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ENVIRONMENTAL GUIDELINES: ROADS AND BRIDGES

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PREFACE

The Environmental Guidelines (EGL) for roads provide detailed analyses of environmental issues arising from road works along with mitigation measures that have been used successfully in national and international contexts. The guidelines identify the direct and indirect effects from road works on the biophysical environment—land, water, air, vegetation, etc.—as well as the socioeconomic and cultural environments—for instance, public health, welfare and safety and valued traditions from the present and past. In keeping with Kenya's environmental law's precepts, the guidelines underscore the importance of public consultations and participation in all aspects of road-transportation development, thereby ensuring accountability, fairness and sustainability.

The EGL is meant for use by road infrastructure designers, project managers, contractors, training institutions as well as environmental practitioners involved in the development and maintenance of all types of roads.

The EGL will form part of the roads and bridges design manual and its use will be mandatory for all types of roads.

EGLs do not address environmental impacts from Road Transport, including:

- Vehicle emissions that degrade air quality, e.g., carbon dioxide, ozone, nitrous oxides, etc.
- Road safety issues that arise from unsafe road designs, failure to correct black spots, etc.
- Vehicle inspections that require repairs to ensure road-worthiness for all transport modes;
- Passenger safety viz use of seat belts; or
- Vehicle overloading.

The EGL is organized in a manner that is user friendly and each EGL environmental attribute at any road development stage is presented as a standalone subsection meaning that the information for each attribute is complete for each stage of development and highlights particular actions and activities related to that stage.

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LIST OF ACRONYMS

AIA	Archaeological Impact Assessment
BOD	Biological Oxygen Demand
BP	Borrow pit
Cap.	Chapter
CITES	Convention on International Trade in Endangered Species
DOSHS	Directorate of Safety and Health Services, Ministry of Labour
dB	Decibel, a measure of sound pressure level
dB(C)	C-weighted dB scale, frequently used for measuring peak-level sounds
dBA	A-weighted dB scale to factor in the relatively insensitivity of the human ear to low frequency sounds
EIA	Environmental impact assessment, equivalent to EIA Study
EMCA	Environmental Management and Co-ordination Act, Cap 371, 1999, Kenya
EMP	Environmental management plan
ESCP	Erosion and sediment control plan
GDP	Gross domestic product
GPS	Geographic positioning system
ha	Hectare
HIV/AIDS	Human immunodeficiency virus/Acquired immune deficiency syndrome
Hz	Hertz, describes the frequency at which an object is oscillating
IEMA	Institute of Environmental Management and Assessment
IOMC	Inter-Organisation Programme for the Sound Management of Chemicals
IUCN	International Union for the Conservation of Nature and Natural Resources
KFS	Kenya Forest Service
KWS	Kenya Wildlife Service
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
KURA	Kenya Urban Roads Authority
LI	Landscape Institute
mm/s	Millimetres per second
MNHC	Ministry of National Heritage and Culture, Kenya
MoR	Ministry of Roads, Kenya
N95	Face respirator that removes 95 percent of particulate matter
NEMA	National Environment Management Authority, Kenya
NGVCP	Noise and ground vibration control plan
NMT	Non-motorised transport
No.	Number
OECD	Organisation for Economic Cooperation and Development
OSHA 2007	Occupational Safety and Health Act, Act No. 15 of 2007
PM	Particulate matter, the sum of all solid and liquid particles, small to large in size, suspended in air, many of which are hazardous
$PM_{2.5}$	Particulate matter, particles less than 2.5 micrometres (microns) in diameter that are referred to as "fine" particles
PM_{10}	Particulate matter, particles less than 10 micrometres (microns) in diameter
PPE	Personal protective equipment
PPV	Peak particle velocity, measures speed at which the ground vibrates, measured in mm/s
REM	Rapid eye movement, important dream-stage during normal sleep

RFP	Request for proposal
ROW	Right-of-way, or road reserve
SIA	Social Impact Assessment
ssp.	Subspecies, or subsp.
SSA	Sub-Saharan Africa
STD	Sexually transmitted disease
TOR	Terms of reference
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VIP	Ventilated improved pit latrine
VS	Vetiver System
WHO	World Health Organisation (United Nations)
WRMA	Water Resources Management Authority
WWF	World Wildlife Fund for Nature
ZOI	Zone of influence, or study area
≥	Greater than or equal to
≤	Less than or equal to
≈	Approximately equal

FOREWORD

In Article 42 of Kenya's 2010 Bill of Rights, the right of every person "to a clean and healthy environment" is established, including the person's right "to have the environment protected for the benefit of present and future generations through legislative and other measures. . . ." In seeming anticipation of these rights, the Environmental Management and Coordination Act No. 8 of 1999 (EMCA) was enacted by the Republic of Kenya to establish "an appropriate legal and institutional framework for the management of the environment," with an ancillary aim of improving the nation's capacity to sustainably manage environmental and natural resources. Among its many provisions, the EMCA endows every person with the right to a clean and healthy environment while entrusting each person with the duty to use the environment in a sustainable manner, ensuring that future generations are able to enjoy equal or better benefits from the environment. The Act also requires that programmes, activities or projects be systematically examined using environmental impact assessments to determine and ensure the environmental soundness of new developments, fully mitigating negative impacts and enhancing positive ones with purposeful, targeted actions.

In recognition of the importance of sound environmental management in the nation's vital road transportation sector, the Ministry of Roads (MOR) put forth this set of environmental guidelines for roads and bridges. MOR's dual aims in offering the environmental guidelines are to provide a valuable tool for implementing EMCA and its subsidiary regulations and in making certain that the delivery of road infrastructure conforms to good environmental practice. Not meant solely for road engineers, the guidelines are appropriate for diverse users from public to practitioners alike. And the guidelines are meant for application at all stages of road-infrastructure development—from conception to operation, including the critical stages of planning, design, construction and maintenance.

Roads constitute a major transportation link in Kenya, moving large numbers of passengers and high volumes of domestic freight throughout the country. To satisfy road-transport demand, a substantial portion of Kenya's annual budget is expended on building and maintaining roads that have underpinned economic development.

But environmental costs accompany these transportation advances. All too often in the past, the environmental costs associated with delivering road transportation have not been addressed in a manner that ensures sustainable development. As a consequence, these costs—for example, eroded soils, polluted water, degraded air—have accumulated to impoverish the environment upon which we all depend. Making certain that environmental costs do not outweigh the economic benefits enjoyed from improved road transportation is a challenge we all face in the 21st century. By anticipating and reducing—or even avoiding—the negative impacts to the environment brought about by building and maintaining road infrastructure, we can meet this challenge by containing and reversing many harmful costs to the biophysical, socioeconomic and cultural environments.

MOR's environmental guidelines are a first attempt at developing another management tool, this one for use within the road sector. The guidelines provide detailed analyses of environmental issues arising from road works along with mitigation measures that have

been used successfully in national and international contexts. The guidelines identify the direct and indirect effects from road works on the biophysical environment—land, water, air, vegetation, etc.—as well as the socioeconomic and cultural environments—for instance, public health, welfare and safety and valued traditions from our present and past. In keeping with EMCA's precepts, the guidelines underscore the importance of public consultations and participation in all aspects of road-transportation development, thereby ensuring accountability, fairness and sustainability.

I wish to thank Swedish International Development Cooperation Agency (SIDA) and the International Labour Organization for their invaluable support in underwriting these important environmental guidelines for roads and bridges. My thanks also go to the authors of the guidelines, Dr. S. H. Cooper and Mr. Tom Omenda as well as Eng Asfaw Kidanu for his very capable coordination and oversight of the final product.

Finally, I urge all road engineers and practitioners to make full use of MOR's environmental guidelines to manage more sustainably Kenya's unique, irreplaceable environmental resources and to help us reduce our part in a changing climate.

Eng. M. S. M. Kamau, CBS, HSC
Permanent Secretary
Ministry of Roads

DEFINITION OF TERMS

Where possible, the meanings for selected terms used in the Environmental Guidelines rely upon definitions from the Environmental Management and Coordination Act, 1999; the regulations and guidelines from the National Environment Management Authority; the Occupational Safety and Health Act, 2007; and, project documents for Updating of the Road Design Manuals. When definitions were not available from the foregoing sources, international references such as technical or standard dictionaries were consulted; in cases where multiple meanings for a selected term were given, the definition most applicable to the Environmental Guidelines for Roads and Bridges was chosen. (Please note that the main entry is shown in bolded text whereas subsidiary entries are not.)

Catchment	The region of land that drains into a specified body of water, such as a river, lake, sea, or ocean; precipitation that falls anywhere within a specific water body's catchment or watershed will eventually drain into that body of water
Lower	The natural terrain on the lower side of a road that is part of a catchment
Upper	The natural terrain on the upper side of a road that is part of a catchment
Chainage	An imaginary line used to measure distance, often corresponding to the centre of a road
Chemical wastes	Chemical waste includes solids, liquids or gases containing or contaminated with flammable solvents (for example, acetone), leachate (e.g., pesticides) and non-leachate toxic materials (e.g., chloroform), corrosives (e.g., hydrochloric acid), reactives (e.g., explosives) and polychlorinated biphenyls (PCBs or flame retardants)
Hazardous	The **probability** that injury will result from the use of (or contact with) a substance; a substance is determined to be a hazard depending on the degree of toxicity; the amount, duration and route of exposure; the individual's sensitivity; and the reaction/ interaction with other substances during exposure
Toxic	The capacity of a substance to cause injury; substances that are known to be carcinogenic (cancer causing),mutagenic (mutation inducing) or teratogenic (interfering with normal fetal development) for humans or other life forms are deemed to be toxic

Contractor camp	Site facilities established by the contractor for the construction of the works, including structures for housing plant and materials, provision of offices, workshops and other buildings as are necessary for the construction of the works; compound and storage areas used by the contractor for storage of materials and equipment including supervising engineer's materials and equipment and, if required, accommodation for the personnel of the contractor, engineer and their respective workforces
Work shop Work area	Area(s) specifically set aside within the contractor camp or elsewhere along the project road for maintenance and repair of project-related vehicles, machinery and equipment; usually sheltered, hard-surfaced with special drainage provisions and fenced for security if located outside the camp
Crusher	A machine designed to reduce large rocks into smaller rocks, gravel, or rock dust; crushers may use one of several methods to crush the material—jaw, gyratory, cone or impact, all fundamentally similar in principle—to reduce the size of the material; screening follows to remove oversized materials for re-crushing; crushed materials move by conveyor belts to secondary crushing, if required, or to a drop-point for loading; crusher dust is produced at all stages of the process, particularly during crushing, screening and loading
Cultural heritage	A term encompassing several main categories of heritage: **cultural** including **tangible** (movable such as paintings, sculptures, etc.; unmovable, e.g., monuments, archaeological sites, etc.; and, underwater, e.g., shipwrecks, ruins, etc.) and **intangible** (for example, oral traditions, rituals, etc.) and **natural** such as natural sites with cultural aspects, i.e., landscapes, physical, biological, geological, etc. (Guidelines for cultural heritage and natural heritage appear separately in the environmental-guideline document.)
Aesthetics, Visual intrusion	A set of principles concerned with the nature and appreciation of beauty, i.e., attractive or pleasing; therefore, a thing that is uninvited and unwelcome that intrudes in the visual appreciation of beauty, e.g., a massive advertising sign board erected in the line of vision at a scenic viewing point
Cultural perception	Refers to the way a culture or community understands (i.e., perceives) a cultural issue (**perceived values**); cultural is defined as the ideas, customs and social behavior of a society as well as its arts and intellectual achievements
Heritage warden	Individual(s) appointed by the Minister of National Heritage and Culture to enforce the National Museums and Heritage Act, Cap 6 of 2006; with dual powers to prosecute a violator of the Act and enter premises to inspect an antiquity or protected object

World Heritage Site	Named and listed by the United Nations Educational, Scientific and Cultural Organisation (UNESCO), a World Heritage Site is a place (such as a forest, mountain, lake, desert, monument, building, complex, or city) that is of special cultural or physical significance
Culvert	A structure other than a bridge which provides an opening **under** a carriageway, median or access road for drainage or other purposes; culverts may be round, **arch** (a round pipe culvert reshaped to allow a lower profile while maintaining the same flow characteristics), **box** (a concrete unit with a clear opening of rectangular shapes) or **elliptical** (a concrete unit that is rounded like an egg)
Bedding	Term normally used for the foundation for a box culvert; the bedding for a box culvert must be able to support the full load of the installed box culvert, its contents, and the loading above the box culvert
Headwall	A concrete, gabion, masonry or timber wall built around the inlet or outlet of a drainage pipe or structure to increase inlet flow capacity, reduce risk of debris damage, retain the fill material and minimise scour around the structure
Inlet	Opening in a drainage structure or pipe into which water flows through the culvert; the inlet is usually higher than the outlet to ensure that water flows through the structure at a given velocity
Outlet	Opening in a drainage structure or pipe from which water exits the culvert; the outlet is usually lower than the inlet to ensure that water flows through the structure
Trash rack	A structural device used to prevent debris from entering a pipe, spillway or other hydraulic structure
Wingwall	Masonry or concrete structure built adjacent to the sides of culvert inlet or outlet headwalls, designed to retain the roadway fill and direct water into and out of the drainage structure while protecting the road and fill from erosion
Decommission	Withdraw from service or disband, demobilize
Decommissioning plan	A plan prepared at feasibility/design stages and finalized prior to siting and building a contractor camp or other facility(ies) ancillary to the works (materials sites, workshops, etc.) ; the plan contents are to include, at minimum: (1) a description of the facility pre- and post-decommissioning, if after-use is agreed upon by all affected parties; (2) a description of the techniques and procedures to be used in disbanding activity in question and cleaning the site; and, (3) in the instance of a contractor camp, a description of waste management—collection and disposal—of all site appurtenances, including but not limited to workshop pits/ drains/ containments, ablution blocks, internal road-surfacing, etc., unless these improvements are to be retained for agreed-upon after-use of the site

Dewatering	To drain or remove water, usually with pumps, from a water-logged area such as a borrow pit or quarry
Coffer dam	A temporary watertight enclosure that is pumped dry to expose the bottom of a body of water thereby enabling construction to take place, e.g., fabricating bridge piers
Sheet piling	A structural steel product with edges designed to interlock; used in the construction of cofferdams or riverbank reinforcement
Drainage	The act of discharging or moving water from one point to another
Bund	A curb or dike of earth, brick or concrete to contain liquids, e.g., oil, or solids, e.g., silt; the purpose of a bund is to contain and prevent substances from moving into surface-water systems or away from a site where spillage has occurred
Check dam	A temporary structure used to contain eroded soil from leaving a disturbed or construction site; may also be used to reduce water velocity in drains and prevent eroded soil from eroding additional soil in a drain
Concrete lining	Layer of concrete on the surface of a drainage structure to prevent soil erosion or excessive water infiltration
Containment area, Secondary containment	An area fully enclosed with impermeable bunds (sidewalls) and base whereby any spilled or leaked materials are contained or captured for final treatment and/or removal to a facility capable of treating and disposing of hazardous wastes; **secondary containment** is required for the secure storage (generally in sealed drums or other secured containers) of all hazardous materials/wastes such as waste oil, spent solvents, etc.
Cross drains	Installed or constructed structures such as culverts and rolling dips that move water from one side of the road to the other
Detention pond	An artificial flow-control structure that is used to contain flood water for a limited period of time, thereby providing protection for areas downstream; in contrast to a retention basin that holds water for an extended period of time
Energy dissipater	A device or material (often rocks) used to reduce the energy of flowing water, typically used at and below culvert outlets and other drainage structures to prevent erosion; a **stone-lined splash basin** used at a culvert outlet dissipates energy from water exiting at the outlet or outfall
Infiltration basin, Infiltration trench	An excavated or constructed basin/trench at the inlet of a cross-drain culvert that is used to store water and direct it into the culvert; trenches can also be filled with stones to remove sediments and several other water pollutants; the major difference between an infiltration basin and an infiltration pond is a matter of dimension

Mitre drain	Also known as **lead-off drain** or **off-shoot drain**, a mitre drain is an excavation designed to divert water away from the roadway and sidedrains (at points where movement away from the road does not occur naturally) in order to reduce the volume and velocity of water in roadside drains
Oil separator	Separators can be either vertical or horizontal in position or cylindrical or spherical in shape; separation is accomplished principally by gravity, the heavier liquids such as water falls to the bottom and the lighter ones such as oil rise to the top; after separation, oil can be siphoned away for safe disposal or treatment
Retention basin, Retention pond	A retention basin or retention pond is a type of constructed, (artificial) wetland that is used to contain stormwater or precipitation runoff; a retention basin provides an area to withhold water from a minor drainage that would otherwise flow into a different drainage; by retention, the captured water remains in the area where the precipitation has fallen
Rip-rap	Well-graded, durable large rock, ideally with fractured surfaces, that are sized to resist scouring or removal of soil by water; installed to prevent erosion of **in situ** soil material
Rolling dip	Shallow, rounded dip in the road where the road grade reverses for a short distance and surface runoff is directed into the dip or trough toward the outside or inside of the road; rolling dips are drainage structures designed to allow passage of motor vehicles at reduced travel speed
Scour	Scour is the hole left behind when sediment (sand and rocks) is washed away from the bottom of a river or a drainage channel; although scouring may occur at any time, it is especially destructive during floods when swiftly flowing water has more energy to lift and carry sediments downriver than has calmer water
Side drains, Side ditches	A channel or shallow canal, generally V-shaped, along the road intended to collect water from the road and adjacent land for transport to a suitable point of discharge; side drains are commonly placed along the inside edge of the road, but they can also be placed either on the outside edges or along both sides of the road
Spill retention	Retaining spills of hazardous materials such as oil or fuel in a specially protected area or special receptacle pending disposal into a dedicated site or treatment system
Stone pitching	Randomly sized and placed stones that form a hard wearing, roughly cobbled, step-down surface; mainly used in side drains on steep gradients where erosion is or can be severe

Sump	A pit or tank that captures liquid runoff for later release as drainage or disposal
V-drains	A V-shaped channel or shallow canal alongside a road with the purpose of collecting water from the road and adjacent land for transport to a suitable point of discharge
Earthworks	To excavate the existing land to a suitable level so that road construction may begin; earthworks can either be excavation in the form of cuts or embankments with fill to elevate a roadbed; usually entails moving earth from one part of a site to another
Bench Benching	Road construction technique where a bench is cut on a sideslope without using fill
Cut	A section of the road where the formation level is above the original ground-level that requires **cuts**, or excavations, for construction of the roadbed and subsequent pavement layers
Fill	A portion of the road prism consisting of approved **fill**, or imported material, that lies below the roadbed and is bounded by sideslopes and on which improved subgrade layers, pavement and shoulders are to be constructed; material imported to replace unsuitable material in the roadbed is also classified as **fill** when placed below the improved subgrade layers
Balanced cut/fill	A method of construction in which a road is built by either cutting into a hillside and spreading the spoil materials in adjacent low areas or sidecasting fill material downslope along the route after which the soils are compacted; a balanced cut/fill utilizes all the "cut" material to generate the "fill," creating no excess waste material and no need for hauling additional fill material
Mass haul diagram	In order to minimise material waste or borrow, a mass haul diagram is produced; the diagram is essentially a plot of cumulative volume of soil against distance along the road, often called the chainage; cut volumes are taken to be positive and fill volumes to be negative
Overburden	Material within or covering a borrow area or quarry, which is not required or is unsuitable for use in construction
Sidecast	Process whereby excess material is pushed outside of the road prism a minimum number of metres from the top and bottom of cut and fill slopes; frequently limited to slopes less than 55 percent

Engineer	A person who designs, builds or maintains a structure such as a road
Resident engineer	The person appointed by the employer to act as the engineer for the purposes of the contract and named as such in the contract
Supervision, supervisory engineer	The terms, supervision engineer or supervisory engineer, are equivalent and used interchangeably with resident engineer
Environment	The physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factors of aesthetics; includes both the natural and the built environment
Ecosystem	An ecosystem is made up of **plants, animals**, **microorganisms, soil, rocks, minerals**, water sources and the local **atmosphere** interacting with one another
Environmental Impact Assessment (EIA)	A systematic analysis of projects, policies, plans or programmes to determine their potential environmental impacts, the significance of such impacts and the measures proposed to mitigate the negative impacts
EIA Study	A systematic study conducted to determine whether or not a programme, activity or project will have any adverse impacts on the environment
Environmental management plan (EMP)	The synthesis of all proposed mitigative and monitoring actions, set to a timeline with specific responsibility assigned and follow-up actions defined; EMP is one important outputs of the EIA process
Impact	Impact is a change to the baseline which is the starting point used for comparisons (a snap-shot taken before any changes contemplated in a project, plan, programme or policy take place); the change to the baseline can be positive or negative; when a positive impact, then enhance (increase); if a negative impact, then mitigate (avoid or reduce)
Cumulative impacts	The impacts to the environment that result from individually minor impacts and incremental processes of projects, programmes or activities over a period of time
Biophysical	A combination of the words, biological and physical, biophysical in the context of an EIA relates to biological attributes such as flora and fauna (e.g., vegetation and wildlife) and physical attributes such as water (both surface and ground), land (including soil, geology, geomorphology, etc.), atmosphere and climate (precipitation, temperature, humidity, etc.)

Cultural	Major elements of culture are **material** (tools, artifacts and technology), **language** (reflective of societal nature and values), **aesthetics** (music, art, drama and dancing), **education** (transmission of skills, ideas and attitudes), **religion** (institutions and group systems), **attitudes and values** (religious, spiritual and/or economic foundations) and **social organisation** (interrelationships among people) .....
Socioeconomic	A combination of the words, social and economic, socioeconomic in the context of an EIA relates to social attributes such as demographics, population growth rate, education, community cohesion, etc., and economic attributes such as employment, household income, health, etc.
Erosion and sediment control plan (ESCP)	An ESCP ensures that the designs of a drainage system take into account potential soil erosion and sediment transport to nearby surface-water resources by (1) focusing on erosion prevention (minimising disturbed areas and forthwith restoring disturbed areas by seeding, mulching or matting); (2) controlling the amount of soil that can run off; and (3) stabilising exposed soil
Feasibility study	A study about a project's practicality and viability—its feasibility—which is summarized in a document; the study addresses issues including the project's benefits and costs; effectiveness in achieving certain goals; alternatives proposed, analyzed and selected; environmental effects; public opinions; and, other factors
Gabion	Rectangular containers (baskets) fabricated of heavily galvanized wire, which are filled with stone and stacked on one another, usually in tiers that step back with the slope rather than vertically (see Fig. 1.3); the most common use of gabions is to stabilise slopes against erosion; other uses include retaining walls, temporary floodwalls, filtering silt (from runoff), damming small streams and rivers, either temporarily or permanently; training rivers; lining channels; and directing flood waters
Geotextile/geogrid	A textile made from synthetic (plastic-like) fibers, usually non-biodegradable, which forms a blanket-like product; **geotextiles** can be woven or non-woven with varying degrees of porosity, openings and strength; used as moisture barrier, separation or reinforcement of soils, filtration, or drainage; likewise, **geogrid**, also fabricated from synthetic fibers, is an open mesh with square, rectangular or triangular grid holes
Materials sites	An area where excavation takes place to produce materials for roadwork such as fill material for embankments; typically a relatively small area used to mine sand, gravel or soil, generally without further processing, and rock that usually must be crushed

Stockpiles	A pile or storage location for bulk materials, normally soil or gravel that is to be used as work progresses
Monitoring	To **observe** and check the progress or quality of something over a period of time; to keep and maintain regular surveillance; or, to check or regulate the technical quality of something; in environmental management, monitoring is required to assure that impacts have been correctly assessed, that mitigation has been or is being properly implemented and that any unidentified impacts will be mitigated
Natural heritage	Often included with cultural heritage (see definition), natural heritage generally refers to natural sites with cultural aspects, i.e., landscapes, physical, biological, geological, etc
Heritage warden	See preceding definition (Cultural heritage)
World Heritage Site	See preceding definition (Cultural heritage)
Noise and ground vibration control plan (NGVCP)	A NGVCP aims to (1) minimise noise and ground vibration generation and propagation by siting materials and processing sources away from human settlements to the greatest degree possible; compensating and temporarily resettling nearby residents, businesses or other sensitive land uses likely to be adversely affected by construction noise and vibrations; and, judicious use of landscape features for noise screening and buffering; (2) control the levels of noise and ground vibrations by utilizing modern blasting materials and techniques to lessen peak air overpressure (noise) and peak particle velocity (ground vibrations); and,(3) respect the lives and routines of people in settlements near materials sites, materials haul roads and materials processing sites by strictly adhering to declared construction operating schedules and quarry-blast warning systems
Hertz (Hz)	Measurement of ground vibration that describes the frequency at which an object is oscillating, i.e., moving back and forth
Decibel (dB)	Unit of measurement to express the relative loudness of sound using a logarithmic scale
dBA	Sound level filter with the A scale to measure sounds with frequencies closely approximating those heard by the human ear, i.e., neither very low nor very high frequencies
dBC	Sound level filter with the C scale to measure very high sound levels, i.e., explosive blasts in rock quarries
Vibration	Mechanical energy transmitted from an oscillating source through the ground to a person's body or other animate/inanimate object

Occupational carcinogen	A group of different diseases that have the same feature: the uncontrolled growth and spread of abnormal cells and well-documented association between occupational exposures to carcinogens (cancer-causing) substances or sources and onset of disease
Particulate matter (PM)	A complex mixture of very small liquid droplets or solid particles suspended in the air; PM is associated with a range of health risks ranging from acute to chronic, transitory to terminal
Fugitive dust	A form of particulate matter, ranging in size from small to large particles; labeled as "fugitive" because it is distributed over a wide area and not restricted to a single point-source
PM10	PM equal to or less than 10 microns in diameter; PM_{10} or smaller are damaging to respiratory systems because they generally pass through the throat and nose to the lungs
PM2.5	PM equal to or less than 2.5 microns in diameter; known as fine particles, $PM_{2.5}$ are the most damaging to a respiratory system; $PM_{2.5}$ is associated with silicosis, an incurable and fatal disease of the lungs
Road components	A road cross-section showing its principal parts (excluding drainage structures that are defined under Drainage)
Carriageway	The surface traversed by vehicles; normally consists of one or a number of contiguous traffic lanes including auxiliary lanes and shoulders
Centerline	An imaginary line that runs longitudinally along the center of a road
Embankment, Sideslope	A section of the road where the formation level is above the original ground level
Roadbed	A prepared foundation or bed that supports the upper layers of a road
Road reserve	An area set aside for the present or future use of the travelling public; an area of land, whether surveyed or not, that is dedicated, notified or declared for the purpose of a road for public use, whether constructed or not, and extends from property boundary on one side to property boundary on the other side of the reserve; also known as **road right of way** (ROW)
Road surface	The top layer of the road surface, also called the wearing course; the surface can be comprised of gravel-wearing course or bituminous surface (pavement) and the shoulder layers, along with improved subgrade, subbase and base
Sanitation	Drainage and disposal of sewage; the science and practice of effecting healthful and hygienic conditions such as drainage, ventilation, pure water supply, etc.

Sealed vault VIP	A latrine with a water-tight pit lining that does not allow significant infiltration into the surrounding soil; requires periodic emptying; ventilated to exhaust interior odors and prevent flies
Leach field	Trenches into which liquid effluents from a septic tank flow; a method used to treat/dispose of liquid sewage wastes in rural areas inaccessible to municipal collection and treatment systems
Septage sludge	The wet solids that remain in a septic tank after the liquid wastes have flowed out of the tank into a leach field; generally consists of all household wastes discharged by a plumbing system
Anaerobic decomposition	The process by which microorganisms break down organic substances into simpler inorganic constituents in an oxygen-free environment; the decomposition of sewage in a septic tank that takes place under anaerobic conditions
Seeding	The process of broadcasting seeds of grasses or other vegetation types on denuded soils, normally on areas without vegetation cover following site preparation and earthworks
Matting	Mats made from either jute or synthetic (geotextile) fabrics or branches and limbs from trees cleared in the road ROW; used to control soil erosion during revegetation; commonly used with slope revegetation; also used to stabilise disturbed river banks and prevent soil loss caused by overland flow in the absence of vegetation cover
Plugging	The process of reestablishing grass cover on denuded soils by placing in the soil separate "plugs" of live plant material with healthy root systems; usually planted in individual holes or shallow rows depending upon the size of the area to be revegetated
Reseeding	The process of rebroadcasting seed to an area previously seeded but where seed germination has been poor and vegetative cover has not been fully reestablished on barren soils; this process is common to stockpiles (see definition) and cut/fill slopes (see definitions)
Seedbank	Seeds that have been deposited naturally onto the ground and that will lie dormant until conditions are conducive to seed germination (light, water and warmth)
Silicosis	A non-cancerous, progressive and fatal disease of the lungs caused by free crystalline silica, the fine particles released when silica-bearing rock is mined, quarried, smelted or crushed (see $PM_{2.5}$ definition); silica is a common, naturally-occurring crystal found in quartz rock, the second-most abundant mineral on the planet; the disease can be chronic or acute, depending upon duration and level of exposure

Crystalline silica	When silicon (the planet's second most prevalent element) combines with oxygen (the planet's most abundant element), silica is formed; a very common chemical compound in nature because of its presence in quartz, silica may be either crystalline or non-crystalline, depending upon temperature, pressure and cooling conditions during formation; in addition to its causation of non-cancerous silicosis (see definition above), crystalline silica is a carcinogen that is associated with lung cancer
Sorbent	A material that adsorbs another substance; i.e., has the capacity or tendency to take it up by either absorption (material that soaks up liquid easily) or adsorption (substance which adsorbs another substance, i.e., hold molecules of a gas, liquid or solute as a thin film on the material's outside surface or on the internal surfaces within the material
Speed control	Measures or devices used to control the travel speed of vehicles
Speed humps Rumble strips	An artificial ridge set crosswise into the surface of a road, parking lot or entry/exit points, the purpose of a **speed hump** is to make vehicle operators decrease speed; a speed hump is often combined (on both sides of the hump approach) with **rumble strips** that are a series of strips of pavement altered in various ways so as to cause the tyres of a vehicle to vibrate audibly as a warning of an approaching obstacle
Surface-water runoff	Precipitation (or irrigation water) in excess of what can infiltrate the soil surface or be stored in surface depressions; a major carrier of pollutants
Sediments	Organic or inorganic material that is carried or suspended in water and settles out to form deposits in a storm drain system or receiving waters; clay, silt and sand eroded from land (and poorly constructed roads) that travel to a water course reducing the quality of that water
Sedimentation	The tendency of solid particles in suspension to settle out of a liquid; the deposition of soil sediments onto the bed (bottom) of a water body
Silt curtain	A temporary barrier of geotextile material used to contain sediments within a defined zone in an aquatic environment
Silt fence	A temporary barrier used to intercept sediment-laden runoff from slopes; typically made from porous geotextile material
Suspended solid	Small solid particles that are suspended in water due to the motion of the water; used as an indicator of water quality

Turbidity	Water that is cloudy or muddy usually due to suspended solids such as soil sediments; the measurement of turbidity is a key test of water quality
Waterbody	A sizeable accumulation of water, i.e., a pond, lake, reservoir, harbor or ocean, either natural or artificial; the term sometimes includes streams or rivers; however, in the context of these environmental guidelines, water body refers to accumulated water, whether large or small in amount
Watercourse	Surface-water systems including streams and rivers; the term includes any well-defined channel with distinguishable bed and bank showing evidence of flowing water indicated by deposit of rock, sand or gravel
Water pan	Generally a natural basin or depression containing water, either fresh or brackish

1.0 INTRODUCTION

1.1 ENVIRONMENTAL GUIDELINES: THEIR URGENCY

Fig. 1.1. Sultan Hamud-Mtito Andei Road

Road transport serves as the primary mode of transportation and communication throughout the world. Roads connect people and places; they enable the delivery of goods and services that underpin economic development. Only in situations where continents or oceans must be crossed do other forms of transport become more important. Road transport, in most instances, tends to be efficient in comparison to more costly air transport and flexible in terms of its relative freedom from geographic constraints. Partly a factor of cost and partly a matter of convenience, roads dominate the minds and budgets of transportation planners and government providers.

With the possible exception of non-motorized transport (NMT), road transport, like virtually every form of transportation, adversely affects the environment when measures are not taken to reduce or avoid negative impacts. NMT, which is emphasized in the draft 2010 Ministry of Roads (MoR) integrated national transport sector policy as well as the Traffic Act and Local Authority by-laws, has few, if any, direct environmental costs, but its economic costs in terms of individual/societal time inefficiencies can be high. Nevertheless, NMT is the current transport option for the majority of Kenyans.

Air pollution from road transport negatively impacts the biophysical, socioeconomic and cultural environments. At minimum, it contributes to harmful changes in Earth's atmosphere; it causes numerous human illnesses including chronic—and sometimes fatal—respiratory complications; and it corrodes humankind's important historic buildings and statuary such as the Taj Mahal in India and statues adorning ancient Japanese temples. Air pollution is directly associated with road transport and indirectly related to road infrastructure.

Additionally, the infrastructure for road transport contributes to soil erosion and water pollution, directly and indirectly. When roads are built, earthworks—essential to site preparation and construction—remove protective vegetation, an action that exposes soils to water and wind erosion. Eroded soils move with surface-water runoff

Fig. 1.2. Kagaeni-Kigachua Road

into nearby waterbodies where they settle and alter benthic (bottom) characteristics. (Important aquatic species feed and breed in benthic zones of lakes and rivers.) They also alter streambed profiles that, in turn, exacerbate flooding, a phenomenon not uncommon to Kenya.

Sedimentation—the deposition of suspended sediments on the bottom of a river or lake—reduces the capacity of these water features; decreased capacity translates into increased risks of flooding and foreshortened design life. Suspended sediments that travel with surface runoff into wetlands also damage these invaluable ecosystems. Wetlands' environmental services of purifying polluted incoming water; retaining and slowly releasing high volumes of water to prevent flooding; and providing breeding and nursery sites for important aquatic species are compromised by soil erosion that is accelerated by road construction, above all by bisecting them unnecessarily with temporary access or deviation roads.

Irrespective of careful implementation of environmental guidelines and mitigation measures, roads with poor design (steep alignment grades or steep cut and/or fill slopes), careless construction (incorrectly installed culverts or headwalls/wingwalls) and inadequate maintenance (clogged culverts or failed reseeding of disturbed areas) confound efforts to correct impacts that degrade water quality. In large part, Kenya offers road-builders optimal terrain that minimizes steep grades and side slopes; however, it presents them with other challenges: crossing wetlands and bridging rivers, actions that require thoughtful environmental management to protect and maintain the environmental services provided by aquatic ecosystems.

In addition to water, air and land impacts to the biophysical environment, road transport impacts the socioeconomic and cultural environments, both positively and negatively. The positive impacts of road transport in Kenya are obvious: linking Kenya by land with its national, regional and international trading partners. As Kenya's roads are improved and expanded, the costs of road transport—namely, vehicle operating costs—will decrease; unless mitigated, the socioeconomic costs in terms of public health and safety will increase, however.

Perhaps the socioeconomic impact of greatest significance is road safety. Suffice it to say here that road fatalities in forty-two Sub-Saharan Africa (SSA) countries are very high. With only 10 percent of the world's population and 4 percent ownership of global vehicles, 10 percent of worldwide road fatalities occur in these SSA countries.

In Kenya, more than 12,000 traffic accidents occur annually resulting in 2,500 fatalities (average) and at least 11,000 serious injuries. Today's average annual costs to the Kenya economy from road accidents total 5 percent of Gross Domestic Product (GDP).

Road safety, though, is not within the scope of these environmental guidelines for roads and bridges. However, road safety in the context of prudent road design, construction and maintenance is addressed in the MoR environmental guidelines.

Roads also open access to Kenya's vast cultural and natural treasures, offering opportunities for increased tourism. An indisputable major contributor to the national economy, the tourism sector can only benefit from improved road transportation and transport.

Public health can be significantly endangered by unmitigated road-construction activities and actions. The transmission of sexually-transmitted diseases (STDs) and HIV/AIDS is strongly linked to road corridors. In fact, the principal transport corridor through East Africa, running from the Kenyan port of Mombasa to landlocked Uganda, has gained notoriety as a main route of HIV/AIDS transmission.

Borrow pits and quarries, if left unreinstated after roadwork is complete, impound water that provides breeding sites for vectors of several life-threatening diseases (i.e., mosquitoes and malaria; snails and bilharzia). In Kenya's moister regions where malaria incidence is already high, the addition of standing water incidental to road construction/ maintenance is untenable.

Roads often introduce new—sometimes unwanted—innovations to isolated communities or groups of people. On occasion, modernization is imposed on people unprepared to cope. For instance, a sand track in a small southern Botswana village was replaced by a tarred road. Bisecting the village, the high-speed road brought crime and prostitution to a place without prior need for law enforcement. Moreover, village livestock, traditionally untended, were often in harm's way, with the result that villagers lost goats and cows to speeding motorists.

Just as biophysical and socioeconomic impacts from road transport and infrastructure must be taken into account, cultural effects must be considered if this form of transportation and communication is to benefit rather than cost recipients. More often than not, community consultation or public involvement offers planners and engineers the best opportunity to understand the cultural needs and concerns of road transport's beneficiaries.

1.2 ENVIRONMENTAL GUIDELINES: THEIR AIM

Fig. 1.3. Sondu River and embankment/bridge protection works

To the greatest degree possible, the road-transport system in Kenya is to be managed in a manner that sustains the many services of the environment to Kenyan society, today and into the future.

Achieving sound environmental management for the road-transportation system in Kenya will be made easier with the application of these environmental guidelines. However, they do require diligence and resolve in their application if the desired results of **sustainable** development of road transportation are to be realized.

In some cases, they may actually simplify fulfilling the law that requires assessing the state of the environment before and after changes to it are made. These guidelines recommend that a full environmental impact assessment (EIA) study be completed at feasibility and updated at design stages; the study area for the EIA Study would include

the road itself; a zone of influence (ZOI) that may be equivalent to a road's catchment area; and the diverse actions and activities associated with road development—construction camp, quarry (stone and gravel), sand-harvesting, etc.

For the road project, an EIA is required by National Environment Management Authority (NEMA) laws, regulations or guidelines, at minimum, for:

- major roads and all roads in scenic, wooded or mountainous areas and wetlands (Environmental Management and Coordination Act, EMCA, Cap 371, 1999, or EMCA 1999);
- stone and gravel quarries (EMCA 1999);
- sand-harvesting at designated sand-harvesting sites (National Sand Harvesting Guidelines, 2007);
- noise and ground vibration (EMCA Noise and Excessive Vibration Pollution Regulations, 2009); and, quite likely;
- the construction camp (disposal of human, solid and hazardous wastes, if the construction camp includes workforce accommodation as well as fueling and working areas).

However, in lieu of a separate EIA for each road-construction related activity—redundant processes that become unnecessarily burdensome for the contractor and NEMA—a **full** EIA Study to assess the overall project and its parts is both rational and manageable. Construction activities and actions, whether road-based or ancillary to the roadworks, are to be carefully scrutinized in the course of the EIA Study.

Following completion of the initial and updated EIA Study, environmental management plans (EMP) for the construction camp, quarries including associated noise/ground vibrations and sand-harvesting sites can be produced using the EIA Study's findings and recommendations. Following NEMA's approval of the EIA Study Report and the EMPs specific to discrete works for the road, the EMPs would be transformed by the contractor into working documents, and, thereafter, approved by the Engineer and the local NEMA representative. (The reader is referred to NEMA regulations for detailed procedures to carry out and report on EIA including preparation of an EMP.)

EMCA 1999, section 68(4), requires that "the owner of premises or the operator of a project shall take all reasonable measures to mitigate any undesirable effects not contemplated" in the EIA Study Report and "shall **prepare and submit an environmental audit report** on those measures to the Authority **annually**" or as required. Moreover, "the records kept in accordance" with the prescriptions of the NEMA director and "any other records available at the site of an establishment or undertaking" must be available to "any environmental inspector for the purpose of an environmental audit." The importance of careful and complete environmental record-keeping becomes obvious and cannot be disregarded: Appendix C contains a monitoring form that is meant to help the contractor prepare and maintain records to facilitate audit reports and inspections.

Finally, these guidelines recommend that a certificate of environmental compliance be issued **prior** to issuance of a certificate of road completion. To determine environmental

compliance,the contractor, the Engineer and their respective environmental specialists and the provincial and/or district representatives from NEMA

are to agree that mitigation of (1) environmental impacts identified in the EIA Study Report and associated EMPs and (2) implementation of approved decommissioning or reinstatement plans for the contractor camp and materials sites (borrow pits, rock quarries, harvested sand and any other construction materials) are satisfactorily completed and in compliance with relevant regulations, standards and guidelines.

Included in these environmental guidelines are several checklists: the "Checklist for Detecting Possible Environmental Impacts (Transport)" is included as Appendix A and the "Checklist for Road-Transportation Infrastructure," the latter comprised of a separate checklist for development actions, environmental attributes, environmental impacts and mitigation measures. The road-transportation infrastructure checklist is attached as Appendix B. Use of these checklists in combination with the environmental guidelines for roads and bridges will advance Kenya's commitment to sustainable development.

Sustainable development takes into account the current and future beneficiaries of environmental services and natural resources. Perhaps a guideline put forward in 2000 by the Organisation for Economic Co-operation and Development (OECD) says it best. One of ten guidelines adopted by OECD to make transport policy more sustainable and enhance quality of life, Guideline 3 observes that

Commonly, transport policy is couched in economic and social terms. These concerns are integrated "upstream" in order to formulate specific policy responses within and outside the transport sector. Health and environmental impacts are typically assessed ex-post and this understanding is used "downstream" to develop mitigation strategies.

Environmentally sustainable guidelines call for health and environmental quality objectives (e.g., clean air, avoiding morbidity and mortality, ecosystem protection, avoiding anthropogenic climate change, etc.) to be integrated from the outset. (Emphasis added.)

That said, this set of environmental guidelines is to be used in conjunction with existing and future regulations and guidelines developed by government—in particular, NEMA. They are meant to contribute to **full** compliance with established laws and regulations, not preempt existing or create new legal requirements.

1.3 ENVIRONMENTAL GUIDELINES: THEIR APPLICATION

A reader/user of these environmental guidelines is urged to look through the document to familiarize him/herself with the contents and to begin the process of learning to observe the environment analytically. Doing so enhances one's awareness and appreciation for the myriad interrelationships and interconnections that make up the environment, itself a collage of biophysical, socioeconomic and cultural parts.

To extend the appreciation and application of these and other environmental guidelines beyond supervision and enforcement by the Engineer, the contractor and their respective environmental staffs, these guidelines recommend that the workforce be trained in the

functions and purposes of the MoR environmental guidelines during induction training. The contractor's safety/health officer is encouraged to include sufficient sessions in a safety and health training syllabus to introduce and explore the relevance of the environmental guidelines to worker health, safety and welfare.

Environmental guidelines are **prescriptions** and **proscriptions** that contribute to sustainability when applied to actions and activities in planning, designing, building, operating and maintaining road-transportation systems. Guidelines are designed to be applied "upstream," not "downstream" when the costs of protecting the environment, including human health, become progressively higher.

Because the environment that the guidelines are meant to protect is constantly changing, the guidelines should be regarded as prescriptions and proscriptions that need to evolve as well. Regular revision is recommended to retain their currency, in terms of the environmental impacts they address and the measures advised for "upstream" impact mitigation. Biennial review is recommended, but triennial reviews are acceptable.

For reader/user ease, all environmental guidelines appear as four- or five-digit numbered text. Text prefatory to the guidelines explains the environmental attributes (e.g., water quality) potentially affected by specific road transportation-related activities or actions (such as providing contractor camps). Equally, text that serves to illustrate the intent of particular development guidelines (e.g., design provisions for contractor camps) comes immediately before the numbered guideline(s) text.

Sustainable environmental management of road development takes place at six stages of development: tender, feasibility, design, construction, operation and maintenance. In most cases, the guidelines address environmental practices to be followed during these development stages, either individually or collectively.

As a final point, the interrelated, interconnected nature of the "environment" is underscored throughout the guidelines. The nature of the environment is dynamic, in keeping with the maxim that "for every action, there is a reaction." As an example, an action to a biophysical parameter—say, soil resources that are allowed to erode—will provoke a reaction in the socioeconomic sphere—reduced food production, increased food costs and growing human hunger. This pervasive interconnectedness and interrelatedness must be borne in mind whenever changes to the baseline environment are being contemplated. By way of explanation, "baseline" environment refers to the biophysical, socioeconomic and cultural data used as a reference with which to compare future changes and results.

2.0 WATER QUALITY

Numerous activities and actions associated with the road-transport sector can affect water quality: providing a contractor camp, carrying out particular phases of building or rehabilitating a road—namely, site preparation, earthworks, road drainage and road materials—and conveying or crossing water with culverts and bridges.

The primary sources of water contamination in the context of roads are soil sediments and wastes—human, solid, or hazardous, the latter including petroleum hydrocarbons such as petrol, diesel, solvents and bitumen. For the most part, these contamination sources can be mitigated with soil-erosion prevention and sound waste management.

Careless handling or accidental spills of petroleum products—classified as hazardous materials because they are known to be harmful to humans and other life forms—also threatens water quality. In the instance of spills, an emergency response plan to contain and remove petroleum hydrocarbons and other toxic chemicals from the environment must be prepared and enabled by the contractor's environmental specialist and safety/health officer, the latter a member of staff required by the Occupational Safety and Health Act, 2007 (OSHA 2007).

Another less pervasive source of degradation to nearby waterbodies is weather-related. To illustrate: precipitation, falling unexpectedly during the course of certain road-surfacing activities, can degrade water quality when chemicals such as cement or bitumen are carried away with runoff into surface-water drainages.

Water-quality guidelines address the aforementioned activities/actions and the measures within each activity or action to be taken to curtail or control degradation of water resources. Where applicable, the guidelines are specific to a stage of development.

Please note that these guidelines do not replace or supersede the water quality regulations adopted by NEMA. The guidelines are to be used as a complement to NEMA's regulations.

2.1 CONTRACTOR CAMP GUIDELINES

Fig. 2.1. Camp workshop with trenches to retain/redirect water runoff

Contractor camps—also known as construction camps or campsites—are necessary to organize the inputs required for building a road and to accommodate workers, if a labour force cannot be recruited locally or if the work site is remote, two situations that rule out the possibility of housing workers in local villages or towns. Irrespective of worker housing, a camp is required to make office space available for staff (contractor and engineer). It is needed to manage construction equipment and supplies as well as provide areas for fuel storage and equipment repair.

The size of the camp will depend upon the size of the project, which, in turn, will determine the size of the workforce. Obviously, the larger the camp, the greater the potential will be for adverse environmental effects to occur. Size does not necessarily dictate the array of likely environmental issues; it may, however, be a factor in determining issue magnitude and significance. For example, the more people accommodated at the camp, the more solid wastes will be generated, underscoring the need to anticipate environmentally sound management of solid-waste collection and disposal.

In the instances of large projects, it often becomes necessary to separate the two functions—worker accommodation and project management/inputs—from one another. Several camps located along the project-road may be required, primarily to store heavy equipment and fuel.

In all likelihood, water quality will be at risk from diverse camp activities. Onsite actions such as washing, fueling and repairing vehicles and equipment in combination with activities common to building and occupying places of human habitation pose serious threats to surface-water and groundwater resources.

In the instance of used lubricants, waste oil poured down drains or onto the ground can work its way into ground and surface waters and cause serious pollution. Waste oil can contain a variety of contaminants, including lead, magnesium, copper, zinc, chromium, arsenic, chlorides, cadmium and chlorinated compounds.

Accidental spills of toxic petroleum hydrocarbons—petrol, diesel, oil, kerosene and solvents, all common liquids at a camp where vehicles and equipment are fueled, washed, repaired and stored—must be handled promptly and carefully according to an emergency spill response plan.

One litre of waste oil can contaminate one million litres of drinking water.

Camp construction entails site preparation and earthworks, activities that remove soil cover, exposing the soil to the erosive forces of water and wind. Eroding soil—itself an indicator of land degradation—impairs water quality. As well, numerous other activities during construction and operation of the contractor camp can accelerate soil erosion.

2.1.1 Development Stage: Tender

2.1.1.1 In conjunction with the EIA Study required at feasibility stage for the road project, an EMP is to be developed for the contractor camp that reflects the recommendations (mitigation measures) put forward in the EIA for location, construction, operation and decommissioning of the contractor camp.

2.1.1.2 Standard and special specifications applicable to road-transport development will integrate relevant water-related environmental guidelines, including but not limited to roads and bridges environmental guidelines, into all requests for proposal (RFP). The appropriate guidelines may not be exclusive to contractor camps, but they will be valid for activities and actions common to site preparation and construction of the camp and road infrastructure.

2.1.1.3 The TOR for the RFP are to include all relevant regulations and standards adopted by the NEMA.

2.1.2 Development Stage: Feasibility


Fig. 2.2. Unsafe disposal of used oil filters

At the feasibility stage when the viability of constructing or rehabilitating the road is being studied, the size of the project and workforce will be known. The proposed location for the contractor's camp should be identified at this stage in concert with the EIA Study Report recommendations captured in the EMP for the contractor camp. Additionally, the terms of reference (TOR) for forthcoming construction will be formulated at the design stage. These TOR are vital in maintaining a focus on environmental matters and management.

The requirement for the contractor's safety/health officer to develop an emergency spill-response plan is to be included in the TOR; the plan is to address the measures needed to contain and remove any hazardous materials that have been spilled within the camp facilities or at any ancillary work and/or storage sites. Mechanical spill containment measures such as booms, barriers, etc., as well as clean-up methods, e.g., sorbent materials and dispersing, gelling and/or biological agents, are to be investigated and recommended for their utility and availability in containing and removing spills of hazardous substances.

At the feasibility stage, reuse or recycling of camp-generated wastes that **might** be incorporated into camp designs are to be investigated: for example, minimising the (1) volume of A4 or A3 paper wastes by printing on both sides; (2) proliferation of plastic carrier bags by reusing them or redirecting them to work areas for temporary storage of parts or tools; (3) accumulation of plastic water bottles by offering them to nearby enterprising companies for fabrication into fencing posts; or (4) discard of empty food containers by reusing them for food storage or food takeaway. Grey water from kitchens and bathing facilities is ideal for supplemental irrigation of camp landscaping because it contains detergents with residual nutrients—phosphorous and nitrogen—that encourage plant growth.

To prevent or reduce the likelihood of impairing water quality and human health from camp construction and operation, the following guidelines will be implemented.

2.1.2.1 Compliance with Relevant Regulations, Standards and Guidelines

2.1.2.2 The TOR for the feasibility study are to include the preparation of an EMP for the contractor camp that reflects the EIA Study Report recommendations and all applicable requirements set forth in MoR's environmental guidelines as well as all relevant regulations and standards adopted by NEMA.

2.1.2.3 To assure that development undertaken for the road-transport sector is environmentally sound by protecting or improving prevailing water quality, environmental guidelines relevant to water quality and the specific action or activity must be reflected in the feasibility study TOR and in TOR forthcoming from feasibility findings and recommendations.

2.1.2.4 Location and Closure of Contractor Camp

2.1.2.5 Identify at feasibility stage a contractor campsite to assure land supply and suitability. Avoid selecting a location contiguous to a village or town, unless the community resident within the village or town agrees to this location.

2.1.2.6 In consultation with members of an affected community, identify at feasibility stage the options for after-use of the camp. A range of options, including any requirement for the camp to remain active during defects liability, is to be evaluated in preparation for drafting a decommissioning plan, which is to be implemented after completion of the road project. Construction TOR are to stipulate that the plan is to be submitted to local NEMA staff and the county council.

2.1.2.7 Avoid a camp location that adjoins a river or lake or that falls within a natural drainage, wetland, delta and/or other environmentally sensitive area.

2.1.2.8 A suitable camp site would be located on level land, except when the site in question is under cultivation. In lieu of temporarily or permanently removing agricultural land from production, an alternative should be identified.

2.1.2.9 **Compensation and Resettlement of Land Owners/Users**

2.1.2.10 All arrangements for compensation and resettlement of land owners and/or occupants are to be investigated at feasibility stage. Because fair and equitable compensation is to be paid in accordance with prevailing land policy and the Land Acquisition Act, Cap 295, the total compensation budget can be estimated at this stage of project development.

2.1.2.11 If the provisional camp site is not accessible by public road, the costs for compensating (and relocating, if absolutely necessary) land occupants and/or owners from the alignment for the access road can be determined at feasibility. Fair and equitable rates of compensation in accordance with prevailing land policy and the Land Acquisition Act, Cap 295, are to be used to determine costs.

2.1.2.12 **Potable Water, Wastewater Treatment and Solid Waste Management**

2.1.2.13 Determine availability, quality and predicted quantity of surface water or groundwater to satisfy camp requirement. Proposed abstractions, whether surface or ground, must be permitted by the Water Resources Management Authority (WRMA), a state corporation under the Ministry of Water and Irrigation. The permit process is outlined on the WRMA website, www.wrma.or.ke. Water-abstraction permission from WRMA will assure that pre-existing water rights and use will not be abridged by the road project for its ancillary water needs.

2.1.2.14 Determine soil characteristics to evaluate suitability for wastewater collection and treatment, i.e., septic tank and leach field (or absorption trenches).

2.1.2.15 Investigate reuse/recycling opportunities for camp-generated wastes. Reuse and recycling of particular items in the waste stream reduce generation volume and treatment requirements, thereby altering the designs for waste management.

2.1.3 Development Stage: Design

The designs for the contractor camp commonly include provisions for

- worker accommodation and welfare
- sleeping accommodation
- ✓ toilet and bathing facilities
- ✓ cooking and eating facilities
- ✓ clinic with first-aid supplies/equipment, condoms and illustrated materials informing about HIV/AIDS awareness and prevention
- recreation facilities (sports, movies, music, etc.) that are separated from living accommodations and nearby settlements
- ✓ staff offices and, if required, accommodation with toilet and bathing facilities
- ✓ storage areas for construction materials, vehicles and equipment
- ✓ storage areas for fuels and lubricants
- ✓ fueling areas
- ✓ vehicle/equipment washing areas
- ✓ work areas (mechanics shop)

Items listed and ticked (✓) above signify actions and activities with potential adverse impacts to water quality. Unticked items pose no threat to the environment. Therefore, designs for the ticked items are to take into account the guidelines and NEMA water-quality regulations.

2.1.3.1 Toilet wastes/wastewater are to be retained and treated onsite; VIP latrines (sealed vault) or conventional toilets with water-borne connections to a septic system are to be provided; and greywater produced from bathing and clothes washing is to be collected separately and used for supplemental water, mainly for irrigating landscaping or gardens.

2.1.3.2 An adequate number of lavatory and ablution facilities is to be provided for workers, the former type of facility for the work camp (when separate from the accommodation camp) and both types in the accommodation camp. The

number—ratio of workers to lavatory/ablution facility—is to be determined using national or international regulations and standards.

2.1.3.3 Design special spill-retention areas for fueling and repairing vehicles/heavy equipment, i.e., areas fully enclosed with impermeable bunds (low curb or dike) and base whereby spilled or leaked fuels are captured in a sump or holding tank for removal to a facility capable of treating and disposing of hazardous wastes. The spill retention area should also be equipped with an oil/water separator to allow the routine discharge of collected rainwater.

2.1.3.4 Design special areas with secondary containment for fuel and lubricant storage; the areas are to be fully enclosed with impermeable bunds (curb or dike) and base to capture spilled or leaked fuels in a sump or holding tank for removal to a facility capable of treating and disposing of hazardous wastes. The containment area should also be equipped with an oil/water separator to allow the routine discharge of collected rainwater.

2.1.3.5 The elements of an emergency spill-response plan investigated during feasibility are to be reviewed for thoroughness and effectiveness; the final definition and contents of the emergency response plan are to be included in construction TOR.

2.1.3.6 Site drainage is to be designed to include provisions for sedimentation or retention ponds to avoid off-site discharge of surface-water runoff carrying high sediment loads.

2.1.3.7 A decommissioning plan—either to remove or reuse the physical site improvements—is to be completed during the design phase. Upon completion, the decommissioning plan is to be filed with local authorities, including local NEMA representatives and the county council, to assure full compliance.

2.1.4 Development Phase: Construction

2.1.4.1 Landowners or land-users occupying the selected camp site and, if required, the camp access road are to be compensated for temporary (or perhaps permanent) land acquisition and use. Although an estimated compensation budget was prepared from compensation rates valid at the time of feasibility, the rates must be reconfirmed to assure that land owners/users are being fairly and equitably compensated in accordance with the prevailing land policy and the Land Acquisition Act, Cap 295.

2.1.4.2 Depending upon the provisions of government compensation laws (with particular reference to the Land Acquisition Act, Cap 295), policies and practices, the land occupant should ideally be given vacation notice of six (6) months and no less than three (3) months.

2.1.4.3 Compensation agreements and payments are to be witnessed by an official from the local authority as well as a MoR or Road Authority representative.

2.1.4.4 Vegetation removal at the site-preparation stage (preliminary to actual construction) is to be minimized, and all soils disturbed by site earthworks

are to be revegetated without delay using indigenous or naturalized grasses (e.g., a creeper grass, Cynodon dactylon, that is naturalized in Africa due to the frequency of its use in soil-erosion prevention and control). In addition, indigenous trees and shrubs are to be planted at the camp to further deter soil erosion and provide shelter for cooling.

2.1.4.5 At this point in the camp development, relevant water-quality environmental guidelines and water-quality measures captured in the EMP are to be carefully implemented. These guidelines will have been integrated into the design plans for specific actions/activities by way of building that does not harm water quality in particular and the biophysical, socioeconomic and cultural environments in general.

2.1.4.6 An emergency spill-response plan is to be prepared and facilitated by the contractor's environmental specialist and safety/health officer; the plan will consist of the containment/recovery measures identified at the feasibility stage along with the procedures required to alert workers, nearby residents and local officials to the spill incident. The procedures to evacuate any affected workers and nearby residents must also be elaborated in the emergency plan.

2.1.4.7 Irrespective of design plans that reflect environmental protection of water quality, monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (Directorate of Safety and Health Services, DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.1.5 Development Stage: Operation

2.1.5.1 Used engine oil is to be handled and disposed of according to NEMA regulations/MoR policy or stored for onward delivery for recycling or reuse. Irrespective of regulatory authority and guidance, used oil is to be containerized and temporarily stored onsite in a secure store, i.e., a fully fenced area with an impervious floor and encircled with impermeable bunds (low curb or dike) to capture spilled or leaked fuels in a sump or holding tank for removal to a facility capable of treating and disposing of hazardous wastes. The spill retention

area should also be equipped with an oil/water separator to allow the routine discharge of collected rainwater.

2.1.5.2 Oil-contaminated wastewater collected from sumps in spill-retention areas is to be containerized and stored in the camp's secondary-containment section, along with used engine oils, in preparation for disposal at a hazardous waste site.

2.1.5.3 Used and containerized engine oil may be stored in common with fuels and lubricants in a fenced area fitted with a secondary-containment system.

2.1.5.4 Fuel spills during transfers from tanker trucks to storage tanks must be controlled by providing shut-off valves on hose ends and installing fixed stanchions to secure hoses in upright positions in an effort to prevent residual siphoning.

2.1.5.5 The emergency spill-response plan developed at the construction stage is to be reviewed for its soundness; any measures overlooked or underestimated in its initial scope, including the methods and procedures required for effective containment and recovery of the spilled materials, are to be remedied and incorporated into a revised plan.

2.1.5.6 Vehicles and/or equipment are to be fueled in an area designed for spill retention, i.e., an area partially enclosed (enclose on downhill sides of fuel station if ground is not level) with impermeable bunds (low curb or dike) and base whereby spilled or leaked fuels are captured in a sump or holding tank for removal to a facility capable of treating and disposing of hazardous wastes. The spill retention area should also be equipped with an oil/water separator for routine discharge of collected rainwater.

2.1.5.7 All fuel supplies are to be in an area designed for secondary containment, i.e., an area fully enclosed with impermeable bunds (low curb or dike) and base to capture spilled or leaked fuels in a sump or holding tank for removal to a facility capable of treating and disposing of hazardous wastes. The containment area should also be equipped with an oil/water separator to allow the discharge of collected rainwater.

2.1.5.8 Advise camp residents about prohibitions against harvesting local fuelwoods and poaching game animals; thereafter, rigorously enforce the restrictions.

2.1.5.9 Enforce water-quality regulations and standards adopted by NEMA (Legislative Supplement No. 36 of 2006).

2.1.6 Development Phase: Maintenance

In order to dispose properly of human wastes collected in **sealed-vault ventilated pit latrines**, several options are available. The first option is to contract with a commercial waste evacuator to collect the wastes from the vaults and dispose of them in a nearby wastewater-treatment plant. In the absence of an available or nearby treatment facility, latrine wastes can be transferred to a camp septic system for anaerobic decomposition.

When septage wastes must be removed, either they can be collected and discharged at a wastewater-treatment plant **or** they can be spread on land.

- Land application of septage sludge is neither novel nor is it unsafe, if certain prescribed conditions are followed. Land application—safely practiced in many countries throughout the world—is permissible
- on remote lands without human occupation/use,
- on slopes less than 12 percent or
- not within 10km of a stream, river, lake or wetlands.

2.1.6.1 Remove all wastes from camp pit latrines and septic tanks on a routine basis or, if required, more frequently; these wastes are to be transported to a licensed wastewater-treatment facility. Pit-latrine wastes can be disposed of in a camp septic system for subsequent sludge treatment/disposal. In camps distant from treatment facilities, land application of septage sludges is permissible on remote lands without human occupation/use, on slopes less than 12 percent or outside 10km of a stream, river, lake or wetlands.

2.1.6.2 Inspect and repair, if necessary, spill-retention and secondary-containment systems to assure their structural integrity and impermeability.

2.1.6.3 Update, when and as required, the emergency spill-response plan.

2.1.6.4 Systematic and thorough monitoring is essential to assure the implementation of these environmental measures. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter.

2.1.6.5 As the roadworks come to an end, the preplanned actions and activities described in the decommissioning plan are to begin. Prepared at design stage, the plan lays out the steps to be taken to disassemble the camp or convert it to an agreed-upon, post-project completion use.

To organize monitoring activities, an administrative form is included in Appendix C.

2.2 SITE PREPARATION GUIDELINES

Site preparation involves clearing vegetation from the road right-of-way (ROW) or road reserve. At this stage, trees, shrubs and grasses—nature's umbrellas meant to protect soil from water and wind erosion—are removed, and soil erosion accelerates.

Erosion degrades soil, the medium necessary for growth and reproduction of green plants, themselves absolutely essential to life support on this planet. (Through the process of photosynthesis, green plants convert carbon dioxide to oxygen, the gas required by all living organisms other than anaerobic microorganisms.) Erosion degrades water

resources when soil particles travel in surface-water runoff to waterbodies, increasing turbidity while they are suspended and harming benthic organisms when they settle.

To control and reduce adverse impacts to water quality from site preparation, the following environmental guidelines are to be followed.

2.2.1 Development Stages: Tender, Feasibility and Design

2.2.1.1 The TORs for tender of the feasibility study and subsequent design are to stipulate that all applicable requirements set forth in MoR's environmental guidelines as well as all relevant regulations and standards adopted by NEMA will be included in forthcoming TORs.

2.2.1.2 Tender TORs for feasibility and design are to stipulate that vegetation clearance within the ROW is to be restricted to the minimum allowable width required for road safety. All trees found within a 10 metre-wide zone or strip (measured from the opposite outer edges of the ROW toward the road centerline) are to be retained. Upon completion of the road, any trees that compromise road safety can be removed.

2.2.1.3 Earthworks, i.e., bulldozing and grading, is to be restricted to those portions of the ROW from which trees and shrubs have been removed. Soil cover is not to be removed within the outer ROW 10-metre wide retention strip where trees and shrubs have not been cleared and grubbed.

2.2.2 Development Stage: Construction

Contractors routinely remove all vegetation from the entire width of the road ROW. These guidelines instruct differently: vegetation—trees, shrubs and grasses—is to be retained inside a 10m-wide strip along the outer edge of each side of the ROW (with the exception of some urban roads where the ROW is simply inadequate to follow this recommendation). To assure that this guideline is carried out on the ground, monitoring is necessary.

2.2.2.1 Cleared vegetation is not to be discarded into any rivers or lakes. Trees felled during site preparation can be made available to the contractor's camp, nearby communities, military installations or industrial operations for use as timber or fuelwoods.

2.2.2.2 Special specifications stipulate retention of vegetation within a predefined and demarcated zone or strip on the outside 10m of the road ROW; monitoring to assure implementation of relevant special specifications and this environmental guideline is essential.

2.2.2.3 Monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for

example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.2.3 Development Stages: Operation and Maintenance

The operational phase entails no application of the guidelines beyond assuring that trees and shrubs within the prescribed ROW retention strip (outer 10m) are not removed. Monitoring is required.

However, to control erosion from soils that are disturbed during site preparation, reseeding or replanting with grass plugs is probably required. A helpful guide in determining the need for replanting/reseeding interventions assesses amount and rate of regrowth.

After earthwork, in areas with rainfall ≥1000mm per year, reseeding/replanting may be necessary if disturbed sites have failed to establish 80 percent plant coverage within 1 month. In areas with ≤1000mm precipitation per year, disturbed soils may require immediate replanting to prevent erosion. Annual rainfall notwithstanding, monitoring the rate and amount of plant recovery on disturbed soils is important.

Weather conditions also dictate timing for reseeding or replanting interventions. If the ROW inside the retention zone has been cleared in the dry season, replanting or reseeding may be contraindicated until ample moisture is available to insure plug survival or seed germination. Conversely, if site preparation occurs during the rainy season, exposed soils should be closely monitored to determine if the resident seed bank **might** be sufficient to reestablish grass cover without supplemental reseeding or plugging.

The objective is to restore as quickly as possible natural vegetation to any soils disturbed during site preparation in order to prevent soil erosion and degraded water quality. Matting or mulching with cleared plant materials—dried grasses or woody shrubs—may be required to protect reseeded/replanted ground until sprouts or plants are established, especially on cleared slopes or drainages. During the maintenance stage, reseeding/replanting is required for any areas that remain without grass cover, irrespective of earlier interventions.

2.2.3.1 Continue monitoring the 10m retention strip on the outside edges of the ROW to assure that no trees or shrubs are cleared, with the exception of invasive plants.

2.2.3.2 To control erosion from disturbed soils, in areas with annual rainfall ≥1000mm, reseeding/replanting may be necessary if new grasses on disturbed sites have failed to establish 80 percent plant coverage within 1 month and, in areas

with ≤1000mm annual precipitation, disturbed soils may require immediate replanting to prevent erosion (unless weather conditions dictate otherwise).

2.2.3.3 If the ROW has been cleared in the dry season, reseeding or replanting may be contraindicated until ample moisture is available to insure seed germination or plug survival. Conversely, if site preparation occurs during the rainy season, exposed soils should be closely monitored to determine if the resident seed bank might be sufficient to reestablish grass cover without supplemental reseeding.

2.2.3.4 Matting or mulching with plant materials—dried grasses or woody shrubs—that have been cleared from the site may be required to protect replanted/reseeded ground until grasses are established, especially on cleared slopes or drainages.

2.2.3.5 During the maintenance stage, replanting or reseeding is required for any areas that remain without grass cover, irrespective of earlier interventions.

2.2.3.6 Regular maintenance of vegetation within the road ROW is necessary to preserve road safety, particularly sufficient sight distance on roads where NMT users, livestock, wildlife or intersecting roads are encountered.

2.2.3.7 Regular maintenance of vegetation within the road ROW is to be done using manual or mechanical means. Chemicals (herbicides) are not recommended, irrespective of road proximity to waterbodies. Manually maintaining the ROW provides work opportunities for casual laborers, an important factor in creating more jobs.

2.2.3.8 At the time of manual or mechanical maintenance of vegetation within the ROW, any and all maintenance laborers are to be advised that poaching of wildlife and/or harvesting of endangered plant species as well as hardwoods in protected areas is strictly forbidden. To assure compliance with this advisory, NEMA, the Kenya Forest Service (KFS) and Kenya Wildlife Service (KWS) are to be notified that ROW maintenance in particular road sectors is underway.

To organize monitoring activities, an administrative form is included in Appendix C.

2.3 EARTHWORKS GUIDELINES

The purpose of earthworks is to "work" the existing "earth" to a suitable level or shape so road construction can begin. In addition to site preparation, earthworks also take place when "cutting" and "filling" of earthen materials occur. Both actions are common in road building, and both hold high risks for adverse impacts to water quality in nearby watercourses or waterbodies, including wetlands.

As a matter of principle, disturbance to in-situ soils must be kept to an absolute minimum and to the required level. Unnecessary earthworks increase the threats to water resources.

Water-quality degradation notwithstanding, improperly planned cutting and filling can add substantial economic and environmental costs to a road project when additional

Fig. 2.3. Earthworking, Timboroa

materials must be collected or disposed of. In order to minimise material borrow or disposal, a mass-haul diagram should be produced at design stage.

In its essence, a mass-haul diagram plots cumulative volume of soil against discrete road distance, often called "chainage." In its execution, a mass-haul diagram helps to avoid costly situations in which too much cut material must be disposed of (under-estimating the amount of material produced in cuts) or too many borrow pits have been excavated (over-estimating the amount of supplemental material needed).

2.3.1 Development Stages: Tender and Feasibility

During feasibility, the probable locations for acceptable road-building materials are investigated. Suitable materials for filling, bedding and surfacing are required, the quantities dependent upon the location and design of the road.

Haul distances from material source to project site are factored into economic-cost calculations. Likewise, the costs of reinstating borrow pits and quarries in accordance with national/international standards must be factored into cost equations.

For new road construction, suitable road alignments are identified as well at the feasibility stage. Identifying an alignment that minimizes cuts and fills ultimately reduces all costs—financial, economic and environmental—associated with building a road.

When new alignments are contemplated for rehabilitated roads, the same maxim applies: avoid road alignments that entail extensive cutting and filling, particularly in or near sensitive ecosystems (e.g., wetlands) that limit options for material sources and disposal sites. Identify an alternative alignment, even if the alternative only marginally reduces cuts and fills.

2.3.1.1 Consider the costs of reinstating (reclaiming) borrow pits and quarries when deciding upon material sources to be put forward in the feasibility study findings and recommendations.

2.3.1.2 The TOR for the tender of the feasibility study are to stipulate that all applicable requirements set forth in MoR's environmental guidelines as well as all relevant regulations and standards adopted by NEMA will be included in forthcoming TORs.

2.3.2 Development Stage: Design

Designs forthcoming from the winning tender recognize the economic and environmental advantages of selecting an alignment that avoids extensive and expensive cutting and

filling. A mass-haul diagram can also be produced that will guide subsequent selection—location and number—of borrow pits.

Additionally, an erosion and sediment control plan (ESCP) must be prepared. The ESCP ensures that potential soil erosion and sediment transport to nearby surface-water resources are addressed at the design stage, one of the most crucial stages of the road project.

After attempting to minimise the extent of land disturbance through a mass-haul diagram and subsequent grading plan, a good ESCP (1) focuses on erosion prevention (minimising disturbed areas and restoring disturbed areas by seeding, mulching or matting), (2) controls the amount of soil that can run off, and, (3) stabilizes exposed soil.

Erosion **prevention** measures are far more effective than sediment control measures (e.g., silt fences) and should be the primary focus of any ESCP.

2.3.2.1 Situate and design the road alignment to avoid extensive and expensive cutting and filling.

2.3.2.2 Prepare a mass-haul diagram to aid the contractor in correctly selecting borrow pits, appropriate in terms of location and number.

2.3.2.3 To avoid consequential soil erosion from cutting and filling, an erosion and sediment control plan (ESCP) is to be prepared for and applied by the contractor. The ESCP responds to the findings and recommendations of the mass-haul diagram and subsequent grading plan that strive to minimise soil disturbance, particularly soils disturbed by unwarranted earthworking at road or materials sites.

2.3.2.4 To avoid adverse environmental impacts to water quality from earthworks for the road or materials development, the requirements set forth in MoR's environmental guidelines as well as all relevant regulations and standards adopted by NEMA are to be reflected in designs for these activities and actions.

2.3.3 Development Stage: Construction

2.3.3.1 Borrow-pit and quarry reinstatement costs, along with haul costs, will be factored into a contractor's decisions about selecting or eliminating materials sites.

2.3.3.2 The mass-haul diagram, prepared at design stage, is to be used by the contractor in deciding upon how many borrow pits are required and at what location.

2.3.3.3 Select materials sites that minimise risks to water resources, i.e., avoid opening sites adjacent to streams, rivers, lakes or wetlands.

2.3.3.4 Implement the ECSP prior to beginning earthworks at cut/fill, borrow or quarry sites.

2.3.3.5 At this point in the road-project development, relevant water-quality environmental guidelines are to be carefully implemented. These guidelines will have been integrated into the design plans for specific actions/activities to avoid harming water quality in particular and the biophysical, socioeconomic and cultural environments in general.

2.3.3.6 Irrespective of design plans that reflect environmental protection of water quality, monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.3.4 Development Stages: Operation and Maintenance

2.3.4.1 Update the mass-haul diagram and grading plan, if changes in road design or alignment indicate changed volumes of materials.

2.3.4.2 If circumstances change, update the ESCP as indicated.

2.3.4.3 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse impacts to water quality. EMCA 1999 requires annual environmental audits of roads under construction; however, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter. Irrespective of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in Appendix C.

2.4 DRAINAGE GUIDELINES

Effective road drainage is critical, if the designed serviceable life of the road is to be attained and if pollution of nearby water resources is to be avoided. Road drainage is complex—it entails moving water away from the road's surface, subsurface and edges.

Accepted as fact by road designers and builders alike, drainage is fundamental to a road's structural performance and its likely impacts on water quality. Three key aspects of sound road design are agreed: drainage, drainage, drainage.

Drainage also involves moving water beneath the road. However, this aspect of road drainage is examined more fully in environmental guidelines for conveying water with culverts or under bridges.

Natural drainage patterns influence designed and engineered drainages. Therefore, gaining insight into natural conditions and patterns before drains are designed is central to protecting the road and the environment.

A lack of foresight in understanding natural drainage patterns and flows often results in uncontrolled road drainage onto adjacent farmlands. The consequences to a farmer can be disastrous, at once causing structures to be inundated, crops to be uprooted and gullies to form on land that once supported farming. This situation can be avoided by either redirecting surface-water flows from the road to retention basins or trenches located away from farmland or coming to a mutual agreement with a farmer to move the water onto his land in drainage ditches that slow and spread water flows to the farmer's benefit. Failing either of the foregoing, the farmer must be fairly and equitably compensated for lost crops and degraded land, a process that must comply with prevailing land policy and the Land Acquisition Act, Cap 295.

Fig. 2.4. Poorly designed road drainage onto farmland

Water must be moved away from the road surface, an action that is usually accomplished by creating a crown that gently slopes (2 to 5 percent) from the middle to the outside edges of the road. Water from the road surface is then collected in side ditches (V-drains) where it can infiltrate into the soil. Water in excess of the soil's infiltration capacity is conveyed away from side ditches, usually in mitre drains, also known as lead-off or off-shoot drains. Water is moved from one side of the road to the other with cross-drains using culverts.

Road drainage depends upon a designed and engineered system that attempts to direct and control the movement of surface water. When water volume or water velocity overwhelms a drainage system, the likelihood of soil erosion and degraded water quality increases downstream. Velocity in side drains or culvert outlets can be checked with energy dissipaters such as check dams, rock-lined outfalls and reinforced splash aprons. In steep terrain, side drains may require rock linings to prevent gully erosion.

Another method of dissipating flow energy depends upon a plant called "vetiver," a native of southern India. According to a May 2010 publication co-authored by Kenya Rural Roads Authority (KeRRA) for the R2000 programme, **Guidelines for Prevention and Control of Soil**


Fig. 2.5. Eroding sidedrain, Mutomo town

Erosion in Road Works, a technique known as the Vetiver System (VS) uses vetiver grass in engineering applications to stabilise slopes, control gully erosion and dispose of wastewater in addition to other environmental protection objectives. VSs are cost-effective and low-maintenance for conserving soil and water resources in road building.

After many years of its use elsewhere in the world for soil and water conservation, clonal domesticated vetiver (Vetiveria zizanioides, newly classified as Chrysopogon zizanioides) has not been found to be invasive, an important consideration in protecting Kenya's rich biodiversity. However, the wild northern India variety—also classified as Vitiveria zizanioides—is thought to be invasive because it can produce fertile seeds. Indigenous to the northern Ganges River basin, it is not recommended for planting outside its home range.

Consequently, early consultations about appropriate VS applications and species selection are advised with an experienced agronomist or botanist, knowledgeable about the species and area in question. To underscore: **only an expert can correctly identify sterile varieties of vetiver**.

The efficacy of energy dissipaters in controlling soil erosion depends upon many factors, including soil characteristics, topography, climatic variations, engineered design capacity, correct installation and routine maintenance. Several schemes can be used to augment conventional road drainage systems in limiting soil erosion and sediment transport:


Fig. 2.6. VS gully erosion control

- Detention ponds or basins temporarily store runoff from a site and release it at a controlled rate to minimise downstream flooding. Detention ponds are very effective in removing suspended sediments (80 percent or more removal) and related pollutants such as heavy metals.
- Infiltration trenches are shallow (1 to 2.5 metres) excavated trenches that are backfilled with stone to create underground reservoirs. Runoff, which is diverted into the trenches, then percolates into the subsoil. Properly designed infiltration trenches effectively remove sediment from runoff and several other pollutants.
- Infiltration basins are fairly large, open depressions shaped either by natural topography or excavation. When runoff enters an infiltration basin, the water percolates through the bottom or the sides, trapping the sediments. The soil in which an infiltration basin is sited must be sufficiently permeable to allow

adequate infiltration. Some pollutants other than sediments are also removed in infiltration basins.

In addition, the above mentioned publication, **Guidelines for Prevention and Control of Soil Erosion in Road Works,** offers suggestions for the planning, design, construction and monitoring of commonly used drainage structures in Kenya. The reader of these guidelines is encouraged to peruse the KeRRA **Guidelines** to improve the sustainable management of soil resources.

Finally, an erosion and sediment control plan (ESCP) must be prepared to ensure that the designs of the drainage system take into account potential soil erosion and sediment transport to nearby surface-water resources. The ESCP:

- focuses on erosion control (minimising disturbed areas and restoring disturbed areas by seeding, mulching or matting);
- controls the amount of soil that can run off; and,
- stabilises exposed soil.

2.4.1 Development Stages: Tender, Feasibility and Design

At these early stages of road-project development, relevant physical characteristics (hydrologic, meteorological, geologic, pedologic and geomorphologic) of the proposed road alignment are studied. Findings and conclusions from these physiographic studies contribute to an understanding of surface drainage formation, knowledge that will later inform road-drainage designs.

Surface-water runoff of unprecedented proportions is associated with new deforestation or vegetation removal from the upper catchment of a road, frequently occurring after the road has been in operation and sometimes many years after its completion. When these events happen, unexpected challenges for effective road drainage are encountered that complicate road maintenance.

The feasibility study should assess the prospects for long-term vegetation cover in the project road's upper catchments, particularly identifying sections vulnerable to clearing. The study report should emphasize the importance of upper-catchment vegetation protection, underscoring its importance where gradients leading to the road are steep enough to cause dangerous surface-water runoff, if ground cover is removed or reduced.

2.4.1.1 In addition to protecting the roadbed and road surface, a primary purpose of the final drainage designs is to curtail surface-water runoff, soil erosion and subsequent water-quality degradation. This environmental objective must be kept in mind in drain design.

2.4.1.2 Where appropriate, the feasibility of entering into joint agreements with owners and/or users of farmland adjacent to the road corridor for the express purpose of capturing and delivering excess water runoff from the road for supplemental irrigation are to be investigated.

2.4.1.3 Construction TOR are to stipulate that any agreement between the contractor and an adjacent owner or user of farmland for capture and delivery of road surface-water runoff is to (1) be in writing; (2) include full details about the engineering required to reduce flow velocity and distribute flow volumes to locations specified by the farmland owner/user; (3) be witnessed by the Engineer; and, (4) be filed with the local representatives of NEMA and the county council.

2.4.1.4 Prepare an erosion and sediment control plan (ESCP) to augment and guide drainage designs. The ESCP, which incorporates soil characteristics, vegetative cover, topography and climate relevant to the road-project site and its surrounds, has bearing on the design and engineering of the road drainage system.

2.4.1.5 The ESCP is to make particular note of upper and lower catchments where removal of vegetation would compromise road-design integrity; special provisions in the ESCP may be necessary to respond to these soil-erosion eventualities.

2.4.1.6 In steep terrain (slopes greater than 10 percent), side drains may require lining or pitching with stone. In this context, lining implies drain bottom and sides.

2.4.1.7 In terrain with slopes ranging between 4 to 10 percent, side drains may require structures such as check dams, scour checks (either at level or raised), etc., to reduce water velocity.

2.4.1.8 Determine the utility of VS for soil-erosion controls (stabilising side slopes in sidedrains or trapezoidal infiltration trenches and/or, when combined with check dams, slowing the velocity of water in side drains).

2.4.1.9 Energy dissipaters—check dams, rock-lined outfalls and reinforced splash aprons—are to be used in side drains and culvert outfalls in dissected or rolling terrain with high rainfall.

2.4.1.10 Where meteorological and soil conditions indicate a need for additional drainage measures to control soil erosion and sediment transport, auxiliary sediment-control systems such as detention ponds, infiltration trenches and infiltration basins will be evaluated for their project suitability.

2.4.1.11 In designing the drainage system for the project road, the RFP with TORs for tender of feasibility and design are to stipulate that all applicable water-quality requirements set forth in relevant environmental guidelines, in particular water-quality regulations and standards adopted by NEMA (Legislative Supplement No. 36 of 2006), will be included in forthcoming TORs.

2.4.2 Development Stage: Construction

2.4.2.1 Install adequately spaced and sized mitre drains to move water away from the road bed and out of side drains.

2.4.2.1 Complete any agreements between the contractor and owners/users of adjacent farmland willing to receive road surface-water runoff identified during the feasibility and design stages; these agreements are to (1) be in writing; (2) include full engineering details required to reduce flow velocity and distribute flow volumes to locations specified by the farmland owner/user; and (3) be approved and witnessed by the Engineer. A copy of each agreement is to be provided to the local NEMA representative.

2.4.2.3 **Stone-pitch side drains, if required by road gradient**.

2.4.2.4 Install side-drain structures, if required by road gradient, to reduce flow velocity.

2.4.2.5 Install VS as indicated in consultation with representatives from NEMA and knowledgeable botanists from the Ministry of Agriculture.

2.4.2.6 Implement conditions and practices called for in the ESCP.

2.4.2.7 Install energy dissipaters, the type and location indicated in the drainage plan.

2.4.2.8 Install auxiliary sediment-control systems (detention ponds, infiltration trenches or infiltration basins) as and where designated in the drainage plan.

2.4.2.9 At this point in building the road drainage system, relevant water-quality environmental guidelines are to be carefully implemented. These guidelines will have been integrated into the drainage designs to avoid harming water quality in particular and the biophysical, socioeconomic and cultural environments in general.

2.4.2.10 Irrespective of design plans that reflect environmental protection of water quality, monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.4.3 Development Stages: Operation and Maintenance

If the environmental guidelines for road drainage have been implemented as envisioned, likely adverse impacts to water quality from soil erosion and sediment transport will

have been mitigated satisfactorily. However, changing conditions can overtake the best intentions.

Therefore, monitoring at the operation and maintenance stages becomes important to ascertain whether or not the drainage system is functioning as designed and whether or not changed conditions and events warrant modifications to the system. These indicators will become known at the stage of road operation when natural runoff volumes have increased due to reduced water infiltration (impermeable road surface).

Fig 2.7. Inadequate drainage system, Miathene

Drainage works to distribute road surface-water runoff to adjacent farmlands for supplemental irrigation must be monitored to assure proper design and function. In the event that road drainage has adversely impacted farmland, irrespective of prior agreements, the owner/user of that land is to be fairly and equitably compensated according to prevailing land policy and the Land Acquisition Act, Cap 295.

Equally important to the monitoring exercise is maintenance oversight. Drainages require routine and periodic maintenance—for example, removing debris from side drains, unclogging cross drains and replacing dislodged stone dissipaters or drain linings.

2.4.3.1 Inspect mitre drains to assure that sidewalls have not collapsed or that debris has not reduced their capacity and flow characteristics. Remove debris and re-excavate, if required. Discard debris in an area designated for disposal of inert construction rubble (cement and oversized rock), i.e., out of a drainage, on dry uncultivated land and away from human habitation.

2.4.3.2 Inspect drainage works used to distribute road surface-water runoff to adjacent farmlands as supplemental irrigation for proper design and function. In the event that road drainage has adversely impacted farmland, irrespective of prior agreements, the owner/user of that land is to be fairly and equitably compensated according to prevailing land policy and the Land Acquisition Act, Cap 295. Corrective measures to the failed drainage works are to be instituted.

2.4.3.3 Inspect and remove debris from inlets/outlets on cross drains. Dispose of debris away from watercourses and waterbodies, including wetlands. Discard debris in an area designated for disposal of inert construction rubble (cement and oversized rock), i.e., out of a drainage, on dry uncultivated land and away from human habitation.

2.4.3.4 Inspect and remove debris from side drains. Dispose of debris away from watercourses and waterbodies, including wetlands. Discard debris in an area designated for disposal of inert construction rubble (cement and oversized

rock), i.e., out of a drainage, on dry uncultivated land and away from human habitation.

2.4.3.5 Inspect VS plants and replace as required.

2.4.3.6 Inspect and repair stone-pitched side drains to assure that pitching is in place.

2.4.3.7 Inspect and repair side-drain structures installed for flow-velocity control.

2.4.3.8 Update ESCP, if indicated.

2.4.3.9 Inspect energy dissipaters in side drains and at culvert outfalls to assure proper performance. Replace and/or augment, if required.

2.4.3.10 If applicable, inspect and remove sediments from auxiliary sediment-control systems. Dispose of sediments in exploited borrow pits awaiting reinstatement.

2.4.3.11 Enforce water-quality regulations and standards that have been issued from NEMA (Legislative Supplement No. 36 of 2006).

To organize monitoring activities, an administrative form is included in Appendix C.

2.5 BORROW PITS GUIDELINES

To build a road, numerous natural resources are required: rock, gravel, sand and water to name the most common. In strictly economic/financial terms, local sources of these resources are less costly than distant ones. The environmental costs can be substantial irrespective of location, however, when the biophysical, socioeconomic and cultural impacts consequent from resource development are left unmitigated.

The guidelines for sound environmental management of road-building materials are specific to the actions of obtaining, exploiting and, in most cases, reinstating the sources or sites for laterite, rock and sand. They do not address material quality, a matter for the materials engineers who must decide upon the suitability of local materials. That said, local materials of acceptable quality may not be plentiful, implying that more distant material sources must be exploited. In this event, the impacts to air quality and noise will increase commensurately.

Fig. 2.8. Unreinstated borrow pit, Mau Summit

Laterite is needed to shape the roadbed and create a base for the road surface. Usually covered by soils, laterite is a loose gravel formed by laterization during which silica is removed leaving a medium rich in iron and alumina oxide. To extract the laterite, covering soils—topsoil and overburden—must be removed. The action of clearing vegetation and removing topsoil/

overburden exposes the site to erosion, putting at risk the quality of water in nearby streams, rivers and lakes.

In common with Site Preparation, the environmental guidelines for sustainably managing laterite borrow sites initially address the steps involved in planning the exploitation of laterite sources and, thereafter, the processes of opening, operating and closing the pits. In addition, land compensation common to Contractor Camps guidelines is taken up.

2.5.1 Development Stages: Tender, Feasibility and Design

At the feasibility stage, the probable sources of laterite were identified. As well, the likely suitability of laterite deposits was investigated. These data are included in supplemental reports for subsequent design.

In addition to identifying laterite sources, an EMP for borrow-pit management will have been prepared in conjunction with the EIA Study. This EMP, along with the materials report, is to be used by the contractor to produce a working borrow-pit (BP) development plan.

The design TOR stipulate that the cost for production and revision of the BP development plan are to be included in final project costs. Initially, the BP development plan will be based on information in the materials report assembled during the feasibility study and in the EMP; finally, the BP development plan will be revised after award of the contract and prior to the onset of construction. The BP development plan includes, **at minimum**: (1) locations of the sites and their limitations; (2) topographic site plans showing development boundaries; (3) excavation, stockpiling and working areas; (4) configuration of pits with cross-sections; and, (5) anticipated volumes of usable materials.

Finally, the revised BP development plan is to be submitted to the Engineer for his approval. After the Engineer's approval, copies of the plan are to be filed with local authorities, including the provincial and/or local NEMA representative and the county council.

After completion of the feasibility study, the project road is designed, using the location, volume and quality of laterite sites presumed in the design TOR. These sites are to be vetted by the project-road construction contractor in preparation for their utilization.

Normally, the contractor selected to construct or rehabilitate the road is given the task of developing a borrow site after core samples from the location have been tested for material suitability. To integrate environmental protection into the activities inherent in opening, operating and closing a laterite pit, the following guidelines are necessary.

Grouped and headed according to progressive actions for a particular activity, the environmental guidelines for constructing and operating a laterite borrow pit may not appear to relate directly—or even indirectly—to protecting water quality. Indeed, they address a range of activities and actions having to do with a myriad of issues, civic and environmental alike. The activities and actions necessary for managing road material sources are interconnected and interdependent—failure to satisfactorily perform parts of them will ultimately not produce the desired result of sustainable development.

2.5.2 Development Stages: Construction and Operation

2.5.2.1 **Community Consultations**

2.5.2.2 Consultations are advised to alert affected communities to eventual development of borrow sites in their surrounding areas. During these consultations, community opinions and requests to retain certain borrow pits as livestock-water sources can be solicited. A proviso to the forgoing reinstatement is that full information must be provided to the community about the health and safety risks (namely, malaria, bilharzia and drowning) inherent in leaving behind standing bodies of water.

2.5.2.3 The numbers and locations of borrow pits without reinstatement must be carefully considered because cumulative costs to the biophysical and socioeconomic environments may outweigh shorter term microeconomic benefits.

2.5.2.4 To minimise human-health risks from non-reinstated borrow pits, select pits that are isolated from communities or settlements.

2.5.2.5 **Borrow-Pit Development Plan and Approvals**

2.5.2.6 Assuming a need for several BPs, prepare BP development plan(s) for sections of the road programmed for upcoming construction. The linear extent of a road section is to be agreed with the Engineer or his representative. In all cases, the BP development plan is to be prepared by the contractor and approved by the Engineer before work progresses at an agreed-upon road section.

2.5.2.7 If prior approval is necessary at the state and local levels before proceeding with materials exploitation, the permission must be obtained. Required permission notwithstanding, the BP development plan is to be filed with relevant local authorities, including representatives from NEMA and the county council.

2.5.2.8 Laterite samples for materials testing are to be taken with the permission of the landowner/land-user. Disturbance to vegetation and soils at sampling sites is to be minimized, and any disturbed sites are to be restored by infilling and compacting sampling holes with excavated soil.

2.5.2.9 **Landowner/Land-user Compensation**

2.5.2.10 Upon completion of satisfactory materials testing, the landowner and/or land-user is to be compensated for temporary land acquisition and use. Compensation is to be paid in accordance with land policy and the Land Acquisitions Act, Cap 295.

2.5.2.11 If the site is not accessible by public road, the costs for compensating (and relocating, if necessary) land occupants and/or owners from the alignment for the access road are to be determined and agreed upon. Prevailing land policy and the Land Acquisitions Act, Cap 295, are to guide compensation rates.

2.5.2.12 Depending upon the provisions of prevailing land policy and the Land Acquisitions Act, Cap 295, the land occupant should be given sufficient vacation

notice; the recommended notice is six (6) months and no less than three (3) months.

2.5.2.13 **Borrow-Pit Reinstatement Plan**

2.5.2.14 Prior to moving onto the laterite site, the contractor is to prepare and submit for the Engineer's approval a plan for BP reinstatement (reclamation or rehabilitation). The BP reinstatement plan, which takes into account all access roads and any other areas disturbed by the activity, is to describe

(1) removal, stockpiling, protection measures, e.g., reseeding with creeper grasses or covering with tarpaulins, and subsequent replacement of topsoil and overburden;

(2) restoring by reshaping (to original contours and restoring natural drainages, to the degrees feasible) and compacting replaced overburden and topsoil;

(3) scarifying access-road surfaces prior to reseeding;

(4) free-flowing drainage at and within reinstated BP sections and sites;

(5) soil-erosion controls;

(6) revegetation plan to include lists of indigenous grass, shrub and tree species; (7) operational safety measures; and

(8) a decommissioning plan at closure, which specifies procedures for removing all work-related machinery and equipment/supplies and cleaning the site/environs.

2.5.2.15 The BP development and reinstatement plans are to declare the hours of operation at the site. Activities at the borrow site are to be conducted between the hours of 6:00 and 18:00 during an extended workweek (Monday through Saturday); operating hours and days are not to be extended without prior consultation and approval of nearby residents and communities.

2.5.2.16 The BP reinstatement plan is to acknowledge and incorporate relevant water-related environmental guidelines, including but not limited to roads and bridges environmental guidelines, into all plan provisions for controlling soil erosion, sediment transport and water-quality degradation as well as relevant recommendations from the EMP.

2.5.2.17 Upon approval by the Engineer, the BP reinstatement plan is to be filed with local and state authorities where it will be made available to the public; in particular, the approved BP reinstatement plan is to be provided to representatives from provincial and/or district NEMA and the District Environmental Committee.

2.5.2.18 Upon approval by the Engineer, the BP reinstatement plan is to be provided to the landowner and/or land-user of the laterite site and any access roads leading to it.

2.5.2.19 Borrow areas that are necessary for road maintenance may require interim reinstatement only. An interim reinstatement plan must be prepared and submitted to the Engineer for approval. The plan must include, at minimum, procedures for assuring that (1) the drainage from the pit is free-flowing, (2) cut slopes are reduced to prevent accidents and (3) fencing around the site is intact and maintained to prevent unauthorized entry.

2.5.2.20 To minimise the number of partially reinstated borrow pits required for maintenance purposes, the free-haul distance may need to be increased, if road maintenance is to be done by private contractor.

2.5.2.21 **Borrow-Pit Site Preparation**

2.5.2.22 Before moving onto the site and commencing development activities, the entire site must be fenced to deny unauthorized entry and to prevent injury to passersby and livestock.

2.5.2.23 Vegetation is to be cleared only in areas where exploitation is to occur and then sequentially reinstated according to stipulations in the BP reinstatement plan.

2.5.2.24 Cleared vegetation is not to be discarded into any rivers or lakes. Trees felled during site preparation can be made available to the contractor's camp, nearby communities, military installations or industrial operations for use as timber or fuelwoods.

2.5.2.25 **Soil Handling, Storage and Replacement**

2.5.2.26 Topsoil and overburden are to be removed and stockpiled separately. To avoid unnecessarily compacting soil cover during removal, wet soils should be allowed to dry.

2.5.2.27 Topsoil and overburden stockpiles are to be located on land that is (1) cleared of vegetation, (2) level and (3) outside any drainages—natural or engineered.

2.5.2.28 **Soil-Erosion and Sediment-Transport Controls**

2.5.2.29 Provide erosion controls around stockpiles to prevent transport of sediments to nearby watercourses and waterbodies, including wetlands.

2.5.2.30 If necessary to prevent water and/or wind erosion, cover stockpiles or reseed with appropriate grasses (e.g., Cynodon dactylon, a naturalized creeper grass used for soil-erosion control).

2.5.2.31 **Revegetation after Pit Reinstatement**

2.5.2.32 To control erosion from replaced soils, reseeding should be commenced if grasses have not been reestablished on 80 percent of the disturbed area within 1 month after recontouring and compacting at excavated sites is completed (unless weather conditions dictate otherwise).

2.5.2.33 Plant indigenous species of trees declared in the revegetation programme which is included as part of the BP reinstatement plan.

2.5.2.34 **Onsite Retention of Leaked or Spilled Fuels/Lubricants**

2.5.2.35 All onsite fuels and lubricants are to be stored in an area designed for spill retention, i.e., an area fully enclosed with impermeable bunds (curb or dike) and base whereby spilled or leaked fuels are captured in a sump or holding tank for final removal to a facility capable of treating and disposing of hazardous wastes. The spill retention area should also be equipped with an oil/water separator to allow the routine discharge of collected rainwater.

2.5.2.36 All machinery-storage and repair areas are to be located in areas designed for spill retention, i.e., areas partially enclosed with impermeable bunds (curb or dike) and base whereby spilled or leaked fuels are captured in a sump or holding tank for removal to a facility capable of treating and disposing of hazardous wastes. A spill retention area should also be equipped with an oil/water separator to allow the routine discharge of collected rainwater.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.5.3 Development Stages: Maintenance and Closure

2.5.3.1 Inspect and repair, if necessary, spill-retention systems to assure their structural integrity and impermeability.

2.5.3.2 Inspect and repair, if necessary, all enclosure fences.

2.5.3.3 Implement the procedures contained in the reinstatement plan for borrow-pit and access-road closure.

2.5.3.4 Inert construction rubble, oversize rock and other non-biodegradable, non-hazardous (e.g., waste concrete, where applicable) materials may be used for infilling the excavated site. Woody materials are not to be used for infilling; upon decomposing, the site will subside and impound water, thereby defeating a reinstatement aim. Furthermore, waste bitumen asphalt is not to be used for infilling because it is a hazardous product.

2.5.3.5 Replace and compact the stockpiled soils to the material-depleted pit in the order in which they were removed, i.e., initially overburden, followed by topsoil.

2.5.3.6 Ensure that procedures laid out in the decommissioning plan—itself a component of the BP reinstatement plan—are carefully and thoroughly implemented.

2.5.3.7 Before site vacation by the contractor or his subcontractor, the Engineer as well as representatives from the provincial or district NEMA office and the

district environment committee must approve final BP reinstatement only after their respective inspections.

2.5.3.8 Monitoring is essential to assure the implementation of these environmental measures. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and requirements of the ministry, authority or agency.

To organize monitoring activities, an administrative form is included in Appendix C.

2.6 ROCK QUARRIES GUIDELINES

Fig. 2.9. Crusher at Kirima Quarry, Molo

Developing a quarry for aggregates (crushed rock of varying particle sizes) reproduces nearly all of the potential environmental impacts mitigated by the foregoing environmental guidelines for developing a laterite borrow pit. Siting, opening, operating and closing a quarry present additional environmental challenges, however.

In lieu of reiterating the previous guidelines that address planning and managing a borrow pit, **the environmental guidelines for quarries should be regarded as additions to the borrow-pit guidelines.** In other words, the quarry guidelines augment the borrow-pit guidelines whenever a quarry is to be developed for a road-building project.

A quarry is usually located in an outcrop of hard minerals (granite, basalt, andesine, limestone, etc.). In general, the rock is drilled and blasted with explosives after which it is loaded onto trucks or conveyors and transported to a nearby crushing plant for treatment.

At the crushing plant, the rock is cracked and screened to produce a range of products. Two or three stages of crushing and screening may be necessary to produce the desired final product size.

Singly or in combination, two activities—blasting and crushing—result in significant adverse impacts to the biophysical and socioeconomic environments. Their mitigation is imperative.

2.6.1 Development Stages: Tender, Feasibility and Design

At the feasibility stage, the probable sources and suitability of rock for the base course, bitumen surface, concrete bridge abutments and culvert headwalls/wingwalls were investigated. These data are appended to supplemental design reports.

Depending upon the assumed volume of materials that might be available at an already operating site, there may not be need for a quarry development plan. However, for any new quarry, a quarry plan will be necessary. In the event, the design TOR are to stipulate that the costs for production and revision of a quarry plan be included in final project costs.

Water for suppressing dust from crushing, conveying and offloading the final aggregate product must also be sourced. Locating water sources in the semiarid to arid regions common to eastern and northern Kenya may be problematic. Extracting water from minor—sometimes ephemeral or seasonal—surface sources is ill-advised because they are often used by local villages or nomadic groups for household consumption, gardens and livestock.

2.6.2 Development Stages: Construction and Operation

2.6.2.1 **Quarry Plans**

2.6.2.2 Prepare a quarry development plan if more than one—already operational—quarry is required to satisfy projected aggregate volumes.

2.6.2.3 A quarry operation and reinstatement plan is to be prepared by the contractor and approved by the Engineer before opening the quarry; this plan is to incorporate the recommendations of the quarry EMP developed during the feasibility/design EIA Study. After approval by the Engineer,the plan is to be filed with the provincial or district NEMA office and the county council. Particular elements in addition to those required in the plan for reinstating borrow-pits follow:

Fig. 2.10. Abandoned quarry, Mau Summit

(1) blasting methodology for suppressing flying rocks and noise;

(2) blasting material, storage and transport (if applicable);

(3) verification and submission of current license for individual assigned to blasting;

(4) intended drilling and blasting schedule;

(5) notification system for informing nearby residents and communities about upcoming blasting events;

(6) warning system for alerting nearby residents and communities to imminent blasting event;

(7) personal protective equipment (PPE) for quarry and crusher workers in accordance with the contractor's safety and health policy administered by the safety and health officer and in compliance with DOSHS rules and OSHA 2007 (see Appendix D).

(8) safety measures for preventing passersby and livestock entry into the site during blasting events;

(9) crusher location and times of operation;

(10) system used for suppressing crusher dust;

(11) scheme for retaining stormwater onsite;

(12) methods for assuring free-flowing drainage from any remaining low-lying areas after closure;

(12) techniques for benching walls to reduce steep rock faces; and

(13) measures (fencing, gating, padlocking, etc.)proposed to permanently prevent unauthorized entry onto the site.

2.6.2.4 Where practical, reinstatement is to occur contemporaneously to minimise safety and environmental hazards from falling rock, standing water or stormwater runoff.

2.6.2.5 A decommissioning plan is to be prepared by the contractor and approved by the Engineer, after which the plan is filed with the local NEMA office and the district environment committee. The plan elements are to stipulate the procedures for removing all work-related machinery and equipment/supplies as well as cleaning up the site and its environs. Additionally, the plan is to establish measures required for long-term site safety, i.e., secure perimeter fencing and padlocked gates, etc.

2.6.2.6 **Blasting Safeguards**

2.6.2.7 Safety questions are common to hard-rock blasting. To mitigate for them, quarry blasting programmes must be rationalized and closely adhered to. Items (1) through (6) in the quarry operation and reinstatement plan are to be carefully monitored for their full implementation and adherence to standards and conditions set forth by the Mines and Geological Department. Failure to implement the declared blasting programme and any standards and conditions prescribed by the Mines and Geological Department should be accompanied by fines or appropriate penalties.

2.6.2.8 Measures required to prevent inadvertent entry onto the site by passersby and livestock before or during a scheduled blast are to include full permanent

perimeter fencing, posting of "NO ENTRY" signs and one or more guards stationed at the entrance/exit gate(s) to the quarry. The perimeter fencing is to be designed to deny entry onto the quarry site by passersby—particularly children—and livestock.

2.6.2.9 **Worker Safety**

2.6.2.10 PPE for quarry workers is to be provided free-of-charge by the employer—the contractor or his subcontractor—in accordance with the contractor's safety and health policy administered by the safety and health officer and in compliance with DOSHS rules and OSHA 2007 (see Appendix D for illustrations and specifications of PPE specific to quarry and crusher tasks). At minimum, the PPE package is to include properly fitted hard hats, N95 face masks, gloves and safety boots. Ear muffs are to be provided to the blasting and crusher crews.

Fig. 2.11. Partial PPE at Kirima Quarry, Molo

2.6.2.11 Workers must be trained by the contractor's safety/health officer in the proper use of PPE, and the routine use of the equipment is to be enforced in accordance with the employer's safety/health policy and the enforcement procedures developed by the employer's safety/health officer. In the absence of these declared procedures, a system of escalating penalties can be used—first failure to use, verbal warning; second failure, dismissal from work for the day; and third and final failure, permanent dismissal from employment. The enforcement procedures in effect must be clearly communicated (verbally and in writing) to all workers issued and required to use PPE.

2.6.2.12 **Operating Schedules**

2.6.2.13 Crusher operating hours are to be scheduled between the hours of 6:00 and 18:00, Monday through Saturday. Working hours extended beyond the scheduled times are to be agreed-upon by nearby residents and communities and approved by the Engineer.

2.6.2.14 Irrespective of production pressures and/or production slumps, blasting is not to take place outside established blasting schedules without community consent and written permission of the local authority and approved by the Engineer.

2.6.2.15 **Water-Quality Protection**

2.6.2.16 Stormwater runoff from the crushing area is to be retained on site and released after crusher fines have settled. The point of release will be dependent upon the quality of the retained water. If suspended solids remain, the water is to be released on dry land, not into rivers or lakes.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.6.3 Development Stages: Maintenance and Closure

2.6.3.1 Ensure that the quarry operations and reinstatement plan is being implemented.

2.6.3.2 Ensure that quarry blasting schedules and notification/warning systems are being adhered to.

2.6.3.3 Inspect and repair, if necessary, stormwater-retention systems to assure their effectiveness in retaining soil sediments onsite.

2.6.3.4 Inspect and repair, if necessary, all enclosure fences.

2.6.3.5 Implement the procedures contained in the decommissioning plan for quarry and access-road closure.

2.6.3.6 Irrespective of benching procedures, steep or sheer rock faces must be reduced in height and pitch by incidental blasting. The final face must not be a safety hazard to trespassers or livestock in the event that perimeter fencing is breached.

2.6.3.7 Before site vacation by the contractor or his subcontractor, the Engineer as well as representatives from the provincial or district NEMA office and the district environment committee must approve final quarry reinstatement following their respective inspections.

2.6.3.8 Irrespective of design plans that reflect environmental protection of water quality, monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

2.7 SAND SOURCES GUIDELINES

The location where sand is found determines the extent of environmental impacts associated with exploiting it. Used primarily in making concrete for culvert headwalls/wingwalls, box culverts and bridge components (foundations, abutments/wingwalls, retaining walls, etc.), most sand in Kenya is found in river floodplains and river channels.

Fig. 2.12. Silt curtain

Therein lies the problem: developing sand deposits in river floodplains or channels can result in degradation of water resources, particularly when the deposit is located in a channel. When sand is being excavated in a river channel, controlling the dispersion of suspended sediments is very difficult.

A modest degree of success in controlling sediment travel from river-channel excavations is possible with silt curtains (a flexible barrier designed specifically to contain and control the dispersion of silt and consequent turbidity in a watercourse), but they are difficult to install and maintain in rivers with high volumes or fast flows. Therefore, the most effective means of avoiding the costs of mitigating significant adverse impacts to river water-quality is to locate and exploit sand deposits from floodplain or terrestrial sources.

Sand deposits located in river floodplains can be developed with fewer potential impacts to water quality, if the deposit is located outside a zone that is frequently inundated. Flooding frequency and severity in designated flood zones (commonly designated as 25, 50 or 100-year flood zones) will depend, at minimum, upon certain factors:

- how deeply the river channel is incised;
- to what degree the capacity of the main river channel has been reduced by sedimentation; and
- changes in land use in the river catchments (i.e., deforestation, damaged wetlands, urbanization, etc.)

These above factors influence flooding, which, in turn, has an effect on the measures required to mitigate the possible harmful impacts from sand harvesting to water quality in nearby watercourses and waterbodies, including wetlands.

Relic terrestrial sand deposits, usually outside active flood zones, can sometimes be found when the natural course of a river has been altered or has been reduced in width, a condition often the result of long-term changes in climate. Relic deposits can be developed for road-construction sand with fewer consequent environmental impacts than deposits in river channels or active floodplain zones.

Finally, an EIA of proposed sand harvesting is required by EMCA 1999. In lieu of a separate EIA for this and several other road-related construction and maintenance activities that call for environmental impact assessments in EMCA 1999, these environmental

guidelines recommend that an EMP for proposed sand harvesting be developed using the findings, conclusions and recommendations put forth in the road-project EIA Study. This recommendation is discussed in greater detail in the Introduction (Section 1) to these environmental guidelines.

2.7.1 Development Stages: Tender, Feasibility and Design

At the feasibility stage, the probable sources of sand were identified in compliance with NEMA's National Sand Harvesting Guidelines, 2007. These guidelines call for a technical sand harvesting committee to designate "authorized sand harvesting sites on riverbeds, lakeshores, seashores, farms and Government or Trust land" within each district. The likely suitability of sand deposits within these designated sites must be investigated. These data are included in supplemental reports appended to the TOR for design.

2.7.1.1 When sand deposits in different physiographic settings (i.e., river channel, floodplain or relic terrestrial deposits) have been discovered during the feasibility study, preference should be given to developing obtainable relic deposits in order to avoid deleterious effects to water quality.

2.7.1.2 In compliance with NEMA National Sand Harvesting Guidelines, 2007, a reinstatement plan is to be prepared by the contractor (or subcontractor) that reflects recommendations found in the EMP developed in conjunction with the road-project EIA Study conducted during the project feasibility/design stage; the riparian resource management association, entrusted by the Sand Harvesting Guidelines with local responsibility for sustainable management of sand-harvesting activities, is to be consulted during reinstatement-plan preparation.

2.7.1.3 The plan for reinstatement of the sand source is to be approved by the Engineer, after which a copy is to be filed with the provincial or district NEMA office, the riparian resource management association and the district environment committee.

2.7.1.4 The TORs for tender of feasibility and design are to stipulate that all applicable water-quality requirements set forth in MoR's environmental guidelines as well as all relevant water-quality regulations and standards adopted by NEMA (Legislative Supplement No. 36 of 2006) will be included in forthcoming TORs.

2.7.2 Development Stages: Construction and Operation

In the event that relic terrestrial sand deposits are available for the road project, the costs to mitigate impacts potentially harmful to water quality will be minimized. In common with floodplain deposits, the material would be excavated to create a pit. To avoid the collection of water (precipitation or groundwater) in the sand pit, measures to drain the pit are required.

Irrespective of physiographic setting, pit walls must be benched to prevent their collapse endangering the safety and health of pit workers. Sand dries when it is exposed to sunlight and, when dry, it tends to lose cohesiveness, making walls more liable to cave in.

When the opportunity to develop a relic deposit is not at hand, sand deposits in a frequently inundated river floodplain require more elaborate surface-water runoff controls during excavation. Depending upon meteorological conditions, perimeter trenching and settling ponds may be required for high-rainfall areas to retain all suspended sediments onsite.

Excavating sand deposits in river channels is not recommended. If, however, no alternatives exist, the river deposit is best exploited in the dry season when sediment-transport controls are more readily installed. Silt curtains around the excavation site will contain some, but not all, suspended sediments (see Fig. 2.12).

Silt curtains, unlike silt fences used to control terrestrial soil erosion, are designed to contain or deflect suspended sediments or turbidity in the water column. Sediment containment within a limited area provides time for the soil particles to settle out of suspension and reduce dispersion to other areas where additional negative impacts could occur.

Suspended solids can also be diverted from areas where environmental damage might occur when the suspended particles settle. In this application, a silt curtain can be used to protect specific areas (e.g., sensitive habitats, water intakes, etc.) from suspended sediments and subsequent sedimentation.

Whatever the source of the sand, it will probably be stockpiled in anticipation of construction demand. Any area designated for sand stockpiles must be level and perimeter-trenched to prevent sediment transport in surface-water runoff.

2.7.2.1 To keep mitigation costs in check, deposits of relic terrestrial sands are to be developed in preference to river deposits.

2.7.2.2 Sand deposits excavated in a river floodplain and in high-rainfall areas usually require surface-water runoff controls such as perimeter trenching and settling ponds to retain and treat surface-water runoff and suspended solids on the site.

2.7.2.3 If no alternatives exist to sand deposits in a river channel, the preferred timing for exploiting the river-channel source is the dry season when sediment-transport controls are more readily installed and maintained.

2.7.2.4 Install and maintain silt curtains around the river-channel excavation site to prevent—to the degree possible—the travel of suspended sediments away from the excavation site.

2.7.2.5 To avoid pools of water (precipitation or groundwater) from forming in an excavated sand pit, measures to drain the pit are required.

2.7.2.6 Irrespective of physiographic setting i.e., relic terrestrial or floodplain deposit, pit walls must be benched to prevent subsidence that would endanger the health and safety of pit workers.

2.7.2.7 To prevent unauthorized entry into the excavation site when there is a possibility of wall collapse, the perimeter of the working site must be fenced.

2.7.2.8 Any area designated for sand stockpiling must be level and perimeter-trenched to prevent sediment transport in surface-water runoff. The stockpile area is to be located on land that is cleared of vegetation and outside any drainages—natural or engineered.

2.7.2.9 At this point in developing a sand deposit, relevant environmental guidelines are to be carefully implemented, including but not limited to NEMA Sand Harvesting Guidelines, 2007. MoR environmental guidelines specific to water quality will be integrated into an inhouse sand-exploitation operating plan and applied by the contractor or subcontractor to specific actions in order to avoid harming water quality in particular and the biophysical, socioeconomic and cultural environments in general.

2.7.2.10 Monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.7.3 Development Stage: Maintenance

2.7.3.1 Inspect perimeter trenches and settling ponds to assure they are working properly.

2.7.3.2 Inspect silt curtains for rents or rips; replace if necessary. The curtains may be removed when no more sand will be excavated, and suspended sediments have settled in the disturbed area.

2.7.3.3 Confirm that perimeter fencing around a terrestrial excavation site, where needed, is intact.

2.7.3.4 Confirm that excavated sand pits are free-draining to prevent standing water.

2.7.3.5 Confirm that benched walls are stable; interventions to induce collapse may be necessary to protect workers and trespassers.

2.7.3.6 Monitor stockpile areas to assure that eroded sediments are trapped and treated by sediment controls.

Fig. 2.13. Silt fence

2.7.3.7 Before sand-harvesting site vacation by the contractor or his sub-contractor, the Engineer as well as representatives from the provincial or district NEMA office, the riparian resource management committee and the district environment committee must approve final reinstatement of the sand site following their respective inspections.

2.7.3.8 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse impacts. Monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

2.8 WATER SOURCES GUIDELINES

When building a road, water is needed for several activities: compacting road sub-base and base layers; mixing with cement and aggregates to produce concrete; suppressing dust from crushers and vehicle travel on non-compacted road surfaces (i.e., all project, deviation and access roads); and supplying the contractor's camp. To reduce construction costs, a supply of water—plentiful surface sources or an already established borehole—near the roadworks is more economic because haul distances are negligible.

However, few, if any, sources of surface water or groundwater in Kenya—particularly in its arid/semiarid portions—are without existing uses and users. Proposed abstractions, whether surface (including wetlands) or ground, must be permitted by the WRMA. The permit process is outlined on the WRMA website, **www.wrma.or.ke.** Water-abstraction permission from WRMA will assure that pre-existing water rights and uses will not be abridged by the road project for its diverse water needs.

Permit approval is especially important for ephemeral or intermittent streams or pools because these sources become waterless during the dry season. Community water pans developed by Kenyan provincial programmes for the benefit of communities in arid/semiarid regions are off-limits to contractors for construction water.

In addition to WRMA permitting procedures, nearby communities ought to be consulted to establish local interest in retaining boreholes for domestic, livestock or agricultural uses. However, WRMA must approve of changed borehole use.

2.8.1 Development Stages: Tender, Feasibility and Design

At the feasibility stage, the probable sources of water will have been identified. Additionally, the likely availability of water in the identified sources was investigated. These data are included in supplemental reports appended to the TOR for design.

In addition to WRMA rules, national or regional laws/regulations governing the withdrawal of water from existing sources may also be in effect; early consultations with WRMA to ascertain any additional legal requirements are recommended. Proposed water sources or existing sources identified during the feasibility study must be vetted against these laws/regulations to ascertain the legal status of potential water sources.

While not an issue in large rivers with perennial (year-round) flows, maintaining minimum stream flows to sustain viable aquatic ecosystems and support aquatic species in lower-order river systems may be at issue. Roadwork withdrawals—particularly during the dry season—that might exceed baseline stream flows necessary to maintain aquatic life and habitat are ill-advised.

Fig. 2.14. Community water pan, Relinyi village

A community near a road-construction borehole may elect to take over the well for supplies of domestic, livestock and/or agricultural water. WRMA must be consulted to determine the procedures for transfer, rather than closure, of the borehole.

In the event the borehole is to be abandoned, however, it must be decommissioned in compliance with WRMA rules. The borehole must be properly closed and sealed; otherwise, it poses a threat to groundwater quality and a potential safety hazard.

2.8.1.1 The TORs for feasibility and subsequent development stages are to take into account the probability of existing uses or users of any surface-water and groundwater sources identified for road-construction water supplies. Compliance with WRMA permitting procedures will establish the status of existing rights/uses.

2.8.1.2 The TORs are to require that any and all national laws and regulations that govern permitting and exploiting water sources be ascertained and vetted against surface waters (including wetlands) or groundwater identified for road-construction uses. Early consultations with WRMA will establish legal requirements in addition to their rules that must be followed to fully comply with Kenyan water law and regulations.

2.8.1.3 The TORs are to require that any and all national laws and regulations stipulating minimum streamflows be ascertained and vetted against the volumes/flows of surface waters identified for road-construction uses. Early consultations with WRMA can establish minimum streamflow requirements.

2.8.1.4 The TORs for tender of the feasibility study and design are to stipulate that all applicable water-quality requirements set forth in MoR's environmental guidelines as well as all relevant water-quality regulations and standards adopted by NEMA will be included in forthcoming TORs.

2.8.2 Development Stages: Construction and Operation

2.8.2.1 In order to make use of a surface-water supply (including a wetland source) with prior appropriation to downstream users, the contractor must enter into negotiations with the existing users and, in all likelihood, pay compensation for its temporary use. WRMA are to be involved in any negotiations and agreements.

2.8.2.2 In addition to fulfilling WRMA permitting requirements, obtain all necessary permits for groundwater exploitation from local, provincial or national authorities.

2.8.2.3 Consult with nearby communities to determine local interest in retaining road-construction borehole(s) for domestic, livestock or agricultural uses. In the event, WRMA must approve transfer of borehole ownership.

2.8.2.4 Adhere to national laws or regulations establishing minimum stream flows in streams or rivers with low or intermittent flows. If minimum stream-flow laws or regulations are not in effect or enforced, avoid withdrawals that exceed flows necessary to sustain aquatic ecosystems and species.

2.8.2.5 Under no circumstances are stream flows to be reduced to the point that pooled water is no longer interconnected or the streambed becomes dry.

2.8.2.6 Monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.8.3 Development Stage: Maintenance

2.8.3.1 If a construction-related borehole is to be kept for community use, any permits authorizing its drilling and use must be transferred. WRMA must be consulted to establish these transfer requirements.

2.8.3.2 If a construction-related borehole is no longer needed for the road project and is unwanted by a local community or government entity, the borehole must be closed to prevent groundwater contamination and safety hazards. WRMA procedures for closing a permitted borehole are to be followed.

2.8.3.3 To close a borehole properly, the casing is removed and the hole filled with grout, i.e., clay or sodium bentonite (a clayey material used as an impermeable sealant). In lieu of filling the entire borehole with grout, the upper portions of the hole can be filled and then capped with concrete.

2.8.3.4 Any abstraction equipment or materials must be removed from riverbanks, wetlands or lake shorelines upon completing road construction or before moving to a new work site.

2.8.3.5 Monitoring is essential to assure implementation of these environmental measures.

To organize monitoring activities, an administrative form is these guidelines (see Appendix C).

2.9 BITUMEN PROCESSES GUIDELINES

Whereas the fabrication and transport of bitumen are outside the scope of these guidelines, its storage and handling are not. Inappropriately selected and secured sites for bitumen storage can adversely affect water quality in the event of leakages and spillage.

Likewise, the failure to provide PPE to construction workers who handle and spread bitumen will negatively affect their near-term wellbeing and long-term health. Bitumen is classified as a toxic material by the Inter-Organisation Programme for the Sound Management of Chemicals (IOMC), an organisation created by six United Nations agencies to promote the sound management of chemicals in relation to human health and the environment.

IOMC also warn that bitumen is a potential occupational carcinogen. As a consequence, inhalation of fumes as well as eye or skin contact is to be avoided by using a respirator and full protective gear for the eyes and extremities (hands, arms, feet and legs) The reader may consult Appendix D for PPE illustrations and specifications.

2.9.1 Development Stages: Tender, Feasibility and Design

Containerized bitumen will be stored at work sites in the ready for final road surfacing. Length of storage is not at issue in mitigating possible impacts to water quality, although the longer the storage period, the greater the likelihood of leaks or spills.

In addition, the TOR for construction are to stipulate that the contractor will be held liable for any bitumen that is carelessly handled and applied by road workers. During application, bitumen material will be applied only to the carriageway, and not beyond into sidedrains. The TOR are to specify that this mitigation measure will be strictly enforced by the Engineer.

Fig. 2.15. Bitumen application, Nakuru-Mau Summit Road

2.9.1.1 To assure that water quality is not adversely affected by bitumen contamination, the TORs at feasibility and subsequent development stages are to require that bitumen containers or tanks be stored in specially prepared sites on level land, outside any drainages and at least 100 metres away from the nearest water sources (stream, river, water pan, pond, lake, wetland or borehole).

2.9.1.2 TORs for feasibility and design RFP stages are to stipulate that bitumen containers or tanks be stored in an area designed for secondary containment, i.e., an area fully enclosed with impermeable bunds (curb or dike) and base whereby any spilled or leaked bitumen is captured in a sump or holding tank for final removal to a facility capable of treating and disposing of hazardous wastes. The containment area should be equipped with a bitumen/water separator to allow the routine discharge of collected rainwater, if it is deemed to be uncontaminated.

2.9.1.3 TORs for feasibility and design RFP stages are to stipulate that road workers assigned to handle and apply bitumen be provided with a full complement of properly fitted PPE, including gauntlet-length gloves, gum boots, face mask or respirator and protective eyewear, and in accordance with the contractor's safety and health policy, DOSHS rules and OSHA 2007.

2.9.1.4 TORs for feasibility and design RFP stages are to require that the road-construction contractor and his safety/health officer train workers in the proper use of PPE and to explain the penalties for failure to regularly use assigned PPE on the job site.

2.9.1.5 Prepared at the design stage, the TOR and tender documents for construction are to stipulate that the contractor will be held liable for any bitumen that is carelessly handled and applied by road workers. During application, bitumen material will be applied only to the carriageway, and not beyond its edges where it can move into sidedrains. The TOR are to specify that this mitigation measure will be strictly enforced by the Engineer.

2.9.2 Development Stages: Construction and Operation

2.9.2.1 Confirm that the bitumen-storage site is located on level ground, outside a drainage and at least 100 metres from the nearest water source (stream, river, water pan, pond, lake or borehole).

2.9.2.2 Confirm that bitumen containers or tanks are placed in a secondary-containment system.

2.9.2.3 Confirm that bitumen is stored in a sealed, non-leaking tank or container.

2.9.2.4 Confirm that all workmen assigned to bitumen detail are provided with properly fitted PPE (gauntlet-length gloves, gum boots, respirators or face masks and protective eyewear) in accordance with the contractor's safety and health policy, DOSHS rules and OSHA 2007. (See Appendix D for PPE appropriate for bitumen handling and/or applying.)

2.9.2.5 Confirm that the contractor and his safety/health officer have trained workers in the proper use of PPE and informed them about the penalties for failure to use as per the enforcement system prepared and adopted by the contractor and his safety/health officer. (In the absence of an enforcement programme adopted by the contractor and his safety/health officer, a penalty system is suggested here: first offense, verbal warning; second offense, one day dismissal from the job; and, third offense, permanent dismissal from the job.)

2.9.2.6 Confirm that application of bitumen is strictly confined to the road carriageway only.

2.9.2.7 To assure the implementation of these environmental measures, systematic monitoring is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.9.3 Development Stage: Maintenance

2.9.3.1 Monitor the use and enforcement of PPE practices and penalties, irrespective of bitumen-related task.

2.9.3.2 Inspect bitumen-storage sites and repair, if necessary, secondary-containment systems to assure their structural integrity and impermeability.

2.9.3.3 Inspect all bitumen-storage containers (or tanks) to assure that seals are intact without visible leakage.

2.9.3.4 Upon completion of road surfacing, all containment-system elements are to be removed and bitumen-storage sites cleaned.

2.9.3.5 Monitoring is necessary to assure the implementation of these environmental measures, and it must be regular and comprehensive.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

2.10 CULVERTS GUIDELINES

As mentioned in the guidelines for road drainage, cross drainage—moving water from one side of a road drain to the other—is accomplished with culverts. As well, culverts are used to pass water from natural drainages and streams under a road.

When properly sized, installed and maintained, culverts protect the road and the ground around it from soil erosion. When none of the foregoing conditions—size, installation or maintenance—is met, culverts can actually accelerate erosion and contribute to sediment loads that significantly degrade nearby water sources.

To efficiently move water under the road, either as cross drains to lessen water in side drains or from natural drainages and streams, correct culvert sizing is key. Sizing depends upon a number of factors, among which are expected flow; watershed size; runoff characteristics; design rainfall event, including its intensity and frequency; and upper-catchment conditions, i.e., deforested, devegetated, debris, etc.

The final factor—the road's upper-catchment conditions—is important because the culvert must be large enough to pass along woody debris or discarded rubbish or it will become clogged, effectively annulling its intended purpose. Water will bypass and overtop the culvert, etching the road surface and bed in its wake.

A pragmatic approach for deciding upon culvert size: oversize rather than undersize. Although the initial cost of an oversized culvert is greater, maintenance and repair—and environmental—costs will be less for the larger diameter pipe in the long run.

A rule of thumb when sizing culverts: oversize rather than undersize.

Concrete headwalls and wingwalls enhance other measures such as trash racks to prevent debris-clogs in culverts by directing water flows into the pipe. Wingwalls, in particular, improve the performance of water flows at the culvert inlet and outlet.

Additionally, culvert length is important in controlling soil erosion in raised or filled areas. Selecting culverts that are sufficiently long to reach the toe of an embankment will minimise necessary soil protection measures.

Equally important to culvert size in controlling soil erosion and impaired water quality is its installation. For a cross drain, the culvert should be placed at the bottom of a filled area. The culvert inlet can be protected with a drop inlet or catch basin, and the outlet protected from erosion with energy dissipaters such as riprap, a concrete apron or stone-lined splash basin.

To align and install culverts for conveying water from natural drainages or streams under the road, precautions apply if adverse impacts—to the roadbed, stability of surrounding soils, water quality and aquatic habitats/organisms—are to be controlled. These precautions are:

Fig. 2.16. Undersized culvert, Mikinduri-Miathene Road

- minimise modifications to the channel to the greatest degree possible;
- avoid narrowing full-flow channel width;
- maintain the natural grade and alignment;
- use appropriate, well-compacted material for culvert bedding (i.e., foundation) and backfilling;
- provide soil-protection measures for culvert inlets and outlets;
- protect streambanks near culvert inlets and outlets with rock riprap or other suitable erosion controls; and
- avoid debris clogs by installing trash racks or other similar devices to trap debris or rubbish before it reaches the culvert.

Box culverts or bottomless arch culverts have fewer adverse impacts to fish and other aquatic organisms than do metal culverts. Box or arch culverts, by preserving the natural materials found in the streambed, reduce harmful reduction and disruption to fish habitat.

In point of fact, culverts—irrespective of type (round, ellipse, arch or box)—are preferable to continuous filled embankments for crossing wetlands. Fill material—quartzite or other metamorphosed material that will not disintegrate in wet applications—is required to create the roadbed for a wetland crossing. Fill-material type notwithstanding, the hydrologic connection between severed parts must be restored to regain the beneficial environmental services provided by a wetland (see page 19). Culverts—carefully sized and placed—in fill embankments are successful in restoring hydrologic connection between and function to bisected wetlands.

Maintenance is critical. Culverts that are not maintained will fail to convey water. In this circumstance, the road will inevitably be damaged, soils severely eroded and water quality badly affected. To prevent these unwelcome outcomes, regular routine maintenance is required. During routine maintenance, culverts are inspected, cleaned and repaired as necessary. During periodic maintenance, culverts may need to be replaced.

2.10.1 Development Stages: Tender, Feasibility and Design

2.10.1.1 TORs for feasibility and subsequent development stages are to take into account all relevant physiographic, hydrologic and vegetation data to assure that culverts for natural drainage or stream crossing are properly sized in terms of their capacity and length.

2.10.1.2 TORs for feasibility and subsequent development stages are to integrate relevant data describing surficial flows, including flows from major precipitation events, that arise from the road and surrounding terrain into determinations for optimal culvert widths.

2.10.1.3 TORs for feasibility and design RFP are to advise that culvert sizing be generous (i.e., oversized) in lieu of sizing that is "just" adequate (i.e., undersized).

2.10.1.4 TORs for feasibility and design RFP are to require that headwalls and wingwalls be included in design specifications for culverts in locations of high rainfall events and extensive drainage networks to prevent soil erosion around culvert inlets and outlets as well as soil losses from backfilled material.

2.10.1.5 TORs for feasibility and design RFP are to require erosion or scouring controls for culvert inlets and outlets, particularly for culverts installed in filled materials or on gradients.

2.10.1.6 TORs for feasibility and design RFP are to take into account precautionary factors stipulated in the roads and bridges environmental guidelines for the proper installation and alignment of culverts used for drainage or stream crossings.

2.10.1.7 TORs for feasibility and design RFP are to require box culverts or bottomless arch culverts for crossings of streams to maintain habitat for fish and other aquatic species.

2.10.1.8 TORs for feasibility and design RFP are to stipulate that grubbing (removing vegetation during site preparation) in sensitive wetlands' crossings be minimized by the placement of geotextile and geogrid prior to fill placement.

2.10.1.9 TORs for feasibility and design RFP are to specify that metamorphosed rock, e.g., quartzite, be used for filling roadbed embankments in wetlands. Laterite is not appropriate for this purpose because it disintegrates in wet applications.

2.10.1.10 TORs for feasibility and design RFP are to require that culverts—properly sized and in suitable numbers—be installed in any fill embankments for roads that cross a wetland. In extensive wetlands, culverts are to be placed at 100m intervals, unless conditions dictate that a higher frequency of culverts be installed.

2.10.1.11 TORs for feasibility study and design are to require that all applicable water-quality requirements set forth in MoR's environmental guidelines as well as all relevant water-quality regulations and standards adopted by NEMA (Legislative Supplement No. 36 of 2006) be included in forthcoming TORs.

2.10.2 Development Stages: Construction and Operation

2.10.2.1 To avoid soil erosion and water-quality harm, confirm that culvert sizes for cross-drains, natural drainages and stream crossings are correct as specified in drainage designs. Incorrect culvert sizes are not to be installed irrespective of supply shortfalls, delivery delays or work-schedule pressures.

2.10.2.2 Install culverts in stream crossings during the dry season to reduce the threats to water quality and aquatic ecosystems.

2.10.2.3 Confirm that headwalls and wingwalls for culverts specified in drainage designs are properly installed to prevent soil erosion, suspended sediments and sedimentation.

2.10.2.4 Confirm that backfilling around headwalls and wingwalls is carried out using backfill materials described in design materials specifications and that fill materials are compacted to design standards and specifications. Improper materials and inadequate compaction will result in soil erosion and impaired water quality.

2.10.2.5 For the purpose of controlling soil erosion, confirm that drop inlet or catch basin at culvert inlets and energy dissipaters at culvert outlets, particularly for cross-drains in fill materials or on gradients, are installed correctly. Energy dissipaters such as riprap, a concrete apron or stone-lined splash basin are recommended.

2.10.2.6 Confirm that box or arch culverts, each type without fabricated bottoms, are installed at stream crossings to preserve natural habitat for fish and other important aquatic species.

2.10.2.7 To maintain hydrologic function in wetlands bisected by a road, ensure that culverts—properly sized and in suitable numbers—are installed in all fill embankments, irrespective of embankment length or permanence.

2.10.2.8 Confirm that grubbing (removing vegetation during site preparation) in sensitive wetlands' crossings is minimized by using geogrid and geotextile prior to fill placement.

2.10.2.9 Verify that metamorphosed rock, e.g., quartzite or an equivalent mineral, is used for filling roadbed embankments in wetlands. Laterite is not appropriate for this purpose because it disintegrates in wet applications.

2.10.2.10 Confirm that culverts—properly sized and in suitable numbers—are to be or have been installed in any fill embankments for roads that cross a wetland.

2.10.2.11 At this point in the selection and installation of culverts, relevant environmental guidelines are to be carefully implemented. Guidelines specific to water quality will be integrated into culvert placement and applied to specific actions in order to avoid harming water quality in particular and the environment in general.

2.10.2.12 Monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.10.3 Development Stage: Maintenance

2.10.3.1 To prevent culvert malfunction or failure, routine and periodic maintenance are required. During routine maintenance, culverts are inspected and cleaned or repaired as necessary. During periodic maintenance, culverts may need to be replaced or if performing poorly, repositioned according to new culvert designs.

2.10.3.2 Monitor the performance of soil-erosion control measures at culvert inlets and outlets. If needed, correct for any deficiencies.

2.10.3.3 To assure that wetlands' hydrologic connection has been restored, monitor water movement and flow at culverts installed in road embankments.

2.10.3.4 Monitor adequacy of measures to control soil erosion of all culvert installations. Augment or replace with more effective measures, if required.

2.10.3.5 Monitoring is essential to assure the implementation of these environmental measures, and it must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

2.11 BRIDGES GUIDELINES

Numerous minor permanent and ephemeral streams drain the Kenyan countryside, ultimately forming several large perennial (year-round) rivers—the Rivers Tana, Athi, Nzoia, Yala and Sondu. Whether minor or major, these watercourses must be crossed by intersecting roads.

While lower-order streams can be crossed with box culverts or similar structures, higher-order watercourses require crossing with designed and engineered bridges. Clearly the design and engineering of bridges are best left to the structural and hydraulic engineers. Nevertheless, practices to protect the environment—particularly for protection of soil and water, including habitats for aquatic species—are recommended in these guidelines.

In order to build concrete bridge footings and abutments, the work area is ideally free of water. In waterlogged areas, a cofferdam may be needed. A type of watertight construction, a cofferdam is installed in the work area and water is pumped out to expose the riverbed.

Sheet piling—flat piling that is driven into the ground and interlocked to create a wall or bulkhead—is commonly used to form the cofferdam. Sheet piles can be used to retain water in low-flow situations or coupled with bypass pumps to keep a site moderately dry during construction.

Fig. 2.17. Bailey bridge crossing the Tana River

Dewatering is the practice of removing water from the work area. Considered as polluted effluent, the water must be treated to remove sediments before being discharged into a stream or river. Effluent water is typically pumped out of the work area and into a settling pond or stilling basin where heavier sediment particles are allowed to settle out. After settling or stilling, the water is returned to the stream or river.

The foregoing activities, in combination with the erosive forces inherent to flowing water, are significant factors in degrading soil, water and aquatic habitats when bridges are being built.

2.11.1 Development Stages: Tender, Feasibility and Design

2.11.1.1 TORs for feasibility and design RFP are to stipulate that cofferdams, river diversions or other modifications to normal stream/river channels and beds be conducted in the dry season.

2.11.1.2 TORs for feasibility and design RFP are to require that cofferdams, river diversions or other modifications to normal stream/river channels and beds be built or conducted in non-breeding periods for fish and other important aquatic species.

2.11.1.3 TORs for feasibility and design RFP are to specify that effluent water produced during dewatering of the work site be pumped to settling or stilling ponds where it is retained until sediments have settled. After onsite sedimentation, the water may be returned to the stream or river.

2.11.1.4 TORs for feasibility and design RFP are to stipulate that wingwalls, gabions, riprap or other methods be used to prevent soil erosion on stream/riverbanks at or near the bridge structure.

2.11.1.5 To maximize the useful design-life of a bridge and prevent damage to the quality of stream or river water from soil erosion, the TORs for feasibility and design RFP are to specify that (a) the entire width of the stream/river channel at full flow, including any overflow channels, be spanned and (b) neither the width of the natural channel of the watercourse be reduced nor the natural course be permanently altered.

2.11.2 Development Stages: Construction and Operation

2.11.2.1 Verify that bridge construction does not commence before onset of the dry season.

2.11.2.2 Following discussions with local or regional ichthyologists (biologist or zoologist who is an expert in fishes), confirm that bridge construction does not commence during known breeding periods of fish or other important aquatic species.

2.11.2.3 Install settling ponds for retention of dewatering effluent before putting in sheet piles for the cofferdam.

2.11.2.4 Confirm that bridge abutments, foundations or retaining walls are not placed in an active stream or river channel or that any of these structures constrict the natural channel width.

2.11.2.5 Assure that stream/riverbanks are protected from erosion by installing concrete wingwalls, gabions, riprap or other suitable controls at or near the bridge structure.

2.11.2.6 Replace and restore stream/river bottom with suitable rock materials prior to returning flows to stream/river channel.

2.11.2.7 Upon completion of bridge construction, disassemble all cofferdams and settling ponds. Remove any residual or waste concrete and clean the work site.

2.11.2.8 Monitoring to assure the implementation of these environmental measures is essential. EMCA 1999 requires annual environmental audits of roads under construction, including ancillary facilities and works. However, monitoring water quality may require more frequent audits depending upon the water-quality parameter being monitored and the requirement of the ministry, authority or agency responsible for management of that parameter—for example, effluent discharges into public waters (WRMA and NEMA), effluent standards (NEMA) or worker safety (DOSHS). Regardless of frequency, monitoring must be systematic and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

2.11.3 Development Stage: Maintenance

2.11.3.1 Monitor settling ponds for proper function and production of release water within acceptable levels of suspended sediments (i.e., visually inspect for residual turbidity).

2.11.3.2 Monitor stream/river banks for evidence of erosion and augment controls, if needed.

2.11.3.3 Monitor bridge foundations for evidence of scouring and install erosion controls as needed.

2.11.3.4 Confirm that all materials used in the cofferdam and settling ponds have been removed before vacating the site.

2.11.3.5 Confirm that all waste materials—concrete, rubble, etc.—have been removed before vacating the site.

2.11.3.6 Monitoring is necessary to assure the implementation of these environmental measures, and it must be regular and thorough.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C.

3.0 AIR QUALITY

Fig. 3.1. Cement dust, example of $PM_{2.5}$

The obvious environmental impact from road transport is reduced air quality—reduced in quality to the degree that in many urban and industrial areas the health of humans and other life forms is imperiled. Direct emission impacts from road transport to air quality are the purview of environmental regulations slated to be adopted by NEMA in late 2010. As a consequence, road-transport (vehicle) emissions are **not** addressed in these MoR environmental guidelines. However, air-quality impacts from road infrastructure—more specifically, the impacts that arise when developing the infrastructure—are the subject of guidelines for roads and bridges.

Fugitive—or airborne—dust is the most common air pollutant associated with road construction. Dust is labeled as a "fugitive" air contaminant because it is distributed over a wide area and not restricted to a single point-source. Its dispersion by wind can increase its spatial impact. As such, the impact from dust particles can be significant because dust is discharged and dispersed at ground level. Fugitive dust, in fact, adversely and irreversibly affects the health and safety of all **flora** and **fauna** in its sway.

Dust, moreover, is a form of "particulate matter," or PM, which can be very harmful to human health, depending upon the size of the particle. In general, the smaller the particle is, the more damaging the effects to the human respiratory and cardiovascular systems. Indeed, particles that are 10 microns in diameter or smaller are the most damaging because they generally pass through the throat and nose to enter the lungs.

Emissions from diesel engines contain high levels of fine particles—2.5 microns or smaller in particle size, known as $PM_{2.5}$. But, diesel emissions from road construction do not constitute a significant source of air degradation in a rural Kenyan setting. This assertion would not hold true for road construction in urban areas, however, where diesel emissions and other sources of air pollution daily degrade urban air quality.

In 2005, the World Health Organisation (WHO) updated its risk assessment for PM, advising that the data show adverse health effects at exposures currently experienced by urban populations throughout the world. In fact, WHO found little evidence to suggest a threshold **below** which **no adverse health effects** from PM exposure would be expected.

Scientific studies have linked particle pollution, especially fine particles, with a series of significant health problems, including increased respiratory symptoms such as irritation of the airways, coughing, or difficult breathing; decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. (Having recited a litany of health

consequences from PM inhalation, diesel generators in a contractor camp are, therefore, best positioned away from office spaces or sleeping quarters to avoid any health risks.)

Fine particles produced by rock crushing can also cause permanent impairment of lung function by way of a disease called silicosis. It is an incurable lung disease caused by inhalation of dust containing free crystalline silica. It is irreversible and, moreover, the disease progresses even when exposure stops. Dust containing crystalline silica is released during operations in which rocks, sand, concrete and some ores are handled or crushed.

In a 2000 fact sheet on the disease, WHO advised that silicosis, one of the oldest known occupational diseases, continues to kill thousands of people every year throughout the world. Work in mines, quarries, foundries, and construction sites, in particular, is highly risky. Respiratory damage, if not properly mitigated and monitored, could have very serious health implications for road-construction workers—above all, workers in rock quarries and crushing operations.

To avoid the long-term deleterious effects on construction-worker health in PM-laden settings, the routine use of face masks is imperative. Their regular use must be enforced by quarry and crusher operators because workers dislike wearing face masks, particularly in hot, humid climates. Failing a system put forward by the contractor's safety and health officer, a system of escalating penalties is recommended to encourage mask use: first offense, verbal warning; second offense, dismissal from work for the day; and third offense, permanent dismissal from work.

Fig. 3.2. Pre-dust suppression, Kirima Quarry

Fig. 3.3. Post-dust suppression, Kirima Quarry

That said, the typical face mask distributed to construction workers is a loose-fitting disposable mask that covers the mouth and the nose when properly fitted and worn. While offering some protection from airborne dust, this type of mask is not designed to protect the user from breathing in very small particles, i.e., $PM_{2.5}$. A N95 respirator—one that removes 95 percent of small particles—is recommended; filtering face pieces are made from the N95 filter material in snug-fitting cup or flat-fold styles for one-time use only.

In addition to negative health effects, airborne dust reduces road safety. Clouds of dust, roiled up by vehicles moving along unpaved roads, put in danger all road users, especially pedestrians and cyclists who currently represent the majority users on Kenya's roads that are upgraded or rehabilitated to gravel-surfaced standards. Effective sight distance and

road visibility can be reduced to zero in these conditions.

Fig. 3.4. Dust suppression, Rongo-Homabay Road

Two main sources of particulate pollution to air quality are addressed in these guidelines:

- Fugitive dust generated by vehicles, including road-construction trucks and equipment, traveling on temporary access or deviation roads or on the project road during earthworks and before its surface is compacted or tarred and
- Particles that become airborne when processing, loading, applying and transporting road materials, particularly crushed rock fines, minute laterite grains or cement.

3.1 AIR QUALITY GUIDELINES

To assure that the health and safety of roads users—NMT and motorized alike—and roadside residents or businesses are not impaired by airborne dust, certain interventions are necessary. As well, mitigation benefits vegetation (natural and cultivated) growing alongside the road—leaves become coated with dust, transpiration is reduced and often the plant dies.

Among the required interventions are dust suppression and speed reduction, the latter often required to control travel speeds of construction-related vehicles and machinery. A behavior often observed at construction sites is the excessive speeds at which large haul trucks travel on access roads, imperiling the lives and wellbeing of roadside villagers who reside adjacent to the road.

Equally important is the health and safety of workers at rock crushing sites. Two interventions are required: PM suppression at the quarry and PPE protection for all quarry and crusher workers.

3.1.1 Development Stages: Tender, Feasibility and Design

3.1.1.1 TORs for feasibility and design RFP are to require the contractor to conduct training for workers about the importance of dust suppression for human health/road safety and about the suppression techniques required during the construction contract; this training is to be included in induction courses on general safety and health for all workers.

3.1.1.2 TORs for feasibility and design RFP are to stipulate that sufficient numbers of water bowsers (tankers) for suppressing dust as indicated by road conditions on all non-surfaced roads—access, deviation or project road during its

construction—be included in the list of equipment required of and provided by the road contractor.

3.1.1.3 TORs for feasibility and design RFP are to require the construction contractor to disclose the source and declared quantity of water available for dust suppression. If haul distances from water source to work site or access and deviation roads exceed standard allowable haul distance, the haul distance specified in standard/special specifications is to be increased to enable mitigation of fugitive dust as and when needed.

3.1.1.4 TORs for feasibility and design RFP are to establish that permits for water abstraction are to be obtained from WRMA by the contractor prior to removing any water from a source. Permit copies, when obtained, are to be submitted to the Engineer.

3.1.1.5 TORs for feasibility and design RFP are to require the installation and maintenance of speed humps on all non-surfaced roads—access, deviation or project road during its construction—to reduce vehicle speeds and subsequent dust generation; this intervention is to be regarded as inclusive of other dust-suppression measures, however.

3.1.1.6 TORs for feasibility and design RFP are to stipulate that high-profile speed humps (minimum 15 cm at elevation midpoint) be installed at 50 m spacing on access (haul) roads, deviations and project road (where traffic travel is necessary because deviations are not available) as appropriate and as required.

3.1.1.7 TORs for feasibility and design RFP are to require that all points of rock-dust generation—jaws, screens, conveyors, stockpiles, etc.—from a crushing plant be equipped with wet-suppression devices, i.e., sprinkler heads, fog shower, water sprays or other appropriate dust-suppression apparatus.

3.1.1.8 If applicable and warranted, TORs for feasibility and design RFP are to stipulate that a wheel-washing scheme (high-pressure washer or drive-through water pool or basin) to wash haul-truck wheels be installed and utilized at the crusher site to prevent transport of mud and rock fines onto public roads.

3.1.1.9 TORs for feasibility and design RFP are to oblige the contractor (or subcontractor for crushing operations) to (a) refrain from overloading haul trucks and (b) fully cover all materials—uncrushed rock, crushed rock and laterite—loaded on and hauled by trucks to the work site. Failure to meet this obligation will result in a percentage of the contractor's certificate for payment being withheld.

3.1.2 Development Stages: Construction and Operation

3.1.2.1 Verify that diesel generators used in contractor camps are positioned away from all office or accommodation buildings or blocks.

3.1.2.2 Ensure that diesel engines in construction trucks and machinery are regularly maintained to avoid excessive diesel-exhaust discharges which are emitted at ground level.

3.1.2.3 Confirm that the number of water bowsers or tankers pledged by the selected contractor are onsite and ready to suppress fugitive dust on all non-surfaced roads—access, deviation or project road—during the road construction.

3.1.2.4 Confirm that the water source for dust suppression is on hand and the declared quantity sufficient to enable full suppression of dust to protect human health and road safety.

3.1.2.5 Confirm that all required WRMA water-abstraction permits have been secured by the contractor and that permit copies have been submitted to the Engineer.

3.1.2.6 Confirm that speed humps—built to recommended design specifications (≥15 cm at elevation midpoint) and placed at the recommended frequency (≤50 m spacing)—are installed and maintained on all roads (access, deviation or project roads during building).

3.1.2.7 Confirm that all points of rock-dust generation—jaws, screens, conveyors, stockpiles, etc.—from a crushing plant are equipped with wet-suppression devices, i.e., sprinkler heads, fog shower, water sprays or other appropriate dust-suppression apparatus.

3.1.2.8 Confirm that construction personnel assigned to work in high-dust conditions are provided with effective face masks and other appropriate PPE (see Appendix D); workers are to be trained in their proper and regular use.

3.1.2.9 If applicable and warranted, confirm that the scheme chosen by the contractor—whether high-pressure washer or drive-through water basin—to wash haul-truck wheels is installed, equipped and in use at the crusher site to prevent transport of mud and rock fines onto public roads.

3.1.2.10 Confirm that the contractor (or subcontractor for quarrying and/or crushing operations) implements load-size restrictions and covers all loads leaving the rock quarry, borrow pit and crusher area and being hauled to the work site.

3.1.2.11 Irrespective of design plans that indicate the integration and application of mitigation measures to protect air quality and road safety, monitoring to assure the implementation of these environmental measures is necessary.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper

implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

3.1.3 Development Stage: Maintenance

3.1.3.1 Inspect speed controls (speed humps) to assure that they are slowing travel speeds on all construction-project roads. If the speed humps are not performing as intended, increase their midpoint heights and placement frequencies.

3.1.3.2 At completion of road construction, all access and deviation roads are to be closed, speed-controls removed and road-surfaces scarified to reestablish grasses or other suitable vegetative cover.

3.1.3.3 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse impacts. Monitoring must be regular, and it must be systematic.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

4.0 NOISE AND GROUND VIBRATION

Noise and ground vibration, generated by road construction, are usually brief in duration. Moreover, they are typically characterized as local, given that noise and ground vibrations generated by particular construction source(s) tend to decay rapidly as distance from the source(s) increases. Temporal and spatial aspects notwithstanding, mitigating noise and ground vibrations is necessary because of their deleterious health and economic effects on nearby receptors.

Excessive noise emissions and ground vibrations are regulated by NEMA through the Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009. Section 15 of the regulations requires the completion of an environmental impact assessment (EIA):

Any person intending to carry out construction, demolition, mining or quarrying work shall during the EIA studies:

- Identify natural resources, land uses or activities which may be affected by noise or excessive vibration from the construction, demolition, mining or quarrying;
- Determine the measures which are needed in the plans and specifications to minimise or eliminate adverse construction, demolition, mining or quarrying noise or vibration impacts; and
- Incorporate the needed abatement measures in the plans and specifications.

NEMA also require an EIA for all major roads (including those in scenic, wooded and mountainous areas and wetlands) as well as quarries and sand harvesting. For purposes of practicality, these environmental guidelines for roads and bridges recommend that a **full** EIA Study, in lieu of multiple EIAs, be prepared at the feasibility and preliminary design stages.

At the time of final design, environmental management plans (EMP) can be prepared from the EIA Study Report's findings and recommendations for specific road-construction actions and activities. (This recommendation is discussed at greater length in the introduction to these guidelines.)

In the instance of fulfilling NEMA requirements and producing a working document equivalent to an EMP, a contractor-prepared noise and ground vibration control plan (NGVCP) is suggested. The recommended NGVCP elements go beyond the requirements of the NEMA-required EIA/EMP for noise and ground vibration control.

4.1 NOISE GUIDELINES

Previously, noise was linked solely to deafness onset. Noise—depending upon its duration and intensity —has recently been associated with a range of health problems, however. WHO have **documented** seven categories of adverse health effects from noise.

1. **Hearing impairment**. Sound levels less than 70 dB are not damaging to the ear.

However, levels greater than 85 dBA for 8 hours or more are potentially hazardous to the ear.

Fig. 4.1. Typical blast at a hard-rock quarry

The unit of measurement for environmental noise is known as dB, or decibel, whereas dBA is an A-weighted dB scale that factors in the relative insensitivity of the human ear to very low frequency sounds, ≤3 dBA. On this scale, the range of human hearing extends from almost 3 dBA to about 140 dBA.

A sound measurement of 60 dBA is perceived by the ear to be twice as loud as one measuring 70 dBA. For purposes of comparison, the jet engine of an airplane at take-off is around 140 dBA whereas normal conversation is 60 dBA.

WHO advises that the threshold for pain is usually 140 dBA, and exposure to 140 dBA should be limited in duration (four hours) and frequency (four times/year). Sound levels greater than 165 dBA, even for milliseconds, can cause acute cochlear (inner ear) damage.

NEMA use dB(C)—the C-weighted dB scale—to regulate noise emissions from mines and quarries. Because the response of the human ear varies with sound level, the ear's response to sound levels higher than 100 dB is flatter. The dB(C) scale, which is frequently used to measure peak sounds, more truly reflects what the ear is actually hearing during a quarry blast.

Blasting at rock quarries is generally in the sound range of 110 dBA to 140 dBA, depending upon the size and type of explosives. NEMA's permitted limits for noise levels originating from mines and quarries differ according to receptor: within the confines of a sensitive receptor (health care, school, etc.), 109 dB(C), and within the confines of residential, commerce, small-scale production, etc., facilities, 114 dB(C).

To protect quarry workers who remain within the quarry confines during blasts, the quarry operator must provide workers with sound-dampening ear muffs to reduce the acoustic energy created by the explosives and the workers' proximity to the sound source. Sound-dampening ear muffs should also be worn by employees working at rock crushers, another source of extreme noise—120 dBA or more produced at the crusher proper. Alternatively, helmets (hard hats) with ear-protection muffs are available on the market; their use is recommended as part of the PPE package issued to quarry/crusher workers. (See Appendix D.)

It is important to remember that ears do not get used to loud noise. They get deaf.

2 **Interference with Spoken Communication**. Noise pollution interferes with the ability to comprehend normal speech and may lead to problems with concentration, fatigue,

uncertainty, misunderstandings, stress reactions, etc. These effects, for example, can compromise communication in a classroom, resulting in impaired academic performance.

The importance of locating a rock quarry and/or rock crusher away from settlements is underscored by the almost certain knowledge that normal conversations conducted in homes, schools, businesses and religious institutions will be interrupted by quarry or crusher noises, be the noise intermittent or relatively constant. The severity and consequences of interferences with spoken communication are unknown. In this instance of irreversible damage—learning impaired by excessive sound interference, the Precautionary Principle applies: uncertainty does not reduce the need to try to prevent environmental degradation.

3. **Sleep Disturbances**. The human body does not perform well in its diurnal activities with interrupted sleep; environmental noise is a known cause of this behavioral phenomenon. Rapid Eye Movement (REM) sleep—the all-important dream pattern that occurs during normal sleep—is disturbed and reduced by continuous or intermittent environmental noise. REM sleep stimulates the brain regions used in learning, particularly learning of certain mental skills. As well, REM sleep may be the time during which the brain's cortex interprets and organizes information the brain receives during consciousness. Disrupted REM sleep, if repeated often enough, can result in unpredictable, sometimes antisocial, behavior.

   In addition to fundamental psychological changes brought about by sleep disturbances (altered mood, reduced performance, etc.), noise during sleep causes physiological changes: increased blood pressure, heart rate and pulse rate as well as vascular constriction, respiratory changes and irregular heartbeat. Thresholds and responses vary according to individual—children, the elderly and the sick the most sensitive to noise-related sleep disturbance.

   The introduction of road construction-related noise—in particular, noises produced by quarrying and crushing operations—to rural settlements can obviously be very detrimental to the health and wellbeing of residents unaccustomed to night noise. For this reason, construction activities—even in urban areas where nighttime noise is not uncommon—must be limited to daylight hours (6:00 to 18:00), preferably during the normal work week (Monday through Friday).

4. **Cardiovascular Disturbances**. Noises above ordinary sound levels, e.g., normal conversation registering ≈60 dBA, has both temporary and permanent effects on the endocrine and autonomic nervous (automatic responses—heartbeat, respiration, etc.) systems of human and other mammals. Noise can trigger responses in these systems that can ultimately lead to cardiovascular disease, causing heart rate and blood pressure to increase. Other symptoms accompany the foregoing—increased blood viscosity, altered blood chemistry and elevated adrenalin levels, the stress-induced hormone associated with the "fight or flight" syndrome.

   These effects seem to manifest themselves with long-term daily exposure to noise levels above 65 dB or with short-term acute exposure (acute exposure is normally characterized as lasting no longer than a day) of 80 dB to 85 dB. From the scientific

research, it appears that the physiologic changes brought about by temporary noise are reversible; however, the changes induced by prolonged, intense and unexpected noise are not quickly—if ever—reversed.

In keeping with the concern for hearing impaired by excessive noise, the cardiovascular health of construction workers and nearby residents is at risk from loud and unpredictable noises, especially during quarry blasts. To reduce this risk, certain precautions are required. The concussive power from blasts can be controlled with the proper selection and placement of modern explosives. A well-publicized system for notifying nearby residents and communities about upcoming blasting events is important for security and certainty. In addition, a warning system for alerting residents and passersby to an imminent blasting event is essential, making certain that the warning system is made known to the affected and wider public.

5. **Disturbances in Mental Health**. Noise pollution can contribute to anxiety, stress, nervousness, headache, mood changes, social conflicts, neurosis and—in some cases—psychosis. In fact, prolonged noise levels greater than 80 dB can lead to increased aggression and anti-social behavior in general. Children, the elderly and people with underlying depression are particularly vulnerable to these responses.

6. **Impaired Task Performance.** Excessive noise impairs task performance at school and at work, by increasing errors and decreasing motivation. Reading attention, problem solving and recall memory are adversely affected by noise.

   The longer the exposure to extraordinary noise, the greater the adverse cognition effect in children. In fact, children raised and schooled in areas of high noise (e.g., highways, airports, etc.) appear to have elevated levels of stress-related hormones (adrenalin) and blood pressure. Their cognitive (thought) processes also appear to be compromised by a noisy environment: levels of academic achievement for children in noisy environments are lower than children from quiet environments.

   These findings underscore the importance of locating road-construction activities that produce excessive and prolonged noise—quarries, rock crushers, etc.—well away from human settlements. This proviso is particularly important for schools and hospitals as well as religious buildings where people congregate to worship quietly.

7. **Negative Social Behavior and Annoyance Reactions**. The social and behavioral effects of noise exposure are complex, subtle and indirect. Aberrant social behavior appears to begin with annoyance reactions like anger, depression, anxiety, agitation and fatigue that are brought about excessive, unexpected or prolonged noise. Annoyance reactions, if noise continues, evolve into behaviors of unfriendliness, frustration or aggressiveness. None of these reactions or behaviors is conducive to social cohesion—the "glue" that holds together disparate individuals and groups into what we call a "civil society."

Construction noise is ephemeral—it comes and it goes, unless its source is a rock crusher that is in daily operation and a fixed location; nevertheless, a plan to mitigate noise/ground vibration generation and propagation is advised. This plan, which would be developed by the contractor as part of his tender proposal, would declare the contractor's intentions and methods for reducing and controlling noise and ground vibration. Like the erosion and sediment control plan (ESCP) developed by the contractor to protect water

quality during road construction, the purpose of the noise and ground vibration control plan (NGVCP) is to safeguard human health and economic wellbeing by way of

- focusing on minimising noise and ground vibration generation and propagation by siting the materials and processing sources away from human settlements to the greatest degree possible; compensating and temporarily resettling nearby residents , businesses or other sensitive land uses likely to be adversely affected by construction noise and vibrations; and, judicious use of landscape features for noise screening and buffering;
- controlling the levels of noise and ground vibrations by utilizing modern blasting materials and techniques to lessen peak air overpressure (noise) and peak particle velocity (ground vibrations); and,
- respecting the lives and routines of people in settlements near materials sites, materials haul roads and materials processing sites by strictly adhering to declared construction operating schedules and quarry-blast warning systems.

To reduce the possibility of adverse noise impacts to human receptors from road construction activities and actions, the following guidelines are to be implemented.

4.1.1 Development Stages: Tender, Feasibility and Design

4.1.1.1 The TOR for feasibility are to assess the practicality of providing specifications for particular noise control treatments, ones that are based on results from design analyses and/or earlier public commitments by authorities, e.g., a temporary noise barrier required to shield a particular community from loud construction activities.

4.1.1.2 The TORs for feasibility and design are to require bidding contractors to prepare a noise and ground vibration control plan (NGVCP) that declares the contractor's intentions and methods for reducing and controlling noise and ground vibration. The NGVCP, which will become binding upon the winning tender, bears upon the selection of materials sites (including the methods for exploiting them); materials processing location and methodology; possible compensation and resettlement costs; location of materials haul roads; and construction work schedules, the latter ultimately determining future rates of materials exploitation and production.

4.1.1.3 The TORs for feasibility and subsequent development stages are to clearly stipulate operating times (6:00 to 18:00) and days (Monday through Saturday) for all activities and actions related to the construction of the project road. In addition to the Engineer's approval, divergence from this schedule is to be approved by nearby residents, communities and the local NEMA official as stipulated in EMCA's noise and excessive vibration pollution control regulations.

4.1.1.4 The TORs for feasibility and design stages are to promote the uses of natural topography or stockpiled overburden/topsoil as noise buffers in siting and developing a quarry. When possible, a quarry is to be sited behind elevated

ground (i.e., a ridge) or stockpiled materials to screen receptors from blasting noise. Trees and shrubs present at the quarry site are to be retained, to the greatest extent possible, for sound-screening and buffering.

4.1.1.5 In addition, the TORs for feasibility and subsequent development stages are to require the contractor or his agent(s) to declare in the quarry operation and reinstatement plan and thereafter publicly the (1) intended drilling and blasting schedule; (2) notification system for informing nearby residents and communities about upcoming blasting events; and (3) warning system by way of sounding a siren for evacuating quarry workers; alerting nearby residents and communities to imminent blasting event; and, (4) an emergency response plan in case of an accident.

4.1.1.6 The TORs for feasibility and subsequent development stages are to stipulate that blasting is not to take place outside established blasting schedules without community consent; written permission of the local NEMA official; agreement from the Department of Mines and Geology; and, written approval of the Engineer. This restriction applies irrespective of road-supply pressures and/or production slumps.

4.1.1.7 Unused explosives are to be kept in a secure store or in the custody of the local police; detonators are to be kept separately from explosives.

4.1.2 Development Stages: Construction and Operation

4.1.2.1 Ensure that conditions and practices required by the NGVCP are being implemented; update the plan if called for by changed circumstances.

4.1.2.2 To preclude creating construction-related noise which requires mitigating, locate and adhere to routes that avoid travel by heavy equipment and trucks through a community or settled area.

4.1.2.3 Confirm compliance with stipulated operating times (6:00 to 18:00) and days (Monday through Saturday) for all activities and actions related to the construction of the project road.

4.1.2.4 Confirm that divergence from stipulated work schedule (6:00 to 18:00, Monday through Saturday) is approved by nearby residents, communities, the local NEMA official and the Engineer.

4.1.2.5 Verify that natural topography or stockpiled overburden/topsoil has been utilized as noise buffering in siting and developing the quarry.

4.1.2.6 Confirm that the contractor or his agent comply fully with (1) intended drilling and blasting schedule; (2) notification system for informing nearby residents and communities about upcoming blasting events; (3) warning system for alerting nearby residents and communities to imminent blasting event; and (4) emergency response plan in case of an accident.

4.1.2.7 Verify that blasting is not conducted outside established blasting schedules without community consent; approval of the local NEMA official; agreement from the Department of Mines and Geology; and written permission of the Engineer and local authority.

4.1.2.8 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse noise impacts. Monitoring must be recurrent, and it must be organized.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

4.1.3 Development Stage: Maintenance

Because maintenance implies looking after a project following its completion, maintenance associated with mitigation of construction-related noises should be unnecessary. Noise-generating activities should cease upon conclusion of road construction.

4.2 GROUND VIBRATION GUIDELINES

In contrast to blast energy transmitted through the atmosphere—airborne vibration or sound measured in dB, ground vibration is the energy wave from a detonation that travels through the ground. Ground vibration is commonly measured in Hertz or Hz, itself a description of the frequency at which an object is oscillating, that is, moving back and forth. However, in order to assess the possible effects on buildings and structures, ground vibrations are also presented in terms of peak particle velocity (PPV), recorded in millimetres per second (mm/s). PPV measures the speed at which the ground vibrates—not the distance that the ground moves. Damage to structures is more frequent when Hz is low and PPV is high.

Vibrations can be equated to waves in a body of water that are propagated from a disturbance source; the waves tend to diminish as they travel away from the source. In the case of a quarry blast, the disturbance source is detonated explosives and in a body of water, the disturbance source may be a pebble or small stone tossed into the water—or ground vibrations, as Figure 4.2 demonstrates. A free-standing tank of water, the obvious waves or ripples on its surface were produced by external oscillating ground vibrations.

The human body is very sensitive to vibration at a level around 1.5 mm/s. Vibration as low as 0.5 mm/s can be felt in some circumstances. To illustrate how remarkably low these levels of vibration are, the act of hammering a nail into a wall causes PPV of 100 mm/s.

In general, the threat to human health is not directly related to ground vibrations **per se**, but from damage to vibration-affected structures and subsequent injury to the occupants therein. That is not to say that a human's sense of wellbeing is not compromised by

ground vibrations, it is, irrespective of vibration damage to a home or workplace. Ground movement is perceived by the human brain as potential danger or impending harm, decreasing the sense of security and certainty.

Ground vibration is not limited to blasting sources, however. Road construction vehicles and machinery also create ground vibrations. Nevertheless, construction equipment, such as D-8 and D-9 Caterpillars, earthmovers and haul trucks, rarely exceed PPV levels of 2.5 mm/s at 10 m, well within NEMA's standard of 5 mm/s (0.5 cm/s) at 30 m.

Certain construction activities such as pile driving or pavement breaking can produce PPV levels higher than the NEMA-recommended limit of 5 mm/s. Vibration levels from high-impact pavement breakers (also known as jack hammers) can exceed single-event PPV levels of 70 mm/s (measured at 3 m), but, with the exception of some urban roads, pavement breakers are not required for road construction in Kenya.

Fig. 4.2. Wave propagation by ground vibration

Obviously, the way a building is constructed and the condition it is in determines how much vibration it can withstand before damage appears. For "ruins and ancient monuments," PPV limits of 2.0 mm/s for continuous ground vibrations are recommended. This criterion level may also be used for historical buildings, or buildings that are in poor condition.

Fig. 4.3. Indoor residential damage from ground vibrations

Although damage to buildings and structures from ground vibrations is generally rare except during earth tremors or earthquakes, buildings and structures in Kenya's rural settlements may be more vulnerable to damage. The durability of their construction materials and fabrication can be insubstantial; as a consequence, they are less likely to withstand ground vibration levels produced by denotations of high explosives at quarries and use of vibration-producing construction vehicles/machinery.

Vibration effects are determined by factors related to the scale of the project and the sensitivity of the surrounding land uses. But certain measures can be employed to reduce the adverse effects from construction-related ground vibrations experienced by people in nearby settlements and, in worse cases, by buildings/structures in those settlements.

At the outset of road planning and design, identified sources of hard rock must be located away from settled areas. Locating rock quarries within or adjacent to settlements is a certain path to persistent nuisance complaints and damage claims lodged against the contractor.

In the event that buildings and structures are located within 100 m of a rock quarry or a rock crusher, the landowners/land users must be compensated and relocated to guarantee

their safety and wellbeing. The relocations (and compensation) can be temporary if the quarry and crusher are to be decommissioned permanently.

Access and haul roads must also be located away from settled areas. Again, if buildings and structures are within 30 m of these roads, the landowners/land users must be compensated and relocated temporarily to avert nuisance complaints and/or damage claims.

If the 100 m (rock quarries and crushers) and 30 m (access and haul roads) clearance zones are followed, a photographic record of building and structure condition is probably not necessary. However, for all buildings and structures within or proximate to these recommended clearance zones, periodic—pre, during and post-construction—photographs of condition are advised. To be taken by the contractor and submitted to the Engineer and a local representative of NEMA, the photographic record establishes the bases, if any, for adjudicating damage claims.

Particular methods and techniques for blasting rock at quarries are known to reduce ground vibrations. They pertain to the weight of explosives per delay; placement of explosives in the rock; and denotation timing delay and firing. While not the subject of these guidelines, road-design and construction standards are to stipulate that modern blasting materials and techniques are required from the construction contractor and any quarry subcontractor.

The NGVCP, discussed in Section 4.1, addresses ground vibrations along with noise. Its purposes are to safeguard human health and economic wellbeing by

- focusing on minimising noise and ground vibration generation and propagation by siting the materials and processing sources away from human settlements to the greatest degree possible; compensating and temporarily resettling nearby residents , businesses or other sensitive land uses likely to be adversely affected by construction noise and vibrations; and, judicious use of landscape features for noise screening and buffering;
- controlling the levels of noise and ground vibrations by utilizing modern blasting materials and techniques to lessen peak air overpressure (noise) and peak particle velocity (ground vibrations); and,
- respecting the lives and routines of people in settlements near materials sites, materials haul roads and materials processing sites by strictly adhering to declared construction operating schedules and quarry-blast warning systems.

To reduce the possibility of adverse ground vibration impacts to human receptors from road construction activities and actions, the following guidelines are to be implemented.

4.2.1 Development Stages: Tender, Feasibility and Design

4.2.1.1 The TOR for feasibility are to assess the practicality of providing specifications for particular ground-vibration control treatments, ones that are based on results from design analyses and/or earlier public commitments by authorities,

e.g., rerouting haul roads in order to divert construction trucks away from a particular settlement or community.

4.2.1.2 The TORs for feasibility and design are to require bidding contractors to prepare a noise and ground vibration control plan (NGVCP) that declares the contractor's intentions and methods for reducing and controlling noise and ground vibration. The NGVCP, which will become binding upon the winning tender, bears upon the selection of materials sites (including the methods for exploiting them); materials processing location and methodology; possible compensation and resettlement costs; location of materials haul roads; and, construction work schedules, the latter ultimately determining future rates of materials exploitation and production.

4.2.1.3 The TORs for feasibility and subsequent development stages are to clearly stipulate operating times (6:00 to 18:00) and days (Monday through Saturday) for all activities and actions related to the construction of the project road. In addition to the Engineer's approval, divergence from this schedule is to be approved in writing by nearby residents, communities and the local NEMA official as stipulated in EMCA's noise and excessive ground vibration control regulations.

4.2.1.4 The TORs for feasibility and subsequent stages of road development are to investigate and recommend the application of new proven blasting materials and methods that minimise the propagation of airborne and ground vibrations, irrespective of quarry setting.

4.2.2 Development Stages: Construction and Operation

4.2.2.1 Ensure that conditions and practices required by the NGVCP are being implemented; update the plan if called for by changed circumstances.

4.2.2.2 To preclude creating construction-related ground vibrations which require mitigating, locate and adhere to routes that avoid travel by heavy equipment and trucks through a community or settled area.

4.2.2.3 Make certain that the usage of construction-related sources of ground vibration—demolition, earthworking and earth-impacting activities, i.e., jack hammers—is staggered to reduce combined vibrations levels. A single source of vibrations may be tolerable whereas many sources in combination may become intolerable.

4.2.2.4 Verify that blasting materials and methods recommended in the feasibility and design stages to reduce ground vibrations are being utilized by the construction contractor or any subcontractors. In any case, the provisions contained in the Explosives Act Cap 115 for manufacture, storage, sales, transport, importation, exportation and use of explosives must be followed by the contractor and any/all quarry subcontractor(s).

4.2.2.5 Confirm compliance with stipulated operating times (6:00 to 18:00) and days (Monday through Saturday) for all activities and actions related to the construction of the project road.

4.2.2.6 Confirm that divergence from the work schedule (6:00 to 18:00, Monday through Saturday) stipulated in the NGVCP is approved in writing by nearby residents, communities, the local NEMA official and the Engineer.

4.2.2.7 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse ground vibration impacts. Monitoring must be recurrent, and it must be organized.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

4.2.3 Development Stage: Maintenance

Because maintenance implies looking after a project following its completion, maintenance associated with mitigation of construction-related ground vibration should be unnecessary. Activities that generate ground vibrations should cease upon conclusion of road construction.

5.0 LAND USE

Fig. 5.1. Kakamega National Forest Reserve

In addition to improved land access provided by new or rehabilitated road infrastructure, changes to land use can arise from road-construction activities. In the first instance, the sites where road materials are extracted are often permanently changed in use. Whereas laterite borrow pits can be partially or wholly reinstated to allow the land's return to its former use, quarries are rarely, if ever, restored to productive uses for agriculture, forestry or urban development. To a lesser degree than borrow pits, extracting sand from designated sand-harvesting sites (as per NEMA's newly adopted National Sand Harvesting Guidelines 2007) can alter land uses, but the amounts of sand required for road construction are minor in comparison to laterite and crushed rock.

In the second case, if not carefully prescribed in special specifications for a road project, construction contractors may dispose **at will** of construction rubble and oversize rock; in doing so, land uses are changed—generally from a productive to a non-productive use and sometimes without compensation to landowners or land-users for the appropriated land. Arbitrarily dumping construction wastes can also pose safety risks in areas used by children for playing.

To restore (as much as possible) original land contours on restored land and prevent pooled water on site, the environmental guidelines for the reinstatement of borrow pits and quarries recommend excavated land be in-filled using **inert** construction rubble and oversize rock (excluding waste bitumen asphalt that is a toxic material). By implementing these reinstatement guidelines, the disposal of unwanted materials is resolved and the final contours of reinstated sites improved.

Providing upgraded road infrastructure improves access—one purpose in building a road. However, improving access to lands with protected status or unprotected resources can often lead to unintended and unmanaged exploitation of them.

Protected areas—in particular, forested areas designated as forest conservancy areas or nature reserves—provide undisturbed habitats for many species of flora and fauna; improving road access increases the opportunities for habitat destruction and illegal plant harvesting or animal poaching.

Likewise, improved access to lands with valuable natural resources such as the Kakamega rain forest with its remarkable biodiversity can result in unmanaged off-take of trees, plants and animals, all with significant monetary and environmental value.

Were an improved, all-season road to be extended into an unique biogeographic region like Kakamega, Kenya's premier rain forest and the eastern most remnant of a dense rain

forest that a thousand years ago stretched across the entirety of central Africa, it becomes abundantly clear that new and comprehensive management strategies—deliberate actions and activities required to inventory, administer and enforce sustainable utilization or conservation—are absolutely urgent.

To mitigate for road-related changes in land use or road-induced changes in managing land resources, the environmental guidelines that follow are necessary. In addition to MoR, their realization depends upon commitment and cooperation from Kenya's several road authorities, NEMA, KFS and KWS.

5.1 MATERIALS SITES GUIDELINES

Although the environmental guidelines for developing borrow pits and quarries require fair compensation to landowners/land-users for temporary use of their land, the return of reinstated land to its former use is not always possible. Material has been removed from the site, and, in so doing, the topography of the land has been altered. Consequently, the capability of the land to produce food crops, for example, may be irreversibly changed. These inadvertent land-use changes that adversely affect the income-earning prospects for a landowner or land-user must be taken into account in advance of their occurrence.

5.1.1 Development Stages: Tender, Feasibility and Design

5.1.1.1 The TORs for feasibility and design RFP are to stipulate that compensation to landowners or land-users for access to and use of land for laterite road-building materials be based upon the plan for reinstatement of the borrow pit. If productive after-use of the site is uncertain viz the plan's findings and recommendations, the landowner/land-user must be informed that full compensation will be based upon probable reinstated land productivity. This stipulation means that for usable reinstated land, full payment was rendered by the contractor at time of initial site access; however, for unproductive land after reinstatement, an additional payment will be made by the contractor to the landowner or land-user for forgone income-earning opportunities.

5.1.1.2 The TORs for feasibility and design RFP are to stipulate that compensation to landowners or land-users for access to and use of land for rock materials be based upon possible productive after-use of the site. For post-construction quarries with deposits of exploitable materials, compensation amount is to be based upon joint agreements between landowner/land-user, the contractor in consultation with the local NEMA representative and a local provincial administrator such as chief or assistant chief.

5.1.1.3 The TORs for feasibility and design RFP are to request that relevant national and provincial governments jointly adopt the laws and standards necessary to enable fair and full compensation for land resources used in building roads, taking into account the forgone income opportunities for landowners or land-users whose land cannot be returned to productive uses.

5.1.2 Development Stages: Construction and Operation

5.1.2.1 Verify that compensation agreements between the road-construction contractor and owners or users of land with laterite materials prospectively acknowledge by additional payment any land that cannot be reinstated to productive use.

5.1.2.2 Confirm that compensation agreements between the road-construction contractor and owners or users of land with rock deposits for quarrying acknowledge post-construction uses that include continued operation when and where residual material remains; in the event that quarry operation continues, any agreement must involve the local NEMA representative.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

5.1.3 Development Stage: Maintenance

5.1.3.1 Monitor and confirm that all compensation agreements between the construction contractor and the owner/user of land with exploitable road materials have been legally and equitably consummated. In instances of agreements to compensate for reinstated land that is no longer productive, assure that agreed-upon obligations have been carried out.

To organize monitoring activities, an administrative form is included in Appendix C.

5.2 DEBRIS DISPOSAL GUIDELINES

Unless the standard/special specifications for road contracts provide extra reimbursement for hauling construction debris—waste concrete, oversize rock, spoil, tree stumps, etc.—to approved disposal sites, a road-construction contractor may be tempted to dump it over the road edge, on vacant land or simply leave it behind. Visual impacts aside, the net effect of unplanned and unauthorized debris disposal is often a taking of land without compensation.

In addition to land taking, uncontrolled disposal of construction debris poses safety hazards to nearby communities, especially to children who may be injured while playing in the rubble. Certain kinds of debris also trap water that can serve as breeding sites for waterborne and vectorborne diseases.

5.2.1 Construction Stages: Tender, Feasibility and Design

5.2.1.1 The TORs for feasibility and subsequent development stages are to provide for and specify the amount of reimbursement to the contractor for additional haulage to authorized construction-debris disposal sites.

5.2.1.2 The TORs for feasibility and subsequent development stages are to require the construction contractor to identify a suitable site(s) for disposal of construction debris. Any and all site(s) are to be approved by the Engineer and the local NEMA representative.

5.2.1.3 The TORs for feasibility and subsequent development stages are to describe, define and list the types of construction debris for disposal at approved site(s). The list of approved debris will be appended to the special specifications. All hazardous materials, including waste bitumen asphalt, are to be excluded from the approved materials list.

5.2.1.4 The TORs for feasibility and subsequent development stages are to specify the methods for (1) disposing of the debris and (2) capping the site upon completion of construction and clean-up activities.

5.2.1.5 The TORs for feasibility and subsequent development stages are to stipulate that the contractor is to compensate the landowner/land-user for permanent use of land taken for the disposal site.

5.2.2 Construction Stages: Construction and Operation

5.2.2.1 Confirm that the road contractor is being reimbursed for additional haulage to authorized construction-debris disposal sites.

5.2.2.2 Confirm that the construction contractor is removing and hauling to the approved disposal site all construction debris.

5.2.2.3 Confirm that the construction contractor is disposing of approved construction debris listed in the special specifications.

5.2.2.4 Confirm that no hazardous materials, including waste bitumen, are being disposed of at the disposal site.

5.2.2.5 Confirm that the road contractor is using the methods described in the specifications for disposal of construction debris.

5.2.2.6 Confirm that the construction contractor has fully compensated the landowner/land-user for permanent use of land taken for the disposal site.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

5.2.3 Construction Stage: Maintenance

5.2.3.1 Upon completion of road construction, confirm that all construction rubble has been disposed of properly.

5.2.3.2 Confirm that no excluded materials have been discarded in the construction-debris disposal site.

5.2.3.3 Verify that the disposal site has been adequately capped with soil material—spoil, for example—and sufficiently compacted to prevent surface-water pools or surface-water intrusion.

5.2.3.4 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse impacts from improper disposal of construction debris. Monitoring to assure satisfactory capping of the disposal site must be continuing.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

5.3 ROAD-INDUCED CHANGES IN RESOURCE MANAGEMENT GUIDELINES

Improved access to lands with valuable biological resources accelerates their exploitation, reducing the intrinsic value of the resources and decreasing the rich biodiversity of flora and fauna they support. The environment—its rich biophysical attributes that underpin almost all of society's socioeconomic activities and cultural values—suffers for the benefit of a few.

The high-speed tarred road bisecting a small village in southern Botswana was mentioned in the introduction to these guidelines. In addition to jeopardizing the safety and welfare of the villagers and their livestock, the road opened access to sizable, unspoiled woodlands on the village fringes. Rich with birdlife and small wild mammals, the woodlands had sustainably provided the villagers with fuelwoods for decades. Shortly after the road was opened, huge stacks of fuelwood began appearing along the roadsides ready to be hauled to Gaborone, the capital city. And soon the woodlands were dramatically reduced in density and scope, no longer able to support the fauna they once hosted or provide vital fuelwoods to the villagers.

Failure on the part of Botswana's road planners to foresee and mitigate this road-induced environmental impact set the stage for the uncontrolled exploitation of these woodlands. Failure on the part of Botswana's forestry authorities to intervene with a management plan to prohibit wholesale removal of trees brought about the woodlands' severe degradation.

No less important to changes in resource management strategies caused by improved road access is harvesting of wild plants and poaching of wildlife in protected areas. An improved road allows all takers to move more quickly into and out of protected areas with illegal plants and wild game.

To mitigate for these unintended and undesirable impacts from improved access, application of the following environmental guidelines is required.

5.3.1 Development Stages: Tender, Feasibility and Design

In order to avoid the loss of important biologic resources from unprotected, unmanaged areas, MoR must make full use of the knowledge available in other road authorities and

government ministries, most notably KFS/KWS when roads near forests or woodlands are being improved. The involvement of KFS/KWS planners and specialists in the early stages of road construction or rehabilitation is critical in designing meaningful interventions, i.e., management and enforcement strategies, to forestall uncontrolled exploitation.

Likewise, the early and ongoing involvement of NEMA in planning the construction or rehabilitation of roads that improve access to protected areas is crucial. By way of example, mitigation actions to alter road alignments or road terminations may be useful in maintaining the "protected" status of these areas.

In addition to MoR-instigated mitigation of road-induced impacts to lands with important biologic resources, several measures can be implemented by NEMA, KFS and KWS in conjunction with MoR:

- **collaboration among Government of Kenya ministries to target such areas for early deployment of protection staff;**
- **boundary re-establishment and demarcation of such areas to be given priority;**
- **signage along the roadside to make users aware of special status and regulations near protected areas;**
- **for each road segment, a site-specific investigation will be necessary, ideally by comparing the planned road alignment with a map of existing areas of undegraded forest or protected areas; and**
- **to initiate community-based natural resources management programmes and co-management programmes established in buffer zones around the protected areas.**

5.3.1.1 The TORs at feasibility and design RFP for roads into or near forest or woodland reserves are to require ongoing involvement of KFS/KWS planners and specialists to advise and consent to more effective resource management strategies made necessary by improved access.

5.3.1.2 The TORs at feasibility and design RFP for roads into or near protected areas or equally sensitive ecosystems are to require the ongoing involvement of KFS, KWS and NEMA in planning the measures required to mitigate for improved access to wildlife—and increasingly, to wild plants.

5.3.2 Construction Stages: Construction and Operation

5.3.2.1 Maintain continuing working relationship with KFS/KWS planners and specialists to assure that recommended mitigation measures to control access to and bolster management of areas of unique biologic resources, e.g., protected areas throughout Kenya's moister regions, are implemented.

5.3.2.2 Maintain continuing working relationship with NEMA planners and specialists to assure that recommended mitigation measures to control access to and bolster management of protected areas and sensitive ecosystems are implemented.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

5.3.3 Construction Stage: Maintenance

5.3.3.1 Monitor the mitigation measures recommended to control access and to strengthen the management of areas with unique biologic resources in order to ascertain their overall effectiveness. If required, augment applied measures or initiate new ones.

5.3.3.2 Monitor the mitigation measures recommended to control access and to strengthen the management of protected areas and sensitive ecosystems in order to determine their overall effectiveness. If required, augment applied measures or initiate new ones.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

6.0 COMMUNITY HEALTH

Fig. 6.1. HIV/AIDS awareness campaign, rural road, Nyandarua

Road-infrastructure development brings costs and benefits to the communities served by road transport. Thus, mitigation is necessary to avoid the costs and enhance the benefits.

One very grave cost associated with road-infrastructure development is proliferation and transmission of HIV/AIDS. People concentrated in a contractor camp can carry and introduce the virus into a nearby community, one that is unprepared to deal with an influx of road workers, many from the "outside" and many with money to spend.

As discussed in Section 2.0 guidelines, a contractor camp is required to house construction workers, the majority recruited outside the community. Mostly without wives and families, these construction workers—usually young and sexually active—are frequently responsible for spreading STDs and HIV/AIDS among camp followers and within nearby villages or towns.

For these reasons, several measures are required to reduce the threat of HIV/AIDS that is related to road construction and maintenance, both inside and outside the camp. They are listed in Subsection 6.1 below for Construction and Operation stages only. Clearly, the contractor must account for mitigation costs in his tender for construction or maintenance, but the actual delivery of HIV/AIDS awareness and prevention will take place during construction or maintenance of the road.

With the exception of STDs and HIV/AIDS mitigation among all people affected, either directly or indirectly, by construction or maintenance of a road, the majority of these impacts has been addressed in previous sections of these guidelines. But their gravity, if left unmitigated, necessitates repeating them here. Vectorborne diseases, dust and noise can and do adversely affect communities; therefore, their mitigation is absolutely critical.

Additionally, road safety, particularly for NMT users, has been mentioned briefly in these guidelines, particularly in the guidelines for mitigation of dust. The subject of road safety extends well beyond compromised visibility, however.

Road safety is dependent upon preventing, at minimum, speeding, wrongly taking the right-of-way, unlicensed drivers and driving while impaired. These and other road-safety impacts, along with measures to mitigate them, are outside the scope of these guidelines. That said, road safety in the context of prudent road construction and maintenance is addressed in these environmental guidelines, however.

In lieu of repeating all six development-stage guidelines (tender, feasibility, design, construction, operation and maintenance) necessary to mitigate significant adverse impacts to community health, **the guidelines for Construction and Operation only are reiterated here.** Doing so assumes that relevant mitigation measures have been

incorporated into the feasibility and design stages with monitoring at the maintenance stage to guarantee their successful implementation.

Finally, construction of road infrastructure offers community members opportunities for jobs. For labour-based road construction, the demand for workers—particularly, unskilled and semi-skilled labour—can be high, depending upon the size of the road project. Experience from countries across Africa has demonstrated that women can participate equally in tasks associated with labour-based construction.

6.1 STDs and HIV/AIDS GUIDELINES

6.1.1 Development Stages: Construction and Operation

6.1.1.1 The designs for the contractor camp are to include provisions for a clinic with first-aid supplies/equipment, condoms and illustrated materials informing about HIV/AIDS awareness and prevention.

6.1.1.2 Through organized and on-going consultations, the community must be fully informed about the camp—its human occupants and mechanical components—and possible unmitigated consequences to community health and safety, including STDs and HIV/AIDS.

6.1.1.3 Community understanding about the unmitigated consequences to community safety and health, including the transmission of STDs and HIV/AIDS, from a nearby camp location is essential. Involving the community in ongoing monitoring of the measures implemented to protect the health, safety and welfare of community members and the workforce is absolutely vital. As one intended recipient of HIV/AIDS awareness/prevention campaigns, the community's active participation in the delivery and appraisal of the information provided them is vital.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

Fig. 6.2. HIV/AIDS awareness campaign, Nyandarua road

6.2 VECTORBORNE DISEASES GUIDELINES

6.2.1 Development Stages: Construction and Operation

6.2.1.1 Consultations are advised to alert affected communities to eventual development of borrow sites in their surrounding areas. These consultations can also solicit community opinions and requests to retain certain borrow pits that may be useful as sources of livestock water. A proviso to the foregoing reinstatement is that full information must be provided to the community about the health and safety risks (namely, malaria, bilharzia and drowning) inherent in leaving behind standing bodies of water.

6.2.1.2 The numbers and locations of unreinstated borrow pits must be carefully considered because cumulative costs to the biophysical and socioeconomic environments may outweigh shorter term microeconomic benefits.

6.2.1.3 To minimise human-health risks from non-reinstated borrow pits, select pits that are isolated from communities or settlements.

6.2.1.4 Where practical, reinstatement of a quarry is to occur contemporaneously to minimise safety and environmental hazards from falling rock or standing water.

6.2.1.5 To avoid pools of water (precipitation or groundwater) from forming in an excavated sand pit, measures to drain the pit are required.

6.2.1.6 Verify that the disposal site has been adequately capped with soil material—spoil, for example—and sufficiently compacted to prevent surface-water pools or surface-water intrusion.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

6.3 FUGITIVE DUST GUIDELINES

6.3.1 Development Stages: Construction and Operation

6.3.1.1 Confirm that the number of water bowsers or tankers pledged by the selected contractor are onsite and ready to suppress fugitive dust on all non-surfaced roads—access, deviation or project road—during the road construction.

6.3.1.2 Confirm that the water source for dust suppression is on hand and the declared quantity is sufficient to enable full suppression of dust to protect human health and road safety.

6.3.1.3 Confirm that all required WRMA water-abstraction permits have been secured by the contractor and that permit copies have been submitted to the Engineer.

6.3.1.4 Confirm that speed humps—built to recommended design specifications (↗15 cm at elevation midpoint) and placed at the recommended frequency (↖50 m spacing)—are installed and maintained on all roads (access and deviation roads or project road during its construction).

6.3.1.5 Confirm that all points of rock-dust generation—jaws, screens, conveyors, stockpiles, etc.—from a crushing plant are equipped with wet-suppression devices, i.e., sprinkler heads, fog shower, water sprays or other appropriate dust-suppression apparatus.

6.3.1.6 If applicable and warranted, confirm that the scheme chosen by the contractor—whether high-pressure washer or drive-through water basin—to wash haul-truck wheels is installed, equipped and in use at the crusher or burrow-pit site to prevent transport of mud and rock fines onto public roads.

6.3.1.7 Confirm that the contractor (or subcontractor for laterite or rock quarrying or crushing operations) implements load-size restrictions and covers all loads leaving the quarry or crusher area and being hauled to the work site.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

6.4 NOISE GUIDELINES

6.4.1 Development Stages: Construction and Operation

6.4.1.1 Ensure that conditions and practices required by the NGVCP are being implemented; update the plan if called for by changed circumstances.

6.4.1.2 Crusher operating hours are to be scheduled between the hours of 6:00 and 18:00, Monday through Saturday. Working hours extended beyond the scheduled times are to be agreed-upon in writing by nearby residents and communities.

6.4.1.3 Irrespective of production pressures and/or production slumps, blasting is not to take place outside established blasting schedules without community consent; written permission of the local NEMA representative and written approval of the Engineer.

6.4.1.4 To preclude creating construction-related noise which requires mitigating, locate and adhere to routes that avoid travel by heavy equipment and trucks through a community or settled area.

6.4.1.5 Confirm compliance with stipulated operating times (6:00 to 18:00) and days (Monday through Saturday) for all construction activities and actions.

6.4.1.6 Confirm that divergence from stipulated work schedule (6:00 to 18:00, Monday through Saturday) is approved in writing by nearby residents, communities, the local NEMA representative and the Engineer.

6.4.1.7 Verify that natural topography or stockpiled overburden/topsoil has been utilized as noise buffering in siting and developing the quarry.

6.4.1.8 Confirm that the contractor or his agent comply fully with (1) intended drilling and blasting schedule; (2) notification system for informing nearby residents and communities about upcoming blasting events; (3) warning system for alerting nearby residents and communities to imminent blasting event, and (4) emergency response plan in case of an accident.

6.4.1.9 Verify that blasting is not conducted outside established blasting schedules without community consent; agreement from the Department of Mines and Geology; and, written permission of the Engineer and the local NEMA representative.

6.4.1.10 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse noise impacts. Monitoring must be recurrent, and it must be organized.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

6.5 GROUND VIBRATION GUIDELINES

6.5.1 Development Stages: Construction and Operation

6.5.1.1 Ensure that conditions and practices required by the NGVCP are being implemented; update the plan if called for by changed circumstances.

6.5.1.2 To preclude creating construction-related ground vibrations which require mitigating, locate and adhere to routes that avoid travel by heavy equipment and trucks through a community or settled area.

6.5.1.3 Make certain that the usage of construction-related sources of ground vibration—demolition, earthworking and earth-impacting activities, i.e., jack hammers—is staggered to reduce combined vibrations levels. A single source of vibrations may be tolerable whereas many sources in combination may become intolerable.

6.5.1.4 Verify that blasting materials and methods recommended in the feasibility and design stages to reduce ground vibrations are being utilized by the construction contractor or quarry subcontractor. In all cases, the provisions contained in the Explosives Act Cap 115 for manufacture, storage, sales, transport, importation, exportation and use of explosives must be adhered to by the contractor and any/all quarry subcontractor(s).

6.5.1.5 Confirm compliance with stipulated operating times (6:00 to 18:00) and days (Monday through Saturday) for all activities and actions related to the construction of the project road.

6.5.1.6 Confirm that divergence from the work schedule (6:00 to 18:00, Monday through Saturday) stipulated in the NGVCP is approved in writing by nearby residents, communities, the local NEMA official and the Engineer.

6.5.1.7 Monitor the effectiveness of environmental-guideline implementation to assure satisfactory mitigation of adverse ground vibration impacts. Monitoring must be recurrent, and it must be organized.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

7.0 COMMUNITY WELFARE

Providing "decent work" to a community is an uncontestable benefit from road construction and maintenance. The term "decent work" is a strategy used by Kenya's Roads 2000 programme to

Fig. 7.1. Labour-based construction, rural road, Nyanza

- provide jobs that beneficiaries willingly take up and take pride in doing;
- observe and ensure workers' rights and dignity;
- assure equity and shared growth;
- provide opportunities for community participation and give voice to the marginalized communities in Kenya; and;
- nuture sustainable livelihood through investment in community projects, whether short- or long-term.

In an effort to achieve the aims of decent work and enhance the positive benefits to communities from road-construction projects, the road contractor must be encouraged to recruit labour locally. Local recruitment is especially valid when a rural road is to be built using labour-intensive techniques.

To underscore the value of local labour recruitment to construction representatives, the following guidelines are to be implemented.

7.1 JOB OPPORTUNITIES GUIDELINES

7.1.1 Development Stages: Tender, Feasibility and Design

7.1.1.1 TORs for feasibility and design RFP are to emphasize recruitment of local workers in preference to outside labour for work requiring equivalent qualification and skills.

7.1.1.2 TORs for feasibility and design RFP are to specify a point system is instituted whereby commitments from contractors to hire local labour are awarded additional points.

7.1.1.3 TORs for feasibility and design RFP are to stipulate that hiring for unskilled or semi-skilled workers recruited from the local labour-pool is to be gender-neutral.

7.1.1.4 TORs for feasibility and design RFP are to specify that wages paid to locally recruited workers are to be equivalent and competitive with wages paid to outside labourers.

7.1.2 Development Stages: Construction and Operation

7.1.2.1 Confirm that local workers are being recruited in preference to outside labour for work requiring equivalent qualifications and skills.

7.1.2.2 Confirm that hiring for unskilled or semi-skilled workers recruited from the local labour-pool is gender-neutral.

7.1.2.3 Confirm that wages paid to locally recruited workers are equivalent and competitive with wages paid to outside labourers.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

7.1.3 Development Stage: Maintenance

7.1.3.1 Before completion of the road-construction project, monitoring is required to assure that labour-recruitment obligations agreed to by the road contractor are being fulfilled.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C).

8.0 CULTURAL AND NATURAL HERITAGE

Fig. 8.1. Archaeological dig, Mt. Elgon

Kenya's cultural and natural heritage—its prehistoric and historic sites/artifacts as well as places of historical, cultural, scientific and scenic interest—are at risk during development of road-transportation infrastructure. In addition to the placement and reservations on both sides of the road where construction can also take place, the activities and actions associated with site preparation, earthworks, drainage/bridge works and materials development, whether laterite, rock or sand, are likely to adversely impact resources of cultural and natural significance.

Kenya has a wealth of cultural-and natural-heritage sites. In terms of cultural heritage, Kenya's importance as a place of archaeological and paleontological richness was already well-established when the 1984 discovery of the Turkana boy—the perfectly preserved body of a boy 12 years in age who died 1.5 million years ago—elevated the country to its present status of World Heritage "Cradle of Humankind." An abundance of fossils in Kenya has enabled archaeologists and paleontologists to reconstruct early man's history, including the recent discovery in 2009 of a set of **Homo erectus** footprints, once again in northern Kenya, that seems to indicate that very early—1.51 to 1.53 million years ago—human species walked upright like present-day **Homo sapiens sapiens**.

Fig. 8.2 Lake Turkana, South Island

Not unlike the nation's cultural legacy, Kenya is also endowed with a splendid natural heritage. For example, Mount Kenya, with its snow cap, is the second highest mountain in Africa and one of the most impressive landscapes in East Africa. In addition to its visual grandeur, Mt. Kenya's forests host large populations of several threatened animal species as well as numerous rare and endemic plants species. Mt. Kenya Park, established in 1949, was designated as a UNESCO Biosphere Reserve in 1978. In 1997, the Park was listed as a World Heritage site—World Heritage List under Natural Criteria. The Park also lies within a WWF Global 200 Eco-region and a WWF/IUCN Centre of Plant Diversity.

Additionally, a second place of natural importance in Kenya has been recognized as a World Heritage site—Lake Turkana National Parks consisting of Sibiloi National Park and two islands within Lake Turkana. The parks' international natural significance is based

primarily on on its use as a stopping point for migratory birds, as breeding grounds for the Nile crocodile, hippopotamus, fish and snakes—the two latter phylla comprised of more than 40 species—and a depository of many fossils at Koobi Fora, a ridge located on the eastern shore of Lake Turkana.

Citing only two examples of Kenya's cultural and natural riches does disservice to the astonishing diversity and number of nationally and internationally recognized sites. Other examples follow, namely:

- A protected monument, **Ft**. **Jesus** in Mombasa town was built by the Portuguese around 1563. The fort resembles a man, thus the religious name given it. Large enough to accommodate 2500 fighters, the fort was the location of many battles between Arabs and Portuguese. The museum at Ft. Jesus contains many fascinating displays, including one with artifacts collected from a Portuguese gunner-boat that sank in 1697 while attempting to dispel a lengthy siege on the fort.

- Located on the coast, **Shimoni Caves** were formed millions of years ago by natural shoreline processes. The caves are far-reaching, most likely extending some 5kms inland. However, only the main entrance to the caves is accessible: the cave floors are rising because of underlying geologic changes. A grim reminder of the atrocities experienced by East African slaves, the metallic studs used for fastening them to cave walls are now the supports for stalactites and stalagmites forming throughout the caves. Despite its horrific past, Shimoni Caves are now an important tourist destination as well as the location for a thriving fishing village. Across from the Shimoni Caves, the former headquarters of the Imperial British East Africa Company still remain, now in a state of ruin.

- **Gede Ruins**, also on the coast, are the remains of a Swahili town that was ruled by sultans. Originally built in the 12th century, Gede was rebuilt with new walls in the 15th and 16th centuries. In the first half of the 17th century, the last family in Gede left, however. During its zenith in the 15th century, the town's inhabitants were very wealthy—among the ruins are numerous mosques, a splendid palace and many spacious houses, all situated in 45 acres of primeval forest. Gede Ruins are currently under the care of the National Museums of Kenya.

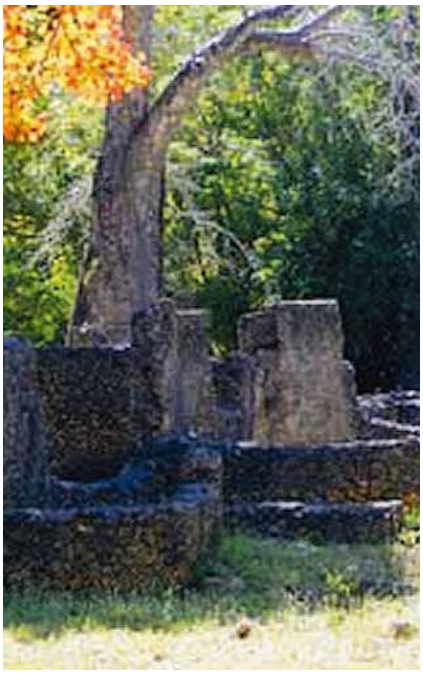

Fig. 8.3. Gede Ruins

- **Kaya Kinondo**—a collection of nine primary kayas of the Mijikenda community within the Kenyan coastal forests—was named a World Heritage site in 2008. These and several other kayas are the remains of numerous fortified villages—known as kayas. Created in the 16th century, the kayas were built on hilltops and inhabited by the clans of the Mijikenda people. In one instance, Kaya Kinondo, the place of the Digo clan, was protected by gates and thick forests to prevent attacks by outsiders. A Council of

Elders now administers the forests, applying strict rules for their use and entry, e.g., no live trees may be cut and no person may enter a forest wearing hat or shoes. Any non-adherence to the rules may result in the violator's death or insanity, **if** the gods are offended. Nevertheless, the forests around the kayas, which have been nurtured by the extant Mijikenda community to protect the sacred graves and groves, are the near-remnants of the once extensive coastal-lowland forest. These kaya forests—some 30 ha in size—are highly diverse: rare plants such as **Trevea madagascarensis**, **Callophyllum inophylum** and **Diphasa** species—the latter yet to be described by botanists—are found, in addition to many others that account for almost 3 percent of Kenya's floral diversity. The forests also provide habitat for 56 of Kenya's 895 known butterfly species.

- Located deep inside the dense Mt. Kenya Forest Reserve, the **Mau Mau Caves** provided hideouts for the Mau Mau freedom fighters. The caves are large, some extend 1km into the mountain. Complete with fire pits and hollowed-out nooks presumably used for bedrooms, the caves were fitted with observations posts to monitor the main cave, itself then concealed by dense shrubbery.

The importance of Kenya's cultural heritage to humanity—individually and collectively—is emphasized by the designation of many of the country's landscapes as World Heritage sites. The country's cultural legacy to future generations is made more certain by this status.

Landscape integrity and the absence of visual intrusion is a cultural value that is transmitted from generation to generation, sometimes by tradition and sometimes by spoken word. And human value for landscape can be based upon myriad factors, many of them highly subjective.

A valued landscape may be a savannah dotted with flat-topped acacia, a meadow uncluttered and unchanged by human alteration, a mountain range with green flanks and lofty snow-capped peaks. It may be an ordinary place where noise is absent, or a place with stunning examples of man's architectural artistry. Establishing landscape value depends very much on the adage that "beauty is in the eye of the beholder." That said, an assessment of landscape value and visual intrusion depends upon quantified data, clear evidence, logical deduction, reasoned argument and informed judgment, thereby attempting to diminish the element of subjectivity.

8.1 CULTURAL AND NATURAL HERITAGE GUIDELINES

The National Museums and Heritage Act, Cap 6 of 2006, captures the nation's appreciation for its cultural and natural heritage. This act enables the "establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya." It creates categories of protected objects and places referring to them as protected objects of historical, archaeological, paleontological, cultural, scientific, architectural or technological interest, practically all located on an area of land, also designated as a protected area. The foregoing are declared as protected objects and/or areas by the

Minister of National Heritage and Culture (Ministry of National Heritage and Culture, MNHC) in consultation with the national museums.

The National Museums and Heritage Act maintains a register of all museum collections and declared protected areas and objects. This register is available to the public, including road-construction planners, designers or contractors (most likely, by way of their environmental or archaeological specialists). Becoming aware of past discoveries of protected objects/places within or near selected road corridors and ancillary works serves to inform road planning, designing and building to avoid damaging or destroying discovered/undiscovered protected or potentially protected items of cultural and natural importance.

As well, the Act provides for "Heritage Wardens" who are empowered to inspect an antiquity or protected object. Presumably a Heritage Warden would be able to respond to field inquiries from road designers and builders about previously or inadvertently discovered—items encountered during road construction—objects and places that require professional evaluation to establish their cultural and natural significance.

Ideally, sites of cultural and natural importance have been mapped to provide transportation planners and engineers with advance information about known cultural and natural sites necessary in planning and designing infrastructure. With advance knowledge, the sites can be avoided to provide protection.

However, in a less-than-ideal world, sites of cultural significance are discovered daily because information about the past is understandably incomplete and fragmented. To compensate for imperfect knowledge, certain precautions are required of and by road planners, engineers and builders to preclude damaging/destroying Kenya's valued heritage.

Field assessment of cultural- and natural-heritage resources potentially affected by developing transportation infrastructure is frequently part of an archaeological impact assessment (AIA), a component of an EIA and sometimes part of a social impact assessment (SIA). AIA is undertaken by a qualified archaeologist and/or geologist. Without benefit of maps or records to guide the AIA assessor or—more likely—without the services of trained, knowledgeable experts, the task of identifying and protecting Kenya's unknown cultural- and natural-heritage resources falls to the construction workforce—most probably, the supervision engineer and construction foreman.

To facilitate the process of evaluating cultural-heritage resources discovered in the course of developing transportation infrastructure—more specifically, during the activities and actions inherent in site preparation, earthworks, drainage/bridge works and materials development, a checklist (Appendix E) is appended to these environmental guidelines. The checklist is not intended as a substitute for professional guidance from trained experts. They are, however, to be used onsite when professional guidance is unavailable to road designer/engineers and their construction surrogates.

By way of further clarification, the Economic Commission for Africa in its review of environmental impact assessments completed in selected African countries defines cultural impacts to include "**changes to shared customs**, **traditions** and **value systems** (e.g., language, dress, religious beliefs and rituals) **archaeological**, **historical** and

cultural artifacts and **to structures and environmental features with religious or ritual significance**." This definition encompasses diverse and wide-ranging cultural resources that may be in harm's way when a road is being built or maintained.

The environmental guidelines specific to cultural and natural heritage are to be applied in combination with other applicable guidelines; for example, cultural- and natural-heritage guidelines that relate to the activities and actions common to site preparation are to be used in tandem with guidelines pertaining to site preparation, the majority found in Water Quality.

The guidelines are inclusive, not exclusive. Moreover, they are meant to complement MNHC and NEMA policies, regulations, rules and guidelines for protection of Kenya's cultural- and natural-heritage resources.

8.1.1 Development Stages: Tender, Feasibility and Design

At the time of feasibility and prior to design, infrastructure planning is to take into account the presence of Kenya's cultural- and natural-heritage resources, whether known or unknown, the latter status to be determined by desk research or consultations with informed experts. In theory, planning seeks to factor any gaps in knowledge into infrastructure plans by avoiding designs that might do significant harm to the environment, including its cultural and natural parts.

To achieve plans that avoid or reduce harm to cultural- and natural-heritage resources, the responsible individuals must investigate, to the greatest degree possible, these gaps in knowledge in order to describe more fully the cultural and natural environment potentially affected by infrastructure development.

8.1.1.1 TOR for preliminary investigations of cultural- and natural-heritage resources potentially affected by development of transportation infrastructure are to be required at the feasibility stage.

8.1.1.2 TOR for project feasibility are to stipulate that preliminary desk/field investigations and public consultations be conducted within the proposed transportation corridor or site, including any identified construction materials locations; ideally, this investigation is to be carried out by an expert trained in identifying and assessing significant cultural- and natural-heritage resources.

8.1.1.3 In the event that an archaeological expert is not available to conduct the required studies, the TOR are to require that the services of informed, knowledgeable person(s) such as Heritage Warden(s) be employed by the contractor as a short-term consultant.

8.1.1.4 TOR for feasibility are to specify that the findings, conclusions and recommendations prepared by the cultural- and natural-heritage resource expert (or his/her equivalent) from desk/field investigations and public consultations within the anticipated transportation corridor/site and identified materials locations be submitted in the form of a written report.

8.1.1.5 TOR for design are to require that the written recommendations of the cultural- and natural-heritage resource expert (or his/her equivalent) be integrated into preliminary and final infrastructure designs.

8.1.1.6 TOR are to specify that the preliminary and final designs be reviewed by the cultural- and natural-heritage resource expert (or his/her equivalent) to confirm correct interpretation and integration of investigation recommendations.

8.1.2 Development Stages: Construction

Environmental guidelines intended to protect cultural- and natural-heritage resources at the construction stage target transportation-infrastructure development activities and actions that disturb or alter the landscape—generally, the activities and actions associated with site preparation, earthworks, drainage/bridge works and materials acquisition. In each of the foregoing actions/activities, the landscape is being disturbed or altered, either by "clearing and grubbing" during site preparation, by altering soil profiles when cutting or filling or by excavating to create drainage/bridge structures and materials sites.

As stated in the preceding text, the environmental guidelines specific to cultural and natural heritage are to be applied in combination with other applicable guidelines; by way of example, cultural- and natural-heritage guidelines that relate to the activities and actions common to site preparation are to be used in tandem with guidelines pertaining to road site preparation.

8.1.2.1 Confirm that the recommendations of the cultural- and natural-heritage resource expert (or his/her equivalent) have been fully integrated into final road designs.

8.1.2.2 Verify that the agencies/individuals responsible for road-infrastructure development have provided the supervision engineer and construction contractor with the written report submitted by the cultural/natural-heritage resource expert.

8.1.2.3 Verify that the agencies/individuals responsible for road-infrastructure development have provided the supervision engineer and construction contractor with all relevant environmental guidelines, including the checklists for Evaluation of Cultural Resources (Appendix E).

8.1.2.4 Verify that the agencies/individuals responsible for road-infrastructure development have provided the supervision engineer and any subcontractors retained for the purpose of extracting materials at disparate locations with all relevant environmental guidelines, including the checklists in Appendix E.

8.1.2.5 Confirm that the cultural- and natural-heritage resource expert or another qualified individual is present onsite during site preparation and earthworks, including drainage/bridge works, and materials-extraction locations; failing that, a representative from the relevant agencies or authorities is to be present during these activities to assure that cultural- and natural-heritage resources are not unwittingly or wantonly damaged/destroyed.

8.1.2.6 Confirm that sites of cultural and natural importance encountered during infrastructure development are promptly reported to the MNHC Heritage Warden, the responsible road authority, agency or ministry and the local NEMA official before continuing with the activity/action during which the cultural or natural resource was encountered or uncovered.

8.1.2.7 Locate the found cultural resource with a geographic-positioning system (GPS); record the GPS location on the administrative form included in these guidelines (Appendix C) for later submission to MoR, NEMA and/or the National Museums of Kenya, if appropriate.

8.1.2.8 Verify that the procedures recommended by the Heritage Warden, MoR, the responsible authority or NEMA for handling the encountered or uncovered cultural or natural resource are followed carefully and thoroughly before proceeding with construction activities/actions.

To organize monitoring activities, an administrative form is included in these guidelines (see Appendix C). Its routine use will facilitate reporting that is required for proper implementation of the environmental guidelines. Additionally, completing and filing the forms during regular monitoring prepares the bases for reports required by NEMA during annual audits. In order to have clean copies on hand for ongoing monitoring, photocopying the form at the outset is suggested.

8.1.3 Development Stage: Operation

Assuming that

1. the entire ROW has been cleared during site preparation (with the exception of the outer 10m strip of the ROW in which vegetation is to be retained unless safety is impaired);
2. the designed alignment or location of the road infrastructure has not been altered from an existing alignment; or
3. the required materials from identified sites are sufficient, thereby negating the need to open new sites,

then the likelihood of impacts to cultural- and natural-heritage resources from operation of developed infrastructure is negligible.

In the event that any of the circumstances enumerated above are changed from final designs, then the requirements of environmental guidelines at tenders for feasibility, design and construction stages are to be reapplied to assure that cultural- and natural-heritage resources are not negatively impacted. For all intents and purposes, the process of identifying and evaluating cultural- and natural-heritage resources begins afresh when final designs have been changed.

8.1.4 Development Stage: Maintenance

Generally, one or more materials sites are retained for the purposes of maintaining developed road-transportation infrastructure. This being the case, the need to inventory and assess cultural- and natural-heritage resources encountered in opening new materials sites is unnecessary.

However, in the process of periodic maintenance, particularly to correct "blackspots" linked to unsafe road locations, an alignment may be changed. In this event, it becomes necessary to inventory and evaluate the realignment for the occurrence of cultural- and natural-heritage resources. To do so, the guidelines recommended for relevant stages of development (feasibility, design and construction) must be applied.

To aid in organizing monitoring activities, an administrative form is included in these guidelines (see Appendix C). Appendix E provides checklists to enable evaluating the significance of any cultural- and natural-heritage resources encountered in developing road-transportation infrastructure.

8.2 LANDSCAPE AND VISUAL INTRUSION GUIDELINES

As stated in Section 8.0, part of Kenya's natural heritage is its landscapes. Landscape value and visual intrusion is a cultural perception. These perceived values are normally transmitted from generation to generation. Our values for an unspoiled landscape are based on numerous factors, many of them matters of personal aesthetics and others transmitted through cultural norms and standards. In most cases, our preferences are highly subjective. But cultural values set **H. sapiens sapiens** apart from other sentient creatures—they are the hallmarks of human civilizations.

Clearly landscapes despoiled by an unreinstated borrow pit or quarry or unvegetated cut slope are not pleasing to the eye. However, the significance of the foregoing examples goes beyond their visual unattractiveness: in all cases, the biophysical and socioeconomic impacts arising from borrow pits, quarries and side slopes that are not reinstated threaten the health and welfare of humans and other life forms.

For this reason, the environmental guidelines repeatedly emphasize the importance of reducing soil erosion, revegetating disturbed soils and reinstating works excavations. By implementing the environmental guidelines—primarily the guidelines for water quality and land use—the visual impacts from landscapes marred by road construction are reduced, if not fully mitigated in the long term.

In evaluating the importance of landscape and visual intrusion, it is necessary to differentiate between judgments about the **significance** of change, which is inherently subjective, and the **magnitude** of change, which can be more objectively quantified. As mentioned before, the evaluation of landscape and visual intrusion depends upon quantified data, clear evidence, logical deduction, reasoned argument and informed judgment, thereby attempting to diminish the element of subjectivity.

Guidelines for determining baseline landscape **character** and **quality** have been assembled by the Landscape Institute (LI) and the Institute of Environmental Management and Assessment (IEMA), two British professional organisations. These guidelines have been modified, where necessary, for the Kenyan context.

Highest Quality Landscape	Areas include the most aesthetically attractive landscapes. Areas of particular natural beauty that are perceived as special in a regional or national context. Nationally or internationally designated land such as national parks or World Heritage sites.
Very Attractive Landscape	Areas include historic or designated landscape of cultural significance. Diverse, semi-natural or farmed landscape with natural features. Normally abundant forest cover together with a high distribution of trees, shrubs, streams, rivers or other unpolluted water corridors may be present.
Good Quality Landscape	Countryside with some variety in land uses or farmland cover. Settlements and villages with pockets of open space. There is a reasonable distribution of semi-natural vegetation, trees and shrub cover and the overall view of the area is pleasant. Local landscape designations of cultural and historic value may be present.
Ordinary Quality Landscape	Areas of open savannah grassland, hilly terrain or agricultural land where attractive features are offset by detractors. Little coherence in land uses is evident. Development is primarily functional including housing, businesses or related land uses. Not particularly aesthetically attractive, but with more value than a poor quality landscape.
Poor Quality Landscape	Areas include detractors such as powerlines and derelict or inappropriate structures with no aesthetic value or evidence of land-use planning. There is lack of mature vegetation cover. Intensively altered landscape, which has lost most of its natural features.

Determining the significance of the effects of development on the landscape and visual resources is based upon the predicted impact in relationship to the baseline conditions. According to LI/IEMA, the significance assessment of landscape and visual impacts relies upon common sense, experience and reasoned judgment, all supported by proven evidence.

Therefore, changes of a relatively low magnitude can be judged to be significant if they are to occur in a highly sensitive (or "highest value" or "very attractive") landscape or visual resource. In effect, the sensitivity of a landscape is based on three attributes: its

character; its quality; and its ability to accommodate change.

Fig. 8.4. Mt. Kenya with garden of giant alpine Senecio ssp. in foreground

Moreover, the sensitivity of a receptor—that is, the individual viewing the landscape—is based on the viewer's familiarity with the landscape, the activity or occupation that brings the landscape into view and the nature of the view, whether a full or glimpsed view, whether a view in the near or far distance. The magnitude of the visual impact from a change to the baseline landscape is determined by the viewer's perception of the change in contrast to the earlier landscape or its similarity with earlier landscape features in terms of the change's form, color, text or scale.

The Environmental Coordination and Management Act, cited on numerous occasions throughout the environmental guidelines, addresses landscape in terms of "scenic" values, specifically in Section 54 (3)(c) to inventory areas within the coastal zone of scenic values; Section 111 (13)(d) to establish an environmental conservation order to preserve scenic views; and Second Schedule (3)(b) to require an EIA of all roads in scenic, wooded or mountainous area and wetlands.

In order to comply with EMCA 1999 requirements and to avoid degrading valued landscapes by road construction-related visual intrusion, the environmental guidelines for roads and bridges are to be implemented fully and carefully. Visual intrusion, brought about by road-construction works, can be mitigated by adherence to the guidelines specific to Site Preparation (Section 2.2), Earthworks (Section 2.3), Borrow Pits (Section 2.5), Rock Quarries (Section 2.6) and Sand Sources (2.7), the foregoing all sections within Water Quality, and Construction Debris Disposal (Section 5.2) and Changed Resource Management (Section 5.3), both found in Land Use. In lieu of repeating the cited guidelines here, the reader is referred to the referenced sections.

Additionally, guidelines for the protection by avoidance of valued landscapes are provided below. They address three stages of road development only—tender for feasibility and design—on the assumption that, if guideline implementation takes place during the first three development stages, then landscape degradation will be avoided in the construction, operation and maintenance stages.

8.2.1 Development Stages: Tender, Feasibility and Design

8.2.1.1 TORs for feasibility and design RFP are to stipulate that road corridors and all ancillary works including materials sites are to avoid alignments and locations in or near landscapes of "highest quality" and "very attractive."

8.2.1.2 TORs for feasibility and design RFP are to require the written permission from a Heritage Warden and the local NEMA representative in the event that

construction of the road will adversely affect, even if temporarily, a landscape of "highest quality" or "very attractive" quality.

8.2.1.3 TORs for feasibility and design RFP are to consult the national register of declared protected areas and confirm with the Heritage Warden and local NEMA representative that the proposed alignment of a new road and its ancillary works do not impinge, physically or visually, upon protected or proposed landscapes of national importance.

8.2.1.4 TORs for feasibility and design RFP are to provide Heritage Wardens and local NEMA representatives, should the road move across several districts or provinces, with reinstatement plans for borrow pits, quarries and sand-harvesting sites to assure shared knowledge of contractor obligations. Upon reinstatement of closed materials sites, the contractor is released from his reinstatement obligations upon the written approval of the Heritage Warden, if any protected area or object has been affected, the local NEMA representative and the Supervision Engineer.

9.0 REFERENCES

Bergland, B., T. Lindvall, and D.H. Schwela, eds, **Guidelines for Community Noise**, World Health Organisation, Geneva, Switzerland, 1999.

Daffron, Mark, "Know Your Hedge Vetiver: Environmental Concerns about **Vetiveria zizanioides**," Office of International Affairs, National Academy of Sciences, Washington, D.C., USA, 1996.

District Road Works, Ministry of Works, Housing and Communications, Government of Uganda, **Environmental Guidelines** (Manual B), "District Administrative and Operational Guidelines," 2004.

Donan Engineering, U.S.A., "Earthquake and Blasting Damage," 2010.

Environmental Health Section, West Dunbartonshire Council, U.K., "Quarry Blasting," undated.

Eriksson, A. and A. Kidanu, United Nations International Labour Organisation and Swedish International Development Cooperation Agency, **Guidelines for the Prevention and Control of Soil Erosion in Road Works**, R2000 Programme, Kenya, 2010.

Goines, L. and L. Hagler, U.S.A., **Southern Medical Journal**, "Noise Pollution: A Modern Plague." Accessed through **www.medscape.com**.

Government of Hong Kong, **Environmental Impact Assessment Ordinance, Cap 499: Guidance Note**, "Preparation of Landscape and Visual Assessment under the Environmental Impact Assessment Ordinance," 2002.

Government of Kenya, Ministry of Public Works, **Minor Roads Programme: Soil Conservation Pilot Project** (Final Report), October 1992.

Government of Kenya, Ministry of Public Works & Housing, Roads Department, **Roads 2000: Environmental Guidelines Manual**, Roads 2000 Programme, December 1997.

Government of Kenya, Ministry of Roads, Roads Department, in cooperation with Swedish International Development Cooperation Agency, **Contractor's Field Handbook,** "Road Improvement Works," 2008.

Government of Kenya, Ministry of Roads, Roads Department, in cooperation with Swedish International Development Cooperation Agency, **Contractor's Field Handbook**, "Routine Maintenance," 2008.

Grimshaw, R. "Ecological Impact of Vetiver in Foreign Environments." 2001.

International Finance Corporation (IFC), **Environmental, Health, and Safety: General Guidelines,** April 2007.

International Finance Corporation (IFC), **Environmental, Health, and Safety Guidelines for Construction Materials Extraction,** April 2007.

International Finance Corporation (IFC), **Environmental, Health, and Safety Guidelines for Roads,** (Draft), April 2007.

International Finance Corporation (IFC), Environmental**, Health, and Safety Guidelines for Toll Roads**, April 2007.

Japan International Cooperation Agency, **Guidelines for Environmental and Social Consideration,** April 2004.

Johannessen, B., United Nations International Labour Organisation, Regional Office for Asia and Pacific, **Building Rural Roads**, 2008.

Keller, G., and J. Sherar, **Low-Volume Road Engineering: Best Management Practices Field Guide** , U. S. Department of Agriculture Forest Service, June 2003.

Kriebel, David, **et al.**, "The Precautionary Principle in Environmental Science," **Environmental Health Perspectives,** V 109, No 9, 871-876, September 2001.

Landscape Institute and Institute of Environmental Management and Assessment, "Detailed Methodology for Landscape and Visual Impact Assessment," London and Lincoln, U.K., undated.

Macharia, Ken. "Kenya rises steadily as dream site for archaeological digs," Kenya **Business Daily,** 23 April 2010.

NoiseMeters Limited, U.K., "Acoustic Terms," undated.

Organisation of Economic Cooperation and Development, **Guidelines for Environmentally Sustainable Transport,** Paris, May 2001.

Republic of Kenya, **Environmental Management and Coordination Act,** No. 8 of 1999.

Republic of Kenya, **Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009, Legal Notice No. 61.**

Republic of Kenya, **Environmental Management and Co-ordination (Water Quality) Regulations, 2006 (Legislative supplement No. 36).**

Republic of Kenya, **Explosives Act**, Cap 115.

Republic of Kenya, **Forest Act,** Cap 385, 2005.

Republic of Kenya, **Land Acquisition Act,** Cap 295, 1968.

Republic of Kenya, **National Museums and Heritage Act**, No. 6 of 2006.

Republic of Kenya, "National Sand Harvesting Guidelines, 2007," **Environmental Management and Coordination Act,** 1999.

Republic of Kenya, **Occupational Safety and Health Act,** Act No. 15 of 2007.

Republic of Kenya, **Water Act,** Cap 372, 2002.

Roadside Conservation Committee, Western Australia, **Guidelines for Managing Special Environmental Areas in Transport Corridors,** undated.

Roadside Conservation Committee, Western Australia, **Handbook of Environmental Practice for Road Construction and Maintenance Works,** undated.

Southern Africa Transport and Communications Commission (SATCC), **SADC Guidelines for Low-volume Sealed Roads,** Chapters 3 and 6, June 2003.

World Health Organisation, Inter-Organisation Programme for the Sound Management

of Chemicals (IOMC), Geneva, Switzerland, 2002.

World Health Organisation, "Silicosis," Fact Sheet No. 238, Geneva, Switzerland, May 2000.

World Health Organisation, "Summary of risk assessment," **WHO air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide,** Global update 2005, Geneva, Switzerland.

World Health Organisation/Europe, "Health Effects of Noise," Technical meeting on exposure-response relationships of noise on health," Bonn, Germany, 19-21 September 2002.

Web sites with useful road-transportation information

African Development Bank **(www.afdb.org)**

American Association of State Highways and Transportation Officials, AASHTO **(www.transportation.org)**

American Road and Transportation Builders Association **(www.artba.org)**

British Columbia (Canada), Ministry of Sports, Tourism and the Arts, Archaeology **(www.tsa.gov.bc.ca/archeaology/index.htm)**

Construction Industry Compliance Center **(www.cica.org)**

European Union **(http://ec.europa.eu/)**

Federal Highway Administration, U.S.A. **(www.fhwa.dot.gov)**

Institute of Transportation Engineers Traffic Engineering Council, ITE TEC **(www.ite.org)**

International Finance Corporation **(www.ifc.org)**

National Roads Authority, Ireland (www.nra.ie.PublicationsResources/)

New South Wales Environmental Protection Agency, NSW EPA

(http://www.epa.nsw.gov.au/)

Non-point Source Pollution, U. S. Environmental Protection Agency, USEPA **(www.epa.gov/owow/nps/roadshyws.html)**

Particulate Matter Pollution, U. S. Environmental Protection Agency, USEPA **(http://www.epa.gov/oar/particlepollution/)**

Roadside Conservation Committee, Western Australia **(www.naturebase.net)**

Silt curtains: **http://www.maccaferri.co.nz/afawcs0140261/ID=26/SID=148854102/productdetails.html**

Silt fences: **http://www.metrocouncil.org/environment/Water/BMP/CH3_RPPSedSiltFence.pdf**

U. N. Economic Commission for Africa (ECA), **Review of the Application of Environmental Impact Assessment in Selected African Countries (http://www.uneca.org/eca_programmes/sdd/documents/EIA_book_final_sm.pdf)**

U. S. Environmental Protection Agency, USEPA **(www.epa.gov)**

United States Agency for International Development, USAID **(www.encapafrica.org)**

Water Resources Management Authority, WRMA (Ministry of Water and Irrigation) **www.wrma.or.ke**

Water Systems Council, WSC **(www.watersystemscouncil.org)**

World Bank **(www.worldbank.org)**

World Health Organisation **(www.who.int)**

APPENDIX A

CHECKLIST FOR DETECTING POSSIBLE ENVIRONMENTAL IMPACTS

TRANSPORT

Transport includes roads, railways, airports, ports, terminals, and complete systems to move people, goods and services. Transport schemes sometimes stimulate new activities that would require environmental assessment from the agency(ies) or organisation(s) responsible for their planning and management.

Answering the questions that follow may indicate the need to apply, at minimum, environmental guidelines to a proposed development action or activity—or to create new guidelines to address issues raised by your answers. Environmental assessments also mention required guidelines in environmental management plans (EMPs).

Will the project:

1. Affect areas with animal or plant life worthy of protection or areas that are environmentally sensitive?
2. Create barriers to movement in areas with conservation-worthy or particularly large game stocks?
3. Affect areas with historic remains or landscape elements that are of importance to the population?
4. Lead to a substantial increase in erosion?
5. Lead to high rates of consumption of scarce material resources?
6. Create pollution problems?
7. Lead to a considerable increased and unintended accessibility to vulnerable or conservation-worthy nature reserves or natural resources for others than the local population?
8. Change the way of life of the local population in such a way that it leads to considerably increased pressure on the natural resource base?
9. Leads to major conflicts with regard to existing land use and ownership of land?
10. Obstruct or lead to changes in the local population's use of natural resources other than those directly affected by the project?

APPENDIX B

CHECKLIST FOR ROAD-TRANSPORTATION INFRASTRUCTURE

- Development Actions
- Environmental Attributes
- Environmental Impacts
- Mitigation Measures

A. DEVELOPMENT ACTIONS CHECKLIST

1.0 Types of Road-Transportation Infrastructure Projects

1.1 Roads

- Urban roads (e.g., freeways, arterial roads, collectors, distributors and streets
- Highways (e.g., national trunk roads—Classes A and B; district—Classes C and D)
- Rural feeder or tertiary roads (e.g., rural access roads—Classes E and R; agricultural roads such as Class T for tea-plantation roads)
- Major road upgrading (e.g., rehabilitation, realigning, widening, conversion of private road to public, that is, in mining, livestock or logging areas)

2.0 Project Inputs

2.1 Construction

- Aggregate materials from local sources (e.g., stones, crushed rock, gravel), steel, cement
- Materials from external sources (e.g., bitumen, petroleum products, etc.)
- Skilled and unskilled workforce exerting indirect demand for energy, water supply, sanitation, health services, etc.
- Heavy machinery (e.g., excavators, earth-moving equipment)

2.2 Construction inputs for maintenance works (same as above)

2.3 Road use:

- Traffic types
  - Passenger
  - Freight
- Engine type
  - Petrol
  - Diesel

- Proposed traffic volumes and frequencies

3.0 Project Activities

3.1 Route selection

- Land-take (accounting for land tenure issues, soil stability, etc.)
- Resettlement
- Proximity to water-bodies, human settlements, protected areas, etc.
- Establishing associated works and supporting infrastructure (e.g., construction camps, clearing of vegetation, wetland reclamation, access roads)
- Obtaining raw materials (e.g., mining, water abstraction, quarrying, dredging)
- Transportation of raw materials, pre-assembled components, machinery and labour to the site
- Excavation and filling
- Spillages (e.g., oil, fuel)
- Exploitation of wildlife and fuelwood resources by workers
- Making good (resurfacing and replanting exposed areas)

4.0 Operational activities

- Route maintenance (ranging from periodic maintenance to major rehabilitation)
- Transportation of people or goods
- Planned induced development (e.g., transportation services, mining, agriculture, industry, commerce, tourism)
- Unplanned induced development (e.g., agricultural squatters, mineral prospectors, wildlife hunting, urban homeless, deforestation)

5.0 Project outputs

- Construction wastes:
- Eroded soil
- Silt from disturbance to riverbeds for gravel
- Surface runoff
- Domestic refuse and sewage waste from construction camps
- Oil and fuel spills
- Wastes from road use
- Increased runoff
- Vehicle emissions (nitrous oxides, hydrocarbons, carbon dioxide, carbon, monoxide, particulates (diesel) and dust
- Noise

- Accidents and hazard waste spillage
- Outputs associated with planned and unplanned induced development

B. ENVIRONMENTAL ATTRIBUTES CHECKLIST

6.0 Human Environment

6.1 Proximity of transport route to rural settlements or urban housing

6.2 Land uses to be displaced/dissected (e.g., agriculture land, forestry reserves, recreational areas)

6.3 Sensitivity of the local population (particularly traditional livelihoods, e.g., indigenous peoples) with regard to

- Cultural sensitivity to construction workers and associated services
- Cultural sensitivity to induced development along route

6.5 Public health consequences (during construction and road use)

6.6 Capacity of local public services to support the increased demands of passenger traffic or induced development

6.7 Security of local livelihoods/cash income generation and competition from outsiders

6.8 Increased noise, dust and air pollution

7.0 Natural Environment

For example, forests, grasslands, arid and semi-arid, inland bodies of water or inland and coastal wetlands with emphasis on:

7.1. Protected areas (on local, national and international scales)

7.2 Areas supporting significant biodiversity

7.3 Areas supporting critical habitats

7.4 Protected areas

7.5 Environments already significantly degraded (particularly rivers)

7.6 Sites of significant cultural, religious or historical importance (including urban protected/listed buildings)

7.7 Sites supporting terrestrial or aquatic flora and fauna, including:

- Rare species (e.g., CITES endangered species)
- Ecologically important species (e.g., soil microorganisms, pollinating insects, natural pest predators)
- Commercially or domestically important species (e.g., fish)

7.8 Soil structure, stability, susceptibility to erosion

7.9 Quality of inland surface waters (e.g., river, lakes, lagoons)

7.10 **Quality of coastal water (e.g., where rivers feed into coastal areas supporting conservation-worthy marine flora and fauna or commercially significant fish including breeding grounds and critical habitats (e.g., mangrove forests, inlets, coral reefs)**

7.11 **Hydrologic flow regime of local rivers (e.g., flood frequency, storm flow volumes)**

C. ENVIRONMENTAL IMPACTS CHECKLIST

8.0 Impacts of Routing

8.1 **Induced exploitation patterns that are difficult to manage or control**

8.2 **Invasion of indigenous lands**

8.3 **Conversion of land to farming of short-cycle crops which are not sustainable**

8.4 **Conversion of forest to pasture**

8.5 **Invasion of weedy species and land degradation resulting in the abandonment of the area**

8.6 **Loss of natural areas, habitats, built heritage**

8.7 **Loss of valuable biodiversity**

8.8 **In large wetland areas (e.g., tidal flats, lagoons or inland deltas) the construction of roads on raised embankments can interfere with the cross drainage and permanently impair the biological cycles and productivity of the ecosystem**

9.0 **Impacts from Construction**

9.1 **Impacts on human health**

- Ground and surface water contamination by oil, grease and fuel spills
- Creation of stagnant waterbodies in borrow pits and quarries which act as habitats for disease vectors
- Environmental and social disruption by construction workers
- Safety of construction workers
- Routes leading to increased disease transmission, i.e., sexually transmitted diseases, tuberculosis, etc.
- Introduction of prostitution, gambling and drug abuse or disruption of traditional life cycles

9.2 **Impacts on soil**

- Soil erosion from excavation, embankments and quarrying
- Landslides, slumps and slips
- Soil contamination from spilled fuels, lubricants and other toxic substances

9.3 Impacts on local hydrology

- Interruption of subsoil and overland drainage
- Increased runoff
- Flood hazard

9.4 Impacts on aquatic ecosystems

- Temporary or permanent covering of benthic organisms and riverbed flora
- Increased biological oxygen demand (BOD) placing fish and aquatic flora under oxygen stress
- Sediments of high nutrient content carried to still-waterbodies causing high BOD (e.g., shallow lakes, lagoons)

10.0 Impacts from Roads

10.1 Socioeconomic impacts

- **Positive socioeconomic impacts**
  - Improved access to markets, places of employment
  - Increased speed of movement to goods and services (e.g., markets, health centers, education, friends and relatives)
  - Improved employment opportunities
  - Reduction in accidents
- **Negative socioeconomic impacts**
  - Land prices rising out of reach of the local population
  - Exaggerated socioeconomic disparities favoring wealthier
  - Dependence on cash crops to the exclusion of subsistence crops
  - Spread of pests and diseases
  - Change in local demographics due to attraction from new activities
  - Noise and visual intrusion
  - Secondary impacts from induced development

10.2 Impacts on human health

- Erosion and silt runoff from poorly constructed roads affecting water supply quality
- Contamination of groundwater by herbicides applied to roadside vegetation and chemicals for dust control
- Vehicle emission pollution (intensified where congestion occurs)
  - Nitrogen oxides (leads to pulmonary effects, e.g., asthma)
  - Hydrocarbons (carry disease into the body, e.g., carcinogens)
- Carbon monoxide (reduces oxygen levels in the blood)
- Particulates (carry diseases into body, e.g., viruses, carcinogens and respiratory diseases)

- Transport spillage of hazardous materials affecting aquatic flora and fauna and water supplies
- Fire and explosions

10.3 Impacts on wildlife and ecology

- Destruction of wildlife habitats and loss of biodiversity through the attraction of roads for developers
- Route acting as a barrier to the movements of territorial and seasonal migratory wildlife
- Reduced reproductive success of sensitive species
- Animal mortality due to road and rail kills
- Competition between wildlife and introduced livestock for grazing resources

10.4 Impacts on flooding

- A completed road (particularly if paved) is likely to increase the volume and rate of precipitation runoff, thereby increasing the frequency of floods and storm-flow volumes.

10.5 Impacts on urban buildings

- Demolition of protected buildings
- Corrosion to protected buildings and monuments

11.0 Significance of Impacts

11.1 Environmental Standards

11.2 National legislation to protect certain lands

- National parks
- Forest and nature reserves
- Protected/listed buildings

11.3 International agreements to protect certain areas

- World Heritage Convention
- Ramsar Convention on wetlands

11.4 Conservation/preservation of species

- National legislation
- International conventions, e.g., CITES Convention on Endangered Species

11.5 Quality of rivers, inland-waterbodies and coastal waters (apply available standards for wastewaters, fisheries and bathing)

11.6 Construction and road-use operational health and safety standards (apply available regulations)

11.7 Ambient air quality and vehicle emission standards (apply available standards)

12.0 Environmental Priorities and Preferences

12.1 **Government policies for environmental protection (including, where appropriate, incorporation of objectives from country environmental studies or environmental action plans**

12.2 **Environmental priorities of international, national and/or local non-governmental organisations and local communities**

12.3 **Participation of affected people in project planning to determine priorities for environmental protection, e.g., route selection, with the following objectives**

- Protect revered areas, flora and fauna (e.g., cultural/medicinal value, visual landscape, etc.)
- Protect areas used for fishing
- Protect surface-waterbodies from siltation during construction (may serve as source of drinking or bathing water for local people)

12.4 **Location of facilities for construction workforce**

12.5 **Level of skills among construction workers to undertake environmental mitigation measures**

12.6 **Potential level of disturbance to residents (e.g., traffic at night)**

12.7 **Conflicts of interest between current and future users of those resources affected by the project, e.g., land (developed land, urban land, recreational areas, urban housing, rural potable water supply, waste absorbing capacities of surface-waterbodies, local skilled labour, credit availability, etc.)**

C. MITIGATION MEASURES CHECKLIST

13.0 **Routing Measures**

13.1 **Route to avoid land-use conflict with project populations/communities**

13.2 **Route to avoid valued and sensitive ecological environments (e.g., protected areas, wetlands)**

13.3 **Route to avoid geologically unstable areas**

13.4 **Route to avoid protected areas, cultural sites or listed buildings**

14.0 **Construction Measures**

14.1 **Mitigation of impacts on human health**

- Collection and recycling of lubricants
- Establish precautions to avoid accidental spills
- Careful handling/disposal of empty containers for toxic substances
- Assessment of disease vector ecology in work areas and employment measures
- Possible options include filling or drainage to avoid creating vector habitats

- Education on avoidance of transmittable diseases

14.2 Mitigation of impacts on soil

- Limit earth movement and soil exposure to the dry season
- Balance cut with fill such that there is minimum deposition of earth
- Resurface and revegetate exposed surfaces
- Protect vulnerable surfaces with mulch
- Provide sedimentation basins and retention ponds where required
- Line receiving surfaces with stones or concrete

14.3 Mitigation of impacts on hydrology

- Limit earth movement and soil exposure to the dry season
- Minimise soil compaction
- Minimise period that soil surfaces are exposed
- Provide adequate drainage in design

14.4 Mitigation of impacts on aquatic ecosystems

- Minimising soil erosion from construction sites
- Constructing bunds (curb or dike) and containments to prevent chemical spills from poisoning watercourses and their fauna

15.0 Measures for Roads

15.1 Mitigation of socioeconomic impacts

- Careful routing, construction and management of construction camps
- In urban areas, routing to avoid congestion and therefore reduce local air pollution
- Careful location for roadside amenities to minimise adverse social impacts
- Compensation for land price and land ownership impacts
- Adequate health services to offset diseases from induced development
- Training and policies to maximize economic opportunities for local people

15.2 Mitigation of impacts on human health

- Maintenance of drainage works
- Drains and culverts placed to avoid cascade effect
- Reduce use of roadside herbicides
- Regulate transport of toxic materials
- Prohibition of toxic waste transport through ecologically valued areas

15.3 **Mitigation of impacts on wildlife and ecology**

- Appropriate routing to avoid ecologically sensitive areas
- Imposition of tolls to discourage non-essential traffic
- Imposition of speed checks to limit traffic flows

- Where practicable, road closure between dusk and dawn to reduce kills to animals and minimise disruption to animal behavior patterns
- Vehicle checks to reduce/discourage illegal exploitation of forest resources
- Tourist site access roads planned with regard for aesthetics
- Grade limitations to avoid cutting and filling where scenery would be spoiled

APPENDIX C

ADMINISTRATIVE FORM
ENVIRONMENTAL GUIDELINE IMPLEMENTATION
Monitoring and Reporting
ENVIRONMENTAL GUIDELINES ROADS AND BRIDGES

MONITORING AND REPORTING

Agency:	Monitored by:
Project Location:	Signature:
Project Activity:	Date:
Action:	Time:
Action Location:	Weather:

- Please provide as much monitoring information as you can about the way in which an environmental guideline is being implemented. Recording details such as development stage (design, construction, etc.) on the date that this monitoring report was recorded as well as the degree to which implementation had progressed will help you to recall pertinent details when it is time for monthly site meetings and for final monitoring reports.
- To keep monitoring records organized, a new form for each action is recommended: that is, after completing a report for stone pitching at Chainage 45.3 on the Voi-Taveta Road (see example), start a new report for a different action on the same road, e.g., borrow pit reinstatement. **Use as many forms as you need to produce clear records**.
- In Column 4, perhaps you discover that the designed intervention does not match what is actually needed on the ground—for example, 100m of stone pitching in a steep sidedrain is indicated in the drainage designs; however, 150m of pitching is actually required to prevent soil erosion. Make a note of that discrepancy and report it to the Engineer.

Environmental Guideline	Development Stage	Percent Complete	Design vs Actual	Work Evaluation
Comments:				

SAMPLE

ENVIRONMENTAL GUIDELINES ROADS AND BRIDGES

MONITORING AND REPORTING

Agency: KeNHA	**Monitored by:** Peter Owieno
Project Location: Voi-Taveta Road	**Signature:** Peter Owieno
Project Activity: Road upgrading	**Date:** 11 March 2010
Action: Stone-pitching sidedrain	**Time:** 13:00
Location: Chainage 45.3	**Weather:** Fine and hot with breeze from west

- Please provide as much monitoring information as you can about the way in which an environmental guideline is being implemented. Recording details such as development stage (design, construction, etc.) on the date that this monitoring report was recorded as well as the degree to which implementation had progressed will help you to recall pertinent details when it is time for monthly site meetings and for final monitoring reports.
- To keep monitoring records organized, a new form for each action is recommended: that is, after completing a report for stone pitching at Chainage 45.3 on the Voi-Taveta Road (see example), start a new report for a different action on the same road, e.g., borrow pit reinstatement. Use as many forms as you need to produce clear records.
- In Column 4, perhaps you discover that the designed intervention does not match what is actually needed on the ground—for example, 100m of stone pitching in a steep sidedrain is indicated in the drainage designs; however, 150m of pitching is actually required to prevent soil erosion. Make a note of that discrepancy and report it to the Engineer.

Environmental Guideline	Development Stage	Percent Complete	Design vs Actual	Work Evaluation
2.4.2.2 (stone pitching)	Construction	75%	Design = 37m lining; actual lining needed = 50m	Appear to be unaware of additional lining needed
2.4.2.5 (energy dissipaters)	Construction	0%		Check dams may be needed to slow water velocity in lined sidedrain (to be confirmed)
2.4.2.7 (infiltration trench)	Construction	0%		An infiltration trench required to move water away from the road at the sidedrain termination

Comments:

Consult with Engineer about the length of the steep sidedrain. Confirm with Contractor that additional stone pitching will be catered for.

Depending upon advice of Engineer, consult with hydrologist for needed check-dam designs.

Remind Contractor that runoff must be controlled during stone pitching.

APPENDIX D

WORKER SAFETY, HEALTH AND WELFARE

including

PPE ILLUSTRATIONS AND SPECIFICATIONS

Worker Safety, Health and Welfare

Personal protective equipment (PPE) is worn by a worker to minimise exposure to specific hazards associated with road construction/maintenance. Examples of PPE are face masks to protect the respiratory system, hard hats to protect one's head, muffs to protect ears and so forth.

While the purpose of PPE is to protect a worker from specific job-related hazards, the PPE package issued to a worker must be specific to the hazard; hence, ear muffs are unnecessary for a worker who is not exposed to high noise levels. Conversely, someone working in a rock quarry or at a rock crusher must have and wear appropriate ear protection.

PPE neither reduces the hazards encountered by road-construction workers nor does it guarantee permanent or total protection. In fact, PPE use is only one element in a complete safety programme that would incorporate various strategies to maintain a safe and healthy working environment.

DO NOT OVERESTIMATE THE PROTECTION AFFORDED BY PPE

The Republic of Kenya's Ministry of Labour maintains a directorate dedicated to worker safety and health. Known as the Directorate of Occupational Safety and Health Services (DOSHS), all road-construction/maintenance projects fall within its purview as mandated by the Occupational Safety and Health Act, Act 15 of 2007 (OSHA 2007).

Section 3, OSHA 2007, applies to "all workplaces where any person is at work, whether temporarily or permanently," whereby the safety, health and welfare of persons at the workplace is to be secured. In addition, Section 3 also stipulates that persons other than workers are to be protected from risks to safety and health that are caused by the activities carried on by workers.

Whereas Section 6 and 7, OSHA 2007, requires employers ("occupiers" in the language of the Act) to make arrangements for ensuring employee safety and health by reducing or eliminating risks and to prepare a safety and health policy that should include the provision of PPE to employees, Section 13 of the Act clearly states that "[E]very employee shall, while at the workplace at all times wear or use any protective equipment or clothing provided by the employer for the purpose of preventing risks to his safety and health" (Section13 (1)(c). The penalties for worker non-compliance are steep: Ksh ⇖50,000 and/or imprisonment up to 3 months.

Among the many OSHA 2007 and DOSHS rules that apply to road construction and maintenance, three sections are particularly germane to the intent of the EGLs:

1. **Registration of workplaces**. Section 44(1) of the Act requires that an application for registration of a workplace be completed prior to occupying working premises and commencing work. After submission of the application (Fourth Schedule, OSHA 2007), the applicant is issued a certificate of registration by DOSHS. The required workplace registration must be renewed annually. First failure to comply with the registration requirement carries a penalty of Ksh ⇖100,000 and/or imprisonment up to 3 months. Subsequent non-compliance after a first cited offence may carry a penalty of Ksh10,000 per day and imprisonment for up to 7 days.

2. **Preparation of Safety and Health Policy**. An employer (or occupier) must prepare, and revise as often as necessary, a "statement describing his general policy with respect to the safety and health at work of his employees and the organisation and arrangements" for carrying out the policy. The safety and health policy will likely contain the general principles and rules that will guide future actions to limit risks to the safety, health and welfare of all persons, worker and non-worker alike. The occupier's employees are to be informed of the safety and health policy (Section 7(1) and (2), OSHA 2007), presumably by way of worksite safety and health training.

Appointment of Safety Supervisors/Officers. Rule 7, (OSH Rules 1984), requires the employer to appoint a safety supervisor/officer to carry out workplace duties related to employee safety and health. These duties involve implementing the employer's safety and health policy, in part, through workplace safety and health training for employees, including training in first aid. Comprehensive curricula for the aforementioned health and safety training courses can be found on the DOSHS web site (www.doshs@go.ke).

Other subsidiary rules—either already developed or being developed by DOSHS—that require compliance by the road-construction contractor (and by extension, enforcement by the supervising authority) are:

- Building Operations and Works of Engineering Rules
- Health and Safety Committee Rules
- Noise Control and Prevention Rules
- Medical Examination Rules
- Hazardous Substances Rules
- Fire Risk Reduction Rules

The Supervision Engineer and road-construction contractor are urged to become familiar with the Occupational Safety and Health Act (Act 15 of 2007) as well as the rules and requirements of the Directorate of Occupational Safety and Health Services, Ministry of Labour. Needless to say, a contractor's tender must reflect the costs associated with implementation of the law.

In addition to OSHA 2007, particular labour laws enacted recently by the Republic of Kenya must be followed in the construction and maintenance of the country's roads:

- Employment Act, 2007, that governs wages and conditions of employment;

- Labour Relations Act, 2007, that establishes the registration and rights of trade unions as well as the mechanisms for resolving labour-related disputes; and
- Work Injury Benefits Act, 2007, that enables compensation for occupational injuries, deaths and diseases.

In the road-construction/maintenance project's initial stage, a safety and health programme—carefully planned and fully developed—should be introduced gradually and in phases. The purpose of the programme and its implementing rules must be clearly stated with a target date set for full compliance with adopted safety and health instruments such as PPE. Prior to the target date for full compliance, time should be allowed for workers to become accustomed to wearing PPE. And until the target date is reached, enforcement action for non-compliance should not be taken. After induction training that includes workplace safety and health and introduction of the period for full-compliance with the safety and health rules, enforcement action must be taken systematically, with the routine use of PPE becoming a required condition of employment.

While not specified in OSHA 2007 or by DOSHS rules, the items in the PPE package provided to the employee by the employer may include some or all of the equipment illustrated and described on the following pages. Certain more common wearing apparel like overalls and dust coats are not included in this listing; however, their exclusion does not discount their importance. Again, protective equipment provided to the worker will be specific to the tasks being performed, and it is the duty of the employer's safety officer to identify the appropriate pieces of equipment required by the worker for his/her assigned tasks and to assure that the PPE is properly fitted and routinely used. (At the time of EGL publication, DOSHS were preparing a "Code of Practice: Personal Protectives"; the user of these guidelines is advised to consult the code when it becomes available.)

Personal Protective Equipment **Road-Construction or Road-Maintenance Workers**			
Item		**Purpose**	**Specifications**
Particulate Respirator		To protect the respiratory system (nose, throat and lungs) from particulate matter including fugitive dust and airborne crusher fines	• Suitable for use in stone quarrying and cement handling; • Molded nose bridge seals easily without a metal nose band; • Naturally contoured face piece relieves pressure points; • Flame retardants are added to the shell to help decrease flammability; and • Filter efficiency level of 95% or greater against airborne particulates free of oil.

Personal Protective Equipment Road-Construction or Road-Maintenance Workers			
Item		**Purpose**	**Specifications**
Particulate Respirator		To protect the respiratory system (nose, throat and lungs) from particulate matter including fugitive dust and airborne crusher fines	• Suited for work settings that involve heat, humidity, or long periods of wear; • Use for dry chemical handling, surface preparation, processing of minerals and certain other substances; • Low profile collapse resistant design, exhalation valve and a soft nose foam pad; and • Filter efficiency level of 95% or greater against particulate aerosols free of oil.
Vapour Respirator		To protect the respiratory system (nose, throat and lungs) from organic vapours including bitumen vapours and toxic chemical aerosols	• Use for protection from certain organic vapors such as prolonged exposure to vapours emitted by bitumen; • Use in a variety of workplace applications, including chemical and construction; and • Entire unit, including chemical cartridges, are disposable.
Safety Helmet		To protect the head from falling or propelled objects; striking one's head on overhead structures; and physically contacting energy sources up to 650V	• Durable injection-molded, high-density polyethylene; • Adjustable crown straps and suspension system to allow air circulation; • Type I hard hat intended to reduce the force of impact resulting from a blow to the top of the head; and • Type II hard hat intended to protect against both side impact and blows to the top of the head.

Personal Protective Equipment Road-Construction or Road-Maintenance Workers			
Item		**Purpose**	**Specifications**
High Visibility Vest		To increase the wearer's visibility while at work on the job site and along travelled roadways	• Standard colors: fluorescent orange or green; • Reflective material; • Lengthwise reflective silver stripes; and • Standard flexible mesh for added comfort in hot, humid weather.
Leather Safety Boot		To protect the foot from injury due to falling objects, cuts and punctures, abrasions, slipping and splashed hazardous liquids	• Lacing leather work boot with dual density polyurethane sole; • Steel toe cap; • Steel midsole for underfoot protection; and, • Resistant to oil and slipping
Rubber Safety Boot		To protect the foot from injury due to liquid or viscous corrosive and/or hazardous chemicals as well as slipping	• Use for applying bitumen and/or working around newly bituminized surfaces; • Waterproof; • Resistant to chemicals and oil; and, • PVC/nitrile rubber.
Ear Muffs		To protect the ears from permanent injury caused by excessively high single-event noise levels or continuous exposure to moderately high noise levels	• Noise reduction rating (NRR) 25 (noise reduction of 25 dBA); • Non-conductive plastic construction; • Padded headband for comfortable, secure fit; • Pivoting cup attachment for equal pressure distribution; and • Easy slide cup adjustment.

Personal Protective Equipment Road-Construction or Road-Maintenance Workers			
Item		**Purpose**	**Specifications**
Safety Helmut/Ear Muffs		To protect the head from hazards equivalent to those listed above and the ears from noise damage as described above	• Durable injection-molded, high-density polyethylene; • Adjustable crown straps and suspension system to allow air circulation; • Foam filled, padded ear cups; and • NRR 26.
Ear Plugs		To protect the ears from permanent injury caused by high single-event noise levels or continuous exposure to moderately high noise levels	• Foam for one-time only use; • Non-irritating, smooth surface for comfort; • Tapered for easy ear insertion; • Bright green color for compliance checks; and • NRR 33.
Ear Plugs		To protect the ears from permanent injury caused by high single-event noise levels or continuous exposure to moderately high noise levels	• TPE (thermoplastic elastomer, mix of rubber and plastic) for multiple use (if properly washed and dried, can be worn daily for 2-4 weeks); • Soft flanges offer a better fit in the ear canal; • Blue color for compliance checks; and • NRR 27.

Personal Protective Equipment Road-Construction or Road-Maintenance Workers			
Item		**Purpose**	**Specifications**
Safety Goggles		To protect the eyes from exposure to hazardous substances, corrosive materials and airborne particles (large and small)	• Standard goggle design with ventilation system; • Adjustable, flexible headband; • UV (ultraviolet or invisible *light* rays with a wavelength shorter than that of visible *light* but longer than that of x-rays) protection; • Resistant to liquid (chemical) splash, large dust particles and molten materials; • Resistant to medium impacts; and • Replaceable lens.
Safety Glasses		To protect the eyes from exposure to hazardous substances and/ or corrosive materials and limited protection from particulate matter (large and small particles)	• Polycarbonate lens that resist shattering and scratching; • Rubber nose pads adjust to the shape of any nose for best fit; • Spherical lens for increased peripheral vision; and • Distortion free lens.
Work Gloves		To protect the hands and wrists from injury due to impacts, abrasion and contact with corrosive and/ or hazardous materials	• Cowhide leather palm; • Leather fingertips, knuckle bands and full-leather index finger; • Cotton lining to keep hands cool and comfortable; and • Safety cuff (6 cms) to protect wrists.

Personal Protective Equipment Road-Construction or Road-Maintenance Workers			
Item		**Purpose**	**Specifications**
Work Gloves		To protect the hands, wrists and forearms from injury due to contact with corrosive and/ or hazardous materials	• Nitrile rubber for protection from contact with chemicals including bitumen; • Gauntlet length (35.5cms long) to protect against skin contact from splashes; • Embossed surface for secure grip; • Resistant to heat up to 100°C; • Resistant to abrasion, cuts, tears and puncture; and • Cotton lined to wick moisture from hands.

APPENDIX E

CHECKLISTS FOR EVALUATION OF CULTURAL RESOURCES

Archaeological Impact Assessment

Indicators for Assessing Impacts on Archaeological Sites

Checklist of Criteria for Site Evaluation at the Feasibility Stage

Checklist of Criteria for Site Evaluation Prior to the Construction Stage

EVALUATION OF CULTURAL RESOURCES

Archaeological Impact Assessment

Archaeological impact assessment (AIA) studies are initiated in response to development proposals that will potentially disturb or alter the landscape, thereby endangering archaeological sites. Although the terminology for development stages used in these checklists may differ from those used in MoR's environmental guidelines, the development stages are essentially equivalent. In this checklist, development stages normally proceed through four general stages of project planning:

- prospectus;
- feasibility or preliminary planning and design;
- final design, licensing and approval; and
- implementation and operation.

At each stage of this general planning process a particular type of archaeological study is undertaken to meet specific project objectives and needs.

The archaeological assessment process is composed of two principal components: assessment and impact management.

1. Assessment is primarily concerned with the inventory and evaluation of archaeological resources, and the assessment of impacts during the initial stages of project planning.
2. Impact management follows directly from assessment and is primarily concerned with managing unavoidable adverse impacts as well as unanticipated impacts.

It is important to recognize that the assessment and impact management stages are approached sequentially in association with specific levels of project planning.

Moreover, each new stage in the process is highly dependent upon results and recommendations made in the preceding stage. The success of this process is also dependent upon effective communication and cooperation between project proponents and the responsible branch of government, and their mutual respect for development and archaeological resource management objectives.

1.0 Indicators for Assessing Impacts on Archaeological Sites

This particular AIA system uses eight indicators to describe potential impacts to archaeological sites—or cultural resources in the context of these environmental guidelines. These indicators are also used in EIA to qualify, rather than quantify, impacts.

Although their application to impact assessment is best accomplished by a trained assessor, the indicators are included here to convey the diversity of impacts to cultural resources. The degree to which a resource is impacted will also determine its potential for preservation; for example, if the magnitude of physical alteration to an archaeological artifact is minimal, the severity of the impact can be assumed to be reversible.

1.1 **Magnitude:** The amount of physical alteration or destruction which can be expected.The resultant loss of archaeological value is measured either in amount or degree of disturbance.

1.2 **Severity:** The irreversibility of an impact. Adverse impacts which result in a totally irreversible and irretrievable loss of archaeological value are of the highest severity.

1.3 **Duration:** The length of time an adverse impact persists. Impacts may have short-term or temporary effects, or conversely, more persistent, long-term effects on archaeological sites.

1.4 **Range:** The spatial distribution, whether widespread or site-specific, of an adverse impact.

1.5 **Frequency:** The number of times an impact can be expected. For example, an adverse impact of variable magnitude and severity may occur only once. An impact such as that resulting from cultivation may be of recurring or ongoing nature.

1.6 **Diversity:** The number of different kinds of project-related actions expected to affect an archaeological site.

1.7 **Cumulative Effect:** A progressive alteration or destruction of a site owing to the repetitive nature of one or more impacts.

1.8 **Rate of Change:** The rate at which an impact will effectively alter the integrity or physical condition of an archaeological site. Although an important level-of-effect indicator, it is often difficult to estimate. Rate of change is normally assessed during or following project construction.

2.0 Checklist of Criteria for Site Evaluation at the Feasibility Stage

2.1 Scientific Significance

2.1.1 **Does the site contain evidence which may substantively enhance understanding of culture history, culture process, and other aspects of local and regional prehistory?**

- internal stratification and depth

- chronologically sensitive cultural items or materials for absolute dating
- association with ancient landforms
- quantity and variety of tool type
- distinct intra-site activity areas
- tool types indicative of specific socioeconomic or religious activity
- cultural features such as burials, dwellings, hearths, etc.
- diagnostic faunal and floral remains
- exotic cultural items and materials
- uniqueness or representativeness of the site
- integrity of the site

2.1.2 Does the site contain evidence which may be used for experimentation aimed at improving archaeological methods and techniques?

- monitoring impacts from artificial or natural agents
- site preservation or conservation experiments
- data recovery experiments
- sampling experiments
- intra-site spatial analysis

2.1.3 Does the site contain evidence which can make important contributions to paleoenvironmental studies?

- topographical, geomorphological context
- depositional character
- diagnostic faunal, floral data

2.1.4 Does the site contain evidence which can contribute to other scientific disciplines such as hydrology, geomorphology, pedology, meteorology, zoology, botany, forensic medicine, and environmental hazards research, or to industry including forestry and commercial fisheries?

2.2. Public Significance

2.2.1 Does the site have potential for public use in an interpretive, educational or recreational capacity?

- integrity of the site
- technical and economic feasibility of restoration and development for public use
- visibility of cultural features and their ability to be easily interpreted
- accessibility to the public
- opportunities for protection against vandalism
- representativeness and uniqueness of the site
- aesthetics of the local setting
- proximity to established recreation areas

- present and potential land use
- land ownership and administration
- legal and jurisdictional status
- local community attitude toward development

2.2.2 Does the site receive visitation or use by tourists, local residents or school groups?

2.3 Ethnic Significance

2.3.1 Does the site presently have traditional, social or religious importance to a particular group or community?

- ethnographic or ethnohistoric reference
- documented local community recognition and concern for the site

2.4 Economic Significance

2.4.1 What value of user-benefits may be placed on the site?

- visitors' willingness-to-pay
- visitors' travel costs

3.0 Checklist of Criteria for Site Evaluation Prior to the Construction Stage

3.1 Scientific Significance

3.1.1 Does the site contain evidence which may substantively enhance understanding of historic patterns of settlement and land use in a particular locality, regional or larger area?

3.1.2 Does the site contain evidence which can make important contributions to other scientific disciplines or industry?

3.2 Historic Significance

3.2.1 Is the site associated with the early exploration, settlement, land use, or other aspect of Kenya's cultural development?

3.2.2 Is the site associated with the life or activities of a particular historic group, organisation, or institution that has made a significant contribution to, or impact on, the community, state or region?

3.2.3 Is the site associated with a particular historic event, whether cultural, economic, military, religious, social or political, that has made a significant contribution to, or impact on, the community, state or region?

3.2.4 Is the site associated with a traditional recurring event in the history of the community, state or region, such as an annual celebration?

3.3 Public Significance

3.3.1 Does the site have potential for public use in an interpretive, educational or recreational capacity?

- visibility and accessibility to the public
- ability of the site to be easily interpreted
- opportunities for protection against vandalism
- economic and engineering feasibility of reconstruction, restoration and maintenance
- representativeness and uniqueness of the site
- proximity to established recreation areas
- compatibility with surrounding zoning regulations or land use
- land ownership and administration
- local community attitude toward site preservation, development or destruction
- present use of site

3.3.2 Does the site receive visitation or use by tourists, local residents or school groups?

3.4 Ethnic Significance

3.4.1 Does the site presently have traditional, social or religious importance to a particular group or community?

3.5 Economic Significance

3.5.1 What value of user-benefits may be placed on the site?

- visitors' willingness-to-pay
- visitors' travel costs

3.6 Integrity and Condition

3.6.1 Does the site occupy its original location?

3.6.2 Has the site undergone structural alterations? If so, to what degree has the site maintained its original structure?

3.6.3 Does the original site retain most of its original materials?

3.6.4 Has the site been disturbed by either natural or artificial means?

3.7 Other

3.7.1 **Is the site a commonly acknowledged landmark?**

3.7.2 **Does, or could, the site contribute to a sense of continuity or identity either alone or in conjunction with similar sites in the vicinity?**

3.7.3 **Is the site a good typical example of an early structure or device commonly used for a specific purpose throughout an area or period of time?**

3.7.4 **Is the site representative of a particular architectural style or pattern?**

APPENDIX F

COMPENDIUM

NATIONAL AND INTERNATIONAL LAWS AND AGREEMENTS

Related To

ENVIRONMENTAL GUIDELINES, ROAD AND BRIDGES

National Laws, Regulations and Guidelines
bearing upon MoR Environmental Guidelines, Roads and Bridges
and including
Implementing Authorities and Directorates
Republic of Kenya

Employment Act No. 11, 2007

An act of Parliament to repeal the Employment Act, declare and define the fundamental rights of employees, to provide basic conditions of employment of children, and to provide for matters connected with the foregoing (commenced 2 June 2008).

Energy Act No.12 of 2006

An act of Parliament to amend and consolidate the law relating to energy, to provide for the establishment, powers and functions of the Energy Regulatory Commission and the Rural Electrification Authority, and for connected purposes. The provisions of this act shall apply to every person or body of persons importing, exporting, generating, transmitting, distributing, supplying or using electrical energy; importing, exporting, transporting, refining, storing and selling petroleum or petroleum products; producing, transporting, distributing and supplying of any other form of energy, and to all works or apparatus for any or all of these purposes.

Environmental Management and Coordination Act, Cap 371, 1999

An act of Parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment; a framework environmental legislation is promulgated so as to establish an appropriate legal and institutional framework for the management of the environment; improved legal and administrative co-ordination of the diverse sectoral initiatives is necessary in order to improve the national capacity for the management of the environment in recognition that the environment constitutes the foundation of national economic, social, cultural and spiritual advancement (commenced 14 January 2000).

National Environment Management Authority (NEMA)

- Environmental Management and Coordination (Conservation of Biological Diversity) Regulations, 2006

- Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009
- Environmental Management and Coordination (Waste Management) Regulations, 2006
- Environmental Management and Coordination (Water Quality) Regulations, 2006
- Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Seashores Management) Regulations, 2009

National Sand Harvesting Guidelines, 2007

Explosives Act Cap 115

An act of Parliament to consolidate and amend the law relating to the manufacture, storage, sale, transport, importation, exportation and use of explosives (commenced 1 July 1931). Subsidiary legislation: Explosive (Blasting Explosives) Rules; LN 94/2010, The Explosives (Blasting Explosives) (amendment) Rules, 2010

Ministry of Environment and Natural Resources

Mines and Geological Department

Control of manufacture, use, storage and movement of commercial explosives.

Fisheries Act Cap 378

An act of Parliament to provide for the development, management, exploitation, utilisation and conservation of fisheries and for connected purposes (commenced 25 August 1989).

Ministry of Fisheries Development

Department of Fisheries

The Department of Fisheries is a technical department of the ministry whose mandate is to provide for the exploration, exploitation, utilization,management, development and conservation of fisheries resources, and undertake research in marine and fresh water fisheries.

Forest Act No. 7 of 2005

An act of Parliament to provide for the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the socio-economic development of the country (commenced 22 December 2008)

Kenya Forest Service (KFS)

KFS is a state corporation established in February 2007 under the Forest Act 2005 to conserve, develop and sustainably manage forest resources for Kenya's social-economic development.

Labour Relations Act No. 14, 2007

An act of Parliament to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratisation of trade unions and employers organisations or federations, to promote sound labour relations through the protection and promotion of freedom of association, the encouragement of effective collective bargaining and promotion of orderly and expeditions dispute settlement, conducive to social justice and economic development and for connected purposes (commenced 26 October 2007).

Land Acquisition Act Cap 295

An act of Parliament to make provision for the compulsory acquisition of land for the public benefit (commenced 23 August 1968).

National Museums and Heritage Act No. 6 of 2006

An act of Parliament to consolidate the law relating to national museums and heritage; to provide for the establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya (commenced 9 August 2006).

National Museums of Kenya

Heritage Warden

The Minister may by notice in the Gazette appoint persons recommended by the National Museums to be heritage wardens for the purpose of enforcing this Act.

Occupational Safety and Health Act Cap 15 of 2007

An act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes (commenced 26 October 2007).

Directorate of Safety and Health Services (DOSHS)

Directorate responsible for administration of the Act and for promulgating rules to implement the intent of the Act. Currently DOSHS are using the rules created for the Factories and Other

Places of Work Act, which was replaced by the Occupational Safety and Health Act. Those rules applicable to the Environmental Guidelines are:

- The Factories (First Aid) Rules 1977
- The Factories (Eye Protection) Rules, 1978
- The Factories (Electric Power) Rules, 1978
- The Factories (Building Operation and Works of Engineering Construction) Rules, 1984
- The Factories and Other Places of Work (Health & Safety Committees) Rules, 2004
- The Factories and Other Places of Work (Medical Examination) Rules, 2005
- The Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005
- The Factories and Other Places of Work (Fire Risk Reduction) Rules, 2007
- The Factories and Other Places of Work (Hazardous Substances) Rules, 2007

Public Health Act, Cap 242 (revised 1986)

An act of Parliament to make provision for securing and maintaining health.

Traffic Act Cap 403

An Act of Parliament to consolidate the law relating to traffic on the roads (commenced 1 January 1954).

Water Act 2002

An act of Parliament to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services; to repeal the

Water Act (Cap. 372) and certain provisions of the Local Government Act; and for related purposes (commenced 18 March 2003).

Ministry of Water and Irrigation

Water Resources Management Authority (WRMA)

WRMA is a state corporation established under the Water Act 2002 and charged with being the lead agency in water resources management.

Wildlife (Conservation and Management) Act Cap 376

An act of Parliament to consolidate and amend the law relating to the protection, conservation and management of wildlife in Kenya; and for purposes connected there with and incidental thereto; whereas is desirable that the present powers relating to the management and conservation of wildlife in Kenya should be amalgamated and placed in a consolidated service of the government; and whereas the prime objective of the service should be to ensure that wildlife is managed and conserved so as to yield to the nation in general and to individual areas in particular, optimum returns in terms of cultural, aesthetic and scientific gains as well as such economic gains as are incidental to proper wildlife management and conservation and which may be secured without prejudice to such proper management and conservation; and whereas it is necessary, for the achievement of that objective, that full account should be taken of the varied forms of land use and the inter-relationship between wildlife conservation and management and other forms of land use (commenced 13 February 1976).

Kenya Wildlife Service (KWS)

KWS conserves and manages Kenya's wildlife for the Kenyan people and the world. It is a state corporation established by an act of Parliament Cap 376 with the mandate to conserve and manage wildlife in Kenya, and to enforce related laws and regulations.

Work Injury Benefits Act No. 13, 2007

An act of Parliament to provide for compensation to employees for work related injuries and diseases contracted in the course of their employment and for connected purposes (commenced 6 February 2008).

International Organisations and Agreements bearing upon MoR Environmental Guidelines, Roads and Bridges including Programmes and Agreements applicable to the Republic of Kenya

Inter-Organisation Programme for the Sound Management of Chemicals (IOMC)

The Inter-Organization Programme for the Sound Management of Chemicals (IOMC) was established in 1995 to strengthen cooperation and increase coordination in the field of chemical safety. The seven participating organizations are (1) the Food and Agriculture Organization of the United Nations (FAO); (2) the International Labour Organization (ILO); (3) the United Nations Environment Programme (UNEP); (4) the United Nations Industrial Development Organization (UNIDO); (5) the United Nations Institute for Training and Research (UNITAR); (6) the World Health Organization (WHO); and , (7) the Organisation for Economic Co-operation and Development (OECD). Two observer organizations are participate: United Nations Development Programme (UNDP) and World Bank. The WHO is the administering organization for the IOMC and provides secretariat services to the **Inter-Organization Coordinating Committee (IOCC).**

International Labour Organisation (ILO)

The ILO is the tripartite United Nations agency that brings together governments, employers and workers of its member states in common action to promote decent work throughout the world.

ILO Convention 29
Forced labour ratified on 13 January 1964

ILO Convention 98
Freedom of association and collective bargaining ratified on 13 January 1964

ILO Convention 100
Equal remuneration for work of equal value ratified on 7 May 2001

ILO Convention 105
Abolition of forced labour 13 May 1957

Organisation for Economic Cooperation and Development (OECD)

The Organisation for Economic Co-operation and Development is a forum where the governments of 30 market democracies work together to address the economic, social and governance challenges of globalisation as well as to exploit its opportunities.

OECD Guidelines for Environmentally Sustainable Transport

United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO's mission is to contribute to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information.

Biosphere Reserve
Biosphere reserves are areas of terrestrial and coastal ecosystems promoting solutions to reconcile the conservation of biodiversity with its sustainable use.

They are internationally recognized, nominated by national governments and remain under sovereign jurisdiction of the states where they are located. Biosphere reserves serve in some ways as 'living laboratories' for testing out and demonstrating integrated management of land, water and biodiversity. Collectively, biosphere reserves form a world network: the World Network of Biosphere Reserves (WNBR). Within this network, exchanges of information, experience and personnel are facilitated. There are over 500 biosphere reserves in over 100 countries.

World Heritage Site
UNESCO seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity. This is embodied in an international treaty called the Convention concerning the Protection of the World Cultural and Natural Heritage, adopted by UNESCO in 1972.

Cradle of Mankind
There are several locations scattered throughout Africa that are recognised for their rich historical and even pre-historical existence based on findings in these places. Kenya is recognised as one Cradle of Mankind as it is the site at which Dr Richard Leakey discovered the bones of human beings dating back to the beginning of mankind's existence. These bones were found on Kenya's Lake Turkana coastline, at Koobi Fora, now the territory of the nomadic tribe of Gabbra. Kariandusi and Ololgesailie are other sites that have become known for their historical and archaeological wealth. Many of the caves in Kenya are home to ancient rock paintings that bear evidence of a prehistoric civilisation in this area.

WWF

WWF's mission is the conservation of nature. Using the best available scientific knowledge and advancing that knowledge where WWF can, the organization works to preserve the diversity and abundance of life on Earth and the health of ecological systems by protecting natural areas and wild populations of plants and animals, including endangered species; promoting sustainable approaches to the use of renewable natural resources; and promoting more efficient use of resources and energy and the maximum reduction of pollution.

Global 200
Global 200 is a first attempt to identify a set of ecoregions whose conservation would achieve the goal of saving a broad diversity of the Earth's ecosystems. These ecoregions include those with exceptional levels of biodiversity, such as high species richness or endemism, or those with unusual ecological or evolutionary phenomena.

Centre of Plant Diversity
The idea of seeking out high concentrations of diversity among plants, animals or both has a long history in biogeography in one form or another. Attention has frequently been paid to the floristic or faunistic richness of certain areas, such as the tropics of Asia, Africa and the Americas, the Mediterranean climatic regions, and the concentrations of species on islands, such as Madagascar and Indonesia. Particular emphasis has been given to the large numbers of species that are

endemic to such areas. More recently, the concept of sites or centres of high diversity has attracted the attention of conservationists, both as a tool for helping determine which areas should receive priority attention, and also as a challenge as to how to undertake the conservation action necessary. Such efforts to seek out areas of high priority for conservation have acquired increased urgency in the light of the accelerating losses throughout the world of natural habitats and the biodiversity they contain, as a result of human action and the growth of the world's population.

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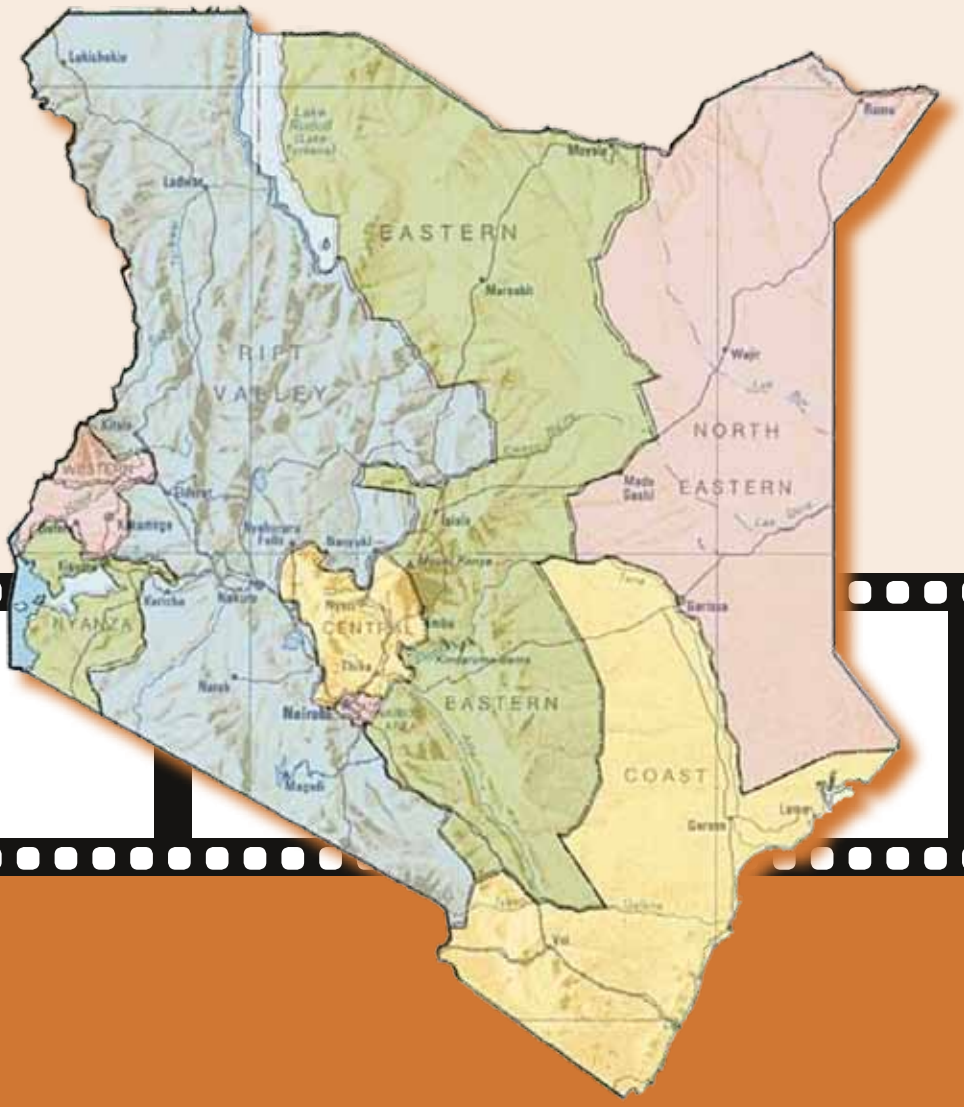

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