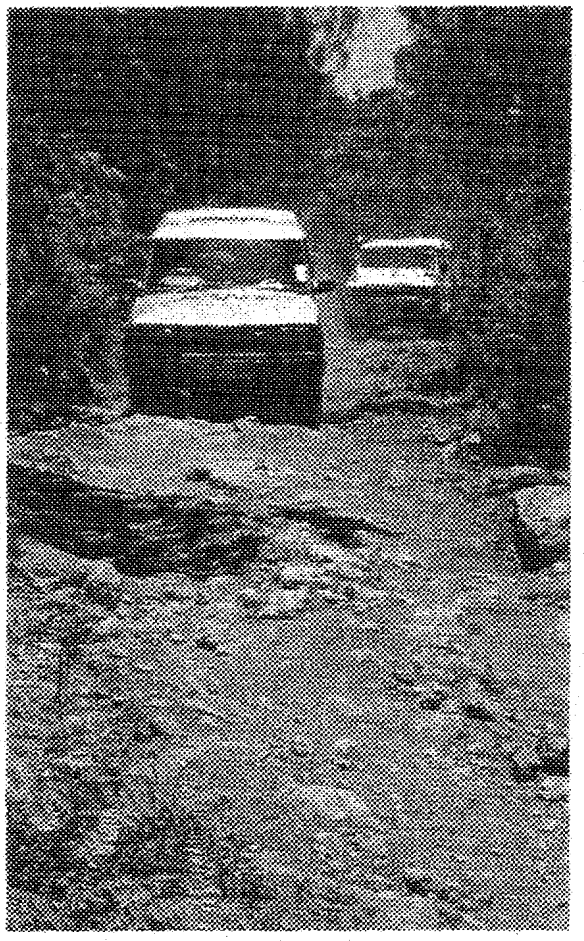
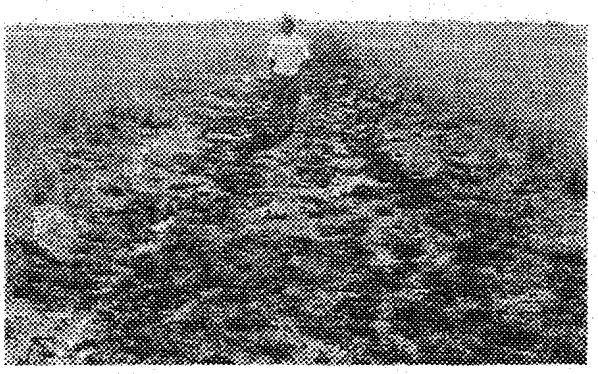
Programmatic Environmental Assessment for Road Improvements in Tanzania's National Parks





September 2001

US Agency for International Development
Bureau for Africa
USAID/Tanzania
USAID/REDSO/ESA and AFR/SD/ANRE

EPIQ

AFRICAN WILDLIFE FOUNDATION

Programmatic Environmental Assessment for Road Improvements in Tanzania's National Parks

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For

Tanzania National Parks TANAPA
USAID/Tanzania – Dar es Salaam, Tanzania

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Contents

Foreword

This Programmatic Environmental Assessment (PEA) for Road Improvements in Tanzania's National Parks (TANAPA) was jointly conceived by USAID and TANAPA and motivated by TANAPA initiative and USAID regulatory requirements. In 1999, TANAPA secured funding from USAID for road equipment to be used in two of Tanzania's parks, Tarangire National Park and Lake Manyara National Park. However, funding was contingent on TANAPA following specific USAID environmental procedures governing the use of USAID monies for infrastructure work within National Parks and protected areas. These procedures also apply to situations where there might be adverse impacts on tropical forests, threatened and endangered species, biodiversity or sensitive habitats, or where potential exists for the introduction of exotic species of plants or animals. Since TANAPA's concerns and environmental impact assessment policy are essentially the same as those of USAID, TANAPA and USAID chose to join as partners in preparing the PEA. Tanzania's National Environmental Management Council was also interested in integrating Tanzania's Environmental Impact Assessment Policy with this USAID/TANAPA joint undertaking.

Readers desiring copies of ths document may go to the Africa Bureau AFR/SD website at http://www.afr-sd.org and search under publications. In addition a contact list for key individuals involved in the development of the PEA may be found at end of Chapter 9.

Acknowledgments

This Programmatic Environmental Assessment (PEA) was conceived jointly by the Tanzania National Park Authority (TANAPA) and USAID with early involvement from the National Environmental Management Council (NEMC). The Team Leader was the Director of the Institute of Resource Assessment at the University of Dar es Salaam. A specialist in USAID environmental procedures served as the Associate Team Leader. Other team members included TANAPA's Senior Planning Manager, TANAPA's Senior Ecologist, a representative from NEMC, Serengeti National Park's Road Supervisor and Inspector, and a Road Engineer from the U.S. Park Service.

The entire effort was supported by Allan Kijazi of the African Wildlife Foundation (AWF), who handled all the logistical details for the PEA including the initial *Scoping* exercise, as well as the actual 4-week-long PEA field exercise which followed. Allan's background as a park planner, and his insightful comments and questions, also made him a valuable eighth member of the team. The entire team thanks AWF for coordinating this effort, and Allan in particular. Dr. James Kahurananga of AWF also provided important project oversight as a senior member of the AWF Arusha staff.

The list of those who helped make this exercise a success is long. To Charlotte Bingham, former USAID Regional Environmental Officer in Nairobi (REDSO/ESA) goes the credit for conceiving and helping shape the initial rationale and outline for the PEA. This PEA is part of her continuing legacy to USAID and TANAPA. She and Walter Knausenberger (USAID's current Regional Environmental Officer) provided the impetus for applying the concept of *Environmental Review* and the use of an *Environmental Screening Form* to individual proposed road improvement segments in Tanzanian National Parks. Joseph Kessy, TANAPA's Senior Planning Manager, readily embraced the need for the PEA as well as the philosophy of a joint USAID/TANAPA partnership in its execution. He played a key role in the PEA process, including initial *Scoping,* field assessment work, and the final preparation of the findings and recommendations which are contained in this report.

We also had strong support for this exercise from USAID/Tanzania, beginning with the Strategic Objective Team Leader for USAID's environmental program, Ron Ruybal, who secured the necessary funding under USAID/Tanzania's Strategic Objective Two: *Improved conservation of coastal resources and wildlife in targeted areas.* Gilbert Kajuna, as the Mission's Environmental Officer, not only participated directly in the *Scoping* exercise, but also was able to serve as a member of the PEA Team for our assessment work at Arusha and Kilimanjaro National Parks. The contribution of Yohannes Mulugetta also deserves recognition. As USAID's Team Leader for their Strategic Objective Five*: Rural roads improved in a sustainable manner*, Yohannes has helped to build a cadre of qualified private engineering firms and construction contractors who are now meeting USAID standards for road rehabilitation and maintenance. He reminded us that we should not overlook possibilities for taking advantage of such services in considering future road works within Tanzania's parks.

Pre-Scoping and the development of Terms of Reference for the *Scoping* exercise were supported by EPIQ/Tanzania through Management Systems International. Subsequently, USAID/Tanzania asked the African Wildlife Foundation to serve as the USAID Partner who would coordinate the work. AWF generously assumed this role. Near the end of the exercise, USAID/Washington through the Bureau for Africa, AFR/SD/ANRE and REDSO/ESA contributed an additional 40 days to the Associate Team Leader's participation in PEA. Faye Camardo, Mark Stoughton, and Steve Bickel of Tellus Institute helped with final formatting, editing and proof-reading. The International Resources Group (IRG), a consulting firm based in Washington, leads a consortium of firms and institutions that provide environmental services to USAID and USAID's Bureau for Africa through the EPIQ Environmental Capacity Building Program. Tellus Institute is one member of this consortium, and Bob Winterbottom of

IRG provided capable oversight of Tellus' involvement in the PEA, through the EPIQ coordinating mechanism.

Appreciation also goes to Chris Snipes of the U.S. Department of Interior for identifying, at short notice, the practical road engineering expertise of Dick Engle from the U.S. National Park Service. As a result we had Dick's presence as a PEA Team member for the full month of field assessment work. Dick also provided virtually all photos which appear in the PEA, as well as the Global Position System readings that accompany many of the photos. We must also thank Chris for the collaboration with Dana Cork, Bureau of Land Management Civil Engineer, and Dave Kruse, National Park Service Landscape Architect, both of whom were perceptive reviewers of the PEA Team's work. Gordon Keller, Geotechnical Engineer with the U.S. Department of Agriculture Forest Service, was also a very valuable external reviewer. Thanks also to USAID's Africa Bureau Environmental Officer, Carl Gallegos, for shepherding the *Scoping Document* and the draft PEA through the official review process, and for providing succinct comments of his own.

Esther Kerario and Paul Mtoni of the National Environmental Management Council (NEMC), both specialists responsible for Tanzania's Environmental Policy, provided advice during the early stages of PEA development. They also made available to us Ms. Zapharani Madayi, who served as NEMC's representative on the PEA Team.

We are grateful to other government officials for the time they spent with us defining the issues to be examined under the assessment — Emil Kayega, Principal Environmental Officer in the Department of Environment within the Vice President's Office; Amant C. Macha from the Tanzanian Tourism Board; Saleh A. Pamba, Director of Tourism in the Ministry of Natural Resources and Tourism; Erasmus Tarimo, Project Coordinator for the Wildlife Department; and Gisbert J. Kinyero, Acting Director for Policy and Planning within the Ministry of Works.

We received useful advice and counsel from various scientific experts as well, most notably Patricia McCauley, Environmental Impact Specialist with WEGS Consultants in Arusha; Alan Rodgers of the Global Environmental Facility in Arusha; Valeri Galanti, Wildlife Biologist with the Tarangire Conservation Project sponsored by the University Degli Studi di Milano and based in Tarangire National Park; Tim Corfield of Foxtrot Charlie Ltd. in Arusha; Silvia Ceppi and Malcolm Ryen with the Earth Fund (Italy); and Dr. Herman Mwangeni, WWF Program Officer in Dar es Salaam.

Other consultants who shared their expertise freely with us included: Mike Clapham of Roughton International; Dr. John Henshaw, Wildlife and Environmental Biologist and Consultant, also with Roughton International; Winnie Mbaga, Flora Ismael and Habib Katove, all of Norconsult (Tanzania).

We are indebted to the 12 representatives of different tour operating groups under the Tanzanian Association of Tour Operators who met with us over a year ago in Arusha to provide their thoughts and useful suggestions on how to go about the PEA process.

Special thanks also to Jonathan Simonson, Managing Director of Tarangire Safari Lodge, for his insights on road-related environmental impacts at Tarangire. We also gained a greater appreciation of road issues associated with tourism from Charles Okoth, Assistant Manager at Lake Manyara Serena Lodge.

The PEA Team traveled over 2200 kilometers within Tanzania's Northern Circuit Parks, interviewing more than 40 members of TANAPA's staff. Throughout this exercise, again and again we met individuals, from Rangers to Wardens, whose admirable purpose, dedication, and pride in their Parks, provided us all with inspiration.

At Tarangire National Park, we were privileged to have David Dyauli, Tarangire's Road Inspector, and Jacob Porokwa, Tarangire's Community Conservation Warden, guide us through the field assessment — both men made themselves available for our Saturday trips to the northeastern sections of the park. Then, the Warden in Charge, Edward Lenganasa, and his staff assembled for a de-briefing by our team early on a Sunday morning.

At Lake Manyara National Park we encountered the infectious humor of Frank Silkiluwasha, Lake Manyara National Park's Chief Ecologist, who during *Scoping* met with us in his house on a Saturday morning when he should have been enjoying his family. On our return for the full PEA exercise, Frank served as our field guide. The dedication of the staff was fully evident at the Ranger level as well. During *Scoping*, we sat together outside one of the Ranger posts with Corporal Amini Mlabage, Private Fredrick Mbwambo, and Riziki Makange-Kibarua, obtaining their clear-minded perspectives on what they believed were the major issues associated with road improvements in the park.

Our de-briefing of the Warden in Charge at Lake Manyara, Marietha Lohay Kibasa, took place in the dark in the open meeting area near the old brick Lake Manyara tourist bandas. Mama Kibasa's concern for the future of her park shone at us, even as we fought off the mosquitoes. Despite the late hour, she was alert and engaging, asking us questions and offering discerning comments and suggestions which found their way into the PEA recommendations.

From Serengeti National Park we received willing support from the Warden in Charge, Justin Hando, who assigned us the fine talents of Ishael Varoya, his Road Inspector, as a PEA Team member for virtually the entire PEA exercise. At Arusha National Park, we were warmly received by the Deputy Park Warden in Charge, Simon Aweda, and then guided through the park by the Tourism Warden, Mary Jerome. Mary knew the park as though she had been born there, and her keen observations on the park's environmental problems made us think she should have been a team member for our entire PEA exercise. At Kilimanjaro National Park, we arrived to discover a major forest fire on the mountain. The extent and severity of the fire was clearly testing the endurance of all the park staff, and yet we were graciously received and thoughtfully briefed by the Warden in Charge, Lorivi Ole Moriana. We were then escorted by his new Tourism Warden, Erastus Ufunguru.

On the last day of our field work, we found ourselves in Londorosi Village on the lower slopes of Mt. Kilimanjaro. The Village consists of small shacks thrown together with rough boards originating from the pines of the Forest Reserve. In one of these we were given a meal by a delegation of villagers, while they told us of their concern about the temporary bridge constructed to provide park visitors with access to Shira Plateau. The villagers asked if there might be a way to make their lives a little easier by upgrading the temporary bridge below the village so the village would not be cut off during the annual stream flooding. Driving back toward Arusha that evening with the snowcrown of Kilimanjaro turning gold in the sunset, we thought about the villagers' basic need, and how they might indirectly benefit from the increased tourism that would probably occur on that side of the mountain if the bridge and the road to the Plateau were upgraded. The villagers brought home the reality and value of our work — these were TANAPA stakeholders, eking out a living in a cold mountain environment. For all of us, for the villagers of Londorosi, for TANAPA and for Tanzania, environmentally sound road improvements matter.

On behalf of the entire team, we thank the Director General of TANAPA, Lota Melamari. His sincere personal interest in this exercise helped ensure that senior staff were freed from their more than full-time duties, some to serve on the team, and others to provide expert advice during the field assessment work. These included key staff at Park Headquarters like Emmanuel Gereta, TANAPA's Senior Ecologist, as well as important engineering and ecological personnel at each of the Northern Circuit parks.

The Director General put aside all pressing commitments three times for us — twice to be briefed prior to the PEA field exercise, and again at the conclusion of field work to discuss the recommendations put forward in the PEA draft. His penetrating grasp of the most important recommendations convinced us that the final products of the PEA will become living documents. We believe this is especially true for the environmental procedures and mitigation measures that will be used to improve how TANAPA plans, designs, constructs, rehabilitates, and maintains the road and trail networks for all the parks. With the direction and impetus of the Director General, and the observed dedication and pride of his staff, we believe this PEA will be of lasting benefit.

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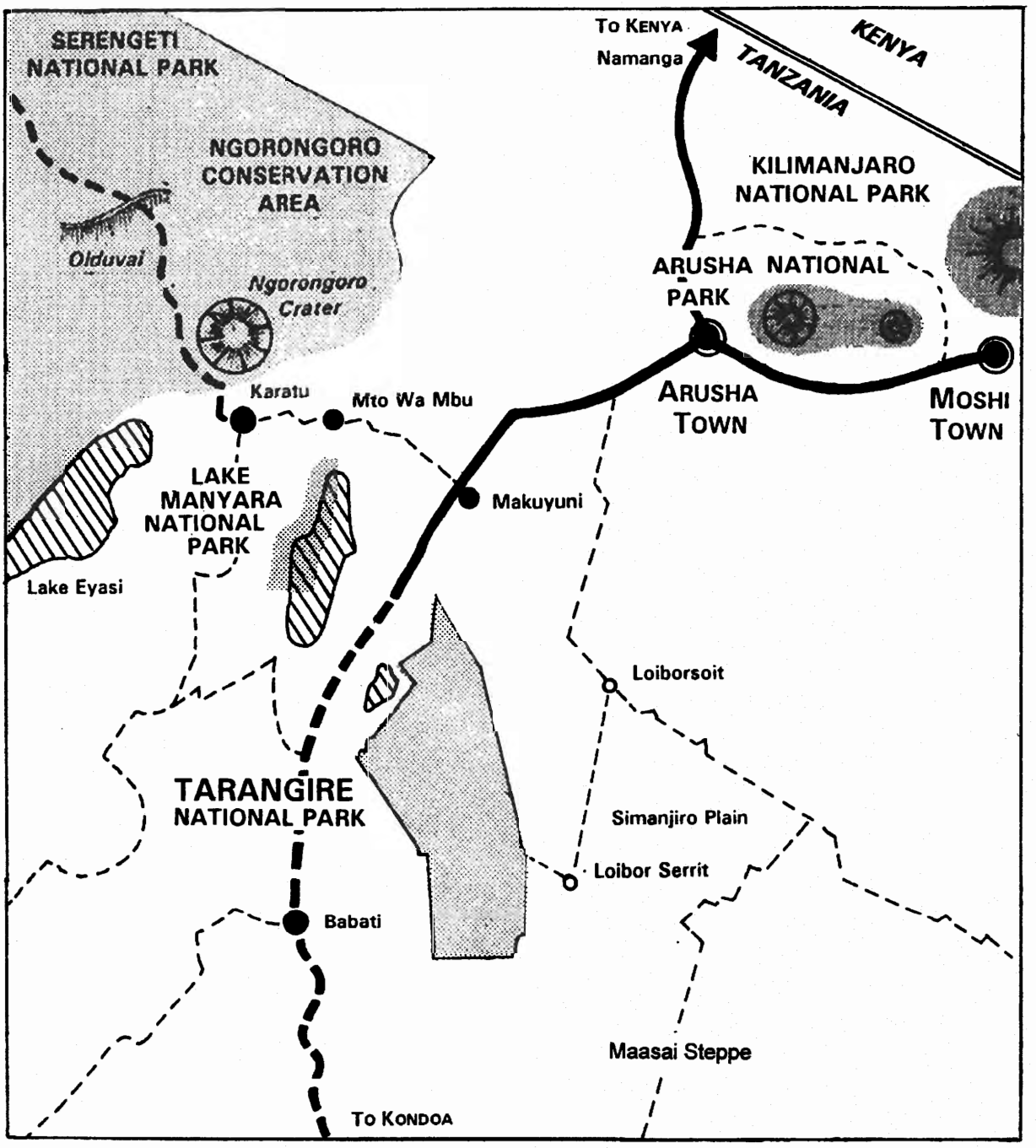
Tellus Institute
Boston, Massachusetts

September 2001

Map 1


TANZANIA NATIONAL PARKS
Lake Victoria
SERENGETI
KENYA
RUBONDO
ARUSHA
KILIMANJARO
LAKE MANYARA
TARANGIRE
GOMBE
INDIAN OCEAN
TANZANIA
MAHALE
DAR ES SALAAM
KATAVI
RUAHA
MIKUMI
Lake Tanganyika
UDZUNGWA
Lake Malawi
KEY
NATIONAL PARKS
INTERNATIONAL AIRPORTS

Map 2


SERENGETI
NATIONAL PARK
NGORONGORO
CONSERVATION
AREA
Olduvai
Ngorongoro
Crater
To KENYA
Namanga
KENYA
TANZANIA
KILIMANJARO
NATIONAL PARK
ARUSHA NATIONAL
PARK
Karatu
Mto Wa Mbu
ARUSHA
TOWN
MOSHI
TOWN
LAKE
MANYARA
NATIONAL
PARK
Makuyuni
Lake Eyasi
Loiborsoit
TARANGIRE
NATIONAL PARK
Simanjiro Plain
Loibor Serrit
Babati
Maasai Steppe
To KONDOA

Acronyms

2wd	two-wheel drive vehicles, including most tour buses
4wd	four-wheel drive vehicles, e.g., land-rovers
AFR/SD/ANRE	USAID Bureau for Africa, Office of Sustainable Development - Agriculture, Natural Resources and Environment
ANAPA	Arusha National Park
AWF	African Wildlife Foundation
BEO	Bureau Environmental Officer
BEPs	Best Engineering Practices
BLM	U.S. Bureau of Land Management
CCS	Community Conservation Service
CCW	Community Conservation Warden
CFR	U.S. Code of Federal Regulations
DALP	TANAPA Development/Action/Lease/Procedures
DOI	U.S. Department of Interior
EIA	Environmental Impact Assessment
EPIQ	A USAID Environmental Indefinite Quantity Contract to provide technical assistance and training in environmental/natural resource policy and management
ER	Environmental Review
EU	European Union
FAA	Foreign Assistance Act
GDP	Gross Domestic Product
IEE	Initial Environmental Examination
Kms	Kilometers
LAU	Limits of acceptable use — planning concept applied to TANAPA Parks instead of the less workable concept of carrying capacity
LMNP	Lake Manyara National Park
MEO	Mission Environmental Officer
MZP	Management Zone Plan

NPS	National Park Service
NEMC	National Environmental Management Council
PEA	Programmatic Environmental Assessment
REDSO/ESA	USAID Regional Economic Development Support Office/East and Southern Africa
REO	Regional Environmental Officer
SCDP	Serengeti Conservation & Development Project
SNP	Serengeti National Park
SO2	USAID Tanzania Strategic Objective 2: Improved conservation of coastal resources and wildlife in targeted areas
SoW	Scope of Work
TANAPA	Tanzania National Parks
TCMP	Tanzania Coastal Management Plan
TNP	Tarangire National Park
ToR	Terms of Reference
URI	University of Rhode Island
USAID	United States Agency for International Development
WIC	Warden in Charge
WWF	World Wildlife Fund

Executive Summary

Tanzania's National Parks contain some of the world's most diverse ecosystems, treasured because of their wildlife concentrations and rare beauty. The number of visitors and vehicles entering the parks has been increasing at a dramatic rate in recent years, as has the contribution of the tourism sector to Tanzania's economy. These trends are expected to continue. Tourism has risen from 3% of GDP in 1996 to 18% in 1998, and is projected to reach 25-30% in 2010.

Benefits from TANAPA road construction/rehabilitation are expected to include more timely, efficient and enjoyable visitor access to various parts of the parks, and longer tourist stays. Potentially, establishing new roads and facilities outside the high-use zones should also relieve pressure on the resources in core zones. This form of development, in turn, may result in increased park revenues needed for sustainable management, without adversely affecting ecological systems, the quality of visitor experience or exceptional resource values.

Road improvements may also be critical for improving anti-poaching and park enforcement operations, as well as in providing improved mobility for Community Conservation Service (CCS) activities.

In response to increased park accessibility, TANAPA revenues are expected to grow. A sound financial position for TANAPA will also mean more revenues contributed to central and local governments, as well as improved local economies, life styles and social services for communities adjacent to the parks.

"Roads vs. no roads." TANAPA must grapple with a philosophical question in considering the role roads will play in the future of Tanzania's parks. The PEA Team moved through many areas with beautiful vistas, unmarred by human presence. These Park resources are growing rapidly in value as "wildlands" shrink globally. While the construction of new roads can in many cases be accomplished without diminishing biodiversity and with minimal impacts on the environment, their impact on wilderness quality and viewsheds is not negligible.

Clearly, improved roads and a good road network contribute to increased park revenues, so vital to ensuring that the parks can continue to be effectively managed and their resources protected. The effects of insufficient revenues on Tanzania's parks have been evident historically. Whenever revenues decline, park management suffers. Yet because of the rapid increase in value of Tanzania's parklands, greater consideration may need to be given to "banking" more unspoiled areas for future very low impact tourism with very limited road access.

If tourist demand to visit the parks continues to rise exponentially, perhaps instead of opening new areas to roads, more thought should be given to holding down the number of vehicles and visitors entering the park, through a general upward adjustment in park entrance fees and bed levies. This would keep revenues high while also allowing TANAPA to keep the number of visitors within established Limits of Acceptable Use (LAUs). Higher fees might also be charged for the opportunity to visit areas with exceptional resources.

Alternatively, TANAPA could adopt a policy of providing only minimal tracks in areas currently designated for future development, such as the western side of Tarangire or the northern Serengeti. By doing so, the road could be easily abandoned and the area in question returned to a natural state if, in the future, Park Management were to decide that the value of the unspoiled resource was greater than the revenues generated by visitors. However, as most planners involved

in conserving natural areas know, closing a well-traveled road is not easy. Once a road is constructed, it develops a history of its own. Efforts to remove it often make little sense to the next generation of park managers and visitors who come to believe "*it was always there.*" It bears remembering that the benefits of opening up new areas to roads, in order to relieve pressure on more intensively used park zones, is not without cost. The impacts may not be severe, but they may still be irreversible.

From a strategic perspective, planned road improvements must take place within the context of TANAPA efforts to set and enforce *Limits of Acceptable Use* for each National Park. Unplanned growth in the number of visitors entering the parks and traveling on park roads, would lead to an incremental, disconnected or opportunistic approach to the development and maintenance of the road systems. Over a span of only a few decades, cumulative effects would contribute to undesirable deterioration in physical and ecological systems, declines in biodiversity, threats to rare and endangered species, declines in the quality of the visitor experience and, ultimately, a drop in park revenues.

On the other hand, through strategic planning, it appears possible in a number of parks to add to the road/trail network without jeopardizing biodiversity or exceptional resource values. Under well-conceived and managed road and trail network plans, the potential exists in several parks to add new and upgraded visitor access, especially to areas further from established lodges and camps. Improved networks could help relieve current pressures on core preservation zones, while allowing a larger number of visitors to enter the parks each year. This assumes, however, that steps are taken to ensure LAUs for each zone are not exceeded. It is suggested that the responsibility for establishing road/trail network plans for each park ultimately lies with the TANAPA Planning Unit, in close consultation with the Chief Wardens in Charge for each park.

The PEA process and methodology. When a PEA or an EA is prepared, the originator of the action, in this case USAID/Tanzania and TANAPA, begin a process of identifying the significant issues related to the proposed action and determining the range of issues to be addressed in the PEA or EA. Known as "*scoping,*" this process involves full consultation with stakeholders, including a range of all affected parties. The *Scoping* exercise was carried out from 28 November through 19 December 1999. The draft of the *Scoping Statement* was reviewed by the PEA Team and the final version is provided in the PEA *Appendix A: PEA Scoping Statement.*

PEA Team selection occurred after review of the *Scoping Statement*, in order to ensure that the team would have the necessary mix of skills needed to address each key issue identified during *Scoping*. The full Team worked together over a period of approximately 4 weeks, from January 31 through March 3, 2000.

Brief Biographical Sketches of the PEA Team are provided in Chapter 9 of the PEA.

Because of limitations on time and resources available to carry out the PEA, the Team was not able to survey all of Tanzania's National Parks. Instead, TANAPA chose five Northern Circuit parks for examination which they believe provide a representative sample of the types of roads and physical and ecological conditions found throughout the entire Park System: Tarangire National Park (TNP), Lake Manyara National Park (LMNP), Serengeti National Park (SNP), Arusha National Park (ANAPA) and Kilimanjaro National Park (KINAPA). (See the map on page 6 for relative locations of these five parks.) The Team made an effort to assess environmental impacts for all TANAPA road classifications and types of road improvements, under a full range of geological, soil, meteorological, topographic and ecological conditions existing in the parks. Approximately 2200 kilometers of park road was observed by the Team.

Programmatic Environmental Assessment Results. The results from this PEA include a set of environmental procedures for screening of various categories of proposed road activities, and for conducting environmental reviews of proposed road construction, rehabilitation, realignment, operation and maintenance, and decommissioning, over which TANAPA has responsibility. These procedures are provided as a separate stand-alone document entitled *TANAPA Procedures for Environmental Reviews of Road Improvements.*

Typically, environmental assessments provide long lists of mitigation and monitoring recommendations; however, the preparation of these lists consumes the bulk of the assessment level of effort, and the end result is that assessments often contain little or no guidance on how to implement the recommendations. The Team has therefore prepared a second stand-alone document entitled *TANAPA Environmental Management Plan Guidelines for Road Improvements.* These *Guidelines* provide the guidance needed for preparation of annual *Environmental Management Workplans* at the park level that can be used to describe who will be responsible for implementing the various recommendations, how and when actions will be taken, and estimated time and cost requirements. Both the *TANAPA Procedures for Environmental Reviews of Road Improvements* and the *TANAPA Environmental Management Plan Guidelines for Road Improvements* are discussed in more detail below.

In addition, the PEA helped TANAPA begin developing environmental criteria and standards for all National Park roads. The exercise also strengthened TANAPA's capacity to conduct environmental impact assessments.

Proposed Action and Alternatives. This PEA examines a representative set of proposed road improvement actions of interest to TANAPA in all of Tanzania's National Parks. It also meets USAID's specific requirements for an assessment of representative actions that may be undertaken using USAID-funded road equipment in the parks, specifically in Tarangire and Lake Manyara National Parks, where USAID support is being provided under USAID/Tanzania's Strategic Objective – *Improved conservation of coastal resources and wildlife in targeted areas (SO2).* For TANAPA's purposes, the PEA is more comprehensive than required under USAID environmental procedures. However, it also meets the requirements of USAID's 216.6(c)(3).

Chapter 2 provides information required by USAID's 22 CFR 216(c)(3) and TANAPA regarding the review and comparison of the proposed action and alternatives.

Description of proposed actions. As mentioned above, the PEA Team examined proposed road improvements in five of Tanzania's northern parks which TANAPA believes provide a comprehensive sample of the types of improvements likely to be undertaken in all parks under varying physical, ecological, landscape and socio-economic conditions. The types of improvements are summarized park-by-park in Chapter 2, Sections 2.1.1 through 2.1.5.

On the basis of observations in the five parks, proposed road (or trail) improvement actions in all of Tanzania's parks, including Tarangire and Lake Manyara National Parks, are expected to include new construction, realignments, major upgrades, road rehabilitation, routine operation and maintenance, and decommissioning. Virtually all work will be performed using park equipment and equipment operators and common laborers under the supervision of park Works Department personnel.

Management and implementation actions. TANAPA organizational structure places prime responsibility for road improvements with the Warden in Charge for each National Park. Thus,

decision-making is decentralized and decisions on improvements are made through a roads committee established by the Warden in Charge and consisting at a minimum of staff within the park responsible for road works (including construction and maintenance). The PEA calls for the establishment in each park of an Environmental Management Team for road improvements, each led by a park Environmental Review (ER) Coordinator. The Team's responsibility is to ensure that environmental review, mitigation and monitoring occurs in a systematic and timely fashion for road improvements for all proposed road segment activities. Members should include a roads engineer, roads manager/inspector and/or roads foreman for road works, and a park ecologist or an individual with training in environmental review and analysis, mitigation and monitoring. It is anticipated that under most circumstances, the park ecologist will be the person chosen by the Warden in Charge to serve as the Environmental Review Coordinator.

Most decisions on improvements are made during development of annual workplans which are used in annual budget submission justifications (typically during May and June). However, decisions may also be made during the year based on unforeseen circumstances and changes in park management priorities. The PEA recommends that all improvements be subjected to TANAPA's environmental screening and review process, with signed copies of completed reviews submitted to TANAPA's Planning Manager. In the case of Tarangire and Lake Manyara National Parks, reviews will also be submitted to USAID/Tanzania's Mission Environmental Officer.

The TANAPA Planning Manager and Planning Unit staff responsible for environmental impact assessment will also require review of significant road construction and realignments. For improvements of this magnitude in Tarangire and Lake Manyara National Parks, review is also required by the USAID Mission Environmental Officer, who determines whether an environmental assessment must be carried out in conformance with 22 CFR 216. The *TANAPA Procedures for Environmental Reviews of Road Improvements* include guidance for park personnel on when review by the TANAPA Planning Manager is required.

The no action alternative. Within an EA or PEA, the alternative of no action must be addressed. The no action alternative is generally defined as meaning that the proposed activities do not take place. The resulting environmental effects from taking no action are compared with those that would occur as a consequence of the proposed action or alternatives to it.

For the purposes of this PEA, the no action alternative is defined as the continuation of the *status quo* with respect to road construction, operation and maintenance, and decommissioning. In effect this means little new construction, and continued inadequate maintenance. The consequences are considered in the PEA for each of the parks in Chapter 2, Section 2.2.1.

Alternative design and maintenance strategies for road improvements. TANAPA's General Management Plans and Management Zone Plans are very valuable tools for evaluating both the existing road networks and the planned development of new roads. TANAPA's use of these documents can help guide the type and level of road improvements anticipated over the next five years. However, they are not sufficient by themselves. Park-by-park analyses of roads and trails need to be carried out to determine the most environmentally sound routings. At the same time, TANAPA assessments need to be conducted to select the most cost-effective and environmentally sound transport alternatives, for example, the appropriate mix of road/trail infrastructure. Multidisciplinary teams should conduct park-by-park surveys of existing and proposed road networks and segments.

TANAPA Management (at both headquarters and the park level) should also conduct a separate assessment of the cost-effectiveness and environmental soundness of using private contractors, rather than relying exclusively on the parks' works departments and supervised casual labor. Such an analysis is especially important in planning future major road improvements.

Institutional alternatives for sound environmental design, construction and maintenance of road improvements. The institutional management approach taken in planning and implementing road improvements may also have major bearing on whether recommendations will be followed and actions taken to actually mitigate potential adverse impacts. Inadequate *Workplans* and budgets, and insufficiently trained staff with poorly defined responsibilities, can make recommended mitigation and monitoring efforts nothing more than a litany of "good intentions." Several institutional management alternatives were considered and are discussed in Chapter 2, Section 2.2.4 of the PEA. The preferred option borrows from these alternatives and has the following characteristics:

- Responsibility for most road improvement decisions is vested in the individual park Wardens in Charge (WICs) but with some centralization at Headquarters to oversee major road works.

- TANAPA would develop standards and specifications for use of private contractors for major construction or rehabilitation activities. Similarly, efficiencies might be realized by having Headquarters develop system-wide service contracts for maintenance of heavy equipment.

- TANAPA would add staff to oversee development of *Road/Trail Network Plans*. This is likely to be a long-term, on-going need; however, it could be largely contracted out to consulting firms with landscape architecture capabilities.

- *Quarry Management Plans* can be developed under a single one-time contract, requiring limited TANAPA oversight to ensure implementation of the plans.

- The PEA Team is strongly in favor of the *Environmental Review* process and the development of annual *Environmental Management Workplans* for road improvements. The effectiveness of *Environmental Reviews* at the park level could be greatly enhanced by having a shared pool of environmental assessment and engineering expertise on call to work with the individual park Environmental Review Coordinators, Environmental Management Teams and/or Works personnel. Such a technical support system might work much the way specialized environmental services are provided to the USAID Mission Environmental Officers at the country level by the Regional Environmental Officer based in Nairobi.

- Headquarters-based expertise could be supplemented by outside consulting services, as needed.

- Headquarters environmental impact assessment staff could also conduct periodic training programs for park personnel in environmental review and environmental management of park road improvements in order to provide new staff with needed expertise, as well as to introduce additional concepts and techniques in environmental management.

No action compared to proposed actions. The proposed action offers important economic and protected area resource management benefits, as well as opportunities for environmental enhancement. By implementing the mitigation and monitoring measures identified by topic in Chapter 6 of the PEA, environmental impacts and risks can generally be avoided, diminished,

controlled or compensated for. Under *most* circumstances, the no action alternative offers no benefits, but at the same time poses significant environmental impact risks.

Identification of preferred action. The preferred action is to carry out road improvements in Tanzania's National Parks, with the incorporation of the following mitigative and monitoring measures:

- multidisciplinary team surveys and assessments, as outlined above under Chapter 2, Section 2.2.3 "Alternative design and management strategies for road improvements," and Chapters 6 and 7 of the PEA;
- training in environmental screening and review, and environmental mitigation and monitoring, including application of the *TANAPA Procedures for Environmental Reviews of Road Improvements* as recommended in Chapter 7;
- development of mitigative and monitoring measures for road construction, operation and maintenance, as described in Chapter 7 and *TANAPA Environmental Management Plan Guidelines for Road Improvements*;
- development and implementation of annual park *Environmental Management Workplans* for road improvements, as recommended in Chapter 7 and specified in the *TANAPA Environmental Management Plan Guidelines for Road Improvements;*
- preparation of standards and specifications for sound environmental design and management of road improvements to be incorporated in a TANAPA *Operations Manual* for road improvements as described in Chapter 7, Section 7.3.

Affected Environment and Institutional Setting. Chapter 3 of the PEA provides descriptions of the affected environment for the five Northern Circuit parks. Chapter 4 reviews the institutional and regulatory setting affecting the PEA.

Impact analysis framework and the environmental impact matrix. Team fieldwork was carried out from Jan 31 - Feb. 18, 2000. Observations from each Park assessment are provided in *Appendix B - PEA Team Field Note Summaries.* Upon completion of fieldwork, the Team conferred on issues to be addressed under four broad categories: physical resources, ecological systems, landscape issues and socio-economics. Each issue was carefully discussed in a day long session to outline the matrix that would be used to match park road activities against the environmental and social impacts of these activities. The Team also made an effort to organize the impact list to correspond as much as possible with the headings found in Section IV of TANAPA's Development/Action/Lease Procedures (1995) Section IV *Environmental Impact Consideration Checklist.* The priority issues identified by stakeholders during the *Scoping* process were also revisited.

The methodology is described in more detail in Chapter 5 and the matrix below appears in the PEA as Table 5-1. On the basis of these rankings the Team members proceeded to write the various sections of *Chapter 6. Environmental Consequences*, addressing each of the environmental impacts identified in the matrix, and placing emphasis on those having the most adverse or beneficial impacts. Mitigation measures were also developed through Team consultative discussions and joint reviews of drafts.

The evaluation of impact significance was for the most part a qualitative interdisciplinary exercise based on discussion among PEA Team members. Decisions were also based on past experiences, expert judgment and stakeholder views and concerns reflected in the PEA *Scoping Statement.*

Environmental consequences: significant impacts and recommended mitigation measures. Chapter 6 of the PEA contains the analysis of the most significant potential adverse environmental impacts identified by the PEA Team and summarized in the Environmental Impact Matrix. Suggested mitigation measures are presented at the same time as the analysis of each impact, so that readers are able to see the direct relationship between individual impacts and proposed mitigation strategies. This is by far the largest Chapter in the PEA. The full set of suggested mitigation and monitoring measures have also been incorporated within *TANAPA's Environmental Management Plan Guidelines for Road Improvements* which are to be used at the park level by Environmental Management Coordinators and Environmental Management Teams in preparing annual *Environmental Management Workplans* for road improvements.

Recommended Strategies for Environmental Management of Road Improvements. In Chapter 7, the PEA also addresses in some detail, institutional mechanisms needed for effective implementation of the PEA recommendations.

Building TANAPA capacity in environmental assessment.

Staffing up. The PEA Team strongly recommends that TANAPA consider adding additional EIA staff resources to the Planning Unit. A full-time specialist is needed to oversee all TANAPA EIA-related activities.

The PEA Team also recommends the designation of an Environmental Review Coordinator for each National Park and establishment of Environmental Management Teams. In most parks it is expected that the Park Ecologist will be appointed the ER Coordinator by the Warden in Charge, and that the Environmental Management Teams will consist of the ER Coordinator, the Road Manager/Inspector or Foreman, the Community Conservation Warden, the Tourism Warden, the Warden for Anti-Poaching, or other personnel whose activities may have impacts on the biophysical environment of the park. The ER Coordinator and the Environmental Management Teams will be responsible for carrying out *Environmental Reviews* of proposed road segments following the procedures developed under this PEA and found in *TANAPA Procedures for Environmental Reviews of Road Improvements*. Together, they will also be responsible for the preparation of annual *Environmental Workplans* for road improvements (identifying mitigation and monitoring measures, reporting on actions taken, outlining future follow-up required, and providing estimated budget requirements for implementation). The *Workplans* are to be prepared in time for consideration as part of the annual budget submission process, following the *TANAPA Environmental Management Plan Guidelines for Road Improvements.*

EA training. One of the results USAID/Tanzania is hoping to achieve under its SO2 is to increase the effectiveness of institutions that support natural resource management in Tanzania (IR 2.2). The thrust of this effort is to increase the skill base of individuals in targeted institutions and to promote organizational improvements directed by the institutions themselves.

The majority of TANAPA staff has only limited understanding of environmental assessment as a planning tool or of environmental issues affecting the National Parks and park management. It is therefore considered highly desirable for the Park system to institutionalize an annual five-day EA training program for those staff members who will be responsible for using the *TANAPA Procedures for Environmental Reviews of Road Improvements.* The training should also emphasize how to apply the *TANAPA Environmental Management Plan Guidelines for Road Improvements* to ensure that the mitigation and monitoring measures outlined in the PEA are implemented. This training should include developing basic familiarity with environmental and

ecological principles. Special attention should be placed on effective training for the individual designated as the Environmental Review Coordinator in each Park, since this person will have lead responsibility for overseeing the preparation of *Environmental Reviews* and completion of *Environmental Screening Forms* (ESFs). Training of the ER Coordinator should also be a priority since this person will also coordinate the preparation and yearly submission of the *Environmental Management Workplan* describing how mitigation and monitoring measures will be implemented. Training should be extended to other members of the Environmental Management Team, as appropriate. The ER Coordinators should themselves be considered future trainers.

A shorter course is also recommended for TANAPA senior staff to introduce them to environmental impact assessment concepts and steps needed to insure recommendations from the PEA are institutionalized. Because of staff turnover, this course should also be repeated periodically.

Building TANAPA road works capacity. TANAPA has been successfully constructing and maintaining roads for many years and has many skilled equipment operators and mechanics on its staff in the larger parks (i.e., Tarangire and Serengeti). Smaller parks such as Arusha and Kilimanjaro with limited road systems still carry out road repair mainly by hand, due to lack of road equipment. Distribution of road equipment and staff varies depending on each park's total road distances to be maintained, and the park's topography and soils. The capacity at TANAPA headquarters for road design and construction support appears limited.

Many of the most common adverse impacts associated with road improvements have been the result of equipment operators receiving insufficient training in how to use the equipment properly to shape the road and provide effective drainage.

Based on observations made at parks surveyed, the majority of heavy road equipment appears to be grounded at any one time, waiting for repairs. Causes of equipment breakdowns are many, with the most common causes apparently related to old equipment that is basically worn out to begin with (e.g., Tarangire and Manyara), equipment that is not suited to the job at hand (too small or large, not enough clearance, not rugged enough—BMC tippers at Serengeti), parts that are hard to find, and one-of-a-kind equipment that is difficult to repair (Fiat graders and BMC tippers at Serengeti). Mechanic shops with a full array of tools, hoists, parts storage, and repair equipment were not evident in the parks surveyed. Equipment operating and repair budgets did not appear sufficient to operate the major park equipment, (such as graders and dozers) as needed during the year or to provide for proper tools, parts, engine repairs, and basic preventive maintenance (e.g., Manyara). Records on equipment use (hour meters, kilometers driven, etc.) are apparently absent except at the largest parks such as Serengeti. Without these records it is difficult to assess when servicing of the equipment is needed. Again, a host of adverse environmental impacts are associated with insufficient road maintenance, and these problems are exacerbated by shortages of equipment needed to maintain the extensive park road networks. These shortages also constrain plans to upgrade, realign or create new roads in an environmentally sound manner.

Suggested improvements to capacity include:

- **Strengthening budgets related to park road maintenance**, especially as it relates to equipment preventive maintenance and repair. The current deficiency undermines all efforts to develop and manage TANAPA's roads in a sustainable manner. The PEA Team believes

creative application of park fee structures could provide the funding needed to support the work's departments and the PEA recommendations.

- **Timely training for equipment operators, and equipment mechanics, and an independent, unbiased assessment of the costs and benefits of establishing equipment maintenance contracts for preventive maintenance.** Of particular concern is the need for TANAPA mechanics to be able to read technical manuals for heavy equipment in English. Without this capability, maintenance of equipment with electronic controls may become a significant constraint to carrying out proposed road improvements as planned.

- **Increased sharing of road works expertise among parks**. The PEA Team noted that the knowledge of environmentally sound road management and proper equipment use and maintenance varies among individual parks and much could be learned through direct sharing of skills in on the job training. For example, skilled grader drivers in the Serengeti could be used as trainers for grader drivers in other parks. This form of mentoring can be applied to other equipment operators and mechanics. Annual equipment operation and maintenance (O&M) training for equipment operators and mechanics could take advantage of the considerable expertise that already exists in selected parks to provide training to roads works personnel in need of further skill development. **Also personnel in parks where road works skills are limited could second their employees to other parks to work in partnership with other more fully trained operators and mechanics.**

- **Training of equipment operators in environmentally sound construction, maintenance and decommissioning of roads.** Periodic training that combines best engineering practice, ecological principles and environmental issues is needed for road works personnel, especially heavy equipment operators. Standard operation and maintenance programs for equipment operators should include an environmental component with instruction from TANAPA ecologists and Planning Unit staff, and outside consultants, as appropriate.

- The TANAPA park road system may be of sufficient importance to TANAPA-wide visitor use that it may be worth establishing a **center for park roads** at some point within the TANAPA system. A centralized place for specialized staff, equipment reference, and road reference manuals and materials would be of help to the various parks. A possible source of funding for building road system capacity may be to designate a larger portion of the growth in gate fee income that should result by improving roads to increase visitor LAUs and access.

- The discipline of Landscape Architecture should be included as an integral part of the park road program, especially if the development of *Road/Trail Network Plans* is deemed a priority. Roads inside parks are different, and issues such as visual quality, visitor experience, and park road planning should strongly influence park road design, construction and repair. Involvement by Landscape Architects could be through U.S. Department of Interior (DOI) technical assistance to TANAPA, by consultants, or through TANAPA itself.

Board of Surveys environmental auditing. The **Board of Surveys' annual park auditing process could serve a valuable function by incorporating, as a member of their survey teams, an individual who would be responsible for determining the effectiveness of road improvement mitigation and monitoring in each park.** This individual's role would not be to enforce implementation, but rather to determine how mitigation and monitoring is working and how further improvements might be made.

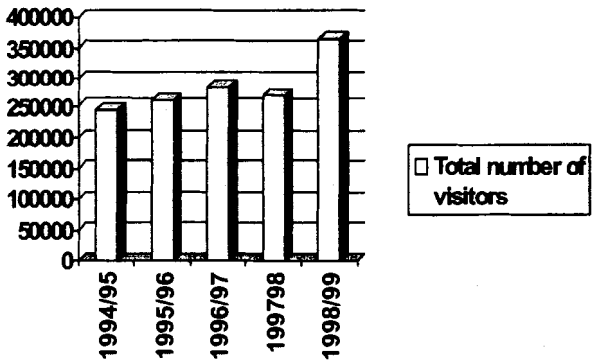
1. Introduction

1.1 The need for road improvements in Tanzania's National Parks

Tanzania includes some of the most diverse ecosystems in the world and is internationally recognized as a key country for the conservation of African biodiversity. This diversity is found inland as well as in coastal areas. In response to this diversity, the tourist industry in Tanzania has grown in importance in recent years, contributing 18 percent of the country's GDP in 1998, up from only three percent in 1996; a record number of tourists visited the country in 1998 (400,000).

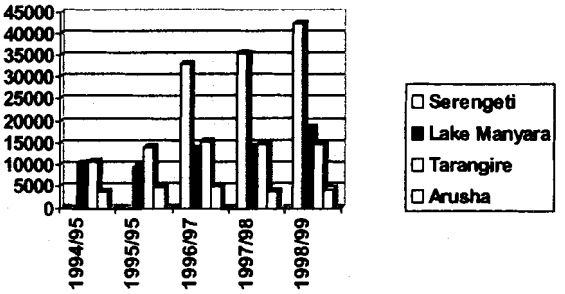
The number of visitors to Tanzania's National Parks and the number of vehicles entering the parks have shown a steady increase over the last five years as evidenced by Figures 1.1 and 1.2 below. While the number of visitors has fluctuated over the years, it has increased on average at a rate of about 8 percent annually.

Figure 1.1 Total number of visitors to Northern Parks from 1994 -1999



(Source: TANAPA Planning Unit 1999)

Figure 1.2 Number of vehicles entering Tanzania Northern Circuit Parks 1994 –1999



(Source: TANAPA Planning Unit 1999)

Tanzania envisages that the number of tourists per year will be in the one million range by the year 2010, and proceeds from tourism are projected to contribute between 25 percent and 30 percent of the nation's Gross Domestic Product.

Direct benefits to TANAPA from road construction/rehabilitation are expected to be considerable, including more timely, efficient and enjoyable visitor access to various parts of the parks and longer tourist stays. There should also be less pressure on the resources in core zones by establishing new roads and facilities outside the high-use zones. This form of development in turn may result in increased park revenues needed for sustainable management, without adversely affecting ecological systems, the quality of visitor experience or exceptional resource values.

Road improvements will probably foster greater economic activity. In response to increased park accessibility, TANAPA revenues are expected to grow. A sound financial position for TANAPA will also mean more revenues contributed to central and local governments, as well as improved local economies, life styles and social services for communities adjacent to the parks.

According to TANAPA, a park *General Management Plan/Environmental Impact Assessment* (GMP/EIA) does not attempt to determine "carrying capacity," at least not in the traditional sense of how much use and development

an area can tolerate. Rather, it proposes that a "limits of acceptable use and development" (LAU) be determined with *"primary emphasis on the conditions desired in the area rather than on the amount of use the area can tolerate."*

LAU criteria are normally set by considering the number of vehicles per kilometer and the number of visitor beds allowable in a given park zone.

The purpose of the zoning schemes and LAU employed by TANAPA for Tanzania's National Parks is to enhance and diversify visitor experience, providing opportunities to escape the relatively overcrowded zones. Fewer tourists pay relatively more for quality experience, so that revenues needed for sustainable park management are balanced against the need to preserve exceptional resource values.

Road improvements may also be critical for improving anti-poaching and park enforcement operations, as well as increased mobility for Community Conservation Service (CCS) activities.

It may be that road improvements can support the expansion of low impact ecotourism without sacrificing park resource values, and that increased access to low-use zones might actually take pressure off the higher-use zones near hotels and lodges.

There is a danger, however, that the development of new roads could result in the deterioration of existing roads, if road expansion exceeds the capacity of the parks' Works Departments to maintain the road network. Also, expansion of the road networks has implications for TANAPA enforcement staff and Park Administration, which must be taken into account as part of plan implementation. Too many roads without the requisite management staff could have severe effects on fragile park resources. Thus, future road improvements must be made only after careful analysis. Environmental screening and review should be carried out for each proposed improvement, and this review process should also attempt to weigh the long-term costs and benefits to Tanzania, TANAPA, and park users of proposed improvements. Assessments of proposed improvements should look as far into the future as feasible for sound planning. Planning horizons of 50 to 100 years are not uncommon for unique protected areas around the world, and many of Tanzania's Parks and protected areas are increasing rapidly in global value.

1.2 Background to the Programmatic Environmental Assessment

1.2.1 The purpose for a joint USAID/ TANAPA programmatic environmental assessment

TANAPA and USAID decided early in May of 1999 to work together on a joint Programmatic Environmental Assessment (PEA) of road improvements in Tanzania's National Parks. USAID funds are being used to provide heavy equipment and to support upgrading and maintenance of roads within Tarangire National Park (TNP) and, to a lesser extent, in Lake Manyara National Park (LMNP). Thus, the Agency must ensure these activities are carried out following provisions of the U.S Foreign Assistance Act. Certain USAID procedures under the Agency's environmental regulations (Regulation 216 under 22CFR216) also apply but, under the Foreign Assistance Act, detailed environmental documentation is required when USAID supports "construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands" (Section 118 of the FAA as amended in 1992 -- See *Annex D.1* of the *PEA Scoping Statement* for the exact language.) Also, under FAA Section 119 (11) "any direct or indirect assistance" is denied for "actions which significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas."

At the same time, TANAPA and Tanzania's National Environmental Management Council (NEMC) have environmental policies and suggested procedures governing activities with potential for significant environmental impacts (see, respectively, *Annex D.2* and *D.3* of the *PEA Scoping Statement*).

Realizing that USAID would be required to undertake an environmental assessment for its support for road improvements in Tarangire, TANAPA and USAID viewed this as an opportunity to work together as partners to help further develop TANAPA's environmental assessment capacity. It was also seen by TANAPA as a vehicle for extending the environmental assessment process to all of Tanzania's National Parks.

USAID/Tanzania and TANAPA recommended that this be done by pursuing a USAID Programmatic Environmental Assessment (PEA) that also follows and incorporates TANAPA's Environmental Impact Assessment (EIA) Procedures. By doing so, TANAPA would be assisted in developing environmental criteria and standards for all National Park roads. The product includes a set of procedures for environmental screening of various categories of proposed road activities, and for conducting environmental reviews of proposed road construction, rehabilitation, realignment, operation and maintenance, and decommissioning over which TANAPA has responsibility. These procedures are provided as separate stand-alone documents entitled *TANAPA Procedures for Environmental Reviews of Road Improvements*. Also developed as a separate document to the PEA are *TANAPA Environmental Management Plan Guidelines for Road Improvements*. Typically, environmental assessments provide long lists of mitigation and monitoring recommendations; however, the preparation of these lists consumes the bulk of the assessment level of effort, and the end result is that assessments often contain little or no guidance on how to implement the recommendations. The *Environmental Management Plan Guidelines* provide a framework that can be used to describe who will be responsible for implementing the various recommendations, how and when actions will be taken, and estimated time and cost requirements.

1.2.2 Objectives of the PEA

The results expected from the PEA included:

1) a process and management structure for environmental screening and review of TANAPA roads;

2) general environmental criteria and guidelines for proposed road activities in National Parks, that TANAPA can use to determine the appropriate level of environmental analysis for park roads, what criteria/guidelines/standards to follow, and how to make appropriate environmental decisions;

3) capacity and awareness building that strengthens EIA, sound environmental design, and improved management of TANAPA roads;

4) effective mitigation at the various stages of road improvements, including planning and design, construction, operation and maintenance, and decommissioning;

5) an environmental management plan outlining, among other things, responsibilities and timelines for mitigation and monitoring;

6) a set of guidelines and best engineering practices for environmentally sound design and implementation of road improvements; and

5) specific information pertinent to USAID-supported roads so that road activities can be implemented in compliance with USAID environmental procedures.

The joint PEA/EIA was conducted in such a way that it satisfied both USAID and TANAPA requirements.

1.2.3 Regulatory considerations

USAID/Tanzania Programs

USAID is working with the Government of Tanzania to maintain and increase the value of Tanzania's spectacular protected areas, by providing targeted assistance in management of their ecosystems and biodiversity.

To provide a framework for understanding USAID's rationale for the PEA, USAID/Tanzania's Strategic Objective #2 (SO2) is: *Improved conservation of coastal resources and wildlife in targeted areas.* (Strategic Objective Grant Agreement Amplified Description, August 11, 2000.)

- Intermediate Result (IR) 2.1—Key Natural Resource Management Policies Applied. This IR focuses on assisting the Government of

Tanzania (GOT) to implement the new Wildlife Policy of Tanzania, including supporting the drafting of legislation, regulations and procedures. The SO2 team also expects to assist the Department of Environment to implement Environmental Policy. Another focus is to develop an Integrated Coastal Management Policy. Additional policy reforms may be pursued during the life of the SO2 program.

- IR 2.2—Increased Effectiveness of Institutions that Support Natural Resources Conservation. The SO2 team will work with selected GOT institutions and Tanzanian Community Based Organizations (CBOs) and Non-governmental Organizations (NGOs). The approach is to increase the skill base of individuals in targeted institutions and to promote organizational improvements directed by the institutions themselves. US-funded partners will assist their Tanzanian counterpart organizations in achieving this IR.

- IR 2.3—Improved Management of Targeted Protected Areas. This result focuses on improving the management of targeted protected areas in both parks and game reserves. The current focus is on Tarangire National Park and Lake Manyara National Park. USAID also intends to work with the Wildlife Division in Ugalla Game Reserve.

- IR 2.4—Community-based Conservation (CBC) Regimes Functioning in Target Areas. The SO2 team will assist communities in gaining legal authority to manage wildlife, and to develop and implement collaborative district and community-level plans for use and management of natural resources in communities adjacent to protected areas. Included in this IR are a) assistance to promote legislation to implement the Wildlife Policy by establishing Wildlife Management Areas (WMAs) and/or Community Forest Reserves and to develop WMA and Natural Resource Management Plans; and b) training and skill development for NRM approaches, such as improved beehives and beekeeping, and the development and management of natural-resource-based enterprises utilizing sustainable practices.

Activities are funded under the Participatory Environmental Resources Management (PERM) Project, the Tuskegee University-Sokoine University of Agriculture Linkage Project, and several buy-ins to global projects, which in FY 99 were grouped and presented in USAID's Congressional notification as the Tanzanian Environment and Natural Resources Partnership.

Approximately 20 partners are engaged in an integrated partnership to achieve environmental and natural resources results under SO2 thematic areas and IRs. Directly funded USAID partners include: Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ)/Tanzania, Department of Interior (DOI), Environment Education and Communication Project (GreenCom), World Resources Institute (WRI), University of Rhode Island (URI) Tanzanian Coastal Management Partnership (TCMP), Africare, African Wildlife Foundation (AWF), World Wildlife Fund-US (WWF), the Peace Corps, and the Tuskegee University-Sokoine University of Agriculture (TU-SUA) Linkage project. Other members of the partnership funded through these partners or through government contributing agencies include: the Division of Environment, the Wildlife Division, Tanzania National Parks (TANAPA), National Environment Management Council (NEMC), Lawyers Environmental Action Team (LEAT), Journalists Environmental Association of Tanzania (JET), and the Maasai Advancement Association.

USAID Regulatory Requirements

Under USAID/Tanzania's Initial Environmental Examination (IEE) of 19 May, 1999, **Categorical Exclusions** are recommended for policy-related studies, research, training, capacity building and similar activities of EPIQ/Tanzania, DOI, Greencom, WRI and URI/TCMP, pursuant to 22 CFR 216.2(c)(2)(i) [technical assistance and training], (iii) [analyses, studies, workshops and meetings] and (v) [document and information transfers].

Negative Determinations with Conditions are recommended for activities of Africare (PORI 1-3

and PORI-4), African Wildlife Foundation, US Peace Corps, WWF-US and TU-SUA Phase II Linkage project, **excluding** roads in national parks. The conditions are utilization of, and adherence to, the Africa Bureau **environmental screening and review procedures**. Under the IEE (Section 4.2 and Annex A), a set of steps is laid out to ensure adequate environmental review of USAID-supported activities, based on the Bureau's *Environmental Guidelines for Small-Scale Activities in Africa.* The IEE also calls for SO2 partners to receive training and capacity building in how to apply the procedures and ensure environmentally sustainable activities.

A **Positive Determination** was recommended for road-rehabilitation activities to be undertaken by SO2 partners (currently TANAPA and AWF) in protected areas—in this case, Tarangire and, potentially, Lake Manyara National Parks. A positive determination was reached, because of 1) potential impacts on relatively undegraded forest pursuant to FAA Section 118(c)(15), endangered species/habitat per 22 CFR 216.5, or because of other potentially significant adverse effects which could not be excluded without further study of each road segment. In response to this determination, a joint Programmatic Environmental Assessment was proposed which would satisfy USAID Environmental Procedures, satisfy USAID needs, achieve compliance with TANAPA policy, build capacity in EIA, and set the stage for more broadly applicable road-related environmental analysis, mitigation and monitoring associated with national parks.

In order to comply with SO team responsibilities, the SO2 team is to continue to monitor all ongoing and proposed new activities to ensure that they remain Categorical Exclusions or within the bounds of the Negative Determination with conditions for environmental screening and review. The team will, at a minimum, re-validate the determinations when the SO2 partners submit annual work plans. For any extension or modification of an existing contract or agreement, or any new contract or agreement with these partners, an IEE amendment will be prepared to substantiate or revise this determination in accordance with the proposed activities.

Government of Tanzania and TANAPA Environmental Requirements

The PEA has been carried out in close consultation with the National Environmental Management Council (NEMC) of Tanzania, and follows both USAID environmental procedures as outlined above and those outlined in NEMC's *Tanzania Environmental Impact Assessment Procedure, Volume 1, EIA Procedure and General Information, 1997.* These guidelines are currently in the form of Policy only; however, it is anticipated that in the future they will be incorporated into EIA law for Tanzania. In addition, the PEA *Scoping* exercise attempted to follow NEMC's *Tanzania Environmental Impact Assessment Procedure, Volume 2, Screening and Scoping Guidelines, 1997,* which are provided in draft in *Annex D.3* of the *PEA Scoping Statement.*

An effort has been made to harmonize USAID requirements for the actual PEA with those of NEMC's, as contained in *Tanzania Environmental Impact Assessment Procedure, Volume 3, Report Writing Guidelines, 1997.*

TANAPA also has policies and procedures related to EIA and roads in *the National Policies for National Parks in Tanzania,* prepared by the National Parks National Policy Committee, March 1994. These are summarized in *the PEA Scoping Statement Annex D.4.* The PEA attempts to be consistent with these policies as well.

1.2.4 Activities being assessed

Through consultation with TANAPA personnel and stakeholders during the scoping exercise, a decision was taken by USAID and TANAPA to include assessment of new roads and road realignments in addition to road rehabilitation.

Road improvements in Tanzania's National Parks are generally budgeted, and planned for, on a park-by-park basis under the jurisdiction of each park's Warden in Charge. Two recent studies examined road improvement issues. The first, *The Serengeti Conservation and Development Project, Environmental Impact Assessment* was completed in June 1997 by Norconsult Tanzania Limited. This document is accompanied by a *Working Paper for Workshop on the Organization of the Work of the*

Roads Unit of Serengeti National Park, which proposes standards for roads and tracks. It also provides specific recommendations for maintenance, organization of roads units teams, operator reporting, job costing, personnel needs, etc. The second, *Draft Road Assessment Report Tarangire National Park, Tanzania*, was conducted by the U.S. Department of Interior and completed in April 1998. Both reports contain information especially pertinent to this PEA. These two assessments used different road classifications systems which, while similar, required harmonization to develop environmental assessment guidelines that can be applied to the various classes of roads in all the National Parks.

1.3 PEA approach and methodology

1.3.1 Scoping

When a PEA or an EA is prepared, the originator of the action, in this case USAID/Tanzania, begins a process of identifying the significant issues related to the proposed action and determining the range of issues to be addressed in the document. Known as "*scoping,*" this process was carried out from 28 November through 19 December, 1999, and is outlined in *Appendix A: PEA Scoping Statement.*

The draft *Scoping Statement* was provided to the USAID/Tanzania Mission Environmental Officer and SO2 Team Leader, TANAPA's Planning Unit, the National Environmental Management Council, the REDSO/ESA Regional Environmental Officer (REO), and the USAID Africa Bureau Environmental Officer (BEO). The BEO distributed the *Scoping Statement* for comment from 27 December, 1999 to 28 January, 2000. It was provided to other USAID offices and U.S. Government departments and agencies, including the Department of Interior, Bureau of Land Management and the U.S. Forest Service. This provided a period of approximately 4 weeks for review and approval prior to initiation of the PEA on 31 January, 2000.

The *Scoping Process*:

- identified the key issues to be assessed during the PEA;
- defined focus disciplines required to assess the most significant environmental concerns as a guide to preparing future scope of work for an interdisciplinary PEA team;
- proposed that the PEA include an environmental screening and review process, guidelines and a management structure for environmentally sound design of future TANAPA roads and road improvements;
- underscored that the PEA should contribute to sounder design, construction, operation and decommissioning of TANAPA and other protected area roads, thereby reducing potentially adverse environmental impacts and avoiding the costs of correcting serious problems after the fact.

Key issues identified during scoping included:

- control of erosion and siltation;
  - soil erosion associated with off-road driving,
  - soil erosion associated with poor road design,
  - soil erosion associated with poor road maintenance,
- changes in water flow;
- construction camp siting and control of waste and sanitation and other related issues;
- road surfacing issues;
- impacts on scenery and changes in views or other aesthetic considerations;
- potential effects on historic, archeological, or cultural heritage sites, or sites of special ecological significance;
- road rehabilitation through relatively undegraded forest;
- tropical forest conversion;
- wetland conversion;
- species and habitat loss;

- loss of biodiversity;
- institutional management issues.

Issues not considered significant enough to be covered under the PEA included:

- potential injury to people and animals;
- health impacts associated with impoundment of stagnant water;
- changes in access to schools and other social services;
- effects of noise on animals;
- possible introduction of pest plants or animals and/or exotic flora or fauna into a park;
- dust;
- water quality;
- pesticides.

The draft *Scoping Statement* was subsequently reviewed by the PEA Team and the final version, together with comments from the reviewers of the draft, is provided in *Appendix A.*

1.3.2 PEA methodology

In accordance with USAID's environmental requirements under 22CFR 216.6 (e), consultations were held between USAID and Government of Tanzania representatives during the Scoping Process, as well as during PEA preparation (see *Appendix A: PEA Scoping Statement - Annex A Scoping Schedule and People Consulted During the Scoping Process).*

Table 1.1 provides the Programmatic Environmental Assessment Schedule and the people consulted during the actual PEA.

PEA Team selection occurred after review of the *Scoping Statement,* in order to ensure that the team would have the necessary mix of skills needed to address each key issue identified during scoping. The full Team worked together over a period of approximately 4 weeks, from 31 January, 2000 through 03 March, 2000.

The PEA Team consisted of the following individuals:

- Team Leader, Professor Raphael Mwalyosi, Institute of Resource Assessment, University of Dar es Salaam;
- Associate Team Leader, Wes Fisher, USAID/African Wildlife Foundation Consultant;
- Senior Planning Manager, TANAPA Planning Unit, Joseph Kessy;
- Senior Ecologist, TANAPA, Emmanuel Gereta;
- Road Inspector, Tarangire National Park, Ishael Varoya;
- Civil Engineer, National Park Service, U.S. Department of Interior, Richard Engle;
- EIA Specialist, National Environmental Management Council, Zafarani Madayi;
- EIA Specialist and Planner, African Wildlife Foundation, Allan Kijazi.
- Brief Biographical Sketches of the PEA Team are provided in *Section 10.*

Because of limitations on time and resources available to carry out the PEA, the assessment was designed to examine only a representative sample of road improvements found in Tanzania's parks. The PEA fieldwork took place in five Northern Circuit parks: Tarangire National Park (TNP), Lake Manyara National Park (LMNP), Serengeti National Park (SNP), Arusha National Park (ANAPA) and Kilimanjaro National Park (KINAPA). The Team endeavored to assess environmental impacts for road improvements under all TANAPA road classifications, covering a full range of geological, soil, meteorological, topographic and ecological conditions existing in the parks.

Total miles traveled by the PEA Team are estimated as follows:

Date (2000)	Approx km within park	Location
02-Feb	50	Tarangire
03-Feb	212	Tarangire
04-Feb	279	Tarangire
05-Feb	150	Tarangire (estimated km)
06-Feb	180	Tarangire – Manyara
07-Feb	99	Manyara
08-Feb	73	Manyara
09-Feb	170	Manyara – Serengeti
10-Feb	291	Serengeti
11-Feb	295	Serengeti
12-Feb	219	Serengeti
13-Feb	50	Serengeti – Arusha
14-Feb		Arusha
15-Feb	40	Arusha NP
16-Feb	60	Arusha NP - Kilimanjaro
17-Feb	40	Kilimanjaro – Arusha
Total	**2208**	

Tasks

The Programmatic Environmental Assessment involved the following:

Task 1: 24 – 29 Jan. Logistics preparation and gathering of documents and reference maps by the Team Leader, AWF EIA Specialist, and USAID/AWF EIA Consultant (Associate Team Leader).

Task 2: 31 Jan – 18 Feb. Team preparation and fieldwork. This period accommodated the schedules of TANAPA Team members. The Serengeti Road Inspector joined the Team at Lake Manyara and participated in all the remaining PEA fieldwork. TANAPA's Senior Planning Manager was present for assessments in all parks, missing one day in Lake Manyara due to official business at TANAPA Headquarters. The Senior Ecologist was not able to participate fully at Tarangire or Lake Manyara due to conflicting engagements, but was present for all assessment work in Serengeti, Arusha National Park and Kilimanjaro. All other team members participated fully.

Working from the detailed Scopes of Work provided in *Annex E* of the *Scoping Statement*, each Team member had specific responsibilities, including field observation, and analytical and writing tasks. Careful attention to SoW preparation prior to initiating the PEA helped avoid duplication of effort and allowed each team member to make specialized contributions.

Task 3: 18 Feb – 02 Mar. Upon completion of fieldwork, the team assembled to prepare draft sections of the PEA/EIA.

Task 4: 03 Mar – 30 Mar. The Team Leader consolidated the sections into the draft PEA in Dar es Salaam, with assistance from the Associate Team Leader in Stow, Massachusetts. This draft was then circulated for comment to TANAPA, USAID/ Tanzania, the U.S. Department of the Interior (DOI), REDSO/ESA, the USAID BEO, USAID's AFR/SD/ANR, the team members, and others, from 17 April – 11 May.

Task 5: 11 May – 16 May. After the Team Leader received comments, a team review meeting was held in Arusha to consider the comments and agree as a group on revisions to the final PEA/EIA document. (This consolidated approach avoided protracted responses and negotiations with the key reviewers.)

Task 6: On 17 May, a one-day seminar was held with TANAPA park personnel to discuss implementation of the PEA, proposed TANAPA *Procedures for Environmental Reviews of Road Improvements*, and the proposed *TANAPA Environmental Management Plan Guidelines for Road Improvements* annual *Environmental Management Plan* for TANAPA road improvements. USAID staff were de-briefed by the Team Leader and Associate Team Leader on 18 May in Dar es Salaam.

Task 7: The Team Leader and Associate Team Leader prepared revised draft PEA/EIA documents on 19 December, 2000, incorporating suggested revisions emerging from the review meetings. Comments on this draft were subsequently incorporated into the final document and then submitted to USAID and TANAPA 23 March, 2001.

Table 1.1: Timing/Phasing of the PEA

Dates	Task	Locations	Comments
27 Dec – 28 Jan, 2000	1. Comments from TANAPA, NEMC, USAID/Tanzania, REDSO/ESA REO, USAID Africa Bureau BEO, DOI, etc. on *Draft Scoping Document* 2. Drafts distributed by Fisher and C. Gallegos (Bureau Environmental Officer) for review	Arusha Dar es Salaam Nairobi, Washington, D.C., etc.	
Mon 24 Jan - Sat 29 Jan	1. Team Leader (and Associate Team Leader) gathered background materials, maps, handbooks and guidelines for PEA and assembled packets for team members 2. Logistics preparation 3. Refinement of Scopes of Work for the PEA Team	Dar es Salaam	Meeting with Esther Kerario of NEMC and assignment of Zafarani Madayi to the PEA as NEMC's representative Meeting with Gilbert Kajuna USAID Mission Environmental Officer The following documents were obtained: - World Bank handbook on *Roads and Environment: A Handbook* (1997) - 3 copies - IRA land use maps for the Parks - Topographic Sheet sets in Dar - NEMC EIA checklists, procedures and policy guidelines - copies of TANAPA DALP - copies of TANAPA policies governing EIA -copies of appropriate Management Zone Plans, Gen. Management Plans, district plans, etc. for Tarangire, Lake Manyara, Serengeti, Arusha and Kilimanjaro and Ruaha Parks -University of Milan Tarangire maps from Dr. Valeria Galanti at Tarangire
Sun 30 Jan	USAID/AWF EIA Specialist (Associate Team Leader) flies to Arusha	Arusha	
Mon 31 Jan	1. Team assembled 2. Initial Team review of Scoping Statement on background, purpose, objectives and expected results 3. Introduced Team to TANAPA HDQ	Arusha	Initial meeting with TANAPA's Director General, Mr. Lota Melamari, to introduce the PEA and PEA Team and identify a TANAPA Road Engineer to be part of the Team.

Dates	Task	Locations	Comments
	4. Team review of SoWs		
Tues 01 Feb	1. Team review of materials 2. Assembled additional background materials 3. Team meeting to discuss SoWs and writing tasks	Arusha	Kessy/TANAPA confirmed availability of Dyauli (Tarangire Road Works Supervisor) and Porokwa (Tarangire CCF Warden) Team Leader (R. Mwalyosi) met again with the D.G. on the need for full involvement of TANAPA expertise in the PEA. Decision made by the D.G. to provide Serengeti's Road Inspector, Ishael Varoya, as PEA Team member.
Wed 02 Feb	1. Additional logistics preparation 2. Drive to Tarangire Safari Lodge 3. Introduced team and initial briefing by Tarangire Park staff, including WIC Edward Lenganasa	Arusha Tarangire	
Thu 03 Feb	Assessed roads in Core Preservation Zone	Tarangire	Traveled along the ridge road to Buffalo Pools Special Campsite, new TTCL cell tower and Poacher's Hide. Followed Tarangire Hill road and returned to Tarangire Safari Lodge via crossing at Kuru Ranger Post, traveling north following the east side of the Tarangire River and crossing at Sopa Lodge bridge.
Fri 04 Feb	Assessed roads in Semi-Wilderness, Wilderness and Conservation General-Use Zones	Tarangire	Traveled south paralleling Silale Swamp, on to the beginning of the Larmakau crossing to Loiborserrit Ranger Post. Traveled from Kuru Ranger Post further south to Chubi Ranger Post. Then north from Chubi along the park's western boundary via Mamire Ranger Post, Sangaiwe Ranger Post and back to Park Headquarters.
Sat 05 Feb	Assessed representative roads in Tarangire National Park	Tarangire	Traveled to Boundary Hill Ranger Post and environs in the north and northwestern Core Preservation Zone and Conservation General-Use Zone near Boundary Hill, including portions of the east and west sides of Silale Swamp.
Sun 06 Feb	1. Morning Team breakfast meeting and de-briefing for Tarangire Park personnel, including WIC Lenganasa 2. Traveled to Lake Manyara National Park	Tarangire Lake Manyara	Dyauli and Porokwa accompanied the Team on all field visits in Tarangire.
Mon 07 Feb	1. Team introductions and meeting with Lake Manyara staff, including WIC Marietha Lohay Kibasa and Frank Silkiluwasha, Park Ecologist 2. Assessed representative Lake Manyara roads	Lake Manyara	

Dates	Task	Locations	Comments
Tues 08 Feb	1. Assessed representative Lake Manyara roads 2. Team Meeting and evening de-briefing of WIC M.L. Kibasa	Lake Manyara	Traveled as far south as Maji Moto hot springs.
Wed. 09 Feb	1. Traveled to Serengeti with early morning departure from Lake Manyara 2. Settling in at Seronera Lodge and note consolidation	Lake Manyara Serengeti	Viewed murram pits on the open plains near Naabi Hill Park Gate.
Thurs 10 Feb	1. Assessed representative Serengeti roads 2. Team introductions and meetings with Serengeti staff including WIC Justin Hando.	Serengeti	Traveled west to Grumeti Intensive-Use and Grumeti Low-Use Zones and visited Nyankoromo construction camp.
Fri 11 Feb	Assessed representative Serengeti roads	Serengeti	Traveled to Fort Ikoma. Visited vehicle and heavy equipment workshop nearing completion. Traveled north to Tabora Guard Post. Proceeded across Northern Serengeti through Low-Use, Wilderness and Intensive-Use Zones to near Kleins Camp. Traveled south to Ngare Naronja Springs and Lobo Lodge. Returned to Seronera Lodge.
Sat 12 Feb	Assessed representative Serengeti roads	Serengeti	Morning travel to assess roads in Intensive-Use, Off-Road and Special-Zone Low-Use near Lake Magadi, Simba and Moru Kopjies Afternoon travel to Gol Kopjes Special-Use Zone, Moderate-Use and No-Access Zones.
Sun 13 Feb	Drive to Arusha	Serengeti Arusha	
Mon 14 Feb	Team planning meeting and writing	Arusha	
Tues 15 Feb	1. Introduced team to Arusha National Park staff, including Deputy Park Warden in Charge, Simon Aweda; and Tourism Warden, Mary Jerome 2. Assessed representative roads in Arusha National Park 3. Overnight stay at Momela Lodge	Arusha	Morning travel on Momela Lakes Circuit including Small Momela Lake and Kinandia Swamp, Lake Rishateni, Big Momela Lake, and Lake Tulusia. Afternoon travel to Mt. Meru Miriakamba Huts with stops at viewpoints, the Arched Fig Tree, and Maio waterfalls near the Jekumia Picnic Site.
Wed 16 Feb	1. Assessed representative roads in Arusha National Park 2. Traveled to Moshi	Arusha Moshi	Visit to old quarry within the park near Lake El Kekhotoito. Stop at Lake Longil. Traveled to Ngurdoto Crater and stopped at various viewpoints, including Leiton Viewpoint and new TTCL

Dates	Task	Locations	Comments
			Tower and Buffalo Viewpoint and Picnic Site. Visit to active murram quarry outside the park, near Serengeti Ndogo.
Thu 17 Feb	1. Traveled to Kilimanjaro National Park 2. Introduced Team to Tourism Warden Erastus Ufunguru and Warden in Charge, Lorivi Ole Moriana at Marangu Headquarters 3. Assessment of representative roads 4. Returned to Arusha	Arusha Kilimanjaro	Traveled the Marangu track beyond Park Head quarters (approximately 6 kms). Observation of abandoned and new trails above the Marangu track. Traveled to western side of the mountain on the Shira Road approach via Londorosi Gate. Road conditions were observed on the approach outside the park, through the Forest Reserve, and inside the park to the transition zone between heather and moorland at approximately 2750 metres.
Fri 18 Feb	1. Planned writing tasks 2. Prepared drafts on affected environment, baseline and trends	Arusha	
Sat 19 Feb	Prepared drafts on affected environment, baseline and trends, alternatives, and institutions	Arusha	
Sun 20 Feb	Day off		
Mon 21 Feb	Reviewed drafts on affected environment, baseline and trends, alternatives and institutions	Arusha	
Tues 22 Feb	Development of impacts matrix	Arusha	
Wed 23 Feb	1. Review of impacts matrix 2. Drafting impacts and mitigation sections		
Thu 24 Feb	1. Drafting impacts and mitigation sections 2. Discussion of institutional issues in environmental screening and review		
Fri 25 Feb	Section drafting		
Sat 26 Feb	Section drafting	Arusha	
Sun 27 Feb	Day off	Arusha	
Mon 28 Feb	1. Section drafting 2. Team review of section drafts		
Tue 29 Feb	1. Section drafting 2. Review of *Environmental Impact*		

Dates	Task	Locations	Comments
	Consideration Checklist and Step-by-Step Guide for Environmental Reviews of TANAPA Road Improvements		
Wed 01 Mar	1. Status of drafts 2. Section drafting	Arusha	Meeting of Team Leader, Associate Team Leader and the U.S. National Park Service Representative with Roughton International Team Leader for a *Feasibility and Environmental Study of the Makuyuni - Lalago Road* for the Ministry of Works. Also discussed EIA guidelines being developed by Roughton for the Ministry of Transport and Telecommunications.
Thu 02 Mar	1. Team review of remaining Team writing details and PEA task completion schedule 2. Team review of process for categorizing environmental significance of road improvement activities 3. Team Leader, USAID/AWF EIA Specialist and NEMC representative fly back to Dar	Arusha Dar es Salaam	
Fri 03 Mar	1. Team Leader, USAID/AWF Specialist and NEMC representative debrief USAID/ Tanzania and NEMC 2. USAID/AWF EIA Specialist departs Dar es Salaam	Dar es Salaam	1. Fisher/Mwalyosi debriefed USAID Tanzania MEO and SO2 Team Leader Gilbert Kajuna, SO5 Team Leader Yohannes Mulugetta, SO4 Peter Hartmann, SO3/SO4 Hamida Sarkar, SO1 Amy Cunningham, SOS Patricia Rader and Hedwiga Mbuya. 2. Zafarani Madayi debriefed Esther Kerario and Paul Mtoni.
Sun 05 Mar	1. Team Leader continues PEA/EA drafting and consolidation of sections	Dar es Salaam	
06 - 31 Mar	Team Leader prepared PEA/EA draft through virtual communication with USAID/AWF EIA Specialist (20 days for Team Leader)	Dar es Salaam	
06 Mar – 18 Apr	USAID/AWF EIA specialist reviewed PEA/EA draft and prepares draft *TANAPA Procedures for Environmental Reviews of Road Improvements* based on PEA/EA findings and recommendations	Boston, MA	
17 Apr – 22	Receipt of comments on draft		

Dates	Task	Locations	Comments
May			
10 May	USAID/AWF EIA Specialist returned to Tanzania for Final Review Meeting on the PEA/EIA to be held in Arusha	Dar es Salaam	
11 May	Team Leader and USAID/AWF Specialist returned to Arusha to work with TANAPA Kessy, et al., in preparation for final review meeting on PEA/EA and incorporation of comments	Dar es Salaam (meeting with Gilbert Kajuna, MEO) Arusha	
12 – 16 May	1. Final review meetings and incorporation of comments	Dar es Salaam Arusha	
Wed 17 May	1. TANAPA staff workshop on PEA recommendations and implementation 2. Team Leader and USAID/AWF debrief TANAPA D.G., L. Melamari	Arusha Arusha	
Thur 18 May	Debrief USAID/Tanzania Mission Staff		
Mon 18 Dec	Comments and revisions to draft incorporated and new draft submitted for review.		
Wed 21 Feb'01	Team Leader provides additional review comments		
9-12 April '01	Final approval for printing and discussion with D.G. of implementation of PEA recommendations	Arusha	
Sat 14 April	USAID/AWF Specialist returns to U.S. and oversee printing		
April 2001	Publication of PEA/EIA and of *TANAPA Procedures for Environmental Reviews of Road Improvements and TANAPA Environmental Management Plan Guidelines for Road Improvements*		

1.4 National Park context

1.4.1 Previous road improvement initiatives in the National Parks

There are no clear guidelines on the design, construction, and maintenance of roads in Tanzania's National Parks. The decision on improvement of roads in Tanzania's National Parks is generally made by the park's Warden-in-Charge, together with the person in charge of park roads. As mentioned in Section 1.2.4, two important road improvement initiatives have been supported by donors: The Serengeti Conservation and Development Project, financed by the European Union; and a roads assessment conducted by the U.S. Department of Interior for Tarangire National Park with USAID/Tanzania and AWF support.

The Serengeti Conservation and Development Project focused on improving the road network in Serengeti by providing different road equipment, classifying the roads into different categories, and carrying out an environmental analysis of selected road improvement impacts. Under the DOI Tarangire road assessment, the road network was reviewed in depth and recommendations made for parkwide improvements. As part of this assessment a road classification system was developed and proposed for use by Tarangire National Park.

To assess environmental issues associated with peak roads, it was considered necessary to harmonize the two road classifications for Tarangire and Serengeti National Parks, and to devise a road classification applicable to all national parks in Tanzania.

1.4.2 Park road purposes and the road classification system employed

The system of road classification as proposed under this PEA is based on usage, width, and type of construction. This proposed system is consistent with both the present Serengeti National Park system, and the classification system proposed by the DOI report for Tarangire National Park. Under this PEA, roads within the Tanzanian National Parks are classified as shown in Table 1.2 below:

Table 1.2: USAID/TANAPA Programmatic Environmental Assessment Standardized Road Classification System for Tanzania National Parks

ROAD USE	CLASS	DESCRIPTION	AVERAGE TRAVELED WIDTH
Major Access	Class I	Cambered, ditches, turnouts, murram surfacing, full 2-lane traffic, all-weather 2WD; roads are shaped and cambered, have drainage ditches and turnouts for removing water from roadway, and have been surfaced full length with murram	7 m
Minor Access	Class II	Cambered, ditches, turnouts, murram surfacing, 1-lane with room for slow speed passing, all-weather 2WD; roads are shaped and cambered, have drainage ditches and turnouts for removing water from roadway, and have been surfaced full length with murram	4.5 m
Minor Access	Class III	Cambered, ditches, turnouts, 1-lane with room for slow speed passing, all-weather 4WD; roads are shaped and cambered, have some drainage ditches and turnouts, and have limited amount of murram at soft spots	4.5 m
Game Viewing	Class IV	Cambered, ditches, turnouts, 1-lane, may not be accessible at all times, 4WD; roads are shaped and cambered, have some drainage ditches and turnouts, and have limited amount of murram at soft spots	3 m
Game Viewing	Class V	No camber or shaping but could be lightly graded, 1-lane, not accessible during wet season, 4WD, basically 2-track	3 m
Administrative	Class V	No camber or shaping but could be lightly graded, 1-lane, not accessible during wet season, 4WD, not open to visitors; basically 2-track	3 m

1.4.3 Road Management – Requirements, Procedures, Responsibilities and Staffing Levels

Different inputs are required for construction and maintenance of park roads, including use of motor graders, bulldozers, wheel loaders, backhoe loaders, trucks and tippers, compactors, etc. Inputs vary considerably from park to park, depending on park usage, topography, climate, soil, and geology. While graders may not be required in a smaller park such as Kilimanjaro, this equipment is essential in parks such as Serengeti, Tarangire and Lake Manyara.

Materials are required for construction and rehabilitation of park roads. In many cases murram is used to make roads accessible throughout the year. Murram is applied to earth roads to increase the bearing capacity of the soils, which are weak and slippery during the wet season. Cement, stones, iron bars, corrugated culverts, coarse and fine aggregate may also be required for construction of water crossings, drifts, and bridges.

In all national parks, management of roads is under the Works Department. In each Works Department there is a road sub department, responsible for construction and maintenance of the roads. Construction or major rehabilitation involves several steps:

- Preliminary survey on the route of the road;
- Route clearance, including the removal of bushes, trees, stones, and topsoil;
- Construction of water crossings using culverts, drifts, and bridges;
- Shaping to form a road camber;
- Watering and compaction of the subgrade soil;
- Applying the layer of murram on the road as needed;
- Spreading, watering, and compacting the layer of murram.

Responsibilities related to management of park roads vary from one park to another. This variation depends on the number of roads and type or class of road, and on usage levels. Allocation of staff for the roads sub department in the parks must take these factors into consideration. For example, Serengeti National Park has over 1000 km of existing roads, requiring a road engineer, heavy plant operators, and different teams for road maintenance. On the other hand, staff requirements for parks such as Arusha, Gombe, Mahale, or Kilimanjaro may be much more limited.

1.5 Results of the PEA

The results from this PEA include a set of environmental procedures for screening of various categories of proposed road activities, and for conducting environmental reviews of proposed road construction, rehabilitation, realignment, operation and maintenance, and decommissioning over which TANAPA has responsibility. These procedures are provided as a separate stand-alone document entitled *TANAPA Procedures for Environmental Reviews of Road Improvements*.

Typically, environmental assessments provide long lists of mitigation and monitoring recommendations; however, the preparation of these lists consumes the bulk of the assessment level of effort, and the end result is that assessments often contain little or no guidance on how to implement the recommendations. The Team has therefore prepared a second stand-alone document entitled TANAPA *Environmental Management Plan Guidelines for Road Improvements*. These *Guidelines* provide the guidance needed for preparation of annual *Environmental Management Workplans* at the park level that can be used to describe who will be responsible for implementing the various recommendations, how and when actions will be taken, and estimated time and cost requirements. Both the *TANAPA Procedures for Environmental Reviews of Road Improvements* and the *TANAPA Environmental Management Plan Guidelines for Road Improvements* are discussed in more detail below.

In addition, the PEA helped TANAPA begin developing environmental criteria and standards for all National Park roads.

The exercise also strengthened TANAPA's capacity to conduct environmental impact analyses.

2. Proposed Action and Alternatives

This PEA examines a representative set of proposed road improvement actions of interest to TANAPA in all of Tanzania's National Parks. It also meets USAID's specific requirements for an assessment of representative actions that may be undertaken using USAID-funded road equipment in the parks, specifically in Tarangire and Lake Manyara National Parks, where USAID support is being provided under USAID/Tanzania's Strategic Objective – *Improved conservation of coastal resources and wildlife in targeted areas (SO2).* For TANAPA's purposes, the PEA is therefore more comprehensive than required under USAID environmental procedures. However, it also meets the requirements of USAID's 216.6(c)(3).

This chapter presents information required by USAID's 22 CFR 216(c)(3) and TANAPA regarding the review and comparison of the proposed action and alternatives in the following order:

- description of the proposed actions;
- description of alternatives to the proposed action, including the no action alternative;
- comparison of the proposed actions and alternatives;
- identification of the preferred alternative, including mitigative measures, not previously included in the proposed action or alternatives.

2.1 Description of proposed actions

The PEA Team examined proposed road improvements in five of Tanzania's northern parks which TANAPA believes provide a comprehensive sample of the types of improvements likely to be undertaken in all parks under varying physical, ecological, landscape and socio-economic conditions. The types of improvements are summarized park-by-park in Sections 2.1.1 through 2.1.5. The road classification outlined in Section 1.4.2.,Table 1.1 is used in this discussion.

On the basis of observations in the five parks, Section 2.1.6 provides a summary of proposed actions expected in all of Tanzania's parks, including Tarangire and Lake Manyara National Parks.

2.1.1 Tarangire National Park

In Tarangire National Park, no new roads are currently planned, except for additional game viewing tracks proposed in the Management Zone Plan for the Conservation General Use Zones East and West. These are planned in order to expand game viewing opportunities (Tarangire MZP: 1994:23, 25). Realignment of the main road leading to the new main gate is also planned in order to serve the new Visitors' Interpretive Center, constructed inside the park.

2.1.2 Lake Manyara National Park

No new roads are currently planned for Lake Manyara National Park. However, in the future, additional game viewing tracks could be added along the forest margin of selected glades in the park. These roads could provide controlled seasonal access, primarily to increase visitor opportunities for viewing lion and leopard.

2.1.3 Serengeti National Park

An inventory of roads in SNP suggests that there are a total of 490 km of roads/tracks identified for rehabilitation, while 830 km of new road will need construction over a period of five years, effective from 1999/2000 (Serengeti: MZP: 1996).

2.1.4 Arusha National Park

Arusha National Park has only 85 km of roads. Presently, most of these roads seem to be in good condition and do not need major rehabilitation. No

GMP or MZP exists for the park at present. Future management plans could potentially allow additional game viewing tracks associated with Ngurdoto Crater and the Ride-on area of the park.

2.1.5 Kilimanjaro National Park

Kilimanjaro National Park has very few roads/tracks, and most of these are within the forest reserve. A 6-km track exists beyond the Marangu gate, and a 23-km track was observed by the PEA Team on the way to Shira Plateau from Londorosi. Both these roads are on rocky, heavily eroded surfaces. Park Management has proposed upgrading for both. The only other track proposed for improvement is Maua-Horombo.

Many trails are used by tourists for scaling Mount Kilimanjaro. They include the Marangu route, Mweka route, Umbwe route, Machame route, and Shira Plateau route. Many of these trails need major rehabilitation, and other "abandoned" trails need effective decommissioning to reduce soil erosion.

2.1.6 Synopsis of proposed actions

Proposed road (or trail) improvements in Tanzania's National Parks are expected to include new construction, realignments, major upgrades, road rehabilitation, routine operation and maintenance, and decommissioning. Virtually all work will be performed using park equipment and equipment operators and common laborers under the supervision of park Works Department personnel. New roads can be Major 2wd (Class I) and Minor Access 2wd (Class II) murramed all-weather surfaces; or Minor Access 4wd (Class III) or Game Viewing roads 4wd (Class IV) — both with limited application of murram at soft spots. New roads may also fall under the category of Game Viewing and Administrative Roads (Class V) which are not accessible during wet seasons, only lightly graded and left unmurramed. TANAPA policy prohibits the use of tarmac (asphalt) for road surfacing, except under exceptional circumstances. Thus, tarmacking of roads is not considered under the PEA.

Construction of new roads or realignments:

During the construction or realignment of roads, trails or firebreaks, the following activities are expected:

- preliminary multidisciplinary survey on the route;
- establishment of equipment workshop support;
- establishment of construction camps;
- location of murram supply and quarries;
- route clearance, including the removal of bushes, trees, stones, and topsoil;
- construction of water crossings using culverts, drifts, and bridges;
- construction of drainage ditches, and runout drains for removing water from the road or trail surfaces;
- shaping to form a cambered surface;
- watering and compaction of the subgrade soil;
- trucking and application of murram on the road or trail as needed;
- cutting and filling;
- spreading, watering, and compacting layers of murram;
- storage of fuel and lubricants;
- waste management.

Rehabilitation, upgrading and routine operation and maintenance:

Activities expected in the National Parks during rehabilitation and upgrading are similar to those for construction although less clearing of vegetation is typically required. The more significant actions are associated with:

- maintenance of runout drains and ditches;
- management of berms along roadways;

- widening existing roads;
- restoration of road camber and shaping to control the flow of water over road surfaces;
- continual road maintenance through murram application;
- dust control;
- maintenance of machinery;
- management of wastes and vehicle pollutants such as petrol, diesel and lubricants;
- efforts to control the spread of exotic species;
- management of vehicle traffic movement, off-road driving and tourist activities.

Road improvements entail upgrading most of the roads to designated standards. In many cases, this involves grading, cambering, cutting and filling, chanelization and heavy use of murram.

Decommissioning

Unlike most rural roads, there are a number of roads and trails within Tanzania's National Parks that have been abandoned and/or are candidates for decommissioning. Re-alignments also require decommissioning of old roads and trails. Well-planned decommissioning can be expected to improve viewshed, scenic quality and visitor experience and reduce the effects of soil erosion. Key activities include:

- ripping the old road/trail surface;
- revegetation using indigenous flora;
- application of techniques to prevent erosion through shaping.

Management and implementation actions

TANAPA organizational structure places prime responsibility for road improvements with the Warden in Charge for each National Park. Thus, decision-making is decentralized and decisions on improvements are made through a roads committee established by the Warden in Charge and consisting at a minimum of staff within the park responsible for road works (including construction and maintenance). The PEA calls for the establishment in each park of an Environmental Management Team for road improvements, each led by a park Environmental Review (ER) Coordinator. The Team's responsibility is to ensure that environmental review, mitigation and monitoring occurs in a systematic and timely fashion for road improvements for all proposed road segment activities. Members should include a roads manager, roads inspector and/or roads foreman for road works, and a park ecologist or an individual with training in environmental review and analysis, mitigation and monitoring. It is anticipated that under most circumstances, the park ecologist will be the person chosen by the Warden in Charge to serve as the Environmental Review Coordinator.

Most decisions on improvements are made during preparation of annual workplans which are used in annual budget submission justifications (typically during May and June). However, decisions may also be made during the year based on unforeseen circumstances and changes in park management priorities. All improvements will be subjected to TANAPA's environmental screening and review process, with signed copies of completed reviews submitted to TANAPA's Planning Manager. In the case of Tarangire and Lake Manyara National Parks, reviews will also be submitted to USAID/ Tanzania's Mission Environmental Officer.

For significant road construction and realignments, review will also be required by the TANAPA Planning Manager and Planning Unit staff responsible for environmental impact assessment. For improvements of this magnitude in Tarangire and Lake Manyara National Parks, review is also required by the USAID Mission Environmental Officer, who determines whether an environmental assessment is required that must conform with USAID's environmental procedures under 22 CFR 216. The *TANAPA Procedures for Environmental Reviews of Road Improvements* include guidance for park personnel on when review by the TANAPA Planning Manager is required.

2.2. Alternatives to proposed actions

Few alternatives are available to perform the same functions as park roads. In most situations, alternatives to roads are neither practicable nor economically viable. However, before constructing new roads or road alignments, or carrying out major rehabilitation or upgrading of existing roads, environmental review of proposed road improvements must consider whether other alternatives might be appropriate and cost-effective. Depending on circumstances, alternatives deserving consideration might include: walking trails; air transport; use of specialized off-road driving and "swamp buggy" equipment; or use of motorized vehicles and all terrain vehicles for mountain rescue and movement of supplies. In special cases, rail or water transport may be appropriate alternatives. Because sufficient information regarding the costs and feasibility of these alternatives relative to specific proposed road improvements cannot be considered in detail here, they are dealt with conceptually under Section 2.2.2. Section 2.2.3 reviews alternative road design and management considerations. Section 2.2.4 considers institutional alternatives for sound environmental design, construction and maintenance of road improvements. The no action alternative is defined immediately below in Section 2.2.1.

2.2.1 The no action alternative

Within an EA or PEA, the alternative of no action must be addressed under USAID environmental procedures (22CFR 216.6(c)(3)). The no action alternative is generally defined as meaning that the proposed activities do not take place. The resulting environmental effects from taking no action are compared with those that would occur as a consequence of the proposed action or alternatives to it.

Under the no action alternative conditions should not be considered unchanging or fixed. In fact, no action can result in significant adverse or beneficial impacts over time, which should, where prediction is feasible, be compared to both the proposed action and other possible alternatives, to determine whether the proposed action is truly the preferred alternative. Sometimes existing conditions are used as an approximate no action measurement (proxy) when major changes are not anticipated and the future is likely to be much like the past.

For the purposes of this PEA, the no action alternative is defined as the continuation of the *status quo* with respect to road construction, operation and maintenance, and decommissioning. In effect this means little new construction, and continued inadequate maintenance. The consequences are considered here for each of the parks assessed by the PEA Team and then summarized at the end of this section.

Tarangire National Park

Most of the primary roads and river crossings in Tarangire National Park are in fair to poor condition, having evolved from dry season overland safari and park administration tracks. The roads provide critical access to the park, from Headquarters to outlying ranger posts, to visitor lodges and campsites, and access to game viewing. Normally, the roads are open to two-wheel drive vehicles during the dry season, but can be difficult to use even with four-wheel drive vehicles in the wet season.

The extreme wet season in 1998 rendered most of the park roads impassable and severely limited or restricted access between Headquarters and ranger posts. Most of these roads were poorly graded, leaving berms on the shoulders and forcing rainwater to flow along the road. As a result, the Team observed significant soil erosion in many locations. Areas experiencing gully erosion are often avoided, leading to off-road driving and multiple tracks, which degrade the environmental quality of the parks. In many cases, grading and erosion lowered roads below the level of surrounding land, making lateral drainage impossible.

Allowing the *status quo* to prevail in TNP would have significant adverse impacts. For example, the Core Preservation Zone ecology and aesthetics would suffer from increased visitor pressure during the high season. Other areas of the park would become less accessible, and other areas that

could be opened to visitors without sacrificing resource values would not be reachable by road. The overall effect would be a decline in visitor revenues needed for sustainable management of park resources.

Lake Manyara National Park

Lake Manyara National Park is accessible to tourists throughout the year up to the Minor Hot Spring (Maji Moto Ndogo). However, even in this area, some road stretches are barely accessible during the wet season due to debris and sediment accumulation on the road. Periodically, during extreme wet years and floods, the lake level rises and damages tracks/roads close to the shore.

Due to the underdeveloped road system in the southern part of the park beyond the Maji Moto Ndogo Springs, this part of the park is accessible at most during the dry season. The possibility exists that the road between Mbulu and Mbuyu wa Gerumani may be upgraded to all-weather standard. Should this occur, it is likely to attract tourists wishing to access Lake Manyara National Park from the southern end. This, in turn, could result in a new gate and development of a road system in the south of the park.

Underutilization of the southern part of the park means that tourists in LMNP will continue to overutilize the northern half, placing increased pressure on the roads/tracks and environment in that area.

Serengeti National Park

Tourists visiting Serengeti National Park have complained about the condition of roads in the park (SCDP/SNP report, 1997). All of Tanzania suffered from exceptionally heavy El Niño rains in 1998, including SNP. The rains caused severe damage to roads, tracks and structures, resulting in the closure of some major and minor roads. Also, most game viewing tracks and anti-poaching tracks were nearly impossible to use and, if used, only with great difficulty. Subsequent assistance from the European Union, and considerable effort on the part of park roads personnel, has returned much of the park road network to usable condition. Off-road driving has occurred at many locations and can be expected to accelerate under the no action alternative, with adverse soil erosion impacts and further deterioration in park aesthetics.

By maintaining and upgrading the existing roads, and constructing new roads to diversify available opportunities for tourists in the park, visitors can be encouraged to spend longer periods in the park, thus enhancing both tour companies' and Tanzania's revenues from tourism. These development goals cannot be realized if the status quo is maintained. Visitor revenues will be insufficient for sustainable park management. Most areas will remain inaccessible and underutilized unless several hundred kilometers of new road and tracks are constructed and many existing roads/tracks are rehabilitated. In the heavily used tourist zones, off-road driving would be likely to increase, with highly detrimental effects on soils, aesthetics, and visitor experience.

Arusha National Park

At the time of the PEA, most park roads were in relatively good condition and accessible throughout the year. However, visiting certain strategic tourist sites is often hampered by relatively poor access. Certain administrative activities, including rescue missions, are also adversely affected.

For example, the sections of the Momella Gate-Miriakamba Hut track beyond the Arched Fig Tree are slippery, steep and hazardous to drivers when wet. Under these conditions, only the most experienced Park drivers are allowed to undertake rescue operations.

The Arched Fig Tree (actually two intertwined Strangler figs) is one of the park's major visitor attractions, since vehicles can drive through it on the road to the Meru Summit. At the Fig Tree, a second track passes next to, instead of through, the tree, perhaps created by visitors turning around at this point, or by larger supply or road maintenance vehicles that cannot pass through the tree. Under the no-alternative scenario, long-term cumulative impacts may adversely affect this exceptional feature.

Also, the access to Ngurdoto Crater is very steep in some stretches and tends to have very sharp

corners difficult to negotiate during the wet season, thus discouraging tourists from accessing the crater. A large stretch of the track around the crater is not accessible by vehicle, so that a number of scenic vantagepoints may only be reached on foot. Potential exists to construct additional viewing points and picnic sites along the rim of Ngurdoto Crater. In the future, Park Management might consider constructing a road to the forest margin on the crater floor, to support a high-cost, low-impact, special campsite. Under the no action alternative, the potential for attracting additional visitors and generating revenues for sustainable management will be limited.

In general, Arusha National Park is not being utilized to capacity. The park could generate much more revenue for TANAPA without significant environmental impacts. The no action alternative would result in deterioration of exceptional resource values and prevent TANAPA from realizing the benefits from road and trail improvement.

Kilimanjaro National Park

Discussions with the Chief Park Warden, Mr. Moerana, suggested that many tracks and trails in the park have not been properly planned or designed. Consequently, soil erosion has been a major problem along many of these tracks and trails. In several areas, multiple trails/tracks have formed due to erosion and gulleying of the original trails and tracks. The abandoned routes have not been reclaimed or revegetated, leaving gullies which adversely affect park aesthetics.

For example, a 6-km road segment beyond the Marangu Gate is characterized by an eroded rocky surface, with only minimal evidence of murram.

Water barriers, resembling vehicle speed bumps, have been used to decrease the energy of water flowing down the road surface. These barriers have companion runout drains. Certain portions of this road were more heavily eroded than others, because of the steepness of the grade. In these steep sections, the road is not following the contour.

The Shira Plateau administrative road is poorly aligned, apparently developed without attention to the advantages of contouring to limit erosion. The road base consists of soft volcanic rock and loam, and is more unstable than the Marangu Gate road. Passage across exposed rock is especially difficult along the stretch in the heather/moorland transition zone.

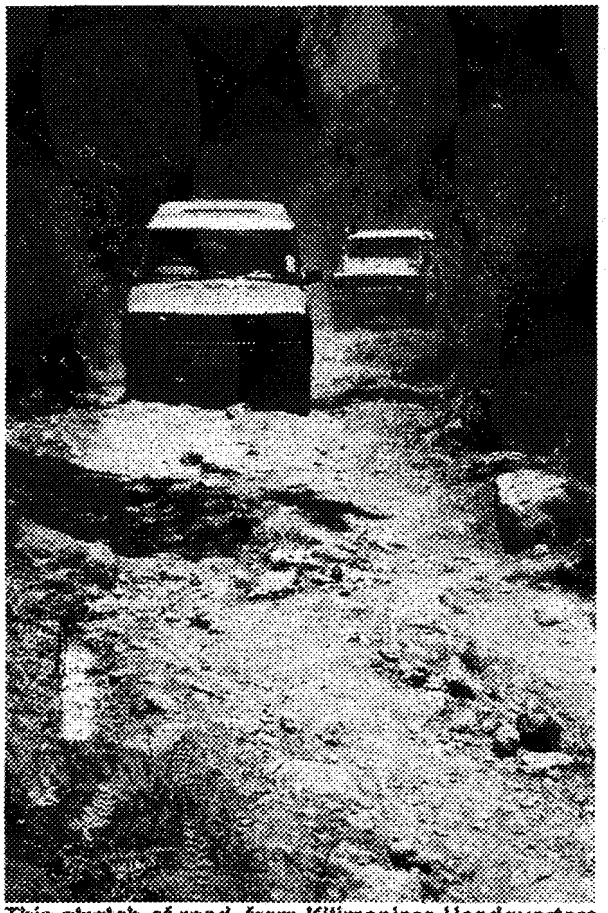
This stretch was in total disrepair and was hardly accessible even by 4x4 wheel drive vehicles during the dry season. Unless this track is made passable throughout the year, access to some of the tourist facilities on the mountain will prove difficult, if not impossible, thus discouraging tourists from visiting and climbing the mountain from this side. Also, only a temporary bridge exists over the river near Londorosi Gate. A more permanent bridge is needed, because emergency rescue from Shira Plateau is cut off often when the river floods, as is Londorosi Village.

Under no action, further erosion and gulleying can be expected in the park, with deterioration in scenic quality, visitor experience and access, and a decline in revenues in TANAPA's highest revenue generating park.

Summary

The design of road infrastructure in almost all parks in Tanzania has been ad hoc. Proper road surveys have never been undertaken which take into account soil characteristics, topography and contours. Many roads and tracks are in a poor state, and their condition worsened following the 1998 El Niño rains. Under no action, road infrastructure would deteriorate further, and runout drains will continue to be clogged or overgrown. Continued improper road grading can be expected, creating road surfaces below the surrounding land area, soil berms along roadsides that prevent proper drainage, and uncambered roads which fail to keep vehicle wheels away from water during rain. The expected results are high erosion, rutting and gulleying of sloping road surfaces, and accumulation of water at low points in the roads and in ruts. Uncontrolled water will also continue to flood areas adjacent to roads, and bridges may deteriorate further or collapse.

Should This Road Be Replaced with a Trail?



This stretch of road, from Kilimanjaro Headquarters to the start of the Muranga Trail 6 kilometers up the mountain, is heavily eroded because of the steepness of the grade and lack of equipment that might be used to break up and reshape the rocky surface, and provide proper drainage. Cost-benefit analysis might show that the benefits from maintaining this short stretch are less than might be obtained by replacing it with a well-murramed permanent trail. Such a trail might follow contours while still providing for evacuation and movement of supplies at least as effectively as the current road. The road also creates a dusty, aesthetically unpleasant initial experience for climbers who chose this route from headquarters.

Vehicles using deteriorating routes would increasingly create deviations or detours to avoid ruts and gulleys, causing significant soil erosion, loss of vegetation on adjacent lands, and further deterioration in aesthetics. Wetlands would be subject to siltation due to lack of controlled drainage and erosion. In the longer term, these effects would diminish, as roads are overgrown with vegetation.

Without road improvements there would be decreased access to park resources, impaired visitor experience, and declines in park revenues. In addition, anti-poaching activities would be hampered as a direct consequence of road deterioration and lack of maintenance.

Increased risk of fires would occur from the absence of roads used as firebreaks, or for fire management accessibility. In the short term, there would be effects of dust and mud on vegetation because of deteriorating road surfaces, despite the lower volume of traffic under the no action condition. However, over the longer term, once roads become virtually impassable, these effects would disappear, and the road would likely revert to a track, footpath or gully.

Under no action, the expense and difficulty of road rehabilitation and maintenance would increase. A good example is the Shira Road in Kilimanjaro National Park, which has deteriorated to a point where rehabilitation is almost impossible. Similar deterioration was observed on some trails. Some stretches of the Marangu trail in Kilimanjaro National Park had to be abandoned altogether, and even decommissioning is difficult because of severe gulleying effects. Under such circumstances realignment with decommissioning of old routes may be less costly than rehabilitation and continuing maintenance. Under the status quo, environmental design considerations for new road segments would receive minimal attention. Surveys to select preferred routes which follow contours and minimize soil erosion and viewshed impacts would probably be minimal. Inadequate emphasis would be given to evaluating the overall costs and benefits of transportation alternatives (e.g., roads versus walking trials).

Rehabilitate or Realign?

This eroded road segment on the route to Kilimanjaro's Shira Plateau is the result of an unplanned steep grade and lack of equipment and casual labor to improve the road surface or to provide runout drains and ditches.

Cost benefit analysis should be employed to determine whether this short steep segment should be maintained or realigned. (Decommissioning this segment and creating a new realignment might actually prove more expensive and environmentally damaging than trying to rehabilitate it.) (S 2°58.6', E 37°10.3')

2.2.2 Other transport alternatives considered

Park planners should carry out analyses that incorporate both environmental and economic cost/benefit analysis in selecting the most appropriate transportation mode. In most cases this choice may be roads; however, depending on circumstances, any one of the following might be a more environmentally and economically sound alternative:

- **Walking trails.** Perhaps the best choice to reach sensitive areas and areas with exceptional resource values—walking trails can either be considered for replacement of existing roads, or as an alternative to new roads. They may, however, require additional park personnel to serve as armed escorts.
- **Use of light aircraft to reach remote ranger posts and for anti-poaching patrols.** Possibly cost-effective under circumstances where posts can not be reached except during the dry season because of very long stretches of impassable road—for example, as observed at Larmakau Crossing in Tarangire National Park's southern wilderness zone. This option also involves construction of landing strips.
- **Special vehicles such as amphibious "swamp buggies" or airboats could be used to cross shallow wetlands.** New technology that allows crossing of wetland areas without leaving a track might be used on an experimental basis.
- **Motorized wheelbarrows.** Potentially useful in mountain rescue operations and for movement of park supplies at Kilimanjaro and Arusha National Parks.
- **Gondolas or aerial cable cars.** Also potentially useful for mountain rescue operations and provision of park supplies.
- **Helicopters**. For rescue operations, where aircraft runways do not exist or are impossible to establish.
- **Larger overland vehicles.** To reduce adverse impacts from vehicular traffic, TANAPA may wish to consider requiring the substitution of larger vehicles with more seating in zones with high vehicles per kilometer averages, while at the same time restricting the use of passenger vehicles, tour operator minibuses or 4wd vehicles to areas which can sustain higher limits of acceptable use.
- **Rail transport.** Very limited potential for use in Tanzania's national parks, but a situation might arise in the future where an existing rail line might make stops to drop off and pick up park visitors.

- **Water transport.** Also of limited potential use, but there may be situations, e.g., Momella Lakes, where use of dugout canoes could provide a pleasant visitor experience for viewing birdlife, without significantly affecting the lacustrine setting. Water transport is probably the alternative of choice for reaching island-based parks.

2.2.3 Alternative design and maintenance strategies for road improvements

TANAPA General Management Plans and Management Zone Plans are effective tools for evaluating both the existing road networks and the planned development of new roads. These documents can be used as guides to the type and level of road improvements anticipated over the next five years. However, park-by-park analyses of roads and trails should be carried out to determine the most environmentally sound routings.

At the same time, TANAPA assessments need to be conducted to select the most cost-effective and environmentally sound transport alternatives, for example, the appropriate mix of road/trail infrastructure. Multidisciplinary teams, consisting at a minimum of a landscape planner, road engineer, park ecologist, and tourism specialist, should conduct park-by-park surveys of existing and proposed road networks and segments to:

- identify portions of the existing park network that could be realigned or removed to reduce overall environmental impacts, maintain access and improve visitor experience;
- recommend cost-effective and feasible transport alternatives for portions of the existing network that would provide greater protection of exceptional resource values while also improving visitor experience, especially through the substitution of walking trails for roads;
- identify the most desirable options for increasing visitor access without adversely affecting park resources, e.g., upgrading existing roads to the most appropriate classification level, constructing trails instead of roads, using air transport, etc.;
- determine whether the parks have environmentally sound road design standards, and whether they are being used;
- provide practical suggestions for further improvements in design standards and their implementation.

In each zone, the TANAPA Planning Unit should assess the cost/benefits of the alternative of further restricting the development of new roads, given the increasing global value of wilderness and the potential for using fee structures to limit the number of visitors, while at the same time, generating higher revenues. These assessments should take into consideration that lands without roads which have been banked for possible future use are appreciating rapidly in value as "wild" attractions.

TANAPA Management (at both headquarters and the park level) should also conduct a separate assessment of the cost-effectiveness and environmental soundness of using private contractors, rather than relying exclusively on the parks' works departments and supervised casual labor. Such an analysis is especially important in planning future major road improvements.

TANAPA should also assess the most appropriate technology and equipment to be used for road improvements. For example, most Class V roads should not be graded, Class IV roads only lightly graded, and the use of bulldozers restricted to murram extraction from quarries and construction of Class I or Class II roads.

TANAPA makes use of labor-based technology and community casual labor for maintenance of park roads, where practical and economically feasible to do so. Labor-based road construction and rehabilitation is normally done with little or no reliance on heavy equipment, and involves the use of local resources (both human and non-human). Through this approach, it is possible to develop local maintenance capability, which is very important in making the roads sustainable. Labor-based methods create employment opportunities and can be a source of income to

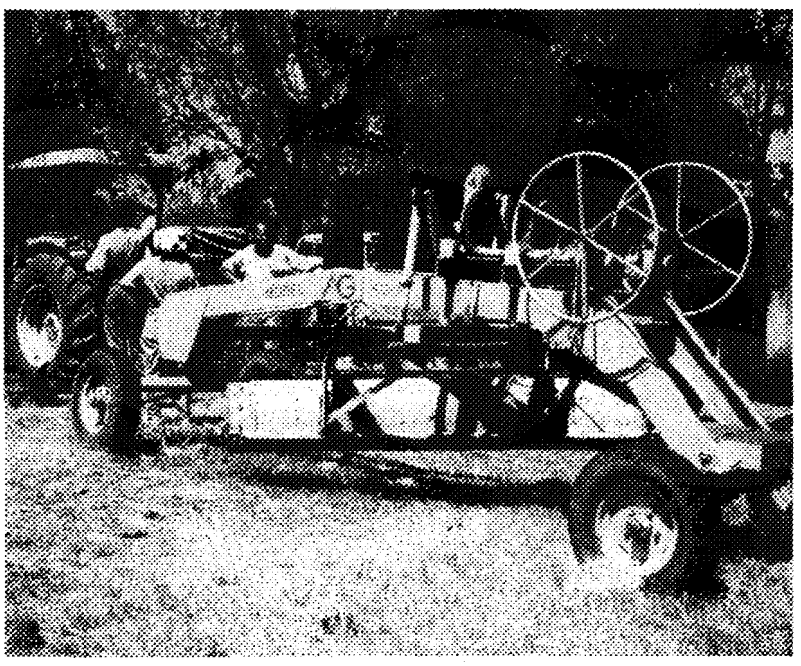
adjacent local communities. It also enhances worker skills.

(However, labor-based methods may also have drawbacks. They may be hampered by insufficient supplies of proper equipment (hand tools) and timely availability of labor, especially during crop planting and harvesting periods when demand for labor can be high. Also, there may be problems with productivity, depending on whether payment is based on a piece (stretch of road) or daily rate. The former is usually more cost-effective, but in such cases estimates of the time to accomplish the work against daily rate are usually crucial, as conditions vary from place to place. Rates are frequently decided on an ad hoc basis, creating conflicts between the administrators and laborers which affect project performance.)

Many park roads/tracks can be rehabilitated as long as there are sufficient park resources to undertake the improvements properly and efficiently, without sacrificing maintenance of the existing network. In some cases, however, where roads/tracks have deteriorated beyond repair, it may be necessary to consider re-alignment. TANAPA will apply cost/benefit analysis to guide decisions on realignments versus rehabilitation.

As mentioned in Section 2.1.6 *Synopsis of proposed actions*, tarmacking or other substances will be allowed by TANAPA only under exceptional circumstances, such as steep road sections where realignment or creation of a contoured slope is not feasible or cost-effective.

Making Due with Less – Using A Tow Grader in Arusha National Park



Roads in Arusha National Park are generally well-maintained using hand labor from neighboring communities under the direction of a dedicated foreman. A tow grader pulled by the tractor in the background is used for shaping the road. Note if the grader blade strikes a rock, the operator can be thrown from the equipment. Thus special safety precautions need to be taken during operation.

2.2.4 Institutional alternatives for sound environmental design, construction and maintenance of road improvements

The institutional management approach taken in planning and implementing road improvements may also have major bearing on whether recommendations will be followed and actions taken to actually mitigate potential adverse impacts. Inadequate *workplans* and budgets, and insufficiently trained staff with poorly defined responsibilities, can make recommended mitigation and monitoring efforts nothing more than a litany of "good intentions." In the case of TANAPA, five management options are considered:

Option 1: *No change in current practice.*

This option represents the status quo, with all the implications described for the no-action alternative.

Option 2: *Turn over all road improvement design and implementation to private contractor(s). Also use private services to operate, maintain and service all heavy equipment*

Road improvement privatization: USAID has been encouraging the privatization of road rehabilitation and maintenance for farm- to market roads in Tanzania under its Strategic Objective 5: *Rural roads improved in a sustainable manner.* With improvements in the quality of work carried out by private contractors, it may be possible for TANAPA to consider engaging contractors with proven track records to carry out certain kinds of road improvement activities. For example, while most private contractors lack experience with Class III through Class V park roads, TANAPA might wish to consider developing standards and specifications for environmentally sound Class I and Class II roads and contract with reputable firms to develop, realign and/or maintain roads with these classifications. Most Parks have their own works personnel for routine road maintenance, thus while it might be efficient to contract out for Class I and Class II road improvements, it would make less sense for Class III through Class V roads.

Maintenance of heavy equipment: Efficiencies might be realized by having Headquarters develop system-wide service contracts for maintenance of heavy equipment, since most of the parks have insufficient resources for training or maintenance of their heavy equipment. The lack of working equipment and inadequately trained operators has serious environmental implications for TANAPA road networks.

Option 3: *Centralize environmental management of road improvements in TANAPA Headquarters. Headquarters oversees preparation of individual environmental impact assessments for all road improvements above a minimum threshold. Staff from the parks are consulted, when deemed necessary.*

Under this option Headquarters would be staffed to provide appropriate technical expertise in environmental impact assessment with environmental scientists and road engineers/technicians who would be called upon to carry out the assessments. The focus at Headquarters would probably be primarily on major road improvement activities and environmental impact assessments would likely be undertaken following a reactive, case-by-case approach. Environmental reviews would not be undertaken at the individual park level.

This approach would probably result in environmental assessment documents whose recommendations for mitigation and monitoring would be difficult to implement because they would originate from Headquarters rather than from staff working in the parks.

This option would also substantially increase Headquarters environmental impact assessment staffing, with significant personnel budget implications for TANAPA. Alternatively, a small unit could be established to provide on-call services and to oversee contracting for specialized outside expertise, as needed.

Managing and controlling road improvement decisions from Headquarters, would distance decision-making from park Wardens in Charge (WICs), park ecologists, road works personnel and other park staff. This is not desirable. Wherever possible, decision-making should be vested with the WICs. However, efficiencies might be realized by centralizing certain functions, including:

- development of engineering specifications and procedures for park roads that can be used by parks road Works personnel and/or private contractors;
- management of private services for maintenance of heavy equipment;
- overseeing the development of *Road/Trail Network Plans* for the entire Park system drawing upon multidisciplinary private expertise with landscape architecture capability and augmented by TANAPA specialists;
- overseeing the use of outside technical expertise for the development of *Quarry Management Plans* for the entire Park system.

Option 4: *Place major responsibility for Environmental Review with the Warden in Charge at each park, and with a park Environmental Review Coordinator and Road Works personnel.*

This option implies the development of procedures for conducting *Environmental Reviews* at the park level, along with use of an *Environmental Screening Form.* Further, *Environmental Management Plan Guidelines for Road Improvements* would be developed to ensure that *Workplans* for road improvements incorporate annual environmental mitigation and monitoring plans. Environmental Review Coordinators and Environmental Management Teams would be established and receive appropriate training in the *Environmental Review* process as well as preparation of annual *Environmental Management Workplans* for road improvements.

Option 5: *The preferred institutional management alternative*

The preferred institutional management alternative borrows from all of the above options. Most responsibility for road improvement decisions would be vested in the individual park WICs, but with some centralization to oversee major road works. TANAPA would develop standards and specifications for use of private contractors for major construction or rehabilitation activities. Similarly, efficiencies might be realized by having Headquarters develop system-wide service contracts for maintenance of heavy equipment.

There are technical and cost advantages in having Headquarters staff up to oversee development of *Road/Trail Network Plans.* This is likely to be a long-term, on-going need; however, it could be largely contracted out to consulting firms with landscape architecture capabilities. On the other hand, *Quarry Management Plans* might be developed under a single one-time contract, requiring limited TANAPA oversight to ensure implementation of the plans.

The PEA team is strongly in favor of the *Environmental Review* process and the development of annual *Environmental Management Workplans* for road improvements as described under Option 5. The effectiveness of *Environmental Reviews* at the park level could be greatly enhanced by having a shared pool of environmental assessment and engineering expertise on call to work with the individual park Environmental Review Coordinators, Environmental Management Teams and/or Works personnel. Such a technical support system might work much the way specialized environmental services are provided to the USAID Mission Environmental Officers at the country level by the Regional Environmental Officer based in Nairobi. Headquarters-based expertise could be supplemented by outside consulting services, as needed. Headquarters environmental impact assessment staff could also conduct periodic training programs for park personnel in environmental review and environmental management of park road improvements, in order

to provide new staff with needed expertise, as well as to introduce additional concepts and techniques in environmental management

2.2.5 Relationship of alternatives to strategic objectives

The implementation of PEA recommendations for environmental screening and review, mitigation and monitoring, and the environmental management workplan for road improvements, supports USAID/ Tanzania's Strategic Objective Two: *Improved Conservation of Coastal Resources and Wildlife in Targeted Areas* by ensuring compliance with Regulation 216. It also ensures that potentially adverse impacts will be avoided on relatively undegraded forest pursuant to FAA Section 118(c)(15), and not adversely affect endangered species/habitat, per 22 CFR 216.5. The environmental review of proposed road segment improvements also supports compliance with TANAPA policy, builds capacity in EIA, and sets the stage for more broadly applicable road-related environmental analysis, mitigation and monitoring in national parks.

It also supports Intermediate Result 2.3 under USAID's SO2, which focuses on improving the management of targeted protected areas in both parks and game reserves.

A segmented, opportunistic strategy is clearly **undesirable** environmentally. In general, following such an approach would pose great threat to the environment, and would likely engender adverse impacts of significant magnitude and extent. Compliance with recommendations contained in Management Zone Plans and General Management Plans, and the implementation of PEA recommendations, will ensure an integrated rather than piecemeal approach to park road improvements.

2.3 Comparison of alternatives

2.3.1 No action compared to proposed actions

The proposed action offers important economic and protected area resource management benefits, as well as opportunities for environmental enhancement. By implementing the mitigation and monitoring measures identified by topic in Chapter 6, environmental impacts and risks can generally be avoided, diminished, controlled or compensated for. Further, unanticipated risks and impacts can be monitored, and subsequently mitigated through implementation of the *TANAPA Environmental Management Plan Guidelines for Road Improvements.*

Under *most* circumstances, the no action alternative offers no benefits, but at the same time poses significant environmental impact risks.

Table 2-1 compares the effects of the "no action" alternative with the proposed actions. Note that under *certain* circumstances, "no action" may be an environmentally preferable choice. Thus, screening and review procedures have been devised to ensure that no action can be chosen where appropriate. These procedures ensure compliance with U.S. requirements under FAA Sections 118 and 119 and 22 CFR 216.5.

2.4 Identification of preferred action

The preferred action is to carry out road improvements in Tanzania's National Parks, with the incorporation of the following mitigative and monitoring measures:

- multidisciplinary team surveys and assessments, as outlined above under Section 2.2.3 Alternative design and management strategies for road improvements, and Chapters 6 and 7 of the PEA.

- training in environmental screening and review, and environmental mitigation and monitoring, including application of the *TANAPA Procedures for Environmental Reviews of Road Improvements* as recommended in Chapter 7;

- development of mitigative and monitoring measures for road construction, operation and maintenance, as described in Chapter 7 and *TANAPA Environmental Management Plan Guidelines for Road Improvements*;

- development and implementation of annual Park *Environmental Management Workplans* for road improvements, as recommended in Chapter 7 and specified in the *TANAPA Environmental Management Plan Guidelines for Road Improvements;*

- preparation of standards and specifications for sound environmental design and management of road improvements to be incorporated in a TANAPA *Operations Manual* for road improvements as described in Chapter 7, Section 7.3.

Table 2-1: Comparison of Environmental Impacts from the "No Action" Alternative with the Proposed Action

Phase	No action Impacts	Proposed Action Impacts
Planning and design	TANAPA Park's road systems planned only to the degree that future road improvements are spelled out in MZPs and GMPs or their amendments. No system-wide quarry management plans or road/trail network plans developed. Inadequate attention given to viewshed impacts.	*Road/Trail Network Plans* and *Quarry Management Plans* developed for all parks. *Environmental Review* process put in place in all parks, with creation of Environmental Review Coordinators and Environmental Management Teams. Development of uniform standards and specifications for environmentally sound road improvements.
Construction	Construction of roads occurs as in the past, with approval on a case-by-case basis, with limited attention to potential adverse impacts. No *Procedures for Environmental Review of Road Improvements.* No development of annual *Environmental Management Workplans for mitigation and monitoring adverse impacts from road improvements.* No standards or procedures established for environmental mitigation and monitoring or Best Engineering Practice during construction.	Potential, short-term and limited impacts, in area and magnitude on 1) physical systems; 2) ecological features; 3) landscape features; and 4) socio-economic characteristics. However, virtually all these impacts can be mitigated by applying *Environmental Review* procedures and implementing annual *Environmental Management Workplans* for road improvements. Impacts on tropical forests, wetlands and habitat can be significant and must be considered and monitored with care. Short-term beneficial impacts on employment and purchase of materials. Significant potential benefits from reducing pressure on high-use park zones.
Operation and Maintenance	No development of annual *Environmental Management Workplans for mitigation and monitoring of adverse impacts from road improvements.* No standards or procedures established for environmental mitigation and monitoring or Best Engineering Practice associated with road maintenance. Continued deterioration of road surfaces from the effects of water and off-road driving, etc., including soil erosion, gulleying, rutting and accumulation of water at low points and in ruts. Limited management of adverse impacts associated with quarry and murram pit extraction. Ad hoc control of construction camp operations.	Potentially adverse impacts, in area and magnitude, on 1) physical systems; 2) ecological features; 3) landscape features; and 4) socio-economic characteristics. However, as noted for the construction phase, virtually all these impacts can be mitigated by applying *Environmental Review* procedures and implementing annual *Environmental Management Workplans* for road improvements. Impacts on tropical forests, biodiversity, threatened and endangered species, wetlands, vegetation and habitat are likely to be less significant than under construction, since proposed actions involve maintenance, rehabilitation or upgrading of existing roads rather than construction of new roads through relatively undegraded areas. Nevertheless, these impacts must identified, mitigated and monitored with care. Short- and long-term beneficial impacts on employment and purchase of materials, including supply of casual laborers from communities bordering the parks and from murram and fill taken from quarry areas outside the parks. Significant potential benefits from reducing pressure on high-use park zones.

Phase	No action Impacts	Proposed Action Impacts
	Continued restriction on access to park areas beyond core preservation zones, due to inability to maintain park road systems adequately. Potentially significant damage to physical systems (e.g., soil and water), sensitive habitats, biodiversity, ecological systems and exceptional resources. Marked decline in scenic quality and visitor experience. Potentially significant decline in tourism and tourism revenues.	No significant adverse effects from traffic flow, air quality, noise. No adverse impacts of note on wildlife migration and movement. Major benefits from tourism revenues and resulting increase in resources. Improved visitor experience without loss of park resource values.
Decommissioning	Abandoned roads would contribute to soil erosion, gulleying and siltation. They would also contribute to a cumulative deterioration in scenic quality and visitor experience.	Under the proposed action, adverse impacts would be minimal, aside from the investment in labor and equipment for ripping, reshaping and revegetating abandoned road and trail surfaces. Benefits could be expected to be substantial, including reduced erosion, restored scenic quality and viewsheds, and enhanced visitor experience.
Induced and Indirect Impacts	No cumulative socio-economic benefits to TANAPA, surrounding communities or the Tanzanian economy. Current trends would continue but without the opportunities for limiting environmental degradation and monitoring for potential impacts. Cumulative adverse impacts associated with high-use zones (core preservation zones). These may include direct impacts such as soil erosion, rutting and gulleying. They may also include indirect impacts such as siltation of wetland areas, cumulative degradation of scenic quality, sensitive habitats, biodiversity, and exceptional resource values. These effects, if continued over time, could result in declining tourist revenues.	Cumulative impacts can be direct, e.g., soil erosion, soil compaction, gulleying and rutting of road surfaces; or indirect, such as siltation, increased off-road driving, changes in hydrology, long-term changes in habitat or species diversity, alteration of scenic quality, failure to meet TANAPA goals for future "Limits of Acceptable Use" and declines in visitor revenues. While potentially serious, these adverse impacts can be mitigated, if *the Environmental Screening and Review* process is applied and annual *Environmental Management Workplans for Road Improvements* are followed with care. Long-term benefits include increased visitor revenues, which can provide the finances needed to manage parks sustainably. Many of Tanzania's park resources are of high global value and long-term benefits include the maintenance of unique species and habitat, world-renowned scenery and wilderness areas. Cumulative benefits would also extend to neighboring communities who work with the parks to maintain park roads and who increasingly benefit from tourism activities. There would also be long-term benefits to the Tanzanian economy.

3. Description of Affected Environment

Note: Because not all locations for future interventions covered under this Programmatic Environmental Assessment are known, and because of the variety of environmental situations encompassed by potential activities, this PEA provides neither comprehensive nor detailed baseline environmental information. Implementation of the recommendations for environmental screening and review (see Chapter 7) will require TANAPA implementers to provide descriptions of the affected environment specific to the setting in which their activities are carried out in their preparation of environmental reviews.

3.1 General Country information[2]

Tanzania is a large and varied country, encompassing 942,800 square kilometers (km^2) of land and water. It is home to 27 million people, with a population growth rate of 2.8 percent per year. About 85 percent of the total population live in rural areas; however, the urban population is growing at a rapid 7 to 8 percent per year. While Dar es Salaam accounts for about half of the urban population, Mbeya, Morogoro, Mwanza, Arusha and Tanga, among others, are large and growing regional urban centers.

Tanzania is endowed with abundant natural resources. In mainland Tanzania, about 50 percent of the total land area is forest and woodland; 40 percent is grassland and scrub; and six to eight percent is cultivated. The terms forest and woodland are comprehensive and only two percent of the country is covered by dense closed forest (1.4 million hectares). The tsetse-fly infested areas of West Central, and South-East Tanzania constitute a large proportion of the woodland. The largest area of mangrove forests, which are an environmentally significant resource in East Africa can be found in Tanzania (0.1 million hectares). Grassland and scrub include most of the rangeland area of the country and support an estimated 13 million cattle and 10 million sheep and goats. However, almost 60 percent of this livestock is concentrated on 10 percent of the land in the north and central parts of the country. The cultivated area is worked largely by smallholder farmers. Although about one percent of the total land area is held in large farms (concentrated in the northern parts of the country), shifting cultivation is still common, particularly in the drier parts of the rainfed agriculture zone. The potential for irrigated agriculture has not been realized due to high investment costs (only 20 percent of irrigable land is currently irrigated, of which four-fifths is under traditional small-scale irrigation).

Biodiversity is one of the country's greatest assets. Sites such as Ngorongoro Crater, the Serengeti, the Eastern Arc mountains, and the Great Rift Valley lakes, are world renowned. Tanzania is among the five most diverse countries in Africa for mammals, birds and swallowtail butterflies, and the second most diverse for plants. The country is also important for endemic species; that is, species that are found nowhere else. Important sites for endemic species include the great lakes for fish, and the forests of the "Eastern Arc" mountains, where one-quarter of the surveyed flora is endemic.

Aquatic resources are important for Tanzania. The country's lake and river systems, the largest in Africa, are a major wetland resource. These include large portions of Lakes Victoria, Tanganyika and Nyasa, as well as a variety of other small lakes, swamps and floodplains. Marine resources include fish stocks, coral reefs, sandy beaches, mangroves, marine grasses, and salt resources, and exhibit high biological diversity. Marine fisheries are mainly coastal, but there is significant potential for game and commercial fishing in deep off-shore waters. Off-shore oil and gas potential also exists.

[2] Section 3.1.1 contains general information derived from USAID/Tanzania's Country Strategic Plan of 1996, 1995 PERM IEE, and information supplied by several of the SO2 partners.

Energy and mineral resources are also important components of the resource base. The major energy resources are woodfuel, hydropower and coal. Potential also exists to exploit natural gas, solar energy and wind energy. Petroleum imports supplement national energy supplies. The country depends heavily (90%) on woodfuel and charcoal for primary energy use. Coal reserves are estimated at 2,200 million tons, but little exploitation has yet taken place. Although minerals only make up a small part of GDP (gross domestic product), mining occurs for gold, diamonds, coal, tin, salt, gypsum, sand, lime, and gemstones, with significant local environmental impacts.

This natural resource endowment is most directly affected by human activity associated with food production. Agriculture is the mainstay of the Tanzanian economy, employing over 80 percent of the adult work force and accounting for about 50 percent of GDP and 60 percent of foreign exchange earnings. Through their agricultural activities, millions of rural families are day-to-day managers of much of the country's land, water and vegetation resources. In the past, natural resource utilization strategies were compatible with conservation of the natural resource base. Crop production activities allowed for the recuperation of soil fertility; transhumance and pastoralist herding was practiced on marginal lands, and forest products were harvested at a sustainable rate. However, the dynamics of rural life have been drastically altered by colonial rule, post-independence policies, global market trends, urban immigration, and population growth. Today, a large proportion of rural Tanzanians are impoverished. Exponential pressure on the resource base due to population increases, erosion of indigenous knowledge, and competing activities such as tourism, irrigation and hydropower generation, have led to unsustainable farming, herding, and wildlife utilization practices. This difficult situation is accompanied by a rise in the illicit use of resources.

The Government of Tanzania has recognized the importance of its natural resource base and has set aside some twenty-five percent of the Mainland as protected areas in national parks, game, forest, and marine reserves. Various laws have been enacted, with policies and planning documents drawn up to encourage sustainable use of natural resources. Unfortunately, no clear and consolidated policy or framework for natural resource management exists, and enforcement of legislation has been weak or absent. Many Tanzanians lack awareness of, or appreciation for, the need for sustainable natural resources management (NRM).

Because USAID is providing funding for road equipment to be used for improvements in Tarangire and Lake Manyara National Park, these two parks received special scrutiny under the PEA.

Tarangire National Park is the fourth largest park in Tanzania, with one of the highest densities of elephants in the country. It is part of Tanzania's popular northern tourist circuit that includes Arusha, Mt. Kilimanjaro, Lake Manyara, and Serengeti National Parks as well as the Ngorongoro Conservation Area. It comprises a 2600 km^2 portion of the Tarangire ecosystem. The entire ecosystem encompasses approximately 20,500 km^2 of the Masai Steppe.

Lake Manyara National Park is located north of Tarangire National Park. The park is small, only 230 km^2, and thus best considered as part of a larger ecosystem. The park contains a large soda lake, providing crucial habitat for exceptional numbers of birds, including flamingos. The park also contains large numbers of mammals, including elephant, buffalo, hippopotamus, giraffe, wildebeest, and zebra.

The sections below examine in more detail the environmental baseline and trends for five of Tanzania's northern circuit parks, selected by TANAPA and USAID as representative of typical conditions found in all of the national parks. TANAPA has reasonable confidence that this baseline and trend information captures most of what might have been learned from visiting all the parks. Baseline data is spotty for many of the parks visited, but Section 3.2 examines vegetation, wildlife, geology and soils, hydrology and resource trends from sources that were readily available to the Team. Section 3.3 looks at road characteristics in the five parks. Road management practice is reviewed in Section 3.4, and Section 3.5 looks at traffic, tourist and revenue characteristics. Section 3.6 outlines socio-economic characteristics.

3.2 Resource characteristics

3.2.1 Tarangire National Park

Vegetation

Tarangire National Park is situated in the wooded steppe in a semi-arid *Acacia* savannah belt, dominated by *Acacia* and *Commiphora* species. The most important vegetation types are:

- Riparian woodland;
- *Acacia tortilis* parkland;
- Wetlands and seasonal flood plains;
- *Acacia – Commiphora* woodland;
- Riverine Grassland;
- *Combretum-Drepanolobium* woodland;
- *Acacia drepanolobium* woodland;
- Rocky hilltop outcrops (kopjes) vegetation;
- Deep gully vegetation;
- Grassland with scattered baobab trees.

Wildlife

Kongoni, ostrich and zebra have shown declining trends in population from 1988 to 1998. On the other hand, oryx, buffalo, giraffe, eland, impala and Grant's gazelle populations have remained stable. The history of elephants in Tarangire National Park suggest that dry season surveys consistently give higher estimates than wet season surveys, because this is the time when elephants concentrate within the park. Dry season population estimates of elephants increased from around 1,399 in 1978, to around 5,684 in 1987, and then declined to 2,897 in 1990. In 1994, approximately 6,386 elephants were recorded. The park is currently estimated to contain 1,550 to 3,300 elephants during the dry season, over a third of which are also present in the wet season. Tarangire National Park did not suffer the extremely high rates of elephant poaching experienced in other protected areas in East Africa during the 1980s. The buffalo population increased, from around 5,324 in 1977 to 9,942 and 10,383 in 1980 and 1987, respectively. Since 1987 the average population has been around 6,000 animals.

Tarangire National Park is a dry season refuge for a majority of migratory wildlife in the Tarangire ecosystem - Maasai Steppe. The park is very rich in mammal and bird life. The dry season biomass estimate for large mammals in the park is in excess of 35 tons/km^2. Important wildlife species include: elephant, lesser and greater kudu, buffalo, cheetah, oryx, leopard, lion, giraffe, hyena, zebra, wildebeest, warthog, eland, baboon, reedbuck, impala, waterbuck, bushbuck, cokes hartebeest, gereank and reedbuck.

The park has more than 550 species of birds, mainly in the open *Acacia* woodland, in the wetlands (Silale Swamp) and in the Tarangire floodplain. Common species include the yellow-collared lovebird, Maasai ostrich, martial eagle, white and pink-backed pelicans, saddle bill stork, goliath heron, bateleur eagle, helmeted guinea fowl, kori-bustard, long-toed lapwing, brown parrot, white-bellied goaway bird, Madagascar bee-eater, African hoopoe, and a variety of kingfishers, weavers, owls, doves, plovers, sandpipers, francolins, and ducks.

During the dry season, large concentrations of animals move into the park, especially the northern portion, where permanent water sources exist. During the rainy season, animals disperse from the park and spread over an area of more than 20,500 km^2 of Maasai country. At the end of the long rains, around June, the Maasai Steppes dry up rapidly and migratory species return to the northern portion of TNP. The Tarangire River system and associated wetlands (Silale swamp), springs and mbugas within the park boundary provide a critical dry season refuge as the primary water supply for wildlife.

Geology and Soils

The park is situated in the eastern part of the East African Rift Valley. The geology is based on three rock formations: Pre-cambrian gneiss, lake deposits, and alluvial deposits. Much of the park is underlain by gneiss and other Pre-cambrian crystalline rocks, giving rise to varied physical features. These parent rocks differ in their resistance to weathering and erosion. The harder rocks stick out as outcrops and

form prominent features in the park like the Sangaiwe hills, Boundary Hill and other small kopjes, most of which have ecologically sensitive and unique habitats.

The major soil types are well-drained red loams that become alluvial along river valleys, alluvial on ridges and colluvial on hill slopes. Other soil types originated from lake deposits and sediments. These vary from clays to sands and are normally very saline. Soils are increasingly stony, due to lack of depth. There are also alluvial deposits that consist predominantly of vertisols (black-cotton soils).

The red loam soil is generally located on the upland ridges and on the higher flood plain terraces along the river. The loam can vary from soil with a proportion of sand, to a hard clay loam. The loam has much lower clay content than the black cotton, with better drainage. The red loam appears to be easily eroded if stripped of vegetative cover and on a slope steeper than approximately 8–10 percent. It can be quite slippery when wet on steep sections of road. Roads following contours or near hillsides are more likely to have a solid base than those traversing lowland areas that have received the finer clays and loams of alluvial deposits.

3.2.2 Lake Manyara National Park

Vegetation

P. J. Greenway and Vesey-Fitzegerald (1968) described the vegetation of Manyara National Park. They classified the vegetation in relation to drainage conditions.

- Groundwater forest and riverine forest are found at the north end of Lake Manyara . These forests are fed by several rivers flowing down from the escarpment and a number of perennial springs which spill out from the base. The characteristic trees of the forest are *Trichelia roka, Bridelia Micrantha, Croton Macrostachys, Drypetes natalensis, Celtis africans* and *C. zenkeri.*

- *Acacia* woodlands occur in a semi-arid environment that is unstable because of periodic changes in the flow of flood waters, the redistribution of soil, and the effects of these flood waters on the availability of subterranean water. The dominant species is *Acacia Tortilis.*

- The escarpment vegetation in the northern end of the park extending southwards to the Msasa drainage line is classified as thicket woodlands. It is composed of a variety of small deciduous trees such as *Commiphora baluensis, C.campestric, C. englen, C. merkeri* and *Sterculia stenocarpa.*

- Alkaline grassland occupies flat, badly drained, often slightly raised beaches in a zone between the groundwater woodland and the lake bed flats around the edges of the alluvial fans. Main species are *Sporobolus Similis, S. spicatus, S. marginatus, Chloris gayana, Digitaria milanjiana.*

- *Cynodon* grassland forms a pure stand of matted sward in poorly drained places where the water table is high, especially around the groundwater forest, the edges of swampy glades, and in the ecotone between alkaline grassland and woodland. Common species are *Cyndon dactycon* and *C. plectostachyus.*

- Swamp occurs where the Simba River and its tributaries enter the north end of Lake Manyara and in shallow basins of impeded drainage that are enclosed within the ground-water forest. *Typha angelistifolia* is the dominant plant in the swamp at the north end of the lake. Elsewhere around the perimeter, *Cyperaceae* is dominant.

Wildlife

Since Lake Manyara National Park forms one ecosystem with Tarangire National Park, most of the animal species are the same except for the presence of oryx at Tarangire National Park. Elephants and buffalo form the bulk of the biomass. Aerial census figures for the 1995 dry season and those for 1998 wet season show that elephants increased from 84 to 128, respectively. The buffalo population during the same period showed a decline from 943 to 308, largely due to physical changes in Lake Manyara.

Geology

The underlying rocks belong to the Mozambique belt which is a part of the ancient crystalline

basement complex in which a wide variety of sedimentary and volcanic rocks were subjected to a similar metamorphic history. This crystalline basement complex consists mainly of Precambrian gneisses, banded with quartzo-feldspathics. The erosion surfaces were formed during the more recent Tertiary period.

The Rift valley was also formed in the Late Tertiary. Typically, the Great Rift Valley is delimited by both western and eastern rift walls, but here only the western side is bordered by an escarpment. At the eastern side, the Maasai Steppe gently dips to the west, forming a depression at the foot of the fault scarp with the formation of Lake Manyara at the lowest point.

Volcanic activity was associated with the formation of the Rift Valley. The occurrence of volcanic lava and ash accounts for the high alkalinity of the area. The rich volcanic material is easily weathered chemically, releasing large quantities of sodium. Lake Manyara is approximately 2 meters deep, with a closed drainage system. As a result, its alkalinity becomes so high through evaporation that soda crystals form along the retreating lake shore during the dry season.

3.2.3 Serengeti National Park

The central part of the Serengeti National Park covers a land area of approximately 2286 km^2. It was declared a Game Reserve in 1929 and declared a National Park in 1951.

Vegetation

The Vegetation of Serengeti National Park can be broadly classified into three major types: a southeastern area comprising open grassland; a northern area of open woodland; and a western area with a mosaic of grassland and woodland.

The south-eastern plains are treeless with alkaline tolerant short grasses and many small dicots. The Seronera area, roughly divides the open grasslands to the south and south-east and the mixed woodland to east, north and west. The dominant grass species in deeper soils of the park consist of *Themeda triandra* and *Penniseteren mezianum.* The open woodland vegetation type in the north is dominated by *Acacia species* and starts at a sharp boundary running south of Seronera in one direction and east of Seronera in the other. The dominant woodland vegetation type in the northwestern part of the park is a mixture of *Terminalia* and *Combretum* species.

Wildlife

The park supports the largest herds of migrating ungulates in the world. Recent estimates indicate that there are over one million wildebeest, 200,000 zebra, and 440,000 Thomson gazelles. Non-migratory species include elephants, which have increased to about 1,500. On the other hand, buffalo have declined to just over 21,000. A handful of Black rhino (*Diceros bicornis*) are under special protection. Other major resident herbivores in the park include Grant's gazelles, impala, topi, warthog, giraffe and waterbuck. The park has one of the highest concentrations of large carnivores in Africa, with hyena estimated at 7,500, 2,800 lions and 300 cheetah.

More than 517 species of birds have been recorded in the park. Eighty (80) species of grasshoppers have been identified and 100 species of dung beetles.

Geology and Soils

The underlying geology of the region is predominantly Precambrian and very old. In the area west of Seronera the underlying rocks are estimated to be 2500 million years old and comprise Precambrian volcanic rocks and banded ironstone of the Tanganyika shield. Much of this is obscured by sedimentary and metasedimentary rocks of the late Precambrian age. Extensive areas are in turn covered by recent alluvial mbuga deposits which form the open plains, and pink sandy soils derived from sandstones and quartzite. Hill ranges in the west are formed from metacherts and jaspilite (Simiti Hills), quartzite sandstones and shales (Nyaruboru, Kimarishe and Stonjo) and granites (Nyamuma). In the north are granites and gneisses (metamorphosed granites) with ranges of hills formed from schistose and quartzite. The plains south east of Seronera are formed from Pleistocene calcareous tuff (layer upon layer of ash derived from volcanic activity in the crater highlands) with calcareous concretions forming numerous layers of hardpan.

The geology underlying these tuffs is primarily Precambrian gneiss, with occasional granites. Outcrops of these old basement rocks, form the characteristic kopjes of the Serengeti plains. On the eastern plains, soils are of recent volcanic origin, highly saline, alkaline and shallow. The soils become progressively deeper and less alkaline towards the northwestern plains and into the woodlands. The soil is characterized by shallow, sandy, well-drained soil at the top, changing to deep, silty, poorly drained soil at the bottom.

Trends

Buffalo: Long-term trends in buffalo population numbers in SNP suggest that the population had been increasing until the mid-1970s. The total buffalo population of the SNP increased from 43,456 in 1986 to 45,941 in 1992. However, by 1994 the number was down to 21,291, a decline of 45 percent from 1992 to 1994. The largest absolute drop was in Central Serengeti, which has always shown the highest buffalo population. More than 8,000 animals disappeared from this area between 1992-1994, which accounts for almost half of the total decrease for the park. Another census in 1998, showed that the buffalo population in the Serengeti stood at 16,778, a decline of 21.2 percent compared to the 1994 population size. The decline was specifically marked in Central Serengeti (39%). A drop in population size was also apparent in Western Serengeti, Central Plains and the Southwest. However, they remained stable in Northern Serengeti. The 1998 buffalo distribution pattern is similar to that of 1992 and 1994, with more animals in a broad east-west band across the center of the park.

Buffalo numbers within the SNP are currently at their lowest levels since 1958, before the eradication of rinderpest. The greatest decrease has occurred in the northern Serengeti and is attributed to heavy human population pressure in the adjacent area and drought experienced in 1993. The northwest suffered major buffalo declines mainly because of the absence of any protective buffer zone and the close proximity of settlement outside the park. In contrast, buffalo increased in the Grumechen and Loliondo blocks, which are relatively far from human influence.

Elephant: The population was over 2,500 animals in 1977. Records were lacking after 1977, but by 1986 elephant numbers had decreased to 467 animals. The population decline in the late 1970s and 1980s has been attributed to:

- the closure of the Kenya/Tanzania border in 1977;
- the marked increase in settlement, with meat poaching along the western boundaries of the SNP;
- migration of animals into Masaai Mara.

By 1994 elephant numbers had risen to 1,000. These increases were recorded in the north around Lobo Lodge and in the hills to the west of the plains.

During the 1998 census, 2,015 elephants were recorded in the Serengeti, suggesting a 48 percent increase over the last four years. Concentrations of elephants were found in the center and along the eastern and northern boundaries of the park. The recent increase in elephant numbers has been attributed to:

- natural increase within the population;
- the return of part of the former Serengeti elephant population from Masaai Mara;
- disallowance of legal ivory sales in Burundi;
- launching of an anti-poaching "Operation Uhai" in 1989; and
- the world ban on the ivory trade in 1989.

Rhino: Rhino were the first to feel the effect of border closure mentioned above. It is estimated that 52 percent of its population was lost in one year, 1977, the first year of the border closure. By 1980, the population was near extinction. Other non-migratory species show very low densities in the northwestern Serengeti for the same reasons.

Wildebeest: Detailed movements of wildebeest and other migratory species, and their timing, are dependent on seasonal rainfall distribution and intensity, itself highly variable from one year to the next. However, the overall migration pattern has largely followed the triangular route (south,

northwest, northeast) as described in the early 1970s.

When the wildebeest population was low (1950s and 1960s), the migrants barely crossed the border into the Masaai Mara, but by the 1970s, when the numbers were high, a large proportion were using the Mara each dry season. Since 1973 no systematic study of movements has been carried out. However, based on fragmentary accounts, a major change has occurred—wildebeest now make greater use of the Salei Plains (within Loliondo GCA) during the wet season, and periodically use the south-western part of Loliondo, both during the wet season and as one of the northward migration routes. It is also reported that a fraction of the migrants move directly north, east of SNP through Loliondo GCA.

3.2.4 Arusha National Park

Vegetation

A diversity of vegetation and habitat typifies Arusha National Park. Habitats include alkaline and fresh water lakes, swamps, grasslands, bushland, forests, heath and bare cliffs.

- Fresh-water swamps have tall plants like *Papyrus, Miscanthidium violaceum* and *Cyperus immensis.* Alkaline swamps and lake-margins have dwarf *Cyprus leavingatus.*
- Derived grassland is a secondary vegetation which includes derived tussock grass on laharic moticules in the Momella area and part of Ngongongare, as well as on the lower slops of Mt. Meru.
- Edaphic grasslands include grassy forest glades, grassland around the spring head and in the perimeter of swamps. These get flooded during the rainy season, especially where the water table is high.
- Sagebushland is a secondary vegetation composed of a mixture of shrubs which have replaced destroyed forests, thickets and woodland below 1680 meters.
- Dodonea Scrub covers areas of boulder beds spread by the Ngarananyuki River at the base of Mt. Meru. This area once supported woodland of cedar, *Juniperus procera,* but was reduced by fire and felling to a thin woodland or scrub of *Dodonaea viscosa,* and scattered relic cedars.
- Woodland includes areas with *Acacia xanthophloea* on the periphery of some lakes and along the lower part of Ngarananyuki River, as well as around the shores of Lake Elkekhotoito.
- Dry open evergreen forest is at altitudes of 1500–1700 meters, where trees include *Diospyros abyssinica, Olea welwitshchee, O. hochstetteri* and *O. affricana.*
- Submontane (or mountain) evergreen mist forest is found between 1700–1880 meters on the Ngurudoto Crater rim and up to 2100 meters on Mt. Meru. Trees on the Ngurudoto rim include *Cassipourece malosana, Tebernaemotana sp.* and *Casearice sp.,* while on Mt. Meru they include *Olea hoschstetteri.*
- The heath zone starts from 3000 meters and reaches up to the Mt. Meru Crater. There is co-dominance of *Erica arborea* and *Stoebe kilimandscharica*, grass glades and emergent tree include *Agauria salicifolia.*

Wildlife

The most important large mammals in Arusha National Park are zebra, waterbuck, elephant, giraffe, and hippos. The common primates are baboons, vervet monkeys, and black-and white colobus monkeys.

Hydrology

Arusha National Park has lakes and rivers that have permanent and temporary water, including strongly alkaline lakes such as *Big Momella, Rishateni, Tulusia* and *Lekandiro.* Weakly alkaline lakes are *Small Momella, Kusare and Elkekhotoito. Longil* is a permanent fresh-water lake. Fresh-water rivers include *Jekukumia. Maji-ya-chai* and *Ngarenanyuki Rivers* have high fluoride content. Temporary lakes include rainwater pools like Seneto and Kiwanja ya Moteo in the forest, Lake Kusare and Lake Elkekhotoito. In dry years the temporary lakes are merely edaphic grass glades; in the rainy season they fill and acquire a cover of water lilies and weeds with a fringing growth of sedges.

Geology and Soils

The arm of Arusha National Park lies on the eastern edge of the Great Rift Valley, which is part of a fault in the earth's crust. The Rift Valley was formed 20 million years ago and, amidst the turmoil, a small subsidiary vent opened at the eastern foot of the present Mt. Meru from which Ngurudoto formed. Molten rock was forced to the earth's surface by superheated steam and ejected, slowly building up a cone around the vent, imprisoning gases from the earth's core. As this activity increased, the size of the crater also increased.

Ngurudoto volcano is now extinct, but from the pear-shape of the present day crater it seems that towards the end of its activity there were in fact two cones lying very close together. When the molten rock below the cones withdrew to deeper levels, the cones were left without support and then collapsed forming the present crater or, as it more correctly should be called, caldera.

Mt. Meru, on the other hand, is a dormant volcano. The crater wall was ruptured by a series of violent explosions a quarter of a million years ago. These explosions may have been caused by blocking of a vent, or from crater lake water seeping in. For whatever reason, the whole eastern wall of the crater was blown away and a mass of water, mud, rocks and lava cascaded down the eastern side of the mountain. The Momella Lakes were formed by depressions in the drying mud. Over time, repeated volcanic activity built the ash cone into the present shape it has today, and sporadic eruptions have streaked the sides of the mountain with lava. The most recent evidence of activity can be seen on the north-western side of the ash cone where a small lava flow occurred just over 100 year ago.

No detailed literature is available on the soils of this park. However, vegetation types found in the park provide some information on soils. A rough list of soil types includes:

- Permeable, dark-reddish brown sandy-clay loam;
- Badly drained, very dark-brown clay-loam;
- Shallow, very dark-brown sand-loam with a brittle structure;
- Very dark-brown, usually fine-textured sandy loam to sandy clay-loam, derived from ash shallowly overlying disintegrating volcanic debris;
- Dark grey-brown silty-loam.

Trends

The PEA Team did not gather specific information on resource trends in Arusha National Park, other than to note the increasing growth in dense settlement up to the park boundary, especially to the north and south of the park. Villagers are engaging in illegal harvesting of fuelwood and poaching of wildlife, and the hand-cleared boundary demarcation does not deter incursions into the park. Villagers also complain of crop damage by problem animals. Community Conservation Service (CCS) activities appear to have been hampered by insufficient staff and resources, including vehicle transport. Settlement effects are especially evident near Lake Tulisia on the northern boundary, where agricultural activities may be contributing significant quantities of silt to the lake, jeopardizing its future existence. Some poaching of flamingos from the lake was also reported.

3.2.5 Kilimanjaro National Park

Kilimanjaro National Park covers 756 km^2 above the 2700-meter contour. It includes the moorland and highland zones, Shira Plateau, Kibo and Mawenzi peaks. In addition the park has six corridors or rights of way through the Kilimanjaro Forest Reserve. The park was established in 1973 and officially opened in 1977.

Vegetation

Mt. Kilimanjaro vegetation zones form belts around the mountain. The vegetation changes with altitude and five major belts can be recognized. These belts are:

- Woodland and Bushland: This belt occurs at the lower mountain elevations. On the wetter southern slopes, the upper limit of this belt is 900 meters, while on the drier northern slopes it reaches up to 1500–1650 meters. It is very susceptible to fire and can be characterized as a

mosaic of *Acacia sp.*, thorn bushland and *Combretum/Terminalia woodland.*

- Cultivated Belt: This belt constitutes the replacement of the lower part of the Montane Forest belt. With the exception of a narrow corridor of native vegetation on the northwestern slope, the belt completely encircles the mountain. It reaches its highest point in the Machame and Marangu region (1900 meters).

- Montane Forest (Heath): This belt has its lower boundary at approximately 1700 meters on the southern side and 2200 meters on the northern side. The upper boundary reaches nearly 3000 meters in places along the southern side and 2800 meters on the western and northern sides.

- Eicaceous (Moorland): This belt extends from the upper limit of the Montane Forest to an elevation of approximately 4000 meters. In this zone, many of these species grow to heights of no more than 6–7 meters.

- Alpine Belt: This belt extends from the top of the ericaceaous belt approximately 4000 meters to the upper altitudinal limit of plant growth. The lower regions of the alpine belt are characterized by flowering woody plants and a number of tussock grasses that are quite common.

Wildlife

The increasing isolation of large mammals and the rate of forest conversion within Kilimanjaro National Park and Forest Reserve (KNP/FR) have adverse implications. These changes probably contributed to the extinction locally of the klipspringer (*Oreotragus oreotragus*) and the mountain reedbuck (*Redunca fulvorufula*) over the last 45 years. Several species have been added to previous checklists of threatened species of large mammals: Crawshay's hare (*Lepus crawshaji*), baboon (*Papio cynocephalus*), spotted hyena (*Crocuta crocuta*), black-backed jackal (*Canis mesomelas*), side-striped jackal (*Canis adustus*), white-tailed mongoose (*Ichneumia albicanda*) and warthog (*Phacocecklists aethiopicus*). Increasing isolation would most adversely affect the moorland fauna, while forest conversion would most adversely affect the large mammal fauna restricted to Montane Forest (IUCN, 1991).

Hydrology

Mount Kilimanjaro plays a critical role in the hydrology of northern Tanzania. The Pangani River Basin, one of the most important in Tanzania, depends largely on the water that flows from the mountain. The entire population around the mountain and much of the agriculture are dependent on this water. Various large national projects such as the Tanganyika Planting Company irrigation scheme and the Nyumba ya Mungu, Pangani Falls, and Kikuletwa hydroelectric power stations also depend on this water. In recent years, many long-term residents on Mount Kilimanjaro have noted that the hydrologic patterns on the mountain appear to have changed. Specifically, many local people feel that many of the rivers and streams that were once perennial are now intermittent. These changes may be occurring because of:

- changes in climate;

- increased use of water; and

- loss of vegetative cover and changes in land use patterns.

Geology and Soils

One to two million years ago, when the Great Rift Valley formed, a gently undulating plain existed, with a few old eroded mountains where Kilimanjaro now stands. A million years ago, the plain buckled and slumped. Fractures and faults allowed molten rock from below the earth's crust to find routes to the surface; volcanoes emerged and the plain became dotted with cones and craters.

About 750,000 years ago, Kilimanjaro began to grow out and over the fractures. Lava came from three main centers, Shira, Kibo and Mawenzi. Their cones grew over thousands of years, reaching about 5,000 m in height. About 500,000 years ago, Shira collapsed into a caldera and became inactive. Kibo and Mawenzi continued, the lavas intermingling, reaching 5,500 m. Then, Mawenzi died and rapidly eroded. Kibo continued to grow, producing several more lava flows. The most extensive eruptions, 360,000 years ago, produced a black lava that filled the old eroded Shira caldera, fanned out over the

Saddle and the base of Mawenzi, and flowed far to the north and south.

Kibo peak was about 5,900 m when Kilimanjaro ceased growing. Eruptions continued intermittently and, during periods of dormancy, erosion sculpted the form of the mountain, leaving the peaks and spires of the hard cone of Mawenzi, and the gentle plateau of Shira. Kibo flattened and subsided into concentric terraces and cones and was repeatedly covered and uncovered by glaciers. Roughly 100,000 years ago, a huge landslide carried away part of the summit and created the huge Kibo Barranco. Volcanic activity became sporadic. Many parasitic vents erupted, leaving a band of distinctive cones and craters running across Kilimanjaro in a south-east to north-west direction. During a final gush of activity, Kibo's present caldera was formed, the flows of the Inner Crater, and the Ash Pit.

The soils of Mount Kilimanjaro are of volcanic origin and have a high base saturation and cation exchange capacity.

Trends

Much of the Montane Forest was cut previously, and thus a very large proportion of the present forest consists of secondary vegetation. In addition, along the southern and eastern sides of the Montane Forest, portions have been opened up through livestock grazing and collection of forage. A significant qualitative change in the forest has occurred as a result of disturbance. Evidence of past human disturbance within the Maua and Marangu corridors and the Kiraragua catchment is fourfold:

- the high density of relatively small-diameter trees; larger-diameter trees are generally scarce;
- the species composition of the forest consists of many early successional species such as *Diospyros abyssinica, Croton megalocapus, Celtis africana* etc.;
- economically important species, e.g., *Olea capensis, O. enropeae* and *Podocarpus falcatus* are relatively rare; and
- most of the large-diameter trees that remain in these areas are economically important standing trees, e.g., *Agauria salicifolia, Rauvolfia caffra* and *acaranga kilimandscharia (IUCN,1991).*

3.2.6 Other National Parks in the TANAPA system

The other national parks in Tanzania are Gombe, Katavi, Mahale, Mikumi, Ruaha, Rubondo and Udzungwa (see Map 1).

Gombe National Park, situated north of Kigoma town in western Tanzania, occupies 51 km^2. Commissioned in 1968, it comprises a narrow strip of a mountainous country bounded to the east by the crest of the Rift Valley escarpment and by Lake Tanganyika to the west. Gombe is a park without roads, thus one can only walk and experience nature. Due to its altitude, the park vegetation varies from evergreen forest with tall trees, to open woodland and grassland. Common mammals found in the park are forest species, mostly primates, including chimpanzees, baboons, blue monkeys, red tailed monkeys and red colobus monkeys.

Katavi National Park is located in Mpanda District, Rukwa Region. It covers an area of 2253 km^2. The park was gazetted in 1974 and is famous for its undisturbed natural face compared to other parks in the country. The main vegetation is Miombo woodland. The major features of attraction include Lake Katavi, Lake Chada and Katuma River. Animals found in the park include zebra, sable and roan antelope, eland, leopard, elephant and buffalo.

Mahale Mountains National Park lies south of Kigoma on a peninsula that cuts out into Lake Tanganyika. The park, which occupies 1577 km^2, was gazetted in 1980 and is dominated by the Mahale Mountains. The park vegetation is mainly Miombo. Common animals include elephants, giraffe, zebra and antelope. The park is also famous for chimpanzees and blue monkeys.

Mikumi National Park lies astride the main highway from Dar es Salaam to Zambia. It covers an area of 3230 km^2 and is the third largest in Tanzania. It was gazetted in 1964 and is the park most accessible from Dar es Salaam. It is rich in wildlife, including buffalo, wildebeest, zebra and elephants, which are easily seen all year round.

Ruaha National Park was gazetted in 1964 and is the second largest in Tanzania, covering an area of 10,300 km^2. The park lies in the central part of Tanzania, just west of Iringa town, and harbors the second highest population of elephants in Tanzania, after the Selous Game Reserve. The park derives its name from the Great Ruaha River which flows through the Rift Valley. The park contains a wide variety of animals that include: Greater and Lesser kudu, and roan and sable antelope. The Great Ruaha River features large numbers of crocodiles and hippos. This park lies within a belt which interfaces species of fauna and flora found in southern and northern Africa.

Rubondo Island National Park was gazetted in 1977 and lies west of Mwanza town. It has an area of about 457 km^2. The park is unique by being the only one situated in Lake Victoria. The lake is the largest in Africa and the second largest in the world. The park provides a variety of habitats ranging from savannah to open woodland, dense forest and papyrus swamps. Animal species (some introduced to the area 20 years ago) include hippos, crocodiles, bushbuck, sitatunga, giraffe, elephant and chimpanzees.

Rubondo is also unique in birdlife. Birds from east, central and southern Africa breed at the "Bird Island."

The 1900 km^2 Udzungwa Mountains National Park was commissioned in 1992. It lies in Central Tanzania, bordered by the Great Ruaha River to the north and the Mikumi-Ifakara road to the east. The park's major attractions are its biodiversity and unique forest. The park harbors plant species found nowhere else in the world, ranging from a tiny African violet to 30 m high trees.

3.3 Road characteristics

3.3.1 Tarangire National Park Roads

Tarangire National Park has approximately 540 kilometers (kms) of road, with only about 21 kms classified as all-weather 2-wheel-drive major access roads, and 95 kms classified as all-weather 2-wheel-drive minor access roads. The remainder of the roads are a combination of minor access roads and Game Viewing roads of lower standard, which may require 4-wheel-drive, and may not be accessible year-round. Only a few new roads are contemplated in the near future, although if a road is included as part of the proposed boundary demarcation configuration, this would represent a large increase in the park road system.

Only major access roads appear to have sufficient drainage ditches and turnouts to adequately handle runoff. Many of the park roads exhibit scouring, rutting and other erosion damage. Significant portions of the road system lack any camber in the road surface to drain water from the wheel paths. Proper drainage is often absent. Drainage problems are exacerbated by berms left along each road shoulder created by improper grading of the road surface. Much of the native soil appears to provide fairly adequate roadway structural support, although it is prone to surface erosion. Most of the wetlands and former lake beds consist of black cotton soils (vertisols), which do not provide an adequate structural base during the rainy season.

Two quarry sites were visited at Tarangire. Both appear to be sufficient for the near term in quality and quantity of murram, although work in outlying portions of the park may require opening additional quarry sites. Murram presently obtained appears to be similar to limestone, does not seem to be excessively dusty, and provides a very good road base.

During the recent El Niño events, all of the park bridges suffered damage to some degree. The Matete Bridge has been repaired. The Sopa Bridge remains load-limited and has not been fully repaired, with a use-at-your-own-risk notice. Koro Bridge was so extensively damaged it was abandoned. Other river crossings are by drifts that appear to function adequately although each could be improved.

3.3.2 Lake Manyara National Park Roads

Lake Manyara National Park does not have a road inventory or road classification system at present. Using the PEA road classification system, the main park access road appears to be Class II up to Maji Moto Ndogo, and Class III beyond. Many of the

roads to ranger posts and to major visitor loops also appear to be Class III, defined as all-weather access, with 4-wheel-drive vehicles. The rest of the road network consists of game viewing routes, open to 4-wheel-drive, sometimes only on a seasonal basis. Several sensitive areas along the road exist, restricting road widening or road alignment changes. These areas include the groundwater forest in the north, several sections along the lake shore affected by rising lake levels, and the hot springs locations in the south.

Much of the park is at the base of the rift escarpment, and suffers significant effects from runoff. During rains, flash-flooding streams, with very high energy levels, bring large quantities of soil and rock debris into the park from upstream lands. Ditches frequently plug with debris; subsequently, water on the road causes erosion damage. Stream crossings are particularly affected since the streams often deposit sediments which fill stream channels over time, raise the stream bed, and result in stream channelization changes. One bridge, which crossed the Ndala River, is reported to have been completely buried by the river due to rapid sedimentation. Many stream crossings are dry-season passable drifts, which appear to be functioning adequately, although they present limitations on wet-season access. Most of the native soils under the roads appear to provide adequate structural support, although dust is a problem. Limited areas of black cotton soil exist, presenting the usual problems with this material. One murram quarry exists close to the park entrance, creating an aesthetic scar; other sources of good murram are available nearby, outside park boundaries.

3.3.3 Other TANAPA Parks' roads

In all parks surveyed, roads were generally maintained to a better standard than adjacent district-maintained roads. In part, this is due to restrictions on access within and across parklands by commercial and non-visitor vehicles. Park road systems appear to provide basic visitor access to primary park resources and attractions, and roads generally lie lightly on the land, meandering to follow contours and the landscape. Recent significant increases in visitor and vehicle use are affecting roads and the capability of park staff to provide adequate maintenance and access to park resources.

Drainage and drainage structures are of particular importance in evaluating the current condition of TANAPA's roads. Inadequate drainage often results from not addressing drainage issues during initial planning and design, road construction and subsequent maintenance. Non-existent or plugged ditches along roads causes water to flow over road surfaces, scouring soil and gravel along the roadway. Traffic traveling these muddy roads produces ruts on the surface, retaining water and softening the road base. Gradually, these ruts deepen into numerous gullies, which directly affect use of the road. Subsequent rains compound erosion and drainage problems, with direct and indirect effects on streams and wetlands. Where improper maintenance with road graders reduces berms along roadsides, water is captured within the roadway. This causes erosion, loss of road structural capacity, and results in substantial standing water during storm events. Most of the drainage problems noted are correctable, given some investment of effort and resources.

Murram quarry sites in the parks appear to be adequate, with viewshed impacts at some locations. They appear reasonably located away from most of the park roads surveyed. Murram quality varied from park to park. As park roads are generally rough, and heavy truck access is limited to the dry season, hauling of murram any significant distance increases costs, and limits the amount of work that can be done. Additional murram quarry sites will probably need to be developed in order to improve park roads to any significant degree.

Stream crossings are generally by bridges or drifts. Bridges provide year-round access and eliminate the hazard of crossing flowing water. However, bridges are much more expensive to construct and maintain and are prone to serious damage or failure due to meandering stream flows. Bridges require specialized design and construction skills not generally available within the park. Alternately, drifts can be installed with much less effort and much less cost by local park crews and are less affected by stream alignment changes which occur in many of Tanzania's parks. Many of the parks surveyed have seasonal streams which are dry during much of the year and have only minor stream

flows during the wet season, thus favoring the use of drifts. It is noted that major stream and river crossings with year-round flows require bridges, as drifts are not practical in these cases.

Many of the park roads are well-maintained with camber, murram and drainage systems in place and functioning. Some roads, especially the ones on steep and inclined stretches such as in northern Serengeti, do not follow the contours. Other steep and inclined roads, such as those found in Arusha National Park, appear to be designed and constructed well.

3.4 Road management

Tarangire and Lake Manyara National Parks have similar road maintenance staff, equipment and capability. Both parks have a limited amount of equipment for road maintenance and repair, much of it in poor condition and not currently operational. The park road maintenance staff generally consist of several equipment operators and truck drivers, with a large number of casual laborers available as needed from neighboring communities. In both parks, shop facilities are located at headquarters with both buildings and sheds. Park capacity for heavy equipment repairs is limited by the available facilities, tools and mechanical skills. Heavy equipment operation and repair budgets are not sufficient to keep equipment in a good state of repair or to operate equipment for very many hours during the year.

In Tarangire and Lake Manyara National Parks, annual management plans which may be used by road crew to know when and who will do a certain activity are inadequate or absent. It is also noted that mechanics keep few records concerning maintenance of road equipment, which may mean that maintenance occurs only on a sporadic basis, without following manufacturers' recommended schedules.

Road maintenance capability for all parks surveyed is limited. Where heavy road maintenance equipment is available for use, it is often fairly old and in poor operating condition. Most parks have access to tipper trucks and some newer trucks were noted. Equipment operators and truck drivers are available to a degree, although, based on practices observed along park roads, skill levels evidently vary from park to park.

Shop facilities for heavy equipment maintenance and repair are limited or non-existent, and equipment maintenance records are often not available. Funds for operating and maintaining heavy equipment are also limited, and work is often postponed due to lack of funds for tools, fuel, materials and casual labor. In some cases, tipper trucks are loaded by hand at murram pits since a loader is not available. This has been the case, for example, at Tarangire National Park. Significant portions of roads within Arusha and Kilimanjaro National Parks are entirely maintained by hand with casual labor, since heavy equipment is not readily available. Except for the Serengeti, parks lacked clear guidelines for the rehabilitation and construction of different roads (for example, Annual Work Plans).

A Road Done Right—A Grader Operator Who Knows His Art

In the Serengeti, this Class I road from Naabi Hill Gate to Seronera was well-maintained, with a good murramed and cambered surface. Using a grader, a newly cut runout drain had just been completed to the right. Knowing how to use the grader to shape park roads is a skill not acquired from manuals. Finding an operator who is also an "artist with the grader blade" is the secret! (S 2°38.5', E 34°54.2')

3.5 Traffic, tourist and revenue characteristics

3.5.1 Visitor numbers and trends

The number of tourists visiting Tanzanian national parks vary from one park to another. Visitor statistics show that more than 90 percent of all tourists visiting national parks in Tanzania, went to the northern parks. The majority (41%) visited Serengeti, followed by Lake Manyara, Tarangire, Arusha and Kilimanjaro, in that order.

Although the number of visitors has been fluctuating over the years, it has increased about 8 percent annually. Visitor trend statistics for all parks between 1994/95 and 1998/99 are indicated in Figure 1-1 and Table 3-1. Note the dramatic leap in the number of visitors to the Serengeti between 1997/1998 and 1998/1999, from 90,973 to 198, 934.

Table 3-1. Visitor statistics trends for Tanzania National Parks from 1994/95 to 1998/99

Park Name	**1994/95**	**1995/95**	**1996/97**	**1997/98**	**1998/99**	**5 Years Total**	**Percent contribution per park**
Serengeti	99,579	98,501	96,886	90,793	198,934	584,693	41.1
Lake Manyara	60,028	61,651	75,847	69,301	67,805	334,632	23.5
Tarangire	38,704	43,792	54,454	50,464	41,147	228,561	16.0
Arusha	13,408	23,347	20,770	21,968	19,138	98,631	6.9
Kilimanjaro	12,967	14,369	18,327	18,275	21,940	85,878	6.0
Mikumi	13,149	8,662	11,894	11,708	10,986	56,399	4.0
Ruaha	4,045	7,907	4,146	4,725	5,274	26,097	1.8
Gombe	736	363	1,231	369	401	3,100	0.2
Katavi	448	539	337	434	368	2,126	0.1
Udzungwa	245	343	345	323	483	1,739	0.1
Rubondo	157	209	159	321	330	1,176	0.1
Mahale	144	225	260	221	217	1,067	0.1
Total	**243,610**	**259,908**	**284,656**	**268,902**	**367,023**	**1,424,099**	
% Increase in visitors number	**-8**	**7**	**10**	**-6**	**36**	**Average increase for 5 years = 8% per year**	

3.5.2 Vehicle numbers and trends

The number of vehicles using the roads is linked to the number of visitors to the parks. For the last five years (1994/95-1998/99), the number of vehicles entering Tarangire and Arusha National Parks showed moderate increases. However, statistics for Serengeti and Lake Manyara show more substantial growth. (See Figure 1.2 and Table 3-2). No vehicle statistics are provided for Kilimanjaro National Park because tourists use only trails in the park. Existing roads are used for administrative and rescue services only.

Table 3-2. Vehicle statistics from 1994/95 to 1998/99

National Park	1994/95	1995/95	1996/97	1997/98	1998/99
Serengeti	-	-	32.923	35.199	42.116
Manyara	10.368	9.333	13.778	13.892	18.665
Tarangire	10.579	14.106	15.209	14.587	14.586
Arusha	3.770	4.620	4.973	3.667	4.265

3.5.3 Tanzania National Parks revenue (1994/95 - 1998/99)

TANAPA has been experiencing a steady increase in income generation for the last five years. This increase has partly been due to the increase in the number of visitors. However, instances exist where the number of visitors decreased, while income increased. This increase in income is due to increased park fees and the number of days visitors stay in the parks. Visitors are staying longer, primarily because of the expansion in accommodation facilities in the parks, including lodges, tented camps and campsites. In Kilimanjaro National Park, visitors stay for five or six nights, while in the Serengeti they stay for one to three nights. In addition, in KINAPA, visitors pay US $25 as a park entry fee and US $40 for banda or camping fees per day. In the Serengeti, Tarangire and Lake Manyara National Parks, on the other hand, the majority of visitors pay US $25 as an entry fee, and a small percentage is paid to TANAPA by the lodge and tented camp operators for accommodation and meal expenses. Only a small proportion of visitors in the northern parks pay US $40 as camping fees.

TANAPA revenue statistics indicate that Kilimanjaro National Park is the number one revenue generator, followed by Serengeti, Tarangire, Lake Manyara and Arusha National Park, in that order.

Figure 3-1 Revenue trend for the Northern Parks in Tanzania Shillings "000

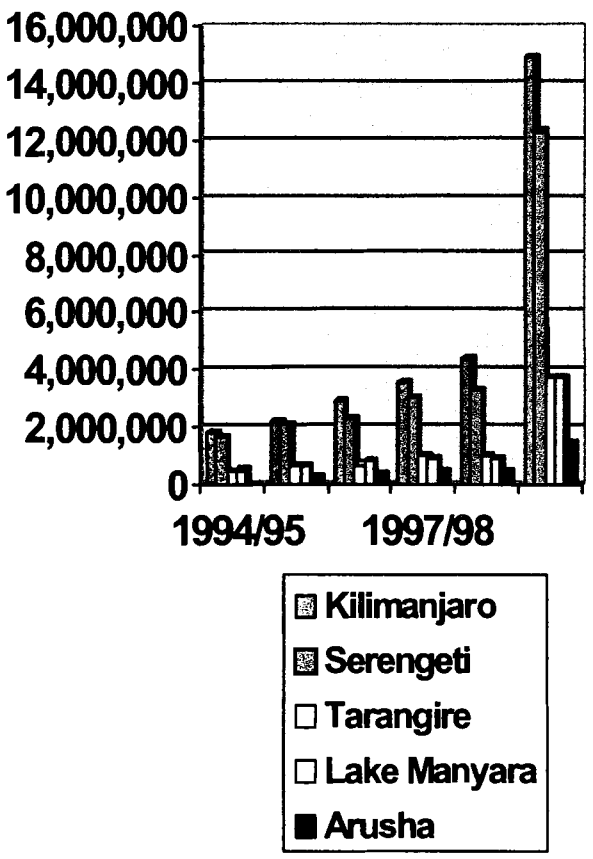


Table 3.3: Revenue Trends for Tanzania National Parks (1994/95 - 1998/99) in Tanzania Shillings "000"

Park Name	1994/95	1995/96	1996/97	1997/98	1998/99	5-Year Total	% Contribution per Park
Kilimanjaro	1,857,933	2,188,750	2,904,128	3,588,317	4,394,268	14,933,396	39.7
Serengeti	1,631,225	2,119,549	2,269,340	2,987,154	3,293,463	12,300,731	32.7
Tarangire	491,074	612,505	678,432	966,888	1,009,226	3,758,125	10.0
Lake Manyara	501,169	614,058	791,129	901,133	945,183	3,752,672	10.0
Arusha	26,950	284,915	333,545	401,828	428,741	1,475,979	3.9
Ruaha	53,583	95,533	89,186	95,125	154,658	488,085	1.3
Mikumi	65,041	79,733	85,898	92,326	103,112	426,110	1.1
Mahale	21,364	43,606	18,937	50,988	35,913	170,808	0.4
Gombe	25,130	28,831	39,054	28,856	48,865	170,736	0.4
Katavi	4,922	8,288	11,637	28,856	12,908	66,611	0.2
Rubondo	6,489	9,560	9,118	19,906	17,879	62,952	0.2
Udzungwa	3,513	4,416	4,107	5,284	6,631	23,951	0.1
Total	**4,688,393**	**6,089,744**	**7,234,511**	**9,166,661**	**10,450,847**	**37,630,156**	
% Increase	28	30	19	27	14	**Average increase for 5 years is 24% per year**	

3.6 Socio-economic characteristics

3.6.1 Tarangire/Lake Manyara National Parks

Geographical extent

This socio-economic section considers the Tarangire/Manyara Ecosystem which is defined by Kurji (1997) as the area of the following wards and districts:

- Babati Districts (Qash, Gallapo, Magugu Rural, Mamire, Mwada and Nkaiti wards), west of Tarangire National Park;
- Kondoa District (Busi and Bumbuta wards), south of TNP;
- Kiteto District (Ruvu Remiti, Orkesumet, Olboloti, Emboret, LoiborSiret, Terrat, Naberera, Makame and Kijungu wards), east and south-east of TNP;
- Monduli District (Sepeko, Makuyuni, Mtowambu, and Engaruka) to the north and northeast of TNP.

Major ethnic groups

There are various ethnic and tribal groups residing in the Tarangire/Lake Manyara Basin, most of whom are pastoralists and agro-pastoralists. However, in the last 20 years, immigration of other groups into the region has been widespread, modifying many of the traditional land and resource use practices.

The Maasai are the largest and most known pastoral group in the region. Historically, they practiced a nomadic livestock management system dependent upon extensive land use to meet the water and pasture needs of their cattle. This traditional pastoral practice has been shown to be compatible with wildlife and the preservation of its habitat (Paterson, 1978; Lane, 1996; Homewood & Rodgers, 1991). However, because of increasing immigration of non-pastoralists into the Basin, and therefore increased competition for resource use, the Maasai are no longer able to meet their subsistence needs based solely on a pastoralist production system, and are now raising their own food crops.

The Ma-Arusha are an off-shoot of the Maasai and are primarily agro-pastoralists. They originally settled in the foothills of Mount Meru, but because of extreme land pressure in this area, they have migrated into the surrounding areas, including the Tarangire/Lake Manyara Area. The other important ethnic groups include the hunters and agro-pastoralist Mbugwe, and the pastoral Barbaig. The smaller ethnic groups in the area include, but are not limited to, the Iraqw, Warangi, Mbulu, Chagga and Nyiramba.

This increasing influx of various groups and their redistribution around the Tarangire and Lake Manyara National Parks has caused the loss of wildlife habitat. The expansion of human populations has led to habitat change around the NP, thus bringing about its biogeographical isolation (Soule, et al., 1979; Diamond, 1981). A related concern is how to support the basic needs of the people who live and carry out various economic activities around the park.

Population and population changes

Kurji (1997) has shown that the western, southern and northern areas of TNP are more densely settled than the central portion and eastern margins of the Tarangire Ecosystem. Thus, the areas of mixed and sedentary agriculture to the west and south, and the transitional areas to the north of the TNP are more heavily populated than the mainly pastoralist and wildlife ranges of Simanjiro and Kitwai to the east and south-east. In-migration is the major factor causing population growth in the area (Kurji, 1997). The prospects for further population growth are very high in the rural populations around the Tarangire ecosystem.

Land use pattern

Several major land use types are found in the Tarangire Ecosystem, relevant to conservation of wildlife and the environment. These are briefly discussed below.

Settlement: Three kinds of housing are known in the area: (i) mabati (corrugated metal) roofed

houses, more prevalent in the Babati District; (ii) thatched roofed houses, which are more widespread, but relatively few in Kiteto and Simanjiro Districts; and (iii) Nkang, traditional mud or dung houses within protective thorn fences built and occupied by pastoralists. These are predominant in Kiteto, Simanjiro and Monduli Districts.

Agriculture: Traditionally, agriculture was for subsistence purposes, but now it is both for subsistence and the market. It currently has expanded to cover large tracts of traditional pastoral areas in the Western and Southern areas (Babati and Kondoa Districts). Recently, irrigated rice production has been introduced, especially along the rift valleys. Large-scale farming with tractors is increasing in the northern area (Monduli District), small/large-scale agriculture and pastoralism are the dominant land uses. The crops grown there are similar to those mentioned above. In addition, large-scale navy bean farming for seed export is carried out in the Lolkisale area, a land use which is encroaching on the northern confine of the Simanjiro Plains. In the East (Simanjiro and Kiteto Districts), cultivation has been mainly limited to small-scale farming, with maize and beans as the principal crops. Given the rapidly increasing numbers of agriculturalists in the area, the traditional pastoralists are being forced to reduce their livestock numbers below the viable stock needed per capita, forcing people into agriculture.

Pastoralism: Pastoralism is a traditional land use among the Maasai and the Barbaig in the northern and eastern parts of Monduli, Simanjiro, Kiteto and northern Babati Districts. Historically, pastoralists practiced a nomadic and extensive land use system, utilizing marginal lands and associated water resources.

Mining: Mining is the latest land use development in the area, dominated by the Minjingu Phosphate Mine in Babati District, which commenced commercial operation in 1982. The mining company has a lease for 1,750ha, of which 280ha is actual mining area. The mining lease area is not available for cultivation (except by mine workers), or livestock grazing. Precious and semi-precious gemstones are found in Simajiro and Kiteto Districts. Most of this mining is small scale in nature.

Charcoal: Charcoal production has increased in Simanjiro and Kiteto Districts as the urban populations of Arusha and Moshi grow and the demand for fuel rises. The Land Management Programme (LAMP) estimates that approximately 117 trees are being cut per day (approx. 43,000 trees per annum).

Hunting: In the Tarangire area, hunting can be divided into three main categories: sport hunting, commercial hunting and traditional hunting. Commercial safari hunting is carried out in several areas by various companies. Some of the hunting grounds include: Mtowambu, Simanjiro, Naberera, Simanjiro GCA, Lolkisal GCA, Burunge and Mkungunero GCA. Hunting quotas are allocated each year by the Wildlife Division. Sport hunting is normally carried out from the beginning of July to the end of December.

3.6.2 Other National Park systems

Serengeti National Park

Poaching has been a perennial problem within the SNP (Scaller, 1972; Sinclair, 1977; Dublin & Douglas-Hamilton, 1987; Campbell & Borner, 1995). However, the situation became markedly worse after April 1977, when the international border with Kenya was closed. This action resulted in a reduction in the number of visitors and a drop in revenue. As a result, the park budget showed little overall increase throughout the 1980s. This affected anti-poaching efforts. Patrol days decreased in the mid-1980s to some 60 percent of the level prior to border closure (Sinclair & Arcese, 1995). During this time the local population continued to grow, and the reduction in the anti-poaching effort resulted in greater illegal hunting in the northern and western Serengeti.

Meat poachers exploit both migratory and resident wildlife in these areas of the park. Snares are the most common method of hunting. Lorries, tractors and land rovers are also used to transport the meat from the park to the market. Particularly hard hit by poaching are the Mara River hippo and buffalo in the northwestern area of the park.

Commercial trophy poaching for ivory and rhino horn is carried out by highly armed and dangerous poachers. Between 1977 and 1986 the elephant population was reduced from 2800 to 400. The rhino population had dropped from several hundred to about six at the time of the PEA.

Long-term trends in buffalo population numbers in SNP suggest that the population had been increasing until the mid-1970s. By 1992 buffalo numbers had declined within the northern part of the SNP, from about 25,000 in 1970, to only 6,142 in 1992. Current estimates are discussed under Section 3.2.3. The northwest suffers major buffalo declines mainly because of the absence of any protective buffer zone and the close proximity of settlement outside the park.

The illegal capture of live wildlife is geared to the supply of the international pet trade. Within the Serengeti, poachers have been caught with a variety of live birds. Cattle rustling is carried out across the park and confrontation occurs between armed people from either side. Wildfires are sometimes started by cattle rustlers during their passage across the park.

Arusha National Park

Arusha National Park is situated in a densely inhabited part of Tanzania, where demands for land are high and parts of the park are already bordered by agricultural settlements. These include northwest (Momella Lakes area), west (Ngurdoto Crater) and southeast.

Park Management in the park is concerned with illegal fuelwood collection and tree cutting for building materials, grazing by domestic livestock, poaching and tourists/tour operators entering the park without paying fees. At the same time, the establishment of effective working partnerships with surrounding communities means that Park Management must also be concerned about helping to reduce the adverse effects of wildlife on bordering communities from crop raiding and problem animals.

The densely populated rural communities bordering the park need wood or charcoal to cook and keep warm, and the demand for fuelwood is high and increasing. A constant demand also exists for building poles. Many of the rural communities surrounding the park also illegally use areas within the park to graze their livestock. This reduces grazing available to wildlife, and the presence of people, particularly when accompanied by dogs, disturbs the park fauna.

There are two types of poaching activities: poaching for meat, usually buffalo and giraffe; and trophy hunting of elephant. The park used to have many rhinos, but most, if not all, have been killed.

Kilimanjaro National Park

The lower slopes of Mount Kilimanjaro formerly comprised lower mountain forest, but are now characterized by agricultural settlement. Kilimanjaro Forest Reserve surrounds the park and covers an area between the 1,820 meter contour and the 2,700 meter contour. Problems in managing and protecting the Forest Reserve include: illegal hunting, honey gathering, tree felling, fuelwood collection, grass burning, and incursions with domestic livestock. The Forest Reserve is all that remains of a large Montane Forest that was continuously reduced in size by conversion to farmland and pine plantations. Due to excessive cutting of hardwoods on Mt. Kilimanjaro over a 50-year period, all harvesting was banned by Presidential order in 1984. Nevertheless, the Reserve remains an important source of building materials and fuelwood for the local people. The most extensive loss of indigenous forest has resulted from to the establishment of softwood plantations in Rongai and West Kilimanjaro by the Forestry Department.

As mentioned in Section 3.2.5, Mt. Kilimanjaro is one of the most important water catchment areas in Tanzania. Pangani River Basin, one of the major river basins in the country, is fed largely by water from the slopes of the mountain. The entire population and most of the agriculture around the mountain depends on this water. In addition, the water from Pangani River and its tributaries is used extensively for irrigation of cash crops and to generate hydroelectricity throughout northeastern Tanzania. The reduction in the size of Kilimanjaro's indigenous Montane Forest from increasing population pressure is threatening its water catchment area capacity.

4. Institutional Framework and Regulatory Setting

4.1. Institutional framework

4.1.1 Introduction

The elements of the institutional framework affecting this PEA are:

- management plans and institutional arrangements which tend to support or contradict the proposed development; and
- the capacity and capability to implement mitigation measures.

Relevant institutions and arrangements are described briefly below.

4.1.2 Ministry of Natural Resources and Tourism (MNRT)

The MNRT is responsible for policy formulation and development of effective legislation and regulatory mechanisms for natural resource management and tourism in the country. Under this Ministry, three specific departments are of importance to the present study, as outlined in Sections 4.2.1 to 4.2.3 below.

Tanzania National Parks (TANAPA)

TANAPA is a parastatal organization under the MNRT established through an Act of Parliament, Cap 412 of 1959 and amended in 1974. The main duty and function of TANAPA is to *manage and regulate the use of areas designated as national parks so as to preserve the fauna and flora, wildlife habitats, natural processes, wilderness quality and scenery therein and to provide for human benefits and enjoyment of the same for future generations.*

Specifically, the functions of TANAPA are:

- protected area management;
- conservation planning;
- policy implementation and formulation;
- regulation of utilization, both consumptive and non-consumptive;
- issuing permits and licensing;
- law enforcement;
- training;
- community-based conservation; and
- provision of technical advice.

The organizational structure of TANAPA consists of three Directorates: Parks Management and Conservation, Finance and Supplies, and Personnel and Administration. The Directorate of Parks Management and Conservation is responsible for road construction and maintenance in the parks. In this directorate, the Road Section, under Department of Works, normally carries out road improvements. (This structure is under review and may change in the near future.)

Wildlife Department (WD)

The Wildlife Department is the oldest government department in Tanzania. Its history goes back to the German era. Since independence in 1961, the WD has been operating under various ministries:

- 1960s: Ministry of Agriculture and Livestock
- 1970s: Ministry of Natural Resources, Tourism and Environment
- 1985: Ministry of Lands
- 1995: Ministry of Natural Resources, Tourism and Environment
- 1997: Ministry of Natural Resources and Tourism

The core functions of the WD related to this study include:

- management of Protected Areas;
- policy implementation;
- conservation planning;
- law enforcement;
- community-based conservation and extension;
- research and provision of training;
- provision of technical advice;
- regulation of utilization of both consumptive and non-consumptive resources; and
- issuance of permits and licenses.

The organizational structure of WD includes sections for Wildlife Development; Anti-poaching Operations; Resource Utilization and Research; and Training and Statistics.

Forestry and Beekeeping Department (FBD)

The Forestry Department was established under the Forestry Ordinance of 1959 Cap. 389. The organizational structure of the FBD comprises four sections, i.e., Forest Development; Forest Utilization & Extension; Research, Training & Statistics; and Beekeeping Development. Impact assessment is normally performed under the Research, Training and Statistics Section.

The functions of the Forestry and Beekeeping Department, pertinent to the PEA, include:

- formulation of policy;
- establishment of national criteria and indicators for sustainable forest management;
- development of guidelines for different forest types based on established national indicators and criteria; and
- preparation of management plans for all types of forest reserves and strengthening the capacity of the sectoral administration to monitor the implementation of these plans.

4.1.3 Vice President's Office

The Vice President's Office (VPO) is responsible for co-ordinating environmental matters in the country. It is also responsible for providing overall policy guidance and advice on the development of strategic environmental vision. This includes formulation, analysis and appraisal of broad environmental goals and policy, in conformity with such vision.

The current VPO's structure includes both the Division of Environment, and National Environment Management Council (NEMC).

Division of Environment (DoE)

DoE was created in 1991. Initially DoE was in the Ministry of Tourism, Natural Resources and Environment (MTNRE). In 1995, the DoE was moved to the VPO and assumed responsibility for the co-ordination of environmental management matters. DoE's specific functions in relation to this exercise include:

- undertaking policy analysis and development of policy choices to influence decision-making;
- co-ordinating broad-based environmental programs, plans and projects which go beyond single sector approaches; and
- development of basic management tools, such as guidelines and criteria for Environmental Impact Assessment, Environmental Standards, National Action Plans, Strategies and Programs etc., in order to ensure systematic and consistent environmental administration.

National Environment Management Council (NEMC)

NEMC was established by Act of Parliament No. 19, September 1983. Before 1995, NEMC was also under the MTNRE. It is now under the VPO and its main function is to advise the government on all matters relating to the environment.

NEMC's organizational structure includes six directorates: Environmental Impact Assessment; Research; Environmental Education and Documentation; Natural Resources Management; Pollution Prevention and Control; and Finance and Administration. All matters concerning impact

assessment are normally done under the EIA directorate. Accordingly, NEMC's functions relevant to this study include the following:

- undertaking or promoting general environmental educational programs for the purpose of creating an enlightened public opinion regarding the environment and role of the public in its protection;
- specification of standards, norms and criteria for the protection of beneficial uses and the maintenance of the quality of the environment through environmental impact assessment; and
- formulation of policy on environmental management and recommending its implementation by the government.

Assuring proper management of Tanzania's natural resources requires an effective legal framework. However, aspects of environmental management in Tanzania fall under several different institutions in both the public and private sectors. In many cases, mandates are unclear or overlapping, with considerable competition among institutions for limited available human and financial resources. Typical examples include NEMC and DoE; two mandated central environmental management institutions: NEMC as a statutory body (Section 4.2.2); and a DoE as a government department (Section 4.2.1). Both are accountable to the VPO. Concern has been expressed over overlapping and competing mandates between these two central structures, as well as between these two and other sectoral institutions such as wildlife, forestry, water, etc. The perception has been that competing mandates discourage inter-sectoral co-operation crucial to effective environmental management.

4.1.4 Ministry of Water

The first Water Ministry was established in 1970 as the Ministry of Water Development and Power. The functions of this Ministry related to this particular study include:

- development of water quality monitoring programs;
- improved management and protection of water source areas; and
- strengthening soil and water conservation activities as set out in the National Soil and Water Conservation Program.

4.1.5 Ministry of Energy and Minerals (MEM)

MEM was established in 1995. Formerly, it was the Ministry of Energy, Water and Minerals. In 1977 the Government separated water issues from the ministry. While the overall environmental function of the Government in the mineral sector is to establish environmental health and safety guidelines and to ensure compliance, the MEM has the following specific responsibilities:

- formulation of policy on minerals;
- administrative oversight of the policy; and
- co-ordination of development in the mineral sector in Tanzania.

The organization structure of MEM is comprised of the Mineral Division; Mines, Mineral Development, Energy and Petroleum Division; Energy Development, Petroleum and Gas, Electricity and Renewable Energy.

4.1.6 District and Local Governments

Statutory provisions for Districts and Local Governments were established by Act of Parliament No. 7 of 1982 and amended in 1992. District and Local Government Institutions are especially important to effective sound environmental management, as constituents must live with the consequences of environmental change. These constituents are the 'custodians' of natural resources and should have both the "ownership and responsibility" to manage local resources sustainably.

The functions of local and district governments include:

- making and issuing by-laws regarding protection of public health and welfare, and environmental resources;

- passing by-laws related to areas of natural resources and environmental management;
- construction, operation and maintenance of economic, social and environmental infrastructure;
- overseeing planning processes and establishment of local environmental policies and regulations, e.g., water pollution regulations; and
- educating, mobilizing and responding to the public to promote environmental objectives.

The organizational structure of Local Government in Tanzania consists of regions, districts, wards and villages. The Office of the Prime Minister and Vice President co-ordinate all matters pertaining to district and local governments. District, Ward and Village Committees are responsible for co-ordinating and advising on obstacles to the implementation of environmental policy and programs; promoting environmental awareness; and information generation, assembly and dissemination on the environment. The Village Council can propose by-laws, which have to be given to the Village Assembly for comment, and which then go to the District Council for approval.

A major issue is the complexity within the institutional structure and the ambiguity in the division of roles and responsibilities concerning environmental management between Central and Local Government. This ambiguity hampers the decision-making system that should facilitate co-ordination, co-operation and responsibility at various levels. Environmental problems cannot be solved in the absence of a clearly identified division of responsibilities between Central and Local Government. Local government authority had been removed in 1972 but, due to increasing realization of the need for district and local institutions, they were re-established and strengthened in 1982.

Currently, there are increasing calls from central government to centralize responsibility for environmental conservation activities. The arguments advanced for taking this away from local government are that central government ministries have a better overview of the resources in need of management, and that the lack of manpower and financial resources at the local level make them unable to manage resources effectively. Proponents of centralization also believe local governments are more susceptible to outside influence.

4.1.7 USAID/Tanzania Strategic Objective for environmental/natural resource management (SO2)

Readers are referred to *Section 1.2.3 Regulatory considerations* for background on the US/AID/ Tanzania SO2.

4.2 Regulatory setting

4.2.1. Introduction

The proposed actions outlined in Chapter 2 have implications for wildlife management, land rights and tenure, and tourism development. Section 4.2 covers some of the aspects of the policy and legislative framework affecting the issues and recommendations emerging from the PEA, including the extent to which mitigation measures are likely to be successful.

4.2.2 International conventions

Biosphere Reserves

The Man and Biosphere Programme (MAB) was launched by the UNESCO General Conference in November 1970. MAB is a long-term programme of research, training and information exchange among states, concerning environmental management. Under this program, a worldwide network of protected areas, called Biosphere Reserves, is being established for the purpose of conserving species and genetic diversity and for use in a program of monitoring, research and training.

Projects under the MAB Programme are expected to demonstrate the advantages of integration, interdisciplinary involvement and participation by local communities. Tanzania, Lake Manyara and Serengeti National Parks have been included in the list of Biosphere Reserves along with Ngorongoro Conservation Area. Lake Manyara National Park was selected as a Biosphere Reserve in the 1980s

on the basis of its uniqueness—as a small park harboring one of the highest biomass/hectare of herbivores in East Africa, and because of its high diversity of habitats. Another factor in selecting Lake Manyara is that it is surrounded by dense farming communities. The management of Biosphere Reserves requires that an integrated approach be used to engage both conservation managers and the neighboring communities in sustainable management of the Reserves. Wide stakeholder involvement is sought in order to eliminate animosity and mistrust that may occur when strict single-purpose conservation is imposed without consultation.

Implementation of road improvements in Biosphere Reserves (Serengeti and Lake Manyara National Parks), must be done in such a way that their global heritage is preserved. Road improvements must also avoid actions which might erode the value of these two Biosphere Reserves, including their value in providing benchmarks for measurement of long-term ecological and environmental change.

World Heritage Sites

The "Convention for the Protection of the World Cultural and Natural Heritage" was adopted by the General Conference of UNESCO in 1972. The Convention aims at safeguarding monuments, cultural sites, and natural areas, which are of outstanding universal value. Tanzania became a party to the Convention in 1977, and Serengeti and Kilimanjaro National Parks have been inscribed on the World Heritage List along with Ngorongoro Conservation Area and Selous Game Reserve.

Of relevance in designating Serengeti and Kilimanjaro National Parks as World Heritage Sites was the need to protect migratory species and the seasonal sites necessary for their survival. In addition, special attention was given to the preservation of habitats which support a variety of rare, endangered and endemic plants and animals. Any road development in these parks must address these issues.

Ramsar Sites

The Ramsar Convention is a global inter-governmental treaty on conservation and wise use of wetlands. Initially, the Convention emphasized the importance of waterfowl, but the current scope emphasizes all natural resources and the concept of wise use. The broad objective of the Convention is to stem the loss of wetlands and to ensure their conservation. Under the Convention, Contracting Parties are required to include wetland conservation considerations in their national land-use planning processes. This includes formulation and implementation of plans to promote the wise use of wetlands. Contracting Parties are also required to promote the conservation of wetlands in their territories through the establishment of protected areas. A specific obligation under the Convention is the designation of wetlands for inclusion in the *List of Wetlands of International Importance.*

Lake Manyara National Park and its associated wetlands have been selected as a potential Ramsar Site for Tanzania. Although the Park is the preferred site, Muyowosi and Lake Natron have often been suggested as other potential Ramsar Sites. The Government of Tanzania has yet to make a final selection and ratify the Convention. The major concerns related to the Manyara site include deforestation of the catchment area and siltation. By including Lake Manyara and its immediate environs within a nominated Ramsar Site, the Government would signal a clear intention to accept responsibility for the protection of the environment of the lake and both the humans and wildlife which depend on it for their survival. Any road improvement activities that could have adverse effects on wetland areas within Tanzania's national parks should be avoided.

4.2.3 National legislation and commitments

Various national environmental policies, such as the National Conservation Strategy for Sustainable Development (NCSSD), the National Environmental Policy (NEP) and the National Environmental Action Plan (NEAP) have been formulated and are in place. All these policies recognize explicitly the need for an effective environmental framework, but they lack the necessary legislative backing (see Hitchcock, 1994; IRA/IIED, 1995 for a review of EIA-related policy and legislation).

In recent years, signs of emerging political interest in EIA have been emerging in the country. In 1995, a Tanzanian delegation signed a communiqué of high-level ministers pledging action to promote EIA as a planning tool (Goodland *et. al.*, 1995), suggesting a growing commitment to the EIA process. Recently, the President of Tanzania re-affirmed commitment to pledges made at the 1992 UNCED meeting (WCST/IRA/Agenda, 1996). However, lack of resources, expertise, institutional capacity and political commitment continue to present formidable barriers to the implementation of these pledges, including those related to EIA. Most recently, an institutional study on EIA was commissioned by the Office of the Vice President with the support of the World Bank.

National capacity (in terms of expertise and financial resources) available to manage and implement environmental assessment has been extremely limited (IRA/IIED, 1995). The institution responsible for managing the EIA process in Tanzania, the National Environmental Management Council (NEMC), has so far played an advisory role, since it lacks legal enforcement powers. This weakness is aggravated by the shortage of relevant expertise and its lack of representation at district and local levels. The Division of Environment (DoE) was created in 1991 to deal with policy issues on environment in the country. However, the conflicts which arose between DoE and NEMC because of unclear and overlapping mandates, have often been to the detriment of the environment.

4.2.4 Land Policy

The overall aim of National Land Policy (MLHUD, 1995) is to promote and ensure a secure land tenure system, to encourage the optimal use of resources, and to facilitate broad-based social and economic development without upsetting or endangering the ecological balance of the environment.

In view of this overall aim, specific environmental objectives related to the PEA include the following:

- modify and streamline the existing land management systems and improve the efficiency of land use systems;
- promote sound land information management; and
- protect land resources from degradation for sustainable development.

The policy also recognizes the importance of protecting sensitive areas like national parks. It stresses that allocating these areas to individuals without due regard for the environmental implications will result in destruction of these sensitive areas. Therefore, the policy states that, *"mechanisms for protecting sensitive areas will be created. Sensitive areas include water catchment areas, small islands, border areas, beaches, mountains, forests, national parks, rivers, river basins and banks, seasonal migration routes of wildlife, national heritage and areas of biodiversity. These areas or parts of them should not be allocated to individuals."*

The Land Policy underscores the importance of wetlands in social and economic development, and recommends that wetlands be studied, proper land use determined, and wetland use allocated to appropriate users. The PEA should ensure that the improvement of roads in the national parks consider the protection of sensitive resources areas, to avoid their degradation or loss as national assets.

4.3 Sectoral policy initiatives

Despite the slow progress at the national level, some notable initiatives have been undertaken to incorporate environmental issues at the sub-national level. These are discussed in the following sections.

4.3.1 Tanzania National Parks (TANAPA) Policy

TANAPA Policy (1994) requires the preparation of EIAs for all developments and activities within and adjacent to national park boundaries. EIAs are also being extended to cover the General Management Plans (GMPs). Facilities necessary for visitor use and park management (e.g., roads) will be identified in the GMP/EIA and associated Technical Detail Plans. The GMPs set "limits of acceptable use" levels that determine the number, location, and sizing of all facilities located in a park. Planning and design of park facilities is to be accomplished

by interdisciplinary teams. Designs are subjected to review for consistency with GMP/EIAs. They must also be harmonious with, and integrated into, the park environment and designated standards.

GMP/EIA for Tarangire National Park has yet to be accomplished. In 1994, the Tarangire Management Zone Plan (MZP) was published in response to tourism development pressure in the parks. Those pressures arose in the wake of the implementation of new national liberalization policies, which encouraged tourism and private-sector development. The MZP was intended to guide tourism infrastructure development in the park. A final GMP/EIA is expected in the near future. A second Draft GMP for Lake Manyara NP is available. Serengeti and Kilimanjaro National Parks each have a GMP, while Arusha NP has none.

Unfortunately, no conventional strategic environmental assessment (SEA) was done for Serengeti or Kilimanjaro National Parks or under the Tarangire MZP. For Tarangire, an environmental review was carried out, not only in order to rationalize tourist management within the park. Further, the planning process lacked the participation of the government and other stakeholder groups. In order to guarantee effective implementation of the plans and, hence, the sustained viability of parks, it is recommended that:

- GMPs/MZPs should be subjected to comprehensive SEA and should consider both the beneficial and adverse impacts of implementing and not implementing the plans;
- the planning should involve all relevant stakeholders; and
- planning should not only consider tourism development, but also other issues, such as those related to wildlife/natural resource management and (baseline) research.

TANAPA Policy specifically calls for a balance between preservation and use that ensures a quality visitor experience without adversely affecting park assets. High-quality visitor opportunities are to be provided through a strategy that maximizes revenues but does not emphasize "mass tourism" at the expense of maintaining park resources and values.

4.3.2 Wildlife Sector Policy

Tanzanian Government policy for the wildlife sector (MNRT, 1998) underscores the need to regulate development projects/activities in Protected Areas (PAs). The Policy calls for the protection of areas of scenic beauty and special or cultural interest, and conservation of water catchments and soil conservation.

As a strategy for conserving and managing wildlife resources, the policy calls for the development of GMPs and zoning. These prescribe levels and types of use in each zone so as to ensure attainment of management objectives for each PA, and to enforce EIA processes for proposed developments in PAs.

In the process of ensuring generation of foreign exchange from PAs, the policy underscores the need to regulate the flow and conduct of visitors within PAs, and the marketing of wildlife resources in accordance with national tourism policy.

The Wildlife Sector Policy is very clear about regulation and development of the wildlife industry. For example, the Policy requires:

- the determination of LAU for the volumes of game-viewing tourists that PAs can sustain;
- assessment of visitor flow that will not result in ecological deterioration, and increasing the quality of visitor experience and enjoyment;
- diversifying tourist circuits and visitor experience; and
- co-operating with relevant sectors in improving road networks leading to tourist destinations and in PAs.

The PEA addresses these issues to ensure that proposed road improvements avoid potential conflict with Wildlife Sector Policy requirements.

4.3.3 Tourism Policy

The draft National Tourism Policy (MNRT, 1999) seeks to assist efforts to promote the economy and

livelihood of the people of Tanzania. It focuses on poverty alleviation by encouraging the development of sustainable and quality tourism that is culturally acceptable, ecologically friendly, environmentally sustainable, and economically viable. It also seeks to market Tanzania as a favored tourist destination for touring and adventure (wildlife safaris), in a country renowned for its cultural diversity, scenic beauty, exceptional ecological resources, and sites of importance to global heritage.

Tanzania envisages the number of tourists will be in the one million range by the year 2010. By then, proceeds from the tourism industry are projected to contribute between 25-30 percent of GDP. To reach such a target, many first-class tourist facilities will have to be established or improved and road infrastructure upgraded and expanded. The draft policy recognizes that the private sector will play a major role in the industry's development, with the government serving as the catalyst by providing and improving infrastructure, as well as fostering a conducive climate for investment, including infrastructure. Road improvements in Tanzania's National Parks should support this policy.

4.3.4 Mineral Policy

The Mineral Policy of Tanzania was formulated in 1997 by the Ministry of Energy and Minerals, because of the vital role the mineral sector plays in boosting the national economy, and the environmental problems associated with mining activities. The Mineral policy contains the following objectives:

- to stimulate exploration and mining development;
- to minimize or eliminate adverse social and environmental impacts from mining development.

In order to achieve these objectives, the strategy focuses on environmental protection and land reclamation in order to reduce/eliminate any environmentally adverse impacts. The policy also emphasizes the need to integrate environmental and social concerns into mineral development programs, recognizing that sustainable mining development requires balancing the protection of flora and fauna and the natural environment with the need for social and economic development. Some of the strategies for protecting the environment include:

- drawing up comprehensive environmental management programs for the mining industry;
- setting appropriate guidelines for allowing the conduct of mining in restricted areas such as forests, national parks, water sources and other designated areas;
- abating the use of toxic chemicals and pollutants when promoting mining in restricted areas such as forests, national parks, water resource protection zones, and other designated areas;
- providing rules for setting up funds to reclaim land for alternative uses after mining;
- ensuring that baseline environmental studies are carried out for new projects, and that environmental impact assessments and environmental action plans are prepared;
- establishing effective environmental regulations and putting in place procedures for monitoring compliance;
- improving environmental awareness associated with small-scale mining; and
- demonstrating and encouraging the application of environmentally sound technologies as well as mining methods.

4.3.5 Water Policy

The Water, Sewerage and Sanitation sector policy supports the overall national objective of providing clean and safe drinking water within easy reach; to satisfy other water needs; to protect water sources; and to prevent environmental pollution. In order to achieve this, some of the policy objectives relevant to the PEA include:

- planning and implementation of water resources and other development programs in an integrated manner and in ways that protect water catchment areas and their vegetation cover;

- improved management and conservation of wetlands; and
- promotion of technology for efficient and safe water use, particularly for water and waste water treatment, and recycling.

4.3.6 Forestry and Beekeeping Policies

Forestry Policy

The first National Forest Policy of Tanzania was enunciated in 1953 and reviewed in 1963. Over the past three decades the perspectives on the importance of forests have changed and broadened. On the other hand, pressures on Tanzania forest resources have been relentless due to increasing demand for fuel, fodder, timber and other forest products. In 1988 the Government began preparation of the Tanzania Forestry Action Plan (TFAP) which was adopted by government in 1989. Between 1992 and 1994 the TFAP was revised, including assessment of policy-related issues emerging from the macro and socio-economic policy reforms implemented in the country.

The new forest policy was prepared with involvement of relevant stakeholders. The policy is based on an analysis of the ecological and economic needs of the country and availability of human and other resources. The revised TFAP provided a basis for the new policy. The new policy has also been formulated in a comprehensive way to cover all forests regardless of ownership or administration, and includes trees on farmland. The concepts of forest sector and forest administration defined and used in this policy comprise all wood and non-wood based forestry activities.

The overall goal of the national forest policy is to enhance the contribution of the forest sector to the sustainable development of Tanzania and the conservation and management of her natural resources for the benefit of present and future generations. The policy objectives relevant to the PEA are:

- ensured sustainable supply of forest products and services by maintaining sufficient forest area under effective management;
- increased employment and foreign exchange earnings through sustainable forest-based industrial development and trade;
- ensured ecosystem stability through conservation of forest biodiversity, water catchments and soil fertility; and
- enhanced national capacity to manage and develop the forest sector in collaboration with other stakeholders.

Beekeeping Policy

The Beekeeping sector in Tanzania has been managed without a policy since 1947 when it was officially formed as a department under agriculture. The many socio-economic developments and environmental changes taking place in Tanzania have necessitated formulation of a Beekeeping Policy. The policy responds to recent macroeconomic reforms implemented in Tanzania, as well as the increased concern for environmental conservation and sustainable development.

Initially it was prepared as part of the Forest Policy. But a decision was then made to write a separate Beekeeping Policy statement in order to have a clear vision and mission, and adequate coverage of beekeeping and beekeeping-based cross-sectoral issues and policy statements necessary for the formulation of new Beekeeping Legislation.

The overall goal of the Beekeeping Policy is to enhance the contribution of the Beekeeping sector to the sustainable development of Tanzania, and to support the conservation and management of her natural resources for the benefit of present and future generations. Some of the sectoral objectives related to the PEA include:

- improved biodiversity, increased employment and foreign exchange earnings through sustainable bee product-based industrial development and trade;
- ensured ecosystem stability by practicing Integrated Pest Management and carrying out EIA for investments inside or around Bee Reserves and Apiaries; and

- ensured sustainable existence of honeybees by maintaining and effectively managing adequate bee reserve areas.

5. Impact Analysis Framework and the Environmental Impact Matrix

5.1 Methodology used in developing the framework

Initial suggestions for issues to be considered under the analysis framework were provided through the PEA Scoping Process carried out during the period November 29–December 13, 1999, and through a combination of semi-structured interviews and meetings. The Scoping Team used an interview questionnaire and obtained views on the issues to be addressed from more than 60 stakeholders, ranging from ecologists and other researchers, National Park personnel, road specialists and tourism industry representatives. The results from Scoping were then applied to develop Scopes of Work (SOWs) for the issues to be addressed, and to select PEA Team members whose expertise matched the SOWs. Because of limitations on resources and time, the Scoping Team concluded that not all of the National Parks could be visited by the Team. Instead, TANAPA's Planning Unit identified five parks that were considered to have a full range of road type characteristics and which would also provide a representative set of physical, ecological, landscape and socio-economic features.

Subsequently, the multidisciplinary team re-examined the Scoping Statement and relevant background references and maps prior to initiating field assessment work. Team fieldwork was carried out from Jan 31 - Feb. 18, 2000. Observations from each Park assessment are provided in *Appendix B - PEA Team Field Note Summaries*. Upon completion of field work, the Team conferred on issues to be addressed under four broad categories: physical resources, ecological systems, landscape issues and socio-economics. Each issue was carefully discussed in a day-long session to outline the matrix that would be used to match park road activities against the environmental and social impacts of these activities. The Team also made an effort to organize the impact list to correspond as much as possible with the headings found in *TANAPA's Development/Action/Lease Procedures (1995) Environmental Impact Consideration Checklist* (Section IV). The priority issues identified by stakeholders during the Scoping process were also revisited.

5.2 Methodology used in ranking

After developing the matrix outline, the Team carried out a joint review of each road activity's impact on various physical features, ecological systems and landscape characteristics, as well as the impact on socio-economics. Ranking considered the range of environmental effects, both adverse and beneficial during all four stages of road improvements: planning and design, construction, operation, and decommissioning. Consideration was also given to indirect, induced and cumulative impacts. To ensure that the full range of Team expertise was brought to bear on the ranking process, each Team member was polled in a group session to obtain a ranking ranging from high, medium or low adverse or beneficial impact for each road activity.

The Team members then reached consensus as a group on the rankings for each category of impact. The results of the exercise were compared with the priority issues identified by Stakeholders during Scoping. The completed matrix is shown in Table 5-1. On the basis of these rankings the Team members proceeded to write the various sections of *Chapter 6. Environmental Consequences*, addressing each of the environmental impacts identified in the matrix, and placing emphasis on those having the most adverse or beneficial impacts. Mitigation measures were also developed through Team consultative discussions and joint reviews of drafts. Suggested mitigation measures are presented in Chapter 6 at the same time as the analysis of each impact, so that readers are able to see the direct relationship between individual impacts and proposed mitigation strategies.

Table 5-1 TANAPA Road Improvements Environmental Impact Matrix

Impacts on / Activities	Construction Phase: Vegetation clearing	Construction camp	Quarry management	Trucking murram	Cutting & filling	Blasting	Use of construction material	Mgt of spoil	Storage of diesel/oils	Waste management	Water use
Physical Resources											
Soil Erosion	●	•	●	•	•	•	•	●			○
Debris Deposition	●					•					
Siltation	●	•	●	•	•	•	•	●			○
Soil Compaction	•	•	•	•	•	•		•			
Surface Runoff	●	•	•	•	•	•		●			•
Hydrology			•		•	•					
Topography			•		•	•					
Drainage			•		●	•		●			
Wetlands	•	•	•		●		•	•	●	●	●
Surface Water Quantity	•	•	•		•	•					●
Surface Water Quality	•	•	•	•	•	•	•	●	●	•	•
Ground Water Quantity	•		•		●	•					•
Ground Water Quality		•	•						●	•	•
Ecological Systems											
Habitat Change	•	•	•		•			•	•	•	●
Species Diversity	•	•	•	•	•	•	•	•	•	•	●
Alien Species		•	•	•			•				
Vegetation	•	•	•		•	•			•	•	•
Poaching		○									
Wildlife Migration/Movement	•	•	•	•	•	•					•
Animal Harassment		•	•	•	•	•					•
Ecological Function	•	•	•		●	•		•	•	•	•
Exceptional Resources	●	•	•		●	●			•	•	
Tropical Forest	●	●	●	•	●	●		●	•	•	●
Landscape Issues											
Scenic Quality	•	●	●	•	●	•	●	●		●	
Wilderness Quality	•	●	●	•	•	●	•	•		•	
Viewshed	•	•	●	•	•	•		●		●	
Carrying Capacity				•							
Visitor Experience	•	●	●	•	•	•	●	●		•	
Socio-Economics											
Human Settlement		•							•	•	•
Compatibility with Policies		●	●						●	●	●
Cost to TANAPA			●	●						●	
Benefit to TANAPA		○	○							○	
Costs to Communities			●						•	●	•
Benefits to Communities	○		○	○			○				
Health		•	●	•		•			•	•	
Disease Vectors		●	●							●	
Noise Levels		•	●	•	•	•					
Dust Levels	•		●	•	•	•	●	•		•	○
Risks/Hazards	•	•	●	•	•	•	•		●	•	
Employment	○		○	○	○			○			
Local Economy	○		○	○			○				○
Tourist Industry											•

BEST AVAILABLE

Impacts on / Activities	Operation phase: Vehicle Traffic Movement	Road maintenance	Maintenance of machinery	Tourist activities	Waste management	Off-road driving	De-commissioning: Ripping old road	Shaping	Revegetation
Tourist Industry	●	○	●	O	•	●			
Local Economy		o	o	O					
Employment		○	o	○	o			o	o
Risks/Hazards	●	●	●	•	●	•		•	
Dust Levels	⬤	•				●			
Noise Levels	•	•		•	•			o	o
Disease Vectors				●	●				
Health	●	•		●	●				
Benefits to Communities	○	o	o	O	o				
Costs to Communities	●			●					
Benefit to TANAPA	○	○	O	O	○	o	o	o	o
Cost to TANAPA	●	●	⬤	●	●	●	•	•	•
Compatibility with Policies	●	●			●	●			
Human Settlement		•							
Socio-Economics									
Visitor Experience	●	•	o	●	●	⬤		o	o
Carrying Capacity	●	•		●					
Viewshed	●	•	●	●	●	●	•	○	○
Wilderness Quality	●	•		●	•	●	•	o	o
Scenic Quality	⬤	•	●	●	●	⬤	o	○	○
Landscape Issues									
Tropical Forest	•	•		●		•		o	o
Exceptional Resources	⬤	•		⬤		●			
Ecological Function	•	•	•	●	•	●	•	•	•
Animal Harassment	●	•		●		⬤			
Wildlife Migration/Movement	•	•		•		•			
Poaching	O	○		O		o			
Vegetation	•	•		•	•	•		o	o
Alien Species	•	•		•	•				
Species Diversity	•	•	•	●	•	●	•	•	•
Habitat Change	•	•		●	•	●		o	o
Ecological Systems									
Ground Water Quality	•		•		•				
Ground Water Quantity							o		o
Surface Water Quality	•	•	•	•	●	•	•	•	o
Surface Water Quantity	•	•					o	o	o
Wetlands	•	•	•	•	●	•	•	o	o
Drainage	•	●		•		●	o	o	o
Topography								o	
Hydrology		•				•			o
Surface Runoff	⬤	●		●		⬤	o	○	○
Soil Compaction	●	•		●		⬤		•	
Siltation	●	●		●		⬤	•	○	○
Debris Deposition									
Soil Erosion	⬤	●		●		⬤	•	○	○
Physical Resources									

Adverse Impact Level

- • low
- ● medium
- ⬤ high

Beneficial Impact Level

- o low
- ○ medium
- O high

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6. Environmental Consequences: Significant Impacts and Recommended Mitigation Measures

6.1 Introduction

The evaluation of impact significance was for the most part a qualitative interdisciplinary exercise based on discussion among PEA Team members. Some of the attributes used to rank impact significance included the following:

- magnitude (small to large),
- severity (slight to severe),
- extent (small to vast),
- duration (short-term to long-term),
- frequency (rare to often),
- likelihood (unlikely to inevitable),
- risk (high to low),
- cost (high to low).

Decisions were also based on past experiences, expert judgment and stakeholder views and concerns reflected in the *PEA Scoping Statement* (December 1999).

6.2 Significant physical impacts and mitigation

6.2.1 Soil erosion and surface runoff

Road improvements will involve considerable earthworks, including excavation and movement of murram, earth moving and construction activities. Murram may be available within the park or may need to be transported from designated areas outside. Borrow pits or quarries may need to be excavated, which in turn will create spoil materials. Soil erosion is extremely common with road projects, not only during construction, but over the long term.

Planning and design

Substantial soil erosion may result from inadequate attention to initial selection of routes for new or re-aligned road segments; hence, the importance of minimizing long and/or steep gradients[3] and the need to follow contours where feasible. For example, the minimal track that exists in the Northwest Zone of the Serengeti from Tabora Ranger Post to Kleins Camp passes across this area without following the contour of the hills.

If this road is eventually upgraded, adverse erosion effects may occur, and an all-weather crossing of valley bottoms which typically contain black cotton clays (vertisols) may be unnecessarily expensive.

Off-road driving is also a major contributor to soil erosion. Significant erosion may occur from failure to include standards for runout drains, drifts and culverts, cambering, and application of murram in planning and design. Siting of new roads or realignment of roads too close to rivers and streams for game viewing purposes can hasten collapse of stream banks and create hazardous driving conditions. Attention must also be paid to the potential adverse effects of road construction/ rehabilitation on unstable soils.

Recommended Mitigation

- Make the Tanapa Road Works motto ***"Ondoa Maji Barabarani"*** --- "Keep the Water Off the Road."
- Develop and provide TANAPA design standards for runout drains, drifts and culverts, cambering, and application of murram.

[3] A general rule is to try to avoid gradients greater than 10 percent, where possible.

- Develop standards for following contours, avoiding gradients greater than 10 percent, or long straight downhill stretches.

- Revise policies related to off-road driving to further restrict this practice in the national parks. (Impacts and mitigation measures associated with off-road driving are discussed below under *Operation and Maintenance.*)

- Use a multidisciplinary team (ecologist, road engineer, soil scientist, hydrologist, tourism specialist) in selecting new routes.

- Follow contours where feasible, and consider routings at the base of hills where coarse alluvium tends to collect, instead of crossing valleys and floodplains often characterized by fine clay deposits (black cotton or vertisols), that are impassable during wet weather.

- Where slopes are overly steep and eroding, consider moving the road. Make decisions on realignments for steep slopes by studying severity of erosion, soil type and relationship to existing erosion control methods. Erosion control for gradients greater than 10 percent may be difficult on many park roads. Where realignment is the preferred alternative, use a multidisciplinary team to select route and design, and follow contours, where feasible.

- Select grader drivers carefully, based on their ability to follow correct design and maintenance standards to keep water off the roads.

- Identify areas that collect or gully water by driving the roads after moderate rains. Mark locations and develop road maintenance and rehabilitation to deal specifically with these problem spots.

- Design roads with wheel tracks elevated above side channel water. See Figures 6-1 through Figure 6-4 alternative designs, e.g., two ditches with cambered center, or road with a little pitch and single-side ditch. Provide side channels/runouts to prevent gullying and standing pools.

- Avoid placement of roads too close to river and stream banks and construction of roads on unstable soils. Conduct land surveys and soil studies needed prior to construction/realignment.

The TANAPA Road Works Motto
"Ondoa Maji Barabarani!"("Keep the Water Off the Road!")

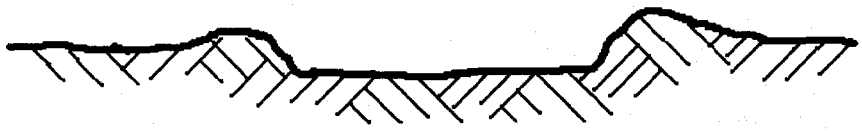
Tarangire National Park (S3°59.8', E36°5.5')

Roads with Long, Gentle Slopes Are Also Vulnerable to Erosion

Eroded surfaces like this one in Tarangire occur even on gentle slopes where the road descends over a considerable distance and no provision has been made for runout drains or ditches. (S3°51.5', E36°1.4')

Figure 6-1

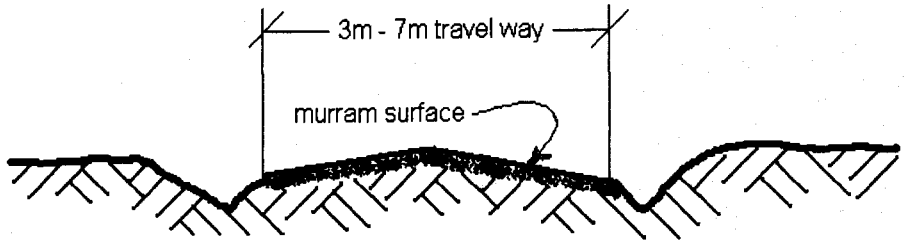
Typical Existing Road Section



Wear and grading or erosion has lowered road surface below surrounding landscape; road now collects rain runoff and is wetter than surroundings

Mmomonyoko umesababisha uso wa barabara kuwa chini zaidi ya kingo zake za pembeni; sasa barabara inakusanya maji ya mvua na kusababisha barabara kulowana sana kuliko maeneo mengine ya pembini mwa barabara

Typical Proposed Road Cross Section



Side Drain Ditch - depth of ditch will vary along the length of the run between turnout or outlet

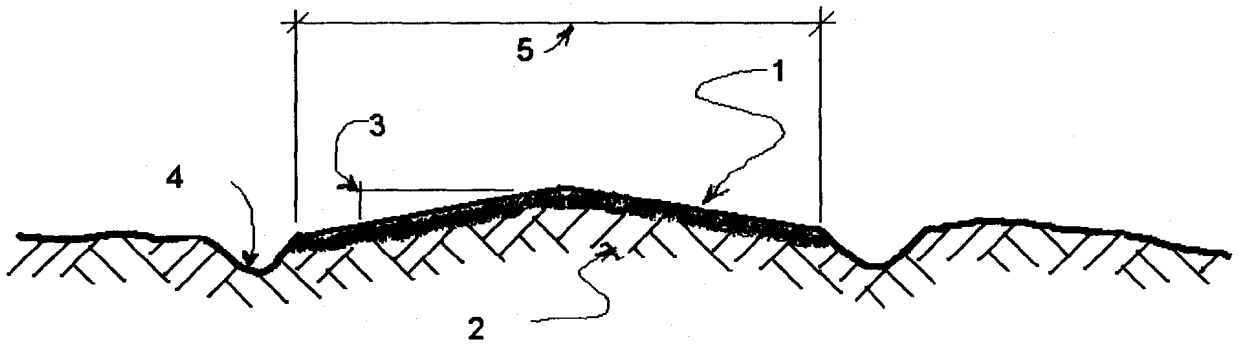
Mtaro wa Maji Wa Pembeni mwa Barabara - kina cha mtaro wa maji wa pembeni mwa barabara hutofautinana kulingana na umbali kati ya mtaro wa kutoa maji nje ya barabara

Note: Max Camber Slope: 1 in 40 to 1 in 33

(2.5%) (3%)

Figure 6-2

Cross Section of a Gravel Road



KEY
1 - Layer of murram; thickness of murram layer depends on soil type at site
2 - Subgrade
3 - Cross-slope 1 in 33 to 1 in 40
(3%) (2.5%)
4 - Side drain ditches
5 - Traveled way; width depends on the class of road

UFUNGUO
1 - Moramu; unene wa kina cha moramu hutegemea aina ya udongo mahali pale
2 - Udongo uliashindiliwa chini ya moramu
3 - Ulalo wa mgongo wa barabara
(1 kwa 33 hadi 1 kwa 40)
(3%) (2.5%)
4 - Mitaro ya pembeni
5 - Upana wa barabara; vipimo vya upana wa barabara hutegemea daraja la barabara

Figure 6-3

Drainage in Hilly Roads Cross Section
Mitaro Ya Maji Katika Maeneo Ya Milimani

Key
1 - Water catchment ditches/drains
2 - Side ditch drain
3 - Traveled way

Ufunguo
1 - Mitaro ya maji katika milima
2 - Mitaro ya maji pembeni mwa barabara
3 - *Upana wa barabara*

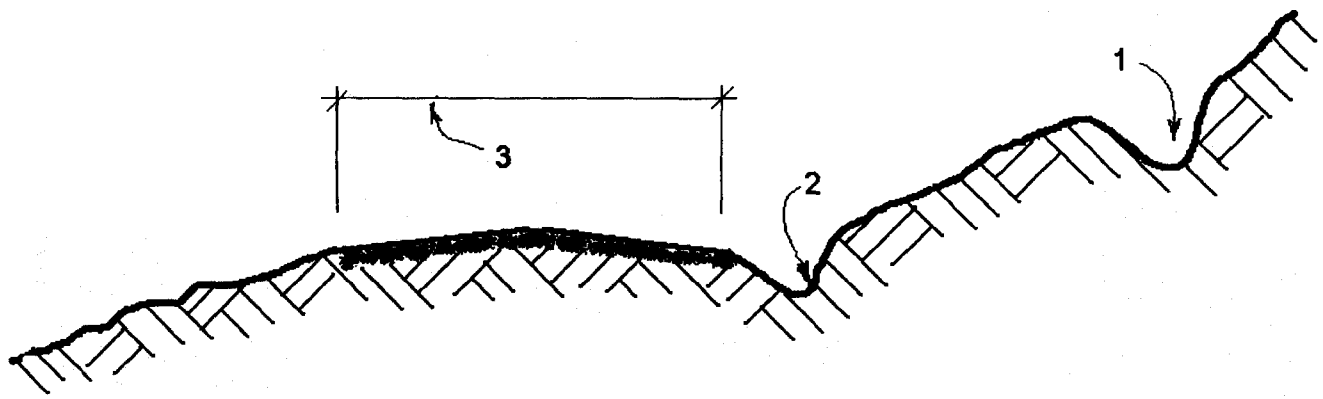
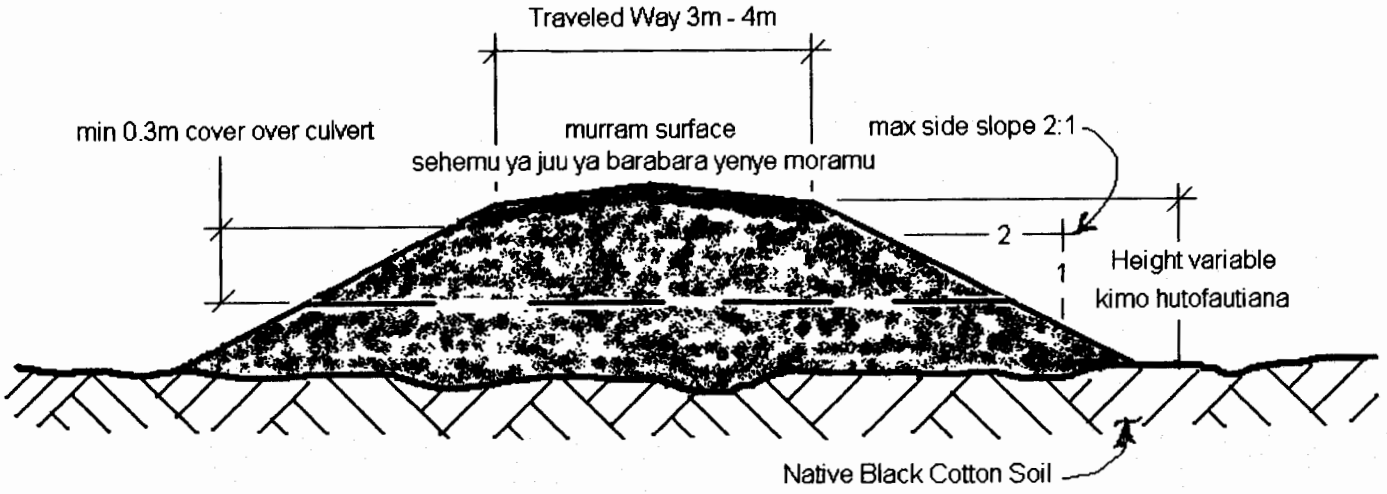


Figure 6-4

Raised Road Embankment

Typical propsed Black Cotton fill cross section

Barabara/tuta ihyonyanyuliwa katika sehemu yenye udongo mweusi



Note: Reapply surface vegetation and surface soil to new fill slopes to aid in revegetation

Rudishia majani na udonogo wa juu wenye rutuba katika pande az tuta ili kusaidia majani kuota tena

Construction

During the construction phase, erosion may result from grader and/or dozer operations and clearing of vegetation. Erosion from cuts and fills and other excavations will likely occur. It may occur during removal of vegetation, although this problem was not noted during field surveys. Erosion may also occur during murram extraction.

As a consequence of erosion or the manner in which debris and spoil material are stockpiled or disposed of, temporary sedimentation and siltation can occur in drainage ways, streams and water bodies, with consequent impacts on surface water quality and aquatic life.

Recommended Mitigation

- Control flow and distribution of water on and around park roads.
- Minimize the amount of clearing.
- Limit earth moving to dry periods.
- Protect susceptible soil surfaces with vegetative matter.
- Clear and grub erodible soil in limited areas at any one time.
- Store topsoil for respreading.
- Install temporary or permanent erosion control features.
- Revegetate as soon as possible.
- If vegetation must be removed, do so during the dry season.
- If removed during wet periods, do not disturb ground until just before road construction is to start.
- Protect drainage channels with berms, straw or fabric barriers.
- Decommission original road sections which are no longer necessary following realignment.
- For steep slopes, install drainage turnouts at more frequent intervals; install drainage check dams to stop ditch erosion; use cuts or fills at either end of steep sections to reduce road or quarry site grades or inclines; use higher grade of murram that erodes much less; provide soil stabilizers or tarmac at very steep sections of roads; evaluate road sections and, if the cost and impact of maintenance appears greater than need, decommission road sections.

Operation and maintenance

In almost all the parks visited, but more so in Serengeti and Tarangire National Parks, off-road driving was a very serious problem with major soil erosion consequences. For example, in the Serengeti, the area between Seronera River and Lake Magadi has very light soils, easily eroded by water, wind and vehicle tires. Drivers go off-road to avoid the water and dust effects of these tracks as they deepen.

It should be noted that off-road driving is allowed in certain park zones; for example, Simba Kopjes in the Serengeti, on condition that no driver is to follow old tire tracks. This is supposed to minimize destruction of vegetation and soil compaction. However, the regulation does not seem to be followed. Tracks have been created and abandoned. Even tracks abandoned for three years did not appear to heal and re-vegetate naturally. The existing policy may, in fact, not be practical, and certainly not in areas receiving large numbers of visitors, since vehicle numbers have to be strictly controlled and the practice requires close and frequent monitoring.

Kopjes further from major tourist lodges and special campsites, such as Gol and Barafu Kopjes are under less significant pressure at this time because of their distance beyond the range of most game drives. In Tarangire National Park, off-road driving was often associated with insufficient attention to road design and with lack of maintenance, especially on steep slopes where alignments did not follow contours.

Multiple tracks scar the landscape leading to Moru and Simba Kopjes.

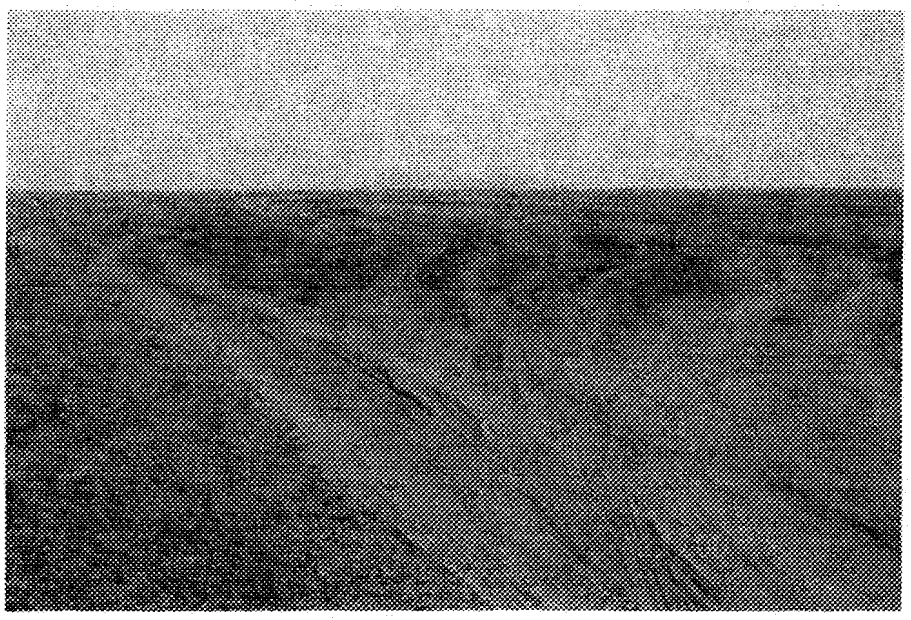
Other unplanned viewing tracks circle the kopjes themselves, where the potential for viewing cats and other predators is high. Most of the multiple tracks are the result of cumulative off-road driving effects over many years.

Road grades are sometimes too steep or inclined, with resulting erosion of the road surface, such as the road leading to Msasa Ranger Post in Lake Manyara, and the Momela Gate to Miriakamba Hut road in Arusha. Quarry operations can also have problems with overly steep slopes around quarry sites.

Recommended Mitigation

- To ensure maintenance of rehabilitated roads over the long term and reduce the erosion potential, close roads (use of rain barriers) during periods when the surface is wet and soft, as appropriate.
- For improperly graded roads, use grader to respread berm materials at road center, camber and reshape driving surface, compact surface, and establish adequate ditches along road edge, so that vehicles' wheels travel above water in side ditch.
- Maintain drainage structures and ditches to prevent gullying and standing pools. Clean side channels/runouts when they begin to fill with sediment and lose their effectiveness.
- For wind-caused soil erosion on light soils, improve roads with designated murram tracks.
- Rotate road closures (temporary closure of roads to allow recovery); provide additional game viewing tracks to lower visitor vehicle traffic levels on any one road.
- Where readily available use murram to reduce wind and tire erosion.
- Water the road immediately prior to compaction to strengthen the road surface. (Otherwise traffic will soon beat back the road surface to pre-bladed condition)
- On heavily used roads consider the use of chemical soil stabilizers.
- Allow work crews to work flexible hours to take advantage of natural night moisture. Have crews ready to work at daybreak, when the ground still has a trace of the night's moisture.
- Rest crews at mid-day to reduce maintenance dust effects.
- Schedule road maintenance for immediately after rainy seasons to take advantage of natural moisture for compaction of Class I and II roads.
- If feasible, use pneumatic rubber tire rollers pulled behind grader to compact Class III and Class IV roads, where needed.

How Can This Problem Be Managed?

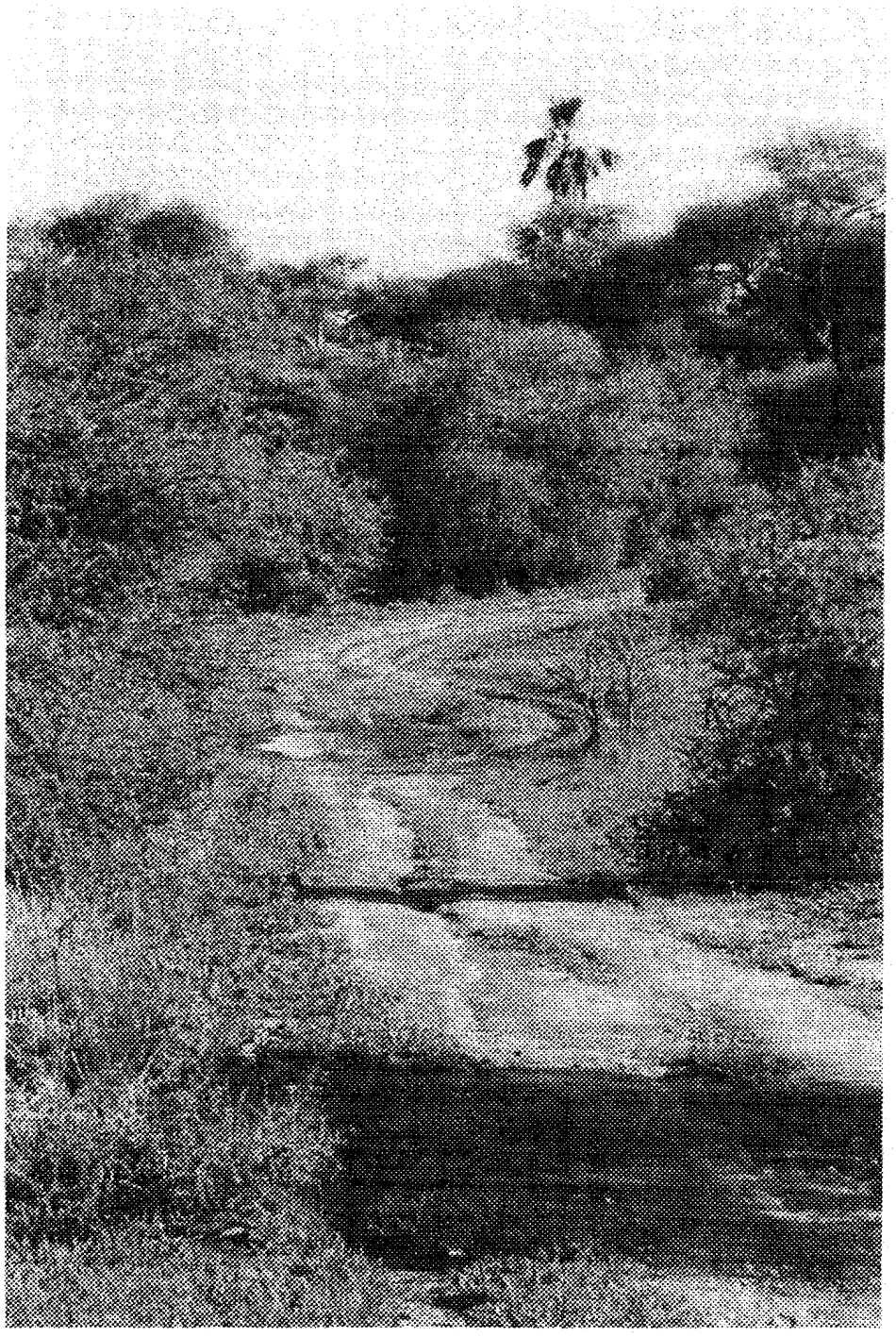


Multiple tracks in high visitor use zones near lodges and camps are common in many of Tanzania's parks, causing soil erosion and affecting aesthetics, as can be seen here on the way to Moru Kopjes in the Serengeti. Closing the tracks with rock barriers would help. Decommissioned roads could then be reshaped to reduce scaring effects, and allowed to revegetate. Establishing a single permanent track with a well-murramed surface, camber and drainage would go a long way toward reducing these impacts. (S2°31.3', E34°48.8').

Berms Keep Water on the Road

To avoid water on the road, drivers created a second track to the right. By cambering the road and providing ditches and runout drains, this problem could have been avoided. Instead, the grader cut a horizontal swath and the road is now lower than surrounding land, with berms on either side that trap and channel water down the road. (S3°58.1', E36°5.4').

No Runout Drains—Water on the Road

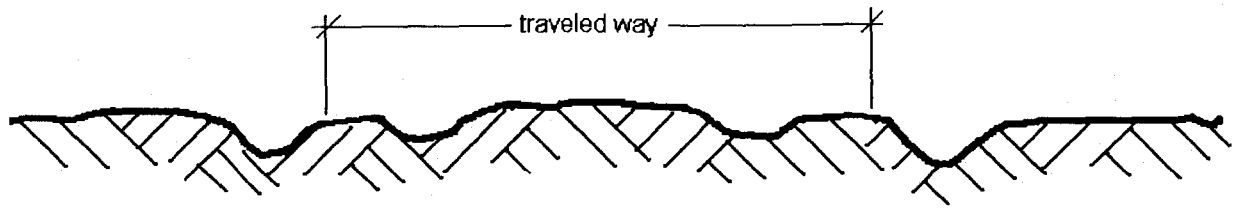


On a Game Viewing road in Tarangire National Park, drivers have created a second track to avoid water that collects at the base of a hill.

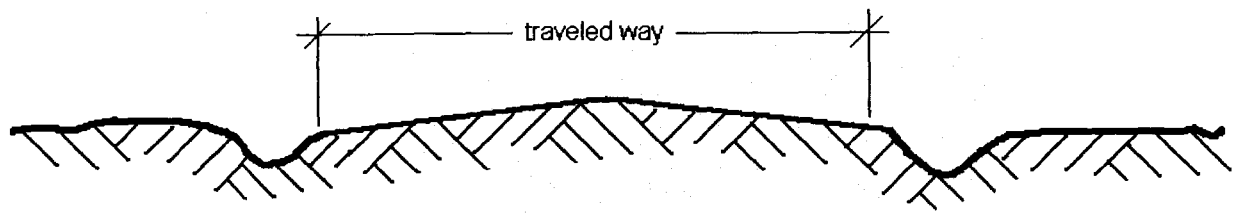
Figure 6-5

Longitudinal Ruts Correction

Typical road cross section with longitudinal ruts caused by vehicle tyres
Barabara inavyoonekana baada ya kuharibiwa/kuchimbwa na matairi ya magari



Typical road cross section after filling up the longitudinal ruts by reshaping the road
Barabara inavyoonekana baada ya kuziba/kujaza sehemu zilizochimbika kwa kuchonga barabara

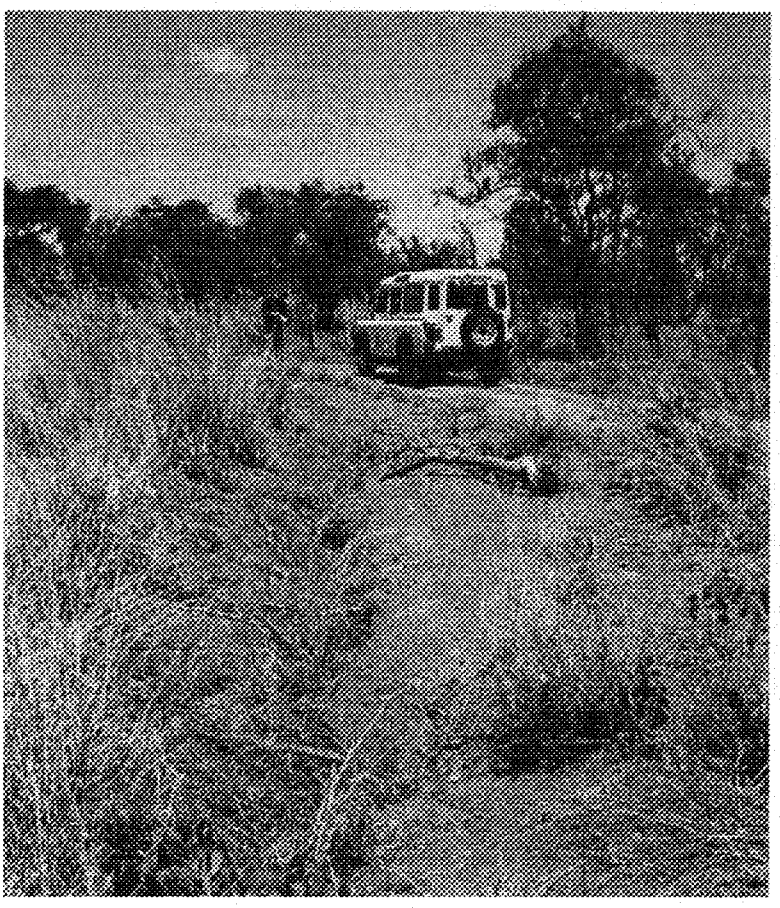


Decommissioning Abandoned Roads - What's the Best Method?

Multiple tracks spread out across the Serengeti plains near the eastern park boundary. Rock barriers and "CLOSED" signs have been used to restrict future traffic. Natural revegetation has occurred on a track in the center of the photo. Regeneration can be accelerated, where necessary, by ripping the old road surface with a grader and reseeding. Reshaping abandoned road surfaces can also reduce the effects of road scars.

An Abandoned Road that Needs Attention

Near the Boundary Hill Campsite in northeastern Tarangire this abandoned track was continuing to gully because no attempt had yet been made to reshape the eroded surface. The new track can be seen entering at center right.
(S 3°54.3', E 36°8.5')



Decommissioning

Abandoned roads are common throughout the national parks, contributing to soil erosion, scarring landscape and degrading viewsheds. Potential cumulative impacts could severely affect the quality of visitor experience. *(See photos, previous page.)*

Recommended Mitigation

- Depending on the seriousness of erosion and levels of compaction, decommission by ripping, shaping and re-vegetating abandoned road segments to stabilize soil and minimize erosion, subsequent surface run-off, and siltation.
- Divert all water away from eroded and gullied roads/tracks.
- Use barriers, "CLOSED" signs, pamphlets and other awareness techniques to keep visitors and operators off abandoned roads/tracks and trails. Provide stiff operator penalties for off-road driving violations.
- Where erosion or gullying is not significant, use of barriers to prevent vehicle traffic may be sufficient to allow revegetation.
- Survey roads near sensitive areas annually to determine where closures are needed, and when regenerated areas can be re-opened.

Indirect and induced effects

Improvement or upgrading of roads without appropriate surface water control measures can result in new areas of significant erosion and stream siltation.

6.2.2 Siltation and debris deposition

Sheet and stream erosion may result in silt and debris deposition, and destruction or burial of roads, bridges and drifts. These effects were apparent throughout the National Park system during the El Niño rains of 1998, and are particularly noticeable in Lake Manyara National Park along the escarpment.

In the National Parks and throughout Tanzania, rivers and streams can rapidly change course. Major road rehabilitation has been required in Tarangire and Serengeti as a result of El Niño.

Outside the parks, population pressures on the land are growing dramatically year by year. Where neighboring communities lie in upper catchment areas, deforestation, overgrazing, cultivation on marginal land, and excessive use of fire for agricultural purposes, causes downstream siltation of park wetlands and waterbodies. Siltation on a large scale threatens the viability of ecosystems on which current park fauna and flora depend, in particular the larger wildlife species of interest to most park visitors. Noticeable examples include Lake Manyara's siltation associated with intensified agricultural activities above the escarpment, the siltation of Silale Swamp in Tarangire National Park, and silt contributions from neighboring farms to some of the Momella lakes in Arusha National Park.

Planning and design

In Tarangire, rivers and streams typically meander and are increasingly subject to violent flooding, in part because growing populations in the watershed outside the park have created dramatic increases in runoff and siltation.

The same is true for the streams at Lake Manyara which flow down from villages and lands above the escarpment. Under these conditions, it may not be possible to effectively manage the path of the streams and rivers coming from the escarpment. This is due especially to the common occurrence of flashflooding and because the height of the escarpment results in very high energy watercourses. In the area of the escarpment characterized by volcanic geology, large volumes of water frequently move at high force, bringing boulders and trees down to the roads with ease. The same high-energy water flows carry enormous quantities of silt down to the lake and the park roads. In fact, cumulative silt deposits have completely buried the bridge originally constructed to cross the Ndala River.

Because of the high potential that streams will carve new courses all along the escarpment, Park Management may wish to adopt a strategy of experimenting with the training of streams, but accept that it will probably be necessary to build new crossings on a regular basis where "training" is found to be ineffectual.

Drifts versus bridges:

The impacts of 100-year floods, silt, and debris deposition may be significant in considering whether to build drifts or bridges, especially when weighed against long-term construction and maintenance costs. In the past, insufficient attention appears to have been paid to the fact that streams and rivers may cut new channels many meters from the original watercourse, leaving behind abandoned bridges and drifts. In addition to seeing these effects in Tarangire and Lake Manyara National Parks, at Kilimanjaro the Team observed a bridge that had been bypassed by the river which passes a village at Londorosi on the Shira route. As a result, the village is cut off during the wet season, potentially impairing visitor rescue operations, as well as movement of park personnel for administrative purposes to and from the Shira Plateau.

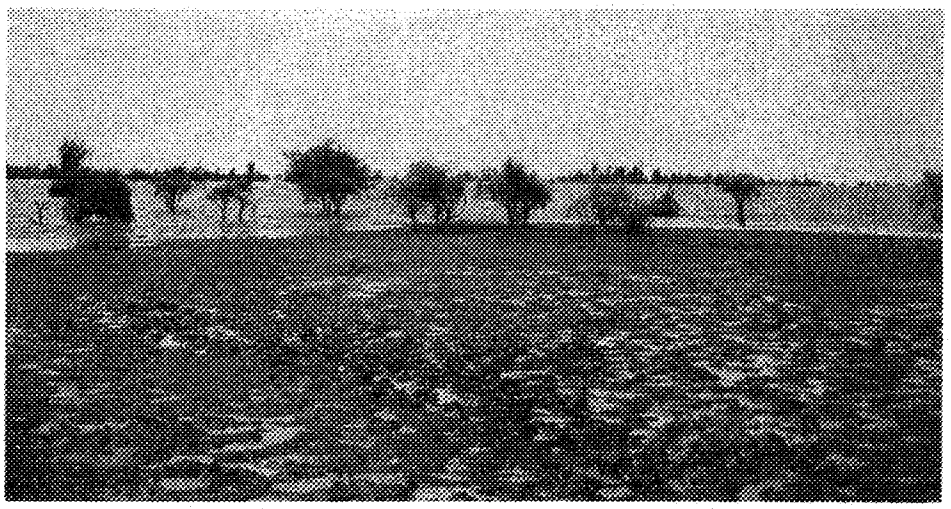
Also, the Tarangire/Lake Manyara region is geologically unstable and watercourses may change direction as a result of geological disturbances.

At Lake Manyara, soil erosion associated with high-energy stream flows lasts only briefly and, because the soils below the escarpment consist primarily of loose sediment accumulations washed down from above, bridge construction in the park is not advised. Drifts appear to be the most practical and less costly means of crossing stream and river courses. However, the creation of an all-weather Class II road to Maji Moto hot springs may be constrained by the flow of the Ndala River, which during the wet season can make it impossible to proceed further toward Maji Moto. If a cost-effective solution cannot be found to provide an all-weather crossing of the Ndala, the value of upgrading the road segment from Ndala to Maji Moto to Class II would be questionable.

Recommended Mitigation

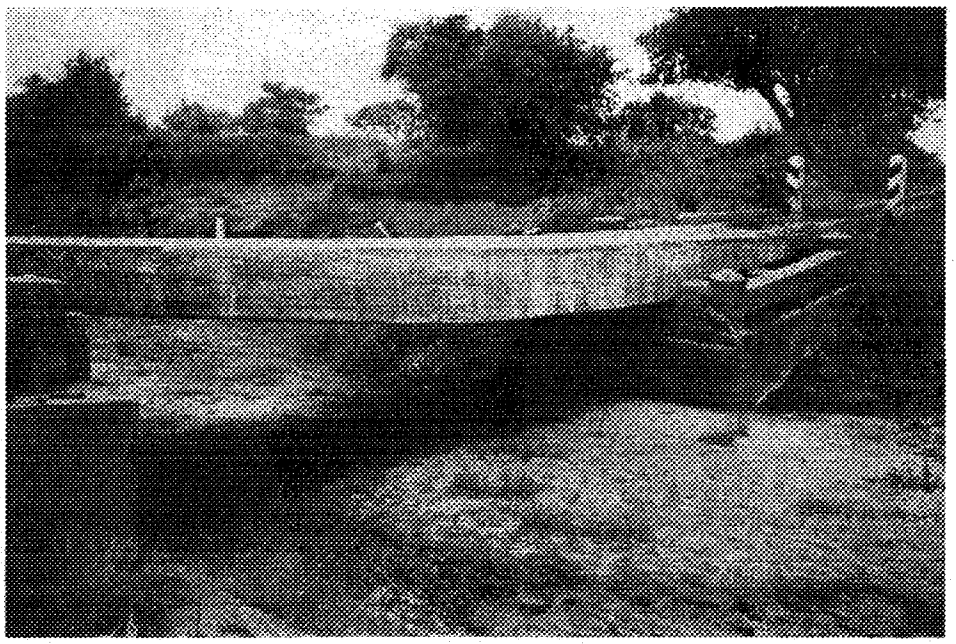
- Work with District Councils, villages and NGOs to develop regional assessments of land use outside the parks and to develop both regional environmental assessments and regional plans for reducing population pressures.
- Foster awareness and strengthen relationships with communities outside the parks (but which are in park watersheds), so as to help them develop and apply soil conservation technologies and practices in upper catchment areas. Encourage support from District Councils, NGOs and others for this purpose.
- Consider the potential impact of 100 year floods in design of bridges versus drifts, including silt, debris deposition and cost implications of each. Construct drifts rather than bridges, where feasible and cost-effective.
- If bridges are needed, consider using bridges that can be easily erected and dismantled, such as Bailey Bridges. (Then if waterways meander, the structure can be dismantled and moved to another site.)

Siltation Threatens Park Resources



At Lake Manyara National Park, silt coming down from the escarpment is rapidly filling the lake. Note the trees in the distance now under water. The lakeshore edge is advancing, threatening to cut off wildlife migration routes. Siltation and debris deposition coming from the escarpment also greatly increases the expense of maintaining the park road systems. At Ndala River, for example, an entire bridge now lies buried beneath a massive accumulation of silt. Overgrazing and intensive cultivation outside the park above the escarpment contributes to the rate of soil erosion and the severity of downstream flashfloods.

Damaged by El Niño Floods in '98—This Bridge Should be Removed



The Sopa Lodge Bridge across the Tarangire survived the 1998 El Niño rains — others did not. However, its abutments have been damaged beyond repair and drivers cross at their own risk.

Construction

Siltation results from erosion of material deposited downstream of eroded road surfaces and slopes.

Recommended Mitigation

- Minimize siltation through erosion control. Refer to the discussion for soil erosion for impacts and mitigations of roadway erosion in *Section 6.2.1 Soil erosion and surface runoff.*

Operation and maintenance

Where park systems lie in downstream watersheds, continuing siltation can threaten the long-term sustainability of park wetlands and lakes.

Recommended Mitigation

- Use water-catchment trenches placed above the road to intercept and divert water and sediments away from the road and into stream channels, or use berms above the road in the same manner.
- Accumulated material in the trenches should be regularly cleaned out prior to each rainy season, or as needed.
- Experiment with training rivers and streams by unblocking stream channels of debris and silt, so as to encourage streams to follow desired channels. Use a combination of hand labor, small machinery, and selective bulldozer work where feasible (remembering that dozer tracks can easily expose soil to erosion and do more harm than good). Determine whether "training" watercourses is a cost-effective technique for controlling silt and debris disposal on road surfaces.
- See mitigation measures discussed under *Wetlands* to minimize environmental impacts associated with possible breakdown of heavy equipment used to train streams, and associated pollution effects.
- Use strategic placement of trenches upslope of roads to divert water away from the road and into stream channels, but keep trenches back from the road and hidden from tourist visitor.
- Use berms on the upper side of the road to achieve similar water diversion.

6.2.3 Soil Compaction

Construction and operation

Soil compaction is common where vehicles repeatedly drive off-road to avoid mud holes, downed trees and vegetation, and rutted tracks, or to view game. Tarangire, Serengeti, and Lake Manyara all show soil compaction effects.

Recommended Mitigation

- Fill mud holes and potholes with good quality murram; remove downed trees, and limbs obscuring roadways.
- Educate tour operators and visitors to stay on the road.
- Maintain or upgrade road so drivers are encouraged to use the existing road.
- Upgrade track or road if surface conditions deteriorate due to heavy use.

6.2.4 Hydrology

Construction and operation

Hydrology concerns changes in movement of water (either surface or groundwater). Impacts on hydrology can occur during road construction cut and fill operations if either the cut or fill significantly disturbs movement of surface or groundwater. The roadway then becomes either a ditch or dam for water. For example, the use of murram and fill to cross wetland areas such as the Larmakau Crossing in Tarangire National Park's southern wilderness zone, may cause major changes in vegetation and microhabitat by damming one side of the road and lowering the water table on the other (See *Section 6.3.2 Wetlands*).

Should drilling, blasting or cutting and filling be required, groundwater aquifers can be exposed or penetrated, affecting the hydrology and drainage of

the area. This is particularly the case in areas where the water table is high, for example, in the northern section of Tarangire National Park. There, groundwater flows from the catchment area of Boundary Hill toward Silale Swamp. Groundwater concerns were also noted by the Team near natural springs in the Lobo Hills area of the Northern Serengeti, and at the Maji Moto (Hot Water) Springs at Lake Manyara National Park.

The short-term impact of road construction activities on hydrology is not expected to be significant. Construction activities would generate some site-specific runoff, which would flow through the natural drainage system. In addition, the construction area may require channeling of rain and flood water runoff through selected locations, which may cause fluctuation in the quantity of runoff flowing over the drainage area to the local streams and other receiving bodies of water. Borrow pits and spoil areas can collect standing water that may serve as breeding habitat for mosquitoes and other disease vectors.

Dewatering, cofferdams, cut and fill or draining can affect water table height. Contamination or long-term effects on the water table can occur, affecting aquifer or aquifer recharge areas that are considered important local or regional resources.

In the long term, roads can cause alterations in the flow and quality of surface water and groundwater and lead to increased flooding, erosion, suspended sediment in streams, siltation or changes in natural groundwater levels. Impacts on water flows can extend beyond the immediate vicinity of the road and have long-term and potentially widespread effects. Roads modify the flow of surface water by concentrating flows at certain points and increasing the rate of flow. Road surfacing reduces permeability of the soil and increases runoff. Road drainage and excavation can sometimes lower the water table, while embankments and structures can raise it by restricting water flow.

Changes in the water table are a critical concern, particularly where groundwater is important for wildlife and, in dry regions, where it is important for maintenance of vegetation.

Indirect and induced effects

Changes in hydrology, such as blocking water flows, alterations to their subsurface course or draining of wet areas, may change soil characteristics as well as the type of vegetation that the soil supports. In turn, these modifications may affect the overall ecology of adjacent areas.

Recommended Mitigation

- Install sufficient culverts across the roadway to pass water from the uphill side to the downhill side.
- Modify the cut or fill design to lessen its impact.
- Eliminate cuts and fills in especially sensitive areas such as wetlands.
- Require regular culvert inspections to ensure proper operation.
- Control waste materials and fuels/oil to prevent contamination of the surrounding land and water.
- Use construction techniques to avoid potential flooding of borrow pits and spoil areas, where potential exists for spread of disease vectors.
- Use water speed reduction measures, drainage structures, settling basins, or infiltration ditches to reduce adverse hydrological effects.
- In flood-prone areas, incorporate retention basins in design, to reduce runoff peaks or to improve drainage in low-lying agricultural areas.
- Where feasible, use water collected in settling basins and retention ponds for road maintenance to reduce potential disease vectors.
- If a proposed road improvement has the potential to aggravate flooding as a consequence of drainage system modifications such as channelizing runoff or creating additional impervious surfaces, consider appropriate diversion structures or

retention ponds (depending on the magnitude of the impact).

- Reduce soil erosion and flooding by providing a well-designed drainage system to control flow, thereby reducing long-term sediment transport and enhancing the quality of surface water in streams.

6.2.5 Drainage

Construction and operation

Most of the erosion impacts noted during the PEA survey work are related to handling of water on the roadway. Water staying on the roadway wheel tracks will result in rutting. Water remaining in roadside drainage ditches for too long will result in ditch erosion. These effects were ubiquitous throughout the parks.

Where grading is done by simply pushing the blade down the road with no shaping, cambering or runout drains, berms can be created on both sides of the road. After repeated passes by the grader, the road may lie below grade. This situation was observed on many of the roads in Tarangire National Park, such as those near Kuro-Sopa Bridge on the Eastern side of Tarangire River, from Kuro to Mamire, and from Kuro Ranger Post to Matete Bridge.

Where these conditions exist, the berms trap water on the road, either creating standing pools or channeling water down the road, with gullying effects.

Recommended Mitigation

- Refer to recommended mitigation in *Section 6.2.1 Soil erosion and surface runoff.*
- Design and construct roads with sufficient shape and camber to keep the wheel track elevated above drainage ditches.
- Provide runout drains at sufficient intervals to handle anticipated drainage.
- Make runout drains sufficiently long to allow water to dissipate evenly and percolate into the ground.
- Provide sufficient culverts, as necessary, to allow water to flow to the downhill side of the road. (Keep in mind that corrugated steel culverts tend to rust and eventually collapse in the Tanzanian environment and that culverts which are too narrow can quickly lose their utility if blocked by floodwater debris.)

6.2.6 Surface water quantity

Construction and operation

TANAPA's official policy states: Park water, either surface water or groundwater, will be withdrawn for consumptive use (for tourism and park administrative purposes only) only if absolutely necessary, and then only when approved by the park's GMP/EIA. The consumptive use of water will not be allowed to significantly alter natural processes and ecosystems (TANAPA Policy, 1994:22). In this case, the GMP/EIA is viewed as the regulatory mechanism for the use of water in the park and, where a GMP does not exist, then the guide used is TANAPA's Development/Action/Lease Procedures (DALP).

Excessive use of water for construction and maintenance activities can adversely affect surface water quantity, which would otherwise be available for wildlife, depending on the source of the water and season of use.

Recommended Mitigation

- Avoid or minimize surface water use during the dry season.
- Prewet murram prior to the dry season when more water is available, and store murram in a way that will keep it wet.
- Delay compaction activities until the beginning of the wet season, or when water becomes more available.

6.2.7 Surface water quality

During the short term, high turbidity, debris and construction-related wastes (such as grease and oil from construction equipment), sand and cement. Construction-related activities may lead to silting

and/or erosion of drainage areas. Given the expected magnitude of construction activities, adverse effects on water quality are not likely to be appreciable. Precautions, however, need to be taken if receiving waters are within the drainage basin of a park or sensitive area. Increased suspended sediment and downstream sedimentation, changes in aquatic ecology of streams and wetlands, and spills of chemicals and pollutants can adversely affect water quality and habitat for aquatic resources and wildlife.

Construction

Ground or surface water contamination by oil, grease, fuel and other pollutants could result from use and storage of construction equipment.

Recommended Mitigation

- Site material storage locations and work depots carefully, take precautions to avoid spills, collect and recycle lubricants, use grease traps, dikes, retention basins or sumps to mitigate impacts.

Operation and maintenance

Soil contamination with heavy metals or other pollutants, associated with very high traffic volumes, is not considered significant, because traffic volumes would not approach such a threshold, e.g., 20,000 vehicles per day (World Bank, 1994). Because of low traffic volume and the likely types of goods to be transported, spills of hazardous or toxic materials, while they cannot be ruled out, would appear to present a small risk.

Recommended Mitigation

- Store oil, fuels, and waste materials properly so that precipitation and runoff does not come into contact with these products and materials.
- Provide oil/water separators at points of discharge of surface water from impervious surfaces that may contain waste oil, fuels, and other contaminants.
- Maintain separators according to manufacturer's instructions.
- In sensitive areas such as wetlands, take special precaution against potential adverse effects such as high turbidity, debris, grease and oil from construction equipment, sand and cement, and other construction-related wastes.

6.2.8 Groundwater quantity and quality

Operation and maintenance

No adverse impacts on groundwater quantity are anticipated. Groundwater quality can be adversely affected by leaking fuel tanks and fuel transfer operations, such as the fueling system observed at the headquarters workshops at Lake Manyara, and by waste oil or fuel finding its way into the ground, as observed at a number of sites throughout the parks, including a construction camp in the Serengeti, and at all workshop sites and fueling areas.

Recommended Mitigation

- Ensure fuel tanks are not leaking, by careful observation of fuel levels as compared to fuel delivered and fuel used (using care to protect workers exposed to fuel fumes during monitoring).
- Ensure fuel pumps and piping are not leaking at any joints, or at pump penetrations.
- Eliminate over-filling of fuel tanks during delivery or during vehicle fueling operations.
- Collect all waste oil and remove from park, preferably to a central buyer.
- Ensure waste oil does not spill onto the ground.
- Use drop clothes or wood shavings to capture leaks and spills occurring during equipment maintenance.
- Tighten fuel lines at generators and other stationary equipment.

* Construct concrete pads with catch drains for vehicle and equipment repair and servicing

Keep Fuel and Lubricants From Spilling on Bare Ground

Fuel and lubricant spills are a common problem at many construction camp and workshop sites, with potential for pollution of streams and groundwater. This fueling area was observed at Nyankoromo Construction Camp in the western Serengeti. Contamination can move long distances, both above and below ground, posing health risks to water users. Care should be taken not to spill hydrocarbons on bare ground. (S 2°12.8', E 34°4.0')

6.3 Significant ecological/biological impacts and mitigation

6.3.1 Habitat change and species diversity

Planning and design

In the preparation of General Management Plans [GMPs] or Management Zone Plans [MZPs], provisions for greater visitor access could potentially severely affect sensitive habitats, areas where biodiversity might be compromised, or areas containing possible threatened or endangered fauna and flora.

Recommended Mitigation

- Involve ecologists, tourism specialists and engineers in deciding where and how to utilize and/or avoid sensitive habitats. Use the GMP/MZP planning process to identify, protect and utilize sensitive habitats.
- Conduct inventories of flora and fauna and ecological studies of species behavior prior to road or trail development in suspected sensitive habitat areas.
- Consider limiting day visitors to certain sections of the Park only and charge higher fees for those who wish to travel beyond the day visitor zone.
- Consider having day visitors park their vehicles at designated lots and then transfer them to larger vehicles to experience the day visitor zone.
- Raise fees to keep demand at a level that does not exceed Zone Management Plan Limits of Acceptable Use (See *Section 6.4.3 Limits of acceptable use (LAU)/carrying capacity*).

Construction

Roads and trails passing too close to sensitive habitats may affect animal breeding and hunting behavior.

Substantial amounts of water may be used primarily in layering and compacting murram. This water is typically drawn from nearby pools and streams. But, according to the park's water policy, the use of all surface water should be highly restricted, in order to avoid significant alteration of natural processes and ecosystems.

Recommended Mitigation

- Avoid siting of roads and trails in areas or locations that may affect animal behavior, as well as sensitive habitats such as the Kopjes in Serengeti, the hot springs in Lake Manyara, and the bird breeding areas around Momella Lakes in Arusha National Park.
- Clearly identify walking trails.
- Keep roads and parking lot areas at sufficient distance to ensure adverse impacts do not occur.
- Strictly enforce TANAPA water policy which highly restricts the use of all surface water in the parks (especially where sensitive habitats exist, such as hippo pools in the Serengeti, sensitive riverine vegetation and groundwater forests, springs and water holes.)

Operation and maintenance

Tourists can affect breeding patterns of birds, other species, and the hunting behavior of predators, including cats. Tourist activities can also exacerbate habitat change associated with soil erosion and siltation.

According to TANAPA policy: Off-road recreational driving for scenic/wildlife viewing will be discouraged, but may be allowed in specific zone(s) of a park if approved by the park's GMP/EIA. Off-road driving will be prohibited at any point in time, if it is determined that it is causing excessive damage to the landscape, wildlife

or other natural or cultural resources (TANAPA Policy, 1994:44).

While off-road driving under special conditions may be permitted in certain park zones, most off-road driving takes place illegally. Drivers commonly go off-road either to avoid poorly maintained and eroded tracks, or to view wildlife close-up. Tour operator drivers may take their clients off-road to encourage tipping, even though they run the risk of park penalties.

Off-road driving contributes to noticeable loss of vegetative cover, exposing the soil to water and wind erosion. The result is formation of numerous eroded and gullied multiple tracks and extensive scarring of landscape, particularly in high game viewing areas. For example, the soils on the Serengeti Plains, Moru Kopjes, Simba Kopjes, Gol Kopjes and the short-grass plains are largely fragile loams of volcanic origin. These locations are favored by tour operators and visitors because of their high game concentrations and opportunities for observing cats and other predators. However, because of the fragile nature of these soils, these areas are particularly prone to erosion and scarring. TANAPA is still grappling with how to best control off-road driving in these locations.

Recommended Mitigation

- Clearly designate roads and trails that pass near sensitive habitats and enforce visitor and tour operators use of designated roads and trails only.
- Allow off-road driving in approved zones only where strict limits of acceptable use (LAUs) are followed for those zones, where effective and frequent monitoring can be performed, and where drivers observe the "no driving over another vehicles tracks" rule. Discontinue legal off-road driving wherever scarring is observed.
- Employ booking systems and/or increase fees for visits to sensitive areas or exceptional resources in order to restrict vehicle traffic close to or through these, and to keep vehicle numbers within acceptable LAUs.
- Discourage illegal off-road driving by: maintaining and using designated roads only and strongly enforcing off-road driving policy; increasing tour operator and visitor awareness; increasing use of park guides; and penalizing tour companies whose drivers violate park regulations concerning off-road driving (e.g., temporary bans on offending tour companies).
- Engage tour operators in helping report off-road driving violations.
- Many of these mitigation measures should also be applied to roads that are posted "CLOSED."

Decommissioning

See the discussion under Section 6.2.1 *Soil erosion and surface runoff.*

6.3.2 Wetlands

Wetlands are one of the most important categories of habitats affected by roads. Wetlands are defined here as: areas of marsh, fen, peatland or with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (Ramsar Convention).

Wetlands are "natural sponges," important for flood control, groundwater recharge, shore line protection, and water pollution abatement. They may also be the most productive ecosystems in many parks, supporting wildlife, bird, fish and invertebrate habitats and high biodiversity.

Because of their importance, TANAPA Policy states clearly that "the occupancy and modification of floodplains and wetlands will be avoided wherever possible. Where no practicable alternatives exist, mitigating measures will be implemented to minimize potential harm to life, property, and the natural values of floodplains and wetlands." (TANAPA Policy, 1994:22).

Construction

Cutting and filling in wetland areas may involve removing black cotton soil from the road base and replacing it with large quantities of murram. The

murram road path is elevated above the surrounding wetland, and normally must be resurfaced with new murram annually, as original murram layers sink. (The assumption here is that the black cotton layer is fairly shallow. Constructing a road by replacing this material with a better foundation such as murram would become cost-prohibitive very quickly if the black cotton soils are deeper than 500mm.)

Excess black cotton spoil material is produced and may be difficult to remove. This form of construction through wetlands with black cotton soils may create a damming effect, with water impoundment on the higher side of the road, while the lower side may show both reduced surface water and depression of groundwater flow. The result may be alterations in vegetation and species habitat, especially on the drier, lower side of the road. Depending on the length of road, it may create major changes in original ecological conditions and landscape.

For example, in Tarangire National Park approximately 20 kms of track crossing the Larmakau wetlands to Loibosiret Ranger Post was proposed for upgrading from a Class V to a Class III road to allow all-weather access to Loibosiret Ranger Post. Larmakau is a Maasai word meaning "the place of the hippos," an indication that at one time there had been hippos in the area, with more water than exists at present. The change in the wetlands may be due to siltation or tectonic movement. The existing track crosses a large expanse of black cotton.

Cutting and filling over this distance has the potential for very significant adverse impacts on these wetlands. To make this road passable during the wet season would require very large quantities of murram, perhaps on the order of several hundred tipper truck loads, as well as annual reapplication. A new murram quarry source would have to be located at some distance from the Larmakau, and the costs of trucking material would also be very high. The cost and ecological risk of murram cut and fill on this road is considered too high to justify its upgrading to Class III.

In constructing roads across low-lying areas of black cotton, spoil may be produced which must be removed or shaped during the construction phase of road operations. Often this material is left unattended, affecting aesthetics and visitor experience. If proper care is not taken, it may also alter wetland microhabitats. The mere presence of such material will affect the wetness of the area and may create localized xeric (dry) environments.

Recommended Mitigation

- Avoid cut and fill across wetlands.
- Use a multidisciplinary team (land surveyor, geotechnical engineer, ecologist, tourism specialist) to conduct cost-benefit analyses of alternatives to crossing wetland areas.
- Where possible, find an alternative around low-lying areas following the contour of hills. (Often lower hill slopes have an alluvial composition with significantly lower clay content than found in low-lying areas.)
- Consider other transport alternatives for moving goods, park personnel and visitors, including: (1) park-owned (or contracted) light aircraft during rainy seasons when movement is impossible; (2) "swamp buggies" or airboats (see Section 2.2.2); (3) no action, i.e., continued use of existing tracks through wetlands during dry seasons only.
- Before construction commences and work is undertaken, determine how spoil will be disposed of or shaped.
- Carefully select storage sites and laydown areas to avoid risk of contamination of wetlands with fuel, lubricants, chemicals or other products used in the operation of equipment and construction activities, and to prevent drainage into wetlands.
- Where wetlands impacts (blocking of cross-drainage or filling, for example) cannot be avoided, provide mitigative compensation by protecting other wetlands. (It is assumed that creation or enhancement of other wetlands as replacement would be cost-prohibitive.)
- Pay particular attention to wetlands during bridge reconstruction.

Road Improvements Across Wetlands May Not Be Wise

In Tarangire, approximately 20 kms of track crossing the Larmakau Swamp to Loibosiret Ranger Post was proposed for upgrading from a Class V to a Class III road to allow all-weather access to Loibosiret Ranger Post. The road would have to be resurfaced annually with murram, as original murram layers sink. Construction on black cotton may create a damming effect, with water impoundment on the upper side of the road, and reduced surface water and depression of groundwater flow on the lower side. Depending on the length of road it may create major changes in original vegetation, habitat, ecological conditions and landscape, especially on the drier, lower side of the road. Upgrading the road across the Larmakau is not recommended. (S 4°14.6', E 36°7.4').

Operation and maintenance

As mentioned in Section 6.2.6, TANAPA Policy does not allow consumptive use of water that might significantly alter natural processes and ecosystems. Any use of wetland water resources for road operation and maintenance must comply with this policy. Because of relatively low traffic volumes in the Parks, contamination of wetlands with pollutants is not considered to be a likely or significant impact, except for the low probability but high risk event of spills of fuel or other toxic materials or chemicals.

Recommended Mitigation

- Avoid transportation of petrol or hazardous chemicals across wetland areas.
- Add protection of wetland resources to overall tour operator and visitor awareness campaigns.

Indirect and induced effects

Draining of wetland would lead to loss of productive ecosystems, wildlife habitats and flood control functions. Special efforts need to be made to protect these resources. The mitigation steps outlined above, combined with monitoring, may help to reduce adverse impacts.

6.3.3 Forest land and tropical forest

This section focuses on impacts on forest land and tropical forest; however, similar caveats and mitigation principles may apply to other types of vegetation encountered in the parks. Where potential impacts on forests apply to other vegetation types, they are addressed in this section to avoid redundancy.

Construction

The rehabilitation of road segments will result in the permanent loss of vegetation, where vegetation is cleared from the sides of roads to rehabilitate drainage structures or improve the road profile or where stream bank vegetation is cleared for bridge reconstruction. In general, this loss will be minor and must be considered unavoidable.

In cases of new road construction or road re-alignment, substantial vegetation biomass may need to be cleared to create road right-of-way. In some areas such as in the Groundwater Forest of Lake Manyara National Park as well as in Arusha and Kilimanjaro National Parks, vegetation may qualify as relatively undegraded forest. Relatively undegraded forest refers to the condition of a forest itself. This definition covers more than legally protected or classified forest and more than virgin forest. Advice and assistance from Tanzanian ecological experts is needed to determine the legal and operational definition of "relatively undegraded forest lands" to be applied in Tanzania.[3]

Forests may contain habitats that support endangered, threatened, rare or endemic species. For example, Kilimanjaro and Arusha National Parks contain primates such as Black and White Colobus Monkey (*Colobus abyssinicus*); Vervet Monkey (*Cercopithecus aethiops*); Blue Monkey (*Cercopithecus mitis*) and Baboon (*Papio anubis*). The Convention on International Trade in Endangered Species of Wild fauna and Flora (CITES) identifies and includes these (CITES Appendix II) as not currently threatened, but which may become so unless trade is subjected to strict regulation.

In particular, Black and White Colobus live in tree tops and feed on leaves. Thus, any forest clearance, especially of emergent tree species, could adversely affect these animals. Kilimanjaro's forest also shelters the Abbott's Duiker (*Cephalophus spadix*) formerly comprising the largest known global population, but now rather rare. Abbott's Duiker is listed as "vulnerable" by the 1990 IUCN-World Conservation Union Red List of Threatened Animals (See TANAPA, 1993).

If detours to maintain traffic flow are required during rehabilitation, or if additional right-of-way (ROW) is required in specific locations, loss or degradation of forest or wetlands could occur.

Inappropriate siting of quarries, borrow pits, debris disposal areas and construction camps can lead to unnecessary loss or degradation of forest and other vegetation.

Construction work forces tend to cut trees for fuelwood, unless subject to prohibitions on clearing trees.

During construction, there is the risk of contamination of forest lands, wetlands and other areas with fuel, lubricants, chemicals or other products used in the operation of equipment and construction activities.

Heavy equipment can break down and result in fuel, oil or lubricants contaminating soils or entering groundwater, streams, or wetland areas.

Recommended Mitigation

- Apply formal environmental screening and review (See *TANAPA Procedures for Environmental Reviews of Road Improvements, 2000*) as they relate to "undegraded forest," tropical forest and degradation of protected areas.

[3] Here, *relatively undegraded forest* is defined as relatively intact and productive forest, i.e., trees 10 or more metres in height, usually multi-storied with closed canopy over 80 percent; terrestrial broadleaf forest formations not classified as "mosaic" or "secondary." It includes catchment forests and forest reserves (*Tanzania Forest Ordinance* Ca. 389: the main legal instrument for administration of all forests). Relatively undegraded forest "along" or "adjacent to" the road segment is determined to mean relatively undegraded forest within *five* kilometers on either side of the road segment. According to TANAPA's Chief Ecologist, other examples of *relatively undegraded* tropical forests, in addition to those mentioned above, might include Rubondo Island National Park and Udzungwa Mountains National Park.

- Similarly ensure adherence to provisions of TANAPA *Procedures for Environmental Reviews* concerning threatened and endangered species.

- Avoid acquisition of additional Right of Way (ROW) through tropical forests. Use a multidisciplinary team (land surveyor, geologist/soil scientist, ecologist, tourism specialist) to conduct cost-benefit analyses of alternative routes and alternative transportation methods to avoid new road construction or realignment of roads through forested areas and especially tropical forest.

- If clearing is unavoidable, provide appropriate replacement vegetation to control erosion as mitigative compensation, and/or protect or restore forests elsewhere within the drainage basin as close as possible to those lost.

- Use a multidisciplinary team to conduct cost-benefit analyses of alternate sites for minor borrow pits, debris disposal areas and construction camps in order to reduce unnecessary loss or degradation of forest and other vegetation. The inventory work should be integrated with an examination of the impacts on forest lands or other sensitive areas, wetlands, endangered or threatened species, unique habitat, or other exceptional features (e.g., cultural, historical, paleontological or archeological resources). Avoid siting these ancillary works near sensitive areas and exceptional features.

- Avoid detours through forest or wetlands whenever possible.

- If detours are required to maintain traffic flow during rehabilitation, and no practical alternatives are available, restore land used for detours (e.g., forest or other vegetation) to prior condition.

- Minimize or prohibit fuelwood harvesting by construction work forces. Consider provision of alternative fuel sources to reduce demand on local fuelwood sources and/or use of vegetation unavoidably cleared during the construction process.

- Minimize use of cut and fill through forest areas. See the wetlands discussion above regarding cut and fill and suggested mitigation measures.

Operation and maintenance

Road traffic can create dust and mud that covers vegetation and results in damage or loss. Unless the area or vegetation adjacent to the road is protected, in a classified forest, or considered special or unique in some way, this effect is considered to be unavoidable.

With increased road traffic, the risk of fires rises, and thus the risk of vegetation loss and damage.

Use of herbicides and pesticides to control vegetation within the ROW is considered unlikely, because of cost.

Recommended Mitigation

- Use murram where feasible and affordable to minimize effects of dust on sensitive habitats, species and other exceptional resources.

- Conduct informational campaigns to heighten awareness about fire, particularly during the dry season. Posting of caution/warning signs could lessen risk.

- If use of herbicides or pesticides is considered, put in place procedures for safe and effective use in order to protect human and wildlife populations and to avoid contamination of water bodies.

- For restoration/decommissioning of murram pits, construction camps, debris and waste disposal areas, include requirements and procedures for reclaiming the land for subsequent sustainable use.

Indirect and induced effects

Road works carried out by TANAPA outside the parks could potentially lead to the intensification of agriculture and forest clearing and/or to increased exploitation of forests and degradation of forest cover. It is assumed that the majority of forest lands are open to exploitation, and that enforcement

of regulations that would protect classified forests is difficult.

Construction of roads to provide access to planned new gates could have significant impacts on forest resources. Under these circumstances, the greatest risk is that farmers would clear forests to create new agricultural lands, in response to lower transport costs and enhanced market opportunities.

Recommended Mitigation

- If TANAPA constructs new roads outside the parks, ensure adherence to *TANAPA Procedures for Environmental Reviews*, regarding loss of tropical forest and degradation of protected areas, and threatened and endangered species.
- Strengthen TANAPA, District and Local Government joint environmental assessment and environmental/natural resource planning at the district level.

6.3.4 Sensitive areas, threatened and endangered species and ecological functioning

Many sensitive/exceptional resource areas were observed in the national parks visited. These resources offer special attraction to visitors. For example: in the Serengeti there are the kopjes mentioned above, forest relics and fresh water springs in the Lobo Area. Arusha National Park's special features include: Momella Lakes, Ngurdoto Crater and the Arched Fig Tree. Poachers' Hide was visited by the PEA Team in Tarangire National Park and the Maji Moto (Hot Water) Springs in Lake Manyara National Park. Existing roads pass too close to these features. Also, uncontrolled tourist activities and off-road driving could further degrade these resources.

Planning and design

As mentioned above under *Section 6.3.1 Habitat change and species diversity*, in preparing GMPs or MZPs, there are pros and cons in providing greater visitor access to sensitive habitats, areas where biodiversity might be compromised, or areas containing possible threatened or endangered fauna and flora. Poor road design and planning could cause major damage to sensitive ecological areas, leading to loss of specific diversity.

Recommended Mitigation

- Use a multidisciplinary team (ecologists, archaeologist, road engineer, soil scientist, tourism specialist, etc.) to survey or inventory areas with sensitive species or ecological features (such as kopjes), in combination with inventory for exceptional paleontological, archeo-logical, historical or cultural features (e.g., rock paintings or gong rocks). The survey should be followed by a prioritization process to:

  1. identify exceptional features where no access will be allowed (in order to protect unique biodiversity or ecological characteristics);

  2. identify features for special use (e.g., guided and self-guided walking trails with designated car park areas);

  3. plan car park areas to match anticipated vehicle usage and provide proper drainage;

  4. identify sensitive areas where driving is permitted (generally off-road, but assess each year to determine if areas should be closed for recovery) and apply murram where necessary;

  5. determine minimum access distance to kopjes; and

  6. undertake awareness training for tour operators, drivers and park visitors.

- These suggestions could affect Limits of Acceptable Use (LAU). To mitigate this impact, consider introduction of higher fees for walking tours and application of booking systems with special permits to restrict visitor access to levels that will allow sustainable conservation of sensitive areas and exceptional resources values.

- Use the GMP/MZP planning process to identify, protect and utilize sensitive habitats.
- Ensure adherence to *TANAPA Procedures for Environmental Reviews* regarding loss of tropical forest and degradation of protected areas, and concerning threatened and endangered species.
- Re-route roads to avoid adverse effects on sensitive resources.
- Close roads that are currently too close to sensitive resources and substitute walking trails with escorts, where feasible.
- Commission hydrological and ecological studies of TANAPA water bodies, such as Momella lakes in Arusha National Park, in order to understand their aging processes and stages of eutrophication and potential impacts of road improvements on them.
- Ensure no surface run-off to lakes through monitoring of existing runout drains.
- Conduct inventories of flora and fauna and ecological studies of species behavior prior to road or trail development in suspected sensitive habitat areas.

How Close Should Roads Come to Sensitive Ecological Systems?

Kopjes are important "islands" of biodiversity in a number of Tanzania's Parks. This is one of the Gol Kopjes in the Serengeti. To protect the unique flora and fauna of the kopjes, including bird species and leopard, it may be best not to have roads draw too near, but rather select only certain kopjes for use by visitors, to be approached on foot along established trails. This strategy implies a need for more armed park guides.

Many Park Roads Pass Too Close to Exceptional Resources

Poachers' Hide in Tarangire National Park is a hollow baobab that sleeps 20! The tree may be threatened by increased road traffic. The existing approach could be closed and replaced by a short trail starting 50 meters from the site. (S 3°57.9', E 36°1.8')

Construction

During construction activities, unavoidable loss of some wildlife may occur, both on the road to be improved and in areas where borrow pits, quarries, work depots, construction camps and the like are located. However, these losses are likely to be insignificant. Road detours or acquisition of additional right-of-way, could also affect wildlife. While these impacts are not likely to be significant, detailed investigation and mitigation planning would be necessary in areas where endangered, rare, threatened or endemic species exist, as loss of such species would have a major impact on biodiversity. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) identifies the species that are believed to be present in the Mt. Kilimanjaro Ecosystem, Serengeti National Park, Tarangire National Park and Lake Manyara National Park which are vulnerable to, or are threatened with extinction.

Operation and maintenance

Disruption of wildlife populations through interruption of their movement or migration routes cannot be ruled out nor can isolation of populations (severance effects), particularly in instances where road rehabilitation or new road segments lie in the vicinity of, or around sensitive areas.

Tourist activities, off-road driving and vehicle traffic movement in and around these areas could disturb certain species and lead to their permanent displacement. The same may be true of certain birds species. Impacts could be significant, long-term, and potentially irreversible.

Disturbance of wildlife as a result of road noise is considered insignificant, because of the low traffic volumes anticipated.

Recommended Mitigation

- Note: *If endangered or threatened species are present and could be affected by road*

improvement activities (especially new road construction, or realignments of existing road segments), an Environmental Assessment would be called for in accordance with TANAPA Procedures for Environmental Review of Road Improvements.

- Apply murram selectively to reduce dust and rutting.
- Mitigate against soil erosion on trails with stone step work and runout drains, where appropriate.

Decommissioning

Where roads are determined to be too close to sensitive areas or adversely affect threatened or endangered species, they will need to be abandoned through effective decommissioning.

Recommended Mitigation

- Close roads passing too close to sensitive areas to motorized traffic and substitute with walking trails, where feasible.

Indirect and induced effects

Effects similar to those described for wetlands, forests and other vegetation could occur through inadequate protection and management of park resources. Loss of habitat can result in the decline or disappearance of wildlife populations. Fragmentation of habitat into areas too small to support various species is also a risk, but lower limits of species and ecosystem sustainability vary, and for the most part are unknown or not well-researched. Without such knowledge, biodiversity could be reduced and/or threatened, or endangered species adversely affected.

Recommended Mitigation

- Support species inventories and ecological monitoring research to maintain sensitive habitats and to develop effective mitigation plans for protection of threatened and endangered species.

6.3.5 Exceptional resources: ecological, paleontological, archaeological, historical and cultural

Planning and design

Certain existing roads are already too close to exceptional resource sites, and future new roads, road realignments, construction camps, borrow pit locations or the like could be. Without adequate planning of roads and trails, many unique park assets could be degraded or destroyed.

Recommended Mitigation

- See above under Section 6.3.4 *Sensitive areas, threatened and endangered species and ecological functioning.*
- Consult with appropriate officials and museum sources to determine if areas have the potential to contain buried resources such as fossils, archeological remains, and cultural artifacts. If warranted, conduct field surveys where such potential exists.
- Put in place procedures that require construction crews and supervisors to be alert to buried resources and which also provide them with guidance in the event they are uncovered.
- Define responsibilities for road crews and companies (e.g., contract clauses, incentives for protection, penalties for damage).

Construction

Buried resources may be damaged and lost.

Recommended Mitigation

- Ensure construction crews and supervisors follow established TANAPA procedures and/or contract clauses for handling possible buried resources.
- Provide rewards and incentives for proper handling of buried resources, and penalties for loss or damage to these resources.

Indirect and induced effects

If road improvements allow increased access to exceptional resources, the potential may increase for vandalism, theft and accidental damage to these park assets.

Recommended Mitigation

- Heighten awareness and enforcement of regulations on the part of park authorities responsible for the protection of cultural resources.
- Limit visitor demand through the use of booking systems and/or higher fees for visits to exceptional features.
- Create barriers (natural materials, if feasible) around selected features to limit access only to approved routes.
- Provide stiff penalties for any damage to exceptional resources.

Does This Road Threaten an Exceptional Resource?

Arched Fig Tree in Arusha National Park is a key attraction for many park visitors. It is actually two Strangler figs joined together and is probably not adversely affected by the vehicle traffic passing beneath it. However, another track exists to the right of the tree that is used by larger vehicles and as a turnaround point for visitors who do not wish to drive higher up on the slopes of Meru Crater. To improve aesthetics this second road could be realigned further from the tree.

6.3.6 Wildlife migration/movement and animal harassment

Most species have adjusted to vehicle traffic in the national parks. Roads are typically narrow and support relatively low volumes of traffic. Also, traffic on the vast majority of roads moves at low to moderate speed. Thus, park ecologists have not seen restricted movements or detrimental impacts on migration resulting from the existing park road system, and do not anticipate problems with future road upgrading and expansion under park GMPs or MZPs, as currently conceived.

The allowed speed limit in all parks is 50km/hr. However, where roads are straight and well-maintained, illegal speeding is common. In Serengeti, for example, users include park visitors, tour operators and public traffic moving in transit on the Class I road passing through the park from Arusha to either Musoma or Mwanza. Despite existing regulations governing night driving and speed limits, problems still occur largely from traffic traveling too fast on this road within the park. A system of fines is in place for speeding.

Animal mortality as a result of collisions with vehicles is a concern. The higher the volume of traffic and/or the higher the travel speed, the higher the mortality; slow-moving animals, such as amphibians, tend to have the highest death rates. Fines are imposed for striking animals. However, enforcement of fines for animal kills is difficult because most go unreported by drivers and resources for apprehension and monitoring of speeders is limited. (Makuyuni-Musoma Road EIA Draft Report, 1996).

Accident hazards to animals and people from speeding vehicles are discussed further under *Risks and hazards* in *Section 6.5.5*.

Construction activities likely to impact on wildlife include use of water, blasting, cutting and filling, and vegetation clearing. Construction and noise from trucking murram could disturb animal behavior. However, these impacts are likely to be short-term and localized.

Recommended Mitigation

- Increase enforcement of speeding regulations.
- Employ additional speed control technology and methods (speed guns appear to be more effective than speed bumps because drivers memorize speed bump locations).
- Design new roads and road realignments to meander, as curving roads deter overspeeding.
- On existing straight roads, ensure brush clearing of ROW is wide enough for vehicles traveling at high speed to see approaching wildlife and vice versa.
- Strengthen informational campaigns to heighten visitor and tour operator awareness of the hazards to animals and vehicles of speeding, and the negative effects on visitor experience.
- Post caution signs and lower speed limits in areas with abundant or unique fauna.
- Engage tour operators in helping report speeding violations and animal accidents.

6.3.7 Poaching

There are increasing settlement pressures on Tanzania National Parks, observed by the Team on the Western boundary of Tarangire National Park, and the Northwestern boundary of the Serengeti in the Ikorongo Controlled Area on the approach to Tabora Guard Post. The Team understands there are similar pressures on the Kenyan border, and along the southwestern boundary of Serengeti. Dense settlement around Arusha National Park also contributes to poaching of wildlife and illegal extraction of fuelwood.

Operation and maintenance

The existence of new or upgraded roads is considered to have a beneficial impact on control of poaching. Improved roads may provide increased access to poachers but, from experience elsewhere, it is anticipated that additional roads will give anti-poaching patrols more mobility. This, combined with more visitors in the area, will actually create

"more eyes" and make it more difficult for illegal activities to occur in the parks unnoticed. For example, upgrading of Northern Serengeti roads is expected to reduce poaching in that part of the park.

Road maintenance has similar advantages. The ability of patrols to cover longer distances is enhanced, and the number visitors traveling a given segment of road is likely to increase.

Indirect and induced effects

Illegal activity in the Northern Serengeti seems to be diminishing with increased Community Conservation Service (CCS) support, communication and awareness building with neighboring villages. Better roads makes it easier for CCS personnel to reach key villages.

Improved roads also have beneficial impacts by increasing the effectiveness of rangers and patrols to provide security for visitors from related anti-poaching activity and possible banditry.

6.3.8 Alien species

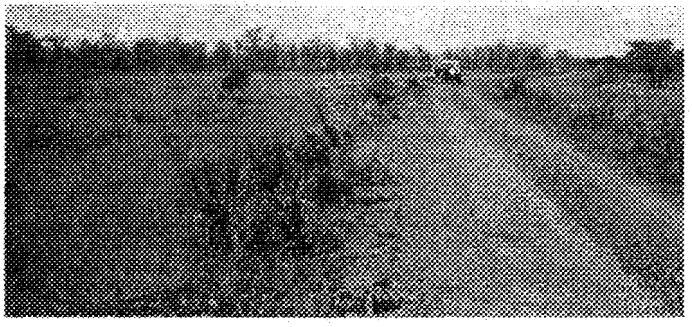
The TANAPA policy governing alien species reads: "Exotic species are those that occur in a given place as a result of direct or indirect, deliberate or accidental actions by humans. Introduction of new exotic species will be prohibited. Management of populations of exotic plants and wildlife species already present in a park, up to and including eradication, will be undertaken wherever such species threaten park resources or public health, and when control is prudent and feasible. High priority will be given to management of exotic species that have substantial impact on park resources and that can reasonably be expected to be successfully controlled; lower priority will be given to exotic species that have almost no impact on the park resources or that cannot be successfully controlled." (TANAPA Policy, 1994:21)

Localized occurrences of exotic plants were observed along roads in several of the parks, but none of these appeared to have impacts of significant concern. However, species of a common cactus *Opuntia*, not native to Africa, were originally introduced to the Serengeti as an ornamental. The cactus subsequently spread in areas near Naabi Gate, Seronera and Banagi. Its removal has involved uprooting by hand, crushing, drying and burial. Despite a large labor investment, eradication has not been completely successful.

Recommended Mitigation

- Avoid murram material that may contain exotic seed.
- Conduct botanical and ecological inventories for exotics.
- Instruct road crews to remove rapid colonizers and quick spreading or reproducing invader species by hand, while control is still manageable.
- Enlist assistance from student groups volunteers where road crew labor is not adequate to control an undesirable invasive species.
- In situations where potential for spread of exotic species is high, wash heavy equipment (park-owned or private contractor) before it enters the park.

How Should Alien Species Be Controlled?



To date, spread of invasive or non-endemic species has not been a major problem in Tanzania's National Parks. On a short stretch of Class I road crossing the western Serengeti from Seronera to Ndabaka Gate, amaranth plants were growing along the roadside, perhaps the result of seed spilled by a passing truck.

6.4 Landscape impacts

6.4.1 Scenic quality and viewshed

Potential visitors are drawn to Tanzania's national parks by the prospect of seeing the large wildlife populations and predator species. They are also aware that Tanzania's parks contain some of the most beautiful and striking landscape features in the world, including the undulating plains and kopjes of the Serengeti; the magnificence of Kilimanjaro; Ngorongoro Crater; the lesser known beauty of Meru and Ngurdoto Crater in Arusha National Park; Tarangire National Park and the *Acacia* woodland, baobabs and wetlands; the rainforest areas found in parks like Udzungwa and Lake Manyara. Recognizing and protecting scenic quality and the aesthetics of viewsheds is therefore extremely important to the future of the parks.

Planning and design

Improperly sited roads leave very visible scars on the landscape. Many of Tanzania's park roads were established many years ago, with little initial thought given to their impact on viewshed. Thus, roads in Tarangire and the Serengeti may cut long straight paths across valleys and plains, and are in plain view at higher elevations. Others cut across hilllsides without regard for whether or not the road and vehicle traffic can be seen by other park visitors.

Little consideration was given to whether these roads could have followed hill contours, or been hidden by forest cover. The same is true of roads created to view game along river courses. Often tour operator vehicles move down both sides of the river, so that visitors stare across at one another, instead of enjoying what they had hoped would be the experience of the African wild. Off-road driving also has very detrimental effects on scenic quality. Many roads pass too close to sensitive areas or exceptional resources. Substituting trails for roads should enhance visitor experience and scenic quality at locations such as Poacher's Hide in Tarangire National Park; the Groundwater Forest at Lake Manyara; the gong rocks and rock painting kopjes in Serengeti National Park; Momella Lakes and Ngurdoto Crater at Arusha National Park.

The absence of attention to landscape architecture/planning for the existing roads in Tanzania's parks could be remedied by conducting a TANAPA-wide survey of the existing road networks. Such a study might identify which roads are in fact well-located, and which roads might eventually be realigned to enhance park aesthetics and to reduce adverse effects, such as soil erosion or threats to sensitive areas.

Improper location and poor management of quarries and murram pits also adversely affects scenic quality. Examples were noted in the Serengeti on the road between Naabi Hill Gate and Seronera and the road between Seronera and Ndabaka Gate. These effects are associated with not conducting initial park inventories of the location of existing and future quarries and murram sites, so as to select sites with good quality and known quantities of murram. The absence of initial survey work also means that most pits and quarries remain open because the extent of the resource is not known. Without such information, it is difficult to prepare plans for phased re-shaping and rehabilitation of the site once sections of the murram resource are exhausted.

Murram pit impacts on scenic quality may also be affected by failure to provide guidance to murram crews regarding retention of topsoil for future reshaping and restoration, and to provide instruction in proper extraction techniques to prevent gullying.

Construction and maintenance of roads in large parks such as Tarangire and Serengeti require road camps. Poorly located camps may affect scenery and viewshed, with detrimental effects on visitor experience. The team observed a construction camp in operation at Nyankoromo in the Serengeti. This camp was established in November 1999. It was situated away from campsites or buildings, and not visible to park visitors. It was also adjacent to an extensive and permanent murram pit that was over 10 years old. The camp appeared reasonably well-managed with minimal impact on the environment. The crew was using a temporary pit latrine for human waste disposal. However, there were discarded oil filters and other non-burnable materials on the ground at the site, and wood was being used as the fuel source. Some waste oil and fuel spillage was also in evidence at the site.

Recommended Mitigation

- Conduct a parkwide inventory of the existing road networks in *each* of Tanzania's national parks, involving a multidisciplinary team (landscape architect/planner, ecologist, road engineer, geotechnical engineer, tourism planner). The study should identify which roads are, in fact, well-located, and which roads might eventually be realigned to enhance park aesthetics and reduce adverse effects, such as soil erosion or threats to sensitive areas. Also, determine which roads might be replaced by trails, or permanently decommissioned.

- Avoid siting roads that cut long straight paths across valleys and plains, and are in plain view at higher elevations.

- Where feasible, design roads to minimize adverse viewshed effects on park visitors by following hill contours, hiding roads beneath forest cover, and using meanders to improve scenic quality. Avoid siting roads along river courses that place vehicles on one side of the river in the viewshed of vehicles on the other side.

- Apply a "clean slate" concept; in other words, consider realignments of all minimal tracks to follow contours and avoid sensitive areas, recognizing that existing minimal tracks can be ripped (to accelerate regeneration of vegetation) and abandoned with no noticeable scars or impact on the environment.

- Manage off-road driving to minimize habitat change, soil erosion, and degradation of scenic quality (See *Section 6.3.1 Habitat change and species diversity)*.

- Use a multidisciplinary team (land surveyor, geologist/soil scientist, ecologist, tourism specialist) to conduct a siting study of existing and potential future sites for quarries and murram pits in and around all of the national parks, to determine their extent and quality, and to develop through cost-benefit analysis a TANAPA-wide quarry and murram pit management plan. Include in the plan a prioritized list of sites for each park.

- Site quarries and murram pits so that they are not visible to visitors.

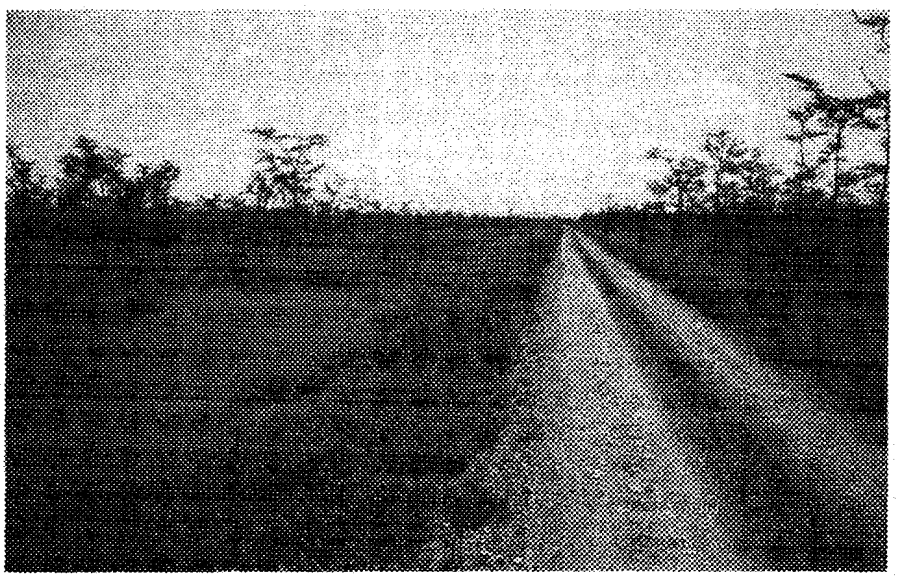
- Take photos of sites before initiating excavation, so that restoration can match original site characteristics as much as possible.

- Develop specific procedures for extraction of murram, storage of topsoil, phased closure and reshaping and restoration when extraction has been completed. Where appropriate, include reseeding or revegetation, to reduce soil erosion, prevent gullying and minimize visual impacts.

- Locate construction camp sites so that they are not visible from the tourist roads or tracks.

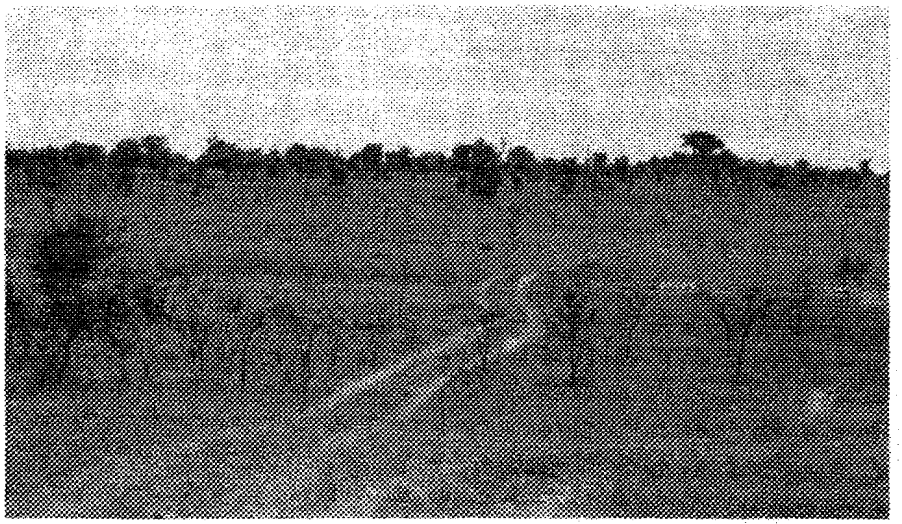
- Provide appropriate training for the road inspector and grader operators on ways to deal with spoil materials.

Why Straight Roads Through National Parks?



Long straight stretches of road encourage speeding and are less aesthetically pleasing to park visitors than roads which meander across the landscape. This main road across the western Serengeti from Seronera to Ndabaka is currently a Class II road (single lane, cambered, all weather, two-wheel drive), but it will probably be improved further to provide safe two-lane passage as a Class I road. Could portions of this road be realigned to create a slower and more enjoyable visitor experience? (S 2°16.5', E 34°31.6')

Use the "Clean Slate" Rule when Considering Improvements to Class IV Roads

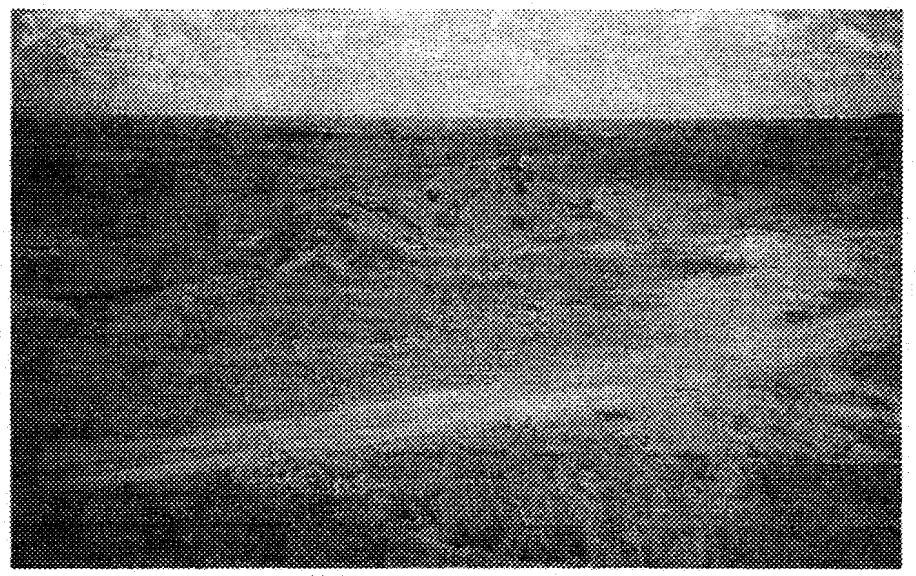


Landscape planning and the use of multidisciplinary teams are recommended to determine the most environmentally friendly routes through park zones. This route in the northern Serengeti is scheduled for upgrading. The current track crosses low areas of sticky black cotton clays (vertisols) and probably should be realigned to follow hill contours. In the future, road improvements in park zones with minimal tracks should follow the "clean slate" rule. Under this rule, upgrading is based on a full review of the best routing alternatives, since most Class IV roads can be readily abandoned and returned to nature, usually with little or no investment in decommissioning. (S 1°46.6', E 34°58.9')

A Quarry Inside the Serengeti - What are the Plans for Reclamation?

This quarry at Nyankoromo in the western Serengeti has been used for many years. It is well away from visitor viewsheds. However, attention has not been paid to restoring those sections of the quarry where murram extraction has been completed. Conducting a multidisciplinary survey of existing and potential sites for murram extraction would be useful in determining the quantity and quality of murram available. This information could then be used to develop parkwide plans for phased reclamation of each individual site, including restoration of stored topsoil. (S 2°12.8', E 34°4.0')

A Scar on the Serengeti



This murram pit was observed on the open Serengeti plains near Naabi Hill Gate. Its creation was probably based on insufficient knowledge of the location of other murram resources in the Park. Hillocks like this one are common in the Serengeti and are often readily visible to tourists. Decommissioning should be carried out, restoring the area near the pits to match the surrounding landscape.

Construction

Impacts from construction are relatively limited, consisting primarily of temporary effects created by large construction machinery and road crews on the road, and from clearing vegetation and regeneration of spoil materials. The spoil materials may be large stones or trees cleared to make the road.

Where quarries and murram pits were not properly located in the parks, they were considered to have significant impact on the outward view of the tourist. For example, in the Serengeti, the PEA Team observed small murram pits just north of the main Naabi Hill Gate and Seronera road. The pits were noticeable to visitors because they form small artificial hills and depressions on the open plains. No signs were posted indicating that roads heading to these sites were for administrative purposes only, and the tracks leading to them could be mistaken for Game Viewing roads.

Quarries, murram borrow pits and accumulation of spoil materials on the roadsides may have significant impact on park viewsheds if they are not removed. The road from Makuyuni to Mto wa Mbu demonstrated dramatically how spoil materials affect views for tourists driving on that road.

Recommended Mitigation

- Follow procedures for reshaping berm materials and clearing *vegetation* (See *Section 6.2.1 Soil erosion and surface runoff* and *Section 6.3.3 Forest land and tropical forest)*. Ensure grader operators and road crews apply techniques for managing spoil materials and cleared vegetation that minimize impacts on scenic quality.
- Try to restrict road machinery and crew operations to low season and low traffic volume periods.
- Ensure dozer operators and casual labor at quarries and borrow pits are following procedures for extraction of murram, storage of topsoil, phased closure and reshaping and restoration when extraction has been completed. Where appropriate, reseed or revegetate to reduce soil erosion, prevent gullying and minimize visual impacts.
- Ensure construction camp sites are not visible from the tourist roads or tracks.

Operation and Maintenance

A direct correlation exists between scenic quality and the number of vehicles moving along a park road at a given time. Vehicle traffic also has a direct bearing on the quality of visitor experience. Most parks are making an effort to follow management plan restrictions on the number of vehicles per kilometer stretch of road. Vehicles per kilometer is an important criteria being applied in efforts to both define and maintain Limits of Acceptable Use (LAU) for various national park zones; for example, in the Management Zone Plans for Tarangire and Serengeti National Parks (See *Section 6.4.3 Limits of acceptable use (LAU)/carrying capacity* for TANAPA's definition of this concept). The above impact from excessive vehicle traffic stands out especially during the dry season when each vehicle leaves a dust trail in the air that can be seen over long distances.

Improper management of waste materials during road maintenance may degrade the quality of park scenery. These wastes may include cement bags, broken culverts, nylon sheeting, littered water bottles, plastic bags, etc.

Illegal off-road driving also degrades the scenic quality of the park.

Recommended Mitigation

- Ensure vehicle per kilometer Limits of Acceptable Use (LAU) are followed for each designated park zone.
- Apply murram where available and feasible to reduce the visual effects of dust for especially important scenic vistas and viewsheds.
- Apply mitigative measures to restrict off-road driving (See *Section 6.3.1 Habitat change and species diversity* for a detailed discussion of off-road driving and mitigation strategies).
- Ensure road crews follow procedures for handling and disposing of waste materials, and understand the rationale for

maintaining roadsides in waste-free condition.

- Remove all abandoned materials and non-functional equipment from roadsides (preferably to a location outside the parks).
- Enforce litter control—what goes in must come out.
- Remove all wastes. Process them from a central location (preferably outside the parks).
- Perform road maintenance when the number of visitors is low to minimize effects on scenic quality.

Decommissioning

Scenic vistas and viewsheds may be affected by the existence of abandoned roads that have not been decommissioned and revegetated.

Recommended Mitigation

- Close off abandoned roads and multiple tracks with barriers (e.g., rocks) and "CLOSED" signs to allow natural regeneration of vegetation to take place.
- Rip and reshape abandoned road segments, where appropriate, such as those with high compaction or deep rutting, to encourage rapid revegetation and restoration to natural conditions (See *Section 6.2.1 Soil erosion and surface runoff*). Decommissioning activities may have a minor adverse impact on the scenic quality of the park for a short period of time, but over the longer term they should have beneficial impacts.
- Rehabilitate existing quarries and murram pits that have an impact on the scenic quality of the park; and, where possible, discontinue use of murram from these sites.

6.4.2 Wilderness quality

Wilderness zones are found in many of Tanzania's parks, and cover large areas. Ruaha's Wilderness Zone consists of 582,555 hectares, Taragarine's 126,653 hectares, and Serengeti 7000 km^2.

According to TANAPA Policy (1994:30) motorized equipment or any type of mechanized transport is prohibited in areas designated or zoned as wilderness with the exception of emergency situations involving human health or safety. Temporary vehicular access may be permitted only to meet the minimum requirements of emergency life-threatening situations. Where abandoned roads have been included within wilderness, they will be used as trails or restored to natural conditions. Unpaved trails and foot bridges may be constructed when necessary for resource protection or visitor safety.

Thus, road construction in wilderness areas is highly restricted. If roads are allowed in wilderness areas, they are to be limited administrative roads for emergency purposes. Under certain exceptional circumstances they may also be necessary for anti-poaching purposes.

Planning and design

If wilderness policy is not followed, the possibility exists that Park Administration may establish or continue using roads that go through, instead of around, wilderness zones.

Recommended Mitigation

- Ensure that TANAPA Wilderness policies, GMT and MZP wilderness zone plans are complied with, prohibiting motorized equipment or any type of mechanized transport in areas designated or zoned as wilderness with the exception of emergency situations involving human health or safety.
- Unless no other alternative is available, roads should pass around, and not through, wilderness zones.
- Use the TANAPA Policy (1994:30) "*minimum tool*" principle to provide emergency access to wilderness areas, for example, use of trails versus roads, small light motorized rescue and supply vehicles instead of transportation, or air transport.
- Ensure that Park Wardens in Charge make staff, visitors, tour companies and developers fully aware of the importance of restricting wilderness access to the absolute minimum.

Construction and operation

If roads must be provided, or already exist, for emergency purposes, they may have potentially detrimental effects on wilderness quality, if not carefully maintained to minimize environmental impact.

Recommended Mitigation

- Ensure the use of TANAPA policy that requires use of the "*minimum tool*" principle to provide emergency access to "wilderness areas."

Decommissioning

According to TANAPA Policy (1994:30), abandoned roads within wilderness are to be converted to trails or restored to natural conditions.

Recommended Mitigation

- Convert abandoned roads to trails or to natural state. See mitigation strategies for decommissioning in *Section 6.2.1 Soil erosion and surface runoff.*

6.4.3 Limits of acceptable use (LAU)/carrying capacity

According to TANAPA, a park General Management Plan/Environmental Impact Assessment (GMP/EIA) does not attempt to determine "carrying capacity," at least not in the traditional sense of how much use and development an area can tolerate. Rather, it proposes that a "*limits of acceptable use and development*" be determined with *"primary emphasis on the conditions desired in the area rather than on the amount of use the area can tolerate."*

LAU criteria are normally set by considering number of vehicles per kilometer and the number of visitor beds allowable in a given park zone.

The addition of new roads, or the upgrading of existing roads, may have significant long-term effects on visitor demand and the LAU adopted for various zones identified in Park General Management Plans and Management Zone Plans. TANAPA wishes to avoid high-density vehicle-per-kilometer averages. For example, in Tarangire, the preferred vehicle density for its Core Preservation Zone (the most heavily visited zone in the park) is approximately 1 vehicle per 2.7 kilometers. They are trying to avoid increasing the vehicles per kilometer LAU in the zone any further (See Tarangire MZP 1994:41). The MZP concern is that pressures for increased tourism in the zone could move Tarangire's Core Preservation Zone in the direction of mass tourism and overuse now associated with certain portions of parks in other countries. For example, Maasai Mara Game Reserve in Kenya has approximately 1 vehicle per 1.2 kilometers of road and averages 10 vehicles around one wildlife event (C. G. Gakahu, 1992) and the most heavily used portion of Kruger National Park in South Africa has approximately 1 vehicle per 0.75 kilometers (Joubert, 1992).

The purpose of the zoning schemes and limits of acceptable use employed by TANAPA for Tanzania's National Parks is to enhance and diversify visitor experience, providing opportunities to escape the relatively overcrowded zones. Fewer tourists pay relatively more for quality experience, so that revenues needed for sustainable park management are balanced against the need to preserve exceptional resource values. An important purpose of road expansion is to relieve pressure on limits of acceptable use (LAU) for various zones. This expansion should allow more visitors to enjoy the park's resources, and increase revenues for sustainable management, without placing undue pressure on the unique physical and biological assets of Tanzania's parks.

The Serengeti Management Zone Plan provides a good example. It calls for an additional 180 kilometers of tourist roads/tracks in the Seronera Intensive Use Zone over 5 years. The MZP goes on to explain that this expansion is expected to reduce the number of vehicles per kilometer from approximately 1 vehicle per 1.5 kilometers to approximately 1 vehicle per 2.7 kilometers. Planned new roads in the Serengeti will also increase the number of visitors where access has been limited in the past. The Serengeti's Mbalageti Low Use Zone currently has no roads. The addition of 210 kilometers of new all-weather roads will allow an increase in number of visitors to this zone, while still maintaining an LAU of only 1 vehicle per 10 kilometers.

Nevertheless, new and upgraded roads will increase visitor and tour operator demand to visit the parks.

Planning and design

Unless limits on the number of visitors and vehicles entering the parks are effectively applied and enforced, the parks will suffer increasingly from the effects of mass tourism. Without upward adjustment of park fee structures for selected booking systems, it will be difficult to ensure high park revenues needed to manage the exceptional resource values of Tanzania's National Parks and the quality of visitor experience.

Current plans exist to upgrade many park roads to all-weather murram standard accessible by 2wd vehicles. These improvements are expected to increase tourist interest in visiting the parks. For example, at some point in the near future the Makuyuni-Ngorongoro road will undergo major improvement. At that time, visitors will have much greater access to Lake Manyara National Park, with planned 2wd access. These road improvements may lead to a large increase in the number of day visitors to the park. Road improvements at Tarangire, Serengeti and Arusha National Parks will create similar pressures. These increases in tourism pressure, if not managed, could result in vehicle traffic exceeding TANAPA LAUs in many park zones throughout the National Park system.

Heavy vehicle traffic movements and off-road driving have major impacts on visitor experience in the parks. Improved roads could attract mass tourist movements and associated tourist activities. Without effective management, TANAPA's park resources could be sacrificed to mass tourism and short-term revenue gains. Overcrowding and uncontrolled use of the parks could create irreversible degradation of park resources, and discourage ecotourism, with subsequent loss of revenue.

Recommended Mitigation

- Strictly follow MZPs, where they exist. In light of the approximate doubling in the number of visitors to the parks over the past decade and the anticipated road improvements, review existing management plans. Where in need of updating, or non-existent, take action to ensure their preparation or updating.
- Conduct multidisciplinary surveys (ecologist, road engineer, geotechnical engineer, hydrologist, tourism specialist) for all new road segments or road realignments and apply cost-benefit analysis to select routes which maximize benefits, while minimizing adverse environmental impacts.
- Where LAU's are approaching unacceptable levels from the addition of new roads or the upgrading of existing roads, consider upward adjustment of fees to balance visitor usage against zone LAUs, or use booking systems to ensure planned LAUs are not exceeded.
- Consider raising fees during the high season, and imposing more moderate fees during the wet season, so as to encourage more park use during the low visitor seasons. Also consider a promotional campaign to attract visitors during low season, perhaps by publicizing low season fees and wet season park attractions.

Pushing Beyond the Limits of Acceptable Use

Too many vehicles at one location can detract from visitor enjoyment and, if frequent enough, indirectly lead to a loss of park revenue. This group of vehicles has stopped along the road in Tarangire's Core Preservation Zone to view lion. Gatherings of this kind temporarily exceed the Limits of Acceptable Use for this zone, set at 1 vehicle per 1.6 kilometers.

6.5 Socio-economic considerations

6.5.1 Human settlement

TANAPA planning includes the development of new roads or the upgrading of existing roads outside the parks, in order to serve new park gates or ranger posts. These improvements may have both adverse and beneficial effects on human settlements in the vicinity of these roads.

Construction and operation

Communities may gain from increased access to schools, health facilities and other social services, as well as increased employment and tourist income as discussed below under *Section 6.5.2 Costs and benefits to TANAPA and to local economies.*

Direct adverse effects on human settlements, such as dust and noise from road construction, are expected to be relatively minor, although it is important to incorporate environmental mitigation into any planning of new or upgraded roads through existing communities. Dust and heavy traffic were especially noticeable in the town of Mto wa Mbu, just before the Lake Manyara park entrance.

Effects of tourists and road crews on the health of local communities is discussed in more detail under *Section 6.5.3 Health and disease.*

Tourist impacts and "culture shock" effects on traditional values and local culture can be significant and are difficult to mitigate against, though tour operators could be asked to incorporate cultural awareness and sensitivity into educational programs for their clientele.

Recommended Mitigation

- Mitigate against vehicle and equipment dust and noise from traffic passing through

communities outside the parks. See *Section 6.5.5 Risks and hazards.*

- Ask tour operators who stop at communities that border the national parks to incorporate cultural awareness and sensitivity into educational programs for their clientele.

- See *Section 6.5.3 Health and disease* for additional mitigation recommendations.

Indirect and induced effects

Road improvements carried out by TANAPA outside the parks can contribute to rapid development of strip settlements with increasing demands for water, fuelwood, grazing and agricultural land. This expansion of human activity outside the parks can, in turn, affect the long-term viability of park systems.

For example, overgrazing, agricultural production on marginal lands, and fuelwood harvesting are occurring in the regions outside Tarangire and Lake Manyara National Parks. Increasing population and grazing pressures, combined with too frequent clearing of vegetation and burning by farmers, has accelerated sheet erosion and gullying, producing major increases in siltation and flooding in the parks downstream. Continuing growth of populations near the parks is in part stimulated by the existence of well-traveled roads. With this growth wildlife corridors may be closed off, and competition may intensify, not only over land that supported wildlife in the past, but also over water resources needed by wildlife outside and inside the parks.

Pressure is building in northeastern Tarangire near Boundary Hill and along the western margin of the park to create new gates or increase visitor access. Similarly, at the southern end of Lake Manyara National Park, road improvements outside the Park are anticipated. Improvement of the Magara road to Mbulu appears to be underway and the road to Babati may also be improved. These developments, together with the possibility of road improvements past Mayoka Village, will increase the demand for creating a Southern Gate to Lake Manyara National Park, with additional visitor pressure on the Limits of Acceptable Use.

If a Lake Manyara Southern Gate eventually becomes a reality, possible development of strip settlement could occur along the road leading to the approach from the South. TANAPA, together with the District, may wish to consider how best to manage such future development.

Visitor interest and demand may also increase if Lake Manyara Park administration goes forward with further road upgrades, or with the development of other possible visitor attractions such as walking safaris, high canopy forest rope bridge walks, or boating. These attractions will require road/trail design collaboration, with thought given to the need for parking areas and armed rangers to protect walkers from undesirable animal encounters.

Outside Serengeti National Park, settlement in and around Ft. Ikoma is expanding in response to the relocation of TANAPA headquarters offices, personnel, support staff and housing. The Team was informed that water supply may become a constraint.

The effects of poaching in Tarangire and the Serengeti are discussed above under *Section 6.3.7 Poaching.*

Arusha National Park also has dense settlement up to the park boundary, especially to the north and south of the park. Villagers are engaging in illegal harvesting of fuelwood and poaching of wildlife, and the hand-cleared boundary demarcation does not deter incursions into the park. Villagers also complain of crop damage by problem animals. Community Conservation Service (CCS) activities seem to have been hampered by insufficient staff and resources, including vehicle transport. Settlement effects are especially evident near Lake Tulisia on the northern boundary, where agricultural activities appear to be contributing significant quantities of silt to the lake, jeopardizing its future existence. Some poaching of flamingos from the lake has been reported.

Recommended Mitigation

- Work with District councils to develop regional environmental assessment capability and regional natural resource and environmental management plans.

- Establish standards for development of roads leading to the national parks to control rapid and potentially adverse effects on the parks.

- Work with communities and district councils to encourage enforceable plans for managing the aesthetics of development along roads outside the parks.

- Support CCS's need for sufficient resources, including vehicles, to help communities recognize the value of the parks, and to ensure that a significant portion of park benefits reach communities most affected by crop damage or injury caused by wildlife, and/or loss of income.

- Utilize resources of park roads departments to assist neighboring communities in improving their farm to market roads, where appropriate, and to improve CCS access by road.

- Support efforts to control in-migration of population to communities adjacent to national parks.

- Support non-farm employment and family planning initiatives.

6.5.2 Costs and benefits to TANAPA and to local economies

Construction

During the construction period, modest and temporary, but locally important, employment and income may be generated with potential multiplier effects, as wages earned are re-spent in the economy. Similarly, the purchase of materials and other goods for road rehabilitation or construction may generate income and employment, with associated multiplier effects. At Lake Manyara, Arusha, and Kilimanjaro National Parks, casual laborers are employed to undertake road maintenance work and minor road construction. Using casual labor strengthens park/community relations and is also relatively inexpensive.

The cost of rehabilitation and/or construction of roads/tracks in parks can be expected to be significant for TANAPA in terms of establishment and management of construction camps (where necessary), quarry management and purchase and trucking of murram (if it has to come from outside parks) and maintenance of machinery. However, the benefits likely to accrue from these improvements are likely to outweigh the costs by far.

Recommended Mitigation

- Encourage use of casual labor from adjacent local communities for road improvements, especially in small parks.

- Conduct cost/benefit analyses of using potential murram sites outside the parks.

Operation and maintenance

It is anticipated that new or improved roads will encourage more visitors to the parks. Local people living in settlements near parks are likely to benefit from a variety of tourist activities. For example, in Lake Manyara National Park, the local population in nearby Mto wa Mbu, and Kibaoni Villages, are taking advantage of the tourist traffic which passes through the villages to establish various service enterprises including private campsites, small hotels, stores, cafes, vehicle repair shops and walking and cycling safaris. These enterprises bring cash to the villages and boost their economies. Benefits, however, tend to be dispersed throughout the region and/or major urban centers and would likely not have a major effect within the context of larger economies.

Once roads are in use, the main costs to TANAPA are associated with road maintenance, maintenance of construction machinery, and the control of off-road driving and vehicle traffic movement (speeding).

Direct economic benefits to TANAPA from road construction/rehabilitation are expected to be considerable. These may include higher revenues from increased visitor access to various parts of the parks, and longer tourist stays in the parks. This may be accomplished without increasing pressure on the limits of acceptable use in core zones by establishing new roads and facilities outside these high use zones. This form of development may result in increased park revenues needed for sustainable management, without sacrificing

ecological assets, the quality of the visitor experience or exceptional resource values.

Indirect and induced effects

Road improvements are expected to foster greater economic activity. In response to increased park accessibility, TANAPA revenues are expected to rise. A sound financial position for TANAPA also means more revenues contributed to central and local governments as well as improved local economies, life-styles and social services for communities adjacent to the parks. There are also important national economic mutiplier effects associated with a vibrant tourist industry.

On the cost side, access may benefit the local tourist industry in the short run but, unless increased activity is carefully thought out and managed, degradation of visitor attractions and the quality of visitor experience may lead to a decline in revenues and resource values.

Recommended Mitigation

- Enforce the Limits of Acceptable Use for park zones.
- Conduct annual park reviews of compliance with Limits of Acceptable of Use and the need for modification, if any.

6.5.3 Health and disease

Construction and operation

Communicable diseases. Because of the relatively small size of the road crew labor force required, and the assumption that some workers could be from the neighboring communities, introduction or spread of communicable diseases is not likely to be a major issue. The possibilities for spread of disease among road crew workers and to populations in the vicinity are not likely to be significant.

During construction and operation, a principal concern related to health is associated with management of murram pits and quarries. Creation of standing water associated with borrow pits and quarries may provide favorable breeding habitat for disease vectors such as malaria parasites, schistosomiasis, etc. This concern also applies to the creation of retention basins, settling basins and retention ponds. (See Section 6.2.4 mitigation measures.)

Improved road access typically facilitates the spread of communicable diseases. In the case of park road improvements, common diseases could include tuberculosis, malaria, diarrhea, bilharzia, cholera, meningitis, and AIDS. These diseases are already endemic in both urban and rural areas due to the absence of safe potable water supplies, control measures, sanitation and/or hygiene practices. Health problems are likely to be more relevant to parks like Arusha, Mukumi and Serengeti, where major public roads traverse the parks, making disease transmission easier. The solution lies in improving water supply, sanitation and health services. Improved road access facilitates health education and vaccination programs. However, new diseases and disease vectors are likely to be introduced as a result of increased interaction between tourists and the local communities outside the parks. Thus, spread of AIDS and STDs may increase dramatically in settlements like Mto wa Mbu where community interactions with tourists, lorry drivers and others in transit, tend to be high. At the same time, road improvements should help facilitate the extension of AIDS-related services and education.

Sanitation and solid waste. Improper disposal of solid and human waste by road crews and visitors may pose a threat to people and wildlife. Open solid waste pits were observed at several locations within the parks, especially in conjunction with construction camps and quarry sites. Almost all pits were left uncovered and unprotected. The presence of wastes under these circumstances can result in the spread of disease between animals and people. Common disease transmission vectors include baboons, monkeys, birds and insects. These, and other species can, in turn, be at risk from human diseases. For example, elephants in Tarangire have died from diseases associated with improper disposal of wastes.

The impact of littering along roads and trails may be significant in certain instances. At Kilimanjaro National Park, littering was observed along one of the more frequently used trails following a stream path. Although this may not be noticed by a casual eye, cumulatively, it may degrade environmental

quality where visitors expect to enjoy pristine conditions. Exposed waste, toilet paper litter, and odor pose health risks and seriously affect visitor experience, as do poorly maintained latrines at visitor rest points along both roads and trails. The problems of littering are especially serious where trails and camp areas are near streams and water bodies, and potential exists to alter water quality. Disposal of human waste in wetland areas has the potential for affecting water quality and wildlife.

Many of these effects are cumulative in nature. For example, at high and cold altitude, human wastes do not degrade and, unless disposed of properly, they may have a noticeable impact on park aesthetics.

Recommended Mitigation

- Provide potable water, appropriate sanitary and solid waste disposal facilities for road crews.
- Collect all solid waste (metal, glass, and burnables) from road crew sites, quarry sites and visitor rest points.
- Require all tour operators and visitors to bag and remove all solid waste from the parks. Where feasible, employ a "check-in, check-out system" for all food consumed by visitors on road and trail circuits.
- Remove solid waste to a central disposal location, preferably outside the parks. Where this is not feasible, incinerate burnable solid wastes at a central location on site or in the park, and place food wastes in well-screened waste pits. Cover pits with soil weekly to control disease transmission from insects, birds and mammals.
- Construct ventilated improved pit (VIP) latrines at permanent road crew camps, workshops and quarry sites, where feasible.
- Instruct road crews to employ soil mining (digging a pit for human waste and covering with soil immediately after use) where pit latrines are not feasible.
- Provide appropriate training in hygiene to road crews, including awareness and instruction in STD and AIDS prevention.
- Provide visitors with designated sites for human waste disposal to avoid indiscriminate contamination of exceptional features (e.g., wetland areas, scenic overlooks, etc.).
- Through the Community Conservation Services (CCS), consult community representatives on the nature of quarry and murram pit restoration, as they may want them to be retained as water collection ponds. Discuss the potential for disease transmission with communities, particularly the risks associated with watering cattle, washing clothes, bathing, and taking drinking water from the same pond, and the increased threat toward the end of dry seasons as ponds evaporate.
- Where populations (including pastoralists) outside the parks consider drainage ditches, pits, and quarries valuable water supply sources, educate users to use separate sources to water cattle, wash, and obtain potable water.

Management of fuel and lubricants. Fuel and lubricants may have long-term effects on human health if not properly stored and handled. Prolonged exposure can be potentially carcinogenic. Leaks and runoff can be especially serious in wetland areas or near rivers and streams, because of the potential for degrading water quality. In all parks visited there were signs of oil or diesel spillage, especially at workshops and construction camps. These problems were localized, but deserve special attention because of the high health risk from contamination of surface and groundwater.

The equipment yard at Lake Manyara National Park HQ provides a representative example of some of the management issues. Here, spills and leaks associated with vehicle maintenance fell on bare ground. A nearby diesel pump was also leaking fuel on bare soil. The problem deserves special attention because of the presence of homes, gardens and a stream course immediately downslope from the equipment yard. Contaminants may be accumulating in both the soil and groundwater, and moving downslope. This could adversely affect water supply downstream and possibly contaminate vegetable gardens in the area below the equipment yard.

Waste oil from vehicles and machinery is being used to treat wood against termites and ants. Some is also being dumped into headquarters' latrines to reduce odor, and some may be being used as cooking fuel in specially vented stoves.

In addition, the individual responsible for checking the level of diesel fuel in the fuel storage tank, climbs down into the fuel tank opening once a day and is breathing fumes from the tank regularly. Continuous inhalation of diesel fumes could have cumulative adverse long-term health implications for this individual.

In the Serengeti, the Team observed the new heavy equipment and vehicle workshop at Fort Ikoma, whose construction was nearing completion. The yard floor was compacted murram with a steep slope that could be expected to erode during the rainy season, though it was to be surfaced in the near future. Hydrocarbon leaks and spills from the equipment on the yard floor will flow to a catchment drain at the base of the sloping yard. Without a means to capture these hydrocarbons (e.g., an oil/water separator), they would flow to nearby stream channels and enter groundwater.

Recommended Mitigation

- Construct concrete pads with catch drains for vehicle and equipment repair and servicing.
- Install oil/water separators in drains, as needed.
- Repair leaking diesel pumps [repairs may pay for themselves quickly in fuel savings] and construct concrete pads to catch spilled fuel.
- Collect all waste oil and remove it from the park, except for that portion used to treat timber.
- Do not use waste oil to cut latrine odors.
- Do not use waste oil as cooking fuel.
- Identify buyers for the waste oil outside the national parks.
- Minimize exposure of staff to petrol or diesel fumes by constructing or purchasing a long dipstick that can be inserted into the tank to check fuel levels without requiring personnel to enter the confined space of the tank.
- Consider other methods for testing tank levels, including installation of piezometers on tank exteriors to allow direct fuel depth readings.
- Have mechanics wear gloves to minimize contamination of hands with hydrocarbon products (fuel, lubricants, etc.).

Indirect and induced effects

Reduced mortality rates resulting from improvements in public health could result in more rapid population growth and increased pressures on the land. It is, therefore, important that family planning programs are operative in affected communities.

6.5.4 Air quality

Construction

During construction, a variety of organic and inorganic substances could be released into the atmosphere, such as dust and other particulate matter from earthwork and construction materials, or fumes, exhausts and spills from construction equipment using liquid fuel, grease and lubricants. The health impacts in humans associated with dust are mostly respiratory in nature (Hoban, 1997).

Because of the near-absence of settlement in national parks where roads will be rehabilitated/constructed, impacts related to air quality are likely to be minimal, with any effects limited to road crews. Dust would be of particular concern only with respect to murram extraction, quarrying and preparation of the road surface. Respiratory protection should be considered if the amount of dust is likely to be excessive, or the particular nature of the airborne particulates might be considered toxic (e.g., because of underlying soils or geology).

Effects of air pollution on the health of road crews or those in the vicinity are expected to minimal.

Recommended Mitigation

- Control dust through use of tarpaulins on murram tipper trucks.
- Apply water on dust-generating surfaces and protect workers with equipment and clothing, as appropriate.
- Use good-quality murram, where feasible, to minimize dust and costs of constant re-surfacing.

Operation and maintenance

Air pollution as a consequence of increased traffic volume is a typical long-term operational impact on roads. For park road improvements, the volume of traffic is not considered high enough to result in major health effects. However, dry season dust was found to be a serious problem in all the parks visited. Conditions were accentuated in Arusha, Kilimanjaro and Serengeti National Parks where soils have been formed from light volcanic ash. In some cases such as Arusha National Park, the type of murram used to surface roads was of poor quality, rapidly turning to dust even when subjected to light traffic.

While the potential for localized air quality problems cannot be ruled out, the likelihood of such problems is not high.

Recommended Mitigation

- Selective application of (good quality) murram and compaction with water can significantly minimize dust. Where feasible, the use of one-way circuits can also reduce adverse dust effects.

6.5.5 Risks and hazards

Construction

Effects of air pollution or noise on the health of construction workers or those in the vicinity are expected to be minimal, although protection against hearing loss should be taken with some machinery, and masks should be worn under conditions where workers are exposed to large amounts of dust.

Recommended Mitigation

- Provide workers with ear plugs or head gear to mute noise from high-decibel equipment.
- Provide masks to workers exposed to large amounts of dust.
- Avoid the creation of unprotected bodies of standing water outside the parks, or fence standing water bodies.

Operation and maintenance

The use of heavy machinery for road construction/rehabilitation has risks for both operators and work crews. In Arusha National Park, for example, the operator of a tow grader has on occasion been thrown from the grader when the blade hits an immovable rock. The operator is at risk of severe injury as a result. The probability of injury is probably also high for mechanics involved in the maintenance and servicing of heavy equipment, especially where workshops lack proper bays, winches and hoists for repair of earth-moving equipment. Other risky activities include quarry operation and trucking of murram.

Improved roads are likely to lead to increased tourist flow into the parks and, hence, increased vehicle traffic. This would increase chances for vehicle and animal accidents, resulting in loss of life and property.

Animal behavior can be altered if animals receive food from visitors or where food wastes are not disposed of adequately. Animals receiving food from visitors along roads or trails may become aggressive hazards to tourists with food.

Improper storage of fuel and lubricants may be a fire hazard.

Recommended Mitigation

- Evaluate worker safety issues in each park associated with road construction and maintenance. Provide safety equipment and institutionalize safety procedures, where appropriate.
- Design roads to minimize speeding and enforce speed limits. See the mitigation suggestions in *Section 6.3.6 Wildlife*

migration/movement and animal harassment.

- Ensure mining of murram and fill is done in a manner which does not put workers or others at risk from falling rock or debris, collapsing quarry walls, or accidental falls from cliffs.
- Enforce park regulations against feeding animals.
- Store fuels and lubricants carefully and at safe distance from park facilities.

6.5.6 Tourist industry

The Management Zone Plans for the national parks should provide a conducive environment for most ecotourism operators' marketing strategies. Their intentions are to satisfy their clients by providing quality experience with relatively high opportunities for solitude and exclusivity. Rehabilitation and construction of new roads will help to diversify the available opportunities for visitors, allowing higher Limits of Acceptable by creating access to additional zones and enticing tourists to spend longer periods in the park. This should mean more revenue for tour companies, lodging facilities and TANAPA, as well as higher contributions to national GDP.

Tanzania envisages that the number of tourists per year will be in the one million range by the year 2010, and proceeds from tourism are projected to contribute between 25 percent and 30 percent of the GDP. To reach these levels, many first-class tourist facilities will have to be established inside and outside the parks, together with supporting infrastructure. Road improvements can be expected to contribute significantly to achieving these targets.

Tour operators who define themselves as caterers to a low impact ecotourism clientele, would like greater access to areas in the parks which are beyond the range of the game viewing drives provided by the larger hotels, lodges and camps located in or adjacent to the parks. They are critical of TANAPA for not moving more quickly to provide additional access to low use zones in accordance with Zone Management Plans, and for not considering additional new roads or other means of access to areas where little or no tourism is currently occurring. They believe low-impact ecotourism could be significantly expanded without sacrificing park resource values, and that increased access to low use zones will actually take pressure off the higher use zones near hotels and lodges.

There is a danger, however, that the development of new roads could result in the deterioration of existing roads, if road expansion exceeds the capacity of the parks Works Departments to maintain the road network. Also expansion of the road networks has implications for TANAPA enforcement staff and Park Administration, which must be taken into account as part of plan implementation.

Recommended Mitigation

- Ensure implementation and enforcement of General Management and Management Zone Plans for road improvements through annual reviews of the status of road improvements against the plans.
- Consider as part of annual review of the road Environmental Management Workplan for each park, new road/trail improvements based on additional information on visitor trends and findings not captured in the GMP/MZPs. (See needed road assessment surveys recommended in *Section 6.3.4 Sensitive areas and threatened and endangered species and ecological functioning, Section 6.3.5 Exceptional resources: ecological, paleontological, archaeological, historical and cultural,* and *Section 6.4.1 Scenic quality and viewshed.*)
- Carefully assess annually the recommendations for new road improvements against the capacity (personnel, equipment and materials) of park Works Departments to maintain the existing road networks and the capacity of park personnel to meet enforcement and management requirements associated with proposed new roads or other road improvements. Make upward adjustments in personnel, equipment and materials to meet approved park recommendations for road improvements.

7. Recommended Strategies for Environmental Management of TANAPA Road Improvements

TANAPA and USAID/Tanzania seek to ensure, for each road improvement segment:

- review and analysis of transport options.
- review and analysis of environmental issues.
- design and implementation of appropriate mitigative measures and monitoring procedures, including an environmental management plan for implementation of measures and necessary tracking and follow-up.

This chapter addresses these three primary objectives of the PEA.

7.1 Strategic evaluation and selection of alternatives

This section provides recommendations concerning the TANAPA-wide strategic assessment of road alternatives and links to the objectives of other partners under USAID/ Tanzania's Strategic Objective # 2.

7.1.1 TANAPA-wide strategic assessments of road improvements

All road improvements in Tanzania's National are to follow TANAPA's mandate: To manage and regulate the use of areas designated as National Parks by such means and measures to preserve the Country's heritage, encompassing natural and cultural resources, both tangible and intangible resource values, including the habitat, natural processes, wilderness quality, and scenery therein and to provide for human benefit and enjoyment of the same in such manner and by such means as will leave them unimpaired for future generations. Doing so will also be consistent with USAID Tanzania's Strategic Objective Two: *Improved Conservation of Coastal Resources and Wildlife in Targeted Areas.*

"Roads vs. no roads." TANAPA must grapple with a philosophical question in considering the role roads will play in the future of Tanzania's parks. The PEA Team moved through many areas with beautiful vistas, unmarred by human presence. These Park resources are growing rapidly in value as "wildlands" shrink globally. While the construction of new roads can in many cases be accomplished without diminishing biodiversity and with minimal impacts on the environment, their impact on wilderness quality and viewsheds is not negligible.

Clearly, improved roads and a good road network contribute to increased park revenues, so vital to ensuring that the parks can continue to be effectively managed and their resources protected. The effects of insufficient revenues on Tanzania's parks have been clearly evident historically. Whenever revenues decline park management suffers. Yet because of the rapid increase in value of Tanzania's parklands, greater consideration may need to be given to restricting visitor access to areas with no roads, and to "Banking" more of these unspoiled areas for future very low impact tourism.

If tourist demand to visit the parks continues to rise exponentially, perhaps instead of opening new areas to roads, more thought should be given to holding down the number of vehicles and visitors entering the park through a general upward adjustment in park entrance fees and bed levies. This would keep revenues high while also allowing TANAPA to keep the number of visitors within established Limits of Acceptable Use (LAUs). Higher fees might also be charged for the

opportunity to visit areas with exceptional resources.

Alternatively, TANAPA could adopt a policy of providing only minimal tracks in areas currently designated for future development such as the western side of Tarangire, or the northern Serengeti. By doing so, the road could be easily abandoned and the area in question returned to a natural state, if, in the future, Park Management were to decide that the value of the unspoiled resource was greater than the revenues generated by visitors. However, as most planners involved in conserving natural areas know, closing a well-traveled road is not easy. Once a road is constructed, it develops a history of its own. Efforts to remove it often make little sense to the next generation of park managers and visitors who come to believe "*it was always there.*" It bears remembering that the benefits of opening up new areas to roads, in order to relieve pressure on more intensively used park zones, is not without cost. The impacts may not be severe, but they may still be irreversible!

From a strategic perspective. planned road improvements must take place within the context of TANAPA efforts to set and enforce *Limits of Acceptable Use* for each National Park. Unplanned growth in the number of visitors entering the parks and traveling on park roads, would be expected to lead to an incremental, disconnected or opportunistic approach to the development and maintenance of the road systems. Over a span of only a few decades, cumulative effects would contribute to undesirable deterioration in physical and ecological systems, declines in biodiversity, threats to rare and endangered species, declines in the quality of the visitor experience, and ultimately a drop in park revenues.

On the other hand, through strategic planning, it appears possible in a number of parks to add to the road/trail network without jeopardizing biodiversity or exceptional resource values. Under well-conceived and managed network plans, the potential exists in several parks to add new and upgraded visitor tracks, especially those further from established lodges and camps. Improved networks could help relieve current pressures on core preservation zones, while allowing a larger number of visitors to enter the parks each year. This assumes, however, that steps are taken to ensure LAUs for each zone are not exceeded. It is suggested that the responsibility for establishing road/trail network plans for each park, ultimately lies with the TANAPA Planning Unit, in close consultation with the Chief Wardens in Charge for each park.

Development of *Road/Trail Network Plans.* As a component of the GMP/MZP process there should be very real benefit from carrying out new park-by-park reviews to determine how best to improve road/trail networks. In several parks, existing roads were originally created in a haphazard and unplanned manner before the parks were gazetted. Often, tracks were established by communities, hunters, researchers or commercial interests simply to get from one point to another by the shortest possible route. Many of these routes have never been questioned. While they may be heavily used, the opportunity exists to comprehensively review and suggest more environmentally sound routings. This is particularly true because most existing visitor tracks can be returned to nature with minimal investments in decommissioning. An exciting opportunity exists through network planning to adopt a "clean slate" approach to the overall design of a park's road system. Old minimal track roads could be abandoned in a systematic fashion over time and replaced by realignments or new roads that more closely follow hill contours, minimize soil erosion effects, bypass areas with black cotton soils, reduce viewshed impacts, and avoid coming in close proximity to exceptional resources.

At the same time, TANAPA has discovered that the visitors have more lasting memories, and park attractions are more fully appreciated, where park visitors are allowed to disembark from their vehicles and move on foot to visit special park features, rather than drive to them. The development of road/trail network plans would afford park staff and the TANAPA Planning Unit the opportunity to review how best to integrate roads and trails in what is becoming an increasing trend in park management planning around the world. Development of these plans will require teams with a wide variety of expertise including: landscape architecture, road engineering, park

planning, ecology, hydrology, geotechnical engineering, and economics (for cost-benefit analyses). Appropriate park staff also need to be involved throughout this process.

A cambered and murramed trail with well-designed channels and runout drains along the Muranga route at Kilimanjaro serves a critical function as an evacuation route for ill or injured visitors. Here stretcher bearers rush a climber down to a waiting ambulance (S 3° 11.8', E37° 30.8')

Various strategies may be equally appropriate as a result of this planning process. However, a strategy based on piece-meal, opportunistic actions could be disastrous over time, and should be avoided.

In network planning, the teams should also be charged with weighing the advantages/ disadvantages and costs of other alternative forms of transport (e.g., air, water or rail) and transport equipment for moving visitors, park personnel and goods through the parks.

Development of *Quarry Management Plans.* Also, within the overall framework of GMP/MZP development, TANAPA Headquarters needs to have a specialized team review all existing and potential quarry sites and murram pits, both inside and outside the parks, to assess the quality and extent of both current and future supplies. By knowing where the murram resources are located, their quantity and quality, and the cost to utilize them, this specialized team could craft for each park, a phased long-term plan for provision or road surfacing materials for the park network, so as to minimize cumulative impacts on the environment from extraction. The plans would designate the most favorable sites with the least impact on viewsheds and exceptional park features. They would also provide sufficient information on the quantity of murram at key sites, so as to allow for much more systematic restoration of mined sites than is currently taking place. A component of each plan should provide individual site information on the method to be used to retain top soil for future restoration of the landscape and suggest how best to phase reclamation at the site. As part of the Terms of Reference for the study team, the plan should also incorporate site specific mitigative measures for reducing hazards and risks to workers, and if quarries exist outside the parks, potential risks and health hazards for communities. For quarries outside the parks, the team should also outline how to maximize benefits to communities in the area, for example, by designing quarries to serve as water reservoirs or temporary catchment areas.

Team composition in this case might include, but not be limited to, the following expertise: geology and soils, land survey, landscape architecture, ecology, civil engineering, socio-economics and tourism. Appropriate personnel from the Works and Tourism Departments of each park should be involved in these surveys.

A Special Consideration: *Roads and Fire Management Plans.* Lightning, poachers, tourists and cattle rustlers can start park wildfires. In addition, fires may enter parks from outside, depending on the prevailing wind direction. In some cases, they originate from traditional burning associated with the preparation of agricultural land for the next growing season.

Where pastoral villages share the border with parks, such as in Serengeti, Tarangire and Arusha National Parks, there are usually complaints from both park management and villagers that wildfires originate from the park or from the villages.

In major tourist game viewing areas especially in the Serengeti and Tarangire National Parks, fire is used to create a green flush of vegetation in order to attract wildlife. In most other areas, early burning is used as a means of safely removing excess dry matter that could later potentially fuel hot and destructive fires.

Early burning schedules, including maps, are drawn up by park management indicating areas to burn for each operational zone, labor and resources required. These are implemented before each dry season. In the Serengeti, early burning is implemented by outposts. Burning mixture is prepared at Seronera and distributed to outposts before the start of burning. Seminars are usually held annually prior to the start of early burning to ensure those involved in implementation are fully aware of their responsibilities. Early burns and wildfires are then documented and mapped.

Management initiated burning, if not properly controlled, may be very destructive, both inside and outside the parks. In the past, runaway fires have been too frequent an occurrence. Sometimes there is misjudgment concerning the appropriate time to start early burning, which results in fires being set too late.

Properly demarcated boundaries (e.g., tracks or belts of cut vegetation), roads, game-viewing and anti-poaching tracks are used as fire breaks and can assist in preventing fires from entering or leaving the parks. At present, boundary demarcation is inadequate in many parks because of lack of appropriate equipment, including vehicles, graders and tools for clearing vegetation. In Tarangire National Park, it was noted that the immediate catchment of the Silale swamp is threatened by wildfires from Lolkisale Game Controlled Area. Uncontrolled burning of this catchment could induce serious soil erosion and subsequent sedimentation of the swamp and affect its ecology permanently, something which is highly unacceptable to the park management.

In developing park *Fire Management Plans* and *Road/Trail Network Plans*, consideration should be given to the use of roads as firebreaks in strategic locations (e.g., boundary demarcations, or vegetated areas with high wind exposure), since doing so could help minimize the dual environmental impact associated with creating separate roads and firebreaks. Also, the presence of a road as part of the firebreak can be useful in slowing the regrowth of vegetation on the road surface. Road/fire break combinations can also be constructed to protect sensitive areas, experimental sites and buildings from burns.

However, because of the required clearing and road width necessary to create effective firebreaks, extensive use of roads as firebreaks could adversely affect park aesthetics. Thus road/firebreak combinations should be used judiciously.

This lightly graded road in Tarangire was enough to serve as firebreak. Note the height of the unburned vegetation on the right. Selectively combining roads and firebreaks can reduce clearing of vegetation and lessen soil erosion impacts. Nevertheless, road/firebreak combinations should be planned strategically to reduce the risk of fire, since wide roads detract from scenic quality and visitor experience. (S 3°57.0', E 36°10.5')

7.1.2 Other strategic considerations

The PEA Team believes that this Programmatic Environmental Assessment has value beyond TANAPA. Environmentally sound design and management of protected area road systems in Tanzania will bring important benefits to the increasing portion of Tanzania's economy that depends on tourism. USAID, through it's Strategic Objective Four: *Increased Micro and Small Enterprise Participation in the Economy* has an interest in Park road improvements as a component of stimulating the segment of the Tanzanian tourism industry which is composed of local tour operators and hoteliers.

More significantly, the findings from the PEA may be equally applicable to TANAPA's sister agency, the Division of Wildlife, which is responsible for managing the Nation's game reserves and controlled hunting areas. It is recommended that, through minor modification, much of the PEA (with its appendices and attachments) be converted to a document for use by the Division, especially those sections

pertaining to mitigation and monitoring, use of a formal environmental screening and review process, and the format and content of the environmental management plan guidelines for road improvements. Other protected area managers throughout East and Southern Africa may also find the proposed approach to mitigation and monitoring applicable to their road improvement activities.

It should be noted that this activity also has links to USAID/Tanzania's Strategic Objective Five: *Rural Roads Improved in a Sustainable Manner*. The Environmental Screening and Review Process adopted here for implementation by TANAPA, was adapted from the process used to screen the rehabilitation of all road segments under USAID's $50 million rural roads rehabilitation program. Further, under USAID's Strategic Objective Five, over 1,000 Tanzanian contractors and consultants are receiving both direct and indirect assistance in the management and execution of road rehabilitation and road maintenance contracts. An important consideration for TANAPA in the future may be to weigh the advantages and disadvantages of utilizing private contractors for selected road improvement works.

7.1.3 Building TANAPA capacity in environmental assessment

Staffing up. The PEA Team strongly recommends that TANAPA consider adding additional EIA staff resources to the Planning Unit. A full-time specialist is needed to oversee all TANAPA EIA-related activities.

The PEA team also recommends the designation of an Environmental Review Coordinator for each National Park and establishment of Environmental Management Teams. In most parks it is expected that the Park Ecologist will be appointed the Environmental Review Coordinator (ERC) by the Warden in Charge, and that the Environmental Management Teams will consist of the ERC, the Road Engineer/Inspector or Foreman, the Community Conservation Warden, the Tourism Warden, the Warden for Anti-Poaching, or other personnel whose activities may have impacts on the biophysical environment of the park. The ERC and the Environmental Management Teams will be responsible for carrying out *Environmental Reviews* of proposed road segments following the procedures developed under this PEA and found in a separate document entitled *TANAPA Procedures for Environmental Reviews of Road Improvements*. Together, they will also be responsible for the preparation of annual *Environmental Workplans* for road improvements (identifying mitigation and monitoring measures, reporting on actions taken, outlining future follow-up required, and providing estimated budget requirements for implementation). The *Workplans* are to be prepared in time for consideration as part of the annual budget submission process. They are to be prepared following the *TANAPA Environmental Management Plan Guidelines for Road Improvements* also developed under this PEA.

EA training. One of the results USAID/Tanzania is hoping to achieve under its SO2 is to increase the effectiveness of institutions that support natural resource management in Tanzania (IR 2.2). The thrust of this effort is to increase the skill base of individuals in targeted institutions and to promote organizational improvements directed by the institutions themselves.

USAID/Tanzania has provided two, five-day workshops for its SO2 partners in Tanzania on *Environmental Assessment for Small-Scale Activities*. The first, held in Morogoro in September 1996, included 50 participants, with some representation from TANAPA. The second workshop, organized by the African Wildlife Foundation, was held in Tarangire National Park from October 4-9, 1999 for a total of 40 participants. This course was well-represented by TANAPA staff from both Tarangire and Lake Manyara National Parks, as well as TANAPA Headquarters. The course covered the application of a version of the environmental screening and review process TANAPA is now employing for new infrastructure activities other than roads.

However, the majority of TANAPA staff have only limited understanding of environmental assessment as a planning tool or of environmental issues affecting the National Parks and park management. It is therefore considered highly desirable for the Park system to institutionalize a

formal five-day EA training program for those staff members who will be responsible for using the *TANAPA Procedures for Environmental Reviews of Road Improvements* and for implementing the mitigation and monitoring measures outlined in the PEA and the *TANAPA Environmental Management Plan Guidelines for Road Improvements*. This training should include developing basic familiarity with environmental and ecological principles. Special attention should be placed on effective training for the individual designated the Environmental Review Coordinator in each Park, since this person will have lead responsibility for overseeing the preparation of *Environmental Reviews* and completion of *Environmental Screening Forms* (ESFs) as well as the preparation and yearly submission of the *Environmental Management Plan* containing the mitigation and monitoring workplans as described above. Training should be extended to other members of the Environmental Management Team, as appropriate. The ERCs should themselves be considered future trainers.

A shorter course is also recommended for TANAPA senior staff to introduce them to environmental impact assessment concepts and steps needed to insure recommendations from the PEA are institutionalized. Because of staff turnover, this course should also be repeated periodically.

7.1.4 Building TANAPA road works capacity

TANAPA has been successfully constructing and maintaining roads for many years and has many skilled equipment operators and mechanics on its staff in the larger parks (i.e., Tarangire and Serengeti). Smaller parks such as Arusha and Kilimanjaro with limited road systems still carry out road repair mainly by hand due to lack of road equipment. Distribution of road equipment and staff varies depending on each park's total road distances to be maintained, and the park's topography and soils. The capacity at TANAPA headquarters for road design and construction support appears limited.

Many of the most common adverse impacts associated with road improvements have been the result of equipment operators receiving insufficient training in how to use the equipment properly to shape the road and provide effective drainage.

Based on observations made at parks surveyed, the majority of heavy road equipment appears to be grounded at any one time, waiting for repairs. Causes of equipment breakdowns are many, with the most common causes apparently related to old equipment that is basically worn out to begin with (e.g., Tarangire and Manyara), equipment that is not suited to the job at hand (too small or large, not enough clearance, not rugged enough—BMC tippers at Serengeti), parts that are hard to find, and one-of-a-kind equipment that is difficult to repair (Fiat graders and BMC tippers at Serengeti). Mechanic shops with a full array of tools, hoists, parts storage, and repair equipment were not evident in the parks surveyed. Equipment operating and repair budgets did not appear sufficient to operate the major park equipment, (such as graders and dozers) as needed during the year or to provide for proper tools, parts, engine repairs, and basic preventive maintenance (e.g., Manyara). Records on equipment use (hour meters, kilometers driven, etc.) are apparently absent except at the largest parks such as Serengeti. Without these records it is difficult to assess when servicing of the equipment is needed. Again, a host of adverse environmental impacts are associated with insufficient road maintenance, and these problems are exacerbated by shortages of equipment needed to maintain the extensive park road networks. These shortages also constrain plans to upgrade, realign or create new roads in an environmentally sound manner.

Suggested improvements to capacity include:

- **Strengthening budgets related to park road maintenance**, especially as it relates to equipment preventive maintenance and repair.
- **Timely training for equipment operators, and equipment mechanics, and an independent, unbiased assessment of the costs and benefits of using equipment maintenance contracts for preventive maintenance.** Of particular concern is the need for TANAPA mechanics to be able to

read technical manuals for heavy equipment in English. Without this capability, maintenance of equipment with electronic controls may become a significant constraint to carrying out proposed road improvements as planned.

- **Increased sharing of road works expertise among parks**. The PEA Team noted that the knowledge of environmentally sound road management and proper equipment use and maintenance varies among individual parks and much could be learned through direct sharing of skills in on the job training. For example, skilled grader drivers in the Serengeti could be used as trainers for grader drivers in other parks. This form of mentoring can be applied to other equipment operators and mechanics. Annual equipment operation and maintenance (O&M) training for equipment operators and mechanics could take advantage of the considerable expertise that already exists in selected parks to provide training to roads works personnel in need of further skill development. **Also personnel in parks where road works skills are limited could second their employees to other parks to work in partnership with other more fully-trained operators and mechanics.**

- **Training of equipment operators in environmentally sound construction, maintenance and decommissioning of roads.** Training that combines best engineering practice, ecological principles and environmental issues is needed for road works personnel, especially heavy equipment operators. Standard operation and maintenance programs for equipment operators should include an environmental component with instruction from TANAPA ecologists and Planning Unit staff, and outside consultants, as appropriate.

- The TANAPA park road system may be of sufficient importance to TANAPA-wide visitor use that it may be worth considering the establishment of a **center for park roads** within the TANAPA system. A centralized place for specialized staff, equipment reference, and road reference manuals and materials would be of help to the various parks. A possible source of funding for building road system capacity may be to designate a larger portion of the growth in gate fee income that should result by improving roads to increase visitor LAUs and access.

- The discipline of Landscape Architecture should be included as an integral part of the park road program, especially if the development of *Road/Trail Network Plans* are deemed a priority. Roads inside parks are different, and issues such as visual quality, visitor experience, and park road planning should strongly influence park road design, construction and repair. Involvement by Landscape Architects could be through U.S. Department of Interior (DOI) technical assistance to TANAPA, by consultants, or through TANAPA itself.

7.2 Environmental Review and analysis procedures

7.2.1 Screening and review

Objectives. An environmental screening and review process for proposed road segments has been devised to ensure that recommendations of the PEA will be followed and to confirm that environmental sustainability is considered for all TANAPA road improvements. The process also determines whether various provisions of USAID's Environmental Procedures are applicable, in particular FAA Sections 118 and 119 and 22 CFR 216.5. The TANAPA Planning Manager is responsible for first level review and approval, based on information submitted in an *Environmental Review* (ER). The ER is to be submitted as a part of the feasibility study for each proposed road improvement segment. Additionally, for Tarangire and Lake Manyara National Parks, the USAID/Tanzania Mission Environmental Officer (MEO) will review and approve *Environmental Reviews* submitted for all road improvements undertaken using USAID purchased road equipment. At Tarangire and Lake

Manyara National Parks, no irreversible commitment of resources can be made for proposed road improvements, until MEO approval has been received. The results of these *Environmental Reviews* will also be used to focus subsequent environmental analysis that might be warranted, as described in Section 7.2.2.

As a prerequisite to site selection and design of road rehabilitation activities, training in environmental assessment methods and mitigative measures is required for TANAPA engineers, road inspectors, ecologists and planners at both the individual park and headquarters level.

USAID and AWF are encouraged to work closely with TANAPA to develop mechanisms to ensure that the environmental issues associated with road improvements are determined and addressed at the early design stage, prior to initiating road improvements, so as to avoid potentially costly errors during implementation.

As mentioned above, the procedures to be employed incorporate a series of guided questions within an *Environmental Screening Form* (ESF), to elicit answers concerning the environmental characteristics and potential environmental impacts of proposed road improvement segments. Use of the ESF and completion of the *Environmental Review* is to be under the overall direction of the Environmental Review Coordinator in each park.

The ESF developed for this PEA has been reviewed by USAID's BEO, REO and the MEO and deemed acceptable for use in conducting environmental reviews of TANAPA road improvements.

Because this screening and review process is new to TANAPA staff, the *Procedures for Environmental Reviews* have been labeled a "Working Draft." They are to be reviewed and finalized after each park has had an opportunity to field test them for a full year.

For both TANAPA and USAID, the ESF incorporates filter questions to provide information concerning threatened/ endangered species, their habitat, biodiversity, tropical forests, introduction of exotic species, and effects on exceptional park resources. Environmental Review Coordinators in each park and reviewers will require sufficient information to reach key determinations regarding these issues. If the particular road rehabilitation under consideration "will have the effect of jeopardizing an endangered or threatened species or adversely modifying its critical habitat ..." (22 CFR 216.5), then an Environmental Assessment (EA) should be prepared. [See provisions of 22 CFR 216.3(a)(9) regarding revisions and 22 CFR 216.3(a)(4) and 216.6 regarding EA]. Similarly, pursuant to Sections 118 and 119 of the Foreign Assistance Act, assistance is denied for:

1) "actions which significantly degrade national parks or similar protected areas which contain tropical forest or introduce exotic plants or animals into such areas" [Section 118(c)(14)];

2) "construction, upgrading or maintenance of roads which pass through relatively undegraded forest lands, colonization of forest lands, and construction of dams or other water control structures which flood relatively undegraded forest lands," "unless an Environmental Assessment indicates that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development" [Section 118(c)(15)]; and

3)"actions which significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas" [Section 119(g)(10)].

Summary of TANAPA Procedures for Environmental Reviews of Road Improvements.

The Procedures are outlined in three sections:

Section 1 contains the Approval Facesheet for an *Environmental Review* and an *Introduction to the Environmental Screening and Review Process* that helps the preparer determine what type of review is required for four levels of road improvement environmental impacts.

Section 2 provides a series of leading questions to guide *Environmental Review* preparers and

outlines the expected contents of any *Environmental Review.*

Section 3 explains, in general, the roles and responsibilities and key steps in preparing an *Environmental Review.* It is keyed to the numbered questions in Section 2.

Each park is responsible for the completion of an *Environmental Review* of each proposed road improvement segment. The Facesheet must be completed by the park's designated ERC for all four levels of *Environmental Review* and signed by the Park ER Coordinator, Road Inspector/Road Engineer and Park Warden in Charge.

The four levels of road improvement activities and the type of road improvement analysis required are described below:

TANAPA Level 1 -- No foreseeable adverse impact on park resources

- no further environmental review needed:
- Typically these are activities which have no impact on the biophysical environment, for example, the provision of technical assistance, training, institutional strengthening, research, education, awareness-building or dissemination activities. These might include public awareness initiatives, such as TANAPA or tour operator environmental awareness campaigns.
- Also usually falling within Level 1, would be technical studies and analyses and other information generation activities not involving sampling which could harm endangered species or sensitive habitats.
- Finally, under *Level 1* are minor road repairs and standard operation and maintenance. However a road improvement activity which appears to fall in this category, does not qualify for "*Level 1*" if such an activity could have a direct effect on the environment.

Under *Level 1*, no further environmental review or action may be necessary. The Park ER Coordinator completes the form and ER facesheet providing the *Level 1* justification. The Park Road Engineer/Road Inspector and the Park Warden in Charge must also approve by signing and dating the completed facesheet. An informational copy of the completed and signed ER is then sent to the TANAPA Planning Manager.

Nevertheless, even if the ER Coordinator finds the proposed road improvement activity falls under *Level 1*, he or she should still consider whether the activities may require some mitigation or monitoring to guard against possible adverse effects. The ER Coordinator should also consider steps to enhance beneficial effects and describe these as part of the *Level 1* summary.

TANAPA Level 2 -- Adverse environmental impacts possible

- *Environmental Review* required (specific conditions, including mitigation and monitoring, may be applied):
- Activities requiring *Level 2* environmental review, including description of appropriate mitigation and monitoring measures, might include: minor construction or rehabilitation of park roads less than 10km in length (with no change in alignment or right of way); activities where ecologically sensitive areas or exceptional resources are at least 200m away from the road and not affected by construction or changes in drainage; no relatively undegraded forest within 5km of the road.

The *Environmental Review* must address why there will be no potential adverse impacts on sensitive areas or exceptional resources, endangered or threatened species or their critical habitat; or relatively undegraded forest, i.e., justify the conclusion that the proposed *Level 2* activities do not belong in *Level 3 or 4.* Even for activities designed to protect or restore natural resources, the potential for environmental harm

exists (e.g., re-introduction of species, effects of roads on spontaneous human population shifts and strip settlement outside parks, etc.). If there is no exact match for the activity being proposed, and it is not in *Level 1, 3 or 4*, then the preparer is to treat it as *Level 2* for purposes of environmental review.

The distances provided above as criteria should be considered only approximate guidance. The expert judgment of the ER Coordinator and others must be applied to determine whether a road improvement impact is significant enough to require more than a *Level 2* review. For example, certain exceptional resources or sensitive habitats could be significantly affected even if the road is more than 200m from the site. Conversely, other exceptional resources can have roads approaching closer than 50m with no adverse impacts.

Nevertheless, if roads pass closer to undegraded forests than 5 kms or within 200 meters of exceptional resources, strong justification must be provided in the *Environmental Review* for why a *Level 2 Environmental Review* will suffice, providing specific details on how impacts will be mitigated and monitored.

The same is true for consideration of road length, since under certain circumstances even a ¼ kilometer road improvement could have very significant impacts. For example, in Arusha National Park, upgrading a short stretch of road passing between two of the Momella Lakes could potentially affect the flow of underground water feeding them, and subsequently alter their ecological conditions.

(When in doubt about significance of impacts, multidisciplinary expertise is to be used to arrive at decisions, in consultation with the TANAPA Planning Manager.)

• TANAPA Level 3 -- Significant environmental impacts likely

- *Environmental Review* required, and Environmental Assessment likely to be required.

These may include road improvement activities such as:

- new road construction, or realignments or major upgrades of a park road over 10km in length;
- any proposed new, realigned or upgraded roads which would pass through or near sensitive ecological areas, wetlands, or relatively undegraded forest lands within 5 km of the road;
- any proposed new, realigned or upgraded roads which might jeopardize threatened or endangered species or adversely modify their habitat (especially wetlands, tropical forests);
- any proposed new, realigned or upgraded roads which would pass through or near other exceptional resources closer than 200m from the road;
- any proposed new, realigned or upgraded roads with potential to introduce exotic flora or fauna.

Level 3 activities are consistent with TANAPA criteria for activities that normally require a TANAPA Environmental Impact Assessment (EIA) and a USAID Environmental Assessment (EA). It is recognized that deciding whether such assessments are needed may be open to debate and require multidisiplinary judgement. The TANAPA Planning Manager must ultimately decide whether an activity falls within *Level 3* and will require an TANAPA EIA. For Tarangire and Lake Manyara National Parks, the decision on whether a USAID EA will be needed rests with the USAID MEO, REO and BEO. following the procedures outlined in 22 CFR 216. 3(a)(4) and 22 CFR 216. 6. In this document we refer to both the TANAPA EIA and the USAID EA as a *Supplemental Environmental Assessment (SEA)* as described in Section 7.2.3.

• TANAPA Level 4 -- Activities not fundable by USAID

- (or fundable only when specifically defined findings to avoid or mitigate the impacts are made, based on an Environmental Assessment)

These activities include:

- road improvements determined likely to significantly degrade park resources and values, such as damage to sensitive ecological areas or exceptional resources;
- introduction of exotic plants or animals;
- road improvements determined likely to jeopardize threatened & endangered species or adversely modify their habitat (esp. wetlands, tropical forests); or
- construction, upgrading or maintenance of roads which pass through relatively undegraded forest lands.

Satisfactory completion of the ESF will require appropriate road reconnaissance and descriptive data to adequately identify the potential for environmental impacts or lack thereof. A vicinity map and more detailed map(s) or descriptions will also be required. Accurate sketch maps may be sufficient under circumstances where cartographic maps are not available. Preparers of the ESF will need to supply documentation covering five km either side of the road centerline, i.e., a band 10 km wide, for some topics. Maps and other appropriate visual documentation are considered necessary to assist the reviewer of the ESF in reaching a determination as to whether the TANAPA Environmental Review Level selected by the ER Coordinator is appropriate.

During completion of the ESF, it will be critical for preparers to understand that if the answer to any question is unknown, effort should be undertaken to obtain available information and/or to consult with other agencies, researchers or knowledgeable individuals. In particular, gathering of information and consultation with the Planning Manager or with other TANAPA Headquarters technical specialists (e.g., the Chief Engineer or Ecologist) may be necessary. Additional information may be available through AWF in Arusha, the Institute of Resource Assessment (IRA) of the University of Dar es Salaam, and the USAID/MEO, or from other relevant government agencies. For example, IRA staff have been involved in several environmental assessment activities in Tarangire, Lake Manyara and Serengeti National Parks. They have extensive resource materials on the physical, ecological and surrounding socio-economic environments of these parks, as well as specialized land-use maps. AWF in Arusha will soon expand its GIS capability, and AWF, the Global Environment Facility in Arusha and WWF can be helpful in guiding reviewers toward specialized sources of information and research.

Lack of information in the ESF may unnecessarily trigger an environmental analysis, as specified in Section 7.2.2, and cause delay in the initiation of road improvement activities.

During road reconnaissance, ESF preparers may identify locations that are environmentally unique, unusual or unusually sensitive and worthy of protection, e.g., a significant wildlife habitat, a critical part of a watershed, an undegraded or dense forest, a significant wetland or the like, not yet formally protected under a GMP or MZP. Similarly, critical environmental issues may also be encountered. To ensure that opportunities to enhance protection are encouraged and pursued, issues of this type should be brought to the attention of the TANAPA Planning Manager for further consideration. The Planning Manager should have a mechanism in place to receive and evaluate this information in order to provide feedback on what levels of protection from development, if any, are appropriate.

TANAPA Park staff will be asked to acquire or refer to manuals and other reference materials, with respect to both environmental analysis and environmentally sound design, engineering and construction management. The TANAPA Planning Unit is encouraged to make the following references available at Park level:

- Keller, Gordon and James Sherar, *Low-Volume Roads: Best Engineering Practices--Field Guide, USDA*. Prepared for AFRICARE and the U.S. Agency for International Development, 2000.

- Keller, Gordon E., Bauer, G.P., and M. Aldana, *Minimum Impact Rural Roads, A Basic Road Design Manual with Emphasis on Environmental Planning, Drainage, Slope Stabilization and Erosion Control*, U.S. Forest Service and USAID, Draft 1999. Chapters 3, 7, 9, and 13 and other relevant sections.

- *Roads and the Environment: A Handbook,* World Bank Technical Paper No. 375, 1997;

- *Environmental Assessment Sourcebook* (3 volumes plus updates), Technical Paper 139, 140 and 154, World Bank, 1991;

- *Environmental Guidelines for Small- Scale Activities in Africa*, USAID Bureau for Africa, 1996

Review of the Environmental Screening Form. The TANAPA Planning Manager will review a completed ESF for a particular road improvement segment to determine completeness. If complete and no significant harm is identified, the Planning Manager will approve the ESF. For Tarangire and Lake Manyara National Parks, copies of ESFs will be sent from the Planning Manager to the USAID/Tanzania MEO, who will also review the ESF and will approve if no significant harm is identified per 22 CFR 216.1(c)(11). Alternatively, the ESF may require revision and/or more information. In such instances, the TANAPA Planning Manager will prepare a specific scope of work (SOW) for appropriate follow-on analyses. The Planning Manager must return the ESF to the preparer within 30 days, with specific instructions on how to proceed. Similarly for Tarangire and Lake Manyara National Parks the USAID/Tanzania MEO will review and approve the SOW for follow-on analysis within 30 days.

As part of the review procedure for environmental screening and any subsequent analyses, TANAPA or the USAID Mission may wish to share information with the National Environmental Management Council (NEMC). For example, information copies may be submitted, and at the TANAPA Planning Manager's discretion, guidance or advice solicited.

Results of ESF review and next steps. The results of an ESF review are anticipated to be one of the following:

- 1) the road improvement segment is approved to proceed, as no significant adverse environmental impacts are predicted, there are no significant unanswered questions regarding impacts, and mitigation and monitoring techniques will be of the type routinely associated with standard road maintenance and rehabilitation (see Section 7.3.1) or are identified in the ESF and will be specified in solicitations and contracts; or

- 2) the road improvement segment requires additional focused environmental analyses, the subject and purpose of which should be clearly specified on the ESF facesheet; or

- 3) the road improvement segment is deemed to have potential, significant environmental impacts. In this case a *Supplemental Environmental Assessment (SEA)* to the PEA will be conducted pursuant to TANAPA's EIA policy, and for Tarangire and Lake Manyara National Parks, USAID Regulation 216 as outlined in Section 7.2.3; or

- 4) TANAPA will choose, based upon the results of the review, not to undertake that particular road improvement, whether because of the types of impacts that trigger the SEA or because of other concerns revealed during the review. For Tarangire and Lake Manyara National Parks, under this option USAID will choose to disapprove the use of USAID funds or USAID-funded equipment for the road segments in question.

Under TANAPA *Level 1* environmental review, no further environmental analysis will be necessary.

Road improvements under TANAPA *Level 2* will have the following requirements:

- mitigation and monitoring measures will be drawn from the *TANAPA Environmental*

Management Plan Guidelines for Road Improvements and a *TANAPA Standard Operations Manual.* The *Environmental Management Plan Guidelines* have been prepared in conjunction with this PEA. The *Standard Operations Manual* should be prepared following the outline recommended in Section 7.3.1;

- park-specific mitigation and monitoring measures will also be needed for individual road improvement segments which should supplement those identified in the *Environmental Management Plan Guidelines* and be incorporated in each Park's annual *Environmental Management Workplan* submissions for road improvements (See Section 7.3.2).

- if private contractors are to be used, these standards and identified mitigation and monitoring measures will be incorporated into solicitations, specifications and construction contracts.

- standardized mitigative measures and monitoring procedures will be developed in consultation with the TANAPA Planning Manager.

- the TANAPA Chief Engineer will review final design drawings or other specifications to ensure that appropriate mitigative measures are duly incorporated.

- general or specific monitoring procedures will be developed, where applicable, as described in Sections 7.3.3 through 7.3.5 or as contained in the *TANAPA Environmental Management Plan Guidelines for Road Improvements.*

- in the event of a TANAPA *Level 2* outcome, procedures described in Section 7.2.2 will be followed for a focused Environmental Review, if needed.

In the event of a *Level 3* Outcome, procedures described in Section 7.2.3 will be followed and for Tarangire and Lake Manyara National Parks, notification will be made in accordance with 22 CFR 216.3(a)(9) that new information has become available. In the event of a *Level 4* outcome, no follow-up is necessary.

7.2.2 Focused *Environmental Review*

Objectives. The objective of focused *Environmental Review* is to follow-up on significant, unanswered questions and issues raised in the screening and review process. In some cases, the analysis will concentrate largely on specific mitigative measures in order to avoid or reduce adverse environmental impacts. In other cases, the analysis will identify specialized monitoring techniques (e.g., where mitigative measures need to be examined periodically, or where monitoring is desired because the particular extent of an impact depends on unknown and uncontrollable factors).

In other instances, the analysis will focus on specific issues which need to be investigated in greater detail. For example, if the likelihood of jeopardizing threatened or endangered species cannot be ruled out at the screening stage or an expert determination of "undegraded forest" is needed, the environmental analysis would examine those issues. In these cases, it is presumed that the focused *Environmental Review* will also address mitigative measures and monitoring needs that might be specific to the issue investigated.

Development and preparation of environmental analysis components. It is assumed that issues were identified in following the ESF procedures.

If the issues to be addressed are largely engineering-related mitigative measures and monitoring for portions or all of a road improvement segment, then it may be appropriate for a TANAPA road inspector or road engineer to pursue and complete the analysis. Documents cited above as reference sources or others, including engineering manuals, will need to be consulted in the preparation of design/engineering specifications and more detailed field investigations may be necessary.

If, however, one or more of the issues to be addressed deals with a specialized, environmental

topic, e.g. forest composition, wildlife habitat, impacts on kopjes or the like, then TANAPA ecologists or the ER Coordinator would need to carry out the analyses or contract out to university experts, researchers or consultants. Maximum use should be made of expertise available in Tanzania in order to strengthen the capacity for performing such analyses.

Environmental experts, and specifically park ecologists, must work closely with park road inspectors and engineers in the development of mitigation and monitoring measures to ensure that they are feasible, cost-effective, well-targeted and realistic; park ecologists and the TANAPA Planning Manager and TANAPA Senior Ecologist will be expected to play a key role in bringing the experts together in teams so that appropriate solutions can be formulated.

In the case of Tarangire and Lake Manyara National Parks TANAPA and the USAID MEO may wish to utilize the resources of the REDSO REO and/or Regional Engineer to assist with the development of mitigative measures and monitoring procedures on those roads which are analyzed during the four year(s) of the SO2 activity.

Opportunities to promote sustainable development and to identify areas that are not suited for intense development or are appropriate for conservation and protection should not be ignored, as noted earlier in the discussion of the ESF.

The format and basic contents of the focused *Environmental Review* have been standarized and are outlined in the *TANAPA Procedures for Environmental Reviews of Road Improvements.*

The TANAPA Planning Manager will re-examine the focused *Environmental Review*, in consultation with the responsible preparers, after a year of trial use, to determine if modifications are needed. For Tarangire and Lake Manyara National Parks, the USAID MEO will conduct a re-examination in consultation with the Planning Manager.

Evaluation and approval Environmental Reviews. At the Planning Manager's discretion, outside expertise from the University of Dar es Salaam, NEMC, etc., may be asked to evaluate *Environmental Reviews* in an advisory capacity. For Tarangire and Lake Manyara National Parks, the USAID MEO also oversees the reviews and may ask for the staff of both TANAPA and NEMC to assist with analysis.

After the analysis is completed, the TANAPA Planning Manager will approve or determine that additional documentation is required. Critical to the review process will be whether unanswered questions stemming from the ESF have been answered, whether sufficient, appropriate and cost-effective mitigative measures are specified by location and timing and whether appropriate and feasible monitoring procedures are described. For Tarangire and Lake Manyara National Parks, USAID will also review the analysis and be required to approve or to determine if additional documentation is needed. The MEO is encouraged to request REO assistance, as appropriate.

Results of ESF review and next steps. The results of the Environmental Review are expected to provide sufficient information so that one of the following determinations can be made:

1) the road improvement for the proposed segment is approved, as no significant adverse environmental impacts are expected and no significant questions remain unanswered. Assuming other TANAPA-mandated requirements are in place, the improvement can proceed, with the provision that mitigative measures are clearly specified and monitoring procedures have been agreed to and are being implemented (within annual *Environmental Management Workplans* for road improvements). Mitigation and monitoring techniques will be of the type normally associated with standard road maintenance and rehabilitation (see Chapter 7, Section 7.3.1). Responsibilities for implementation of mitigation and monitoring must also be specified and agreed to in the *Workplans.* If outside contractors or consultants are used, the procedures should be incorporated in solicitations and construction contracts. For Tarangire and Lake Manyara National Parks, the MEO will determine whether USAID-mandated requirements and procedures are also being satisfactorily followed;

2) the road improvement segment requires additional focused environmental analysis, the subject and purpose of which should be clearly specified on the ESF facesheet;

3) The road improvements segment is revealed to have potentially significant adverse environmental impacts, such as jeopardizing an endangered or threatened species or adversely modifying critical habitat, or passing through relatively undegraded forest land. In this case, a *Supplemental Environmental Assessment (SEA)* to the PEA is necessary and will be conducted pursuant to TANAPA's EIA policy. For Tarangire and Lake Manyara National Parks the procedures specified in USAID's Regulation 216 apply as outlined in PEA Chapter 7, Section 7.2.3. The MEO, REO and BEO decide whether an SEA will be required;

4) TANAPA will choose, based on the results of the review, not to undertake that particular road improvement. The road improvement will not proceed or be funded, because significant adverse impacts require a SEA, or they cannot be mitigated, or they are prohibited under TANAPA or national policy. For Tarangire and Lake Manyara National Parks, under this option USAID will choose to disapprove the use of USAID funds or USAID-funded equipment for the road segments in question. The MEO and BEO make this determination, taking into account the provisions of Regulation 216 and the various provisions of Section 118 and Section 119 of the U.S. Foreign Assistance Act. The REO should also be involved in the review.

In the event of the first outcome, procedures to be followed will include those described in Chapter 7, Sections 7.3.1 through 7.3.4. If an SEA is deemed necessary, TANAPA SEA procedures will be followed as described in Section 7.2.3. In the case of Tarangire and Lake Manyara National Parks, procedures of Regulation 216, also described in Section 7.2.3, will be followed.

If TANAPA decides not go forward with the proposed road improvement, no further analysis will ensue. For Tarangire and Lake Manyara National Parks, if USAID/Tanzania decides not to allow use of USAID-funded road equipment, no further action is necessary.

7.2.3 Supplementary environmental assessment (SEA)

Should the determination be made that an SEA is required for a particular park road improvement, a Scope of Work particular to the road segment will need to be prepared, indicating the issues of concern identified during screening and analysis. The SEA preparers must also take into account the results of 'scoping' (described below). If an SEA is required, the TANAPA Planning Manager will organize it. For Tarangire and Lake Manyara National Parks, the USAID/Tanzania Mission will contract for it directly. Maximum participation of Tanzanian consultants and professionals is advised.

Scoping. Scoping and circulation of a *Scoping Statement* are described by NEMC. For USAID they are contained in Regulation 216.3(a)(4). After a determination that an SEA is required, the originator of the action will commence the process of identifying the significant issues relating to the proposed action and of determining the scope of the issues to be addressed in the SEA. This scoping process will begin as soon as practicable. Persons having expertise relevant to the environmental aspects of the proposed action will also participate in scoping. Participants may include but are not limited to representatives of host governments, public and private institutions, the USAID Mission staff and contractors.

This process results in a written statement (referred to as a *"Scoping Statement"*), the contents of which are listed by NEMC and for USAID supported activities in 22 CFR 216. 3(a)(4).

The *Scoping Statement* must be reviewed and approved by the TANAPA Planning Manager and the TANAPA Director General. National EIA agencies (e.g., NEMC) may also review the *Scoping Statement*, where appropriate. For Tarangire and Lake Manyara National Parks, it must also be reviewed and approved by the USAID Mission and Bureau Environmental

Officer. [USAID/Tanzania may elect to have a contractor prepare a preliminary draft of the *Scoping Statement*, but USAID is responsible for the draft that is circulated and the circulation process.]

To assist in the preparation of an SEA, TANAPA and/or a National EIA agencies may coordinate the circulation of copies of the written statement, together with a request for written comments, within 30 days, to selected units of Government, if TANAPA or the EIA agencies believe comments by such units will be useful in the preparation of the SEA. Comments received from the reviewing units will be considered in the preparation of the SEA and in the formulation of the design and implementation of the project, and will, together with the *Scoping Statement*, be included in the project file. In the case of Tarangire a parallel process will be followed by the USAID BEO, with circulation of the *Scoping Statement* to selected federal agencies of the U.S. government. Again comments received by the BEO will be considered in preparing the SEA and in formulating the design and implementation of the activity. These will be included with the *Scoping Statement* in USAID's project file.

Content and Form of Environmental Assessment. In Tanzania, the purpose, content and form of an environmental impact assessment is specified as part of NEMC's EIA policy. Provisions of TANAPA's GMP/EIA also apply. For USAID supported activities Environmental Assessment procedures (and by extension, those for an SEA) are contained in 22 CFR 216.6. The purpose of the SEA is to provide TANAPA and Tanzanian decision makers (and USAID in the case of Tarangire and Lake Manyara National Parks) with a full discussion of the significant adverse environmental effects of a proposed action. It includes alternatives to avoid or minimize adverse effects or enhance the quality of the environment. Collaboration in obtaining data, conducting analyses and considering alternatives is considered desirable to build awareness and assist in building Tanzanian institutional capacity. The SEA must be based on the *Scoping Statement* and must address the elements summarized below, as appropriate.

- **Summary**.
- **Purpose**—Purpose and need in proposing alternatives, including the proposed action.
- **Alternatives including the proposed action**—Presents environmental impacts of the proposed action and alternatives in comparative form; explores and evaluates reasonable alternatives and discusses why alternatives not included were eliminated; devotes substantial treatment to each alternative; includes the alternative of no action; identifies preferred alternative(s); and includes appropriate mitigation measures.
- **Affected Environment**—Succinct description of environment of area(s) affected or created by alternatives under consideration. Data and analysis are commensurate with the significance of the impact.
- **Environmental Consequences**—This section is the analytical basis for the above Alternatives section. It covers the environmental impacts of alternatives including the proposed action; any adverse effects that cannot be avoided should the proposed action be implemented; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity (including residual or cumulative effects); and any irreversible or irretrievable commitments of resources. This section addresses 1) direct effects and their significance; 2) indirect effects and their significance; 3) possible conflicts between the proposed action and land use plans; policies and controls for areas concerned; 4) energy requirements and conservation potential of various alternatives and mitigation measures; 5) natural or depletable resource requirements and conservation potential of various requirements and mitigation measures; 6) urban quality; 7) historic and cultural resources and design of the built environment including the reuse and conservation potential of alternatives and mitigation measures and 8) means to mitigate adverse environmental impacts.
- **List of Preparers**—names and qualifications.
- **Appendix** - if needed.

Consultation, Review and Clearance. Consultations between TANAPA and NEMC are expected, both in the early stages of SEA preparation and on the results and significance of the completed SEA. The TANAPA Planning Manager and the Director General must review and clear the PEA. For Tarangire and Lake Manyara National Parks, USAID and Tanzanian Government consultations are also expected. USAID's Regulation 216 encourages USAID to have the host country make the SEA available to the general public. The BEO must review and clear the SEA. The USAID Environmental Coordinator in Washington, D.C. may also review it. In the particular case of a road improvement SEA stemming from the process outlined in this PEA for Tarangire and Lake Manyara National Parks, the REO should also review the document.

7.3 Recommendations for development & implementation of mitigative measures

7.3.1 Standard mitigative practices for road improvements

Objectives. Practices to mitigate potential, direct environmental impacts must be incorporated within TANAPA operating procedures (or where private contractors are used, into solicitations, specifications and contracts) in order to ensure that mitigative measures will be implemented. An additional objective is to strengthen TANAPA internal expertise, as well as TANAPA's ability to acquire outside expertise in environmentally sound road improvement practices and mitigation.

Development of standard practices. For TANAPA road improvements one can not overemphasize the importance of: controlling erosion; proper compaction and stabilization of the subgrade and subbase of the road; installation of proper drainage; and effective routine and periodic maintenance. TANAPA is encouraged to seek the advice of soil scientists or geotechnical engineers familiar with local conditions to assist in road design, rehabilitation, maintenance, and decommissioning.

TANAPA will develop, adapt, or adopt from other sources, standardized sets of specifications for environmental mitigative measures that will be part of design specifications and which might also be used for any future private contracts to be awarded.

TANAPA will develop an *Operations Manual*, containing sample plans and technical specifications and other documentation to be used internally, or which can be incorporated into solicitations and contracts; plans and technical specifications for engaging outside contractors, engineering or specialized consulting expertise. The suggested target for TANAPA's completion of the *Operations Manual* is the first quarter of 2002.

TANAPA engineering staff will develop the standard specifications for the *Operations Manual* in consultation with the TANAPA Chief Ecologist and the TANAPA Planning Manager. It is recommended that the MEO also be consulted in developing the procedures and that at the discretion of the MEO, the USAID REDSO engineer and REO also assist in the review of the procedures to be adopted.

For preparation of possible private contracts, the preparers of these standard specifications are urged to consult *Roads and the Environment: A Handbook* (World Bank, 1997), which include sample contract clauses regarding many of the topics listed below:

The *Operations Manual* will incorporate technical specifications, including, but not limited to the following:

- erosion control and stabilization structures, such as intercepting ditches, gutters, spillways, terraced or stepped slopes, riprap, vegetation, and retaining structures (gabions, cribs) or retaining walls;
- drainage features or structures for surface runoff and storm water based on flood history, including intercepting ditches, flood basins,

settling basins and infiltration ditches where pollutant control may be needed;

- methods to reduce the runoff velocity on the downstream side of roads crossing waterways, e.g., rock, brick or concrete cut-off walls;
- protection of base of bridge abutments or columns against erosion;
- means to avoid filling or draining wetlands;
- tree removal and vegetation clearing practices, including provisions for utilization of cut materials and planting of trees along right of way as a standard practice;
- siting and methods of working and restoring borrow pits and quarries.
- stockpiling of soils during roadbed preparation, including location, storage procedures and reutilization;
- limitation of earth moving to dry season periods;
- revegetation or new plantings of outer portions of road right of way (where appropriate), exposed slopes (or other provision for stabilization), quarries, borrow pits, haul roads, construction staging areas, construction camps or any other areas where vegetation is removed or disturbed;
- requirements for appropriate reinstatement of land used temporarily, to ensure future sustainable use;
- construction camp and worker-related practices, including siting, design and operation of camps and facilities (specifically sanitation, water provision); procedures to avoid creating stagnant water bodies, solid waste disposal, prohibitions on clearing trees for fuelwood or other purposes; provision of alternative fuels to minimize demand on local fuelwood resources; prohibitions on poaching of animals; provision of health facilities and worker health education;
- soil erosion and sedimentation control practices, including requirement for a soil erosion and sedimentation control plan, with provisions for protection of drainage channels, installation of sedimentation basins, seeding or planting;
- dust control measures;
- protection of surface and underground water quality and wetlands through appropriate drainage practices and control of sedimentation and pollutant runoff from construction equipment or other materials;
- procedures for recovery and reuse/recycling of motor oil, lubricants and similar materials utilized during construction;
- procedures defining responsibilities of companies and workers who discover buried historic or archaeological resources, including stop-work and contact names, and penalties for damage to known sites;
- construction traffic management, so as to minimize effects of any detour sections;
- noise attenuation for inhabited areas (where appropriate) and to protect workers from excessive noise exposure;
- regular work site clean-up;
- environmental training for road inspectors, engineers, foremen and equipment operators;
- Terms of Reference for *TANAPA-wide Road/Trail Network Plans;*
- Terms of Reference for a *TANAPA-wide Quarry Management Plan* with procedures for implementation.

In addition, the *Operations Manual* will specify when the procedures are applicable, i.e. during design, construction, road operation and maintenance, or decommissioning.

The *TANAPA Environmental Management Plan Guidelines for Road Improvements (Working Draft, 2000),* developed and provided with this PEA as a separate document, contains the recommended mitigation and monitoring measures identified by the PEA Team.

Implementation of standard practices. TANAPA will require the development of annual *Environmental Management Workplans* for road improvements for each park, outlining responsibilities and timelines for implementation of mitigation and monitoring measures. A similar plan will developed, outlining TANAPA Headquarters responsibilities. Sample tables for these *Workplans* are contained in the *TANAPA Environmental Management Plan Guidelines for Road Improvements.*

TANAPA may also wish to develop standard language requesting information from contractors and firms regarding their environmental capability and experience, particularly in mitigation of impacts. This information could be used, when appropriate, to help in developing Terms of Reference, standards and specifications for possible use of outside contractors, engineering firms, and technical expertise.

7.3.2 Road segment-specific mitigative measures

As mentioned under Section 7.2.1 (Results of ESF review and next steps), TANAPA Park Management will be responsible for developing park-specific mitigation and monitoring measures and specific road segment procedures and specifications, based on the ESF and any subsequent focused E*nvironmental Review.* Some of these may be variations on the more general design, construction practices and restoration procedures listed in Section 7.3.1 above, and the more specific list of mitigative measures contained in the *TANAPA Environmental Management Plan Guidelines for Road Improvements.* These will need to be tailored to characteristics that are unusual or unique, e.g., Momella Lakes in Arusha, kopjes in the Serengeti, Poacher's hide in Tarangire, Groundwater Forest in Lake Manyara, relatively undegraded forests, wetlands, specific geological and soil conditions, presence of wildlife, vegetation characteristics, exceptional features, and the like.

A number of road-specific mitigative measures need to be incorporated into design specifications, for example, bridge design or drainage system design. Improper drainage with consequent erosion is one of, if not typically, the most damaging environmental consequence of road construction and maintenance. Road design must also incorporate measures to avoid interfering with crossdrainage and the movement of water so that the productivity of wetland ecosystems is maintained.

Where impacts on natural ecosystems are to be mitigated, the advice and services of ecologists, hydrologists, geologists and other specialists will be necessary to devise mitigative measures, not all of which may be structural in nature. For example, if wetlands impacts are unavoidable, it may be appropriate to provide protection to other wetlands as compensation. Similarly, in the instances where mitigative measures are necessary for social and community-related impacts, the advice and assistance of social scientists may be appropriate.

Specifications for road-specific mitigative measures will follow the same review procedures as those for standard mitigative practices. In the development and or review of road-specific mitigative measures for Tarangire and Lake Manyara National Parks, the MEO is urged to draw upon the advice and assistance of the USAID REDSO REO, or Regional Engineer, as needed.

The park-specific mitigation and monitoring measures, including all indirect and induced impacts, should also be incorporated in each Park's *annual Environmental Management Workplan* submissions for road improvements, along with budget estimates for their implementation.

7.3.3 Recommendations for development and implementation of monitoring

Three types of environmental monitoring need to be distinguished and all will be needed to ensure that sound environmental road design and operation have been achieved and that TANAPA's long-term development goals are being achieved in an environmentally sustainable manner.

- standard construction-related and road operation and maintenance monitoring will largely require engineering expertise. These monitoring requirements should be made part of the *Operations Manual* with annual surveys conducted by the park Environmental Review Coordinator and the Road Engineer/Road Inspector, or incorporated into regular park monitoring procedures on a case-by-case basis.

- specialized monitoring of specific mitigative measures as a result of recommendations in the ESF, focused environmental analysis or SEA. Tailored expertise will be required to determine if the mitigation is achieving its intended objectives.

- long-term monitoring of the environmental effects of indirect and induced development.

7.3.4 Standard road construction, operations and maintenance monitoring

Development of standard road construction, operation and maintenance monitoring procedures. The TANAPA Planning Manager in consultation with the TANAPA Chief Engineer and Chief Ecologist will develop generic, road construction, operations and maintenance monitoring procedures. For Tarangire and Lake Manyara National Parks, the Planning Manager and/or respective TANAPA personnel will consult the MEO in the development of standardized monitoring procedures to be incorporated into the *Operations Manual.* USAID/Tanzania may also wish to draw upon the advice and assistance of the REDSO REO and/or Regional Engineer for the completion of this task.

Monitoring of construction activities and the installation of design components to ensure that environmental specifications are being followed for road improvements will be the responsibility of selected TANAPA Engineering Staff, under the direction of the TANAPA Planning Manager.

Environmental oversight of road improvements will also need to assured, most likely by the individual Environmental Review Coordinators and the Park Road Engineer/Inspector or Foreman. Yearly *Environmental Management Workplans* for road improvements will be required as part of the development of the *Annual Work Plan* for each park's roads, typically prepared by the Works Department for annual budgeting purposes.

Some mitigative measures will require frequent oversight. For example, initially the survival and vigor of erosion control plantings need to be monitored frequently. In addition, adequacy of drainage structures and erosion control measures, success in restoration of borrow pits, quarries or spoil sites, and other mitigative measures need to be examined to determine if they are achieving their intended effects. It is also recommended that drainage structures be inspected regularly after rain. To the maximum extent road foreman and workers should be given these more routine monitoring responsibilities as an integral part of their maintenance responsibilities. Training by TANAPA may be required for park ecologists and road works personnel in how to monitor adequacy or effective performance of mitigative measures. TANAPA, with possible USAID assistance, is encouraged to provide such training.

It is recommended that monitoring data and information be compiled and submitted as part of a park's annual *Environmental Management Workplan* for road improvements. This should include data and information on factors closely related to road usage and necessary to determine the effectiveness of maintenance and mitigation actions, such as correct shaping and drainage, control of gulleying, etc. As part of the monitoring process, composition and volume of traffic will also need to be monitored at least annually. The *TANAPA Road Improvements Operations Manual* will list the types of monitoring to be performed for road improvement operations.

In addition, information concerning the success or failure of construction phase mitigative measures, short-term viability of restoration activities and road design features, and the results of road surveys shall be reported in writing to Park Management in monthly or quarterly reports.

Implementation of monitoring procedures. Monitoring at the park level shall be the under the

direction of the Environmental Review Coordinator, who shall ensure that necessary ecological and socio-economic data is provided and that engineering-related data and information is submitted by the Road Engineer/inspector and/or Road Foreman. The TANAPA Planning Manager will have responsibility for ensuring that park monitoring plans are implemented effectively, drawing upon the TANAPA Senior Ecologist and TANAPA Chief Engineer.

7.3.5 Monitoring of long-term cumulative impacts

It is particularly important as part of the GMP/MZP process to ensure that both the planning of road improvements, mitigation measures and monitoring plans take into account possible long-term cumulative impacts on the environment. This task falls primarily on the shoulders of park ecologists, in consultation with the TANAPA Senior Ecologist and the TANAPA Planning Manager. The importance of establishing reliable baseline data on park ecological systems and of tracking key environmental indicators and proxies for this purpose, deserves special emphasis here. This information should be an integral part of the periodic evaluation of park *Road/Trail Network Plans* and activities.

7.3.6 Board of Surveys environmental auditing

The Board of Surveys annual park auditing process could serve a valuable function by incorporating as part of their survey teams, an individual who would be responsible for determining the effectiveness of road improvement mitigation and monitoring in each park. This individual's role would not be to enforce implementation, but rather to determine how mitigation and monitoring is working and how further improvements might be made.

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9. Brief Biographical Sketches of the PEA Team Members

Professor Raphael Mwalyosi, PEA Team Leader, Ph.D. in Conservation Biology, Agricultural University of Norway 1990. Over 20 years experience in ecology and environmental research in Tanzania. He has served as Team Leader for several environmental assessments and has numerous environmental publications. He is currently the Co-ordinator of the Environment and Natural Resources Section at the Institute of Resource Assessment, University of Dar es Salaam and serves on the Board of Directors of the International Association for Impact Assessment (IAIA).

Weston Fisher, Associate Team Leader, M.S. Geology, Stanford University 1966. With 30 years experience in environment, energy and natural resource management, he has carried out assignments in 21 countries. He has also served as a trainer in environmentally sound design and environmental assessment for USAID partners engaged in small-scale development activities, a course repeated in various forms, 10 times throughout Africa. He has specialized knowledge of USAID environmental procedures and the USAID Bureau for Africa environmental screening and review process for USAID partners.

Joseph Kessy, Senior Park Planner, TANAPA Planning Unit, B.A. in Land Use Planning and Environmental Studies, University of Dar es Salaam 1988. Postgraduate Diploma in Geographical Information Systems, ITC, Enshede, the Netherlands 1992. He has 12 years experience as a natural resource planner and previous experience in environmental impact assessment. He joined TANAPA in December 1995. His primary responsibilities are to ensure timely and economical preparation, review and implementation of TANAPA's corporate plan, environmental impact studies and management plans for the all of Tanzania's National Parks.

Emmanuel Gereta, Senior Ecologist, TANAPA, M.S. Range Science, Texas A&M University, College Station Texas 1987. 25 years of experience in natural resource management with a strong background in range management. He joined TANAPA in 1994 as Senior Park Ecologist and Head of the Ecology Department in Serengeti National Park. His primary responsibilities include, among other things: developing and managing grazing systems, development and implementation of fire management strategies, coordination of ecological monitoring of flora and fauna, vegetation and biodiversity surveys, EIA, use of GIS and GPS systems, and provision of expertise in development of General Management Plans and Zone Management Plans.

Zafarani Athumani Madayi, EIA Specialist, National Environment Management Council (NEMC), B. A. in Land Use Planning and Environmental Management; Natural Resources Assessment and Environmental Management; University of Dar es Salaam 1999. She has over 5 years experience with NEMC and has conducted field research on environment and population in Northern Tanzania; Dar es Salaam and coastal regions. She also assessed environmental costs and benefits associated with the Kilimanjaro National Park ecosystem; conducted EIA work on the Tanzam Highway Road rehabilitation from Ubungo Traffic lights to Kimara – Kibangu, Dar es salaam.

Alan Kijazi, Planner and EIA specialist, African Wildlife Foundation (AWF), MSc. (Management of Natural Resources), Agricultural University of Norway, 1992. He has 15 years of experience in environmental and natural resource planning, including serving as Head of the Planning and Research Unit of the Ngorongoro Conservation Area (NCAA) from 1992 – 1998. As a Project Officer for AWF in Arusha, his current responsibilities include support and backstopping to TANAPA on areas of tourism development, community conservation, strategic planning and infrastructural development (working with the private sector). He also coordinates technical support provided by the U.S. Department of Interior to TANAPA and served ably as the Logistics Coordinator for this PEA.

Richard L. Engle, U.S. National Park Service Park Engineer, M..S., Civil Engineering, Universiy of California, Berkeley 1970. A park engineer with 30 years experience in U.S. National Parks. Currently Park Road Coordinator for the northwest states of

Washington, Oregon and Idaho (18 parks) responsible for major park road construction and rehabilitation. Program manager for the Park Road Program for all park roads including a number of unpaved gravel roads in the more remote park districts. A significant amount of this work has involved emergency repairs and restoration of essential traffic on many of these mostly unimproved roads. He is a Registered Professional Engineer in California.

Ishael J. Varoya, Roads Inspector/Engineer, Serengeti National Park, Full Certificate in Highway Engineering, Dar es Salaam Technical College, 1992-1995. He began working on construction and maintenance of roads in 1993 and joined the Serengeti Conservation and Development Project (SCDP) in February 1996 and is now Serengeti's Road Inspector and advisor to TANAPA on road improvement engineering issues.

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