would occur by siltation of, and toxic inputs into, the Jorodane River due to the close proximity of the road to the river (J Rall, Rand Afrikaans University, pers. comm.). The survival of the spiral aloe population near Soosa (1.5 km away from LCAR alignment), would be seriously threatened by the collection of plants for roadside sale, a common occurrence in Lesotho (Donnay and Meyer 1991, Witzsch and Ambrose 1992).

(iv) Impacts on ecologically sensitive areas

The entire length of the Jorodane River can be considered an ecologically sensitive area. According to criteria listed below for stream assessment (MacMillan 1986), the river deserves a high conservation status of national significance:

* the river catchment processes are entirely without industrial development, only being modified to a very minor extent by riparian agricultural practices:
* the input of toxic and non-toxic pollutants into the system is negligible, mostly in the form of sediment;

* there are endemic species present in the river which are endangered or vulnerable, and
* there are no exotic or introduced species of fish present in the river.

A conservation programme for the Maluti minnow in the upper reaches of the Jorodane River has been proposed (Rall et al 1993) and plans are presently being considered for the declaration of the remote, uninhabited upper regions of the Jorodane valley as a national park (Dr Maema, LHDA Environment Division). The construction of the LCAR through this area as is proposed, would foreclose these conservation options.

A number of important wetlands would be traversed by the alignment of the LCAR. A major wetland at the source of the Jorodane River would be crossed for a distance of 500 m at the head of the Jorodane River, with smaller wetlands being crossed for the length of the Jorodane River, as the LCAR traverses the low-lying, and often marshy, valley floor. Damage to these wetlands would affect the hydrology and water quality, and in turn the ecological balances in the valley.

3.4.4 LOSS OF RESOURCES REQUIRING COMPENSATION

Western Access Route and Least Cost Alternative Route

(i) Loss of privately owned resources subject to compensation

The compensation costs associated with the WAR would be M 654 775 and including the Maseru bypass, M 1 572 935. The compensation costs of the LCAR would be M 973 761. A breakdown of these costs is given in Report EEU/2/93/104a - page 21, EEU/2/93/104b - page 71, and EEU/2/93/104c - page 79.

The LHDA is legally bound by Section 7(18) of the 1986 LHWP Treaty and by the Lesotho Highlands Water Project Compensation Regulation, 1990 (no. 50), to compensate individuals who lose or suffer damage to resources - such as built structures (houses, businesses, toilets, livestock stables), arable land, vegetable gardens, fruit and other trees, kraals and fences - as a result of any development associated with the LHWP. A compensation plan has been finalised by the LHDA (LHDA 1990b) for the efficient implementation of compensation in affected areas. Compensation requirements along the WAR and LCAR would mostly involve the replacement of building structures and the monetary remuneration of persons losing agricultural land. The replacement of structures is generally acceptable, despite complaints of cracked houses and poor insulation.

(ii) Interference with potable water supplies

Most villages are reliant on unprotected springs and potable water is already in scarce supply in many areas. Each village generally possesses one or more springs which serve as water collection points for the whole village. Rivers and streams in the immediate vicinity of villages are generally of poor quality from contamination by human and livestock excrement, and washing of clothes. The issue of potable water is one of major concern for villagers, and a high proportion of people mentioned the need for standpipes, properly protected springs or wells.

Road upgrading activities may cause immediate, direct destruction of springs, or delayed interference effects as a result of pollution by road runoff, altered drainage patterns or rock falls. Along the Katse road, 43 respondents in 6 villages commented that their source of water had been destroyed by the construction of the road, and 2 villages reported damage to their springs by rocks. Many respondents reported that it now took them longer to fetch water than before the road had been constructed.

The destruction of a village water point, without replacement, is a severe loss to the individuals of the affected village. LHDA compensation policy states that springs which are destroyed by actions associated with the LHWP would be replaced or substituted for (L Lekholoane, LHDA Environment Division, pers. comm.). Although water-points and hand operated pumps have been installed for villages along the recently constructed Katse Road, it is also true that a village's spring, destroyed during construction of the Katse road has not yet been replaced (J Raimondo, EEU, pers. comm.).

3.5 Incomplete or unavailable information:

During the EIA of the alternative routes, certain information concerning the overall Mohale Dam development and engineering specifics of road construction was not available to the study team. This placed limitations on being able to assess numerous secondary impacts and cumulative impacts which might arise from the development of either alternative.

Information concerning the overall plans or "Area Master Plan" (AMP) for the LHWP Phase 1B development were unavailable at the time of this study, as the area is presently being researched and the AMP is still to be finalised. Some information is provided in the 1986 Feasibility Study (KOL 1986), but much of this information is dated and is subject to change. The cumulative impacts associated with either alternative access road would be greatly influenced by the future plans for the entire Phase 1B area. Thus the full spectrum of impacts associated with the alternative access roads cannot be accurately assessed without such information, and the development of the access road should not be viewed in isolation of the overall plans for the area.

For example:

1. It is not known what feeder roads would be constructed in the area for communities that lose access routes as a result of flooding of the Senqunyane and Jorodane valley. Thus it is unknown if the people of the Jorodane valley who are presently in need of a road, might not be adequately serviced by a feeder road from the Mohale Dam.

2. It is not known how many people would relocate onto higher lying areas up the Jorodane River valley, resulting in increased pressures on land for agricultural and food resources, and thus, increasing the need for easier access to food aid or commercially available foodstuffs.

3. It is not known what tourism facilities would be located at the Mohale Dam and what the purpose or attractions of such facilities would be, i.e. nature conservation or high convenience, money-spinning luxury hotels, "wilderness" experiences or scenic drives.

Information on the location of quarry sites, borrow pits and construction camps for the construction of the LCAR was not available from GBJV.

The brief of the study limited the investigation of the WAR to the Maseru bypass and the section of the Mountain Road between St Michael's and Patiseng. The environmental impacts associated with upgrading the stretch of road between Maseru and the turnoff at St Michael's (approximately 20 km of road) (see Map 1 - stippled green line) was not investigated by this study. This information may prove to be an important consideration in the overall development of the WAR as the access road to the Mohale Dam site.

CHAPTER FOUR

The comparative evaluation of the alternative access routes.

4.1 Overview

This chapter presents the comparative evaluation of the WAR and the LCAR in terms of the environmental criteria of efficiency, equity and sustainability. The trade offs associated with the selection of either of the routes above the other, are discussed.

4.2 Introduction

The evaluation of alternatives and the selection of a preferred action is the central component in decision making for development (Lahlou and Canter 1993). The purpose of the comparative evaluation of the impacts associated with the WAR and the LCAR, is (i) to weigh the information available and (ii) to recommend a preferred alternative route which will provide the greatest benefit to society and result in the least cost to present and future generations (DEA 1992, TEAM 1992).

The concept of "costs" and "benefits" originates in the economic valuation method of cost-benefit analysis (CBA), which involves expressing benefits and costs associated with a development in monetary terms, where possible, and quantifying a net valuation of economic costs and benefits/profits (Pearce 1983). It is increasingly recognised by decision makers that the full spectrum of costs and benefits associated with a development cannot be reduced to financial terms for quantitative analysis, and that environmental costs and benefits must be considered in qualitative terms (Tisdell 1990, Randall 1991, Stauth et al 1993).

It is also recognised that the purpose of the evaluation of alternatives is not only to identify that alternative which results in the greatest number of benefits, but also to identify how costs and benefits are distributed amongst groups in the present-day society, and how they would be distributed between present and future generations (Costanza and Daly 1992, Stauth *et al* 1993). Stauth (1989) refines this in the statement that **"the goal of resource allocation is to achieve the highest possible level of social well-being over a time period spanning multiple generations"** (p. 59), where

* *social well-being* is defined where "a society is better off as more of its members satisfy their true, biologically-determined basic needs, and social well-being would be maximised when all of its members have attained self-actualisation" (p.59), and;

* *multiple generations* is defined to "encompass all posterity and so extend the time horizon of concern into the indefinite future on the assumption that (1) social progress can and should be perpetuated, and (2) the welfare of remote generations is inherently as important as that of present generations" (p.59).

Stauth (1989) and Stauth *et al* (1993) propose that the objectives and criteria which should guide decision-making in the evaluation of alternatives and the implementation of project actions, best be defined as:

* the decision should have the **objective** to maximise the efficiency, equity and sustainability of the resource use or development, and
* the **criteria** used to evaluate alternatives and proposals are efficiency, equity and sustainability.

The **efficiency criterion**:
An action should be efficient i.e. total benefits resulting from the project action should exceed total costs, and those who benefit from the action could potentially compensate those who bear the costs, and still be better off.

The **equity criterion**:
An action should be equitable i.e. benefits and costs resulting from the project should be fairly distributed across the different groups of the present-day society affected by the development. The equity criterion is reflected in the 1986 Lesotho Highland Water Treaty, Article 7(18):

> *...members of the local communities in the Kingdom of Lesotho, who will be affected by...Project related causes will be enabled to maintain a standard of living not inferior to that obtaining at the time of first disturbance.*

If the gainers compensate the losers so that the distribution of costs and benefits remains the same or improves, the action is considered both efficient and equitable.

The **sustainability criterion**:
An action should be sustainable i.e. the proposed development action should be able to provide a net benefit to society over intergenerational time periods. Future generations should be able to enjoy the same level of welfare as enjoyed by members of present-day society. Sustainability also requires that long-term ecological productivity or carrying capacity of a natural system is not traded-off for short-term economic gain or project needs. The sustainability criterion is reflected in the 1986 Lesotho Highlands Water Project Treaty, Article 15:

> *...the implementation, operation and maintenance of the Project are compatible with the protection of the existing quality of the environment and in particular shall pay due regard to the maintenance of the welfare of persons and communities immediately affected by the Project.*

It is very unusual that all three criteria can be maximised simultaneously. The criteria trade-off technique (Stauth *et al* 1993), is concerned with the systematic comparison of the effects of

project alternatives in terms of the criteria of efficiency, equity and sustainability. The judgement of the preferred alternative should be directed at the best overall outcome, and the process must be explicit and open where subjective value judgements are applied. The decision should satisfy the development needs, without compromising environmental considerations and the objective of achieving the highest level of social well-being possible.

4.3 Method of comparative evaluation

4.3.1 The cost-benefit framework for the comparison of the alternative routes.

The key impacts associated with each alternative, identified in Chapter Three, are listed as key "benefits" or "costs", depending on whether the impact is rated positive or negative, respectively.

4.3.2 The evaluation of alternatives according to the criteria of equity, efficiency and sustainability.

The identification of impacts as costs and benefits facilitates the assessment of the efficiency of the alternatives. If benefits are found to outweigh the costs, the action is efficient. The equity and sustainability evaluation enables the assessment of how the benefits and costs of the WAR and the LCAR are distributed amongst the affected communities.

4.3.3 Trade-offs associated with the two alternatives

The trade-offs associated with the choice of either one of the alternative routes above the other are listed and discussed.

4.4 The key costs and benefits associated with the WAR and the LCAR.

Western Access Route:
The key benefits of the development of the WAR are:

* Upgrading of the first 60 km of the Mountain Road would further Lesotho road network planning priorities, enhancing the prospects of the complete upgrading of the Mountain Road to Thaba-Tseka.
* The Lesotho government would "save" in excess of M 10 million on the costs of upgrading the first 60 km of the Mountain Road. Real savings of approximately M 2.7 million would accrue to the Lesotho Roads Department, as maintenance of this stretch of road would be done by LHDA during the 5 years of construction of the dam.

* Traffic congestion in Maseru would be reduced by the construction of a bypass, which will benefit a large number of people in Maseru and passing through Maseru.
* The development of a railhead in Maseru would promote economic investment in Maseru.
* Road safety for people presently using the Mountain Road would be greatly increased and vehicle operating costs (VOC) would be decreased by the upgrading of the present, poorly maintained, road.
* Development of the WAR would not result in any highly significant negative impacts on the biophysical environment.

The key costs of the upgrading of the WAR are minimal, and can be mitigated:
* The disturbance of 5 water points.
* Traffic congestion along the WAR at construction points during upgrading.
* Social disturbance of villages situated close to construction camps for the period of the camps presence.

Least Cost Alternative Route:
Only one key benefit associated with the construction of the LCAR was identified:
* The LCAR would provide socio-economic benefits to the remote, rural population living in the Jorodane valley who are presently without any road.

The construction and operation of the LCAR would, however, result in numerous environmental costs of national and local significance:
* The LCAR would detract from, rather than enhance, national road network priorities, in particular, from the priority of the upgrading of the Maseru-Thaba-Tseka road.
* The LCAR would have high maintenance costs and place an additional burden on the national road maintenance budget.
* The presence of a high speed road through the Jorodane valley would result in severe social disturbance of the communities' present way of life.
* The alignment of the road would destroy 4 water points.
* The presence of a road in the valley would disrupt the local informal economy.
* The LCAR would result in highly significant negative biophysical impacts, in particular hydrological impacts and the disturbance of wetland systems.
* The LCAR could threaten the local extinction of the endangered Maluti minnow, found to occur in the Jorodane River, and a population of the endangered spiral aloe existing near Soosa, 1.5 km from the proposed road alignment.

4.5 Applying the equity, efficiency and sustainability tests.

4.5.1 The efficiency test

In determining efficiency, two questions need to be asked:

* Do the benefits of an alternative outweigh its costs?
* If this is true for both alternatives, are the benefits of one alternative greater than the benefits of another?

The Western Access Route:

Using the cost-benefit listing in 4.4 above, the total benefits associated with the development of the WAR and the associated Maseru bypass outweigh the total costs for this alternative. Furthermore, the costs can be relatively easily compensated for or mitigated. Thus the action of upgrading the WAR is efficient.

The Least Cost Alternative Route:

In the consideration of the LCAR, the key costs of construction of the LCAR appear to greatly outweigh the benefits to local communities associated with the LCAR. However, the local communities of the Jorodane valley have repeatedly stated that the overall socio-economic benefits would greatly outweigh the costs of the road. Many of the costs, however, would not be easily mitigated or compensated for (e.g. biophysical impacts, maintenance of a little used road) and would impact on national levels rather than local scales. The action of constructing the LCAR is considered to be inefficient.

Summary:

The development of the WAR would result in a net overall benefit, whilst the development of the LCAR, although of benefit to the local people of the area, would result in a net national and local cost.

4.5.2 The equity test

The following questions need to be asked in determining equity:

* How are the costs and benefits associated with each alternative distributed?
* Are some groups of people losing or benefitting disproportionately in comparison to others?
* Which alternative would result in benefits affecting more people and being more evenly distributed.
* Are the costs more evenly spread in the choice of one alternative above the other?

The Western Access Route:

The WAR is well utilised road by both local people and tourists. The 1992 average daily traffic (ADT) in the lowlands is given as 352 vehicles (4% buses), and 85 vehicles in the highlands

(9% buses) (Report EEU/2/93/104b). People also use the roadside as a place of trade, selling fruit and handcrafts to passers by at stopping places. All present road users and traders would benefit from upgrading the WAR, by either improved safety, decreased vehicle operating costs or more traffic for roadside trade. Using estimations of 220 vehicles (average between 352 and 85), 4 people per vehicle (includes buses) and approximately 3 500 persons living along the WAR, the approximate total number of people who would benefit by the upgraded WAR is 4 300. This excludes people who would in future begin to use the WAR because of improved conditions.

The bypass of Maseru associated with the WAR would alleviate traffic congestion in Maseru and extend the paved road network of the city, benefitting both road users and people using the road service extension. The possible construction of a railhead in Maseru would provide job opportunities and may increase economic investment in Lesotho, which would be of benefit to numerous people. It is estimated that 1 000 - 2 000 light motor vehicles would use the bypass route through Maseru daily. If an average of 2 people per vehicle is assumed, the bypass could benefit between 2 000 and 4 000 people per day. It is not feasible to quantify the number of people directly and indirectly benefitted in Maseru by the railhead as the provision of the railhead is uncertain.

Thus the immediate benefits of the WAR and the Maseru bypass would be felt by 6 000 - 8 000+ people per day. Furthermore, upgrading of the WAR would further government plans to upgrade the full stretch of Mountain Road between St Michael's and Thaba-Tseka. Thus the benefits of developing the WAR may be transferable to people living beyond the Mohale Dam site, as far east as Thaba-Tseka. Also by upgrading the WAR, the Lesotho Roads Department would save monies which would have been spent on maintenance of the WAR during the 5 year period of construction. These monies could be made available for maintenance of other roads in Lesotho. This would benefit those persons using the roads maintained by redirected funds.

During construction of the WAR and the 5 year construction period of the dam, the major costs would incur to road users and roadside dwellers. These costs would involve the inconvenience of traffic delays at construction points, the construction of detours and diversion of traffic onto detour roads, and an increase in the ADT volume of 80 - 200 vehicles, 16% of which are predicted to be heavy vehicles. Social costs associated with the presence of construction laborers would be localised in the villages near the construction camps. Water points which are destroyed should be substituted for, but in the event that they would not be, the costs would fall heavily on the village using the water point.

The Least Cost Alternative Route:

The key benefit associated with the LCAR is the provision of a road to communities who are presently without one. 2 000 - 3 000 people, presently resident in the Jorodane valley and Pulane basin, have to walk or ride for 2-5 hours before they have access to a good road with public transport. The benefits of constructing a new road in these unserviced areas are extremely localised and accrue, disproportionately, to these remote communities only.

Alternatively, it could be viewed that as those people living along the Mountain Road already have a road, the costs of *not* constructing the LCAR are disproportionately carried by the Jorodane valley communities.

On a national scale, there would be new road users who might benefit from the LCAR as a tourist or trade route, but the number of new road users is not likely to be very high. The region is remote from regional service centres and established tourist amenities. Key costs associated with the long term maintenance of the LCAR would incur to the Government of Lesotho.

Costs to the biophysical environment of the Jorodane valley ultimately affects the future generations of communities living in the Jorodane valley. The Jorodane valley residents are adamant that such costs, as well as the social costs associated with social disruption, the destruction of springs and the presence of labour camps, would not outweigh the potential benefits of a road in the valley.

Summary:
Overall, the development of the WAR is more equitable than the development of the LCAR for the following reasons:

* The WAR would benefit more people than the LCAR.

* The benefits of the WAR would be more widely distributed than the LCAR.

* The costs of the WAR would be more equitably carried by all road users, although social costs are inequitably carried by certain communities exposed to labour camps. Such costs could be mitigated. The costs of the LCAR would be inequitably carried by those communities exposed to labour camps and the traffic of strangers for the first time, the Government of Lesotho, and the biophysical environment. Ecological costs would be inequitably carried by future generations.

4.5.3 The sustainability test

In determining sustainability, the following questions are asked:

* Does the development meet the needs of the present society without jeopardising the ability of future generations to meet theirs?
* What are the irreversible effects of the development and could these effects foreclose any options for future generations?
* Does the development impact on the ecological integrity of the affected natural systems, and if so would the continued productivity of the system be in any way impaired.

The primary needs of the present and future generations are quality of life and the ability to secure a livelihood (Gale 1991, Gardner 1989). Quality of life is typically difficult to define,

but for the purposes of this evaluation, the combination of criteria as they appear in the 1986 LHWP Treaty, of "...standard of living not inferior to that obtaining at the time of first disturbance" and "...quality of the environment...(for) the maintenance of the welfare of persons and communities", would be adopted.

It is assumed that future generations cannot afford a decision by the present generation that may foreclose their options of preserving the earth's species and the few remaining places of outstanding natural beauty of high conservation status (Hill 1984).

The Western Access Route:

The improvement of a national road such as the Mountain Road, would improve existing services, and promote economic and tourism opportunities along this road. These benefits would be carried over to future generations. The standard of living of persons living along the WAR would be increased by improved road and safety conditions (reduces mud and dust, wider road and verge), improved economic opportunities (businesses) and new and improved services. The environment would not suffer any additional degradation, as the road exists and has already impacted on the environment. The ability of future generations to meet their needs would not in any way be reduced by the upgrading of the WAR.

The Maseru bypass associated with the selection of the WAR as the access route, and the possible railhead in Maseru, are all long-term improvements of the Lesotho capital's services and efficiency. Future long-term problems could arise, however, if urban growth is not associated with improved services.

No highly significant ecological impacts are predicted for the development of the WAR. This would be of benefit to future generations, who typically bear the long-term costs of any severe ecological damage resulting from a development (Norton 1989).

The Least Cost Alternative Route:

The presence of a road in the Jorodane valley would enable the present and future generations to improve their material standard of living, have better access to services and be more easily able to secure food aid or commercial foodstuffs during years of poor harvest. These improvements in convenience and medical care would be beneficial for future generations.

It is possible that the LCAR would be poorly utilised and fall into disrepair following the construction of the dam. Thus future generations may not receive the level of benefits perceived by the present-day generation. With the presence of a road, however, future generations would have a greater level of choice and exposure to alternative lifestyles. Such opportunities do not exist in the absence of a road, where rural life is isolated from urban and foreign influences and centred around daily domestic chores.

However, social costs are also likely to be associated with a road through this presently peaceful area. Increased social disorder and loss of social identity, crime, stock theft,

alcoholism and the widening of the gap between rich and poor have all been identified as potential impacts of a new road. The degradation of a functional social order is inevitably suffered by future generations, who are born into a more violent society.

The construction of the LCAR would represent the first development in a remote, mountainous area. This represents an irreversible alteration of the landscape and natural scenic beauty of the area. A conservation proposal is in preparation for establishing a national park in the remote, uninhabited areas of the upper Jorodane valley and Maluti Mountain range. The benefits associated with increased tourism to the area and the long-term conservation of an area of great natural beauty, would accrue to future generations. The construction of the LCAR through this area would foreclose these conservation options to future generations.

The destruction of wetlands and increased siltation of the Jorodane River would be unavoidable with the construction of the LCAR. Severe hydrological impacts may threaten an endangered species, the Maluti minnow, with local extinction, and cause a general decline in the ecological functioning of the entire catchment system. A conservation programme for the continued survival of the Maluti minnow in the upper reaches of the Jorodane River has been proposed. This proposal would not be viable if the LCAR were to be constructed. Although the minnow is of no present-day value to communities in the Jorodane valley, it cannot be assumed that future generations would not value its continued existence in the Jorodane River.

An ecological equilibrium exists presently exists in the Jorodane valley. The area is subject to some erosion resulting from poor agricultural practices and overgrazing of the grasslands. Construction of a road through the valley would inevitably increase soil loss through erosion for some years following road construction. Further changes in ecological balances could result from altered agricultural practices where communities have access to mechanised ploughing or fertilizer application for the first time. Such changes would alter ecological balances irreversibly, possibly resulting in the long-term decline of the productivity of the system.

Summary:
The WAR would be a more sustainable alternative than the LCAR for the following reasons

* The WAR would provide for the present-day generation without jeopardising the ability of future generations to meet their needs. The LCAR would provide for present-day generations, but would involve social and ecological costs which would negatively effect future generations.

* Upgrading of the WAR would be a long-term improvement of, and investment in, the existing national road network and social infrastructures. The LCAR would be a new development in a natural and rural area. No other developments presently exist in the remote mountainous regions, and the existing natural habitats and character of the area would be irreversibly altered.

* The upgrading of the WAR would not foreclose any future options for different land use or conservation of endangered species and undeveloped areas, as the road already exists. The LCAR could threaten an endangered species in the Jorodane River with possible local extinction and would foreclose the conservation options for a sanctuary stream and a national park in the upper reaches of the Jorodane valley.

* The WAR would not result in any significant ecological impacts. The proposed alignment of the LCAR would significantly alter hydrological and ecological balances in the Jorodane valley, possibly reducing biological productivity in the long-term.

4.6 Trade-offs associated with the alternative routes

In the choice of the WAR as the access route, three main trade-offs would be made.

1. The opportunity for the construction of a new, well engineered road in Lesotho, which would service remote people, presently without paved road access, would be lost.
2. The people of the Jorodane valley, in the absence of the existing track being upgraded, would be forced to continue living under their present difficult conditions, without access to improved services and opportunities.
3. Traffic congestion and some disturbance of local communities between St Michael's and Likalaneng would be likely to occur during the period of road reconstruction.

In the choice of the LCAR as the access route, the trade-offs are numerous.

1. The national planning priorities of road networks and settlement planning would be contradicted, rather than enhanced.
2. The Government of Lesotho would lose the benefits of having the first 60 km of the Mountain Road upgraded at the expense of LHDA, and would have to carry the costs of maintaining the Mountain Road during dam construction, and both roads once dam construction is completed.
3. The presence of a new road which is poorly utilised by the general traffic, may prove to be more of a national burden in terms of long-term road maintenance costs, than of benefit.
4. The city of Maseru would not benefit by the construction of the bypass and railhead, with the associated economic benefits.
5. The communities and existing facilities along the Mountain Road would not benefit by improved access and services.
6. The affected area of the Jorodane River valley is a sensitive ecological area of national importance, in that it forms a primary catchment for the proposed Mohale dam. Biophysical impacts, both primary and secondary, resulting from construction and operation of the LCAR would increase siltation of the Jorodane River and reduce the water quality exiting from the system.

7. The siltation of the Jorodane River could threaten an endangered species (the Maluti minnow) with local extinction, and the presence of a road could cause the exploitation of an undisturbed spiral aloe population for roadside sale.
8. The presence of a road in the upper regions of the Jorodane valley would irreversibly change the nature of the regions, and foreclose future options for conservation and establishment of a national park, and the associated tourism opportunities.

CHAPTER FIVE

Conclusions and recommendations

5.1 Conclusions

In terms of environmental evaluation criteria and the analysis of trade-offs, the WAR is the preferred alternative route for access to the Mohale Dam.

The WAR would result in numerous long-term benefits which would accrue locally and nationally. The costs associated with the WAR would likely be minimal, as mosts negative impacts have already occurred due to the fact that the road already exists.

The benefits associated with the LCAR would accrue disproportionately to a few people in the Jorodane valley. A new road would result in long-term costs, both nationally and locally. The construction of a road through the Jorodane valley would foreclose options for alternative land use of the area, such as a National Park in a remote mountainous area of outstanding natural beauty.

5.1.1 The evaluation of the alternatives

The efficiency test

The development of the WAR would result in benefits of national significance, in addition to those directly associated with the upgrading of the WAR and the bypass in Maseru. The development of the LCAR, although of benefit to the local people residing in the immediate area, would result in costs of national and local significance.

Upgrading the WAR would be more efficient than the development of the LCAR.

The equity test

The development of the WAR would more equitable than the development of the LCAR for the following reasons:

* Upgrading the WAR would benefit more people than the construction of the LCAR.

* The benefits of the WAR would be more widely distributed than the LCAR.

* Many of the costs associated with the WAR could be compensated for, whilst those associated with the LCAR could not.

The sustainability test

The WAR would be a more sustainable alternative than the LCAR for the following reasons:

* The WAR would provide for the present-day generation without jeopardising the ability of future generations to meet their needs. The LCAR would provide for present-day generations, but would involve social and ecological costs which would negatively effect future generations.

* Upgrading the WAR would be a long-term improvement of, and investment in, the existing national road network and social infrastructures. Upgrading the WAR would reinforce national planning objectives and would therefore benefit the entire country in the long-term.

* The LCAR would be a new development in a natural, rural area. No other developments presently exist in the remote mountainous regions, and the existing natural habitats and character of the area would be irreversibly altered. Future generations might place higher value on areas of great natural beauty than the present generation.

* Upgrading the WAR would not foreclose any future options for different land uses such as the conservation of endangered species and undeveloped areas. The LCAR could threaten an endangered species in the Jorodane River with possible local extinction and would foreclose the conservation options for a sanctuary stream and a National Park in the upper reaches of the Jorodane valley.

5.1.2 Main trade-offs associated with the alternatives

Only one major trade-off would be associated with the selection of the WAR as the access route.

1. The people of the Jorodane valley, who are presently without a road, would have to continue living without vehicular transport to services, in particular, emergency services.

In the selection of the LCAR, five main trade-offs have been identified:

1. National planning priorities would not be realised.

2. Future national costs of road maintenance would be high, on a potentially seldom-used road.
3. People presently using the WAR would have to continue to use an unsafe, poor quality road.
4. The Maseru bypass would not be constructed. Thus Maseru would not receive the associated benefits of the bypass.
5. Future options for conservation and the associated benefits of tourism in the Jorodane valley and Maluti mountains would be foreclosed by the construction of the LCAR.

5.2 Recommendations

The following nine recommendations are made:

1. **Preferred alternative:** The Western Access Route is recommended as the preferred access road to the Mohale dam site, in terms of environmental criteria.

2. **Environmental management:** The actions for optimisation of positive impacts and mitigation of negative impacts associated with the upgrading of the WAR, as recommended in Report **EEU/2/93/104b**: Appendices 3, 4, 5 and 9, should be implemented in full during, and following, construction activities.

4. **Project planning:** Integrated Environmental Management and consultative planning should be continued throughout the construction period. This is particularly important with respect to the participation of affected communities, in order assess whether compensation for resources lost as a result of the development, is adequate. Project planning should consider tourism development with respect to the existing tourist facilities along the WAR, to Thaba-Tseka.

3. **Project alternatives:** In the event that the WAR is not selected by the Joint Permanent Technical Commission (JPTC) as the preferred alternative route, it is strongly recommended that the identification of alternatives be reconsidered. The results of this EIA clearly show that a major road running north-south through the Jorodane valley is not a viable option.

4. **Area Management Plan:** The development of the WAR should not be considered in isolation of the development plans for the entire Phase 1B area. It is recommended that the Area Management Plan (AMP) be developed for the Phase 1B region in conjunction with the planning process for the selected access route.

5. **Further studies:** The section of road between Maseru and St. Michael's should be assessed in similar detail to the EIA for the WAR, in terms of environmental impacts and compensation requirements.

6. **Provision for disadvantaged communities:** It should be recognised that the people of the Jorodane valley are in need of a road. It is recommended that a feeder road be provided by the LHDA from the Mohale dam site to communities in remote regions of the Jorodane valley. Alternatively, the track which presently exists between Thaba Putsoa on the Mountain Road, and Ha Rapokoloane in the Jorodane valley, should be upgraded to an all-weather road.

7. **Maseru bypass:** The Maseru bypass should be constructed prior to the commencement of construction of the Mohale Dam (1997), in order to avoid the passage of heavy construction vehicles through the central business district of Maseru.

8. **Selection of the LCAR:** In the event that the LCAR be selected by the JPTC as the preferred alternative, further planning of this route should not proceed without a more detailed environmental impact assessment of the affected area.

9. **Rural development:** It is recommended that rural development programmes be timeously implemented in the regions affected by the selected alternative. Such actions would be necessary for the affected communities to be able to realise fully the potential socio-economic benefits associated with the access road development.

REFERENCES

Beanlands G 1986. Scoping methods and baseline studies in EIA. In: *Environmental Impact Assessment : Theory and practice.* P Wathern (ed.). London: Unwin Hyman Publishers. p. 33-46.

Bisset R 1986. Developments in EIA methods. In: *Environmental Impact Assessment : Theory and practice.* P Wathern (ed.). London: Unwin Hyman Publishers. p. 47-60

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.

Canter L W, Robertson J M and Westcott R M 1991. Identification and evaluation of biological impact mitigation measures. *Journal of Environmental Management.* **33**: 35-50.

Costanza R and Daly H E 1992. Natural capital and sustainable development. *Conservation Biology* **6**(1): 37-46.

Council for the Environment 1989. *Integrated Environmental Management in South Africa.* Joan Lotter Publications, Pretoria.

De Jonge P 1986. Uncertainty in EIA. In: *Environmental Impact Assessment : Theory and practice.* P Wathern (ed.). London: Unwin Hyman Publishers. p. 62-83.

Department of Environment Affairs 1992. *Integrated Environmental Management guideline Series 1 - 6.* Department of Environment Affairs, Pretoria, South Africa.

Donnay, T. J. and Meyer, K. 1991. The distribution and status of the endemic spiral aloe, *Aloe polyphylla* in Lesotho. *Excelsa* **15**: 29-34.

Elkin T J and Smith P G R 1988. What is a good environmental impact statement? Reviewing screening reports from Canada's National Parks. *Journal of Environmental Management* **26**: 71-89.

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

Fuggle R F 1989. Integrated environmental management: An approach to environmental concerns in developming countries. *Impact Assessment Bulletin* **8**: 31-46.

Gale R J P 1991. Environment and development: Attitudinal impediments to policy integration. *Environmental Conservation* **18**(3): 228-236.

Gardner J E 1989. Decision making for sustainable development: Selected approaches to environmental assessment and management. *Environmental Impact Assessment Review* **9** : 337-366.

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

Graybill D L 1985. If environment impact assessment is everything, maybe it's nothing - some arguments for more attention to practical aspects of implementation. *The Environmental Professional* 7(4): 344-351.

Hill R C 1984. *Environmental evaluation of proposed main road No. 28 from Die Dam to Struisbaai.* School of Environmental Studies, University of Cape Town.

Hill R C and Fuggle R F 1988. IEM of development in South Africa. *Paper presented at 8th Quintennial Convention of South Africa.*

Hollick M 1986. Environmental Impact Assessment: An international evaluation. *Environmental Management.* **10**(2): 157-178.

Htun N 1986. The EIA process in Asia and the Pacific region. In: *Environmental Impact Assessment : Theory and practice.* P Wathern (ed.). London: Unwin Hyman Publishers. p. 225-238.

Kennedy W V 1986. Environmental impact assessment and bilateral development aid: an overview. In: *Environmental Impact Assessment : Theory and practice.* P Wathern (ed.). London: Unwin Hyman Publishers. p. 272-285.

Kingdom of Lesotho (KOL) 1986. Lesotho Highland Water Project: Feasibility Study. Supporting Report G Infrastructure: Annex G3 - Phase 1B Infrastructure. (Lahmeyer Macdonald Consortium & Oliver Shand Consortium). April 1986.

Lahlou M and Canter L W 1993. Alternatives evaluation and selection in developmental remediation projects. *Environmental Impact Assessment Review.* **13**: 37-61.

Lee N 1982. The future development of Environmental Impact Assessment. *Journal of Environmental Management.* **14**: 71-90.

LHDA 1990 (a). *Lesotho Highlands Water Project - Environmental Action Plan: A synopsis of studies and proposed programmes.* LHDA May 1990.

LHDA 1990 (b). *Lesotho Highlands Water Project Compensation Plan: Phase 1A.* LHDA.

Lim G-C 1985. Theory and practice of EIA implementation: A comparative study of three developing countries. *Environmental Impact Assessment Review* 5(2): 133-156.

Lowry K and Carpenter R A 1985. Institutionalizing sustainable development: Experiences in five countries. *Environmental Impact Assessment Review* 5(3): 239-256.

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, Chisholm, Institute of Technology, Australia.

McAuslan P 1987. The Lesotho Highlands Water Project and Environmental Law: A case study in the light of "Our Common Future". *Lesotho Law Journal* 3: 41-65.

Medical Research Council (MRC) 1992. Visit to Lesotho (18-23 October 1992) at the request of the Lesotho Highlands Development Authority. Trip report: by J W van der Spuy.

Ministry of Planning, Economics and Manpower Development 1993. Lesotho Fifth Five-year Plan (final draft), Maseru.

Norton, B. G. 1989. Intergenerational equity and environmental decisions: a model using Rawls' veil of ignorance. *Ecological Economics* 1:137-159.

Rall J L 1992. *An ecological study on the Maluti Minnow, Pseudobarbus quathlambae, in the catchment area of Phase 1B of the Lesotho Highlands Water Scheme.* Progress Reports, November 1991 to September 1992. Rand Afrikaans University, Johannesburg.

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

Randall, A. 1991. The value of biodiversity. *Ambio* 20(2): 64-68.

Sowman M, Fuggle R and Preston G 1993. A review of the evolution of environmental evaluation procedures in South Africa. *Environmental Impact Assessment Review.* In press.

Stauth R B 1989. *An environmental evaluation methodology for improving resource allocation decisions: A treatise with selected South African studies.* Ph. D thesis, Department of Environmental and Geographical Scienc, University of Cape Town, South Africa.

Stauth R, Sowman M and Grindley S 1993. The panel evaluation method: An approach to evaluating controversial resource allocation proposals. *Environmental Impact Assessment Review.* **13**: 13-35.

Thoahlane T 1991. *The missing link in developing Phase IA for the Lesotho Highlands Water Project.* Ph. D. thesis, Graduate School of Arts and Sciences, Columbia University, New York.

Thompson M A 1990. Determining impact significance in EIA: A review of 24 methodologies. *Journal of Environmental Management* **30**: 235-250.

Tisdell, C. 1990. Economics and the debate about preservation of species, crop varieties and genetic diversity. *Ecological Economics* **2**:77-90.

Transportation Environmental Appraisal Manual (TEAM) 1986. Scottish Transportation Board.

Wathern P 1986. An introductory guide to EIA. In: *Environmental Impact Assessment : Theory and practice.* P Wathern (ed.). London: Unwin Hyman Publishers. p. 3-28.

WCED (World Commission on Environment and Development) 1987. *Our Common Future.* Oxford University Press, Oxford, England.

Witzsch G and Ambrose D 1992. *Lesotho environment and Environmental law.* National University of Lesotho, Roma, Lesotho.

World Bank Technical Paper 1991. *Environmental Assessment Sourcebook: Vol I - Policies, procedures, and cross-sectoral issues.* Technical Paper no. 139, Environment Department, The World Bank, Washington, United States of America.

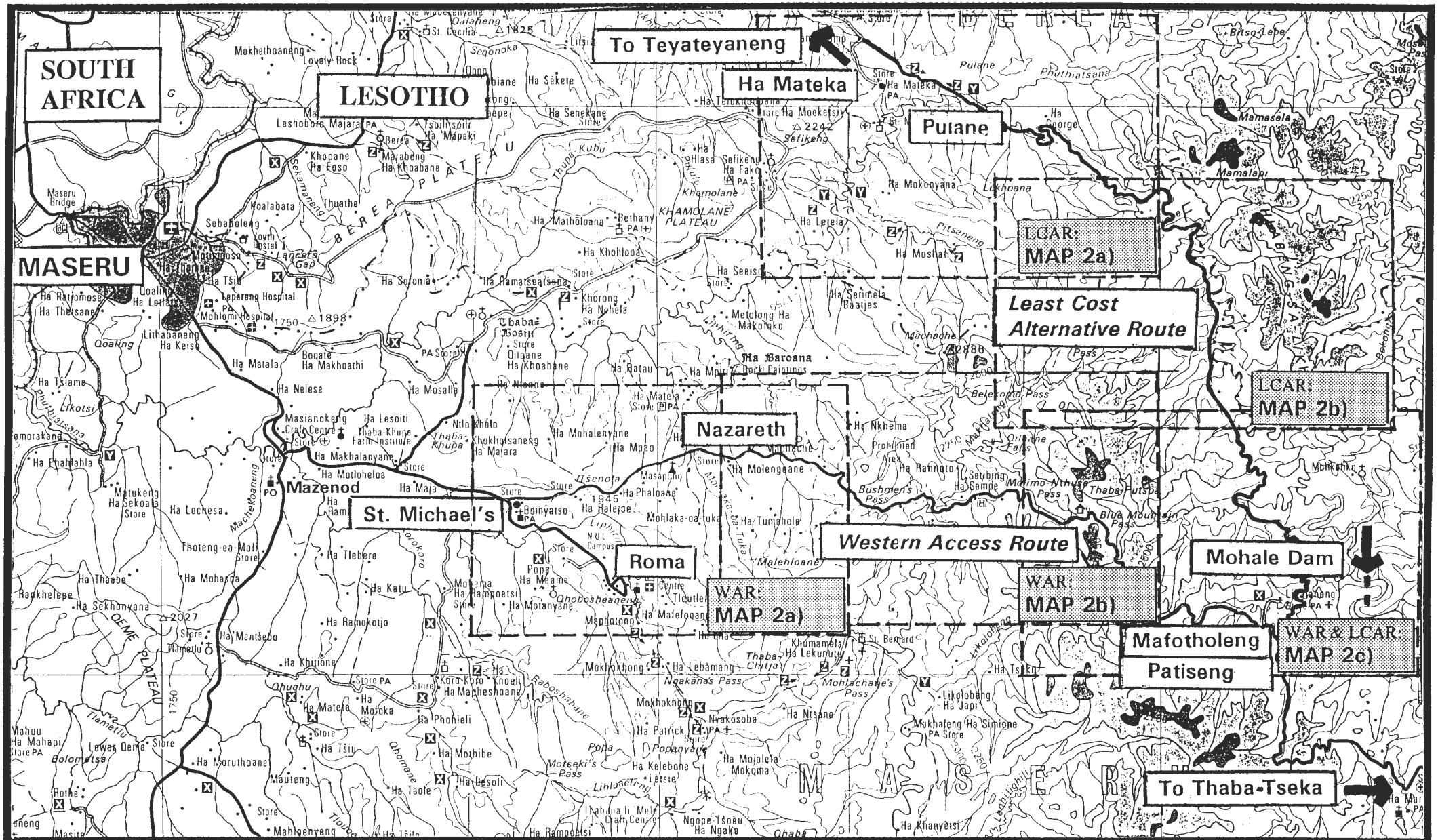
APPENDIX ONE

The detailed maps of the alignments of the alternative access routes

Note:

A location map (Map 2) is provided to show the location of the two routes relative to the 1:50 000 maps of the WAR and the LCAR.

There are three maps (2a, 2b and 2c) for both alignments.



MAP 2: POSITION OF 1:50000 MAPS

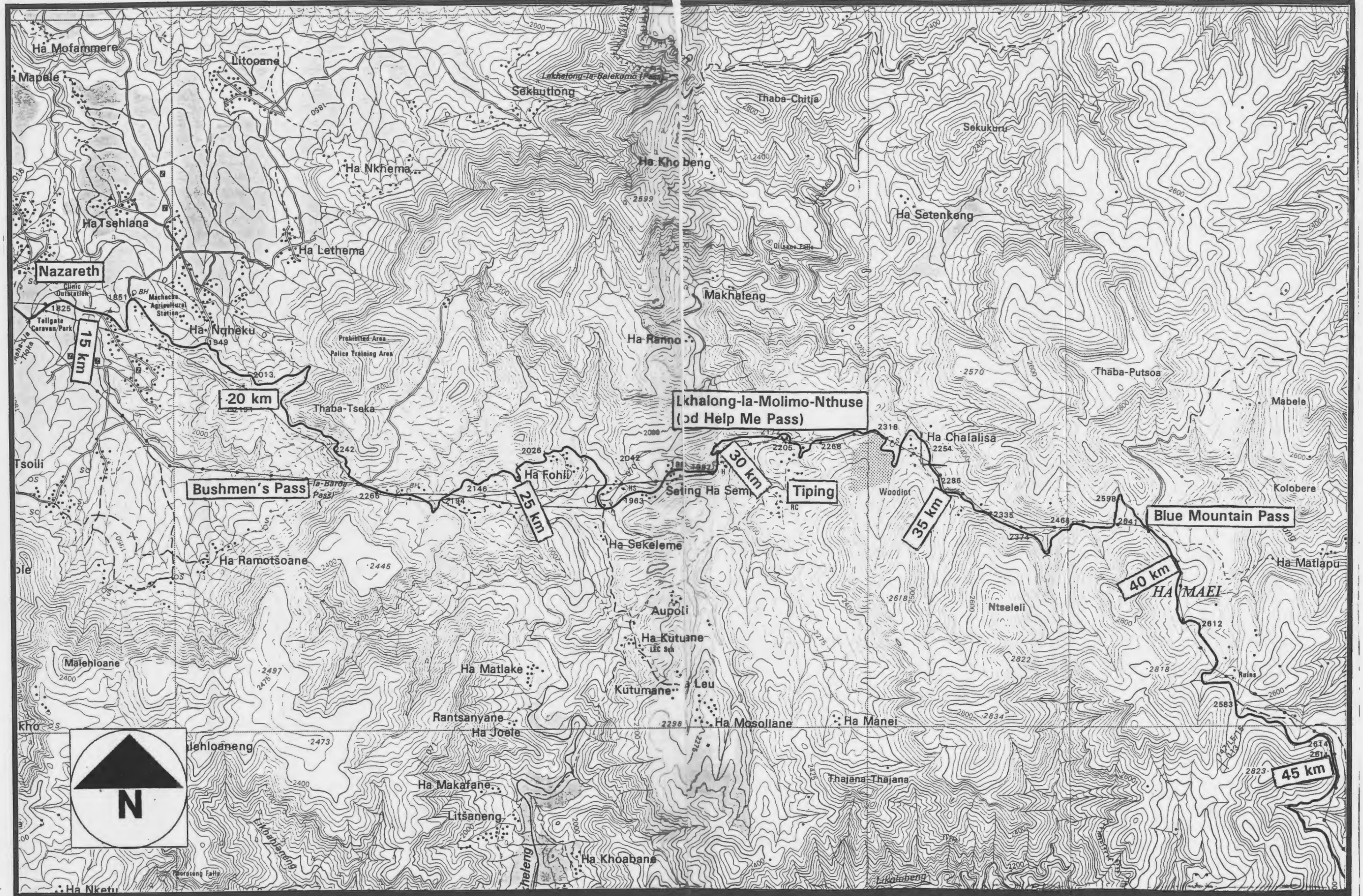
Scale 1:250000

W

The Western Access Route

MAP 2a) ALIGNMENT OF WESTERN ACCESS ROUTE

Scale 1:50000



MAP 2b) ALIGNMENT OF WESTERN ACCESS ROUE

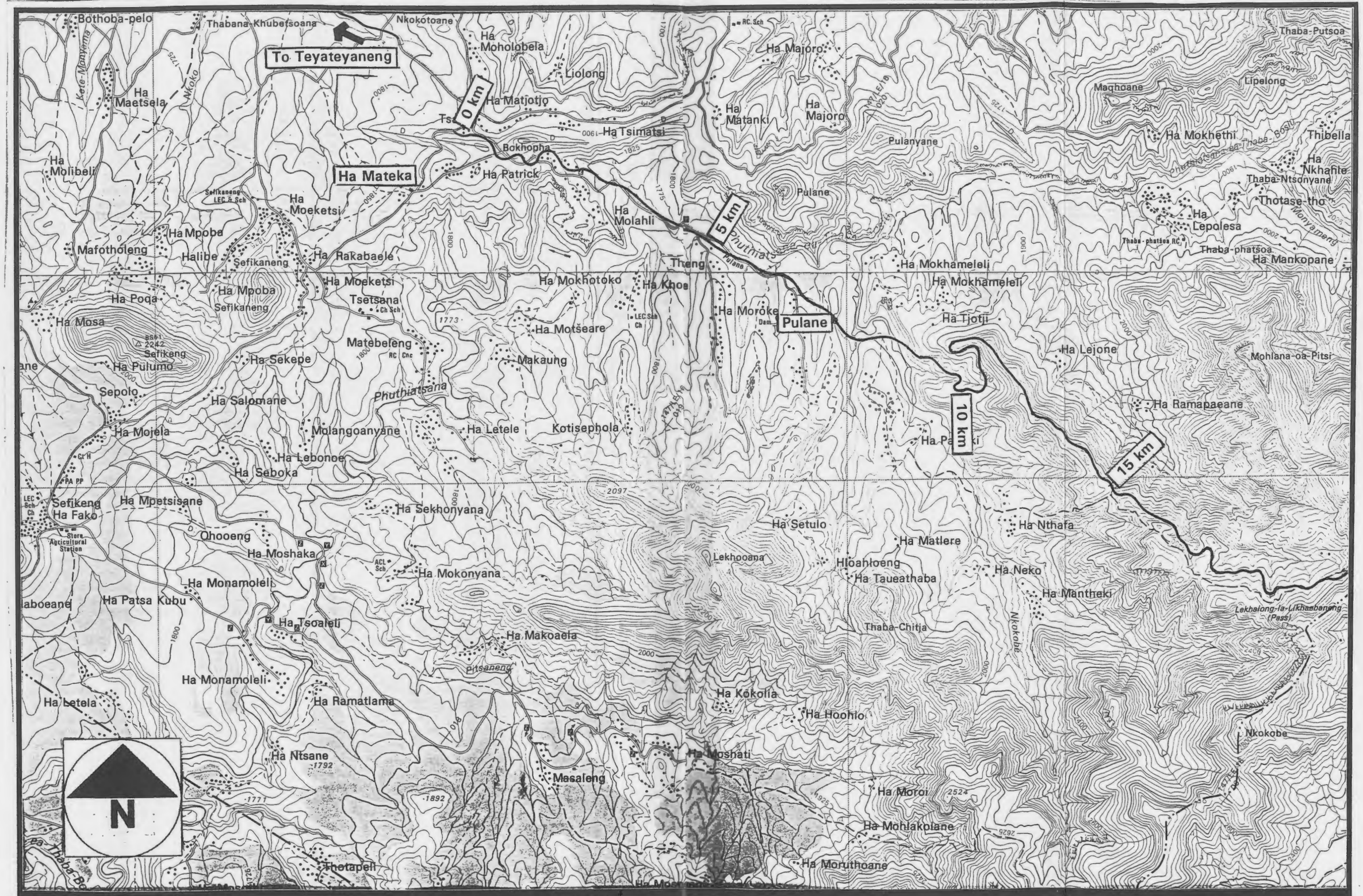
Scale 1:50000

a Setenkeng
Patising Ha Malebanye Theko
SEHLABA-SA HA MAKHOBO
Thaba-Putsoa
Mabele
Ha Chalalisa
2254
2286
2335
2466
2641
2374
2598
Kolobere
35 km
Blue Mountain Pass
40 km
HA MAEI
Ha Matlapu
Ntseleli
Matsiring
2612
Ruins
2583
2614
45 km
Ha Likomisi
Ha Nyakane
Khoaba-lea-bua
Ha Montsi
Ha Mokhosi
Jordane
2075
Ha Phoofolo
LEC Ch & Sch
LEC Th
Molikaliko
Maetsisa
Ha Makhobalo (Phomtseng)
Ha Seotsa
2080
Ha Tsapane
Tsatsa-le-Meno
Nokeng
Thaba-Chitja
Ha Lebiletsa
Ha Tholoana
Ha Mphakho
Phomolo
Ha Matsoai
Ha Koporale Letsatseng
Mankoka
Ha Takatso
Ha Tsiu
Ha Mohlabane
Ha Nthakhane
SEHLA-SA-LIKALANENG
Likalaneng
Mohale Dam
Ha Mofa
LIKALANENG
Ha Mohale
Mokunyane
Likalaneng
2268
2200
2209
50 km
Tiping
55 km
Ha Ramohope
Sekokoaneng
Ha Liau
Ha Teri
Letapata
SENQUNYANE
Ha Moeketsi
Ha Raselasela (Mahaoaneng)
Mafotholeng
Boitsireletso
Thaba-Ntso
Setharna
Ha Mohau
Ha Khama
Sethamana
Marhoarakhoara
60 km
Patiseng
To Thaba-Tseka
N

MAP 2c) ALIGNMENT OF WESTERN ACCESS ROITE

Scale 1:50000

The Least Cost Alternative Route

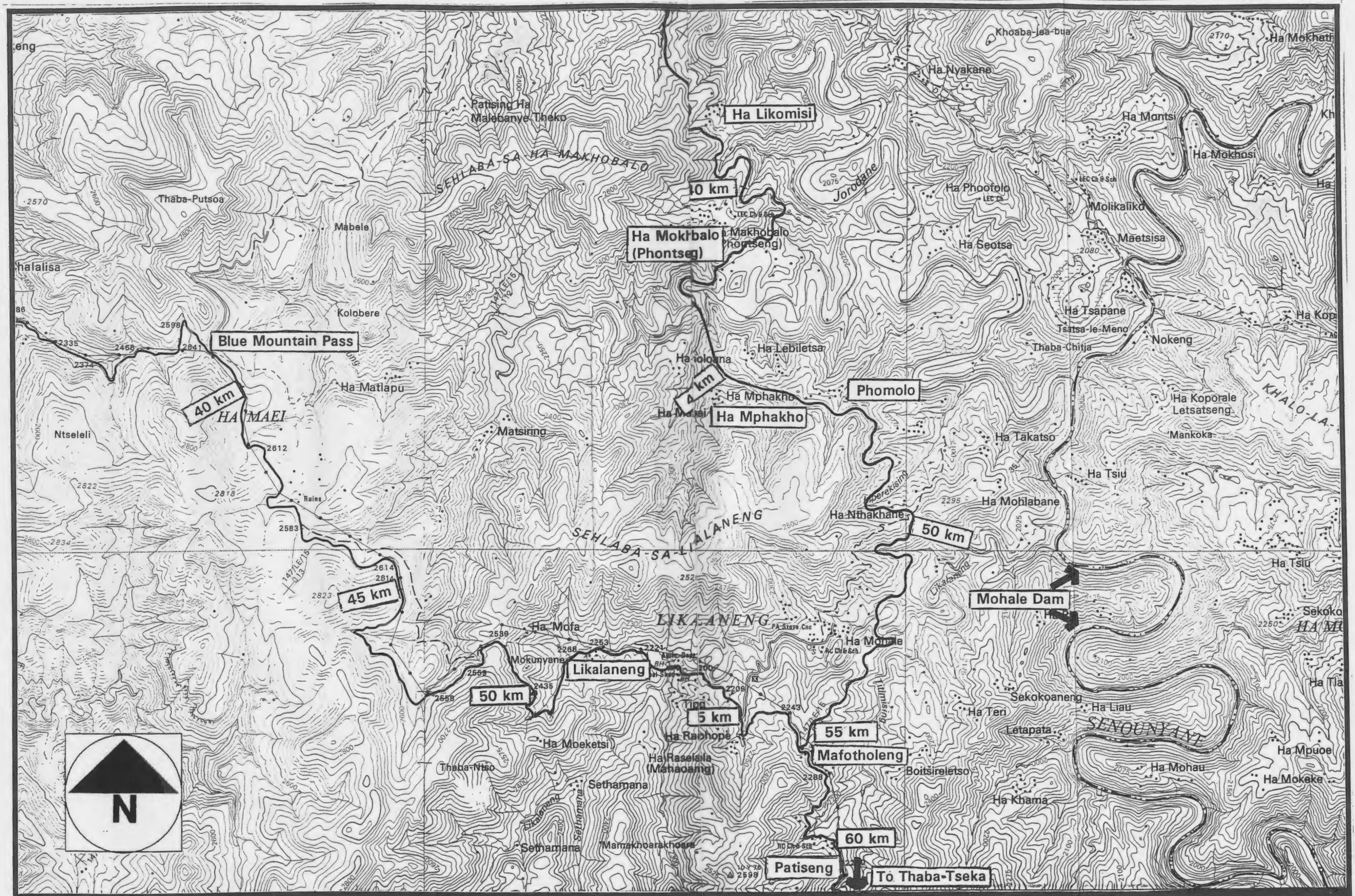


MAP 2a) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

Scale 1:50000

MAP 2b) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

Scale 1:50000



MAP 2c) ALIGNMENT OF LEAST COST ALTERNATIVE ROUTE

Scale 1:50000

APPENDIX TWO

The summary tables of impacts associated with the Western Access Route and the Least Cost Alternative Route.

Note:

Both summary tables, indicating impact significance for impacts without mitigation/optimisation and with mitigation, are presented for both routes.

Summary Table of impacts without mitigation or optimisation (WAR)

	Significance	Negative impacts	Significance	Positive impacts
National / Regional		No significant impacts	High High Moderate Low Low	• Reinforces national road network plans • Maseru bypass will alleviate congestion • Promotes national planning objectives • Promotes the objectives of the National Settlement Policy • Promotes tourism
Socio-economic	High High High High Moderate Moderate Moderate	• Interference with potable water supplies • Loss of houses, businesses & facilities • Social disruption • Loss of agricultural resources • Inconvenience and increased risk to people and livestock • Increased cost of living • Aesthetic impacts	High Moderate Moderate Low	• Improved transport and access to facilities, goods and services • Reduced dust and mud • Increased business and employment opportunities • Improved speed & safety of travel
Biophysical	Moderate Moderate Moderate Moderate Moderate Moderate Low	• Clogging of watercourses with rocks • Loss of marsh areas • Destruction of spiral aloe populations • Destruction of *Leucosidea* shrubland • Increased siltation of watercourses • Disturbance/death of faunal elements due to construction and improved access • Destruction of *Erica alopecurus* habitat		No significant impacts
Archaeology	Low	• Loss of archaeological materials		No significant impacts

Western Access Route: Summary Table of impacts with mitigation and optimisation

	Significance	Negative impacts	Significance	Positive impacts
National / Regional		No significant impacts	High High High Moderate Low	• Accords with national road plans • Reinforces national planning objectives • Maseru bypass will relieve congestion • Reinforces objectives of the National Settlement Policy • Promotes tourism
Socio-economic	 Moderate Moderate Moderate Moderate Moderate Low Low	 • Loss of agricultural resources • Social disruption • Interference with potable water supplies • Inconvenience and increased risk to people and livestock • Loss of houses, businesses & facilities • Aesthetic impacts • Increased cost of living	High Moderate Moderate Moderate	• Improved transport and access to facilities, goods and services • Increased business and employment opportunities • Reduced dust and mud • Improved speed & safety of travel
Biophysical	Low Low Low Low Low Low Low	• Increased siltation of watercourses • Clogging of watercourses with rocks • Loss of marsh areas • Destruction of spiral aloe populations • Loss of faunal elements • Loss of *Leucosidea* shrubland • Loss of other vegetation		No significant impacts
Archaeology	Low	• Impact on archaeological materials		No significant impacts

Least Cost Alternative Route: Summary Table of impacts without mitigation or optimisation

	Significance	Negative impact	Significance	Positive impact
National / Regional	High Moderate Moderate	• Not in accordance with existing road plans & places additional burden on maintenance budget • Contradicts settlement planning & may detract from growth of identified rural centres • Negative impact on existing tourist facilities	Moderate Low Low	• Could promote exploitation of motorist tourist opportunities • Promotion of national planning objectives, economic growth, employment creation & democratisation • Limited reinforcement of plans for Leribe district
Socio-economic	High High High Moderate Moderate Moderate Moderate high Moderate Moderate Low	• Impacts on resources requiring compensation • Disruption of local economy • Interference with access to or destruction of potable water supplies • Increased crime • Increased risk/dangers to livestock • Rockfall on cultivated land • Disturbance of burial sites • Social disruption of local communities • Increased traffic congestion Maputsoe to Ha Mateka • Noise disturbance from blasting • Scarring of landscape and loss of rural character	High Low Low	• Improved access to facilities, goods and services for rural, remote areas • Increased opportunities to market goods • Increased employment opportunities
Biophysical	High High moderate High-moderate High-moderate Moderate Moderate high	• Increased siltation of watercourses • Impact on SA Red Data species: Maluti Minnow (endangered) and Aquatic River Frog (restricted) • Loss of *Leucosidea* woodland • Clogging of watercourses with rocks • Destruction of wetlands • Altered drainage through culverts & bridges • Loss of future options for conservation • Loss of spiral aloe populations		No significant impacts
Archaeology		• Loss of known and unknown sites of archaeological interest		No significant impacts

Least Cost Alternative Route: Summary Table of impacts with mitigation and optimisation

	Significance	Negative impact	Significance	Positive impact
National / Regional	High Moderate	• Contradicts existing road plans and places additional burden on road maintenance budget • Impact on existing tourist facilities	High Moderate Moderate Moderate-Low	• Promotion of planning objectives of economic growth, democratisation and employment creation • Creation of new transport linkages • Promotion of tourism • Promotion of decentralisation
Socio-economic	Moderate Low Low Low Low Low Low Low Low Low	• Disruption of local economy • Interference with access to or destruction of potable water supplies • Traffic congestion & increased accidents • Increased crime • Increased risk/danger to livestock • Disturbance of burial sites • Social disruption of local communities • Noise disturbance from blasting • Rockfall on fields • Scarring of landscape and loss of rural	High Moderate Low	• Improved access to goods, services and facilities for remote rural people • Increased employment opportunities • Increased opportunities to market goods
Biophysical	High Moderate Moderate-Low Moderate-Low Low Low Low Low	• Impacts on SA Red Data Book species: Maluti Minnow (endangered) and Aquatic River Frog (restricted) • Loss of spiral aloe populations • Increased siltation of water courses • Destruction of wetlands • Loss of *Leucosidea* woodland • Clogging of river courses with rockfall • Altered drainage through culverts and bridges • Loss of future options for conservation		No significant impacts
Archaeology		No significant impacts		No significant impacts