

**Malawi**

Beneficiary Framework  
Contract Lot 2 - Transport  
and Infrastructures

Technical Assistance to  
Rail Sector Development

**Draft Final Report**

An EU-funded project implemented by GOPA, a  
member of the COWI Consortium



May 2009

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## **Draft Final Report**

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## Abbreviations

AfDB	African Development Bank
BOO	Build – Own – Operate
BOOT	Build – Own – Operate – Transfer
BOT	Build – Operate – Transfer
CDN	Corridor de Desenvolvimento do Norte
CEAR	Central East African Railways Ltd.
CCFB	Compania dos Caminhos de Fero da Beira
CFM	Caminho de Ferro de Mozambique
CSS	Catalog of Standard Services
CVRD	Companhia Vale do Rio Doce
ISO	International Organisation for Standarization
EIB	European Investment Bank
EN	European Norm
GoM	Government of Malawi
MCC	Millenium Challenge Corporation
MGDS	Malawi Growth and Development Strategy
MOTPW	Ministry of Transport and Public Works
MtwDC	Mtwara Development Corridor
NDC	Nacala Development Corridor
PN	Porto de Nacala
PPP	Public Private Partnership
PWI	Permanent Way Instructions
RDC	Railroad Development Corporation, U.S.A.
RSDI	Regional Spatial Development Initiative
SADC	Southern African Development Community
SDCN	Sociedade de Desenvolvimento do Corridor de Nacala
TERA	TERA International Group, Inc.
TWR	Train Working Rules
UIC	Union Internationale des Chemins de Fer
WB	World Bank
ZMM-GT	Zambia-Malawi-Mozambique Growth Triangle

## **Executive summary**

Transport infrastructure plays a vital role to the economy of landlocked and comparatively densely populated Malawi, in particular for distribution of exports and imports. Before the civil war in Mozambique, almost all international freight was carried by rail via Mozambique and its natural accesses to the sea at Beira and Nacala. The use of the railways for imports and exports came to a complete halt during the war. Afterwards traffic could be resumed on the Nacala corridor only, and the connection to Beira has remained closed until today.

Commercialisation of the formerly state-run railways started in 1994, and in 1999 and 2005 respectively concessions were granted to a consortium of private investors for operation of the railways in Malawi, and Northern Mozambique and the Port of Nacala. But due to the lack of a proper legal and institutional framework and insufficient clarity of responsibilities, the public-private-partnership has not been successful so far. Maintenance of infrastructure and rolling stock has been neglected and rehabilitation deferred, resulting in unacceptable lead times, frequent line closures, and high tariffs. Consequently, traffic performance declined drastically, and road transport is now the main mode in domestic and international transport.

In view of the high transport costs that represent 55% of production costs compared to 17% in other Sub-Saharan countries, development agencies are assisting Malawi to produce a Transport Sector Programme and this has generated renewed interest in the rail sub-sector which would be capable of transporting large volumes of goods more cost-effective than road transportation.

Accordingly, the global objective of this Technical Assistance had been defined as reduction of transport costs within the region, with the specific objective of compilation of data for the successful launch of the full Malawi government railway rehabilitation programme. But taking into account the complexity of a railway system in general and the circumstances in Malawi and the region in particular, the consultant came to the conclusion that rehabilitation can be only successful if planning comprises a complete pattern of all factors and parameters and their interdependencies. Therefore, beyond the pre-defined objective, a Railway Master Plan has been elaborated, including the rehabilitation programme, as part of the National Transport Sector Programme.

As a first step, the railways in Malawi and the adjoining countries have been assessed by means of evaluation of existing studies, stakeholder meetings, and site surveys. The following subjects have been analysed in detail:

- The functionality of Malawi railways as part of the regional network,
- Network details and inventory,
- Rolling stock, and
- Institutional framework, management, operations and maintenance.

Global result of this analysis is that from their functionality, railways in Malawi (including the link to Chipata in Zambia) and Mozambique must be considered ***one consistent network***.

Main problem areas have been identified as

- Condition of substructure and drainage, in particular in the vicinity of bridges and culverts,
- Condition of bridges and culverts, and their foundations,
- Bridges due for replacement because of their age or type,
- Permanent way technology and condition of permanent way,
- Employed technology, and condition and lack of rolling stock,
- Lack of a legal framework, and fragmentary and outdated standards, rules and regulations, and
- The lost know-how within the rail sector.

*The present condition of the rail infrastructure suggests that operations may already collapse during the next rainy season. To prevent this, an emergency programme to be started timely before next rainy season has been elaborated.*

Technical standards and requirements for the rehabilitation of the infrastructure have been defined taking into account cost-effectiveness, availability and maintainability, and aiming at raising the permissible axle load from the present 15 to 18 tonnes.

For the quantity structure and cost estimate for the infrastructure the network in Malawi has been subdivided into the sections

- That belong to the Nacala Corridor i.e. Nayuchi – Nkaya – Mchiniji (- Chipata) and Limbe – Nkaya,
- That are part of the non-operational Beira Corridor (Southern Border – Limbe).

Accordingly, the rehabilitation proposal for the Malawian part of the Nacala Corridor comprises

- The emergency programme,
- Complete renewal of 249.5 track kilometres and 101 turnouts,
- Rehabilitation of 352.7 track kilometres,
- Replacement of 168 rail frame culverts,
- Renewal of 2,408 bridge beams (sleepers),
- Concrete banks repair and corrosion protection for 151 bridges with a total length of 1,302 metres, and
- Rehabilitation of concrete deck bridges with a total length of 1,055 metres.

The costs for rehabilitation of these sections are estimated as 222.2 m US \$, thereof

- 8.0 m US \$ for the emergency programme,
- 124.2 m US \$ for track renewal,
- 78.8 m US \$ for track rehabilitation,
- 4.5 m US \$ for bridge renewal / replacement, and
- 9.7 m US \$ for bridge rehabilitation.

Assuming 01.05.2010 as starting date, renewal / rehabilitation could be completed by the end of 2013.

For the Southern Border – Limbe section (Beira Corridor), estimated rehabilitation costs add up to 305.0 m US \$, out of which

- 95.3 m US \$ for renewal of 198.9 track kilometres and 40 turnouts, and
- 209.7 m US \$ for replacement / renewal of 144 steel bridges with a total length of 1,591 metres, 2,323 bridge beams and 90 rail frames.

Under the view of national interest the transport system has to ensure adequate supply to the entire population and economy. Accordingly, the Railway Master Plan must aim at setting up an optimum rail network in the first place, and this should take precedence over aspects of regional development.

In spite of the political commitment, a re-opening of the Beira corridor in the near future seems unlikely whereas the railway lines belonging to the Nacala Corridor are operational, and the extension further to Chipata is expected to be completed by 2012. Thus, in order to cope with traffic demand immediately, the Nacala Corridor should be rehabilitated and developed in the first instance. The Beira corridor should be included later if and when its feasibility has been evaluated, and a time frame for restoration can be assessed.

As basis for the Railway Master Plan, only safeguarded traffic potentials have been considered, in other words amounts of traffic that customers intend to transport. Accordingly, traffic on the Nacala Corridor will amount to 524,000 tonnes equivalent to 409 m tonne-kilometres per annum. With the start-up of the extension to Chipata (Zambia) in 2012, these figures are expected to increase to 962,000 tonnes and 890 m tonne-kilometres, and further to 1.45 m tonnes and 1,445 m tonne-kilometres in 2016.

On basis of these traffic figures and further taking into account seasonal peaks and empty movements, operating programmes for two scenarios have been developed with the basic parameters as follows:

*Scenario I (October 2012)*

- Present axle load of 15 tonnes
- Present rolling stock technology
- Present vacuum brake system

*Scenario II (October 2016)*

- Axle load raised to 18 tonnes
- Complete rolling stock renewal
- Air brakes according to UIC standard

The results of the Operating Programme 2012 clearly indicate that the railways cannot cope with the future traffic demand under the *Scenario I* conditions. Moreover, the usage of rolling stock would be highly uneconomical, and the high lead times would make it difficult to gain the anticipated traffic at all.

Therefore, it is recommended to apply the *Scenario II* parameters from the very beginning, in particular concerning complete renewal of the rolling stock rather than rehabilitation.

In addition to the infrastructure rehabilitation, the Operating Programme 2016 (Scenario II) requires some minor network development (Nkaya station update, loop line extension, signalling equipment).

After rehabilitation and the upgrades as outlined above, the network capacity will be adequate for the safeguarded traffic. Additional traffic potentials of up to 1.8 m tonnes p.a. have been identified, however. On the Blantyre – Nkaya – Chiptata sections, even with these additional traffic potentials, no capacity constraints must be expected, but may occur between Nacala and Nkaya, requiring further development of this section.

The operating programmes apply to the entire Nacala Corridor, i.e. the lines Nacala – Nkaya – Chipata and Blantyre – Nkaya. To assess the economic viability of the project, costs for the entire corridor had to be considered. Accordingly, initial investment costs (2009-2014) for the entire corridor are roughly estimated to add up to 523.8 m US \$, thereof

- 222.2 m US \$ for infrastructure rehabilitation Malawi,
- 5.4 m US \$ for network development Malawi,
- 110.0 m US \$ for infrastructure rehabilitation Mozambique,
- 15.0 m US \$ for loading / unloading equipment at Nacala Port,
- 1.6 m US \$ for Chipata (Zambia) extension,
- 8.7 m US \$ for signalling (entire network), and
- 160.9 m US \$ for rolling stock.

In the period from 2017 thru 2029, additional investments into rolling stock of up to 49.5 m US \$ may be required to cope with increasing traffic.

It must be noted that due to the long lifetime of railway assets, there will be considerable residual values after a period of 20 years; these would amount to 272.8 m US \$ in 2029.

The economic appraisal had to consider both financial viability from the concessionaire's and economic viability from the public's view. On the basis of O & M costs estimated as

fixed base amount of 13.30 m US \$ p.a. plus 1.0125 cents per tonne-kilometre, and an average traffic income of 6 cents per tonne kilometre, the financial evaluation results in a NPV of 30.28 m US \$ and 11.1% FIRR for the network. Even though a lower tariff of 5 cents per tonne kilometre would still result in financial viability, the aforementioned parameters have been used for the economic evaluation.

The economic evaluation has been confined to benefits from transport cost differences between road and rail, and from time costs. Benefits have been evaluated on basis of the “Malawi Transport Cost Study” by TERA International Group, Inc., April 2005, but unit costs have been updated as 2.34 US \$ per vehicle kilometre equal to 10 cents per tonne kilometre for road transport, and with a factor of 1.4 for sea transport. The results (EIRR = 47.1%, NPV = 733.37 m US \$) shows that the project is economically viable under the precondition of a regional approach, and it should be noted that the major part of benefits would arise from Zambian traffic due to the transportation distance. Therefore, the implementation of the Chipata Dry Port is of vital importance for the region.

Assuming the implementation of the rail extension to and of the Dry Port at Chipata, potential risks are a lower traffic growth than assumed, an increase in rail operation and maintenance costs, and a decrease in road tariffs (“price war”), but further evaluation shows that the project remains viable even under these conditions.

A proper institutional framework is an essential precondition for success. Therefore, the Governments concerned must

- Establish an adequate legal framework (Railway Act, including a clear separation of operations from infrastructure, and by-law required for general standards, rules and regulations),
- Set up Regulatory Authorities,
- Harmonise these activities, and
- Only then elaborate fresh concession agreement(s) based on international best practice.

The legal framework should generally take precedence over the contractual provisions, and the latter should be confined to issues specific to the actual agreement, particularly

- Share holder’s financial capacity and expected investments
- Concessionaire’s operational and technical capability
- Concessionaire’s staffing, experience and know-how
- Network access fees, accounting and audit, and penalties

In view of the lost-know-how problem, further Technical Assistance will be indispensable to successfully implement the proposed programme.

## **1 Introduction**

### **1.1 Background**

Malawi is comparatively densely populated (about 13 million inhabitants on 118,484 km<sup>2</sup>), with 54% of the population below the poverty line. High transport costs that represent 55% of production costs compared to 17% in other Sub-Saharan countries are an important threat to economic development and poverty reduction in landlocked Malawi. Thus, transport infrastructure plays a vital role to the Malawian economy, in particular for distribution of exports and imports, and the development of major corridors has been essential. But the freight capacity of Malawi's four modes of transport - road, rail, inland waterways and air - as well as the access to sea ports are limited due to various reasons.

Malawi has since 1997 been part of the Southern African Development Community (SADC) countries actively pursuing the concept of development corridors in the scope of the Regional Spatial Development Initiative (RSDI) Programme with its neighbours to attract private and public sector investments that would lead to the creation of wealth, reduction of poverty, and promotion of equity. In 2000, the Zambia-Malawi-Mozambique Growth Triangle (ZMM-GT) and the Nacala Development Corridor (NDC) were launched, followed by the Mtwara Development Corridor (MtwDC) in 2004. A key aspect of the national strategy will be to define how the corridors related to each other.

Transport infrastructure development is one of the Government's priority areas for intervention under the Malawi Growth and Development Strategy (MGDS). Emphasize is on improving road and water supply infrastructure in the medium-term, but also focusing the rail sub-sector which is capable of transporting large volumes of goods and approximately 20% more cost-effective than road transportation, its functionality thus being of vital importance to Malawi.

According to the National Transport Policy '07, the objectives of the Rail Transport Policy are to provide a well-managed, viable and sustainable railway system that promotes accessibility and the safe, affordable, reliable movement of goods and people including those with disabilities. It also includes general objectives such as to promote and sustain the participation of the private sector in operation, financing, construction, maintenance and management of railways, and to provide efficient and competitive links to the sea ports.

Before the civil war in Mozambique, almost all international freight was carried by rail via Mozambique and its natural access to the sea at Beira and Nacala. The use of the railways for import and exports came to a complete halt during the war, and afterwards traffic could be resumed on the Nacala corridor only. The connection to Beira remained closed until today due to the destroyed embankment between Chiromo and Bangula washed away in 1996. In January 2003, another wash-out destructed the Rivi-Rivi Bridge near Balaka, and Lilongwe and the Central Region were cut off until its restoration in 2005.

In 1994, the formerly state-run railways were commercialised and Malawi Railways Ltd. was established. Despite the new management, the railway was not able to attract much of the traffic then carried by road through the Durban and Beira routes. As a result, the Government of Malawi decided to licence the railway, and in 1999 the Central East African Railways Ltd. (CEAR) took over the responsibility for the management of rail services. In Northern Mozambique, the railways and Nacala port operations were also granted a concession to a consortium of private investors, Corridor de Desenvolvimento do Norte (CDN), later in January 2005. Both concessionaires have a similar shareholding structure, consisting of the Sociedade de Desenvolvimento do Corridor de Nacala (SDCN), a consortium of private-sector entities holding 51%, and Caminho de Ferro de Mozambique (CFM) with 33%, and the locals. Until present, no Malawian investor has acquired the available 16% shares in CEAR.

For lack of a proper legal framework and a regulatory body, as well as due to insufficient clarity of responsibilities, and a missing depreciation fund for re-investments, the concession agreement turned out to be unsatisfactory for both the Government and CEAR and is currently being reviewed. Consequently, maintenance of infrastructure and rolling stock was neglected and rehabilitation deferred. Unacceptable lead times, frequent line closures and high tariffs resulting from this situation badly affect competitiveness and reputation of the railways. Performance - though very encouraging during the first two years - declined drastically; commercial freight traffic decreased from 502,482 tonnes in 2000 to 213,959 tonnes in 2008. Now, road transport is the main mode in domestic and international transport.

Though the Nacala rail route is the lowest cost route for foreign trade, the broken rail link through the south of Malawi via Nsanje and Marka represents a possible alternative link to Beira. The major part of this link in Mozambique is being rehabilitated by Companhia dos Caminhos de Ferro da Beira (CCFB), a joint venture between CFM and two Indian companies (Arcon and RITES), which has also the concession to operate the line; this rehabilitation is funded by the concession and with a WB loan. Rehabilitation of the Malawian part of the Beira link is under consideration, and the Government of Malawi has invited CCFB to produce a detailed plan.

In their meeting on the development of Beira and Nacala Corridors on 16<sup>th</sup> December 2008, the Ministers responsible for Transport in the Governments of the Republics of Mozambique, Malawi, Zambia and Zimbabwe agreed upon a firm commitment to encourage and support the entire railway network in Malawi in general. And, in particular, they agreed to consider CCFB's expressed interests to rehabilitate and operate the Malawian railways from Marka to Blantyre including an immediate improvement of the 27 km Vila Nova - Nsanje link to open the route access.

A new rail link from Chipata to Mchinji (Malawi) is almost completed and will give Zambia access to the network.



In recent years, various studies, such as the Malawi Transport Cost Study (TERA), the PPP Case Study (SADC Banking Association), and the Railway Track Inspection (E. R. Limbe), have addressed the railway sector, but for the lack of funds no action could be taken so far.

Development agencies are assisting Malawi to produce a Transport Sector Programme and this has generated renewed interest in the rail sector. A Railway Task Force has been assembled to focus activities, ensure a regional approach to the problem and verify the "bankability" of the overall rehabilitation of the rail network. Substantial terms of reference to prepare a detailed railway rehabilitation programme are being prepared by the Ministry of Transport, Public Works and Housing. The purpose of the present Technical Assistance is the compilation of data for the successful launch of this programme.

## 1.2 Objectives

The Global objective of the Technical Assistance is the reduction of transport costs within the region.

The specific objective is the compilation of data for the successful launch of the full Malawi government railway rehabilitation programme study.

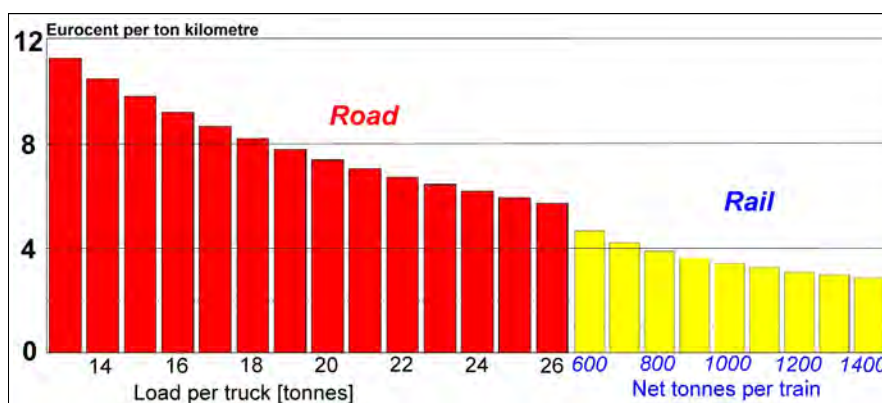
## 1.3 Methodology

### 1.3.1 General economic comparison between different modes of transport

Transport planning must not only consider financial viability but necessarily the total economic costs caused by any transport. These include external costs such as environmental and accident costs as well as energy consumption.

Economic costs vary largely for different modes of transport. Compared to railways, external costs and energy consumption for road transport are in general at least twice the amount, but only one third or half for inland waterways. To arrive at more accurate figures, condition, usage, and length of each transport corridor must be taken into account.

As illustrated in Fig. 1 taken from a recent study on transport costs in Europe, costs also depend on the utilisation - net loads and empty runs - of trucks and trains respectively. Thus - though these figures suggest a general economic viability for net train loads of 600 tonnes and more - viability must be carefully examined for each corridor.



**Figure 1: Total economic costs of rail and road with reference to net load**

## 1.3.2 Approach towards a Railway Master Plan

### 1.3.2.1 General

Transport planning in general and railways in particular are matters of great complexity. In the mid-term and long-term, a successful outcome can only be achieved if planning comprises a complete pattern of all factors and parameters and their interdependencies. Therefore, it is the consultant's firm opinion that - as part of the Transport Sector Programme - a full Railway Master Plan is required rather than a rehabilitation programme only.

### 1.3.2.2 Demand model, capacity considerations, assets management and development

The traffic forecast containing year-wise figures for the anticipated freight and passenger traffic is the basis for a Railway Master Plan. For freight traffic, the forecast must include net tonnes for each traffic relation (origin/destination) and commodity-wise, for passenger traffic numbers of passengers for each relation.

Taking into account commodity and vehicle parameters and peak factors (for unequal distribution of traffic over periods of time), traffic figures are then converted into number of trains as can be seen in detail from the "Demand Model" chart in Annex 1.3.2.2.

The second step addresses line capacity, and maximum number of trains for each section compiled from track and train parameters such as alignment, permissible speed, axle load, and traction power.

Subsequently, assets - both infrastructure and rolling stock - are scrutinised concerning their numbers, age, condition, availability, maintenance facilities, and possible obsolescence. The comparison of the findings with those from the first two (if need be modified) steps finally results in requirements for assets rehabilitation, renewal, upgrade and/or expansion.

### 1.3.2.3 Legal framework, standards, rules and regulations

The technical complexity of railways, their safety-sensitive nature, and the indispensable interoperability with other networks require a sound basis of a legal framework, as well as detailed technical standards, and rules and regulations for operations and maintenance. In the absence of such frameworks and standards, or in case they are outdated, it is just not possible to properly run and maintain a railway system, both under technical and managerial aspects.

Most of the items are interdependent. Interoperability with adjoining railways must be considered from the very beginning.

The legal framework should comprise

- a) A general law on railways (Railway Act) covering
  - network ownership
  - concessions and network access
  - regulatory authority
  - general guidelines and procedures for planning, construction and operations
  - compensation for services for public interest
  - finance and accounts
  - sanctions and penalties
- b) A law or by-law on construction, operation and maintenance of railways containing basic standards and parameters for
  - Infrastructure:
    - track gauge
    - minimum curve radius and transition curves
    - maximum gradients
    - permissible load on permanent way and structures
    - track clearance gauge
    - track distance
    - level crossings
    - platforms
    - signals, turnouts, signalling and telecommunications
    - inspection and supervision
  - Rolling Stock:
    - axle loads and mass per unit length
    - wheels and wheel sets
    - vehicle clearance gauge
    - brakes
    - couplers
    - equipments and inscriptions
    - acceptance, inspection and periodical overhaul

- Operations:
  - definition, type and length of trains
  - train brakes
  - train formation
  - first aid equipment on trains
  - sequence of trains
  - train speed
  - shunting and stabling vehicles
  - staff on locomotives and trains
  - security, law and order on railway premises
- Personnel:
  - medical check-up requirements for operating staff
  - education, training, qualification

The laws may also stipulate that certain international standards (such as ISO, UIC, EN) apply.

Standards, rules and regulations should be worked out and kept up to date jointly by the concessionaire(s) and the regulatory authority as follows:

- Infrastructure:
  - detailed alignment specifications
  - detailed technical specifications for subsoil, embankments and drainage
  - detailed technical specifications for bridges and culverts
  - detailed technical specifications for the permanent way including turnouts
  - specifications and rules for continuous welding
  - maintenance manual for substructure, bridges and culverts
  - maintenance manual for permanent way
  - operating manuals for permanent way machinery
  - maintenance manuals for permanent way machinery
  - maintenance manual for signalling and telecommunications
- Rolling Stock:
  - maintenance manuals for locomotives
  - maintenance manuals for wagons and coaches
  - operating and maintenance manual for brakes
  - rulebook for types, specifications and dimensions of wagons
  - operating manuals for workshop machinery and equipment

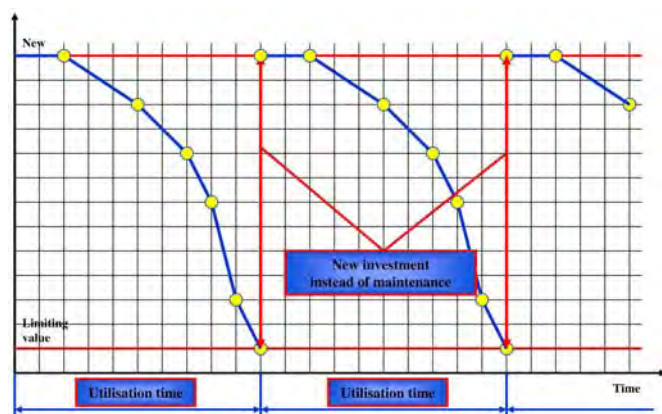
- Operations:
  - train working rules
  - working time tables
  - operating manuals for locomotives
  - rules for operating signalling and telecommunications
  - rules for construction management
  - rules for emergency management and fire protection
- Other standards, rules and regulations as required

#### 1.3.2.4 Maintenance and maintainability

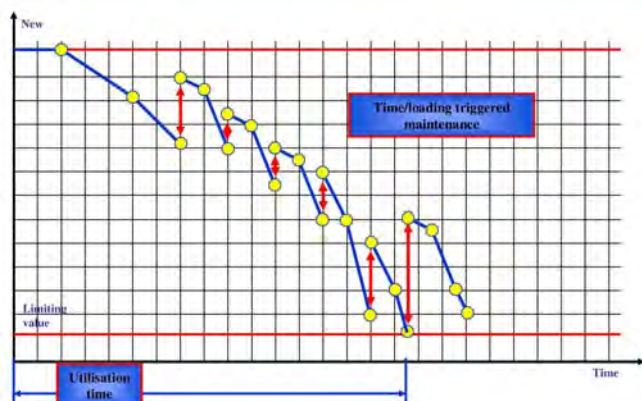
In general, maintenance means any activity, such as tests, measurements, replacements, adjustments and repairs, intended to restore or retain a functional unit in a specified state in which the unit can perform its required functions. In other words, the unit must be kept in such condition that it may be continuously used, at its original or designed capacity and efficiency for its intended purpose. Maintenance includes all action taken to retain material in a serviceable condition or to restore its serviceability. Maintenance includes inspection, testing, servicing, classification as to serviceability, repair, and reclamation.

The maintenance of a technical system has to guarantee, that the reliability does not fall below a given threshold. Maintenance and servicing keep the system on an intended technical level with regards to its functionality, safety, reliability, availability, maintainability and structural integrity. Maintenance cannot achieve a technical level beyond original capacity, efficiency and design.

A new unit - such as a railway track - degrades within a period of time which depends on various factors such as quality of design, work and material, usage (axle load, tonnage), climate conditions, and quality of rolling stock. Once the degradation has gone beyond the given threshold, the unit must be considered no longer maintainable and must be renewed.



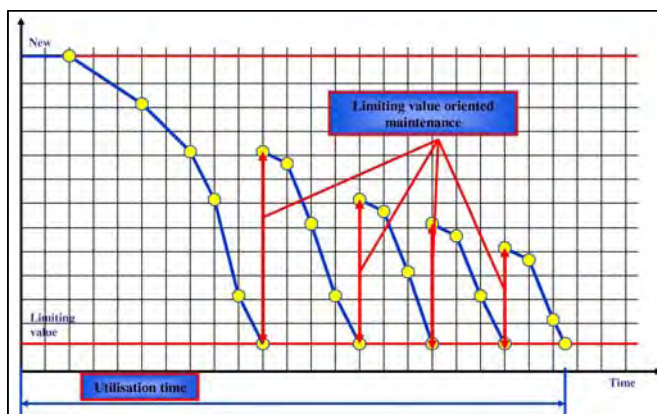
**Figure 2: New investment instead of maintenance**



**Figure 3: Time/loading triggered maintenance**

There are various approaches towards maintenance, e.g.

- Degradation without maintenance (wear and renew)
- Time/loading triggered maintenance
- Limiting value oriented maintenance
- Preventive maintenance



**Figure 4: Limiting value oriented maintenance**

Maintenance strategies depend on

- Original construction standards
- Current strategic plan
- Availability of budget and technology
- Know-how, experience, level of education
- Type of maintenance approach
- Deterioration driving factors
- Topographic and geographic characteristics

Only renewal restores the original quality level.

Initial maintainability can be improved through

- Development and adaption of standards and regulations
- Development of a catalogue of standard services (CSS) and tasks
- Implementation of a rolling (multi-)annual action-plan
- Implementation of a feedback control system (cycle)
- Budget planning
- Contractual basis between budget manager and maintenance executing units

### **1.3.3 Concessions: Outline on methods**

Historically, almost all Railways were state owned as well as state-run entities managing infrastructure as well as operations, and controlled by the government. The modern railway age started with the privatization according to the principle of separation of operation from infrastructure, with a further split into freight, passenger and urban transport as well as into regional companies. New financing concepts were developed to modernize and economize rail transport.

Any rail concession follows the principle that the licensor grants the concessionaire(s) the right to finance/build/operate a railway for public use for a predefined period of time, the railway afterwards to be handed back to the licensor.

Common rail concession concepts are

- PPP            Public – private – partnership
- BOT           Build – operate – transfer
- BOO           Build – own – operate
- BOOT          Build – own – operate – transfer

They are further outlined below.

#### ***PPP Method: Public – Private - Partnership***

- Partner cooperation between government and private concessionaire(s).
- Share of each segment freely negotiable depending on the requirements of the partners
- Advantages:
  - Value for money
  - Risk partly transferred to private sector
  - Quick project execution
  - Innovation
  - Improved services

#### ***BOT Method: Build – Operate - Transfer***

- Project financed by investor(s) and/or concessionaire
- Private concessionaire builds and operates the railway

- Concession period: Usually 30 years, in Africa usually approx. 15 to 20 years due to specific situation (lack of planning reliability etc.)
- Investors charge fees/tolls over concession period to recover investment
- Railway to be handed back to the owner (usually the government) at termination of the concession

***BOOT Method: Build – Own - Operate - Transfer***

- Project financed by private investor(s) and/or concessionaire
- Concessionaire builds and operates the railway over a predefined period
- Concessionaire is holder and owner of the railway over the concession period
- Concessionaire recovers investment by income from transport business
- Railway to be handed back to the final owner (government) at termination of the concession at a price predefined in the contract

BOO/BOT/BOOT and similar concepts have several *advantages* such as

- Fully competitive bidding situation
- Low investment cost burden to public budget
- Risk shifting to the private sector
- Private sector's abilities regarding fund raising, and management of construction and operations
- Access to the latest technology
- Much faster construction than by public entities
- Business-oriented and, thus, economic operations
- Sample function of efficient private sector operations leading towards improvement of public sector operations
- Railway to be handed back to the owner (long-term ownership by the state/society)

There is, however, the *disadvantage* of high perceived costs. Besides the borrowing cost, there is a profit element in the equity portion of the financing, which is higher than the debt cost. That is the price to pay for the risk transfer to the private sector.

#### **1.3.4 Site survey**

The consultant's findings are as far as possible based on and supported by observations made during site surveys. Because of time constraints and restricted accessibility due to rainy season, it was not possible to inspect the entire network, however.

A diary of site surveys is attached as Annex 1.3.4. The observations are described in the relevant subchapters.

#### **1.3.5 Stakeholders meetings**

A list of stakeholders meetings is attached as Annex 1.3.5.



## 2 Railways in Malawi and adjoining countries

### 2.1 Malawi Railways as part of the regional network

#### 2.1.1 Transport corridors and catchment areas of seaports

According to “Malawi Transport Cost Study” by TERA International Group, Inc., April 2005, Malawi’s international trade is served by four regional ports on four key corridors as listed below:

##### **Dar es Salaam Corridor**

*Multi-modal (road/rail)*

Mzuzu	1,300 km
Lilongwe	1,667 km
Blantyre	1,976 km

##### **Nacala Corridor**

*Rail*

Lilongwe	989 km
Blantyre	815 km
Chipata <sup>1</sup>	1,138 km

##### **Beira Corridor**

*Rail<sup>2</sup>*

Lilongwe	948 km (1,108 km on road via Tete)
Blantyre	568 km

##### **Durban Corridor**

*Road*

Lilongwe	2,650 km (3,709 km via Tete, 4,085 km via Lusaka)
Blantyre	2,340 km



**Figure 5: Malawi’s international transport corridors**

Despite the huge distance, more than 50% of Malawi’s international (both regional and overseas) traffic is transported on the Durban Corridor against approximately 20% each on the Beira and Nacala Corridors. This is mainly due to the fact that South Africa is Malawi’s major trade partner for imports. Concerning overseas traffic, key factors are efficiency and reliability of the ports, transit times and ETA assurance.

<sup>1</sup> Section Chipata – Mchinji (31 km) yet to be completed

<sup>2</sup> Section Makhanga – Dona Ana (110 km) not operational

### **2.1.2 The rail corridors**

Railway construction in the region started already before World War I; the first line from Blantyre to Chiromo was opened 1908 and reached the Zambesi River at Dona Ana in 1915. In Mozambique, a short link from the port of Lumbo to Monapo was completed 1914 and extended to Nampula 1922; in the same year, the railway south from Beira reached the Zambesi River at Vila de Sena which was connected by a ferry to Dona Ana.

Through the opening of the Zambesi Bridge and also the Northern Extension to Salima in 1935, the “Beira Corridor” was complete, and Malawi connected to the South African rail network.

Shortly after World War II, the Sena - Moatize link was opened in 1949, and the new Nacala Port in 1951.

The network has been extended to today's size only much later with the completion of the corridor from Nacala in the East to the Zambian border in the West (Nampula - Nkaya 1969/70, Salima - Lilongwe 1978, Lilongwe - Mchinji 1982).

During the war in Mozambique, all railways there were closed from 1983 and partly destroyed, and further network development ceased.

In 1989, the Nacala corridor re-opened after rehabilitation, but the Beira corridor remained (and is still) closed. The Mchinji - Chipata (Zambia) section was also not completed but will be open to traffic soon.

It must be emphasised that from their functionality, railways in Malawi (including the link to Chipata in Zambia) and Mozambique must be considered one consistent network.

For an overview of the network, refer to the map attached as Annex 2.1.2.

### **2.1.3 Mozambique's strategies**

According to the Mozambique Ministry of Transport, Mozambique at present strongly supports the development of the Nacala Corridor, also in order to improve the poor northern part of the country, and the railway line from Port Nacala to Malawi and further to Zambia got first priority. Private investors also support the Nacala Corridor strategy, as well as the operators (CDN, CEAR, PN) and the Insitec Group.

The frequently mentioned 77 km Cuamba - Entré Lagos section is presently being rehabilitated with good progress.

In spite of the political commitment, there is no progress as yet towards re-opening the Sena - Nsanje - Makhanga line that has been closed 26 years ago. Though the Beira - Sena - Moatize line is being rehabilitated and likely to be re-opened soon, it is a fact that neither a decision has been taken how to rebuild the Bangula - Chiromo section, nor has CCFB produced a detailed rehabilitation plan.

#### 2.1.4 Future projects: The Proposed Moatize Link



The idea to link the Moatize coal fields by rail to the Nacala Corridor was born already in 1970. These days, the development of the mines is being explored and supported by Brazilian Companhia Vale do Rio Doce (CVRD). Strategic planning of the Moatize coal transport line, as a link to the railway line Blantyre - Nkaya, is also in progress.

But mine development and construction of a new railway take both several years, and coal transport from the Tete/Moatize mines cannot be assumed to start before 2018. Therefore, the proposed link from Moatize to the Nacala corridor must be considered a long-term project.

Thus, the rehabilitation cannot wait for the implementation of the Moatize link - the existing railway lines would not survive for such a long period.

**Figure 6: The proposed Moatize Link**

Furthermore, once the Moatize link is implemented, the envisaged amount of traffic will also require an upgrade and expansion of the Nkaya - Nacala line beyond the levels under rehabilitation, probably requiring a complete switch to modern technology.

## 2.2 Network details and inventory

### 2.2.1 General standards and parameters

The network in Malawi has been designed, or is operated respectively, according to the standards as follows:

#### Track gauge

- Standard 1067 mm
- In Curves with  $242 \text{ m} < R < 403 \text{ m}$  1076 mm
- In Curves with  $R \leq 242 \text{ m}$  1086 mm
- Maximum including side wear 1092 mm

#### Curves

- Minimum radius on existing lines 111 m
- Minimum radius on new running lines 244 m
- Transition curves parabolic
- Maximum cant 76 mm
- Maximum ramp gradient 1 in 480

#### Maximum gradients

- Existing lines 1 in 44
- New lines (from 1969 onwards) 1 in 60 compensated (=including curve resistance)
- Stations 1 in 400

#### Permissible axle load on permanent way and structures

- Design load 13 tonnes
- Operated at 15 tonnes

#### Track Distance and clearance

- Structure gauge see Annex 2.2.1
- Track distance  $\geq 4572 \text{ mm}$

#### Speed

- Maximum section speed 50 km/h

## 2.2.2 Lines

The network under review consists of the following railway lines:

Line Code	Operator	Relation	Chainage	
			from km	to km
0001	-	(Vila Nova de Fronteira -) Border - Nsanje - Makhanga	0.000	80.400
	CEAR	Makhanga - Limbe - Nkaya - Kanengo - Mchinji (- Chipata)	80.400	696.460
1000	CEAR	(Entré Lagos -) Border - Nayuchi - Nkaya	0.000	100.218
2000	CDN	Nacala - Nampula - Cuamba	-0.446	533.473
3000	CDN/CEAR	Cuamba - Entré Lagos - Border (- Nayuchi)	0.000	78.620
4000	CFM/CCFB	Beira - Dondo	0.000	28.000
5000	CCFB	Dondo - Sena - Dona Ana	0.000	291.000
	-	Dona Ana - Vila Nova de Fronteira - Border (- Nsanje)	291.000	328.000

## 2.2.3 Stations and terminal facilities

The network comprises

- 45 stations in Malawi, out of which 5 are on the section presently not operated
- 32 stations on the Nacala - Entré Lagos line in Mozambique
- 23 stations on the Beira - Vila Nova de Fronteira line in Mozambique

In Malawi, only 16 stations serve for commercial purpose (loading/unloading); the other stations are kept for operations (crossings) only. For the lack of traffic, many of the latter are unmanned and used from time to time only (“Kilometre Loop Line Points”).

For more details see the Station List in Annex 2.2.3.1. The layouts schemes of the stations in Malawi are attached as Annex 2.2.3.2.

At commercial stations, there are only basic terminal facilities such as side ramps, goods sheds and some cranes, most of the latter being out of order. Loading and unloading containers is performed by the customers. This results in the problem of holding wagons thereby increasing the dwell time at the drop/load zones.

## 2.2.4 Alignment

The table below shows that the network contains some sections with difficult or very difficult alignment limiting train loads and forming bottlenecks for operations. These are

- between Makhanga - Limbe - Nkaya from km 94 to km 253, in particular the very difficult sections from Sankhulani to Blantyre,
- between Salima and Kanengo from km 489 to km 561.

Section	Length [km]	Gradient		Curves		
		≥ 15 N/kN	Max. [N/kN]	Total	R ≤ 201 m	R <sub>min</sub> [m]
Border - Makhanga	80.4	0.0%	4.58	5.1%	0.2%	181
Makhanga - Limbe	120.6	46.7%	22.73	39.4%	23.8%	111
Limbe - Nkaya	96.1	24.9%	22.73	23.4%	15.7%	111
Nkaya - Salima	171.7	2.2%	17.54	5.8%	0.7%	141
Salima - Kanengo	105.5	32.5%	16.63	38.5%	12.7%	131
Kanengo - Border	122.1	0.0%	14.94	24.6%	0.4%	171
Nayuchi - Nkaya	100.2	0.0%	9.09	51.6%	0.0%	241
Nacala - Cuamba	533.9	26.1%	21.20	22.8%	0.0%	282
Cuamba - Entré Lagos	78.6	0.0%	11.50	7.1%	0.0%	500
Beira - Vila Nova de Fronteira	356.0	no data	7.60	no data		

Except for the Beira - Vila Nova section for which no data is available, gradients are listed in detail in Annex 2.2.4.1, and curves in Annex 2.2.4.2. It must be noted that data - in particular for gradients - had to be based on assumptions to a certain extent for lack of consistent data. Furthermore, the gradients of the Salima - Kanengo section were evaluated from topographical maps, taking the application of the 1969 standard (see 2.2.1 above) for granted, because of missing longitudinal profiles.

## 2.2.5 Infrastructure

### 2.2.5.1 Structures and Level Crossings

On the network in Malawi, there are 1794 bridges and culverts with a total length of 7,453 metres, out of this number 636 with a length of ≥ 2 metres.

All bridges built until 1935 (sections Vila Nova - Limbe - Salima) are steel bridges (open top/girder/truss type). Later, except for long river bridges (Shire, Rivi-Rivi), bridges were designed as concrete deck type (Nayuchi - Nkaya) or concrete deck on steel girder bridges.

On sections constructed until 1935, there are 258 rail frame culverts. Other culverts are of slab, arch, box, or concrete channel or - the more recent ones - pipe type.

The detailed bridges and culverts register - incomplete concerning lengths for some sections - is attached as Annex 2.2.5.1.1. The bridge data evaluation in Annex 2.2.5.1.2 contains a section-wise summary and shows also to which extend data about the length had to be assumed, usually as the known average length of the same bridge type. The bridge register contains also data for overhead (road) bridges; these have not been further evaluated.

There are no railway tunnels in Malawi.

CEAR's level crossing register (Annex 2.2.5.1.3) shows 205 level crossings; all are unprotected.

#### 2.2.5.2 Permanent Way

For the tracks in Malawi, various technologies were applied over the years as follows:

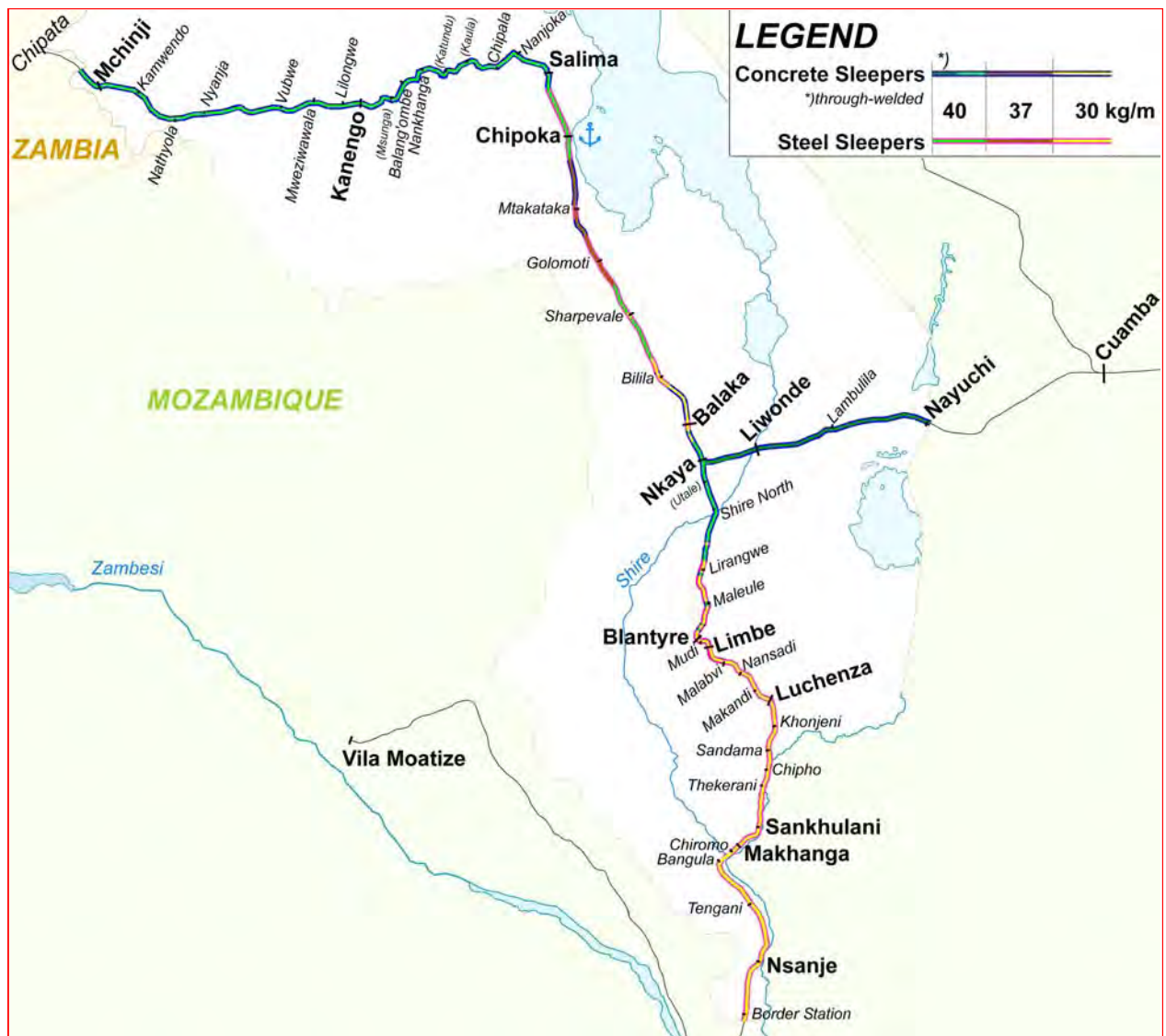
##### Rails

- 30 kg/m type dating back to 1925 - 1935
- 37.5 kg/m type, 1969 - 1975
- 40 kg/m type, after 1975

##### Sleepers and fastenings

- Steel sleepers with rigid fastenings
- Wooden sleepers with rigid fastenings (a few short sections only)
- Steel sleepers with elastic fastenings (Pandrol type)
- Concrete sleepers with elastic fastenings (Pandrol type)

The map shown in Fig. 7 below gives an overview of the permanent way type on through lines.



**Figure 7: Permanent Way Map**

Rails are continuously welded only on the Nayuchi - Nkaya section, otherwise partly welded but fish-plated at every fourth rail length i.e. approximately 40 to 55 metres. Rail inclination is 1 in 20.

Except for the Shire and Rivi-Rivi Bridges on the Nayuchi-Nkaya section, on open deck steel bridges rails are fitted on wooden sleepers (bridge beams) with rigid fastenings, sometimes supplemented with elastic rail spikes. Ballasted concrete deck bridges have steel or (on the Kanengo - Mchinji section) wooden sleepers. All longer bridges have guard rails to prevent fall of derailed vehicles. On rail frames, steel sleepers are laid directly on the frame.

Sleeper spacing is 0.70 metres in general and 0.60 metres on open deck steel bridges.



Standards for stone ballast are 1000 m<sup>3</sup>/km on Salima - Mchinji and Nayuchi-Nkaya sections, otherwise 800 m<sup>3</sup>/km. There are also some sections with earth ballast, in particular in stations.

The CEAR network contains 294 Turnouts, out of this 141 in through lines. There are various designs, such as 30-111-1:8, 30-145-1:8, 30-161-1:10, 40-145-1:8 and 40-265-1:12. Some turnouts have cast Manganese crossings. Turnouts are on steel or wooden sleepers or on a mix of both. All types have loose heels and an insatisfactory geometric layout and must be considered non-state-of-the-art.

The lengths of the through tracks (in kilometres) with various types of permanent way are summarised in the table below.

Rail	Steel Sleepers	Concrete Sleepers
30 kg	266	27
37.5 kg	37	28
40 kg	60	383

A more detailed summary of the permanent way on through tracks can be found in Annex 2.2.5.2.1, and all details are listed in Annex 2.2.5.2.2.

### 2.2.5.3 Signalling and Telecommunications



**Figure 8: Token Instrument**

The Electric Train Token Absolute System (Fig.8) that was previously for control of sequence of trains cannot be used any more for the lack of transmission - most of the open wire lines have been vandalised. The proposed satellite connected Combo Box GPS system with base stations in train control offices and users in locomotive cabs could not be implemented due to technical deficiencies. Therefore, there is currently no effective line signalling, and working of trains is exclusively done by means of voice communicated train proceeding authority. Communication is established through ordinary cell phones (GSM). The GSM coverage is roughly estimated to be 75%.

Turnouts are manually operated - usually by the driver or his assistant - and have no proper locking device whatsoever, though some have been equipped with padlocks to prevent unauthorised operation.

## 2.3 Rolling Stock

### 2.3.1 Motive Power

CEAR have 12 main line locomotives, of which 6 are operational, and 4 shunters, thereof 2 operational ones. All main line locomotives are of C<sub>0</sub>'C<sub>0</sub>' type, with 90 tonnes adhesive mass and 1500 HP rated output, manufactured by Bombardier in 1980 as MX615 (ALCO251). The shunters of GM R' type arrived in 2007 as grant from Taiwan, Republic of China.

CDN operate their part of the Nacala Corridor with 4 C<sub>0</sub>'C<sub>0</sub>' main line locomotives manufactured by GE as U20C, with 87.5 tonnes adhesive mass and 2000 HP rated output; another 2 locos of this type are awaiting repair. Motive power is being restocked with 2 locomotives from India and another 6 from Southern Mozambique.

For further technical details see Annex 2.3.

### 2.3.2 Wagons and Coaches

CEAR and CDN claim to operate a common wagon pool. Data submitted by both concessionaires are inconsistent, however. The table below may just give an idea about types, numbers and availability of wagons.

Type	Fleet	Operational
Covered	126	98 (78%)
Low sided	95	84 (88%)
Ballast hoppers	76	68 (89%)
High sided	64	56 (88%)
Tank	64	52 (81%)
Flat/platform (container)	181	136 (75%)

For technical details of wagons see Annex 2.3.

For their passenger services, CEAR have 17 (15 operational), CDN 22 (12) coaches.

All wagons and coaches are of bogie type.

### 2.3.3 Brakes

All rolling stock is equipped with vacuum brakes type Westinghouse that are also used in the networks adjoining to Southern Mozambique.

#### **2.3.4 Workshops**

Workshops for maintenance and repair of rolling stock are located in Limbe (CEAR) and Nampula (CDN).

### **2.4 Operations and Management**

#### **2.4.1 Privatisation and concessions**

The operational part of the network in Malawi was licensed to *Central East African Railways Ltd.* (CEAR) in 1999, and the railways in Northern Mozambique and the Nacala port operation to *Corridor de Desenvolvimento Do Norte* (CDN) in 2005. Both concessionaires have a similar shareholding structure (see also para. 1.1).

Both concessions follow the principle of a Public - Private - Partnership (PPP) where the ownership of the network (infrastructure) remains with the government (see also para. 1.3.3). In Mozambique, the government also retained the ownership of rolling stock, whereas Malawi has transferred rolling stock to the concessionaire.

For several shortcomings concerning both the legal environment and the content of the agreement, the concession has not been successful so far. Therefore, the concession agreement is being reviewed since January 2009. The deficiencies and weaknesses of the present agreement are analysed in section 3.5.

#### **2.4.2 Train operations**

##### **2.4.2.1 Speed**

On CEAR lines, section speed is

- 25 km/h on section Makhanga - Limbe - Blantyre,
- 40 km/h on section Blantyre - Namatunu,
- 50 km/h on all other sections.

At turnouts, speed is generally restricted to

- 15 km/h over facing points,
- 40 km/h over trailing points (straight track),
- 25 km/h over trailing points (branch track).

##### **2.4.2.2 Method of working**

Regular trains are run according to the *Working Time Table*, whereas for special trains a *Train Notice* is issued.

For the lack of signalling, CEAR basically operate their network on the principle of *simplified secondary railway service*, i.e. a central *Train Control Office* is responsible for the sequence of trains.

The *Train Control Officer* authorises train movements over one or several sections through a *Voice Communicated Train Proceeding Authority* to the trainmen and records this in the *Train Control Diary*.

Responsibility for *Train Safety of Operations* rests with

- the *Train Control Officer* concerning sequence of trains,
- the *Station Master* concerning admission of trains to and their safe movement within the station,
- the *Trainmen* concerning “line clear” messages, point setting, and also for the safe movement within unmanned stations (“Kilometre Loop Line Points”).

### 3 Status of the Railways in Malawi

#### 3.1 Infrastructure

##### 3.1.1 Sections



**Figure 9: Evaluation sections**

For further evaluation, the network has been subdivided into 6 sections i.e.

1. Kanengo - Mchinji - Border
2. Salima - Kanengo
3. Nkaya - Salima
4. Border - Nayuchi - Nkaya
5. Limbe - Nkaya
6. Border - Makhanga - Limbe

In some evaluations, Section 6 is further subdivided in 6a = Bangula - Limbe and 6b = Border - Bangula.

Criteria for the subdivision are

- Year of construction
- Level of traffic
- Permanent way type
- Alignment

##### 3.1.2 Substructure and drainage

On all sections it is obvious that substructure and drainage have not been maintained for a long period - and most probably not even regularly inspected, not to talk about preventive work. Consequently, a considerable part of the formation is out of shape, and most of the drainage systems are out of order.

Naturally embankments are subject to erosion at their shoulders, which has actually occurred at many places due to various reasons, such as

- lack of maintenance,
- insufficient subsoil compaction,
- washed-out unpaved roads at level crossings,
- trails from trespassers and cattle treading;

and at all these places the top of the embankment is narrowed down from the prescribed standard of 4.90 m to the ballast width i.e. 3.40 m or even less, resulting in considerable amounts of ballast lost due to sliding. If not fixed soon, erosion will steadily continue and endanger stability of the track over long sections.

But the most vulnerable sections are in the vicinity of bridges and culverts:

- Where wing walls are missing and the embankment is not paved - what is true for most of the bridges - the embankments are eroded where they adjoin the bridge foundations, particularly at the downstream side and often up to and even underneath the sleepers, resulting in one or two metres of track hovering at both ends of the bridge; insufficient compaction next to the bridge foundations and non-functional drainage of the foundations contribute to the problem;
- At many rivers, rivulets and ditches, neither the riverbed nor the banks are paved, or not paved over a sufficient length, so that the embankment base and foundations of pillars and abutments are washed out by floodwaters, both upstream and downstream, the more as riverbeds cannot be kept clean from hydrophytes and rubbish;
- In some cases wash-outs occur also due to insufficient width/diameters of culverts - floodwater dams up upstreams and causes suction downstreams;
- Insufficient lateral length of culverts - in particular in the case of pipe type culverts -, occurred due to whatever reason, results in too steep embankments and sliding or wash-out by implication. The situation becomes worse through repairs done not workmanlike i.e. widening the top of the embankment and thus further steepening its slope.

In this context, reference should be made to the Hydrological Study as suggested by CEAR and supported through the Malawi Transport Cost Study (TERA).

Drainage systems that are destroyed or not functional for lack of maintenance

- contribute to the wash-out of embankments due to uncontrollable surface runoff,
- cause wash-in of soil into the track in cuttings, often up to and even above rail surface,
- result in permanently wet and muddy tracks in flat sections, particularly in stations, and
- abet the growth of weed in and near the track and even on bridges.

In many sections, track and structure gauge are not kept free of weed and shrubbery which reaches up to 2 metres and grows alongside and even within the track. As a result,

- visibility is severely affected, endangering operations especially at level crossings and in curves,
- the cess is not walkable what causes difficulties in coping with irregularities and emergencies, and
- the ballast becomes more and more fouled through humus.

### **3.1.3 Bridges and culverts**

As explained in 3.1.2 above, the most severe problems requiring immediate action occur due to the condition of substructure in the vicinity of bridges and culverts. But there are also several difficulties with the bridges themselves as outlined below.

All open deck (girder/truss) steel bridges on Section 6 (Southern Border - Limbe) were constructed between 1908 and 1915 and must consequently be considered near the end of their lifetime - which is usually assumed 100 years due to deteriorating steel characteristics after that period. But whether those bridges must be replaced in the short-term or might be still maintained for some time can be decided based on a detailed engineering assessment for each bridge only. This would however be beyond the scope of this project.

Except for a few bridges that have been renewed recently, the open deck steel bridges on Sections 3 and 5 (Limbe - Nkaya - Salima) date back to 1930 - 1935. Concerning these bridges, there are four problem areas; these are

- the concrete elements - pillars and abutments - have cracks and break-aways,
- the steel elements lack corrosion protection,
- the bridge beams (timber sleepers) are rotten and not fixed properly to the girders, resulting in their being out of square and in irregular spacing,
- rails are not fastened properly on the sleepers, mostly with screw spikes and without intermediate layer (base plate and pad), fish-plated joints are next to the bridge ends or on the bridge itself, and there are no overlaps of rail to absorb the longitudinal movements occurring from train loads and temperature differences on long bridges.

On many of the concrete deck bridges, as a consequence of having used a mix of sand and gravel instead of stone ballast, outlets of the drainage are blocked, and stagnant water causes damages to the isolation and leads to instability of the track that is overgrown with weed and even groves. This is particularly true for the bridges at Sections 1 and 2 (Salima - Mchinji), and on all three bridges between Kanengo and Mchinji (Section 1) wooden sleepers have become unusable.

The condition of the steel girders of the concrete deck bridges in Sections 1 and 2 does not imply an immediate problem but must be monitored carefully, and corrosive protection carried out in due maintenance.

Rail frames are of obsolete technology in general, and - since they have been constructed for the previous 13 tonnes axle load - must be considered not fit for present and future traffic.

### 3.1.4 Permanent way

The 37.5 and 40 kg/m *rails* are not more than 40 years old and still in acceptable condition in most of the sections where mounted on concrete sleepers.

Unlike this, all 30 kg/m rails - still used in 288 km of the through track - date back to 1925 thru 1935 and their steel characteristics have deteriorated beyond acceptable quality since. Therefore, these rails are subject to high wear and cracks certainly occur even where visual inspection does not suggest failures. Furthermore, the dimension of 30 kg/m rails is insufficient even for the present 15 tonnes axle load

Dimension, profile and inclination of the rails do generally not fit to wheel profiles.

In several sections fish plated joints are in very bad condition due to a lack of maintenance, and low joints even caused several derailments in the past.

The present *sleeper* spacing of 0.70 m is too wide and results in a weak track frame in general, but in particular in a too high load per square unit, especially where the embankment is weak or not properly compacted. Sleeper spacing should be decreased accordingly; with 40 kg/m or heavier rails axle load may then be increased up to 18 tonnes.

A considerable part of the concrete sleepers produced around 1970 in cooperation with Canada have fabrication faults such as cracks along the surface and break-outs at the heads, and it must be expected that many of such sleepers will not survive mechanised track rehabilitation or maintenance.

Except for wooden sleepers, derailed vehicles generally damage sleepers and make them unusable. This is because steel sleepers get bent, and concrete sleepers break and then also change shape due to the pre-stressing. This results in gauge narrowing for both sleeper types which in turn leads not only to extraordinary wear of rails and wheels but also to further derailments.

This is confirmed through spot checks on the track gauge, e.g.

- in km 394.30 (straight track)  
 $g_{\min} = 1050 \text{ mm}$
- in km 393.02 (Curve No. 658, R = 141 m)  
 $g_{\min} = 1076 \text{ mm}$   
 $g_{\max} = 1080 \text{ mm}$

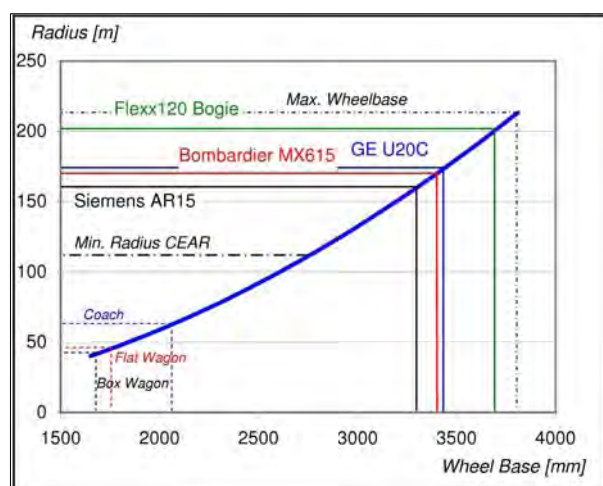
Erroneous *alignments* form one of the main causes of derailments.

Tracks with steel sleepers are generally difficult to maintain, and on the given condition of sleepers and ballast, all these tracks must be considered non-maintainable.



Many sections have no or only little *ballast*, resulting in unequal load distribution and alignment errors. Where tracks are ballasted, ballast is fouled, and weed and shrubbery further contribute to the problem.

Where speed had to be temporarily reduced in curves, the cant - initially determined by section speed - results in unwanted centripetal acceleration causing additional wear of rails and wheels.



**Figure 10: Sideway Running**

Wear of rails in *curves* is generally higher than in the straight; it assumes an extraordinary dimension especially where sideway running occurs, i.e. where the wheel flanges are forced to both - outer and inner - rails. As can be seen from the chart in Fig. 10, parameters for sideways running are curve radius and bogie wheelbase. Accordingly, in the network under review sideway running is to be expected at curves with radii  $\leq 201$  metres.

Though stock rails and crossings seem to be in a fair condition in some cases, all *turnouts* in running lines must be considered not suitable for operations because of their design with loose heel switches, their missing locking devices and the sleeper arrangement that does not allow any maintenance.

### 3.2 Rolling Stock

Though the workshops are equipped with basic machinery and tools - e.g. wheel lathes -, regular maintenance of rolling stock is disrupted due to lack of spare parts and qualified personnel, and the machinery being partly out of order. Condition and availability of rolling stock are, therefore, unsatisfying. The condition of locomotives is, for example, indicated by the fact that all speedometers are out of order. Moreover is the major part of the fleet rather near the end of usual lifetime - this goes also for the locomotives for which the lifetime of 40 years as assumed in the concession agreement is very much on the high side.

Major overhaul of locomotives cannot be expected to be carried out in the country. For a decision on whether to rehabilitate or renew motive power, the comparatively low performance of the present locomotives - limiting train loads due to axle load and rated output - must be taken into account.

In view of the many speed restrictions and the resulting extraordinary lead times, CEAR and CDN can hardly cope with the demand for rolling stock. In case of loco failures there are no spare engines, and cargo waiting for transport e.g. in the Nacala Port is a common phenomenon. Due to the shortage of shunters, main line locomotives must be used for the purpose.

The wagon fleet is largely composed of conventional types such as box, high side or drop side wagons. Besides fuel tank wagons and flat wagons designed for container transport, there are no special goods wagons. To cope with the problem of special goods wagon shortage, CDN currently converts Ballast Hoppers into food grain wagons.

Though done on a daily basis, management of the CEAR/CDN wagon pool seems not sufficiently efficient due to the lack of computerised databases and tools.

### **3.3 Operations and Management**

#### **3.3.1 Operational performance**

##### **3.3.1.1 Temporary speed restrictions**

In January 2009, speed was restricted on 386.3 km (55%) of the 703.2 km operational network in Malawi. This was mainly due to the condition of track and substructure on 227.4 km (32.3% of the operational network). On 128.6 km (18.3%) speed was restricted to 15 or even 10 km/h.

Details of all speed restrictions can be seen from Annex 3.3.1.1.1, a section-wise summary is attached as Annex 3.3.1.1.2.

##### **3.3.1.2 Travelling time and travelling speed**

In 2008, average travelling speed of freight trains on various sections was 14.3 to 18.8 km/h, down to minimum values of 11.2 to 14.9 km/h in December. Accordingly, a freight train journey between Blantyre and Liwonde (113.3 km) took between 5½ and more than 8 hours, from Kanengo to Liwonde (302.4 km) as much as 27 hours. This is partly due to the temporary speed restrictions but also to the laborious method of working, trains stopping dead ahead of switches to be operated by the driver, and the train loco used for putting vehicles on and off the trains.

With an average travelling speed between 10.2 and 20.1 km/h, performance of passenger trains is alike for the same reasons.

Monthly details of travelling time and travelling speed for the various traffic relations are attached as Annex 3.3.1.2.

### 3.3.1.3 Train services

As can be seen in detail from Annex 3.3.1.3, train services are very limited at present, and - including the section to Cuamba in Mozambique presently operated by CEAR - in 2008 only 161,877 train kilometres were performed for freight, and 48,428 train kilometres for passenger services.

Freight train relations are

- Cuamba - Liwonde,
- Liwonde - Blantyre,
- Limbe - Luchenza,
- Liwonde - Kanego, and
- Kanengo - Mchinji (during tobacco season only).

Passenger services are now restricted to Makhanga - Limbe - Balaka - Nayuchi, and the 2009 time-table has been designed in a way to perform all services with only *one* train unit. Accordingly, the Makhanga - Limbe sections is served twice, the other sections once a week.

### 3.3.1.4 Derailments and line closures

CEAR's derailment rates are amongst the highest worldwide. Due to deteriorating condition of infrastructure and rolling stock, the number of monthly train derailments rose from between 1 and 6 from 2004 until mid 2007 to a peak of 15 in October 2008.

78% of the train derailments have been attributed to infrastructure failures (including obstructions and vandalism), 16% to human errors such as point mismanagement and over-speeding, and 6 % to rolling stock and improper loading. These figures may be misleading to a certain extent, however - the interaction between wheel and rail is of some complexity, and a faulty vehicle usually does not derail on a perfect track, and vice-versa.

As explained in para. 3.1.4 above, derailments cause substantial damages to permanent way but also to the rolling stock. It must be stated that if a proper safety standard is set and observed, a train (unlike shunting units where derailments cannot be totally avoided) should theoretically never derail. In practice, taking into account external reasons like level crossing accidents, roaming cattle and similar, not more than one train derailment per year should be deemed acceptable.

Each train derailment results in a closure of the line lasting from a few hours to several days. Every line closure affects availability of the network and thus necessarily the reliability of the entire railway system.

The charts and the table at Annex 3.3.1.4 give an overview of derailments and line closures, including those caused by washaways.

### **3.3.2 Managerial performance**

#### **3.3.2.1 Rules and regulations**

In the absence of a comprehensive legal framework (see para. 1.3.2.3), the railway's rules and regulations remained fragmentary and were never maintained over a long period of time.

Technical Rulebooks such as the *Permanent Way Instructions* (1969) were comprehensive when first published but never updated. Today there are, for example, no rules concerning concrete sleepers, elastic fastenings and welding. Consequently, the rulebooks are no longer fully applied for their lack of completeness but above all due to downsized workforce and lack of educated and skilled staff. In other words, the rules if applied as they are would still work though an update is indeed required. The biggest problem is non enforcement of the existing.

Operational Rules do still ensure safety but are long-winded and outmoded. The damage of signalling and introduction of modified methods of working as a substitute forced the railways to update their operational rules. But this has not been done comprehensively as yet, and the *Train Working Rules* proposed to be reissued in 2005 are still under review.

#### **3.3.2.2 Lost know-how**

Due to their technical specialisation and complexity, success of railways depends not only on good education but also largely on the long-years experience of their staff. In history, this experience has continuously been transferred from generation to generation.

This process was disrupted in the course of privatisation, and within ten years CEAR have lost the larger part of their know-how through retirements and staff reduction.

Consequently,

- Rules and Regulations are neither properly interpreted nor further developed,
- The complexity of the system and all its interdependencies are no longer fully understood,
- Maintenance and repair is not carried out workmanlike, and
- The chance for training on the job - learning by doing - becomes less year by year, both for management and workforce.

#### **3.3.2.3 Documentation**

As a basis for rehabilitation or renewal, and to allow proper management and maintenance, a complete and detailed documentation of assets is indispensable. In Malawi, documentation of rail infrastructure is incomplete and not up to date, and documentation of rolling stock seems inconsistent.

In particular,

- There are no accurate longitudinal profiles for the “old” railway (until 1969),
- Maps of station layouts and turnout registers date back to 1969 or earlier and have never been updated since,
- For the new links Nayuchi - Nkaya and Lilongwe - Zambian border, consultant’s detailed plannings are available, but the lines were built not exactly in accordance, and variations have never been recorded,
- Longitudinal profiles for the Salima - Lilongwe section are entirely missing, and
- The bridge register is incomplete, and hardly any details, even for long bridges, are available.

The incomplete documentation not only results in a lack of planning reliability but also in the necessity to re-survey infrastructure at considerable cost, whereas an update of rolling stock data will be comparatively easy.

#### 3.3.2.4 Statistics

Traffic and operational statistics need to be used for monitoring performance. Currently these indicators are not compiled by the monitor and it is difficult to measure progress and assess policy review requirements.

### 3.4 Traffic performance

CEAR’s freight traffic nowadays consists mainly of international traffic since domestic traffic has dropped to an insignificant level after the collapse of the Rivi-Rivi bridge in 2003.

In 2008, about two-thirds of cross-border traffic were imports. Main import commodity was fertilizer (35%), followed by general cargo (33%). Other important commodities for import are clinker (11%) and fuels (9%).

Main export commodity carried on rail is sugar (64%), whereas the railway’s share of other important export goods has become rather marginal.

The development of CEAR’s freight traffic over ten years (in terms of tonnes) is shown in the table below:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Exports	38,594	101,017	135,624	93,663	83,303	88,487	60,984	57,141	94,406	66,565
Imports	108,714	155,088	139,739	186,005	150,040	134,547	109,868	114,324	121,505	133,039
Local	196,843	249,685	172,492	183,483	39,685	17,077	23,315	19,580	14,987	14,355
<b>Total</b>	<b>344,151</b>	<b>505,790</b>	<b>447,855</b>	<b>463,151</b>	<b>273,028</b>	<b>240,111</b>	<b>194,167</b>	<b>191,045</b>	<b>230,898</b>	<b>213,959</b>

Further details and passenger traffic data is provided in the charts in Annex 3.4.

## **3.5 Institutional analysis**

### **3.5.1 General**

Poor condition and performance as described above primarily evolved from deficiencies and shortcomings that occurred during the privatisation process. The present agreement between the Government and CEAR lacks a clear structure and concept in general. The target of the agreement is not defined at all, and responsibilities of the contracting parties are not sufficiently distinguished. Some of the key issues and weaknesses are analysed below.

### **3.5.2 Legal environment**

The agreement has been drafted without any sound legal basis since the Railway Act dates back to 1907 when privatisation surely was not an issue. Taking into account that the Government requires a tool to enforce adherence to the agreement if need be on one hand, and that uniform regulations are required if several concessions are considered on the other hand, a legal framework as outlined in para. 1.3.2.3 must be regarded indispensable.

The agreement leaves application and development of standards and regulations extensively with the concessionaire, only suggesting that “rules generally accepted by railway industry” be used, and allows alterations and modifications of even safety-relevant regulations without requiring any approval (items 32, 33 of the agreement).

For continuous monitoring and control of the execution of concession agreement(s), it is common practice worldwide to install a regulatory body that is also responsible for the development and approval of standards, rules and regulations, as well as for the regular inspection of assets. At present, there is no provision for that, neither in the law nor in the concession agreement.

### **3.5.3 Definition and management of assets**

Concessioneering a railway means also to transfer managerial responsibility of assets representing a tremendous value at least partly to the concessionaire. Since the usual lifetime for railway assets is generally beyond the intended concession period, e.g.

- 20 - 25 years for signalling and telecommunications,
- 30 - 35 years for permanent way,
- 30 - 50 years for rolling stock,
- 50 - 80 years for buildings,
- 100 years and more for substructure, bridges and tunnels;

The concession agreement must unambiguously define for each asset

- the ownership,
- the condition at the time of hand-over,
- the minimum condition to be maintained during the concession period,
- the remaining lifetime, and
- responsibilities for and means of rehabilitation and/or renewal.

Except for a listing of some of the assets and their value according to an inventory compiled several years before its introduction, the present agreement contains nothing of the above, neither any strategy concerning further development of assets. Rehabilitation is assumed as the concessionaire's overall responsibility but no budgetary provision is made for the purpose.

A depreciation fund for re-investments as suggested by TERA in 2004 has not been established so far.

### **3.5.4 Concessionaire's capabilities**

Because of the scope and technical and managerial complicity and complexity, any railway concession must consider and monitor the concessionaire's

- technical and managerial qualification and experience,
- its staffing, and
- its financial capability;

and stipulate minimum levels for these items in the agreement.

Except for an amazing clause stating that another service provider if sub-contracted must be qualified, the present agreement seems to tacitly assume concessionaire's sufficient capabilities, and does not provide for any monitoring on the subject.

### **3.5.5 Maintenance and repair**

There is no proper definition of maintenance (as outlined in para. 1.3.2.4 above) in the present agreement. The agreement also leaves the quality level (see also 3.5.3) open, and just assumes "repair and rehabilitation" as concessionaire's responsibility.

The agreement also mentions cases of *force majeure* but does not explicitly define the term, and contains no unambiguous clauses about responsibility and handling, financing and compensation whatsoever. This led for example to the unacceptable delay in restoring the Rivi-Rivi Bridge after the collapse in 2003.

## **4 Proposal for Network Rehabilitation**

### **4.1 Strategy and Technical Requirements**

#### **4.1.1 Emergency programme**

The present condition of the rail infrastructure suggests that operations may already collapse during the next rainy season. To prevent this, emergency actions are recommended to be started timely before next rainy season as follows:

- To clear the structure gauge,
- To repair all drainages,
- To stabilise the substructure, in particular in the vicinity of bridges and culverts, and
- To correct all critical and unstable sections of the permanent way.

A detailed proposal for the emergency programme including approach, methodology and scope of work is attached at Annex 4.1.1.

#### **4.1.2 General strategy**

Network rehabilitation requires to

- Define the technical standards and requirements for
  - Substructure and drainage,
  - Permanent way,
  - Bridges and culverts;
- Initiate survey and engineering assessment where required, in particular for all bridges and culverts with spans or diameters of  $\geq 2$  metres,
- Define criteria as to which assets shall be rehabilitated, or must be renewed, also taking into account financial feasibility,
- Develop the quantity structure for rehabilitation and renewal,
- Estimate the costs,
- Develop a time frame for implementation,
- Define framework requirements.

#### **4.1.3 Technical requirements**

##### **4.1.3.1 Substructure and drainage**

Standards and requirements for substructure and drainage have been defined under the proposed emergency programme (4.1.1).



#### 4.1.3.2 Bridges and culverts

Due to their age, all open deck (girder/truss) steel bridges on Section 6 (Southern Border - Limbe) are in a first approach considered to be due for renewal. Possibly some of these bridges can still be maintained for some time; this can however only be decided on basis of a detailed engineering assessment for each bridge.

The open deck steel bridges on Sections 3 and 5 (Limbe - Nkaya - Salima) require

- repair of the concrete elements - pillars and abutments -,
- corrosion protection, and
- renewal of all bridge beams including proper fastenings.

For open deck steel bridges, it is further recommended

- to avoid fish-plated joints next to the bridge ends and on the bridge itself, and
- to install overlaps of rail to absorb longitudinal movements on long bridges.

On concrete deck bridges that have no stone ballast or blocked drainages, it is required

- to remove the track and completely clear the decks,
- to repair the isolation, and
- to reinstall, reballast and tamp the track, replacing all wooden sleepers where applicable.

To cope with present and future traffic, all rail frames must be replaced through adequate types of culverts.

It is expected that also several culverts of other than rail frame type require renewal or rehabilitation. An appraisal would require a detailed engineering assessment for each culvert that is beyond the scope of this study, however. Therefore, no provision has been made for the purpose except in the framework of the emergency programme (4.1.1).

#### 4.1.3.3 General standards for the permanent way

To cope with future traffic and to achieve a long-lasting, efficient, and cost-effective permanent way, the following standards are proposed:

- UIC 54 Rails,
- Concrete sleepers with elastic fastening system,
- Sleeper spacing  $\leq 0.65$  metres,
- Ballast thickness 0.30 metres (0.25 m with wooden sleepers),
- Standard turnouts UIC54-300-1:12, or other UIC54 turnouts in case of insufficient space, and
- Cross sections according to PWI.

#### 4.1.3.4 Permanent way renewal and rehabilitation

Through tracks are due for immediate renewal according to the criteria listed below:

- All tracks with 30 kg/m rails regardless of sleeper type (Renewal I),
- Tracks where condition requires renewal, in particular with broken sleepers due to derailments or manufacturing faults (Renewal II),
- Tracks with 37.5 and 40 kg/m rails on steel sleepers, except on concrete deck bridges (Renewal III).

All turnouts in through tracks must be replaced in course of the track renewal.

In Curves with radii  $\leq 201$  metres, it is recommended to use head-hardened rails (see also para. 3.1.4).

Tracks with 37.5 or 40 kg/m rails on concrete sleepers can be brought into a maintainable condition through rehabilitation. Depending on the present condition, one of the following methods must be applied:

- Cleaning ballast, reprofiling substructure, adding ballast, tamping; optional sleeper re-spacing and welding (Rehabilitation I),
- Reprofiling substructure, adding ballast, tamping; optional sleeper re-spacing and welding (Rehabilitation II).

## 4.2 Quantity structure

### 4.2.1 Track renewal and track rehabilitation

According to the criteria defined in 4.1.3.4 above, complete renewal is proposed for 249.5 track kilometres (41.4%) on Sections 1 - 5; the remaining length can be rehabilitated. Section 6 (Southern Border - Limbe, 198.9 track kilometres) must be completely renewed. The renewal includes 101 turnouts on Sections 1 - 5 and 40 on Section 6.

For further details see the quantity structure table in Annex 4.2.1 and the through track inventory in Annex 2.2.5.2.2.

### 4.2.2 Bridge renewal and bridge rehabilitation

Renewal or replacement respectively is proposed according to the criteria in 4.1.3.2 for

- 2,408 bridge beams and 168 rail frame culverts on Sections 1 - 5, and
- 144 steel bridges with a total length of 1,591 metres, 2,323 bridge beams and 90 rail frames on Section 6.

The rehabilitation proposal (Sections 1 - 5 only) comprises

- Concrete banks repair and corrosion protection for 151 bridges with a total length of 1,302 metres, and
- 1,055 metres of concrete deck rehabilitation.

For further details, refer to the quantity structure table in Annex 4.2.2.

### 4.3 Cost estimate

#### 4.3.1 Emergency programme

For the emergency programme, a lump sum of 8,000,000 US\$ has been estimated.

#### 4.3.2 Track renewal and track rehabilitation

Cost estimates for track renewal and track rehabilitation amount to

- 199.966 m US\$ for Sections 1 - 5, and
- 95.345 m US\$ for Section 6.

Unit costs are given in Annex 4.3.0; section-wise details can be seen from the table in Annex 4.3.2.

#### 4.3.3 Bridge renewal and bridge rehabilitation

The costs for bridge renewal and bridge rehabilitation are estimated as

- 14.200 m US\$ for Sections 1 - 5, and
- 209.698 m US\$ for Section 6.

Costs have been compiled on basis of the unit costs (Annex 4.3.0) as shown for each section in the table of Annex 4.3.3.

#### 4.3.4 Cost summary

The total costs for network rehabilitation (in millions US\$) are shown in the table below:

Section	Emergency Programme	Tracks	Bridges	Total
1-5	8.000	199.966	14.200	222.167
6		95.345	209.698	305.043
<b>Total</b>	<b>8.000</b>	<b>295.311</b>	<b>223.899</b>	<b>527.210</b>

Section-wise details can be seen from Annex 4.3.4.

#### 4.4 Time schedule

An overall time schedule for implementation is attached as Annex 4.4. The schedule is based on the following assumptions:

- For track renewal, performance is 6 km/month at each site,
- For track rehabilitation, performance is 10 km/month at each site,
- During the rainy season (months 12 - 04), performance is only 50% of the above,
- Turnout renewal and bridge renewal/rehabilitation is done in course of track renewal/rehabilitation,
- Not more than two construction sites are allowed simultaneously and only if
  - situated in different parts of the network not interfering with each other,
  - logistic (rolling stock and station capacity) allows,
  - operations can cope with.
- Starting date for the emergency programme is 01.07.2009, for renewal/rehabilitation 01.05.2010.

Accordingly, the network rehabilitation could be completed by the end of 2013 if funds are provided in time.

#### 4.5 Education and training

Due to the lost know-how, the situation of the railways during and after renewal and rehabilitation is likely to deteriorate again quickly. In the consultant's opinion, there is no way but to "buy back" the know-how.

Therefore, it is suggested that an education and training programme be developed, organized, and financed as an indispensable precondition for and part of the rehabilitation.

The education and training programme requires the employment of foreign experts and should be the subject of another Technical Assistance project.

The programme should comprise

- Definition and description of the required positions,
- Management training specifically targeted at positions in a railway concessionaire company, but also for the regulatory authority to be established,
- Workshops for basically educated staff,

- Selection of qualified personnel, and
- Classroom and on-the-job training of personnel for the specific railway tasks such as
  - permanent way,
  - rolling stock,
  - operations and traffic.

Furthermore, it should be considered to support the Government of Malawi in setting up the required legal framework and in completing the concession contract through the task of a *Railway Adviser* in the framework of such Technical Assistance.

## **5 Malawi Railway Master Plan**

### **5.1 Corridor pre-evaluation**

#### **5.1.1 Beira corridor**

In spite of the political commitment, a re-opening of the Beira corridor in the near future seems unlikely. This is mainly due to the fact that no decision could be taken as yet on how and when to restore the Chiromo - Bangula section. Recently, a feasibility study has been proposed with Japanese TA, but it is not yet clear whether such study would cover the entire Dona Ana – Limbe section. In view of these circumstances, re-opening the Makhanga - Dona Ana (- Sena) line must be considered a mid-term goal.

Survey results confirm the consultant's earlier findings on condition and required renewal of the Limbe - Makhanga section, and actual costs may even exceed the estimate in section 4.3.

An assessment of the Beira corridor must also take into account capacity constraints due to the difficult alignment between Limbe and Sankhulani as well as the limited capacity and expandability of the Beira port.

#### **5.1.2 Nacala corridor**

The railway lines Nacala - Nayuchi - Nkaya - Kanengo - Mchinji and Limbe - Nkaya are operational, and the extension further to Chipata is expected to be completed by 2012.

All these lines can be rehabilitated in the short-term, and to cope with future traffic, only minor network development is required such as extension of loop lines at a few stations.

The Nacala Port has an adequate and expandable capacity, and - unlike Beira - provides unrestricted access for deep-sea vessels.

#### **5.1.3 Conclusion**

The question whether giving first priority to the Nacala corridor would adhere to Malawi's national interest has been discussed extensively in the course of the project. As a result, it must be stated that under the view of national interest the transport system has to ensure adequate supply to the entire population and economy. Accordingly, the Railway Master Plan must aim at setting up an optimum rail network in the first place, and this should take precedence over aspects of regional development.

Thus, in order to cope with traffic demand immediately, the Nacala Corridor should be rehabilitated and developed in the first instance. So long the Makhanga - Dona Ana section is not

operational, the Limbe - Makhanga section must be considered a branch of the Nacala Corridor.

The Beira corridor should be included later i.e. if and when its feasibility has been evaluated, and a time frame for restoration can be assessed.

## 5.2 Traffic evaluation

### 5.2.1 Safeguarded traffic potentials

A practicable Railway Master Plan must be based on realistic traffic volumes. Consequently, for the present Master Plan only safeguarded traffic potentials have been considered, in other words amounts of traffic that customers intend to transport. These include

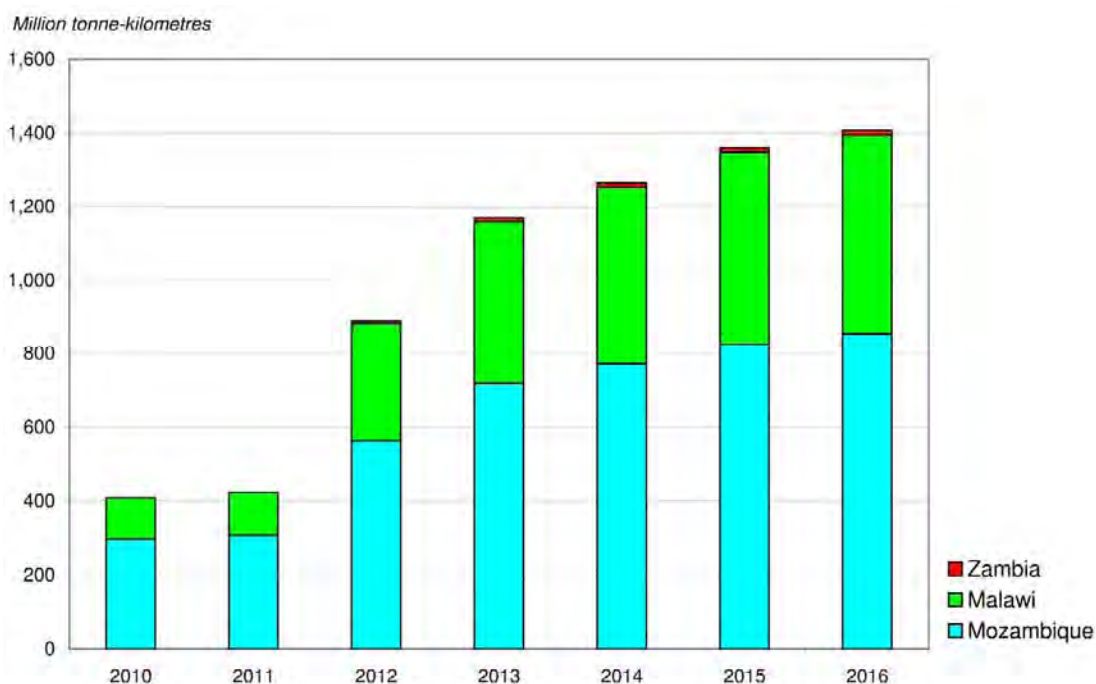
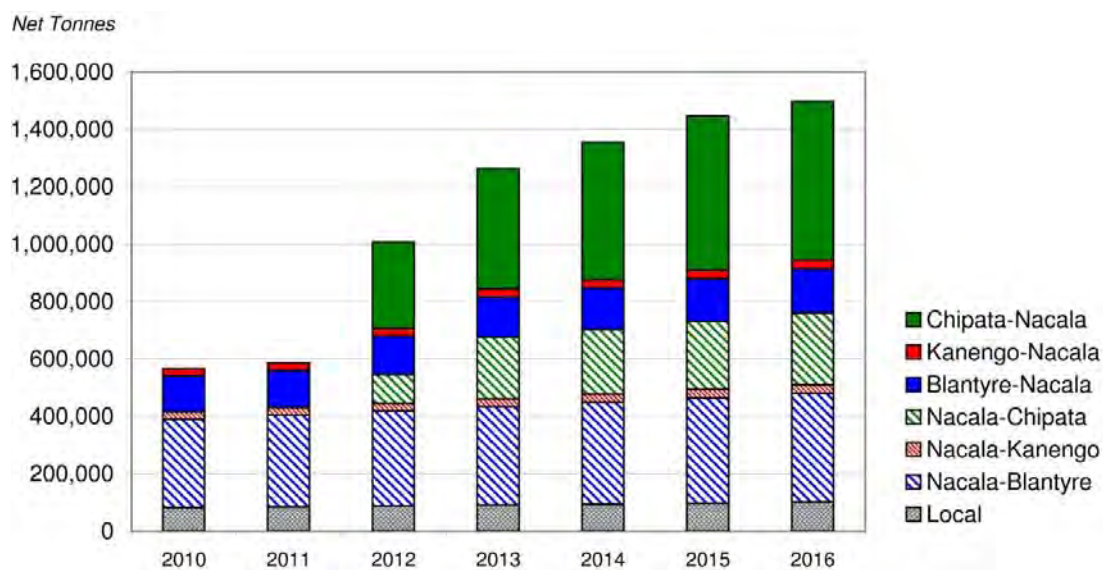
- Figures obtained from customers by CEAR and through the ongoing Chipata Dry Port Pre-feasibility Study,
- Amounts forecasted by Nacala Port, and
- Mineral ore traffic ex Chipata according to CEAR's forecast and the draft MOU.

Anticipated economic growth in Malawi is 5% p.a. For the traffic forecast, more conservative growth rates have been assumed as shown in the table below:

Origin/ Destination	Commodity	2010-2012	2013	2014-2015	2016	2017-2021	2022-2029
Malawi	all	3.5%				2.0%	
Chipata Dry Port <sup>3</sup>	Fertiliser	-	+45,000 t	5.0%		2.0%	1.5%
	Fuel	-	+40,000 t	5.0%		2.0%	1.5%
	Other Imports	-	+30,000 t	5.0%		2.0%	1.5%
	Sugar	-	+50,000 t	+50,000 t	5.0%	2.0%	1.5%
	Cotton	-	+40,000 t	5.0%		2.0%	1.5%
	Other Exports	-	+30,000 t	5.0%		2.0%	1.5%
Chipata	Mineral ore	-	0.0%			2.0%	

The resulting traffic performance between 2010 and 2016 is shown in the charts below.

<sup>3</sup> According to Chipata Dry Port Pre-Feasibility Study, preliminary traffic forecast



The detailed traffic forecast is attached as Annex 5.2.1.

## 5.2.2 Additional traffic potentials

Additional traffic potentials from various projects have been identified and are summarised in the table below:



Projects <sup>4</sup>	Net tonnes p.a.			
	Local	Export via Nacala	Export via Chipata	Total
Short-term	80,000	391,000		471,000
Mid- and long-term	72,500	1,209,100	50,000	1,331,600
<b>Total</b>	<b>152,500</b>	<b>1,600,100</b>	<b>50,000</b>	<b>1,802,600</b>

These projects are listed in Detail in Annex 5.2.2.

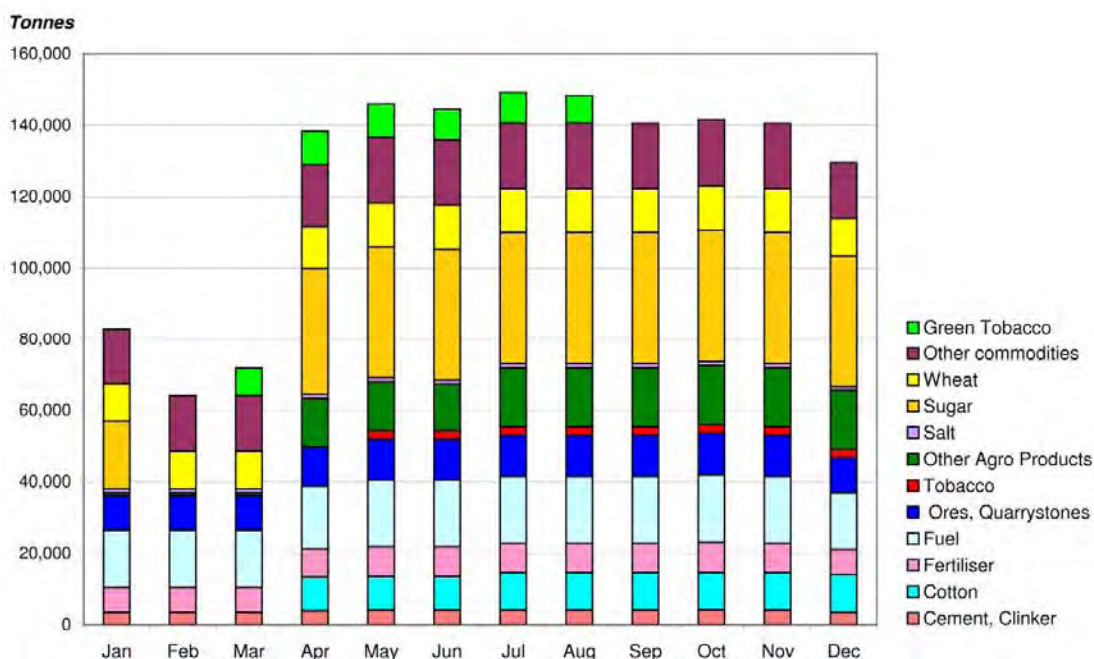
Depending on the quality of services, traffic lost earlier may also be regained from road traffic, in particular concerning tobacco exports.

These additional potentials have not been considered in the operating programmes. The latter will have to be updated accordingly whenever additional traffic is likely to occur.

### 5.3 Demand Model

#### 5.3.1 Seasonal peaks

For further evaluation, seasonal peaks had to be considered. A sample for the year 2016 is shown in the chart below.



<sup>4</sup> Source: "Anchor Project" Profiles Of The MtDC In The Republic Of Malawi, MANT Consultants 2006, and MOU between CEAR and Consolidated Resources

The operating programmes have been worked out for long-distance freight traffic only and do not include the local traffic from green tobacco collection. Moreover, to determine operational peaks, the movements of empty wagons had to be considered. Accordingly, the operating programmes are based on the long-distance traffic figures for the month of October.

### 5.3.2 Scenarios

Operating density, rolling stock usage, and lead times resulting from an operating programme are largely determined by rolling stock technology and permissible axle load. The network rehabilitation as proposed in section 4 would allow raising axle load from the present 15 to 18 tonnes, but the existing rolling stock has been designed for 15 tonnes only, and an increase is not possible due to technical reasons.

In order to get a sound basis for the decision whether to rehabilitate or renew the rolling stock, two scenarios have been developed with the basic parameters as follows:

#### *Scenario I*

- Present axle load of 15 tonnes
- Present rolling stock technology
- Present vacuum brake system

#### *Scenario II*

- Axle load raised to 18 tonnes
- Complete rolling stock renewal
- Air brakes according to UIC standard

### 5.3.3 Wagon and commodity parameters

To convert traffic figures (net tonnes) into operational values (number of wagons, gross tonnes and rake length), wagon parameters have been used as shown in the table below:

International Code (UIC 438-2)	CEAR/ CDN Code	Type	Tare [kg]	Max. Load [kg]		Capacity [m <sup>3</sup> ]		Length [m]
				Scenario I	Scenario II	Scenario I	Scenario II	
Ea	HSB	High sided bogie	20,410	39,545	<b>51,500</b>	39	39	13.614
Ga	CB	Covered bogie	22,724	36,314	<b>49,000</b>	49	49	13.614
Rl	LSB	Low sided bogie	19,091	38,100	<b>52,500</b>	21	21	14.531
Sg	U	Flat bogie (container)	13,490	40,000	40,000			13.155
Tag	BB	Food grain hopper	27,500	40,500	40,500	40	40	12.967
TEU	CC	Container (20')	2,100	16,950	24,150	28	28	
Za	FT	Tank	20,094	40,298	<b>51,900</b>	40	<b>57</b>	13.767

As can be seen in detail from the Commodity Parameter Table in Annex 5.3.3, these values have been applied to each commodity taking into account its density and a practicable capacity usage.

### 5.3.4 Empty movements

Due to unequal traffic flows in the network, wagons must be moved empty to the next loading point in many cases. The number of empty runs for each wagon type has been compiled from traffic flows as can be seen from the sample (October 2016) below:

Relation		No of wagons moved by type				
		Ea	Ga	Sg	Tag	Za
Loaded	Nacala - Kanengo		30	394		202
	Kanengo - Nacala	174		1,348		
	Kanengo-Chipata			346		202
	Chipata-Kanengo	174		1,214		
	Nacala - Nkaya					
	Nkaya - Nacala	79	3	17		
	Nacala - Blantyre	53	334	244	160	167
	Blantyre - Nacala		189	179		
	Blantyre - Kanengo		131	31		
	Kanengo - Blantyre					
Empty	Kanengo - Chipata					
	Blantyre - Chipata	53		34		
	Blantyre - Nacala		14		160	167
	Kanengo - Nacala		158			
	Nacala - Chipata	121		834		
	Nacala - Kanengo			55		
	Nacala - Blantyre					
	Chipata - Nacala					202
	Nacala - Nkaya	79		17		
	Kanengo - Nkaya		3			

### 5.3.5 Train parameters

The number of trains has been compiled from gross tonnes and rake length – including both loaded and empty wagons – as input data, using the train parameters as shown in the table below:

Section	No. of Locos	Scenario I			Scenario II		
		Train Length [m]	Max. Starting Load [t]		Train Length [m]	Max. Starting Load [t]	
			UP	DN		UP	DN
Nacala - Cuamba	1		638	666		945	986
	2	666	1276	1333	666	1890	1973
Cuamba - Nayuchi	1	587	1002	986	587	1474	1450
	2					2948	2901
Nayuchi - Nkaya	1	708	1136	1120	708	1614	1591
	2					3228	3183
Nkaya - Salima	1	311	786	937	457	1122	1353
	2					2244	2511
Salima - Kanengo	1	518	720	754	518	1029	1077
	2					2059	2155
Kanengo - Chipata	1	549	852	849	549	1215	1211
	2					2430	2422
Blantyre - Nkaya	1	292	792	615	457	1132	1058
	2					2265	2116

For *Scenario I*, starting loads have been compiled from the locomotive data as shown in Annex 2.3, and the existing loop lengths applied.

*Scenario II* assumes

- new locomotives with 18 tonnes axle load, and
- extension of the loops between Blantyre and Salima to 457 metres.

## 5.4 Operating programmes

### 5.4.1 General approach

Detailed operating programmes have been elaborated

- Using the methodology as described in the sections above,
- Assuming 6 transportation days per week,
- Compiling the running time by a service programme,
- Assuming train formation at Nkaya instead of Liwonde, and
- Assuming the border procedures Zambia/Malawi to be done at Chipata (One Stop Border Post)

For each of the scenarios as defined above, an operating programme has been developed:

- Operating programme 2012, using the Scenario I parameters and traffic data for October 2012, and
- Operating programme 2016, using the Scenario II parameters and traffic data for October 2016.

Results of the operating programmes are

- Tabular and graphic time-tables for a peak day,
- An overall capacity assessment,
- Rolling stock demand and usage, and
- Lead times.

### 5.4.2 Operating programme 2012

For the operating programme 2012, further assumptions have been made

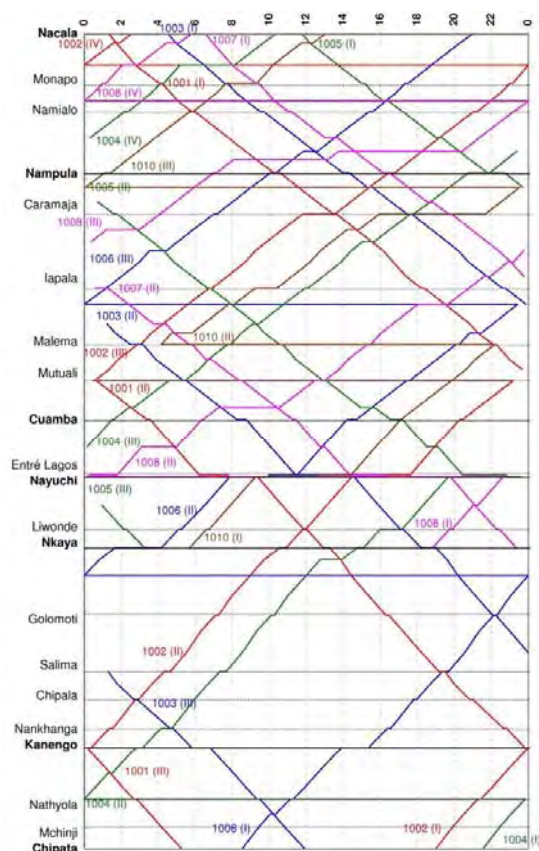
- Change of locomotives (CDN/CEAR) at Nayuchi,
- 90 minutes for border procedures each at Entré Lagos and Nayuchi, and
- Operating time for crossings is
  - 10 ( $\pm 5$ ) minutes at manned stations ,
  - 18 ( $\pm 9$ ) minutes at kilometre loop line points,

Gross tonnes and rake length on a peak day are shown in the table below:

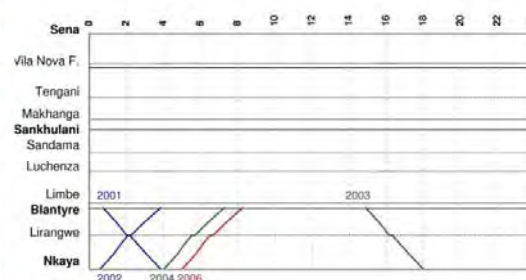
Section		Gross tonnes	Rake length [m]
Nacala	Nkaya	2,975	983
Nkaya	Nacala	3,271	1,041
Nkaya	Kanengo	1,360	583
Kanengo	Nkaya	2,074	636
Kanengo	Chipata	996	501
Chipata	Kanengo	1,790	501
Blantyre	Nkaya	1,283	464
Nkaya	Blantyre	1,864	467

As can be concluded from the graphic below, the operating programme 2012 results in

- A high operating density that is near capacity limit for the section Nacala – Nkaya,
- Unacceptable lead times i.e. on average
  - Nacala - Chipata 53 hrs. (UP)/59 hrs. (DN),
  - Nacala - Kanengo 49 hrs. (UP)/54 hrs. (DN), and
  - Nacala - Blantyre 41 hrs. (UP)/62 hrs. (DN).



Graphic Time-table Operating Programme 2012



For more details refer to the tabular time-table in Annex 5.4.2.1. Locomotive rosters are attached as Annex 5.4.2.2. Accordingly, 31 locos are required with an average performance of 351 kilometres per day.

### 5.4.3 Operating programme 2016

Additional assumptions for the operating programme 2016 are

- No change of locomotives at the border - one common loco pool - ,
- 90 minutes in total for border procedures at either Entré Lagos and Nayuchi (One Stop Border Post), and
- Operating time for crossings is 10 ( $\pm 5$ ) minutes at *all* stations.

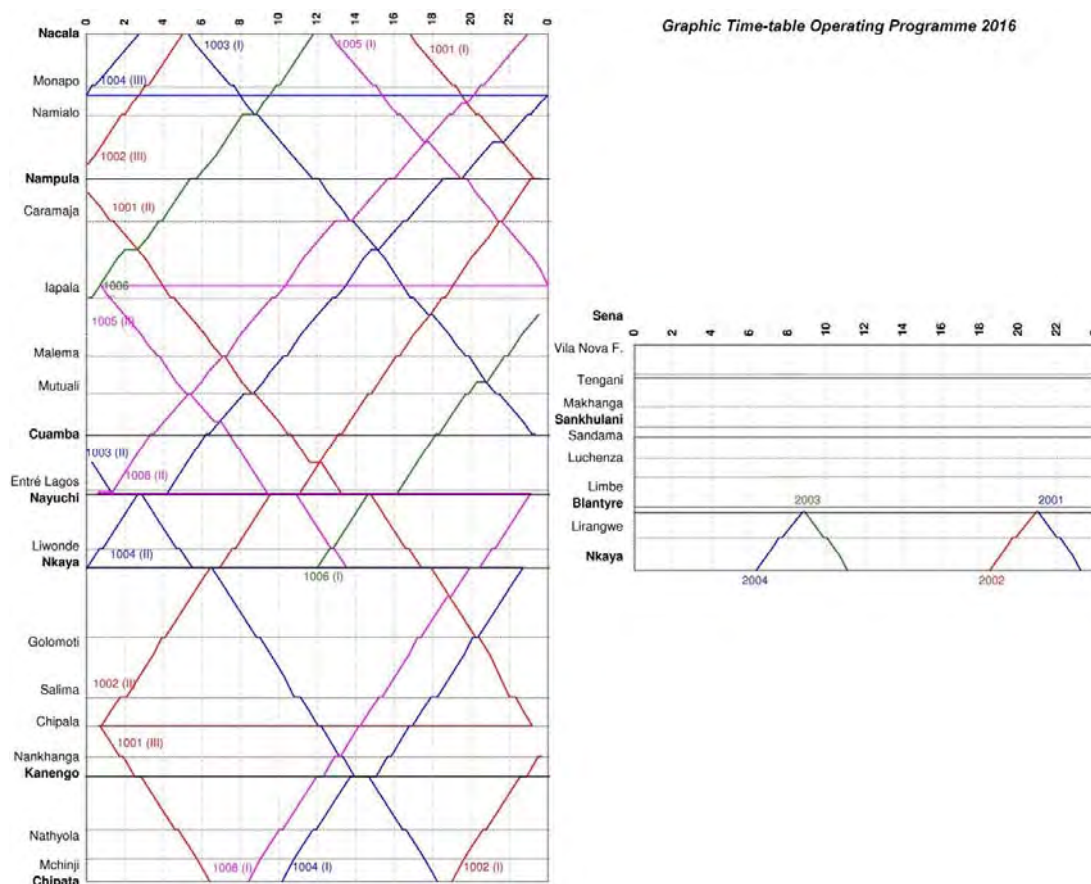
Gross tonnes and rake length on a peak are shown in the table below:

Section		Gross tonnes	Rake length [m]
Nacala	Nkaya	4,118	1,360
Nkaya	Nacala	4,877	1,360
Nkaya	Kanengo	2,345	954
Kanengo	Nkaya	3,530	949
Kanengo	Chipata	1,861	800
Chipata	Kanengo	3,213	800
Blantyre	Nkaya	1,456	488
Nkaya	Blantyre	2,065	490

The graphic below illustrates that the operating programme 2016 results in

- An acceptable operating density providing sufficient spare capacity,
- Acceptable lead times, i.e. on average
  - Nacala - Chipata 37 - 38 hrs,
  - Nacala - Kanengo 33 - 36 hrs, and
  - Nacala - Blantyre 28 hrs.





For more details refer to the tabular time-table in Annex 5.4.3.1. Locomotive rosters are attached as Annex 5.4.3.2. 18 locomotives are required with an average daily performance of 585 kilometres.

#### 5.4.4 Conclusion

The results of the Operating Programme 2012 clearly indicate that the railways cannot cope with the future traffic demand under the *Scenario I* conditions. Moreover, the usage of rolling stock would be highly uneconomical, and the high lead times would make it difficult to gain the anticipated traffic at all.

Therefore, it is recommended to apply the *Scenario II* parameters from the very beginning, in particular concerning complete renewal of the rolling stock rather than rehabilitation.

## 5.5 Network development

### 5.5.1 Upgrade and expansion

As precondition for the operating programme, minor network developments are required as outlined below.

#### 5.5.1.1 Nkaya station upgrade

At present, Liwonde serves as freight junction where trains from and to Nacala are split up or formed respectively according to the Blantyre/Kanengo origins/destinations. But from its situation in the network, Nkaya is predestined to this function. Main reason for the present solution is the lack of accessibility and site development at Nkaya. However, using Liwonde as freight junction results in the considerable operational disadvantages that

- The operating density on the 25 kilometres section Liwonde – Nkaya is increased by the number of trains to and from Blantyre,
- Approximately 2 additional locomotive hours for each train from and to Blantyre are required, and
- The lead time between Nacala and Blantyre is increased by about 1 hour.

Accordingly, it is proposed to upgrade Nkaya station through

- Re-assembly of Turnouts No. 3 and 4, and rehabilitation of Tracks No. 3 and 4,
- An additional link from Liwonde to Track No. 1 in order to allow simultaneous entries/exits from or to Liwonde and Blantyre,
- A paved access road,
- Repair and extension of buildings,
- Power supply, and
- 2 spurs and a fuel station for diesel locomotives.

#### 5.5.1.2 Loop line extensions

Between Blantyre and Salima, the length of loop lines is only 292 through 313 metres at 9 stations. To cope with the future demand, these loops should be extended to at least 457 metres.

Draft layout schemes for the Nkaya station upgrade and the loop line extensions are attached as Annex 5.5.1.

#### 5.5.1.3 Regular braking distance

Regular braking distance is defined as 400 metres at present, which means that speed must be adjusted in a way that the train can be brought to a halt within this distance under any circumstances. To observe this, train speed must be reduced accordingly at every steep slope.



In view of the difficult alignment on almost all sections, it is recommended to increase regular braking distance generally to 1000 metres according to international standards, and to update rules and regulations accordingly.

#### 5.5.1.4 Further development

After rehabilitation according to section 4 and the upgrades as outlined above, the network capacity will be adequate for the safeguarded traffic (section 5.2.1). On the Blantyre – Nkaya – Chiptata sections, even with the additional traffic potentials as listed in section 5.2.2, no capacity constraints must be expected. Such constraints may occur between Nacala and Nkaya, however, requiring further development of the network if such additional traffic occurs, e.g. through restoring stations that have been previously abandoned.

### 5.5.2 Signalling and Telecommunications

For safety and efficient management of operations, a signalling system is indispensable. To achieve a cost-efficient solution, a GPS based system is proposed for the entire network (in all three countries) with a base station at *one* central control office and user equipments in all locomotives as well as the stations. Only a technically mature system should be selected. Depending on market availability and local conditions, base station and users may be connected through satellite or GSM or both.

#### 5.5.3 Cost estimate

As can be seen in detail from Annex 5.5.3, the costs for the loop line extensions and Nkaya station upgrade according to section 5.5.1 are estimated as 5.37 million US \$. For the signalling equipment, a rough estimate results in 8.73 m US \$ for the entire network, thereof 3.75 m US \$ for Malawi.

### 5.6 Rolling stock

#### 5.6.1 Motive power

In general, the maximum train load that can be moved from standstill (starting load) is proportional to the adhesive mass of the locomotive. Therefore, use of heavier locomotives would decrease not only the demand into motive power but also number of trains. Moreover, modern locomotives have anti-slip protection systems allowing even greater starting loads through more efficient adhesion.

Adhesive mass, output rating, reliability and availability of all existing locomotives are unsatisfactory. It cannot be expected to maintain these locos beyond 2015 without general rehabilitation - which cannot be carried out in Malawi or Mozambique.

According to the Operating Programme 2012, 31 locomotives of the existing type would be required to haul 2.03 m gross tonnes p.a. In comparison, the Operating Programme 2016 requires only 18 modern locomotives with 18 tonnes axle load for 2.76 m gross tonnes p.a.

Therefore, it is recommended to keep the existing locomotives running for a transition period with minimum maintenance and repair as required, and to use exclusively new locomotives afterwards.

Initially, by 2016 a number of 19 new locomotives (including 1 spare) will be required for the long-distance freight trains. Depending on the growth of traffic, this number may have to be increased up to 25 in 2028.

### 5.6.2 Wagon pool

The wagons of the existing fleet - all with plain-bearing axle boxes - have been designed for the present 15 tonnes axle load, so that it is not possible to increase their load capacity, both in terms of tonnes and cubic content. Wagons are 30 to 40 years old, but their condition suggests that they cannot be maintained until the end of their usual lifetime.

In view of the limited capacity and outdated technology, it is recommended to replace the entire wagon fleet through modern wagons with roller-bearing axle boxes and adequate load and cubic capacity. Whether some of the existing flat wagons for container transport can be equipped with air brakes and maintained for a certain period must be determined under economic criteria. To further reduce empty runs, the possibility of enhanced use of special wagons should be looked into, such as for wheat grain (import) and bulk sugar (export).

The recommendation to renew the entire fleet is also supported through the results of the Operating Programmes, where the wagon usage with existing types (2012) would be 1.32 million tonne-kilometres per wagon and year against 1.92 million tonne-kilometres in 2016.

To arrive at the number of wagons required, commercial times have been added to the mere lead time as follows:

<i>Time for</i>	<i>hours</i>
Put at disposal	4
Loading/unloading	12
Collection	4
Wait for train	16
<i>Total loaded run</i>	<i>56</i>
<i>Total empty run</i>	<i>24</i>

Accordingly, for the Operating Programme 2016 an initial stock of 732 new wagons is required, thereof

- 67 High sided bogie (Ea/HSB),
- 120 Covered bogie (Ga/CB),
- 423 Flat bogie for containers (Sg/U),
- 36 Food grain hoppers (Tag/BB), and
- 86 Tanker bogie (Za/FT).

Depending on the growth of traffic, this number may have to be increased up to 949 in 2029.

### **5.6.3 Brakes**

The vacuum brake system has been replaced through air brakes by most railways worldwide. This is due to technical limitations such as brake power being determined by the size of brake cylinders, low propagation and high release time, high exhaustibility, brake fade and brake power deterioration.

Consequently, it is recommended that in course of the rolling stock renewal all new vehicles should be equipped with air brakes according to UIC standard. For a transition period that may be between 5 and 10 years, the compatibility problem must be coped with, that means locomotives must have *both* air and vacuum brake.

### **5.6.4 Cost estimate**

The initial investment for the new rolling stock pool (for the entire network) is estimated as

- 95.0 m US \$ for 19 locomotives (5.0 m US \$/loco), and
- 65.9 m US \$ for 732 wagons (90,000 US \$/wagon).

Using the locomotive kilometres from the Operating Programme 2016 as parameter, out of these amounts 37.1 m US \$ for locos and 25.8 m US \$ for wagons (39% each) would have to be allocated to Malawi's part of the network.

## **5.7 Economic viability**

### **5.7.1 General approach**

An economic appraisal has to consider both financial viability from the concessionaire's and economic viability from the public view. Though a detailed evaluation is beyond the scope of this study, a basic assessment has been carried out as outlined in the sections below.

The economic appraisal has been confined to benefits from transport cost differences between road and rail, and from time costs. Additional benefits will arise from reduced environmental and accident costs, and through local employment during the rehabilitation phase,

for example through re-opening the quarries at Limbulila and Sharpevale, and rehabilitation and maintenance works.

### 5.7.2 Capital costs

The investments for infrastructure for the entire network are summarised in the table below:

m US \$	Track		Network Development		Bridges	
	Rehabilitation	Renewal	Infrastructure	S & T	Rehabilitation	Renewal
Malawi	83.81	124.15	5.37	3.75	9.67	4.53
Mozambique	75.22	20.30	15.00	4.88	9.83	4.60
Zambia			1.61	0.10		
<b>Total</b>	<b>159.03</b>	<b>144.45</b>	<b>21.98</b>	<b>8.73</b>	<b>19.50</b>	<b>9.13</b>

For Malawi, the amounts comprise the estimates according to sections 4.3 and 5.5.3.

Concerning Mozambique, the investments required have been roughly estimated for

- Track rehabilitation Nacala – Cuamba (533 kilometres),
- Track renewal Cuamba – Entré Lagos – Border (78 kilometres),
- Renewal of 95 turnouts in through lines,
- Upgrading the Nacala Port with loading/unloading equipment 5,
- Signalling according to Annex 5.5.3, and
- Bridge rehabilitation/renewal on basis of the average cost per kilometre in Malawi.

Infrastructure investments for Zambia consist of the costs for railways as estimated in the Pre-feasibility Study for the Chipata Dry Port <sup>6</sup>, and for signalling equipment according to Annex 5.5.3.

The initial investments for rolling stock will be 160.88 m US \$. As outlined in sections 5.6.1 and 5.6.2 above, increasing traffic will require additional investments of up to 49.53 m US\$ in the years 2017 through 2029. For further details refer to the table in Annex 5.7.2.1.

Railway assets are generally characterised through a long lifetime as shown in the table below:

<sup>5</sup> The total investment for upgrading the port would amount to approx. 35 m US \$, but the full amount has not been taken into account because benefits will not only apply to the railways but also to sea traffic and local development.

<sup>6</sup> Exchange rate used: 1 US \$ = 5.65 ZMK\*10<sup>-9</sup>

<b>Lifetime of assets [years]</b>	
Track, rehabilitated	20
Track, new	40
Signalling	25
Bridge, rehabilitated	50
Bridge, new	100
Locomotive, new	35
Wagon, new	50

Consequently, after a period of 20 years there will be still considerable residual values. As can be seen in detail from the Investment and Depreciation Table in Annex 5.7.2.2, these would be (for the entire network) by the end of the year 2029

- 138.1 m US\$ for infrastructure, and
- 134.7 m US \$ for rolling stock.

### **5.7.3 Operations and Maintenance costs**

As input data for the financial evaluation, costs of operation and maintenance have been estimated on basis of CEAR's preliminary figures for 2008 as

- a fixed base amount of 6.65 m US \$ p.a. for Malawi, or 13.30 m US \$ for the entire network respectively, plus
- 1.0125 cents per tonne-kilometre.

### **5.7.4 Financial viability, network access fees and rail tariffs**

The results of the financial evaluation for the entire network with a tariff range from 4 to 6 cents per tonne-kilometre are shown in the table below:

Year	Investments		Capital Costs	O & M Costs	Tonne-km Network	Traffic Revenue with			Net Benefit with		
	Infra-structure	Rolling Stock				4	5	6	4	5	6
						cents / Tonne-km			cents / Tonne-km		
2009	6.00		-6.00	-17.20	385.26	15.41	19.26	23.12	-7.79	-3.94	-0.09
2010	52.69		-52.69	-17.39	404.34	16.17	20.22	24.26	-53.91	-49.87	-45.82
2011	101.38	40.22	-141.60	-17.59	423.42	16.94	21.17	25.41	-142.25	-138.02	-133.78
2012	101.38	40.22	-141.60	-22.31	889.81	35.59	44.49	53.39	-128.32	-119.42	-110.52
2013	101.38	40.22	-141.60	-25.15	1170.52	46.82	58.53	70.23	-119.93	-108.23	-96.52
2014		40.22	-40.22	-26.10	1264.59	50.58	63.23	75.88	-15.74	-3.09	9.55
2015			0.00	-27.07	1360.30	54.41	68.01	81.62	27.34	40.94	54.55
2016			0.00	-27.54	1406.91	56.28	70.35	84.41	28.73	42.80	56.87
2017		1.35	-1.35	-27.83	1435.05	57.40	71.75	86.10	28.22	42.57	56.92
2018		6.35	-6.35	-28.12	1463.75	58.55	73.19	87.83	24.08	38.72	53.35
2019		1.35	-1.35	-28.42	1493.03	59.72	74.65	89.58	29.95	44.88	59.81
2020		6.44	-6.44	-28.72	1522.89	60.92	76.14	91.37	25.76	40.99	56.21
2021		1.44	-1.44	-29.03	1553.35	62.13	77.67	93.20	31.67	47.20	62.73
2022		1.44	-1.44	-29.34	1584.41	63.38	79.22	95.06	32.59	48.44	64.28
2023		11.53	-11.53	-29.66	1616.10	64.64	80.81	96.97	23.45	39.61	55.77
2024		1.53	-1.53	-29.99	1648.42	65.94	82.42	98.91	34.42	50.90	67.39
2025		6.53	-6.53	-30.32	1681.39	67.26	84.07	100.88	30.40	47.22	64.03
2026		1.62	-1.62	-30.66	1715.02	68.60	85.75	102.90	36.32	53.47	70.62
2027		1.62	-1.62	-31.01	1749.32	69.97	87.47	104.96	37.34	54.83	72.33
2028		6.62	-6.62	-31.37	1784.31	71.37	89.22	107.06	33.39	51.23	69.07
2029	-138.11	-134.65	272.77	-31.73	1819.99	72.80	91.00	109.20	313.84	332.04	350.24
<b>Totals</b>			<b>-298.76</b>	<b>-566.57</b>	<b>28372.18</b>	<b>1134.89</b>	<b>1418.61</b>	<b>1702.33</b>	<b>269.56</b>	<b>553.28</b>	<b>837.00</b>
									NPV	-181.75	30.28
									FIRR	3.6%	11.1%

Accordingly, the projects would seem financially feasible with a tariff of minimum 5 cents per tonne-kilometre.

Due to the huge maintenance backlog, the results are less favorable if the evaluation is confined to Malawi's part of the network:

Year	Investments		Capital Costs	O & M Costs	Tonne-km Malawi	Traffic Revenue with					Net Benefit with				
	Infra-structure	Rolling Stock				4	5	6	7	8	4	5	6	7	8
						cents / Tonne-km					cents / Tonne-km				
2008			0.00	-7.13	47.41	2.83					-4.30				
2009	6.00	0.00	-6.00	-7.75	108.25	4.33	5.41	6.49	7.58	8.66	-9.42	-8.33	-7.25	-6.17	-5.09
2010	33.90	0.00	-33.90	-7.79	112.28	4.49	5.61	6.74	7.86	8.98	-37.19	-36.07	-34.95	-33.83	-32.70
2011	63.80	15.72	-79.52	-7.83	116.30	4.65	5.82	6.98	8.14	9.30	-82.69	-81.53	-80.37	-79.20	-78.04
2012	63.80	15.72	-79.52	-9.89	320.13	12.81	16.01	19.21	22.41	25.61	-76.60	-73.40	-70.20	-67.00	-63.80
2013	63.80	15.72	-79.52	-11.12	441.73	17.67	22.09	26.50	30.92	35.34	-72.97	-68.55	-64.14	-59.72	-55.30
2014	0.00	15.72	-15.72	-11.52	480.68	19.23	24.03	28.84	33.65	38.45	-8.01	-3.20	1.60	6.41	11.22
2015	0.00	0.00		-11.92	520.27	20.81	26.01	31.22	36.42	41.62	8.89	14.10	19.30	24.50	29.70
2016	0.00	0.00		-12.10	538.03	21.52	26.90	32.28	37.66	43.04	9.42	14.80	20.18	25.56	30.95
2017	0.00	1.35		-12.21	548.80	21.95	27.44	32.93	38.42	43.90	9.75	15.23	20.72	26.21	31.70
2018	0.00	6.35		-12.32	559.77	22.39	27.99	33.59	39.18	44.78	10.07	15.67	21.27	26.87	32.46
2019	0.00	1.35		-12.43	570.97	22.84	28.55	34.26	39.97	45.68	10.41	16.12	21.83	27.54	33.25
2020	0.00	6.44		-12.55	582.39	23.30	29.12	34.94	40.77	46.59	10.75	16.57	22.40	28.22	34.04
2021	0.00	1.44		-12.66	594.03	23.76	29.70	35.64	41.58	47.52	11.10	17.04	22.98	28.92	34.86
2022	0.00	1.44		-12.78	605.91	24.24	30.30	36.35	42.41	48.47	11.45	17.51	23.57	29.63	35.69
2023	0.00	11.53		-12.91	618.03	24.72	30.90	37.08	43.26	49.44	11.81	17.99	24.17	30.35	36.54
2024	0.00	1.53		-13.03	630.39	25.22	31.52	37.82	44.13	50.43	12.18	18.49	24.79	31.09	37.40
2025	0.00	6.53		-13.16	643.00	25.72	32.15	38.58	45.01	51.44	12.56	18.99	25.42	31.85	38.28
2026	0.00	1.62		-13.29	655.86	26.23	32.79	39.35	45.91	52.47	12.94	19.50	26.06	32.62	39.18
2027	0.00	1.62		-13.42	668.98	26.76	33.45	40.14	46.83	53.52	13.34	20.03	26.72	33.41	40.09
2028	0.00	6.62		-13.56	682.36	27.29	34.12	40.94	47.77	54.59	13.74	20.56	27.38	34.21	41.03
2029	-95.17	-77.18	172.35	-13.70	696.01	27.84	34.80	41.76	48.72	55.68	186.49	193.45	200.41	207.37	214.33
<b>Totals</b>			<b>-121.82</b>	<b>-247.93</b>	<b>10694.18</b>	<b>427.77</b>	<b>534.71</b>	<b>641.65</b>	<b>748.59</b>	<b>855.53</b>	<b>58.02</b>	<b>164.96</b>	<b>271.90</b>	<b>378.84</b>	<b>485.78</b>
											NPV	-146.95	-107.76	-68.584	9.78
											FIRR	1.3%	3.7%	6.0%	10.6%

Consequently, an average tariff of 6 cents per tonne-kilometre seems realistic and has been applied for the economic appraisal.

From the view of the concessionaire, financial viability largely depends on traffic revenue vs. O & M costs. The latter include the network access fee charged by the network owner. Taking into account the Government's obligation to ensure adequate supply of appropriate means of transport to Malawi's population and economy, the network access fee should not be assessed only in order to recover the infrastructure investments, but should also consider financial feasibility from the concessionaire's side. Accordingly, it should be carefully considered whether the network access fee should be measured by performance (e.g. gross tonne kilometres) instead of fixing a lump sum.

#### **5.7.5 Benefits**

Benefits have been evaluated commodity-wise on basis of the findings of the "Malawi Transport Cost Study" by TERA International Group, Inc., April 2005.

The costs used in this study refer to the year 2003, however. Accordingly, unit costs have been updated as follows:

- 2.34 US\$ per vehicle kilometer equal to 10 cents per tonne kilometre for road transport <sup>7</sup>, and
- with a factor of 1.4 for sea transport <sup>8</sup>

As can be seen in detail from the table in Annex 5.7.5.1, economical benefits have been estimated as

- cost difference (according to assumed tariffs) between road and rail transport, also taking into account the different costs of sea transport from different ports, and
- time costs resulting from lead time differences, using interest rates of 15% for the sea leg and 30% for the land transport.

A table of annual economic benefits is attached as Annex 5.7.5.2.

#### **5.7.6 Economic appraisal**

The table below shows that the project is economically viable under the precondition of a regional approach:

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<sup>7</sup> On the basis of Raballand, G. and Macchi, P., 2009: Transport Prices and Costs: The Need to Revisit Donors' Policies in Transport in Africa; based on: Teravaninthorn, S. and Raballand, G., 2008: Transport Prices and Cost in Africa: A Review of the Main International Corridors. World Bank: Washington D.C.

<sup>8</sup> According to HGCA, IGC and USDA publications



Year	Capital Costs	O & M Costs	Total Costs	Gross Benefits			Net Benefit	
				Zambia	Malawi	Mozambique	with Zambia	without Zambia
2009	-6.00	-17.20	-23.20	0.00	44.76	0.41	21.96	21.96
2010	-52.69	-17.39	-70.08	0.00	49.70	0.42	-19.97	-19.97
2011	-141.60	-17.59	-159.19	0.00	51.46	0.43	-107.29	-107.29
2012	-141.60	-22.31	-163.91	59.24	53.26	0.45	-50.97	-110.20
2013	-141.60	-25.15	-166.75	94.25	55.12	0.47	-16.91	-111.17
2014	-40.22	-26.10	-66.32	103.77	57.05	0.48	94.98	-8.79
2015	0.00	-27.07	-27.07	113.45	59.05	0.50	145.92	32.47
2016	0.00	-27.54	-27.54	117.51	61.11	0.52	151.60	34.08
2017	-1.35	-27.83	-29.18	119.86	62.34	0.53	153.54	33.68
2018	-6.35	-28.12	-34.47	122.26	63.58	0.54	151.91	29.65
2019	-1.35	-28.42	-29.77	124.70	64.85	0.55	160.34	35.63
2020	-6.44	-28.72	-35.16	127.20	66.15	0.56	158.75	31.55
2021	-1.44	-29.03	-30.47	129.74	67.47	0.57	167.32	37.58
2022	-1.44	-29.34	-30.78	131.76	68.82	0.58	170.38	38.62
2023	-11.53	-29.66	-41.19	133.81	70.20	0.59	163.41	29.60
2024	-1.53	-29.99	-31.52	135.89	71.60	0.61	176.58	40.69
2025	-6.53	-30.32	-36.85	138.00	73.04	0.62	174.80	36.80
2026	-1.62	-30.66	-32.28	140.15	74.50	0.63	182.99	42.84
2027	-1.62	-31.01	-32.63	142.33	75.99	0.64	186.33	44.00
2028	-6.62	-31.37	-37.99	144.55	77.51	0.65	184.72	40.17
2029	272.77	-31.73	241.04	146.80	79.06	0.67	467.56	320.76
<b>Totals</b>	<b>-298.76</b>	<b>-566.57</b>	<b>-865.33</b>	<b>2225.27</b>	<b>1346.60</b>	<b>11.41</b>	<b>2717.94</b>	<b>492.68</b>
NPV							733.37	-40.80
EIRR							47.1%	8.1%

It should be noted that the major part of benefits would arise from Zambia traffic due to the transportation distance. Therefore, the implementation of the Chipata Dry Port is of vital importance for the region. The imbalance of benefits should also be taken into account when elaborating the loan conditions for financing.

### 5.7.7 Risk assessment

Assuming the implementation of the rail extension to and the Dry Port at Chipata, potential risks are

- a lower traffic growth than assumed,
- an increase in rail operation and maintenance costs, and
- a decrease in road tariffs (“price war”).

The table below shows that the project remains viable even if traffic remains constant from 2014 onwards:



Year	Capital Costs	O & M Costs	Total Costs	Gross Benefits			Net Benefit
				Zambia	Malawi	Mozambique	
2009	-6.00	-17.20	-23.20	0.00	44.76	0.41	21.96
2010	-52.69	-17.39	-70.08	0.00	49.70	0.42	-19.97
2011	-141.60	-17.59	-159.19	0.00	51.46	0.43	-107.29
2012	-141.60	-22.31	-163.91	59.24	53.26	0.45	-50.97
2013	-141.60	-25.15	-166.75	94.25	55.12	0.47	-16.91
2014	-40.22	-26.10	-66.32	103.77	57.05	0.48	94.98
2015		-26.10	-26.10	103.77	57.05	0.50	135.22
2016		-26.10	-26.10	103.77	57.05	0.50	135.22
2017		-26.10	-26.10	103.77	57.05	0.50	135.22
2018		-26.10	-26.10	103.77	57.05	0.50	135.22
2019		-26.10	-26.10	103.77	57.05	0.50	135.22
2020		-26.10	-26.10	103.77	57.05	0.50	135.22
2021		-26.10	-26.10	103.77	57.05	0.50	135.22
2022		-26.10	-26.10	103.77	57.05	0.50	135.22
2023		-26.10	-26.10	103.77	57.05	0.50	135.22
2024		-26.10	-26.10	103.77	57.05	0.50	135.22
2025		-26.10	-26.10	103.77	57.05	0.50	135.22
2026		-26.10	-26.10	103.77	57.05	0.50	135.22
2027		-26.10	-26.10	103.77	57.05	0.50	135.22
2028		-26.10	-26.10	103.77	57.05	0.50	135.22
2029	232.47	-26.10	206.36	103.77	57.05	0.50	367.68
<b>Totals</b>	<b>-291.24</b>	<b>-517.30</b>	<b>-808.55</b>	<b>1813.83</b>	<b>1167.09</b>	<b>10.14</b>	<b>2182.52</b>
						NPV	597.42
						EIRR	44.1%

Even an assumed increase of rail O&M costs per tonne-kilometre by 250% with simultaneous decrease in road transportation costs from 10 to 8 cents per tonne-kilometre still results in economic viability:

Year	Capital Costs	O & M Costs	Total Costs	Gross Benefits			Net Benefit
				Zambia	Malawi	Mozambique	
2009	-6.00	-23.05	-29.05	0.00	31.68	0.16	2.79
2010	-52.69	-23.53	-76.22	0.00	35.22	0.17	-40.84
2011	-141.60	-24.02	-165.62	0.00	36.47	0.17	-128.97
2012	-141.60	-35.82	-177.42	40.12	37.74	0.18	-99.39
2013	-141.60	-42.93	-184.53	63.72	39.06	0.19	-81.56
2014	-40.22	-45.31	-85.53	70.13	40.43	0.19	25.22
2015	0.00	-47.73	-47.73	76.65	41.84	0.20	70.96
2016	0.00	-48.91	-48.91	79.40	43.31	0.21	74.00
2017	-1.35	-49.62	-50.97	80.99	44.17	0.21	74.40
2018	-6.35	-50.35	-56.70	82.61	45.06	0.21	71.18
2019	-1.35	-51.09	-52.44	84.26	45.96	0.22	78.00
2020	-6.44	-51.85	-58.29	85.94	46.88	0.22	74.76
2021	-1.44	-52.62	-54.06	87.66	47.82	0.23	81.65
2022	-1.44	-53.41	-54.85	89.03	48.77	0.23	83.19
2023	-11.53	-54.21	-65.74	90.41	49.75	0.24	74.66
2024	-1.53	-55.03	-56.56	91.82	50.74	0.24	86.24
2025	-6.53	-55.86	-62.39	93.24	51.76	0.25	82.86
2026	-1.62	-56.71	-58.33	94.69	52.79	0.25	89.41
2027	-1.62	-57.58	-59.20	96.17	53.85	0.26	91.07
2028	-6.62	-58.46	-65.08	97.66	54.93	0.26	87.77
2029	272.77	-59.37	213.40	99.18	56.02	0.27	368.87
<b>Totals</b>	<b>-298.76</b>	<b>-997.46</b>	<b>-1296.23</b>	<b>1503.68</b>	<b>954.26</b>	<b>4.55</b>	<b>1166.27</b>
						NPV	155.26
						EIRR	15.6%

## 5.8 Financing scenario

In view of the condition of the infrastructure as analysed in 3.1 above, it must be emphasised that the investments according to the proposal for network rehabilitation (section 4) are indispensable in order to keep the railway operational even in the short-term. Therefore, any cutback cannot be considered even in view of fiscal constraints.

Due to the considerable investment required and the long lifetime of assets, it seems indicated to continue the present Public – Private – Partnership (PPP) with the Governments retaining the ownership of the network. Accordingly, the rehabilitation of the infrastructure requires public financing. An international group of donors consisting of Millennium Challenge Corporation (MCC), European Investment Bank (EIB), African Development Bank (AfDB) and World Bank (WB) evaluate financing possibilities at present. Activities will be possibly co-ordinated by the World Bank. EIB has emphasized the importance of maintenance components to be included in the loan scheme.

There are basically three options for the financing of rolling stock investments:

- Private financing by the concessionaire (assuming that CDN and CEAR merge),
- Public financing through the Governments (with leasing agreements with the conces-

sionaire), or

- Private financing by a separate rolling stock company.

The latter could be for example a manufacturer bringing in own rolling stock under license of the Governments.

## 5.9 Institutional framework

### 5.9.1 Tasks and responsibilities of the Government in general

The Government has to ensure adequate supply to population and economy through appropriate means of transport.

This has to be achieved through

- Legislation
- Planning, monitoring and control

At present,

- The legal framework for the transport sector is fragmentary and largely outdated
- There are neither a comprehensive Transport Master Plan nor adequate tools for monitoring and control
- In the scenario of privatisation, matters are dealt with on contractual basis rather than legislation

This results in

- The Government's inability to effectively control the transport sector
- Poor performance and high costs of transportation
- Severe deterioration of infrastructure and equipment

Accordingly, it is recommended that the Government

- Establish an adequate legal framework
- Elaborate a Transport Master Plan defining the role of the various modes of transport
- Define a conveyance obligation for basic goods and passengers
- Set up Regulatory Bodies to monitor and control the various modes of transport
- Define responsibilities for further development of the Master Plan and co-ordination between the various modes of transport

### 5.9.2 Tasks and responsibilities of MOTPW for the railway sector

The aforementioned complex of problems applies to the railway sector in particular.

Due to the unsatisfactory results, the 1999 concession contract has been reviewed since a considerable time with support of the Privatisation Commission and a consultant. A draft version is expected to be finalised by mid-May, but is unlikely to be evaluated before mid-June in view of the elections. But even this revised agreement is likely to fail again - for the lack of a sound legal basis and of adequate administrative tools to enforce its provisions, particularly in view of the recent changes of the share holder's structure.

It is, therefore, recommended that MOTPW - rather than pursuing the review of an agreement that lacks both structure and clear provisions -

- Draft a new Railway Act (including a clear separation of operations from infrastructure) and submit to the Cabinet at the earliest
- Pass the by-law required for general standards, rules and regulations, this also to provide the possibility to have several concessionaires
- Set up a Regulatory Authority
- Only then elaborate a fresh concession agreement on basis of samples proven successful elsewhere

Consequently, the legal framework would take precedence over the contractual provisions, and the latter had to be confined to issues specific to the actual agreement, particularly

- Share holder's financial capacity and expected investments
- Concessionaire's operational and technical capability
- Concessionaire's staffing, experience and know-how
- Network access fees, accounting and audit, penalties

### **5.9.3 Share holder's structure and capacity**

CEAR, CDN and PN are under the same share holding company. The share holder's structure has undergone considerable changes recently, and changes are likely to continue. After the withdrawal of RDC, the INSITEC group is now the main share holder (51%) and aiming at an absolute majority.

None of the reserved shares have been acquired by Malawian investors as yet, but negotiations with CFM are on the way in order to release some of their (presently 33%) shares to be offered to the Government of Malawi. Malawi is currently not represented in the board of directors.

A new management model is being introduced with an Executive Committee for management of the Nacala Corridor, consisting of CDN and CEAR board members, which is likely to be announced presently.

The financial capacity and capability is not clearly defined. The share holder's general business plan shows about 150 m US \$ investments for the entire corridor but does not indicate the period of investment.

Amounts and kind of short-term investments suggest their nature of emergency measures - just to keep the railway in running condition - and do neither consider nor ensure the transport of the envisaged amounts of freight. Proposed short-term investments are

- 10 m US\$ for CEAR in general, thereof about 50% for infrastructure material, but no new rolling stock and no workshop upgrade,
- 20 m US\$ for CDN including 4 new locos, 200,000 US\$ for signaling, and 9.5 m US\$ for repair of the Cuamba - Entré Lagos section, and
- 10 m US\$ for the Nacala Port.

The proposed investments are not clearly structured and not properly coordinated. Moreover, actual costs are expected to exceed the amounts as proposed by far. For example, for a new locomotive that costs about 5 m US \$, only 650,000 US \$ are provided. The amounts proposed for the Cuamba - Entré Lagos section and the Nacala Port may be just sufficient for the most urgent repairs.

The little amount proposed for CEAR that is in much worse condition than CDN suggests further disadvantage for Malawi's part of the network.

#### **5.9.4 Concessionaire's organisation and capacity**

CEAR have no adequate organisational structure, i.e. the basic departments required to operate any railway have never been properly established. Neither CEAR nor their share holding company have sufficient experience in operating a railway.

Staffing cutbacks beyond an acceptable level affect operations and maintenance. Continuity of know-how transfer from generation to generation has been interrupted. About 20% of the staff haven't got any education at all, and the qualification of most of the educated staff is not sufficient for their respective positions.

In view of the above, it is recommended

- That the concessionaire establish partnership with an experienced rail operator, or employ foreign experts as advisers for up to 2 years,
- That the concessionaire implement an adequate organisational structure, and
- To outsource the maintenance of the infrastructure to an independent private Rail Infrastructure Construction and Maintenance Company.

In addition, a separate rolling stock company (see also section 5.8) should be considered.

### 5.9.5 Proposed structure of the rail sector

On basis of the analyses in sections 5.9.1 – 5.9.4 above, main requirements for restructuring the rail sector are

- An adequate legal framework,
- Integration of policy and implementation including a Regulatory Authority for continuous monitoring and control of the execution of concession agreement(s), and
- Clear separation of infrastructure from operations.

Accordingly, and assuming that the Government retains ownership of the infrastructure, the concessionaire's tasks must be basically confined to operations, whereas an independent private Rail Infrastructure Construction and Maintenance Company reporting directly to the Regulatory Authority has to be put in charge of construction, rehabilitation and maintenance of the infrastructure.

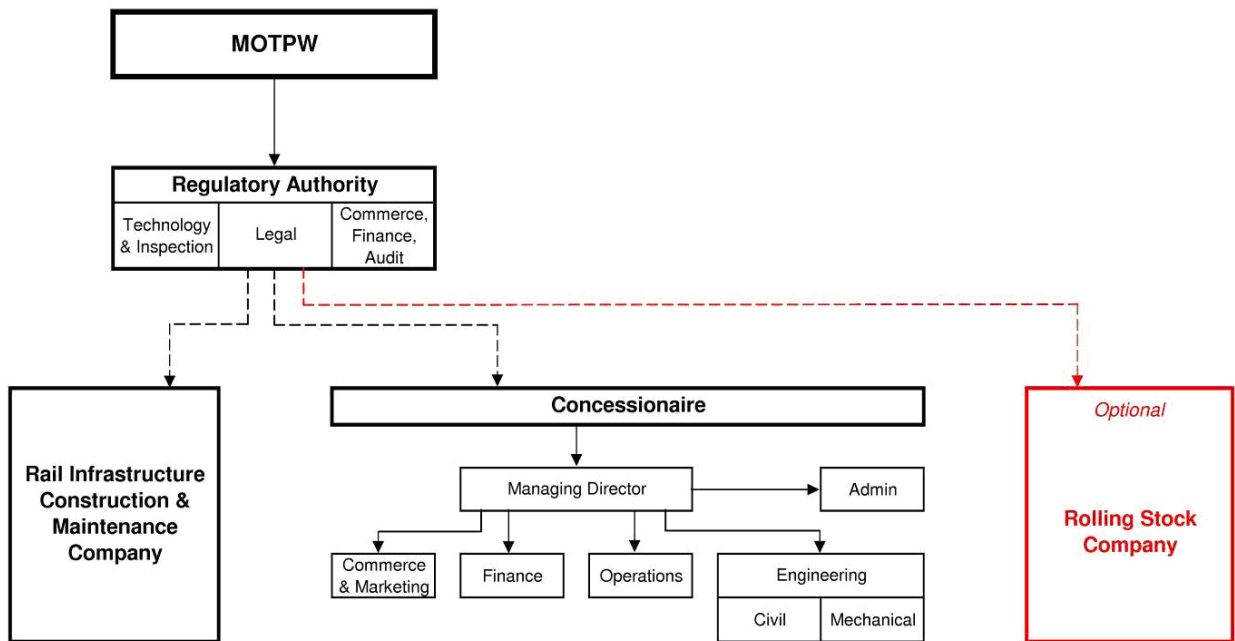
Considering a possible further segmentation of tasks and responsibilities such as rolling stock and/or different business lines, the comparatively small size of the enterprise must be taken into account. Therefore, it is expected that the Rail Infrastructure Construction and Maintenance Company suggested will have to extend business all over the Nacala Corridor railway in order to operate successfully; the same goes for the optional Rolling Stock Company. In view of the inconsiderable passenger traffic a split into various business lines seems not advisable at present.

The operating programme (5.4) shows that the railway can be only operated economically as consistent network stretching over Mozambique, Malawi and Zambia. To achieve smooth and step-less services through from Nacala to Chipata and Limbe, operations as well as monitoring and control should be ideally each in one hand. In other words, the optimum solution would be to have *one* operator and *one* Regulatory Authority for the entire Nacala Corridor railway.

Though an investigation into the political and legal aspects of such a solution would be beyond the scope of this study, it is recommended that the Governments concerned consider a Treaty on the Nacala Corridor Railway implying

- Harmonised legal frameworks,
- A common Regulatory Authority, and
- A common policy for granting concessions.

Provided such treaty turns out feasible, the institutional structure will be as shown in the chart below:



## **6 Further Technical Assistance**

To successfully implement the proposed actions, further Technical Assistance will be indispensable.

In particular, Technical Assistance will be required for

- The infrastructure rehabilitation including the emergency programme,
- Setting up the legal framework, standards, rules and regulations,
- Setting up the Regulatory Authority, including training and operations & construction management for the rehabilitation, and
- To draft a fresh concession agreement.

In total, an input of approximately 54 man-months will be required over a period of 2.5 years.

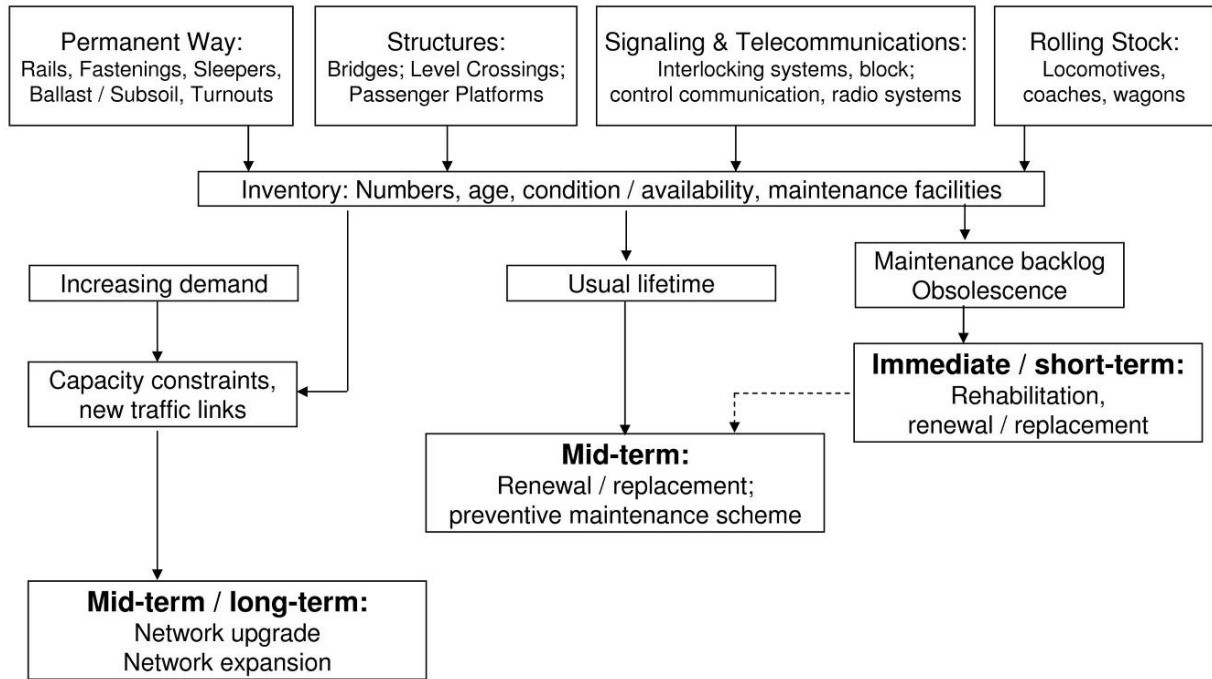
For the scope of work and further details refer to Annex 6.



**Demand model, capacity considerations,  
assets management and development**



## Assets Management and Development



Annex 1.3.4

**Site survey diary**

**Site Survey Diary*****Wednesday 11.02.09***

By car:

Access to Utale station failed (muddy road)

Bilila station,

Bridges No. 919 (steel girder, 2.40 m) and 920 (steel girder, 2.90 m)

Track km 373.7 - 374.0 (before Kasinje),

Bridge No. 1024 (steel girder, 3 x 15.11 m)

***Wednesday 18.02.09***

By car:

Kanengo Station

***Tuesday 03.03.09***

By car:

Mchinji station and Curve No. 913 upto km 683.7

Along the track from km 685.2 upto Zambian border

Bridge No. 1647 km 651.7 (concrete deck, 8 x 15.85 m)

Bridge No. 1646 km 648.3 (5 pipes 3.93 m each)

Track km 594.3 - 595.0 and Bridge No. 1566 (concrete deck, 3 x 15.85 m)

***Friday 06.03.09***

By trolley:

Kanengo -Chipala

Kanengo	(km 575.4)	10:50	
Bridge No. 1523	(km 569.0, track cleaning)	11:04 / 11:12	(27.4 km/h)
Track cleaning	(km 567.5)	11:14	(35.0 km/h)
Track cleaning	(km 567.4)	11:20	
Track cleaning	(km 558.2)	11:39 / 11:41	(29.1 km/h)
Nankhanga	(km 547.4, crossing Work Train)	12:04 / 12:13	(28.2 km/h)
Bridge No. 1433	(km 520.8)	13:05 / 13:20	(30.7 km/h)
Chipala	(km 507.2)	13:52	(25.5 km/h)

By car:

Salima station

Chipoka station and port

**Thursday 12.03.09**

On locomotive Train No. 305:  
Lambulila - Balaka

**Friday 13.03.09**

By trolley:

Lirangwe - Balaka		
Lirangwe	(km 248.3)	10:56
Namatunu	(km 261.6)	11:24 (28.5 km/h)
Shire North entry point	(km 275.4)	11:51 (30.7 km/h)
Shire North	(crossing Train No. 200)	11:54 / 13:22
Shire North exit point	(km 275.9)	13:25
Utale	(km 288.4)	13:46 (35.7 km/h)
Nkaya	(km 297.1)	14:04 (29.0 km/h)
Balaka	(km 313.2)	14:34 (32.2 km/h)

**Saturday 14.03.09**

By car:

Track km 332.465 (Level Crossing) - 332.300,  
Bridge No. 911 (rail frame, 0.91 m)

Track km 341.345 - 341.800 (Penga-Penga),  
Bridge No. 935 (steel girder, 2 x 6.50+15.30 m)

Track km 357.15 - 357.72 (Bwanje),  
Bridges No. 981 (steel girder, 17.00 m), 982 and 983 (rail frames 0.91m)

Bridge No. 1028 (km 376.30, steel girder, 2 x 7.62 m)

Track km 394.5 - 394.2, 393.2 - 392.9

Bridge No. 1062 (steel girder, 4.58 m)

Bridge No. 1061 (steel girder, 2 x 17.00 + 1 x 15.60 m)

**Friday 17.04.09**

By trolley:

Luchenza – Makhanga - Luchenza

**Stakeholders meetings**

## Stakeholders meetings

Date	Location	Participants	Subject
09.02.2009	EC-Delegation, Lilongwe	Jocelin Cornet	Kick-off meeting
09.02.2009	MOTPW, Lilongwe	Victor Lungu Patrick G.J. Lapukeni	Kick-off meeting
10.02.2009	CEAR, Limbe	Hendry Chimwaza Kondwani Mkonda	Data collection
26.02.2009	EC-Delegation, Lilongwe	Railway task force meeting	
04.03.2009	MOTPW, Lilongwe	Patrick G.J. Lapukeni Dr. Charles K. Kaira	Site survey
19.03.2009	MoT, Maputo	Jose Albano Lourenco Junior, Secretario Permanente Catherine Zamaere, Embassy of Malawi Ana Dimonde, MoT Teresa Jeremias, MoT Andre Couto, CDN Agostinho F. Langa Jr., PN	Coordination of activities
19.03.2009	INSITEC, Maputo	Jiva Remtula, INSITEC Catherine Zamaere, Embassy of Malawi	Tete coal mines project
19.03.2009	World Bank, Maputo	Boris E. Utria, WB Catherine Zamaere, Embassy of Malawi	Financing infrastructure rehabilitation
20.03.2009	CDN, Nampula	Manuel Macoba	Infrastructure, traffic, rolling stock, workshop
21.03.2009	PN, Nacala	Andrea Fynn	Port infrastructure and operations
02.04.2009	EC-Delegation, Lilongwe	Railway task force meeting	
06.04.2009	MOTPW, Lilongwe	Patrick G.J. Lapukeni	Reporting, concession, financing
07.04.2009	MCA, Lilongwe	Alex C. Gomani Penjani Karya	Rehabilitation proposal, priorities
08.04.2009	Lilongwe	Kondwani Mkonda	Emergency programme
14.04.2009	EC-Delegation, Lilongwe	Jocelin Cornet	Emergency programme, further TA
16.04.2009	Limbe	Hendry Chimwaza Patrick G.J. Lapukeni Representatives of Petrol Industry, Lafarge Cement Industry, Illovo Sugar Industry	Rail transport problems, intended traffic
19.04.2009	Lilongwe	Dr. Alois Bauer Levi Zulu	Coordination of activities with Chipata Dry Po
20.04.2009	Lilongwe		Privatisation Commission Meeting
21.04.2009			
22.04.2009	Lilongwe	Dr. Alois Bauer Levi Zulu	Chipata Dry Port traffic forecast
24.04.2009	Farmer's World, Lilongwe	C.Giannakis	Rail transport problems, intended traffic
01.05.2009	Lilongwe	Hendry Chimwaza	Concessionaire's organisation and capacity
04.05.2009	EC-Delegation, Lilongwe	David Ivan White, EIB Jocelin Cornet	Coordination of activities
04.05.2009	EC-Delegation, Lilongwe	Railway task force meeting	
05.05.2009	MCA, Lilongwe	Themba Gilbert Chirwa	Economic appraisal
05.05.2009	MOTPW, Lilongwe	Patrick G.J. Lapukeni	Concluding meeting



**The rail corridors**

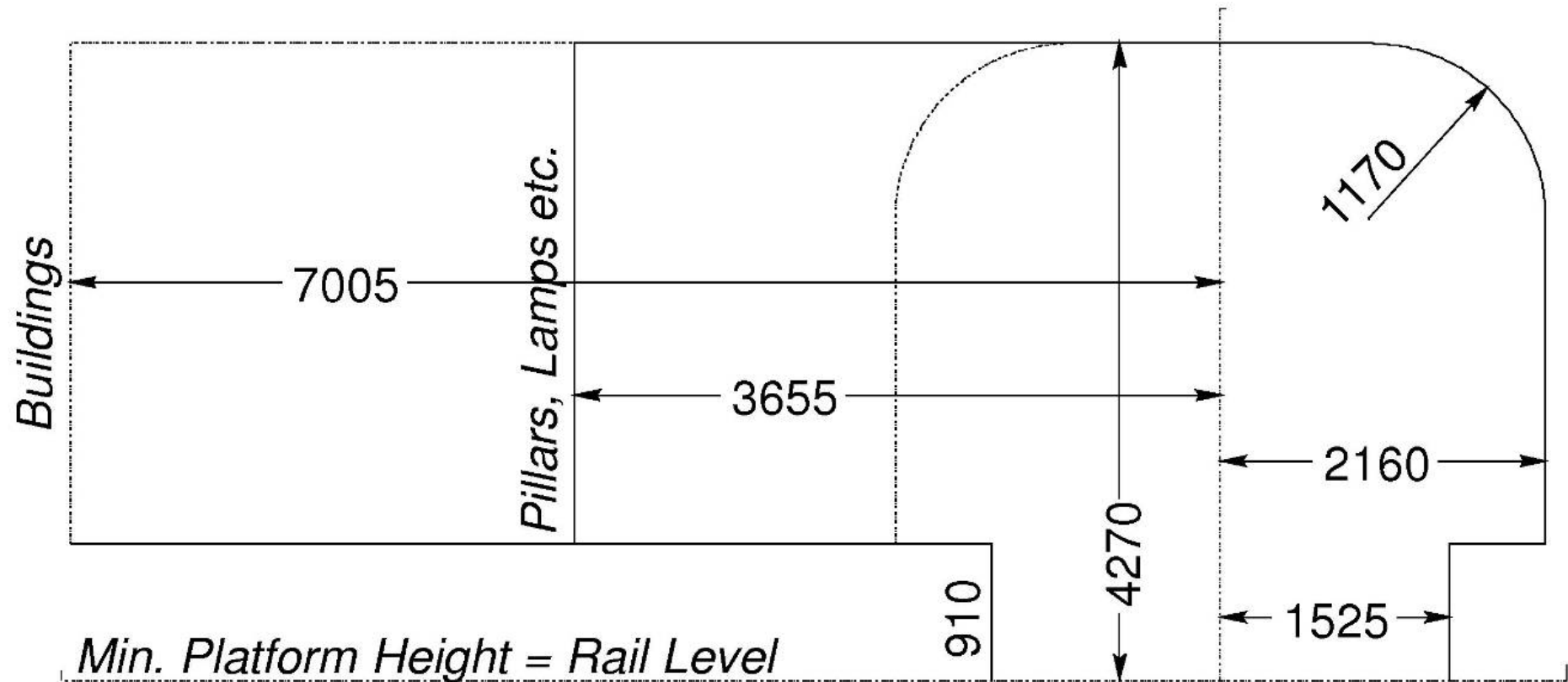
## The Rail Corridors



Annex 2.2.1

## **Structure gauge**

## Structure Gauge for the Straight Track



Annex 2.2.3.1

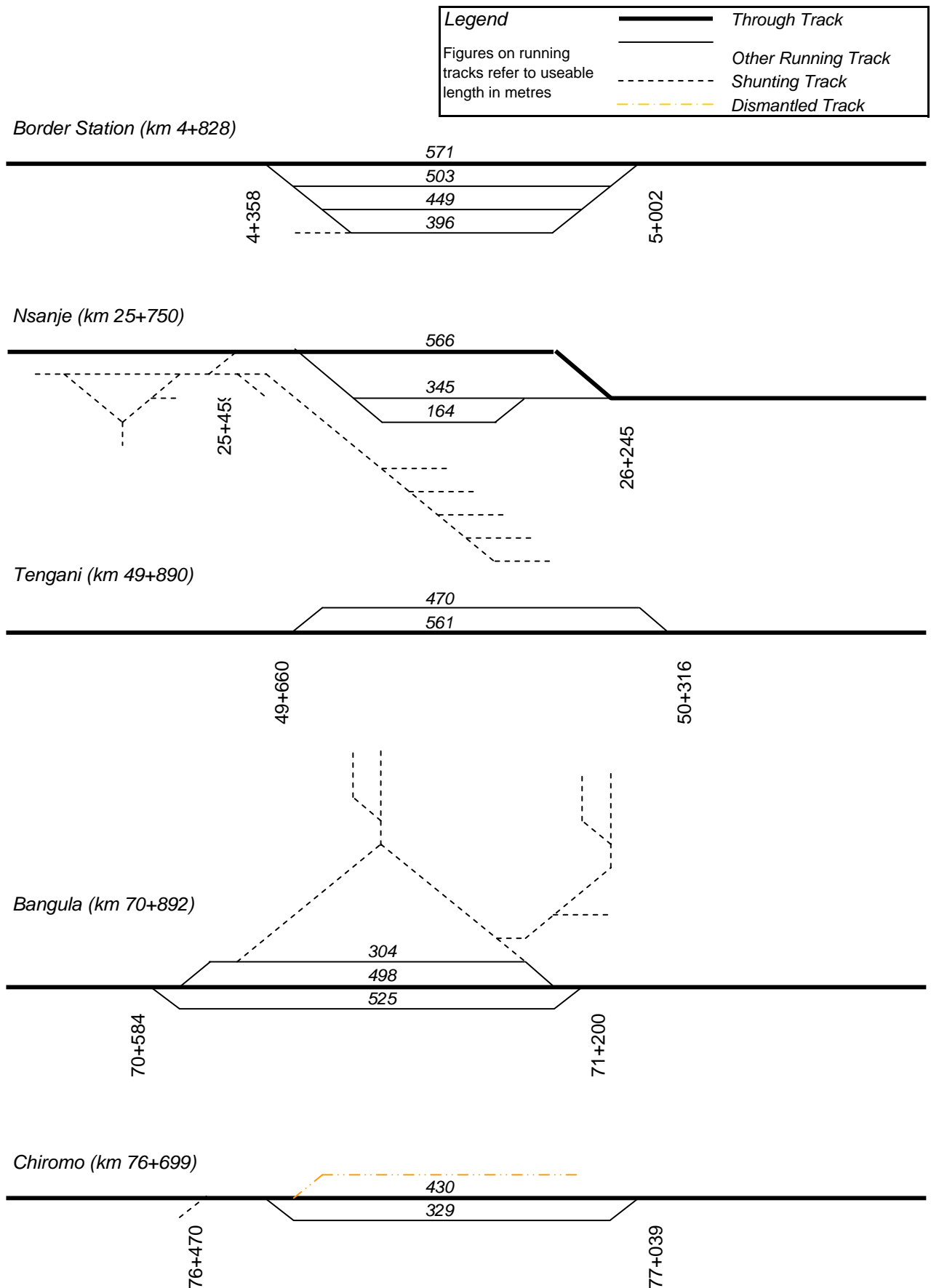
**Station list**

km	Station Name	Altitude [m.a.s.l.]	Maximum Loop Length [m]	km	Station Name	Altitude [m.a.s.l.]	Maximum Loop Length [m]
<b>Border - Nsanje - Limbe - Nkaya - Mchinji (- Chipata)</b>				<b>Nacala - Nampula - Cuamba (contd.)</b>			
4.828	Border Station	53.19	503	107.063	Namialo	197.50	757
25.750	Nsanje	39.01	566	143.596	Nacavala	300.12	705
49.890	Tengani	73.76	561	162.287	Muizia	326.55	705
70.892	Bangula	51.21	525	173.781	Anchillo	346.51	706
76.699	Chiromo	49.63	430	192.215	Nampula	437.37	1245
80.400	Makhanga	52.51	457	211.678	Rapala	446.56	697
93.870	Sankhulani	78.33	478	232.808	Mutivase	417.81	706
112.982	Thekerani	331.93	314	249.192	Caramaja	533.31	703
121.100	Chipho	342.75	487	270.485	Namina	608.46	717
128.609	Sandama	397.00	338	287.265	Murrula	654.44	701
147.100	Khonjeni	592.82	353	299.660	Caia	630.54	707
157.050	Luchenza	682.14	343	315.397	Ribaue	643.23	693
165.793	Makandi	723.01	382	335.593	Outeiro	670.24	706
177.948	Nansadi	796.16	313	351.645	Iapala	675.72	757
189.701	Malabvi	969.90	303	374.007	Mussa	709.45	705
201.000	Limbe	1158.87	292	400.875	Namecuna	651.89	706
207.479	Mudi	1061.44	244	413.954	Nataleia	668.34	740
209.079	Blantyre	1039.24	292	429.313	Malema	624.82	666
230.406	Maleule	790.07	341	450.076	Tui	685.32	699
248.227	Lirangwe	603.83	400	463.778	Nacata	618.22	702
261.600	Namatunu	512.62	420	479.631	Mutuali	593.74	677
275.500	Shire North	473.99	366	516.947	Murissa	557.34	708
297.149	Nkaya	535.44	780	533.473	Cuamba	583.06	763
313.200	Balaka	633.20	585	<b>Cuamba - Entré Lagos (- Chipata)</b>			
335.409	Bilila	726.64	457	0.000	Cuamba	583.06	763
364.100	Sharpevale	621.48	457	38.667	Caronga	627.95	587
390.300	Golomoti	546.20	311	78.094	Entré Lagos	643.96	693
412.700	Mtakataka	532.18	263	<b>Beira - Dondo Jn.</b>			
441.618	Chipoka	490.12	377	0.0	Beira	8.00	
468.800	Salima	506.88	333	7.0	Manga	19.58	
485.700	Nanjoka	579.12	518	16.0	Povoa	34.47	
507.160	Chipala	801.62	524	28.0	Dondo Jn.	46.33	280
547.400	Nankhanga	1116.18	518	<b>Dondo Jn. - Sena - Vila Nova de Fronteira (- Nsanje)</b>			
553.750	Balang'ombe	1141.17	533	0.0	Dondo Jn.	46.33	280
574.342	Kanengo	1116.43	914	26.0	Savane	107.59	430
579.900	Lilongwe Passenger Stat.	1119.00	502	48.0	Semacuesa	131.06	492
592.663	Mweziwawala	1128.21	549	70.0	Derunde	192.94	474
608.535	Vubwe	1148.20	549	90.0	Muanza	273.71	474
629.165	Nyanja	1126.94	549	112.0	Cundue	287.73	445
644.766	Nathyola	1107.14	549	138.0	Mazamba	281.33	442
665.569	Kamwendo	1140.50	549	157.0	Inhaminga	300.23	439
683.071	Mchinji	1203.22	610	165.0	Bemcanta	243.42	382
<b>Chipata - Nkaya</b>				182.0	Inhamitanga	179.53	450
714.071	Chipata	1197.83	723	197.0	Lavos	113.64	435
1.722	Nayuchi	646.02	717	221.0	Nangue	43.03	379
41.453	Lambulila	676.22	708	232.0	Caia	35.97	479
75.005	Nkaya	535.44	780	249.0	Murraca	33.83	363
<b>Nacala - Nampula - Cuamba</b>				265.0	Magagade	38.40	364
0.000	Nacala	7.98		282.0	Inharuca	46.02	
12.389	Muchildo	139.44	705	286.0	Sena	52.43	479
42.806	Namarral	131.47	692	291.0	Dona Ana	57.00	
67.740	Monapo	57.85	689	294.2	Baue	42.98	477
81.821	Evate	155.71	315	327.2	Vila Nova de Fronteira	73.15	457
92.378	Metochera	193.94	674				
104.741	Namialo Siding	188.88					

Annex 2.2.3.2

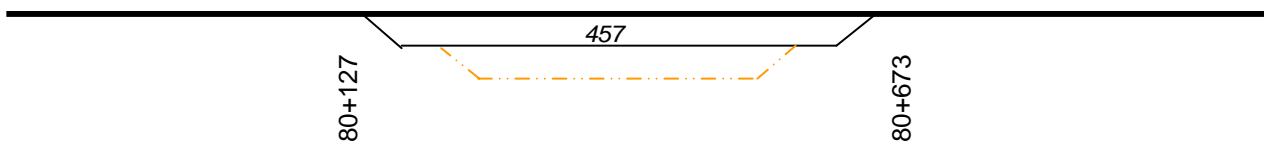
## **Station layouts**

## Station layouts

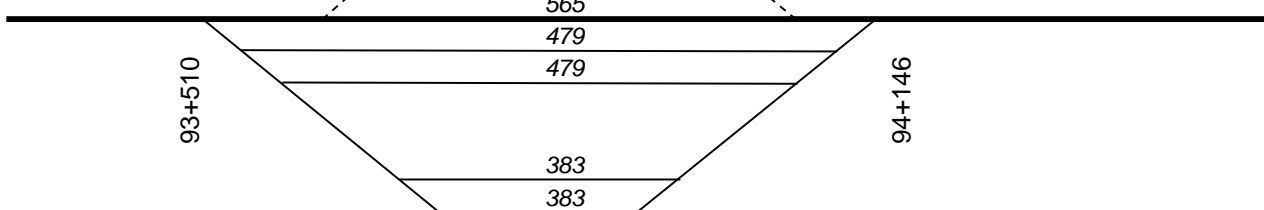




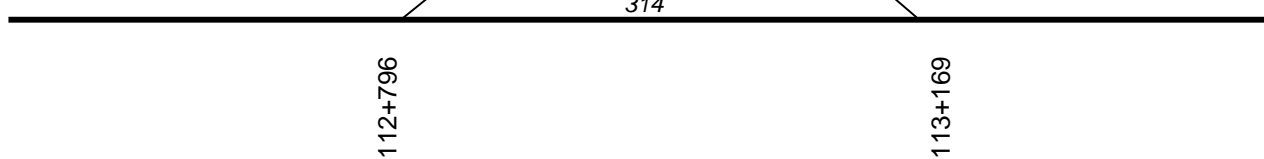
Makhanga (km 80+400)



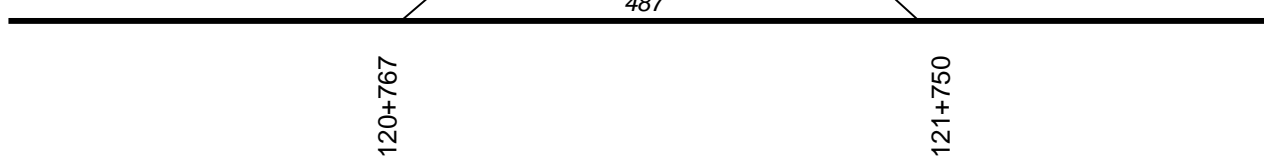
Sankhulani (km 93+870)



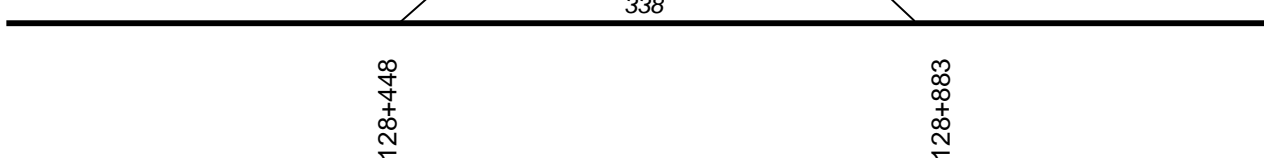
Thekerani (km 112+982)



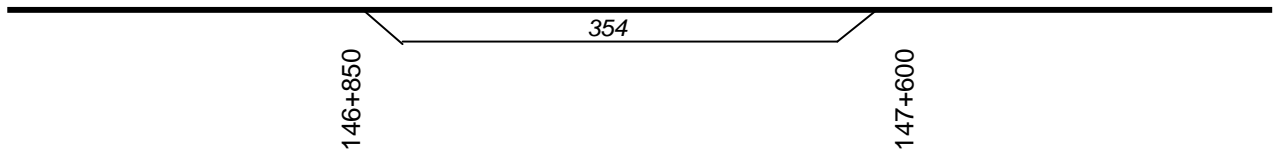
Chipho (km 121+100)



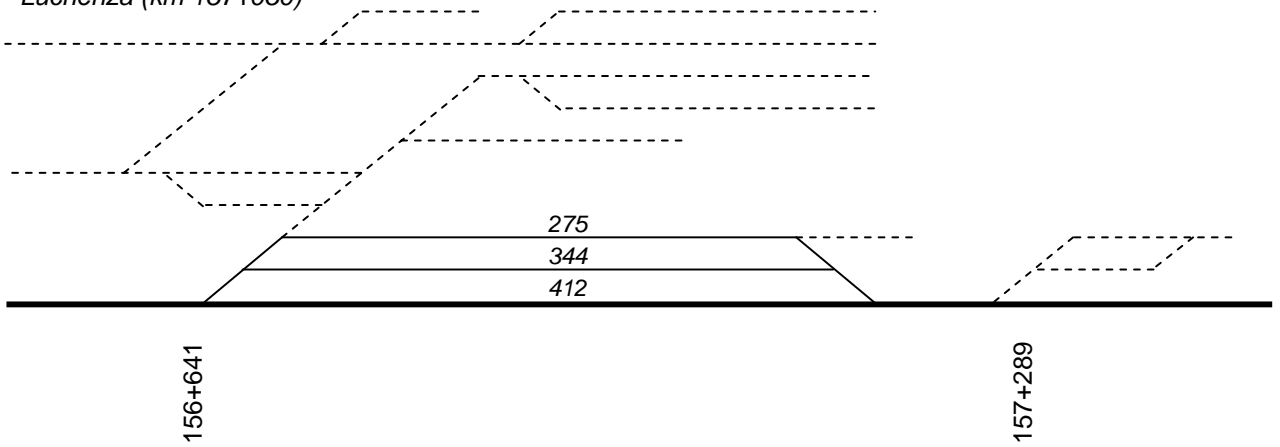
Sandama (km 128+609)



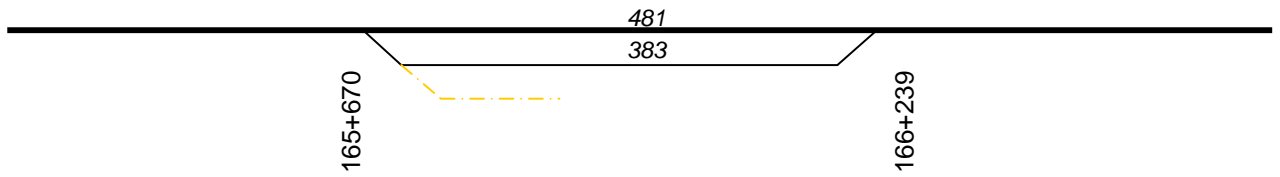
*Khonjeni (km 147+100)*



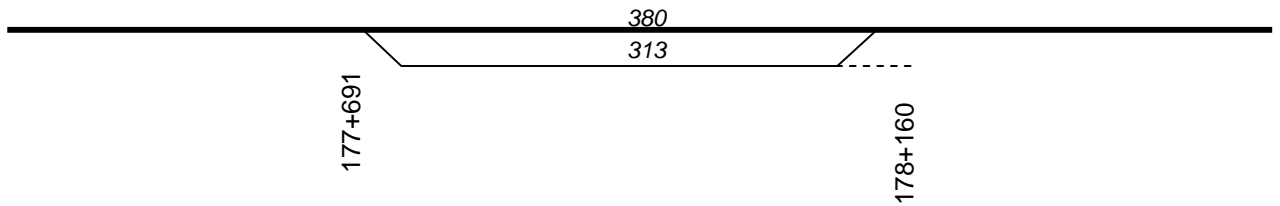
*Luchenza (km 157+050)*



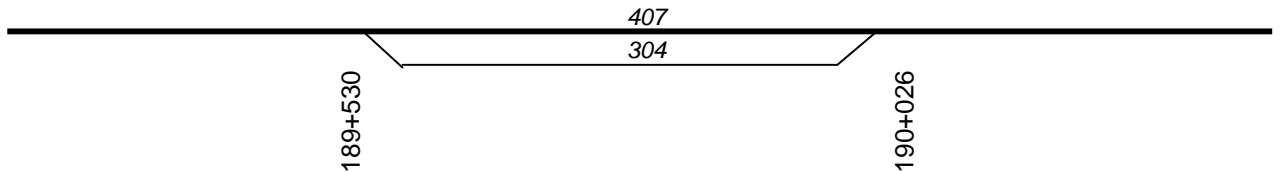
*Makandi (km 165+793)*



*Nansadi (km 177+948)*



*Malabvi (km 189+701)*



Annex 2.2.4.1

## **Gradients**

## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata)</b>											
0.000	-4.58	73.15	123.050	10.58	342.75	152.620	0.00	644.42	168.150	0.00	741.31
4.358	0.00	53.19	123.370	10.10	346.13	152.940	-15.15	644.42	168.230	22.73	741.31
<i>Border Station</i>			123.530	22.73	347.75	153.270	0.00	639.42	168.560	0.00	748.81
5.002	-0.69	53.19	124.660	12.94	373.43	153.390	-15.15	639.42	168.600	-15.15	748.81
25.459	0.00	39.01	124.860	0.00	376.02	153.510	0.00	637.60	168.700	0.00	747.30
<i>Nsanje</i>			124.940	12.50	376.02	153.670	18.18	637.60	168.760	12.50	747.30
26.245	1.48	39.01	125.710	20.00	385.64	154.230	0.00	647.78	168.960	0.00	749.80
49.660	0.00	73.76	126.670	-0.22	404.84	154.350	15.15	647.78	169.120	22.73	749.80
<i>Tengani</i>			128.120	-20.00	404.52	154.800	0.00	654.60	169.600	0.00	760.71
50.316	-1.11	73.76	128.480	-2.50	397.32	154.880	22.73	654.60	170.160	13.89	760.71
62.150	-1.12	60.66	<i>Sandama</i>			155.560	0.00	670.05	170.410	0.00	764.18
70.584	0.00	51.21	128.840	18.18	396.42	155.760	22.73	670.05	170.930	22.73	764.18
<i>Bangula</i>			129.410	0.00	406.79	156.240	2.94	680.96	171.290	-20.92	772.36
71.200	-0.38	51.21	130.130	22.73	406.79	156.641	0.00	682.14	171.450	0.00	769.01
75.855	0.00	49.43	130.490	0.00	414.97	<i>Luchenza</i>			171.570	-22.73	769.01
76.035	0.29	49.43	130.610	16.13	414.97	157.490	10.00	682.14	171.770	0.00	764.47
76.470	0.29	49.56	130.780	0.00	417.71	158.010	0.00	687.34	172.380	22.73	764.47
76.699	0.29	49.63	131.020	22.73	417.71	158.220	15.15	687.34	173.020	0.70	779.01
77.039	0.29	49.72	131.740	0.00	434.07	158.380	0.00	689.77	173.100	16.67	779.07
78.516	1.88	50.15	131.940	22.73	434.07	158.620	15.15	689.77	173.220	0.70	781.07
80.010	-1.15	52.96	132.180	0.00	439.53	158.900	0.00	694.01	173.540	16.67	781.29
<i>Makhanga</i>			134.880	22.73	439.53	158.980	10.00	694.01	173.850	0.70	786.46
81.351	1.50	51.41	135.320	0.00	449.53	159.340	0.00	697.61	173.950	16.67	786.53
84.399	0.54	55.97	135.400	16.21	449.53	159.420	15.15	697.61	174.150	0.70	789.86
88.117	9.96	57.96	135.810	0.00	456.17	159.620	0.00	700.64	174.830	15.15	790.34
90.525	-5.47	81.95	135.890	15.75	456.17	159.780	22.73	700.64	175.350	22.73	798.22
92.049	4.52	73.62	136.170	0.00	460.58	159.950	0.00	704.50	175.460	0.70	800.72
93.268	-3.29	79.13	137.130	22.73	460.58	160.190	-22.73	704.50	175.540	15.15	800.77
93.510	0.00	78.33	137.580	16.67	470.81	160.550	0.00	696.32	176.060	0.00	808.65
<i>Sankhulani</i>			137.780	0.00	474.14	160.710	15.15	696.32	176.140	-22.73	808.65
96.340	22.73	78.33	138.180	22.73	474.14	160.790	0.00	697.53	176.520	0.00	800.02
97.900	0.00	113.79	138.860	13.16	489.60	160.910	15.15	697.53	176.580	22.73	800.02
100.240	13.51	113.79	139.180	0.00	493.81	161.070	0.00	699.96	176.720	0.00	803.20
100.680	12.20	119.73	139.790	12.66	493.81	161.390	22.73	699.96	176.800	-15.15	803.20
100.880	0.00	122.17	139.950	0.00	495.83	161.510	0.00	702.68	177.060	-10.00	799.26
101.650	22.54	122.17	140.270	-20.83	495.83	162.160	15.15	702.68	177.210	0.00	797.76
102.610	0.00	143.81	140.750	22.73	485.83	162.240	0.00	703.90	177.330	-10.00	797.76
102.690	21.28	143.81	145.020	0.00	582.88	162.560	15.15	703.90	177.490	0.00	796.16
102.930	0.00	148.92	145.220	15.15	582.88	162.800	0.00	707.53	<i>Nansadi</i>		
103.290	22.73	148.92	145.980	0.00	594.39	162.880	-22.73	707.53	177.970	22.73	796.16
106.310	15.15	217.56	146.060	-20.00	594.39	163.040	0.00	703.90	178.190	11.36	801.16
106.470	22.73	219.98	146.190	-0.97	591.79	163.320	22.73	703.90	178.590	22.73	805.70
111.380	15.15	331.57	146.850	0.00	591.15	163.450	14.49	706.85	180.260	12.94	843.66
111.460	-0.64	332.78	146.990	15.15	591.15	163.530	2.23	708.01	180.520	22.73	847.02
112.796	0.00	331.93	<i>Khonjeni</i>			163.770	21.14	708.55	181.390	3.37	866.79
<i>Thekerani</i>			147.350	0.00	596.61	164.210	2.23	717.85	181.470	22.73	867.06
113.680	22.73	331.93	147.430	-22.73	596.61	164.730	15.15	719.01	182.230	3.37	884.34
113.840	0.00	335.56	147.630	12.50	592.06	165.100	2.23	724.61	183.280	11.36	887.88
114.400	22.73	335.56	147.910	22.73	595.56	165.220	-22.73	724.88	183.480	0.00	890.15
114.480	0.00	337.38	149.600	0.00	633.97	165.460	-2.23	719.43	184.610	15.15	890.15
116.050	22.73	337.38	149.730	15.15	633.97	165.620	22.73	719.07	184.890	3.37	894.39
116.250	-11.11	341.93	149.850	0.00	635.79	<i>Makandi</i>			185.210	11.36	895.47
116.490	0.00	339.26	149.930	18.52	635.79	165.860	0.00	724.52	185.450	22.73	898.20
118.100	22.73	339.26	150.170	0.00	640.24	166.300	15.15	724.52	187.380	3.37	942.06
118.540	0.00	349.26	150.330	-22.73	640.24	166.460	0.00	726.95	187.710	22.73	943.17
118.750	15.15	349.26	150.810	16.67	629.33	166.830	22.73	726.95	188.030	3.37	950.44
118.870	0.00	351.08	151.090	0.00	633.99	166.990	0.00	730.59	188.150	17.86	950.85
119.230	-15.15	351.08	151.540	10.31	633.99	167.270	18.42	730.59	188.570	3.37	958.35
119.390	0.00	348.65	151.820	0.00	636.88	167.630	0.00	737.22	188.670	11.36	958.69
119.710	-15.15	348.65	151.980	15.15	636.88	167.770	12.66	737.22	188.870	3.37	960.96
120.100	0.00	342.75	152.220	0.00	640.52	167.950	0.00	739.49	188.970	22.73	961.30
<i>Chipho</i>			152.300	12.20	640.52	168.030	15.15	739.49	189.280	3.37	968.34

## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
189.530	2.50	969.18	213.090	-13.07	1003.12	224.890	-13.65	864.58	236.880	-13.07	712.25
189.680	16.67	969.56	213.340	-16.67	999.86	225.150	-16.67	861.03	237.010	0.00	710.55
<i>Malabvi</i>			213.450	-13.16	998.02	225.240	-13.07	859.53	237.160	-13.07	710.55
190.080	22.73	976.23	213.590	-16.67	996.18	225.500	-3.79	856.13	237.580	0.00	705.06
190.760	4.90	991.68	213.740	-12.99	993.68	225.530	-13.07	856.02	237.610	-13.65	705.06
190.880	22.73	992.27	213.990	-14.29	990.43	225.730	-3.79	853.40	237.840	0.00	701.92
191.650	4.90	1009.77	214.140	-12.52	988.29	225.780	-13.65	853.21	237.920	-16.67	701.92
191.730	22.73	1010.16	214.330	-16.67	985.91	225.890	-16.67	851.71	238.279	13.89	695.93
192.130	4.90	1019.25	214.370	-13.07	985.25	226.350	-10.00	844.05	238.764	16.67	702.67
192.290	22.73	1020.03	214.410	-14.86	984.72	226.600	-16.67	841.55	238.915	-13.59	705.19
193.860	10.00	1055.71	214.480	-13.07	983.68	226.880	-13.33	836.88	239.066	-16.67	703.14
194.100	4.90	1058.11	214.680	-13.65	981.07	227.320	-14.29	831.01	239.157	-13.07	701.62
194.340	15.15	1059.29	214.820	-16.67	979.16	227.440	-16.67	829.30	239.460	-16.67	697.66
194.910	-16.67	1067.93	214.870	-13.07	978.32	227.560	-3.79	827.30	239.551	-13.07	696.14
195.390	22.73	1059.93	215.050	-16.67	975.97	227.680	-13.07	826.84	239.748	0.00	693.57
196.240	21.28	1079.24	215.190	-13.07	973.64	228.050	-3.79	822.01	239.839	-12.50	693.57
196.560	22.73	1086.05	215.500	-13.65	969.59	228.120	-16.67	821.74	239.930	0.00	692.43
197.640	4.90	1110.60	215.690	-16.67	966.99	228.290	-12.50	818.91	239.975	-16.67	692.43
197.760	22.73	1111.19	215.750	-13.65	965.99	228.440	-3.79	817.03	240.066	0.00	690.91
198.450	15.15	1126.87	215.890	-16.67	964.08	228.502	-16.67	816.80	240.187	-10.00	690.91
198.890	22.73	1133.53	215.980	-13.65	962.58	228.770	-14.29	812.33	240.247	-16.67	690.31
199.490	17.24	1147.17	216.080	-16.67	961.22	229.030	-16.67	808.62	240.467	-11.95	686.65
199.570	22.73	1148.55	216.150	-13.65	960.05	229.770	-3.79	796.28	240.799	-16.67	682.68
199.860	4.90	1155.14	216.260	-16.67	958.55	230.110	-16.67	795.00	241.049	-13.65	678.51
200.623	0.00	1158.87	216.590	-13.65	953.05	<i>Maleule</i>			241.360	-16.67	674.26
<i>Limbe</i>			216.800	0.00	950.18	230.700	13.07	785.16	241.702	-13.65	668.56
201.220	-16.67	1158.87	216.940	13.07	950.18	231.020	-16.67	789.35	241.869	-16.67	666.28
201.630	0.00	1152.04	217.240	-12.08	954.10	231.260	-13.07	785.35	242.537	-10.00	655.15
201.910	-22.73	1152.04	217.360	-14.29	952.65	231.640	-16.67	780.38	242.658	0.00	653.94
202.630	0.00	1135.68	217.480	-13.65	950.94	231.690	-14.29	779.54	242.779	-16.67	653.94
202.830	-22.73	1135.68	217.870	-13.70	945.61	231.840	-13.07	777.40	243.545	-14.29	641.17
204.640	0.00	1094.54	217.930	14.29	944.79	232.020	-16.67	775.05	243.727	0.00	638.57
204.770	-17.54	1094.54	218.430	-16.67	951.93	232.280	-13.07	770.72	244.633	-16.67	638.57
205.250	15.15	1086.12	218.510	-13.07	950.60	232.510	-16.67	767.71	244.876	-14.29	634.52
205.570	1.46	1090.97	218.910	-16.67	945.37	232.590	-13.07	766.38	245.012	0.00	632.58
206.050	-22.73	1091.67	218.950	-13.07	944.71	232.780	0.00	763.89	245.102	-16.67	632.58
207.380	0.00	1061.44	219.300	-16.67	940.13	232.830	-16.67	763.89	245.467	14.29	626.50
<i>Mudi</i>			219.350	-13.07	939.30	232.970	-14.29	761.56	245.611	-16.67	628.55
207.580	-22.73	1061.44	219.670	-16.67	935.11	233.220	0.00	757.99	245.869	-13.64	624.25
208.020	-20.00	1051.44	219.800	-14.86	932.95	233.270	-14.29	757.99	246.005	-16.67	622.40
208.630	0.00	1039.24	219.890	-16.67	931.61	233.360	-16.67	756.70	246.513	-13.07	613.93
<i>Blantyre</i>			220.110	-13.07	927.94	233.540	-14.29	753.70	246.612	-16.67	612.64
209.590	-13.16	1039.24	220.240	-16.67	926.24	233.660	0.00	751.99	246.733	-10.00	610.62
209.840	-15.38	1035.95	220.290	-13.07	925.41	233.740	-16.67	751.99	246.854	-16.67	609.41
209.930	-13.16	1034.57	220.400	-16.67	923.97	233.880	-13.65	749.65	247.036	-10.00	606.38
210.150	0.00	1031.67	220.520	-12.59	921.97	234.120	-16.67	746.38	247.582	3.14	600.92
210.180	-13.16	1031.67	220.920	-16.67	916.94	234.210	-15.48	744.88	248.148	14.29	602.70
210.400	0.00	1028.78	220.980	-13.07	915.94	234.350	-16.67	742.71	<i>Lirangwe</i>		
210.460	-13.33	1028.78	221.260	-15.46	912.28	234.480	0.00	740.54	248.330	0.00	605.30
210.610	0.00	1026.78	221.350	-13.07	910.88	234.550	-13.65	740.54	248.367	-14.29	605.30
210.830	-13.33	1026.78	221.460	-16.67	909.45	234.880	0.00	736.04	248.534	-16.67	602.91
210.900	0.00	1025.84	221.540	-13.07	908.11	234.940	-13.65	736.04	248.702	-14.29	600.11
211.080	-13.07	1025.84	223.100	-16.67	887.72	235.030	-16.67	734.81	248.822	-16.67	598.40
211.480	-10.53	1020.61	223.160	-10.00	886.72	235.140	-13.07	732.98	248.998	0.00	595.46
211.850	-16.67	1016.72	223.310	-13.07	885.22	235.460	0.00	728.79	249.134	-16.67	595.46
211.980	0.00	1014.55	223.830	-16.67	878.42	235.520	-16.67	728.79	249.445	0.00	590.28
212.070	-13.07	1014.55	223.900	0.00	877.26	235.730	0.00	725.29	249.487	-16.67	590.28
212.350	0.00	1010.89	223.930	-13.07	877.26	235.910	-12.50	725.29	249.608	-12.50	588.26
212.460	-16.67	1010.89	224.330	-13.65	872.03	236.160	0.00	722.17	249.714	0.00	586.94
212.590	-13.07	1008.73	224.510	-16.67	869.57	236.220	-16.67	722.17	249.797	-12.50	586.94
212.840	0.00	1005.46	224.590	-13.65	868.24	236.520	-13.07	717.17	250.039	0.00	583.91
212.950	-16.67	1005.46	224.770	-10.00	865.78	236.820	-16.67	713.25	250.312	16.67	583.91

## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
250.500	-16.67	587.05	274.655	0.00	473.99	310.000	15.38	594.96	339.580	-12.50	688.53
251.509	-13.65	570.23	<i>Shire North</i>			310.220	16.67	598.34	339.700	-12.29	687.03
251.653	-16.67	568.26	276.416	10.00	473.99	311.000	6.39	611.34	340.260	-10.00	680.15
251.972	-13.65	562.95	276.567	5.00	475.50	311.130	16.67	612.17	340.690	-12.29	675.85
252.390	-16.67	557.24	278.907	10.00	487.20	311.230	6.39	613.84	340.750	-10.00	675.11
252.551	-14.29	554.56	279.180	5.00	489.93	311.290	16.67	614.22	341.190	-12.29	670.71
252.809	0.00	550.87	281.792	10.00	502.99	312.050	10.00	626.89	341.475	0.00	667.21
252.991	-16.67	550.87	281.883	1.21	503.90	312.230	6.39	628.69	342.010	10.00	667.21
253.082	0.00	549.36	288.400	0.00	511.79	312.937	0.00	633.20	342.100	3.61	668.11
253.401	-16.67	549.36	<i>Utale Halt</i>			<b>Balaka</b>			342.280	10.00	668.76
253.659	-16.13	545.06	290.354	-10.00	511.79	313.270	10.00	633.20	342.520	12.50	671.16
253.848	-14.29	542.01	290.475	0.00	510.58	313.580	0.00	636.30	342.770	10.00	674.28
254.273	-16.67	535.94	290.566	10.00	510.58	313.800	10.00	636.30	343.370	12.50	680.28
254.424	0.00	533.42	290.657	0.00	511.49	314.080	3.80	639.10	343.970	3.61	687.78
254.507	-10.00	533.42	291.051	10.00	511.49	314.450	10.00	640.51	344.280	10.00	688.90
254.621	0.00	532.28	291.142	0.00	512.40	314.660	3.80	642.61	344.530	3.61	691.40
254.795	16.67	532.28	291.176	10.00	512.40	314.940	12.50	643.67	344.890	10.00	692.70
255.265	0.00	540.11	291.662	0.00	517.26	315.190	3.80	646.80	344.980	0.00	693.60
255.462	-12.28	540.11	292.324	16.00	517.26	318.230	10.00	658.35	345.200	-10.00	693.60
255.994	-16.13	533.58	292.461	0.00	519.45	319.030	3.80	666.35	345.410	0.00	691.50
256.403	0.00	526.98	292.719	16.67	519.45	320.960	10.00	673.68	346.470	-12.50	691.50
256.539	-16.67	526.98	293.094	0.00	525.70	321.420	3.80	678.28	346.710	0.00	688.50
256.736	-10.00	523.70	293.306	10.00	525.70	322.480	12.50	682.31	346.900	-11.63	688.50
256.827	0.00	522.79	293.640	0.00	529.04	322.850	3.80	686.94	347.140	0.00	685.71
257.395	16.67	522.79	293.726	-16.00	529.04	323.030	10.00	687.62	347.320	-10.00	685.71
257.410	0.00	523.04	293.885	10.00	526.49	323.390	0.00	691.22	347.500	0.00	683.91
257.470	-16.67	523.04	294.787	16.67	535.51	323.790	10.00	691.22	347.990	-10.00	683.91
257.652	0.00	520.00	294.938	-10.00	538.03	323.880	0.00	692.12	348.290	0.00	680.91
258.228	-10.00	520.00	296.095	10.00	526.46	324.970	12.50	692.12	348.570	-12.50	680.91
258.379	0.00	518.49	296.188	16.67	527.39	325.340	10.00	696.74	349.400	0.00	670.53
258.837	-10.00	518.49	296.540	7.36	533.26	325.500	0.00	698.34	349.690	-10.00	670.53
259.141	0.00	515.45	296.660	2.66	534.14	326.300	12.50	698.34	349.940	0.00	668.03
260.452	-10.00	515.45	297.149	0.00	535.44	326.600	0.00	702.09	350.930	-12.50	668.03
260.527	0.00	514.70	<b>Nkaya</b>			326.820	10.00	702.09	352.360	0.00	650.16
261.310	-12.50	514.70	297.210	10.00	535.44	326.980	0.00	703.69	356.380	-12.50	650.16
261.477	0.00	512.62	297.360	0.00	536.94	327.310	10.00	703.69	356.630	0.00	647.03
<i>Namatunu</i>			297.700	15.00	536.94	327.740	12.50	707.99	358.100	-10.00	647.03
261.719	-12.50	512.62	297.830	6.39	538.89	327.980	0.00	710.99	358.280	0.00	645.23
261.961	0.00	509.59	298.040	16.67	540.23	328.870	10.00	710.99	359.130	-10.00	645.23
261.962	-13.33	509.59	298.220	6.39	543.23	328.990	0.04	712.19	359.380	0.00	642.73
262.432	0.00	503.33	298.890	10.00	547.51	330.070	15.79	712.24	360.230	-12.50	642.73
262.538	-10.00	503.33	298.980	6.39	548.41	330.320	0.04	716.19	360.670	0.00	637.23
262.858	0.00	500.13	299.040	13.33	548.79	333.720	10.00	716.34	361.600	-12.50	637.23
262.979	-10.00	500.13	299.410	10.00	553.73	334.140	0.04	720.54	362.110	0.00	630.86
263.373	0.00	496.19	299.710	6.39	556.73	334.750	10.00	720.56	362.230	-12.50	630.86
264.515	-10.00	496.19	300.010	10.00	558.64	334.870	0.04	721.76	362.500	0.00	627.48
264.575	0.00	495.59	300.320	6.39	561.74	334.980	12.50	721.77	362.630	-12.50	627.48
264.969	-11.11	495.59	300.850	10.00	565.13	335.370	0.04	726.64	363.110	0.00	621.48
265.242	0.00	492.55	301.030	6.39	566.93	<i>Bilila</i>			<i>Sharpevale</i>		
265.903	-10.00	492.55	301.530	16.67	570.12	335.409	12.50	726.64	364.690	-12.50	621.48
267.024	0.00	481.34	301.680	6.39	572.62	335.800	-10.00	732.60	365.180	-2.97	615.36
267.447	-10.00	481.34	301.870	17.54	573.83	335.843	-12.29	732.07	369.120	-10.00	603.65
267.598	0.00	479.83	302.050	16.67	576.99	336.270	-10.00	727.76	369.640	0.00	598.45
269.798	-10.00	479.83	302.140	6.39	578.49	336.480	-12.29	725.66	372.140	-12.50	598.45
269.919	0.00	478.62	303.770	-11.00	588.90	336.540	-10.00	724.92	372.460	0.00	594.45
270.223	-10.00	478.62	304.080	0.00	585.49	336.720	-12.29	723.12	372.740	-12.50	594.45
270.345	0.00	477.40	308.240	16.67	585.49	336.880	-10.00	721.16	373.470	0.00	585.33
270.891	-10.00	477.40	308.620	6.39	591.82	337.180	-12.29	718.16	376.160	-10.00	585.33
271.012	0.00	476.19	309.200	16.67	595.52	337.938	-12.50	708.84	376.710	-2.97	579.83
273.077	-10.00	476.19	309.460	5.00	599.86	338.080	-12.29	707.06	377.560	-10.00	577.30
273.198	-0.06	474.98	309.580	-16.67	600.46	338.550	-12.50	701.29	377.900	-2.97	573.90
274.564	-10.00	474.90	309.910	0.00	594.96	339.030	-12.29	695.29	381.570	-10.00	563.00

## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
381.760	0.00	561.10	444.730	12.50	501.97	520.000	15.24	908.30	600.360	9.97	1142.72
382.700	-12.50	561.10	444.980	0.00	505.09	520.800	16.63	920.50	601.300	-5.02	1152.09
382.940	0.00	558.10	445.280	11.72	505.09	525.200	16.60	993.65	602.700	0.64	1145.06
385.250	-12.50	558.10	445.470	0.00	507.32	529.000	3.50	1056.74	603.800	6.21	1145.76
385.460	0.00	555.47	445.670	-11.00	507.32	531.700	2.03	1066.19	604.360	-3.84	1149.24
388.680	-10.00	555.47	446.190	0.00	501.60	532.000	0.00	1066.80	605.660	-12.67	1144.25
388.930	0.00	552.97	446.400	12.50	501.60	<i>Katundu Halt</i>			606.620	13.03	1132.09
389.070	-10.00	552.97	446.950	0.00	508.47	532.450	9.83	1066.80	607.820	0.67	1147.72
389.410	0.00	549.57	447.310	12.50	508.47	534.000	-7.62	1082.04	<i>Vubwe</i>		
390.030	-12.50	549.57	447.920	0.00	516.10	536.000	-1.52	1066.80	608.800	8.07	1148.38
390.300	0.00	546.20	448.130	12.50	516.10	538.000	-15.85	1063.75	610.300	6.78	1160.49
<i>Golomoti</i>			448.380	0.00	519.22	540.500	16.31	1024.13	611.300	3.68	1167.27
392.970	10.00	546.20	448.770	-12.50	519.22	544.050	11.65	1082.04	611.700	7.34	1168.74
393.770	1.85	554.20	449.010	0.00	516.22	546.979	0.00	1116.18	612.080	9.89	1171.53
397.700	10.00	561.45	449.500	-10.00	516.22	<i>Nankhanga</i>			613.660	0.28	1187.15
397.920	0.00	563.65	450.050	0.00	510.72	547.615	6.15	1116.18	614.300	2.55	1187.33
398.660	-10.00	563.65	452.980	12.50	510.72	549.500	0.00	1127.76	615.100	9.81	1189.37
399.580	0.00	554.45	453.250	0.00	514.10	549.800	6.10	1127.76	616.300	3.98	1201.14
399.880	-10.00	554.45	453.440	12.50	514.10	552.300	-1.62	1143.00	616.860	-4.46	1203.37
400.070	0.00	552.55	453.960	0.00	520.60	553.431	0.00	1141.17	617.600	-0.49	1200.07
402.310	-12.20	552.55	455.030	12.50	520.60	<i>Balang'ombe</i>			618.300	-13.45	1199.73
402.590	0.00	549.14	455.240	0.00	523.22	554.100	-11.02	1141.17	620.500	-3.88	1170.15
403.950	-12.05	549.14	459.410	-10.00	523.22	556.700	-16.04	1112.52	621.380	5.32	1166.74
404.260	0.00	545.40	459.540	-1.32	521.92	558.600	-8.82	1082.04	622.460	3.71	1172.49
406.590	-10.00	545.40	460.280	-10.00	520.95	561.100	7.89	1060.00	623.300	-9.71	1175.61
406.760	0.00	543.70	460.460	-1.32	519.15	563.000	2.21	1075.00	624.420	-6.04	1164.74
407.390	-12.50	543.70	461.110	-10.00	518.29	565.713	0.00	1081.00	625.800	-8.76	1156.40
407.760	0.00	539.08	461.200	-1.32	517.39	<i>Msunga Halt</i>			626.300	-8.10	1152.02
410.810	-10.00	539.08	461.460	-10.00	517.04	566.414	-10.69	1081.00	627.500	-7.82	1142.30
411.350	0.00	533.68	461.680	-1.32	514.84	569.500	15.73	1048.00	627.840	-11.90	1139.64
412.550	-10.00	533.68	462.040	-10.00	514.37	573.850	0.00	1116.43	628.420	-8.11	1132.74
412.700	0.00	532.18	462.280	-1.32	511.97	<b>Kanengo</b>			629.120	-2.65	1127.06
<i>Mtakataka</i>			464.920	-10.00	508.48	574.833	-10.90	1116.43	<i>Nyanja</i>		
412.730	-12.50	532.18	465.080	0.00	506.88	576.800	8.42	1095.00	629.720	-5.43	1125.47
414.061	0.00	515.54	<b>Salima</b>			579.650	0.00	1119.00	630.300	-13.35	1122.32
417.770	-12.50	515.54	469.007	2.26	506.88	<i>Lilongwe</i>			631.760	-14.50	1102.83
418.010	0.00	512.54	474.000	3.91	518.16	580.300	-10.08	1119.00	632.100	-14.72	1097.90
420.470	-10.00	512.54	477.900	4.01	533.40	580.900	-14.79	1112.95	633.160	-0.02	1082.30
420.740	0.00	509.84	481.700	13.25	548.64	582.280	-1.96	1092.54	633.700	7.76	1082.29
422.440	-10.00	509.84	482.850	6.35	563.88	583.100	13.98	1090.93	634.960	6.04	1092.07
422.720	0.50	507.04	485.252	0.00	579.12	583.520	14.30	1096.80	635.460	12.00	1095.09
422.780	-10.00	507.07	<i>Nanjoka</i>			583.920	12.54	1102.52	635.800	3.58	1099.17
422.960	0.00	505.27	485.700	2.50	579.12	584.400	-13.02	1108.54	636.540	-13.83	1101.82
430.670	-10.00	505.27	485.900	5.85	579.62	585.460	-3.06	1094.74	637.980	14.23	1081.90
431.070	0.00	501.27	487.900	1.85	591.31	586.580	2.33	1091.31	639.740	5.33	1106.95
439.960	-10.00	501.27	489.550	15.24	594.36	587.240	-2.26	1092.85	640.980	-3.67	1113.56
440.210	0.00	498.77	491.350	6.49	621.79	588.220	7.00	1090.64	641.580	5.76	1111.36
440.330	-10.00	498.77	491.820	15.86	624.84	588.840	14.18	1094.98	642.420	-7.84	1116.20
440.570	0.00	496.37	493.550	16.14	652.27	590.680	6.06	1121.08	643.240	3.97	1109.77
440.810	-12.50	496.37	494.400	12.38	665.99	591.860	0.69	1128.23	643.840	-7.07	1112.15
441.150	0.00	492.12	496.000	3.67	685.80	592.400	-1.50	1128.60	644.420	-2.63	1108.05
441.390	-10.00	492.12	500.150	14.99	701.04	<i>Mweziwawala</i>			<i>Nathyola</i>		
441.590	0.00	490.12	503.200	15.32	746.76	593.020	-12.06	1127.67	645.060	-5.37	1106.37
<b>Chipoka</b>			506.781	0.00	801.62	593.500	-14.91	1121.88	646.320	-14.55	1099.60
441.920	12.50	490.12	<i>Chipala</i>			593.940	-14.08	1115.32	647.200	-14.29	1086.80
442.580	0.00	498.37	507.435	3.90	801.62	594.340	-14.83	1109.69	647.620	-13.42	1080.80
443.070	10.00	498.37	509.000	15.24	807.72	595.000	-6.86	1099.90	648.380	13.00	1070.60
443.380	0.00	501.47	514.000	11.08	883.92	595.500	10.38	1096.47	648.980	12.80	1078.40
443.600	-12.50	501.47	516.750	2.81	914.40	596.180	14.26	1103.53	649.980	-13.08	1091.20
443.880	0.00	497.97	517.400	0.00	916.23	597.320	14.94	1119.79	650.600	-14.30	1083.09
444.090	10.00	497.97	<i>Kaula Halt</i>			598.300	8.85	1134.43	650.900	-14.58	1078.80
444.490	0.00	501.97	518.069	-4.10	916.23	598.820	2.40	1139.03	651.620	-0.33	1068.30



# Gradients

# Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
651.800	11.91	1068.24	665.960	-0.97	1139.57	679.760	7.47	1178.18	686.350	13.46	1207.87
653.320	6.51	1086.34	666.820	3.05	1138.74	680.340	-3.97	1182.51	686.830	-5.31	1214.33
655.040	0.64	1097.54	667.460	-4.01	1140.69	681.020	14.43	1179.81	687.890	14.43	1208.70
656.000	-4.27	1098.15	668.620	0.00	1136.04	682.180	9.65	1196.55	689.210	6.05	1227.75
657.000	7.05	1093.88	670.400	3.65	1136.04	682.800	2.55	1202.53	689.590	14.56	1230.05
659.280	3.39	1109.96	672.300	0.60	1142.97	<b>Mchinji</b>			690.070	8.33	1237.04
660.400	-0.77	1113.76	673.760	4.95	1143.85	683.380	10.49	1204.01	691.390	5.76	1248.03
661.680	9.98	1112.77	674.420	-1.92	1147.12	684.010	12.44	1210.62	692.330	14.84	1253.44
662.760	5.30	1123.55	675.020	10.36	1145.97	684.550	-13.02	1217.34	694.350	3.36	1283.42
663.420	9.18	1127.05	675.780	5.28	1153.84	685.090	-14.10	1210.31	695.370	1.99	1286.85
664.580	6.22	1137.70	676.420	6.80	1157.22	685.390	-11.76	1206.08	696.050	-9.51	1288.20
665.180	-2.38	1141.43	677.620	1.18	1165.38	685.810	10.14	1201.14	696.460		1284.30
<b>Kamwendo</b>			678.600	10.03	1166.54	686.030	14.06	1203.37			
<b>(Entré Lagos -) Nayuchi- Nkaya</b>											
0.000	1.82	643.97	65.075	-4.00	519.10						
1.128	0.00	646.02	65.928	-2.50	515.69						
<b>Nayuchi</b>			66.873	-5.88	513.33						
6.126	-1.51	646.02	67.666	-3.00	508.67						
7.620	3.33	643.77	73.152	0.00	492.19						
8.443	1.21	646.51	74.767	0.50	492.19						
12.954	-0.56	651.97	<b>Liwonde</b>								
18.440	3.00	648.93	75.651	2.50	492.63						
19.812	-2.00	653.04	76.352	-7.15	494.39						
20.818	0.00	651.03	77.084	-6.45	489.16						
<b>Namanja Halt</b>			77.480	0.00	486.60						
24.079	-3.33	651.03	78.212	8.69	486.60						
25.116	2.50	647.58	79.126	1.33	494.55						
25.725	-1.00	649.10	80.437	8.00	496.30						
27.432	3.00	647.39	82.875	-8.00	515.81						
28.895	-1.50	651.78	83.515	8.00	510.69						
29.413	-5.11	651.00	85.222	2.00	524.34						
29.980	4.88	648.11	86.258	-2.50	526.42						
30.480	1.25	650.55	86.472	8.00	525.88						
31.852	-2.00	652.26	87.173	1.25	531.49						
33.040	4.00	649.88	88.303	5.01	532.91						
36.728	3.33	664.63	88.636	0.00	534.58						
38.649	-6.67	671.04	89.672	8.33	534.58						
39.472	6.25	665.55	93.238	-2.50	564.29						
40.996	2.50	675.07	94.366	-5.00	561.48						
<b>Lambulila</b>			96.561	-2.50	550.50						
42.001	7.14	677.59	97.902	-8.00	547.15						
42.885	-7.69	683.90	99.578	2.66	533.74						
45.933	-8.34	660.46	99.730		534.14						
46.360	-7.54	656.90									
47.762	-6.25	646.33									
49.408	-6.67	636.04									
49.896	-7.70	632.79									
50.079	-8.34	631.38									
50.505	-7.69	627.83									
50.993	-2.50	624.07									
51.755	-9.09	622.17									
52.090	-8.00	619.12									
52.761	-9.09	613.76									
56.236	-8.62	582.17									
56.845	-2.50	576.91									
<b>Molipa Halt</b>											
57.638	-9.09	574.93									
58.674	-7.14	565.51									
61.905	9.09	542.43									
62.118	-9.09	544.37									
62.880	-2.50	537.45									
63.124	-9.09	536.84									



## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi)</b>											
-0.446	0.00	7.98	52.137	-17.39	160.68	103.269	2.94	194.91	149.279	-11.78	320.35
<b>Nacala</b>			52.531	-0.91	153.83	103.449	-5.95	195.44	149.700	-19.56	315.39
1.000	17.18	7.98	53.061	14.68	153.35	104.499	-1.27	189.19	150.180	11.15	306.00
2.349	5.46	31.15	53.527	-0.13	160.19	<i>Namialo Siding</i>			150.570	0.26	310.35
2.620	17.89	32.63	54.727	9.03	160.03	104.949	15.37	188.62	150.960	9.60	310.45
4.020	-1.12	57.68	55.379	-0.41	165.92	105.489	0.37	196.92	151.800	0.06	318.51
4.494	18.89	57.15	56.400	-17.58	165.50	<i>Namialo</i>			152.120	-6.73	318.53
5.158	3.01	69.69	57.077	-0.67	153.60	107.543	-6.98	197.68	152.750	5.17	314.29
5.510	16.98	70.75	57.527	-12.18	153.30	108.100	-0.74	193.79	153.195	-1.16	316.59
6.206	14.79	82.57	58.179	0.00	145.36	109.450	5.28	192.79	153.470	-8.96	316.27
7.354	4.29	99.55	58.637	-15.79	145.36	110.460	3.29	198.12	154.030	14.03	311.25
7.711	17.92	101.08	60.377	-7.84	117.89	111.250	7.22	200.72	154.980	0.95	324.58
9.464	3.10	132.49	60.867	-15.44	114.05	112.800	1.38	211.91	155.550	12.85	325.12
10.150	-0.91	134.62	62.222	-16.62	93.13	113.250	-7.16	212.53	156.630	-13.19	339.00
10.910	10.86	133.93	62.927	-3.60	81.41	113.700	0.76	209.31	158.545	16.33	313.75
11.387	0.33	139.11	63.077	0.20	80.87	114.449	7.12	209.88	159.785	-18.71	334.00
<i>Muchildo</i>			64.114	-9.45	81.08	116.500	7.43	224.49	160.600	5.80	318.75
12.950	8.28	139.62	64.677	-14.80	75.76	117.100	0.24	228.95	161.850	1.25	326.00
13.485	0.19	144.05	65.817	-6.31	58.89	118.050	8.89	229.18	<i>Muizia</i>		
14.394	-11.61	144.22	66.782	14.47	52.80	118.627	0.61	234.31	162.450	11.67	326.75
15.546	-0.28	130.84	66.952	5.92	55.26	119.350	7.95	234.75	162.900	-14.19	332.00
16.899	-9.52	130.46	67.440	-1.01	58.15	119.887	8.64	239.02	163.358	15.04	325.50
17.086	-3.70	128.68	<i>Monapo</i>			120.400	7.29	243.45	164.023	-17.74	335.50
17.586	-7.26	126.83	68.656	7.94	56.92	121.539	7.78	251.75	164.615	6.20	325.00
18.348	-15.54	121.30	69.590	11.85	64.34	123.007	4.20	263.17	164.820	-13.63	326.27
20.186	-1.46	92.73	70.388	10.21	73.80	123.805	7.93	266.52	165.280	20.03	320.00
20.632	-15.09	92.08	71.960	11.45	89.85	124.250	0.17	270.05	166.470	7.28	343.83
24.250	1.02	37.50	73.740	2.81	110.23	124.882	-11.28	270.16	166.830	16.04	346.45
24.750	5.66	38.01	74.687	11.92	112.89	125.030	-0.47	268.49	167.920	0.65	363.93
25.100	-1.64	39.99	75.339	-0.97	120.66	125.330	0.17	268.35	168.400	-12.48	364.24
25.460	12.33	39.40	76.020	-2.19	120.00	126.600	2.26	268.57	168.900	19.20	358.00
26.075	1.08	46.98	77.520	12.20	116.72	128.580	7.70	273.04	169.525	-18.53	370.00
26.778	14.73	47.74	77.807	3.19	120.22	130.495	-5.97	287.78	170.248	-1.45	356.60
27.700	1.79	61.32	77.970	11.65	120.74	132.050	18.66	278.50	170.950	-18.70	355.58
27.951	-15.44	61.77	79.370	7.61	137.05	132.586	-14.28	288.50	172.045	17.04	335.10
29.500	0.52	37.85	<i>Evate</i>			133.100	5.23	281.16	172.720	-0.09	346.60
30.591	16.12	38.42	82.210	15.31	158.67	134.154	-0.27	286.67	<i>Anchillo</i>		
31.997	-0.15	61.09	82.470	3.70	162.65	134.380	-16.50	286.61	173.877	-18.24	346.50
33.439	-15.46	60.88	86.550	-0.15	177.75	134.800	-1.73	279.68	174.535	18.56	334.50
34.337	16.18	47.00	86.940	-12.37	177.69	134.950	7.26	279.42	175.013	-0.05	343.37
35.247	0.84	61.72	87.400	8.35	172.00	135.566	15.86	283.89	175.413	13.45	343.35
35.557	15.16	61.98	88.370	0.93	180.10	136.400	-3.57	297.12	176.530	17.56	358.37
36.137	0.34	70.77	88.895	-13.95	180.59	136.750	-18.36	295.87	177.050	-8.06	367.50
36.805	16.50	71.00	89.300	-2.84	174.94	137.250	-0.11	286.69	177.980	20.76	360.00
37.437	11.53	81.43	89.610	13.41	174.06	137.790	12.10	286.63	179.001	18.50	381.20
38.287	10.33	91.23	90.200	-0.02	181.97	138.210	-0.16	291.71	179.394	1.57	388.47
38.957	0.64	98.15	90.720	11.14	181.96	138.530	-8.15	291.66	179.560	-17.72	388.73
39.427	16.52	98.45	91.810	-0.28	194.10	139.097	0.49	287.04	180.250	14.18	376.50
40.997	0.70	124.39	<i>Metochera</i>			140.450	6.44	287.70	180.838	0.80	384.84
41.637	11.62	124.84	92.690	-17.14	193.85	141.270	-18.58	292.98	181.400	18.33	385.29
42.243	0.42	131.88	93.750	-0.78	175.68	142.000	-1.63	279.42	182.530	-14.58	406.00
42.722	-7.21	132.08	95.737	20.12	174.14	142.350	19.11	278.85	183.250	9.07	395.50
<i>Namarrai</i>			96.229	-0.50	184.04	143.457	0.78	300.01	183.801	0.00	400.50
43.634	14.66	125.50	97.289	-8.63	183.51	<i>Nacavala</i>			185.285	18.50	400.50
44.629	7.52	140.09	97.820	0.37	178.93	143.840	17.42	300.31	186.150	-20.08	416.50
45.234	8.74	144.64	98.088	-12.32	179.03	144.927	0.43	319.25	186.872	0.61	402.00
45.767	-1.92	149.30	98.699	14.69	171.50	146.090	-15.42	319.75	187.365	-8.42	402.30
46.334	1.98	148.21	99.729	0.65	186.63	146.750	-0.15	309.57	187.757	21.20	399.00
48.007	-18.96	151.53	101.039	-11.74	187.48	147.215	15.11	309.50	188.257	1.26	409.60
48.615	15.09	140.00	101.349	2.18	183.84	148.190	0.37	324.23	188.655	21.15	410.10
49.725	17.54	156.75	101.899	0.53	185.04	148.570	-10.82	324.37	189.265	-16.85	423.00
49.928	0.17	160.31	102.649	15.27	185.44	148.950	0.27	320.26	189.710	9.01	415.50

## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi) (contd.)</b>											
190.875	17.60	426.00	231.520	-14.12	418.92	262.500	-9.97	610.80	300.700	7.37	627.52
191.500	0.52	437.00	231.780	2.49	415.25	263.280	-17.42	603.02	301.780	0.03	635.48
<b>Nampula</b>			<b>Mutivase</b>			264.171	-1.15	587.50	304.880	-11.86	635.56
192.470	-13.29	437.50	232.880	17.82	417.99	264.440	-12.74	587.19	305.750	11.58	625.24
192.902	-1.58	431.76	233.335	-1.75	426.10	264.750	1.05	583.24	307.230	0.03	642.38
193.175	-17.30	431.33	233.907	10.26	425.10	264.940	15.17	583.44	307.900	9.75	642.40
193.482	-2.00	426.02	234.330	-4.08	429.44	265.350	4.95	589.66	308.700	0.06	650.20
193.772	-13.84	425.44	235.100	13.77	426.30	265.980	0.00	592.78	309.780	-13.17	650.26
194.663	-1.23	413.11	235.410	5.15	430.57	266.260	-5.08	592.78	310.200	0.27	644.73
195.160	13.81	412.50	235.670	-0.75	431.91	266.640	10.31	590.85	311.050	-4.55	644.96
195.475	0.25	416.85	235.830	11.47	431.79	267.500	17.78	599.72	311.450	0.02	643.14
196.040	-17.01	416.99	236.000	2.20	433.74	268.050	-17.34	609.50	<b>Ribaue</b>		
196.745	18.76	405.00	236.354	-0.64	434.52	268.550	0.20	600.83	315.890	16.85	643.24
197.270	-2.38	414.85	236.900	18.36	434.17	268.700	13.45	600.86	316.430	-0.24	652.34
197.560	-8.06	414.16	237.735	-17.41	449.50	268.987	0.84	604.72	316.975	-14.74	652.21
197.720	1.85	412.87	238.410	18.60	437.75	269.430	11.48	605.09	317.610	-0.16	642.85
197.980	15.27	413.35	239.180	-0.63	452.07	269.720	0.05	608.42	318.240	6.05	642.75
198.350	0.00	419.00	239.800	14.35	451.68	270.485	-13.09	608.46	319.760	-0.35	651.95
198.850	-13.68	419.00	240.060	0.74	455.41	<b>Namina</b>			320.130	12.07	651.82
199.325	17.06	412.50	240.400	16.95	455.66	270.760	-0.91	604.86	321.360	-0.12	666.66
200.175	1.56	427.00	240.830	1.72	462.95	271.420	18.41	604.26	323.380	13.56	666.42
200.630	-3.61	427.71	241.300	18.48	463.76	271.760	0.39	610.52	324.520	3.57	681.88
200.940	0.29	426.59	241.920	3.86	475.22	272.040	-15.22	610.63	325.380	-0.42	684.95
201.250	-6.16	426.68	242.200	18.19	476.30	272.890	0.00	597.69	326.170	13.50	684.62
201.980	7.35	422.18	243.360	-0.80	497.40	273.290	10.24	597.69	326.570	1.90	690.02
202.870	-5.84	428.72	243.660	-8.68	497.16	273.920	0.04	604.14	327.150	-16.04	691.12
204.320	-9.45	420.25	243.850	0.86	495.51	274.970	-17.28	604.18	327.430	1.17	686.63
205.410	11.04	409.95	244.070	18.78	495.70	276.570	0.55	576.53	327.610	11.14	686.84
206.755	-11.24	424.80	244.710	3.30	507.72	276.860	16.41	576.69	327.980	-0.09	690.96
207.253	9.14	419.20	245.250	18.51	509.50	277.370	0.74	585.06	328.320	12.95	690.93
208.140	-0.57	427.31	246.620	0.12	534.86	277.980	19.15	585.51	328.750	-0.49	696.50
209.480	9.87	426.54	247.050	7.88	534.91	278.700	4.20	599.30	329.360	12.00	696.20
211.512	-0.24	446.60	247.300	0.08	536.88	279.000	-18.30	600.56	329.740	-0.18	700.76
<b>Rapala</b>			248.480	-14.15	536.98	280.110	-5.50	580.25	330.070	-11.24	700.70
212.400	14.27	446.39	248.750	0.33	533.16	280.290	-16.31	579.26	331.590	0.21	683.62
212.770	1.45	451.67	<b>Caramaja</b>			281.060	0.76	566.70	332.070	-7.67	683.72
212.990	14.81	451.99	250.078	-11.58	533.60	281.430	17.81	566.98	332.671	-0.14	679.11
214.172	-14.12	469.50	250.700	-1.20	526.40	282.610	5.93	588.00	333.300	-14.35	679.02
214.760	16.85	461.20	250.900	14.55	526.16	282.910	20.72	589.78	333.700	1.06	673.28
215.550	0.96	474.51	251.340	-0.21	532.56	283.910	3.86	610.50	334.273	-10.00	673.89
216.040	17.39	474.98	252.210	-7.43	532.38	284.325	19.21	612.10	334.640	0.02	670.22
216.760	-17.46	487.50	252.510	-0.04	530.15	285.465	2.33	634.00	<b>Outeiro</b>		
217.660	-3.96	471.79	252.760	18.87	530.14	285.740	10.88	634.64	335.820	12.09	670.24
217.930	-12.40	470.72	253.537	-9.29	544.80	286.720	16.77	645.30	336.400	6.29	677.25
218.375	14.43	465.20	254.032	17.55	540.20	<b>Murrula</b>			337.200	0.31	682.28
218.950	-15.33	473.50	254.670	-1.26	551.40	287.865	0.89	664.50	337.560	-9.06	682.39
219.700	16.12	462.00	254.900	17.77	551.11	288.875	0.17	665.40	338.040	-0.38	678.04
221.065	-12.03	484.00	255.650	5.41	564.44	289.467	20.46	665.50	338.300	17.30	677.94
221.514	3.68	478.60	255.940	16.14	566.01	290.160	19.73	679.68	338.600	7.86	683.13
222.575	16.72	482.50	256.700	4.38	578.28	290.835	-0.28	693.00	339.500	-0.33	690.20
223.532	-10.44	498.50	257.020	14.38	579.68	292.060	-5.70	692.66	339.800	-6.99	690.10
223.990	-0.59	493.72	257.810	1.26	591.04	292.460	0.69	690.38	341.851	1.64	675.76
224.310	-18.26	493.53	258.080	18.75	591.38	292.925	-17.07	690.70	342.010	9.71	676.02
224.850	1.01	483.67	258.400	-0.16	597.38	293.950	-3.53	673.20	342.350	1.01	679.32
225.178	-16.95	484.00	258.650	14.29	597.34	294.290	-18.70	672.00	342.925	-19.67	679.90
226.850	-2.00	455.66	259.130	1.38	604.20	295.270	0.28	653.67	343.225	-10.87	674.00
227.140	-18.20	455.08	259.390	-9.96	604.56	295.520	-19.73	653.74	344.062	-3.42	664.90
228.820	-2.54	424.50	259.860	-0.31	599.88	296.115	0.05	642.00	344.340	17.90	663.95
229.060	-16.81	423.89	259.990	13.56	599.84	297.740	-13.05	642.08	344.787	0.72	671.95
229.900	0.82	409.77	260.400	0.18	605.40	298.612	-0.15	630.70	345.134	-18.72	672.20
230.350	10.45	410.14	261.750	8.84	605.64	<b>Caia</b>			345.564	-1.70	664.15
231.130	1.62	418.29	262.300	1.50	610.50	299.690	-2.99	630.54	346.000	13.19	663.41

## Gradients

## Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi) (contd.)</b>											
346.310	0.11	667.50	385.620	-12.32	713.51	428.400	-0.66	625.15	465.400	0.65	625.24
347.825	17.38	667.66	385.965	20.27	709.26	428.900	0.00	624.82	465.800	-13.26	625.50
348.650	0.23	682.00	387.336	-18.25	737.05	<i>Malema</i>			466.650	-19.64	614.23
349.040	-16.07	682.09	388.325	-0.02	719.00	429.400	-4.26	624.82	467.390	0.64	599.70
349.500	0.11	674.70	389.343	-5.30	718.98	429.750	-14.54	623.33	467.860	20.41	600.00
350.230	0.80	674.78	389.562	0.74	717.82	430.100	-2.39	618.24	468.350	7.69	610.00
351.300	0.23	675.64	389.860	-10.39	718.04	430.410	12.04	617.50	469.000	-17.73	615.00
<i>lapala</i>			390.040	-0.14	716.17	431.800	2.81	634.23	470.100	-1.18	595.50
352.000	16.96	675.80	<i>Cais De Riane</i>			432.500	-10.93	636.20	470.525	-2.41	595.00
353.850	1.55	707.18	390.730	-3.63	716.07	433.250	9.48	628.00	477.900	0.00	577.20
354.070	14.21	707.52	391.460	0.13	713.42	434.000	10.49	635.11	478.460	20.68	577.20
355.332	-21.00	725.45	391.770	-7.89	713.46	434.350	8.29	638.78	479.260	0.00	593.74
355.563	0.00	720.60	392.120	0.17	710.70	435.100	12.32	645.00	<i>Mutuali</i>		
355.600	11.79	720.60	393.790	-10.43	710.98	435.750	12.22	653.01	479.975	-9.05	593.74
356.355	-18.20	729.50	394.070	-0.20	708.06	439.125	9.17	694.25	480.775	-2.80	586.50
357.737	18.42	704.35	395.050	-15.51	707.86	439.900	9.07	701.36	480.800	0.37	586.43
358.212	-17.94	713.10	395.600	1.47	699.33	440.450	-4.40	706.35	481.150	-10.47	586.56
358.934	-0.42	700.15	396.075	-19.04	700.03	441.075	-12.29	703.60	481.600	-6.00	581.85
359.770	-5.91	699.80	398.175	0.00	660.05	442.475	-3.45	686.40	482.275	0.00	577.80
360.090	-6.00	697.91	398.875	-6.20	660.05	443.000	-9.47	684.59	484.475	10.68	577.80
360.350	16.09	696.35	399.125	0.00	658.50	443.900	-5.65	676.07	485.250	0.68	586.08
361.040	-17.15	707.45	400.000	-15.55	658.50	444.300	-0.18	673.81	485.810	-13.66	586.46
362.930	-0.65	675.04	400.425	0.00	651.89	444.687	-11.05	673.74	486.100	-7.20	582.50
363.665	-14.93	674.56	<i>Namecuna</i>			446.275	-8.00	656.20	486.725	-16.00	578.00
364.275	10.22	665.45	402.325	-8.22	651.89	446.900	18.74	651.20	487.100	-14.61	572.00
364.920	-0.39	672.04	403.150	0.13	645.11	447.487	0.15	662.20	487.975	0.72	559.22
365.480	7.40	671.82	403.925	8.22	645.21	447.820	12.74	662.25	488.500	12.86	559.60
365.780	-1.08	674.04	405.375	0.00	657.13	448.320	2.72	668.62	489.420	0.00	571.43
366.375	17.33	673.40	405.850	-6.29	657.13	448.687	13.07	669.62	489.910	-18.01	571.43
367.131	-1.02	686.50	407.550	-1.27	646.43	448.837	15.47	671.58	490.600	19.75	559.00
367.513	14.58	686.11	407.700	-5.39	646.24	449.725	0.00	685.32	491.385	-11.86	574.50
368.083	-0.29	694.42	408.825	0.00	640.18	<i>Tui</i>			491.950	-18.38	567.80
368.783	14.66	694.22	409.175	18.78	640.18	450.360	-15.96	685.32	492.900	-0.79	550.34
369.424	0.00	703.62	409.650	0.00	649.10	450.850	-5.58	677.50	493.650	-10.41	549.75
369.988	15.50	703.62	410.550	13.01	649.10	451.237	-1.28	675.34	494.600	-17.71	539.86
370.925	-0.04	718.14	411.325	1.06	659.18	451.737	-7.72	674.70	494.950	-0.19	533.66
371.483	-15.47	718.12	412.800	10.37	660.74	452.487	-14.80	668.91	496.000	6.10	533.46
371.783	-1.09	713.48	413.525	0.18	668.26	452.787	16.51	664.47	496.300	-0.31	535.29
372.094	-16.98	713.14	<i>Nataleia</i>			452.850	-0.29	665.51	496.850	-0.41	535.12
372.750	10.49	702.00	414.750	-19.03	668.48	453.900	-2.63	665.21	497.775	17.01	534.74
373.463	-0.05	709.48	415.050	-10.83	662.77	454.600	-15.94	663.37	498.575	0.00	548.35
<i>Mussa</i>			415.400	-14.64	658.98	455.125	-11.67	655.00	499.125	12.49	548.35
374.293	-17.14	709.44	415.900	-17.80	651.66	455.725	0.00	648.00	500.510	0.83	565.65
375.850	16.99	682.75	416.300	-16.16	644.54	455.975	-17.23	648.00	501.050	3.78	566.10
376.930	-0.07	701.10	416.875	0.00	635.25	456.325	-6.24	641.97	501.550	6.36	567.99
377.480	17.61	701.06	417.100	-2.86	635.25	457.025	15.20	637.60	502.415	9.85	573.49
377.860	-0.63	707.75	417.170	-18.21	635.05	457.525	-0.48	645.20	502.750	0.34	576.79
378.160	12.05	707.56	418.650	-3.00	608.10	457.900	15.29	645.02	503.375	-17.23	577.00
378.370	-0.07	710.09	418.750	0.00	607.80	458.225	3.22	649.99	503.880	0.20	568.30
378.650	-13.17	710.07	419.450	-9.78	607.80	458.850	-12.53	652.00	504.520	19.12	568.43
379.130	-1.82	703.75	419.915	-2.58	603.25	459.225	0.00	647.30	504.950	0.00	576.65
380.210	7.48	701.78	420.400	7.73	602.00	459.425	1.49	647.30	505.650	-18.74	576.65
380.460	-0.41	703.65	420.950	7.33	606.25	460.150	1.13	648.38	506.325	-0.68	564.00
381.550	13.50	703.20	421.400	6.21	609.55	460.450	7.03	648.72	506.650	-15.65	563.78
381.887	-17.89	707.75	422.600	7.27	617.00	460.750	0.00	650.83	507.275	16.18	554.00
382.432	20.16	698.00	423.500	6.30	623.54	461.425	-18.69	650.83	508.125	16.15	567.75
382.943	-13.08	708.30	424.550	6.51	630.16	462.050	-12.33	639.15	508.650	8.14	576.23
383.310	14.94	703.50	425.250	-1.23	634.72	462.200	-16.50	637.30	509.850	12.56	586.00
383.660	-0.97	708.73	425.600	-9.77	634.29	463.350	-0.22	618.32	510.885	-18.60	599.00
384.105	17.14	708.30	426.000	-0.70	630.38	<i>Nacata</i>			511.250	-0.81	592.21
384.700	-13.33	718.50	426.600	0.17	629.96	464.330	14.83	618.10	512.000	-17.41	591.60
385.075	0.02	713.50	427.975	-11.88	630.20	464.800	0.28	625.07	513.000	2.64	574.19

# Gradients

# Annex 2.2.4.1

from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]	from km	Gradient [N/kN]	Altitude [m.a.s.l.]
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi) (contd.)</b>											
513.450	-7.77	575.38	35.410	-3.02	633.80						
515.775	0.02	557.31	36.460	-10.96	630.63						
<i>Murissa</i>			36.910	0.00	625.70						
518.300	-8.60	557.37	37.360	2.81	625.70						
518.500	-0.08	555.65	38.160	0.00	627.95						
519.000	9.76	555.61	<i>Caronga</i>								
519.450	0.72	560.00	38.860	-6.00	627.95						
519.700	12.55	560.18	39.610	0.00	623.45						
519.935	0.09	563.13	40.460	6.50	623.45						
520.858	9.46	563.21	41.460	10.00	629.95						
521.100	-0.26	565.50	42.160	6.00	636.95						
524.150	14.14	564.71	43.660	2.03	645.95						
524.520	0.29	569.94	45.210	4.98	649.09						
524.900	-12.14	570.05	46.910	6.67	657.55						
525.320	18.47	564.95	48.110	2.00	665.55						
526.200	-17.51	581.20	49.060	0.00	667.45						
526.750	0.09	571.57	49.710	-3.00	667.45						
527.400	-7.52	571.63	51.260	0.00	662.80						
528.050	-2.36	566.74	51.860	8.50	662.80						
529.425	8.12	563.50	52.860	-2.12	671.30						
529.850	-3.03	566.95	53.460	-7.00	670.03						
530.150	-6.03	566.04	54.410	0.00	663.38						
530.500	-1.69	563.93	55.210	-9.00	663.38						
531.050	20.06	563.00	56.460	0.00	652.13						
531.560	1.31	573.23	56.760	7.38	652.13						
531.920	13.12	573.70	57.960	3.33	660.98						
532.250	-0.20	578.03	58.560	6.57	662.98						
532.400	5.40	578.00	60.410	2.00	675.13						
532.550	12.66	578.81	61.360	0.00	677.03						
532.960	-1.84	584.00	62.160	7.00	677.03						
533.473=0.000			62.660	-2.00	680.53						
<b>Cuamba</b>			63.610	-6.51	678.63						
0.064	-0.92	582.94	64.360	0.00	673.75						
1.210	0.00	581.89	64.810	11.20	673.75						
1.560	8.76	581.89	66.060	2.07	687.75						
2.760	2.00	592.40	67.510	8.00	690.75						
4.460	5.66	595.80	68.310	1.80	697.15						
5.910	0.00	604.00	68.810	-10.50	698.05						
7.110	7.33	604.00	70.460	-11.50	680.73						
7.860	3.33	609.50	72.110	-5.26	661.75						
9.060	0.00	613.50	73.260	0.00	655.70						
9.810	-2.07	613.50	73.560	-8.54	655.70						
12.710	7.91	607.50	74.810	0.02	645.03						
14.860	2.85	624.50	77.310	-2.51	645.08						
16.960	3.22	630.49	77.760	0.02	643.95						
19.260	-1.57	637.89	<b>Entré Lagos</b>								
19.960	-7.00	636.79	78.620		643.97						
20.510	-8.00	632.94									
21.660	0.00	623.74									
22.060	-3.33	623.74									
23.410	-9.15	619.25									
24.910	0.00	605.53									
25.210	9.00	605.53									
27.410	6.86	625.33									
28.310	1.91	631.50									
29.660	1.33	634.08									
30.260	-1.96	634.88									
30.760	3.50	633.90									
32.360	-3.84	639.50									
32.860	-5.50	637.58									
34.310	0.00	629.60									
34.710	6.00	629.60									

Annex 2.2.4.2

**Curve register**

## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata)</b>											
4.358	∞	75.520	402	99.447	∞	107.023	141	114.187	∞	121.843	-272
16.423	764	75.770	∞	99.623	-523	107.077	∞	114.243	111	121.877	∞
16.737	∞	76.130	-372	99.727	∞	107.323	-433	114.477	∞	121.923	251
20.088	352	76.440	∞	99.803	342	107.427	∞	114.523	-131	121.957	∞
20.362	∞	76.623	-634	99.897	∞	107.673	121	114.577	∞	122.013	-312
25.508	-181	76.747	∞	100.013	-634	107.757	∞	114.703	-121	122.107	∞
25.662	∞	84.223	634	100.027	∞	107.803	-121	114.757	∞	122.163	292
26.164	-231	84.407	∞	100.123	412	107.857	∞	114.803	111	122.427	∞
26.166	∞	86.243	523	100.327	∞	107.903	111	114.927	∞	122.483	-131
26.638	352	86.487	∞	100.593	-1348	108.097	∞	114.973	-181	122.547	∞
26.662	∞	87.113	-604	100.637	∞	108.143	-111	115.127	∞	122.593	272
28.593	503	87.187	∞	100.973	-221	108.357	∞	115.193	141	122.647	∞
28.627	∞	87.673	644	101.097	∞	108.423	111	115.267	∞	122.723	-241
30.738	322	87.917	∞	101.193	392	108.497	∞	115.353	-141	122.787	∞
30.822	∞	88.013	-714	101.437	∞	108.543	-131	115.377	∞	122.833	332
35.790	-382	88.267	∞	101.523	-181	108.677	∞	115.443	131	122.927	∞
35.930	∞	88.553	-1106	101.647	∞	108.723	111	115.487	∞	122.983	-191
37.023	573	88.827	∞	101.773	241	108.837	∞	115.543	-231	123.007	∞
37.127	∞	89.153	-563	101.927	∞	108.943	111	115.567	∞	123.053	272
37.350	-412	89.817	∞	102.223	-241	109.147	∞	115.833	-221	123.117	∞
37.470	∞	89.983	593	102.397	∞	109.213	-111	115.987	∞	123.293	-121
37.680	-382	90.417	∞	102.573	-433	109.457	∞	116.133	-684	123.327	∞
37.790	∞	91.223	915	102.687	∞	109.503	111	116.187	∞	123.373	141
45.253	573	91.377	∞	102.743	161	109.697	∞	116.443	-372	123.427	∞
45.337	∞	91.583	-604	102.797	∞	109.743	-111	116.557	∞	123.473	-201
48.523	-503	91.937	∞	102.893	-241	109.877	∞	116.623	724	123.517	∞
48.737	∞	92.253	-553	102.927	∞	110.003	121	116.727	∞	123.623	312
49.140	412	92.557	∞	103.123	-272	110.057	∞	117.033	553	123.667	∞
49.400	∞	92.743	593	103.177	∞	110.103	-121	117.167	∞	123.723	-433
49.610	-382	92.907	∞	103.293	161	110.157	∞	118.023	322	123.807	∞
49.880	∞	93.144	-161	103.327	∞	110.273	121	118.107	∞	123.923	-251
52.038	342	93.146	∞	103.393	-141	110.347	∞	118.163	-191	124.007	∞
52.142	∞	93.428	221	103.427	∞	110.433	-121	118.187	∞	124.093	141
52.450	-372	93.452	∞	103.473	121	110.537	∞	118.243	272	124.185	151
52.600	∞	94.183	-161	103.497	∞	110.623	131	118.337	∞	124.277	∞
54.128	-302	94.247	∞	103.553	-131	110.727	∞	118.413	-191	124.323	-201
54.222	∞	94.673	503	103.627	∞	110.793	-241	118.517	∞	124.367	∞
54.380	372	94.887	∞	103.713	151	110.877	∞	118.573	191	124.413	221
54.510	∞	95.623	-1921	103.767	∞	110.973	-131	118.677	∞	124.477	∞
56.893	1106	95.787	∞	103.823	-161	111.327	∞	118.723	-171	124.603	-141
56.967	∞	96.123	-392	103.877	∞	111.373	111	118.887	∞	124.647	∞
57.790	422	96.277	∞	104.073	111	111.597	∞	118.933	604	124.743	-312
57.980	∞	96.443	-262	104.337	∞	111.673	-201	119.007	∞	124.787	∞
58.080	-372	96.577	∞	104.403	-111	111.857	∞	119.103	805	124.873	614
58.350	∞	96.823	141	104.527	∞	111.903	201	119.147	∞	125.047	∞
64.123	-795	96.927	∞	104.573	111	112.277	∞	119.253	-191	125.093	-684
64.197	∞	96.993	-141	104.677	∞	112.453	121	119.297	∞	125.177	∞
64.700	-392	97.047	∞	104.743	-121	112.527	∞	119.343	241	125.223	674
64.790	∞	97.113	121	104.777	∞	112.613	-111	119.547	∞	125.287	∞
65.473	1217	97.227	∞	104.893	121	112.727	∞	119.593	-191	125.333	-734
65.577	∞	97.373	-131	105.037	∞	112.843	111	119.657	∞	125.387	∞
65.803	1408	97.447	∞	105.193	-121	112.997	∞	119.763	282	125.493	604
65.947	∞	97.623	131	105.377	∞	113.343	-111	119.867	∞	125.607	∞
66.653	3048	97.727	∞	105.503	121	113.407	∞	120.093	-463	125.903	-453
66.907	∞	97.923	-141	105.667	∞	113.453	111	120.227	∞	125.947	∞
67.680	392	97.977	∞	105.723	-111	113.477	∞	120.943	-422	126.313	-332
67.870	∞	98.223	-131	105.957	∞	113.673	-141	121.077	∞	126.527	∞
70.003	473	98.297	∞	106.053	-121	113.697	∞	121.393	463	126.973	644
70.097	∞	98.363	121	106.177	∞	113.753	141	121.457	∞	127.097	∞
72.438	332	98.497	∞	106.303	111	113.777	∞	121.513	-372	127.323	-141
73.042	∞	98.693	-262	106.577	∞	113.933	-231	121.657	∞	127.427	∞
74.583	-935	98.787	∞	106.723	-121	114.027	∞	121.703	141	127.563	181
75.097	∞	99.393	-694	106.957	∞	114.133	-121	121.757	∞	127.647	∞



## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
127.773	-131	136.083	774	142.547	∞	148.223	181	155.927	∞	165.033	-201
127.887	∞	136.237	∞	142.723	-111	148.277	∞	156.153	-402	165.077	∞
127.933	141	136.633	1016	142.777	∞	148.343	-181	156.407	∞	165.233	221
128.027	∞	136.797	∞	142.823	111	148.397	∞	156.683	-302	165.427	∞
128.123	-241	137.103	221	142.927	∞	148.483	402	156.817	∞	165.583	121
128.177	∞	137.177	∞	142.973	-111	148.527	∞	157.443	-241	165.647	∞
128.693	-302	137.363	-604	143.147	∞	148.593	-111	157.727	∞	166.233	201
128.757	∞	137.417	∞	143.243	-111	148.627	∞	157.873	-241	166.277	∞
128.973	-533	137.503	-573	143.327	∞	148.813	181	158.027	∞	166.383	-201
129.027	∞	137.607	∞	143.383	111	148.827	∞	158.133	201	166.427	∞
129.173	272	137.773	805	143.447	∞	148.903	282	158.277	∞	166.823	-121
129.275	211	137.877	∞	143.493	-121	148.927	∞	158.443	503	166.887	∞
129.377	∞	137.983	634	143.547	∞	149.003	-201	158.477	∞	167.203	604
129.473	573	138.087	∞	143.663	-201	149.047	∞	158.593	-402	167.277	∞
129.527	∞	138.263	785	143.687	∞	149.143	111	158.677	∞	167.393	111
129.673	302	138.367	∞	143.803	201	149.227	∞	158.773	111	167.447	∞
129.787	∞	138.643	-1559	143.817	∞	149.343	-111	158.927	∞	167.533	-382
129.893	-563	138.687	∞	143.873	-805	149.527	∞	159.033	-151	167.627	∞
130.017	∞	138.763	1046	143.977	∞	149.593	201	159.177	∞	167.733	-282
130.243	-473	138.787	∞	144.143	-201	149.627	∞	159.293	111	167.777	∞
130.327	∞	138.843	-231	144.177	∞	149.683	-111	159.497	∞	168.023	-604
130.583	-191	138.897	∞	144.243	111	149.727	∞	159.623	-121	168.177	∞
130.727	∞	139.063	-2173	144.327	∞	149.783	111	159.787	∞	168.553	-402
130.803	191	139.097	∞	144.423	-201	149.897	∞	159.843	-201	168.627	∞
130.857	∞	139.163	151	144.457	∞	150.043	161	159.977	∞	168.683	121
131.053	1247	139.237	∞	144.733	111	150.157	∞	160.043	201	168.777	∞
131.277	∞	139.293	-151	144.887	∞	150.373	-121	160.247	∞	169.023	-141
131.393	-161	139.367	∞	145.043	201	150.497	∞	160.673	111	169.137	∞
131.417	∞	139.463	-191	145.047	∞	150.673	-805	160.777	∞	169.253	111
131.473	121	139.577	∞	145.133	-111	150.737	∞	160.873	-111	169.377	∞
131.601	141	139.703	-392	145.317	∞	150.873	-181	161.007	∞	169.423	-121
131.786	443	139.857	∞	145.383	111	150.927	∞	161.133	-161	169.577	∞
131.857	∞	139.933	-352	145.477	∞	151.043	141	161.197	∞	169.673	161
132.113	-553	139.977	∞	145.609	111	151.157	∞	161.243	111	169.777	∞
132.157	∞	140.043	151	145.611	∞	151.643	805	161.387	∞	170.083	-221
132.233	211	140.197	∞	145.643	-111	151.677	∞	161.573	-503	170.177	∞
132.367	∞	140.323	805	145.777	∞	151.953	-181	161.687	∞	170.303	-382
132.523	342	140.377	∞	145.833	111	152.027	∞	161.923	503	170.617	∞
132.577	∞	140.703	-201	145.937	∞	152.093	111	162.017	∞	170.763	282
132.633	-151	140.807	∞	146.013	-111	152.227	∞	162.373	-503	170.947	∞
132.667	∞	140.873	111	146.097	∞	152.283	-111	162.457	∞	171.123	-201
132.773	-221	140.997	∞	146.173	111	152.427	∞	162.590	-111	171.207	∞
132.977	∞	141.053	-111	146.327	∞	152.543	111	162.620	∞	171.583	181
133.133	201	141.127	∞	146.453	-201	152.657	∞	162.700	111	171.627	∞
133.197	∞	141.173	201	146.557	∞	152.703	-141	162.770	∞	171.723	141
133.283	-111	141.177	∞	146.623	201	152.797	∞	162.833	-302	171.857	∞
133.297	∞	141.243	-201	146.667	∞	152.938	111	163.127	∞	172.023	-201
133.603	-593	141.297	∞	146.743	201	152.962	∞	163.223	181	172.187	∞
133.657	∞	141.403	-201	146.827	∞	153.053	402	163.337	∞	172.473	-221
133.703	744	141.437	∞	146.903	-201	153.227	∞	163.423	-241	172.837	∞
133.707	∞	141.493	201	146.977	∞	153.383	-111	163.487	∞	172.923	111
133.813	-503	141.537	∞	147.143	-805	153.527	∞	163.653	-201	173.207	∞
133.917	∞	141.593	-121	147.257	∞	153.633	161	163.747	∞	173.273	-302
134.043	422	141.677	∞	147.333	201	153.767	∞	163.843	201	173.777	∞
134.177	∞	141.723	121	147.357	∞	154.423	503	163.957	∞	173.823	282
134.553	503	141.820	∞	147.543	111	154.577	∞	164.063	-221	173.877	∞
134.627	∞	141.893	-201	147.627	∞	154.643	-121	164.127	∞	174.793	-402
135.023	483	142.047	∞	147.693	111	154.887	∞	164.213	121	175.017	∞
135.157	∞	142.123	201	147.827	∞	154.943	302	164.357	∞	175.183	-402
135.393	-131	142.147	∞	147.903	-201	155.067	∞	164.403	-121	175.367	∞
135.557	∞	142.243	-181	147.927	∞	155.283	402	164.527	∞	175.853	-402
135.743	211	142.337	∞	148.123	-181	155.327	∞	164.663	-221	175.927	∞
135.907	∞	142.493	111	148.147	∞	155.653	161	164.777	∞	176.563	141

## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
176.687	∞	185.483	201	194.347	∞	204.623	-121	213.410	∞	221.330	161
176.753	-201	185.567	∞	194.563	201	204.657	∞	213.600	-161	221.380	∞
177.003	∞	185.733	121	194.607	∞	204.763	-302	213.780	∞	221.470	-201
177.333	201	185.857	∞	194.713	201	205.017	∞	213.873	241	221.520	∞
177.397	∞	185.943	141	194.797	∞	205.293	121	213.927	∞	221.600	161
177.813	161	186.037	∞	194.883	-201	205.457	∞	214.000	-151	221.660	∞
177.867	∞	186.103	-121	194.917	∞	205.663	-201	214.160	∞	221.750	161
178.183	161	186.267	∞	194.963	342	205.797	∞	214.258	141	221.890	∞
178.257	∞	186.313	161	195.117	∞	205.973	-241	214.402	∞	221.968	-141
178.343	-161	186.377	∞	195.343	-201	206.177	∞	214.600	161	222.172	∞
178.517	∞	186.613	121	195.417	∞	206.393	604	214.630	∞	222.268	141
178.663	-161	186.687	∞	195.703	111	206.977	∞	214.710	-161	222.512	∞
178.767	∞	186.743	-141	195.807	∞	207.123	402	214.850	∞	222.648	-151
178.883	201	186.797	∞	195.893	181	207.257	∞	214.920	201	222.862	∞
179.007	∞	186.913	302	195.967	∞	207.333	402	214.960	∞	222.948	151
179.183	-201	187.000	111	196.333	111	207.497	∞	215.068	141	222.982	∞
179.277	∞	187.087	∞	196.457	∞	207.653	-604	215.192	∞	223.120	-161
179.343	201	187.203	111	196.683	-241	207.727	∞	215.320	-161	223.180	∞
179.427	∞	187.267	∞	196.767	∞	208.013	161	215.350	∞	223.258	151
179.503	-302	187.333	-121	196.933	-161	208.207	∞	215.440	161	223.532	∞
179.587	∞	187.567	∞	197.037	∞	208.263	-241	215.490	∞	223.658	-151
179.643	111	187.653	-121	197.643	201	208.367	∞	215.638	-141	223.782	∞
179.717	∞	187.767	∞	197.767	∞	208.493	-241	215.862	∞	223.908	151
179.773	-111	187.833	141	197.883	-161	208.687	∞	215.993	241	223.982	∞
179.867	∞	187.997	∞	197.967	∞	208.763	241	216.267	∞	224.070	-161
179.933	161	188.093	201	198.503	201	208.837	∞	216.413	-241	224.120	∞
180.217	∞	188.187	∞	198.727	∞	208.903	-201	216.447	∞	224.190	161
180.313	-121	188.263	-111	198.883	-201	208.977	∞	216.573	241	224.260	∞
180.627	∞	188.467	∞	198.987	∞	209.323	121	216.647	∞	224.430	161
180.703	161	188.543	131	199.073	161	209.487	∞	217.020	-161	224.460	∞
180.887	∞	188.767	∞	199.177	∞	209.578	-151	217.120	∞	224.530	-161
181.083	-201	189.003	-604	199.253	-161	209.652	∞	217.208	141	224.740	∞
181.157	∞	189.057	∞	199.437	∞	209.768	151	217.262	∞	224.840	161
181.253	221	189.123	201	199.663	302	209.932	∞	217.458	-151	224.960	∞
181.427	∞	189.227	∞	199.717	∞	210.108	-151	217.702	∞	225.110	-161
181.593	-121	189.453	-161	200.443	302	210.152	∞	217.793	-241	225.200	∞
181.757	∞	189.507	∞	200.597	∞	210.233	402	217.817	∞	225.330	161
181.813	241	189.813	402	201.153	302	210.257	∞	217.920	161	225.500	∞
181.847	∞	189.887	∞	201.217	∞	210.348	-151	218.190	∞	225.563	-241
182.053	121	190.143	-111	201.533	-111	210.502	∞	218.340	-201	225.597	∞
182.287	∞	190.347	∞	201.677	∞	210.598	151	218.710	∞	225.768	-151
182.393	-161	190.403	241	201.783	121	210.612	∞	218.798	-201	226.012	∞
182.617	∞	190.580	111	201.917	∞	210.899	151	218.802	∞	226.108	151
182.783	302	190.757	∞	202.073	-111	210.901	∞	218.988	-151	226.192	∞
182.887	∞	190.893	-161	202.217	∞	211.109	151	219.082	∞	226.300	161
182.983	-161	191.187	∞	202.293	111	211.111	∞	219.168	151	226.370	∞
183.107	∞	191.243	141	202.447	∞	211.198	-151	219.222	∞	226.880	161
183.263	241	191.287	∞	202.603	-141	211.262	∞	219.413	-241	227.010	∞
183.327	∞	191.393	-161	202.757	∞	211.410	171	219.477	∞	227.383	-302
183.383	-161	191.567	∞	202.903	402	211.620	∞	219.540	161	227.447	∞
183.437	∞	191.633	161	202.937	∞	211.700	-151	219.720	∞	227.840	-201
183.503	121	192.107	∞	203.053	-161	211.820	∞	219.820	-161	227.900	∞
183.657	∞	192.513	-161	203.087	∞	211.920	151	219.890	∞	228.280	201
183.793	-201	192.737	∞	203.283	-201	212.130	∞	219.978	151	228.430	∞
183.987	∞	192.963	-161	203.317	∞	212.330	151	220.072	∞	228.550	-201
184.083	-302	193.157	∞	203.633	-402	212.470	∞	220.294	-241	228.810	∞
184.217	∞	193.213	121	203.677	∞	212.550	-151	220.296	∞	229.250	-161
184.283	241	193.267	∞	203.913	161	212.770	∞	220.570	161	229.390	∞
184.347	∞	193.643	302	204.037	∞	212.970	-161	220.660	∞	230.320	181
184.553	-201	193.757	∞	204.263	-201	213.000	∞	220.768	-151	230.420	∞
184.717	∞	193.963	-121	204.397	∞	213.118	151	220.812	∞	231.070	-161
185.233	-201	194.117	∞	204.493	-121	213.142	∞	221.018	-141	231.250	∞
185.337	∞	194.293	-805	204.517	∞	213.310	161	221.252	∞	231.330	161



## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
231.430	∞	245.320	-201	299.017	∞	406.923	483	493.677	∞	508.723	181
231.698	-141	245.370	∞	300.723	875	406.947	∞	493.923	1519	508.997	∞
231.852	∞	245.910	-201	300.877	∞	411.473	-764	494.237	∞	509.053	-191
231.940	161	246.020	∞	310.530	433	411.677	∞	494.423	-211	509.577	∞
232.020	∞	246.360	201	310.650	∞	415.288	191	494.777	∞	510.093	201
232.163	-241	246.420	∞	313.623	875	415.462	∞	495.323	-513	510.397	∞
232.267	∞	246.990	-161	313.627	∞	415.638	282	495.577	∞	510.623	241
232.358	151	247.040	∞	313.723	-875	415.702	∞	495.923	231	510.767	∞
232.452	∞	247.293	503	313.757	∞	418.607	-382	496.237	∞	511.353	221
232.788	151	247.527	∞	322.738	-433	418.840	∞	496.683	-191	511.557	∞
232.962	∞	247.993	-1066	322.962	∞	428.293	-1157	496.787	∞	511.723	-221
233.058	-151	247.997	∞	326.573	1750	428.397	∞	496.923	181	511.907	∞
233.272	∞	248.073	302	326.827	∞	435.273	1147	496.977	∞	512.403	-262
233.470	201	248.097	∞	332.023	-1026	435.312	∞	497.183	785	512.977	∞
233.780	∞	248.533	-241	332.127	∞	439.288	-181	497.377	∞	513.193	221
234.053	-241	248.947	∞	336.730	563	439.862	∞	497.603	-191	513.447	∞
234.177	∞	249.213	402	336.870	∞	441.130	-362	497.957	∞	513.823	-211
234.350	-161	249.377	∞	337.223	905	441.320	∞	498.043	422	513.977	∞
234.530	∞	250.323	443	337.477	∞	441.788	-181	498.247	∞	514.383	171
234.743	503	250.507	∞	343.723	-664	441.862	∞	498.323	171	514.677	∞
234.757	∞	251.290	-171	343.927	∞	442.273	-563	498.837	∞	514.833	181
234.990	161	251.420	∞	349.088	382	442.577	∞	499.003	-181	514.977	∞
235.140	∞	251.808	151	349.212	∞	443.508	241	499.297	∞	515.093	-201
235.360	161	251.882	∞	351.723	-1026	443.762	∞	499.483	181	515.377	∞
235.460	∞	252.470	-171	351.827	∞	447.553	-563	499.777	∞	515.733	-211
235.648	-151	252.580	∞	357.738	-382	448.077	∞	499.893	-171	515.907	∞
235.892	∞	252.830	-171	357.962	∞	448.280	-422	500.077	∞	516.023	191
236.298	151	252.880	∞	362.123	845	448.670	∞	500.183	201	516.397	∞
236.412	∞	253.050	171	362.277	∞	451.088	221	500.377	∞	516.553	191
236.490	161	253.160	∞	363.323	-573	451.362	∞	500.493	-161	516.627	∞
236.560	∞	254.223	-935	363.527	∞	452.238	262	500.587	∞	516.773	-181
237.088	-141	254.707	∞	364.638	382	452.562	∞	500.643	-181	517.057	∞
237.272	∞	255.893	211	364.862	∞	462.780	443	500.697	∞	517.223	181
237.378	151	256.097	∞	373.680	-573	463.170	∞	500.893	-191	517.377	∞
237.522	∞	256.523	-935	373.820	∞	465.138	241	501.037	∞	518.223	-845
237.688	-151	256.887	∞	374.338	282	465.312	∞	501.273	-181	518.417	∞
237.942	∞	263.903	935	374.512	∞	466.138	151	501.477	∞	518.723	865
238.050	161	264.017	∞	375.938	-382	466.262	∞	501.723	171	519.027	∞
238.130	∞	270.593	935	376.112	∞	467.338	-251	501.877	∞	519.133	191
238.220	-201	270.657	∞	380.230	-382	467.562	∞	502.103	-201	519.277	∞
238.290	∞	273.920	-443	380.420	∞	469.360	-422	502.247	∞	519.363	-181
239.410	201	274.330	∞	386.574	382	469.910	∞	502.373	181	519.517	∞
239.530	∞	275.590	443	386.576	∞	476.333	1670	502.697	∞	519.758	-161
239.688	151	275.710	∞	389.623	573	476.507	∞	502.783	-191	519.862	∞
239.932	∞	276.440	-443	389.777	∞	479.843	-1670	502.907	∞	520.323	-262
240.078	-151	276.550	∞	391.480	-382	480.517	∞	502.983	181	520.697	∞
240.452	∞	282.993	-935	391.720	∞	480.873	1720	503.107	∞	520.773	-352
240.723	241	283.247	∞	392.588	-161	481.687	∞	503.623	-171	520.977	∞
240.757	∞	285.933	935	392.762	∞	484.153	865	503.697	∞	521.130	191
240.873	302	286.337	∞	392.888	141	484.817	∞	503.823	181	521.350	∞
240.917	∞	294.763	935	393.012	∞	485.923	-593	503.947	∞	521.450	-171
241.180	161	295.117	∞	393.238	-251	487.187	∞	504.243	-221	521.890	∞
241.350	∞	295.448	-211	393.262	∞	490.283	352	504.377	∞	521.980	392
241.440	-161	295.642	∞	394.023	654	490.757	∞	505.073	-2002	521.990	∞
241.630	∞	296.023	-604	394.177	∞	490.923	-272	505.117	∞	522.060	181
241.910	161	296.187	∞	405.980	382	491.337	∞	505.243	1519	522.370	∞
242.180	∞	296.273	604	406.220	∞	491.843	161	505.427	∞	522.530	221
242.580	201	296.387	∞	406.580	402	492.077	∞	505.593	-1519	522.800	∞
242.700	∞	297.603	750	406.590	∞	492.453	835	505.627	∞	522.923	292
243.723	-503	298.047	∞	406.680	402	492.727	∞	506.000	-131	523.137	∞
243.777	∞	298.143	-750	406.700	∞	492.873	-1519	506.190	∞	523.360	-181
244.473	241	298.517	∞	406.859	-463	493.017	∞	506.243	191	523.870	∞
244.547	∞	298.923	-750	406.861	∞	493.603	-1519	506.477	∞	523.943	422

## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>											
524.047	∞	543.823	-1670	567.057	∞	593.043	503	630.977	∞	686.025	500
524.360	-191	544.277	∞	567.223	1500	593.297	∞	631.323	523	686.334	∞
524.390	∞	545.293	-453	567.827	∞	594.003	-483	631.647	∞	687.288	1000
524.450	191	545.377	∞	567.873	-480	594.227	∞	632.243	-513	687.548	∞
524.750	∞	545.680	221	568.227	∞	594.523	1670	632.547	∞	690.155	800
524.830	201	545.770	∞	568.343	211	594.597	∞	632.803	523	690.896	∞
525.170	∞	546.050	-211	568.777	∞	595.173	503	633.097	∞	691.616	-800
525.683	-422	546.170	∞	568.823	-251	595.397	∞	633.273	543	692.050	∞
525.747	∞	546.730	221	568.897	∞	595.593	-493	633.527	∞	694.404	-500
526.923	282	546.820	∞	569.173	-312	596.077	∞	633.823	-543	694.740	∞
527.077	∞	548.038	171	569.377	∞	596.253	684	634.377	∞	694.835	500
527.280	-221	548.112	∞	569.523	-282	596.757	∞	634.623	684	695.380	∞
527.640	∞	548.288	-171	569.897	∞	597.923	-1529	634.877	∞	696.110	-500
528.023	251	548.612	∞	570.338	-412	597.977	∞	636.710	-463	696.460	∞
528.457	∞	549.510	-181	570.592	∞	598.923	-1187	637.100	∞	714.387	∞
528.680	-191	549.770	∞	570.843	704	599.077	∞	637.723	513		
528.850	∞	549.838	171	570.947	∞	599.643	503	637.927	∞		
529.173	-453	550.162	∞	571.423	412	599.827	∞	642.703	-1388		
529.527	∞	550.303	805	572.507	∞	600.023	-533	643.227	∞		
529.993	453	550.657	∞	572.553	-380	600.127	∞	644.073	573		
530.477	∞	550.743	-352	573.227	∞	600.773	674	644.427	∞		
530.723	-412	550.977	∞	573.273	1000	600.897	∞	645.303	-1428		
530.777	∞	551.550	-221	573.827	∞	602.623	-1006	645.757	∞		
532.710	-211	551.890	∞	574.888	-181	603.497	∞	647.393	1609		
533.040	∞	552.003	251	575.102	∞	605.143	-553	647.597	∞		
533.138	131	552.247	∞	575.188	171	605.247	∞	649.123	1318		
533.262	∞	552.423	-604	575.462	∞	606.873	604	649.277	∞		
533.330	221	552.477	∞	575.588	221	607.277	∞	650.723	1428		
533.570	∞	552.700	221	575.642	∞	608.023	1448	650.827	∞		
534.110	-211	552.870	∞	576.238	-241	608.197	∞	652.503	-1670		
534.270	∞	554.373	-704	576.692	∞	611.593	835	652.507	∞		
534.438	171	554.907	∞	576.923	553	611.777	∞	653.623	1519		
534.512	∞	554.983	895	577.227	∞	612.983	774	654.277	∞		
535.650	-221	555.227	∞	577.693	-1499	613.147	∞	655.823	1609		
535.820	∞	555.723	805	577.897	∞	613.793	795	655.877	∞		
536.010	211	556.127	∞	578.608	-262	614.047	∞	657.173	1428		
536.140	∞	557.173	251	578.982	∞	615.623	-503	657.627	∞		
536.550	211	557.457	∞	579.158	231	616.037	∞	659.073	1921		
536.850	∞	557.638	-171	579.612	∞	616.150	-402	659.157	∞		
537.050	-221	557.862	∞	582.503	483	616.570	∞	660.523	-1519		
537.570	∞	557.980	211	582.947	∞	617.523	895	660.877	∞		
538.180	181	558.320	∞	583.580	-422	617.597	∞	663.123	-4536		
538.290	∞	558.450	-181	583.870	∞	618.923	835	663.627	∞		
538.730	-181	558.690	∞	584.793	-533	619.247	∞	666.823	-754		
538.750	∞	559.123	503	584.897	∞	620.693	945	667.227	∞		
538.888	171	559.557	∞	585.973	714	621.427	∞	670.723	1609		
539.062	∞	560.288	171	586.197	∞	622.023	-945	670.947	∞		
539.138	-171	560.482	∞	586.773	-754	622.127	∞	673.223	-1086		
539.362	∞	560.618	171	586.797	∞	622.573	-835	673.547	∞		
539.488	171	560.662	∞	587.773	-513	623.697	∞	675.053	1519		
539.612	∞	560.788	-171	588.097	∞	623.923	-795	675.377	∞		
539.688	-131	561.082	∞	588.323	513	624.097	∞	677.823	-1670		
539.912	∞	561.243	-453	588.697	∞	624.623	1519	678.077	∞		
540.188	171	561.877	∞	588.943	-473	625.697	∞	680.223	553		
540.382	∞	562.003	251	589.477	∞	626.123	-1318	680.757	∞		
540.630	-201	562.797	∞	589.703	-684	627.157	∞	681.143	-593		
541.090	∞	562.993	-453	589.827	∞	627.723	835	681.297	∞		
541.680	211	563.377	∞	590.123	473	628.177	∞	681.643	-865		
541.870	∞	564.653	-805	590.557	∞	628.603	503	682.547	∞		
542.530	221	565.147	∞	590.750	-463	628.677	∞	683.473	543		
542.870	∞	565.403	463	590.990	∞	629.503	483	683.927	∞		
543.273	342	565.577	∞	591.943	503	629.647	∞	685.098	-800		
543.577	∞	566.923	704	592.277	∞	630.673	-523	685.364	∞		

## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>(Entré Lagos -) Nayuchi- Nkaya</b>											
1.320	∞	26.303	10672	46.570	∞	52.010	-402	72.247	∞	84.153	614
1.103	-1982	26.977	∞	46.623	764	52.380	∞	72.293	1841	85.157	∞
1.297	∞	27.023	-3048	46.807	∞	52.440	402	73.427	∞	85.203	-4567
2.643	-3963	27.407	∞	46.860	-402	52.720	∞	73.473	-1831	86.377	∞
3.097	∞	28.383	-3048	47.430	∞	53.143	-614	74.017	∞	86.423	4567
4.803	-3963	29.917	∞	47.490	402	53.367	∞	74.153	1831	87.177	∞
5.037	∞	35.903	-9143	47.700	∞	53.953	-614	74.557	∞	88.043	-4567
6.713	-3963	37.077	∞	47.760	-402	54.387	∞	75.433	-3048	88.807	∞
7.417	∞	40.233	1217	48.060	∞	54.623	614	76.037	∞	88.853	764
10.273	-9143	40.977	∞	48.120	402	55.357	∞	76.343	3048	90.097	∞
10.337	∞	41.943	-915	48.580	∞	56.113	614	76.587	∞	90.143	-764
12.033	-9143	42.707	∞	48.640	-402	56.607	∞	76.633	-2434	91.357	∞
12.227	∞	42.760	402	49.340	∞	57.703	1217	76.887	∞	91.403	1217
13.523	-9143	43.350	∞	49.400	402	58.937	∞	76.933	1831	93.177	∞
13.807	∞	43.410	-402	49.850	∞	58.983	-2434	77.347	∞	94.053	-2434
15.043	-9143	43.990	∞	49.918	-241	59.947	∞	77.503	-1066	94.987	∞
15.177	∞	44.050	402	50.022	∞	59.993	1831	77.767	∞	95.053	2434
16.413	-9143	44.190	∞	50.098	241	61.087	∞	78.433	-493	95.587	∞
16.767	∞	44.250	-402	50.382	∞	62.103	-1831	80.137	∞	95.633	-2434
18.363	-18286	44.680	∞	50.458	-241	64.257	∞	80.190	402	96.597	∞
18.537	∞	44.740	402	50.762	∞	64.303	2434	81.340	∞	96.643	1831
19.673	-9143	45.640	∞	50.888	272	65.667	∞	81.400	-402	97.057	∞
20.567	∞	45.700	-402	51.162	∞	66.683	-1831	82.470	∞	97.123	-915
21.803	-9143	45.850	∞	51.230	-402	68.177	∞	82.530	402	98.457	∞
22.247	∞	46.080	402	51.420	∞	68.223	2434	83.150	∞	99.373	915
23.963	-10672	46.320	∞	51.473	614	69.067	∞	83.218	-302	99.707	∞
24.367	∞	46.380	-402	51.627	∞	71.443	-3661	84.092	∞	99.730	∞
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi)</b>											
-0.420	385	30.880	∞	66.903	455	100.425	∞	141.580	∞	178.661	485
0.055	∞	33.172	877	67.106	385	112.000	909	144.533	1000	178.977	∞
0.057	296	33.414	∞	67.308	∞	112.158	∞	144.836	1020	179.224	1042
0.210	∞	36.518	476	68.121	961	114.498	990	145.139	∞	179.316	1064
0.970	442	37.059	∞	68.251	500	114.661	∞	147.672	1020	179.408	∞
1.092	∞	38.382	532	68.381	625	118.663	952	147.815	1064	179.765	746
1.474	962	38.694	∞	68.511	∞	118.807	826	147.958	∞	180.015	∞
1.666	∞	42.006	980	69.123	588	118.951	1000	149.066	709	181.663	704
4.609	700	42.403	∞	69.507	∞	119.095	∞	149.593	∞	181.807	685
4.738	662	44.200	685	70.394	500	119.782	781	150.745	1190	181.950	∞
4.866	∞	44.659	∞	70.766	485	119.903	714	150.982	∞	184.688	980
5.636	758	45.620	781	71.137	∞	120.025	769	155.735	962	184.880	∞
5.898	∞	45.824	714	71.726	806	120.146	∞	155.896	943	188.768	1613
7.731	758	46.027	∞	71.922	769	121.290	769	156.056	∞	188.943	∞
8.020	∞	46.547	602	72.118	∞	121.454	794	158.672	962	190.832	515
8.752	588	47.048	∞	72.814	758	121.617	∞	158.922	∞	191.031	∞
9.195	∞	49.682	943	73.134	∞	122.848	909	160.716	820	191.264	538
10.091	980	49.921	∞	74.231	602	122.980	∞	161.182	∞	191.435	∞
10.499	∞	52.570	685	74.680	∞	124.793	1136	164.465	806	192.822	685
16.339	1515	53.041	∞	75.353	794	124.951	∞	164.721	∞	193.192	∞
16.535	∞	54.978	685	75.652	806	126.765	495	166.602	1613	193.502	943
18.089	980	55.433	∞	75.951	∞	127.131	∞	166.687	∞	193.862	∞
18.975	∞	57.671	588	76.496	526	127.772	485	169.956	1020	194.303	641
21.461	793	58.210	∞	76.741	595	128.122	500	170.058	1000	194.643	∞
22.189	∞	61.092	1000	76.986	∞	128.472	∞	170.160	∞	194.770	943
23.415	588	61.538	∞	79.455	668	130.174	769	171.823	1000	195.090	∞
23.926	∞	63.208	806	79.978	∞	130.852	735	171.942	∞	196.410	685
26.752	431	63.653	∞	84.584	980	131.530	∞	175.002	962	196.850	∞
27.049	∞	64.202	1000	84.995	962	134.074	1020	175.171	960	197.440	1000
27.887	490	64.617	∞	85.405	∞	134.273	∞	175.339	∞	197.820	∞
28.438	∞	65.004	595	88.504	980	135.536	1000	177.183	510	198.720	1087
29.066	485	65.492	∞	88.926	∞	135.749	∞	177.363	490	198.980	∞
29.480	∞	65.937	397	94.786	971	139.524	595	177.542	∞	200.360	403
30.427	641	66.336	∞	95.222	∞	140.071	∞	177.839	562	200.870	∞
30.654	758	66.701	360	100.189	1000	141.169	1020	177.982	∞	201.710	397

## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi) (contd.)</b>											
202.160	∞	238.750	∞	275.022	∞	320.550	1389	378.812	495	428.950	∞
204.180	781	238.924	298	275.560	1000	320.850	∞	378.985	481	429.830	373
204.540	∞	239.225	∞	275.966	∞	323.800	1493	379.159	515	430.050	385
204.800	847	241.121	382	276.723	400	324.140	∞	379.332	∞	430.270	∞
205.100	∞	241.375	∞	277.162	∞	325.300	500	380.818	909	430.390	943
205.650	602	241.703	305	277.519	980	325.750	∞	381.026	1020	430.625	1000
206.020	∞	241.973	∞	277.942	∞	328.050	503	381.233	∞	430.860	∞
206.170	714	242.023	481	278.227	1515	328.470	∞	382.410	862	431.790	532
206.350	∞	242.204	∞	278.607	∞	330.400	943	382.724	794	432.050	549
207.354	490	242.322	303	279.200	500	330.770	∞	383.038	∞	432.310	∞
208.054	∞	242.617	∞	279.522	∞	333.650	1000	383.320	676	432.510	3846
208.105	385	242.735	403	279.913	400	334.050	∞	383.542	725	432.700	∞
208.695	∞	242.950	∞	280.506	∞	340.870	794	383.764	685	432.830	481
212.110	1613	243.019	303	280.600	600	341.430	∞	383.986	∞	433.100	∞
212.238	∞	243.415	∞	280.918	∞	342.530	990	385.514	1000	433.180	291
213.060	980	244.335	806	281.355	394	342.920	∞	385.673	943	433.320	296
213.543	∞	244.792	∞	281.741	∞	344.940	490	385.833	1000	433.460	301
215.679	795	245.559	400	282.075	500	345.440	∞	385.992	∞	433.600	∞
216.024	∞	245.749	∞	282.385	∞	347.450	1000	386.149	1020	433.710	282
216.930	695	247.939	296	283.447	962	347.880	∞	386.379	862	433.927	287
217.420	∞	248.298	∞	283.682	∞	349.260	781	386.609	1020	434.143	307
220.398	1020	248.960	1064	284.189	4545	349.670	∞	386.839	∞	434.360	∞
220.763	∞	249.141	1389	284.537	∞	352.705	1000	388.137	962	434.460	295
222.936	500	249.321	∞	285.020	1000	353.645	∞	388.576	∞	434.770	∞
223.343	∞	249.651	1020	285.360	∞	354.408	820	389.504	943	434.900	590
223.884	505	249.979	∞	286.910	962	354.572	794	389.580	∞	435.150	∞
224.573	∞	251.474	403	287.270	∞	354.736	820	391.062	1000	439.340	481
224.692	617	251.839	∞	288.740	1000	354.900	∞	391.642	∞	439.543	490
225.128	∞	252.566	595	289.170	∞	356.703	1080	391.875	1000	439.747	515
226.275	303	252.910	∞	289.350	600	356.863	962	392.605	∞	439.950	∞
226.918	∞	253.326	398	289.750	∞	357.022	∞	393.540	1020	440.520	495
227.065	299	253.481	311	290.530	600	361.031	610	394.038	∞	441.060	∞
227.615	∞	253.635	∞	290.940	∞	361.334	∞	396.927	1515	441.900	1020
228.250	305	253.925	1020	291.710	1471	364.420	769	397.361	∞	442.450	∞
228.688	∞	254.256	∞	292.060	∞	364.775	∞	398.259	1429	444.660	909
228.847	299	255.075	1563	292.610	690	365.719	575	398.701	∞	444.860	962
229.043	∞	255.384	∞	293.140	∞	365.999	∞	403.418	1000	445.060	1064
229.136	362	256.113	1000	293.720	1000	366.490	505	404.593	∞	445.260	∞
229.277	∞	256.387	∞	294.200	∞	366.587	490	412.140	962	445.537	300
229.336	343	256.717	291	294.560	962	366.685	500	412.624	∞	446.087	∞
229.675	∞	256.907	∞	294.930	∞	366.782	∞	415.314	472	446.277	373
230.599	1000	256.979	338	295.140	1000	366.989	495	416.076	∞	446.430	391
230.922	∞	257.215	∞	295.470	∞	367.460	∞	416.147	575	446.584	926
231.822	562	257.503	588	295.860	758	368.597	3124	416.444	∞	446.737	∞
232.002	610	257.750	∞	296.300	∞	368.702	∞	416.512	658	447.037	769
232.181	∞	258.282	397	299.380	990	369.090	2273	417.104	∞	447.244	833
233.378	1000	258.761	∞	299.830	∞	369.293	1852	417.354	588	447.450	926
233.565	∞	259.783	350	300.330	588	369.496	2000	417.976	∞	447.657	∞
233.740	649	260.152	∞	300.580	∞	369.699	∞	418.755	455	448.117	962
234.029	∞	261.282	1000	302.040	800	371.459	602	419.140	∞	448.380	1042
234.525	305	261.572	∞	302.840	∞	371.904	∞	419.784	388	448.644	1111
234.803	362	262.428	625	304.650	980	372.260	510	420.035	∞	448.907	∞
235.080	286	262.873	∞	305.370	∞	372.446	500	420.377	704	450.447	695
235.450	∞	263.668	1020	306.510	500	372.632	490	420.884	∞	451.067	∞
235.503	388	264.092	∞	307.100	∞	372.818	∞	422.453	962	454.500	990
235.769	∞	270.607	394	309.730	700	375.069	781	422.862	∞	455.310	∞
236.614	562	270.854	403	310.350	∞	375.330	877	424.552	943	456.410	490
236.885	∞	271.101	∞	312.130	1000	375.590	746	425.192	∞	456.850	∞
237.089	391	272.187	538	312.690	∞	375.851	∞	426.502	1042	457.130	781
237.518	∞	272.628	∞	314.480	6000	376.533	980	427.027	∞	457.540	∞
238.010	685	273.743	725	314.980	∞	376.894	∞	428.090	400	460.680	1515
238.406	∞	274.134	∞	317.450	500	377.718	1786	428.584	∞	460.990	∞
238.643	439	274.603	500	317.920	∞	377.949	∞	428.650	446	462.680	4545

## Curve Register

## Annex 2.2.4.2

from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]	from km	R [m]
<b>Nacala - Nampula - Cuamba - Entré Lagos (- Nayuchi) (contd.)</b>											
462.960	∞	526.550	980								
465.850	3333	527.000	∞								
466.020	4545	527.350	980								
466.190	∞	527.850	∞								
468.730	1282	529.970	602								
469.060	∞	530.540	∞								
471.620	500	530.900	1000								
472.000	∞	531.700	∞								
472.240	490	533.473 =									
472.455	505	0.000	∞								
472.670	∞	0.553	500								
477.680	1352	0.733	∞								
477.915	2000	1.451	1000								
478.150	∞	1.603	∞								
480.010	2778	2.499	1000								
480.500	∞	2.555	∞								
483.460	1042	5.381	1000								
484.230	∞	5.673	∞								
487.140	5556	7.246	1000								
487.365	3846	7.808	∞								
487.590	∞	11.282	1000								
488.830	1852	11.772	∞								
489.370	∞	18.152	1000								
492.690	1000	18.902	∞								
492.950	962	22.891	1000								
493.210	∞	23.164	∞								
495.030	431	33.489	1000								
495.193	435	33.565	∞								
495.357	459	37.890	1000								
495.520	∞	38.164	∞								
496.890	400	42.177	1000								
497.480	∞	42.277	∞								
497.720	481	46.390	1000								
498.110	500	46.664	∞								
498.500	∞	50.643	1000								
499.620	1000	51.011	∞								
500.320	∞	55.352	1000								
502.140	3125	55.702	∞								
502.600	∞	66.248	1000								
503.620	3405	66.406	∞								
504.090	∞	68.438	1000								
508.730	4545	68.616	∞								
509.160	∞	74.177	1000								
512.760	781	74.877	∞								
513.420	∞	75.063	1000								
515.230	588	75.391	∞								
515.840	∞	78.620									
517.330	909										
517.590	∞										
517.650	877										
518.050	∞										
518.750	893										
519.050	∞										
520.000	495										
520.300	∞										
520.600	581										
521.100	∞										
522.400	685										
522.810	∞										
523.160	483										
523.460	∞										
523.500	806										
524.060	∞										

**Bridges and culverts register**

# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Border - Bangula</b>					<b>Border - Bangula (contd.)</b>				
1	0.300	Open Top	1	3.30	63	31.700	Open Top	1	2.10
2	0.975	Open Top	1	3.30	64	32.475	Open Top	1	2.10
3	1.200	Open Top	1	3.30	65	33.125	Pipe		0.92
4	1.500	Rail Frame	1		66	33.500	Open Top	1	7.70
5	1.925	Open Top	2	7.17	67	34.175	Open Top	3	5.40
6	2.550	Open Top	1	3.30	68	34.550	Open Top	1	7.70
7	2.950	Rail Frame	1		69	35.700	Pipe		0.92
8	3.075	Rail Frame	1		70	36.600	Open Top	1	4.24
9	3.550	Open Top	1	3.30	71	37.200	Open Top	4	14.47
10	3.900	Open Top	4	16.12	72	37.800	Pipe		0.92
11	5.000	Open Top	2	3.70	73	38.450	Pipe		0.92
12	7.350	Bridge/ steel girder	1	5.48	74	39.150	Open Top		
13	7.825	Bridge/ steel girder	1	5.48	75	39.250	Open Top		
14	8.300	Open Top	1	3.30	76	40.100	Open Top		
15	9.700	Open Top	1	3.70	77	40.700	Open Top		
16	10.250	Open Top	1	3.70	78	41.125	Open Top		
17	10.700	Rail Frame			79	41.300	Open Top		
18	11.050	Rail Frame			80	41.600	Pipe		
19	11.850	Rail Frame			81	41.650	Pipe		
20	11.875	Pipe	1	0.92	82	42.000	Pipe		
21	12.200	Rail Frame			83	43.675	Open Top		
22	12.800	Rail Frame			84	44.000	Pipe		
23	13.800	Open Top	4	16.12	85	44.100	Open Top		
24	14.025	Open Top	1	6.60	86	44.500	Pipe		
25	14.350	Open Top	1	6.60	87	44.750	Open Top		
26	14.900	Open Top	6	7.22	88	45.525	Open Top		
27	15.400	Rail Frame			89	46.200	Pipe		
28	16.000	Open Top	1	7.00	90	46.625	Pipe		
29	16.575	Open Top	1	7.00	91	47.000	Open Top		
30	16.825	Open Top	1	3.30	92	47.800	Open Top		
31	16.925	Rail Frame			93	48.200	Open Top		
32	17.550	Open Top	1	3.30	94	48.700	Open Top		
33	18.050	Open Top	3	7.23	95	48.900	Rail Frame		
34	18.600	Open Top	4	7.23	96	49.500	Open Top		
35	19.100	Open Top	2	7.70	97	50.100	Rail Frame		
36	20.050	Open Top	2	6.30	98	50.500	Rail Frame		
37	20.575	Rail Frame			99	50.600	Open Top		
38	20.800	Rail Frame			100	51.200	Rail Frame		
39	21.150	Rail Frame			101	51.800	Open Top		
40	21.550	Open Top	7	7.70	102	52.400	Open Top		
41	22.500	Open Top	2	6.20	103	53.000	Open Top		
42	22.850	Pipe		0.92	104	53.700	Rail Frame		
43	22.875	Pipe		0.92	105	54.000	Rail Frame		
44	22.925	Open Top	1	3.30	106	54.000	Open Top		
45	23.400	Rail Frame			107	54.500	Rail Frame		
46	24.700	Rail Frame			108	54.700	Rail Frame		
47	25.375	Rail Frame			109	55.100	Open Top		
48	25.650	Box Culvert			110	55.900	Open Top		
49	25.675	Box Culvert			111	56.500	Rail Frame		
50	25.750	Box Culvert			112	56.800	Open Top		
51	25.775	Box Culvert			113	57.100	Rail Frame		
52	25.850	Pipe			114	57.500	Open Top		
53	25.950	Pipe		0.92	115	58.000	Open Top		
54	26.550	Pipe		0.92	116	58.600	Rail Frame		
55	27.550	Open Top	1	7.70	117	59.300	Open Top		
56	27.950	Open Top	1	2.10	118	60.100	Open Top		
57	28.650	Open Top	1	4.25	119	60.500	Open Top		
58	30.000	Open Top	1	10.19	120	61.100	Open Top		
59	30.875	Pipe		0.92	121	61.285	Open Top		
60	30.975	Pipe		0.92	122	61.545	Open Top		
61	31.300	Open Top	1	2.10	123	61.945	Open Top		
62	31.425	Open Top	1	2.10	124	62.158	Open Top		



# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Border - Bangula (contd.)</b>					<b>Bangula - Limbe (contd.)</b>				
125	62.350	Open Top			186	100.500	Pipe		8.93
126	62.375	Rail Frame			187	100.600	Pipe		0.56
127	62.830	Rail Frame			188	100.725	Pipe		5.73
128	63.150	Rail Frame			189	100.900	Pipe		7.33
129	63.375	Open Top			190	101.025	Box Culvert		8.74
130	63.500	Open Top			191	101.125	Open Top		28.00
131	64.090	Open Top			192	101.450	Pipe		6.28
132	64.328	Rail Frame			193	101.725	Pipe		9.13
133	65.490	Rail Frame			194	101.900	Pipe		5.68
134	66.135	Rail Frame			195	101.975	Bridge/ steel girder		24.54
135	66.510	Rail Frame			196	102.200	Pipe		1.02
136	67.685	Open Top	1	7.60	197	102.400	Box Culvert		0.64
137	68.193	Open Top	1	7.60	198	102.600	Box Culvert		0.64
138	68.396	Open Top	1	4.50	199	102.850	Bridge/ steel girder	3	37.21
139	69.045	Open Top	1	3.68	200	103.150	Pipe		8.73
140	69.430	Open Top	1	4.00	201	103.425	Pipe		8.00
141	69.845	Open Top	1	3.00	202	103.600	Pipe		4.10
142	70.245	Rail Frame		0.61	203	103.900	Pipe		1.28
143	70.570	Open Top	1	3.30	204	104.000	Box Culvert		4.13
<b>Bangula - Limbe</b>					205	104.200	Pipe		4.80
144	71.165	Arch		1.22	206	104.450	Pipe		1.09
145	71.860	Rail Frame		0.28	207	104.750	Pipe		0.95
146	72.210	Rail Frame		0.99	208	105.100	Box Culvert		4.45
147	75.945	Open Top	3	180.85	209	105.300	Pipe		28.00
148	87.250	Rail Frame		0.61	210	105.535	Pipe		28.89
149	87.660	Rail Frame		1.46	211	105.800	Pipe		33.36
150	87.790	Rail Frame		0.92	212	106.625	Pipe		41.26
151	88.150	Rail Frame		0.92	213	107.000	Pipe		5.53
152	88.410	Rail Frame		0.92	214	108.000	Pipe		41.29
153	88.975	Box Culvert		2.00	215	108.200	Pipe		21.69
154	90.365	Rail Frame		0.85	216	108.400	Pipe		0.92
155	90.630	Rail Frame		0.85	217	108.675	Box Culvert		5.17
156	91.575	Rail Frame		0.85	218	108.900	Pipe		0.55
157	92.100	Rail Frame		0.61	219	109.025	Pipe		0.94
158	92.750	Rail Frame		0.96	220	109.500	Pipe		27.83
159	93.060	Open Top	3	24.60	221	109.750	Pipe		26.43
160	93.500	Box Culvert		1.00	222	110.000	Pipe		4.26
161	93.750	Slab		0.50	223	110.125	Box Culvert		3.40
162	93.850	Rail Frame		0.26	224	110.475	Box Culvert		3.20
163	93.975	Slab		0.45	225	110.650	Pipe		8.00
164	94.210	Rail Frame		0.92	226	110.720	Pipe		17.60
165	94.750	Rail Frame		0.31	227	110.825	Pipe		8.00
166	95.205	Open Top	3	28.10	228	110.960	Box Culvert		5.30
167	95.810	Rail Frame		0.85	229	111.010	Pipe		16.90
168	96.112	Rail Frame		0.92	230	112.000	Bridge/ steel girder	3	21.10
169	96.450	Pipe		4.10	231	112.250	Box Culvert		3.70
170	97.550	Open Top		1.57	232	112.400	Pipe		5.40
171	97.675	Pipe			233	112.580	Open Top	2	20.70
172	97.750	Pipe		0.54	234	112.700	Pipe		6.17
173	97.850	Pipe		0.40	235	113.000	Pipe		0.96
174	98.050	Pipe		0.84	236	113.170	Open Top		3.96
175	98.175	Pipe		0.31	237	113.250	Box Culvert		8.90
176	98.300	Pipe		0.79	238	113.380	Open Top		10.38
177	98.475	Pipe		0.62	239	113.640	Box Culvert		6.93
178	98.550	Pipe		6.48	240	113.690	Open Top		4.06
179	98.650	Pipe			241	113.840	Box Culvert		3.24
180	98.900	Pipe		10.90	242	114.150	Box Culvert		3.70
181	99.250	Bridge/ steel girder	3	24.00	243	114.370	Pipe		0.31
182	99.625	Pipe		8.62	244	114.590	Pipe		4.46
183	99.775	Pipe		8.62	245	114.690	Pipe		4.22
184	99.950	Bridge/ steel girder	1	3.35	246	114.789	Box Culvert		4.63
185	100.325	Pipe		3.35	247	115.015	Pipe		8.14



# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Bangula - Limbe (contd.)</b>					<b>Bangula - Limbe (contd.)</b>				
248	115.160	Pipe		5.00	310	127.575	Pipe		0.58
249	115.210	Pipe		4.72	311	127.675	Box Culvert		3.32
250	115.460	Box Culvert		4.76	312	127.775	Pipe		5.67
251	115.500	Box Culvert		5.15	313	127.950	Pipe		11.80
252	115.585	Pipe		5.28	314	128.025	Pipe		0.38
253	115.700	Box Culvert		4.42	315	128.050	Open Top	1	5.00
254	116.150	Pipe		20.45	316	128.550	Pipe		0.60
255	116.200	Pipe		17.78	317	128.600	Box Culvert		11.00
256	116.270	Box Culvert		5.15	318	128.775	Pipe		0.45
257	116.465	Box Culvert		4.58	319	129.375	Pipe		0.92
258	116.540	Pipe		5.58	320	129.750	Box Culvert		0.49
259	116.650	Pipe		8.33	321	130.000	Box Culvert		2.41
260	116.800	Open Top	1	17.60	322	130.225	Open Top	2	14.00
261	117.480	Pipe		8.39	323	130.810	Box Culvert		1.29
262	117.775	Pipe		5.54	324	130.900	Open Top	5	67.00
263	117.850	Pipe		8.42	325	131.150	Box Culvert		3.09
264	118.150	Pipe		5.50	326	131.200	Box Culvert		3.05
265	118.250	Pipe		11.34	327	131.300	Box Culvert		2.97
266	118.300	Pipe		11.40	328	131.630	Box Culvert		3.23
267	118.550	Pipe		11.28	329	131.875	Pipe		30.54
268	118.675	Pipe		8.32	330	132.275	Pipe		3.09
269	118.800	Pipe		8.32	331	132.625	Pipe		5.59
270	118.975	Pipe		3.88	332	132.950	Pipe		8.63
271	119.050	Pipe		4.20	333	133.185	Pipe		31.69
272	119.475	Open Top	1	7.27	334	133.450	Pipe		14.79
273	119.600	Box Culvert		3.00	335	133.630	Box Culvert		2.48
274	119.755	Open Top		7.21	336	133.710	Box Culvert		2.48
275	120.100	Pipe		7.97	337	133.960	Pipe		0.62
276	120.250	Pipe		14.00	338	134.220	Pipe		0.15
277	120.350	Pipe		5.06	339	134.381	Pipe		8.83
278	120.650	Pipe		8.16	340	134.683	Pipe		0.36
279	121.025	Pipe		9.53	341	134.980	Open Top	1	14.33
280	121.400	Pipe		12.04	342	135.760	Pipe		11.28
281	121.500	Pipe		12.40	343	135.995	Box Culvert		2.44
282	121.650	Pipe		7.28	344	136.550	Box Culvert		3.47
283	121.750	Open Top	1	10.70	345	136.650	Box Culvert		3.51
284	121.950	Pipe		13.34	346	136.826	Pipe		17.25
285	122.200	Box Culvert		4.43	347	137.200	Open Top	3	43.40
286	122.350	Pipe		11.88	348	137.450	Pipe		0.30
287	122.450	Pipe		8.39	349	137.720	Pipe		8.26
288	122.575	Pipe		7.47	350	137.800	Pipe		14.46
289	122.700	Box Culvert		4.47	351	138.350	Pipe		0.78
290	122.750	Open Top	2	29.95	352	138.500	Box Culvert		3.69
291	123.050	Pipe		11.54	353	139.125	Pipe		0.78
292	123.400	Pipe		10.89	354	139.400	Pipe		0.21
293	123.675	Pipe		23.88	355	139.570	Pipe		5.22
294	123.950	Box Culvert		4.00	356	139.880	Box Culvert		3.19
295	124.010	Box Culvert		4.14	357	140.050	Pipe		0.82
296	124.150	Box Culvert		3.77	358	140.200	Arch		0.70
297	124.500	Open Top	3	24.60	361	140.400	Pipe		0.61
298	124.700	Pipe		5.35	362	140.675	Pipe		0.30
299	125.000	Pipe		14.00	363	140.925	Arch		1.32
300	125.100	Pipe		4.78	364	141.175	Pipe		0.30
301	125.175	Box Culvert		4.50	365	141.330	Pipe		0.30
302	125.300	Box Culvert		3.29	366	141.500	Pipe		0.45
303	125.550	Pipe		4.88	367	141.800	Pipe		0.30
304	125.725	Pipe		14.70	368	142.125	Pipe		0.96
305	126.100	Pipe		4.88	369	142.175	Pipe		0.45
306	126.675	Box Culvert		0.40	370	142.375	Pipe		0.61
307	126.975	Pipe		0.55	371	142.565	Arch		1.32
308	127.160	Pipe		0.36	372	142.775	Pipe		0.30
309	127.275	Pipe		0.31	373	142.900	Pipe		0.30

# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Bangula - Limbe (contd.)</b>					<b>Bangula - Limbe (contd.)</b>				
374	143.150	Rail Frame		0.45	436	165.220	Box Culvert		0.46
375	143.440	Pipe		0.61	437	165.380	Box Culvert		0.82
376	143.625	Pipe		0.61	438	165.470	Box Culvert		0.92
377	143.765	Rail Frame		1.83	439	165.660	Open Top	1	13.65
378	143.865	Rail Frame		1.98	440	166.150	Box Culvert		1.15
379	144.240	Pipe		0.61	441	166.200	Box Culvert		0.80
380	144.350	Pipe		0.91	442	167.050	Box Culvert		0.42
381	144.365	Pipe		0.91	443	167.350	Open Top	1	11.35
382	144.400	Rail Frame		0.30	444	168.320	Rail Frame		1.22
383	144.750	Pipe		0.91	445	168.820	Open Top	1	10.40
384	145.100	Open Top	1	24.75	446	169.320	Pipe		0.95
385	145.430	Pipe		0.30	447	169.730	Pipe		0.91
386	145.600	Pipe		0.30	448	170.750	Pipe		1.27
387	145.840	Pipe		0.30	449	171.250	Box Culvert		0.77
388	146.200	Box Culvert		0.30	450	171.415	Rail Frame		1.20
389	146.365	Pipe		0.30	451	171.670	Open Top	1	10.40
390	146.630	Pipe		0.30	452	171.950	Rail Frame		0.60
391	146.800	Pipe		0.30	453	172.270	Pipe		0.92
392	146.950	Slab		0.30	454	172.600	Pipe		0.88
393	147.125	Slab		0.61	455	172.850	Rail Frame		0.71
394	147.400	Pipe		0.61	456	173.040	Open Top	1	10.40
395	147.600	Open Top	3	31.20	457	173.975	Rail Frame		0.61
396	148.395	Pipe		1.00	458	174.240	Pipe		0.88
397	148.725	Pipe		0.95	459	175.000	Pipe		0.91
398	149.150	Pipe		0.36	460	175.250	Pipe		0.91
399	149.250	Pipe		1.00	461	175.750	Pipe		0.91
400	149.715	Pipe		0.73	462	176.200	Rail Frame		
401	150.100	Pipe		1.00	464	176.300	Pipe		0.91
402	150.150	Pipe		1.00	465	176.600	Open Top	1	
403	150.604	Open Top	2	13.50	466	177.250	Open Top	3	
404	152.150	Pipe		1.00	467	177.400	Rail Frame		
405	152.550	Pipe		1.00	468	177.425	Pipe		0.91
406	153.200	Pipe		0.36	469	177.900	Arch		0.91
407	153.700	Open Top	1	7.00	479	178.300	Open Top	3	
408	154.040	Open Top	1	3.25	480	178.600	Slab		
409	155.200	Open Top	1	10.40	481	178.650	Rail Frame		
410	156.100	Pipe		0.90	482	179.000	Rail Frame		
411	156.600	Pipe		0.46	483	179.200	Rail Frame		
412	157.000	Box Culvert		0.40	484	179.500	Slab		
413	157.275	Box Culvert		0.56	485	179.800	Rail Frame		
414	157.400	Box Culvert		0.76	486	179.950	Slab		
415	157.800	Box Culvert		0.86	487	180.000	Rail Frame		
416	158.200	Box Culvert		0.56	488	180.250	Rail Frame		
417	158.400	Pipe		0.81	489	180.550	Open Top	1	1.20
418	158.550	Pipe		0.89	490	181.000	Rail Frame		
419	158.900	Pipe		1.00	491	181.550	Open Top	1	2.28
420	159.400	Pipe		0.96	492	181.800	Rail Frame		
421	160.100	Pipe		0.96	493	182.850	Rail Frame		
422	160.300	Pipe		1.10	494	183.300	Pipe		0.91
423	160.650	Open Top	3	10.40	495	183.650	Pipe		
424	161.350	Box Culvert		0.48	496	184.100	Slab		
425	161.960	Pipe		0.89	497	184.450	Pipe		
426	162.250	Pipe		0.60	498	184.800	Pipe		
427	162.800	Pipe		0.71	499	185.050	Open Top	1	3.65
428	163.200	Pipe		0.30	500	185.300	Rail Frame		
429	163.350	Open Top	1	7.00	501	185.600	Pipe		0.61
430	163.500	Box Culvert		0.30	502	185.900	Open Top	3	
431	163.825	Box Culvert		0.30	503	186.250	Pipe		
432	164.280	Pipe		1.08	504	186.550	Pipe		
433	164.450	Rail Frame		1.25	505	186.750	Box Culvert		
434	164.700	Rail Frame		0.62	506	187.050	Rail Frame		
435	164.940	Box Culvert		0.75	507	187.150	Rail Frame		

# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Bangula - Limbe (contd.)</b>					<b>Limbe - Nkaya (contd.)</b>				
508	187.550	Open Top	1	2.28	567	203.100	Bridge/steel girder		
509	187.850	Pipe			568	203.400	Pipe		
510	188.100	undefined			569	203.450	Slab		
511	188.500	Rail Frame			570	203.600	Pipe		
512	188.600	Box Culvert			571	203.800	Pipe		
513	188.650	Pipe			572	204.150	Pipe		
514	188.900	Pipe			573	204.550	Bridge/steel girder		
515	189.200	Rail Frame			574	204.900	Arch		
516	189.300	Open Top	3		575	205.200	Pipe		
517	189.600	Pipe			576	205.250	Slab		
518	189.900	Slab			577	205.500	Slab		
519	190.150	Pipe			578	205.650	Pipe		
520	190.600	Pipe			579	205.850	Bridge/steel girder		
521	190.750	Open Top	1	2.28	580	206.100	Bridge/steel girder		
522	191.300	Open Top	3		581	206.650	Slab		
523	191.500	Pipe			581A	206.700	Overhead Bridge		
524	191.700	Pipe			582	206.800	Pipe		
525	192.200	Rail Frame			583	206.850	Pipe		
526	192.800	Open Top	3		584	207.000	Slab		
527	193.200	Pipe			585	207.050	Slab		
528	193.400	Rail Frame			586	207.070	Pipe		
529	193.600	Rail Frame			587	207.200	Pipe		
530	193.700	Pipe			588	208.000	Slab		
531	193.925	Pipe			589	208.500	Twin Arch		
532	194.300	Rail Frame			590	208.700	Box Culvert		
533	194.600	Rail Frame			591	208.800	Slab		
534	194.700	Rail Frame			592	208.900	Slab		
535	195.000	Pipe			593	208.930	Slab		
536	195.100	Rail Frame			594	209.000	Slab		
537	195.300	Open Top	3		595	209.250	Slab		
538	195.400	Rail Frame			595A	209.300	Under Bridge		
539	195.650	Pipe			596	209.580	Arch		
540	195.750	Box Culvert			597	209.680	Rail Frame		
541	195.850	Pipe			598	210.130	Arch		
542	195.950	Open Top			599	210.450	Arch		
543	196.300	Open Top	3		600	210.700	Arch		
544	196.700	Rail Frame			601	211.000	Rail Frame		
545	197.200	Arch			602	211.050	Arch		
546	197.300	Slab			603	211.250	Arch		
547	197.600	Open Top			604	211.500	Arch		
548	198.100	Pipe			605	211.800	Arch		
549	198.400	Pipe			606	212.000	Arch		
550	198.700	Pipe			607	212.250	Slab		
551	198.875	Open Top			608	212.650	Arch		
552	198.900	Open Top			609	212.900	Arch		
553	198.925	Rail Frame			610	213.050	Slab		
554	199.200	Pipe			611	213.230	Slab		
555	199.600	Pipe			612	213.530	Slab		
556A	200.300	Pipe			613	213.700	Arch		
556B	200.850	Open Top			614	213.800	Slab		
557	200.925	Open Top			615	214.050	Arch		
<b>Limbe - Nkaya</b>					616	214.150	Slab		
558	201.050	Open Top			617	214.450	Arch		
559	201.300	Slab			618	214.600	Open Top		
560	201.450	Slab			619	214.730	Slab		
561	201.500	Slab			620	215.000	Arch		
562	201.600	Box Culvert			621	215.200	Slab		
563	201.700	Slab			622	215.300	Slab		
564	201.900	Pipe			623	215.730	Slab	1	0.91
565	202.150	Box Culvert			624	216.400	Bridge/steel girder	3	22.56
565A	202.300	Overhead Bridge			625	216.750	Arch	2	1.82
566	202.650	Slab			626	216.980	Arch	1	0.91

## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Limbe - Nkaya (contd.)</b>					<b>Limbe - Nkaya (contd.)</b>				
627	217.100	Arch	1	0.91	689	231.150	Slab	1	0.46
628	217.300	Arch	1	0.91	690	231.450	Arch	1	0.91
629	217.500	Slab			692	232.080	Arch	1	0.91
630	217.600	Slab	1	0.91	693	232.300	Arch	1	0.91
631	217.900	Bridge/steel girder	1	12.19	694	232.800	Rail Frame	1	0.91
632	218.000	Slab			695	233.200	Arch	1	0.91
633	218.200	Pipe	1	0.61	696	233.300	Arch	1	3.66
634	218.500	Arch	1	0.46	697	233.530	Arch	1	0.91
635	218.800	Bridge/steel girder	1	12.19	698	233.950	Arch	1	0.91
636	219.100	Arch	2	1.82	699	234.150	Arch	1	0.91
637	219.280	Arch	1	0.91	700	234.500	Arch	1	0.91
638	219.450	Arch	1	0.91	701	234.900	Slab	1	0.46
639	219.700	Arch	1	0.91	702	235.150	Arch	1	0.91
640	219.850	Slab	1	0.46	703	235.500	Arch	1	0.91
641	219.900	Slab	1	0.91	704	235.900	Arch	1	0.91
642	220.100	Arch	1	0.91	705	236.200	Arch	1	0.91
643	220.200	Slab	1	0.46	707	237.000	Pipe	1	0.30
644	220.400	Arch	1	0.91	708	237.200	Arch	1	0.91
645	220.600	Arch	1	0.91	709	237.400	Slab	1	0.46
646	220.700	Arch	1	0.91	710	237.700	Arch	1	0.91
647	220.900	Arch	1	0.91	711	237.900	Rail Frame	1	0.46
648	221.100	Arch	1	1.83	712	238.100	Slab	1	0.46
649	221.400	Bridge/steel girder	3	51.82	713	238.350	Arch	1	0.46
650	221.550	Pipe	1	0.61	714	238.500	Slab	1	0.46
651	221.750	Arch	1	0.91	715	238.700	Slab	1	0.91
652	222.000	Arch	1	0.91	716	238.900	Arch	1	0.91
653	222.030	Arch			717	239.100	Arch	1	0.91
654	222.200	Arch	2	1.82	718	239.300	Slab	1	0.46
655	222.500	Arch	2	1.82	719	239.700	Arch	1	0.91
656	222.700	Arch	1	0.91	720	240.150	Arch	1	0.91
657	222.850	Arch	1	0.91	721	240.400	Arch	1	3.66
658	223.150	Arch	1	0.91	722	240.650	Arch	1	0.91
659	223.300	Arch	2	1.82	723	240.800	Arch	1	0.91
660	223.700	Rail Frame	1	0.46	724	241.100	Arch	1	0.91
661	223.900	Arch	1	0.91	725	241.380	Arch	1	0.91
662	224.050	Arch	1	0.91	726	241.800	Slab	1	0.46
663	224.150	Slab	1	0.91	727	241.900	Arch	2	1.82
664	224.400	Arch	1	0.91	728	242.150	Arch	1	0.91
665	224.500	Slab	1	0.46	729	242.200	Slab	1	0.46
666	224.650	Bridge/steel girder	3	33.52	730	242.250	Slab	1	0.46
667	224.780	Arch	1	1.52	731	242.330	Slab	1	0.46
668	225.150	Slab	1	0.46	732	242.550	Slab	1	0.46
669	225.330	Arch	2	1.82	733	242.950	Arch	1	0.91
670	225.600	Rail Frame	1	0.91	734	243.350	Slab	1	0.91
671	225.800	Arch	1	0.91	735	243.800	Slab	1	0.91
672	225.900	Arch	1	0.91	736	244.300	Bridge/steel girder	1	3.66
673	226.050	Arch	1	1.83	737	244.600	Slab	1	0.91
674	226.200	Arch	1	0.91	738	245.000	Slab	1	0.91
675	226.600	Rail Frame	1	0.46	739	245.250	Bridge/steel girder	1	3.66
676	226.950	Arch	1	0.91	740	245.900	Arch	1	0.91
677	227.200	Arch	1	0.91	741	245.950	Slab	1	0.46
678	227.430	Rail Frame	1	0.91	742	246.200	Arch	2	1.82
679	227.630	Arch	1	1.83	743	246.300	Arch	1	0.91
680	227.850	Arch	1	0.61	744	246.600	Slab	1	0.46
681	228.100	Arch	1	0.91	745	246.800	Arch	1	0.91
682	228.400	Bridge/steel girder	2	21.33	746	247.200	Slab	1	0.46
683	228.700	Arch	1	0.91	747	248.000	Bridge/steel girder	3	42.67
684	228.800	Arch	1	0.91	748	248.450	Arch	2	1.82
685	228.830	Arch			749	248.650	Arch	1	0.91
686	229.750	Arch	2	1.82	750	248.800	Arch	2	1.82
687	230.080	Arch	1	0.61	751	249.550	Arch	1	0.91
688	230.150	Bridge/steel girder	1	3.66	752	250.100	Arch	1	0.91

# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Limbe - Nkaya (contd.)</b>					<b>Limbe - Nkaya (contd.)</b>				
753	250.650	Slab	1	0.91	816	281.500	Rail Frame	1	0.91
754	250.800	Bridge/steel girder	1	3.66	817	281.600	Rail Frame	1	0.30
755	251.050	Pipe	1	0.30	818	282.000	Bridge/steel girder	1	2.44
756	251.400	Slab			819	282.300	Rail Frame	2	1.82
757	251.800	Arch	1	0.91	820	282.500	Pipe	1	0.30
758	252.200	Arch	1	0.91	821	282.600	Bridge/steel girder	1	2.44
759	252.400	Slab	1	0.91	822	283.200	Rail Frame	1	0.91
760	252.550	Arch	1	0.91	823	283.600	Rail Frame	1	0.91
761	252.700	Slab	1	0.46	824	283.900	Bridge/steel girder	2	7.32
762	252.850	Arch	1	0.91	825	286.500	Slab	1	0.91
763	253.030	Arch	1	0.91	826	286.600	Pipe	2	
764	255.000	Rail Frame	1	0.91	827	287.700	Bridge/steel girder	1	3.66
765	255.800	Arch			828	288.800	Rail Frame	1	0.91
766	257.000	Bridge/steel girder	3	27.42	829	289.200	Bridge/steel girder	2	3.35
767	257.600	Arch	1	0.91	830	289.700	Bridge/steel girder	1	2.44
768	257.900	Box Culvert			831	290.100	Pipe	1	0.30
769	258.100	Box Culvert			832	291.400	Rail Frame	1	0.91
770	258.500	Rail Frame	1	0.91	833	291.700	Arch	2	1.82
771	258.800	Bridge/steel girder	1	3.66	834	292.100	Bridge/steel girder	4	12.50
772	259.200	Pipe	1	0.30	835	292.400	Bridge/steel girder	1	3.66
773	259.300	Rail Frame	1	0.91	836	292.800	Bridge/steel girder		
774	259.400	Rail Frame	1	0.91	837	293.200	Bridge/steel girder	2	3.35
775	260.000	Rail Frame	1	0.91	838	293.800	Rail Frame	1	0.91
776	260.100	Pipe	1	0.30	839	294.100	Bridge/steel girder		
777	260.200	Bridge/steel girder	1	3.66	840	294.700	Rail Frame	1	0.91
778	260.800	Bridge/steel girder	1	3.66	841	295.300	Bridge/steel girder	1	3.66
779	261.100	Rail Frame	1	0.91	842	295.700	Bridge/concrete deck	2	21.34
780	261.400	Rail Frame	1	0.91	843	297.000	Box Culvert		
781	261.600	Pipe	4		<b>Nkaya - Salima</b>				
782	261.700	Pipe	2		845	298.500	Pipe		
783	263.400	Bridge/steel girder	1	3.66	846	299.100	Pipe		
785	263.500	Arch	1	0.91	847	299.300	Pipe		
786	264.800	Bridge/steel girder	2	3.35	848	299.500	Bridge/steel girder	1	3.66
787	265.100	Rail Frame	1	0.91	849	301.300	Pipe		
788	266.100	Bridge/steel girder	1	3.66	850	301.700	Pipe		
789	267.600	Bridge/steel girder	1	3.66	852	304.200	Bridge/steel girder	1	3.66
790	268.400	Slab	1	0.91	853	306.900	Bridge/steel girder	1	3.66
791	268.600	Bridge/steel girder	1	2.44	854	309.200	Bridge/concrete deck	1	3.66
792	269.000	Pipe			855	310.000	Bridge/concrete deck	2	82.00
793	269.050	Pipe			856	310.400	Rail Frame		
794	269.100	Rail Frame	1	0.91	857	310.600	Rail Frame		
795	269.150	Pipe	1	0.30	858	310.800	Rail Frame		
796	269.200	Pipe	1	0.30	859	311.000	Rail Frame		
797	269.400	Pipe			860	311.500	Rail Frame		
798	269.800	Pipe			861	311.600	Rail Frame		
799	270.500	Bridge/steel girder	2	12.18	862	312.000	Bridge/steel girder	1	3.66
800	271.200	Bridge/steel girder	2	3.35	863	312.900	Rail Frame		
801	271.500	Rail Frame	1	0.91	864	313.100	Pipe	2	1.82
802	271.800	Bridge/steel girder	1	2.44	865	313.300	Rail Frame	1	0.91
803	272.600	Bridge/steel girder	3	8.22	866	314.100	Rail Frame	1	0.91
804	273.000	Bridge/steel girder	1	2.89	867	314.150	Pipe	2	1.82
805	273.100	Bridge/steel girder	1	2.44	868	314.250	Rail Frame	3	2.73
806	273.700	Bridge/steel girder	1	2.89	869	314.700	Bridge/steel girder	1	3.66
807	275.345	Bridge/steel girder	6	67.04	870	314.800	Rail Frame	1	0.91
808	275.900	Pipe	8	7.28	871	315.700	Pipe	2	1.82
809	276.100	Rail Frame	1	0.46	872	315.800	Pipe	1	2.00
810	276.900	Rail Frame	1	0.46	873	315.850	Pipe	2	1.82
811	277.600	Bridge/steel girder	3	5.79	874	315.900	Pipe	2	1.82
812	278.200	Slab	1	0.61	875	316.300	Pipe	1	0.91
813	279.700	Bridge/steel girder	1	2.44	876	316.400	Rail Frame	2	1.82
814	280.100	Pipe			878	317.050	Rail Frame	1	0.91
815	281.000	Rail Frame	1	0.91	879	317.300	Rail Frame	3	2.73

## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Nkaya - Salima (contd.)</b>					<b>Nkaya - Salima (contd.)</b>				
880	317.400	Rail Frame	3	2.73	941	343.900	Box Culvert	1	1.30
881	318.000	Bridge/steel girder			942	344.250	Bridge/steel girder	1	3.53
882	318.750	Bridge/steel girder	1	2.89	943	344.400	Box Culvert	1	2.85
883	319.450	Rail Frame	1	0.91	944	344.550	Box Culvert	1	3.89
884	319.900	Bridge/steel girder	2	5.78	945	345.100	Pipe	1	0.91
884A	320.100	Pipe	3	4.50	946	345.150	Rail Frame	1	4.00
885	320.750	Rail Frame	3	2.73	947	345.350	Rail Frame	1	1.59
886	321.350	Rail Frame	1	2.50	948	345.600	Rail Frame	1	1.53
887	321.500	Rail Frame	1	2.50	949	345.950	Pipe	2	1.82
888	322.100	Rail Frame			949A	346.100	Pipe	2	1.82
889	322.300	Rail Frame			950	346.600	Rail Frame	1	0.61
890	322.450	Rail Frame			951	346.900	Bridge/steel girder	1	3.22
891	322.700	Rail Frame			952	347.000	Bridge/steel girder	1	3.22
892	322.800	Rail Frame			953	347.400	Rail Frame	1	1.13
893	323.000	Rail Frame			954	347.800	Rail Frame	1	1.17
894	323.100	Rail Frame			955	348.100	Rail Frame	1	1.25
895	323.900	Rail Frame			956	348.300	Rail Frame	1	4.00
896	324.300	Rail Frame			957	348.600	Pipe	2	3.00
897	324.700	Rail Frame				undefined		1	0.61
898	324.950	Rail Frame			958	349.100	Rail Frame	1	1.47
899	325.450	Rail Frame			959	349.300	Rail Frame	1	3.95
900	325.500	Rail Frame			960	349.650	Rail Frame	1	0.85
901	326.000	Rail Frame			961	349.800	Rail Frame	1	1.10
902	326.600	Rail Frame			962	349.950	Pipe	1	0.91
903	327.100	Bridge/steel girder	2	6.08	963	350.500	Rail Frame	1	2.45
904	327.550	undefined			964	350.700	Rail Frame	1	0.91
905	328.550	undefined			965	351.100	Rail Frame	1	1.50
906	329.250	undefined			966	351.500	Rail Frame	1	0.81
907	330.000	undefined			967	351.600	Bridge/steel girder	1	3.20
908	330.500	Rail Frame	1	0.91	968	351.900	Pipe	1	0.81
909	330.900	Bridge/steel girder	1	19.08	970	352.900	Pipe	1	0.91
910	331.400	Rail Frame	1	0.91	971	353.000	Rail Frame	1	0.68
911	332.400	Rail Frame	1	0.91	972	353.250	Rail Frame	1	2.46
912	332.900	Box Culvert	1	1.66	973	353.350	Pipe	1	0.91
913	333.000	Box Culvert	1	1.12	974	353.750	Rail Frame	1	1.54
914	333.100	Box Culvert	1	2.67	975	354.200	Bridge/steel girder	1	2.40
915	333.600	Pipe	2	1.70	976	354.600	Pipe	1	0.83
916	333.650	Box Culvert	1	1.60	977	355.000	Pipe	1	0.83
917	333.700	Pipe	2	1.70	978	355.200	Bridge/steel girder	1	2.40
918	334.100	Pipe	1	0.91	979	355.750	Pipe	1	0.91
919	335.300	Bridge/steel girder	1	2.40	980	356.100	Rail Frame	1	1.70
920	335.700	Bridge/steel girder	1	2.90	981	357.150	Bridge/steel girder	1	17.00
921	336.200	Pipe	4	2.00	982	357.600	Rail Frame	1	0.91
922	336.300	Rail Frame	2	0.92	983	357.720	Rail Frame	1	0.91
923	336.400	Rail Frame	1	0.46	984	358.100	Rail Frame	1	1.40
924	336.800	Rail Frame	1	0.84	985	358.500	Rail Frame	1	1.07
925	337.000	Arch			986	358.700	Bridge/steel girder	1	4.58
926	337.800	Rail Frame	1	2.40	987	358.850	Rail Frame	1	1.44
927	338.350	Rail Frame	1	1.50	988	359.150	Rail Frame	1	0.91
928	338.700	Rail Frame	1	1.50	989	359.350	Rail Frame	1	1.50
929	338.950	Rail Frame	1	2.45	990	359.950	Bridge/steel girder	1	17.00
930	339.500	Bridge/steel girder	1	17.00	991	360.500	Pipe	1	1.20
931	340.200	Rail Frame	1	1.44	992	360.750	Rail Frame	1	1.20
932	340.300	Rail Frame	1	0.91	993	360.800	Bridge/steel girder	1	7.05
933	340.600	Rail Frame	1	1.00	994	361.600	Rail Frame	1	1.10
934	341.100	Pipe	1	0.30	995	361.900	Arch	1	2.46
935	341.800	Bridge/steel girder	3	28.30	996	362.000	Rail Frame	1	1.10
936	342.200	Rail Frame	1	2.44	997	362.250	Rail Frame	1	1.20
937	342.600	Rail Frame	1	1.33	998	362.700	Bridge/steel girder	1	3.00
938	342.900	Rail Frame	1	2.00	999	363.600	Rail Frame	1	1.44
939	343.700	Box Culvert	1	2.44	1000	363.900	Rail Frame	1	0.91
940	343.750	Box Culvert	1	2.44	1001	364.450	Pipe	1	0.83

## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Nkaya - Salima (contd.)</b>					<b>Nkaya - Salima (contd.)</b>				
1002	364.900	Box Culvert	1	0.87	1064	393.930	Pipe	1	0.91
1003	365.100	Pipe	1	0.81	1065	394.050	Box Culvert	1	0.91
1004	365.300	Pipe	1	0.46	1066	394.300	Pipe	1	0.91
1005	366.300	Pipe	1	0.46	1067	394.500	Pipe	1	0.91
1006	366.500	Pipe	1	0.46	1068	394.800	Box Culvert	2	1.82
1007	367.000	Bridge/steel girder	1	2.40	1069	395.200	Box Culvert	1	0.91
1008	367.100	Pipe	1	0.46	1070	395.250	Pipe	2	1.82
1009	367.250	Bridge/steel girder	1	4.00	1071	395.400	Bridge/steel girder	1	2.45
1010	367.300	Pipe	1	0.46	1072	395.530	Rail Frame	1	0.91
1011	367.800	Pipe	1	0.46	1073	395.650	Rail Frame	2	0.92
1012	368.100	Bridge/steel girder	1	3.90	1074	396.100	Box Culvert	1	0.91
1013	368.400	Bridge/steel girder	1	2.40	1075	396.400	Bridge/steel girder	1	2.45
1014	369.000	Bridge/steel girder	1	3.90	1076	396.800	Bridge/steel girder	1	2.45
1015	369.100	Pipe	1	0.46	1077	397.000	Bridge/steel girder	1	2.45
1016	369.350	Box Culvert	1	1.25	1078	398.300	Pipe	1	0.91
1017	369.800	Rail Frame	1	1.67	1079	398.550	Pipe	1	0.91
1018	370.400	Arch	1	1.80	1080	398.600	Rail Frame		
1019	370.550	Arch	1	0.80	1081	399.000	Bridge/steel girder	1	2.50
1020	371.100	Arch	1	0.87	1082	399.900	Rail Frame	1	0.91
1021	371.400	Arch	1	0.90	1083	400.200	Pipe	1	0.91
1022	372.200	Bridge/steel girder	1	2.42	1084	400.250	Pipe	1	0.91
1023	373.000	Bridge/steel girder	1	2.42	1085	400.300	Pipe	1	0.91
1024	374.000	Bridge/steel girder	3	45.33	1086	400.350	Box Culvert	1	0.91
1025	374.600	Bridge/steel girder	1	10.27	1087	400.600	Rail Frame	1	0.91
1026	375.100	Pipe	1	0.46	1088	400.750	Box Culvert	1	0.91
1027	375.800	Pipe	1	0.46	1089	401.000	Box Culvert	1	0.91
1028	376.300	Bridge/steel girder	2	15.24	1090	401.200	Rail Frame	1	0.91
1029	377.400	Box Culvert	1	0.91	1091	401.550	Bridge/steel girder	1	2.40
1030	377.600	Bridge/steel girder	1	2.70	1092	401.800	Box Culvert	1	0.91
1031	378.300	Box Culvert	1	0.83	1093	401.900	Box Culvert	1	0.91
1032	378.400	Pipe	1	0.91	1094	402.200	Box Culvert	2	2.40
1033	378.500	Bridge/steel girder	1	2.50	1095	403.230	Box Culvert	2	3.70
1034	379.500	Rail Frame	1	0.91	1096	403.600	Box Culvert	2	4.00
1035	379.550	Rail Frame	1	0.91	1097	404.750	Box Culvert	2	4.00
1036	379.650	Rail Frame	1	0.91	1098	404.850	Rail Frame		
1037	379.800	Rail Frame	1	0.91	1100	405.600	Rail Frame	1	0.91
1038	380.100	Bridge/steel girder	1	3.60	1101	406.750	Bridge/steel girder	3	51.00
1039	380.300	Rail Frame	1	0.91	1102	407.800	Bridge/steel girder	2	34.00
1040	380.530	Rail Frame	1	0.91	1103	408.350	Rail Frame	1	0.91
1041	380.750	Rail Frame	1	0.91	1104	408.500	Box Culvert	1	0.85
1042	381.100	Rail Frame	1	0.46	1105	408.850	Rail Frame	1	0.91
1043	381.330	Rail Frame	1	0.91	1106	409.100	Box Culvert	1	0.91
1044	381.450	Box Culvert	1	0.91	1107	409.200	Box Culvert	1	0.91
1045	381.900	Bridge/steel girder	1	2.45	1108	409.400	Box Culvert	1	0.91
1046	382.500	Bridge/steel girder	1	2.45	1109	410.000	Box Culvert	1	0.91
1047	382.550	Box Culvert	1	0.91	1110	410.250	Box Culvert	1	0.91
1048	382.900	Box Culvert	1	0.91	1111	410.300	Pipe	1	0.91
1049	383.450	Box Culvert	1	0.91	1112	410.450	Bridge/steel girder	1	2.50
1050	384.100	Bridge/steel girder	3	11.10	1113	411.200	Bridge/steel girder	1	3.60
1051	384.650	Box Culvert	1	0.91	1114	411.700	Pipe	1	0.30
1052	385.200	Box Culvert	1	0.91	1115	411.750	Pipe	1	0.30
1053	386.100	Bridge/steel girder	1	2.60	1116	411.800	Bridge/steel girder	1	6.90
1054	386.500	Bridge/steel girder	1	2.80	1117	412.000	Rail Frame	1	0.91
1055	387.000	Bridge/steel girder	1	3.25	1118	412.350	Rail Frame	1	0.91
1056	387.300	Box Culvert	2	1.82	1119	412.600	Bridge/steel girder	1	2.00
1057	387.800	Pipe	1	0.30	1120	412.900	Box Culvert	1	0.61
1058	388.400	Rail Frame	1	0.91	1121	413.500	Pipe	1	0.30
1059	389.000	Rail Frame	1	0.91	1122	414.150	Bridge/steel girder	1	3.65
1060	392.000	Bridge/steel girder	3	50.75	1123	414.400	Box Culvert	1	0.91
1061	392.800	Bridge/steel girder	3	49.60	1124	415.000	Bridge/steel girder		
1062	393.100	Bridge/steel girder	1	4.58	1125	415.300	Pipe	1	0.91
1063	393.250	Bridge/steel girder	1	7.00	1126	415.500	Box Culvert	2	1.82



## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Nkaya - Salima (contd.)</b>					<b>Nkaya - Salima (contd.)</b>				
1127	415.550	Bridge/steel girder	3	47.25	1189	433.650	Bridge/steel girder	1	3.25
1128	415.900	Rail Frame			1190	433.700	Bridge/steel girder	1	3.66
1129	416.150	Bridge/steel girder	1	3.25	1191	434.000	Rail Frame	1	0.91
1130	416.600	Pipe	2	1.82	1192	434.150	Rail Frame	1	0.91
1131	416.650	Box Culvert	1	0.91	1193	434.500	Arch	1	0.82
1132	416.900	Box Culvert	1	0.85	1194	434.850	Box Culvert	1	2.88
1133	417.000	Pipe	2	1.82	1195	435.230	Pipe	1	0.91
1134	417.100	Pipe	2	1.82	1196	435.400	Bridge/steel girder	1	2.46
1135	417.330	Bridge/steel girder	1	2.73	1197	435.800	Bridge/steel girder	1	3.62
1136	417.450	Bridge/steel girder	1	2.45	1198	435.900	Bridge/steel girder	1	3.62
1137	417.600	Arch	1	0.91	1199	436.500	Bridge/steel girder	2	14.00
1138	417.750	Rail Frame	1	0.91	1200	437.150	Rail Frame	1	0.91
1139	418.150	Arch	1	0.91	1201	437.500	Bridge/steel girder	1	3.58
1140	418.300	Arch	1	0.91	1202	437.800	Rail Frame	1	0.91
1141	418.900	Bridge/steel girder	1	2.45	1203	438.100	Arch	1	0.80
1142	419.330	Bridge/steel girder	1	4.00	1204	438.330	Rail Frame	1	0.91
1143	419.700	Rail Frame	1	0.91	1205	438.700	Bridge/steel girder	1	3.25
1144	419.950	Bridge/steel girder	1	4.00	1206	439.130	Bridge/steel girder	1	7.00
1145	420.550	Bridge/steel girder	1	4.00	1207	439.300	Bridge/steel girder	1	3.25
1146	420.600	Pipe	1	0.30	1208	439.450	Pipe	1	0.30
1147	420.650	Pipe	1	0.30	1209	439.600	Pipe	1	0.30
1148	421.050	Rail Frame	1	0.79	1210	440.730	Rail Frame	1	0.91
1149	421.350	Bridge/steel girder	1	2.46	1211	440.900	Pipe	1	0.30
1150	421.700	Rail Frame	1	0.91	1212	441.100	Rail Frame	1	0.70
1151	421.800	Rail Frame	1	0.91	1213	441.930	Bridge/steel girder	1	19.80
1152	422.650	Rail Frame	1	0.91	1214	442.330	Bridge/steel girder	1	7.00
1153	423.230	Bridge/steel girder	2	14.00	1215	442.850	Arch	1	0.95
1154	423.400	Bridge/steel girder	1	3.66	1216	443.200	Box Culvert	1	1.54
1155	423.550	Rail Frame	1	0.91	1217	443.300	Box Culvert	1	0.91
1156	423.950	Arch	1	0.91	1218	443.500	Box Culvert	1	0.91
1157	424.100	Box Culvert	1	0.78	1219	443.600	Box Culvert	1	0.91
1158	424.300	Box Culvert	1	0.89	1220	443.800	Bridge/steel girder	2	14.00
1159	424.500	Box Culvert	1	0.91	1221	444.350	Arch	1	0.91
1160	424.650	Box Culvert	1	0.91	1222	444.600	Arch	1	0.91
1161	424.750	Box Culvert	1	1.48	1223	444.750	Pipe	2	1.82
1162	424.930	Box Culvert	1	0.91	1224	445.100	Rail Frame	1	0.91
1163	425.000	Box Culvert	1	1.38	1225	445.200	Rail Frame	1	0.61
1164	425.550	Box Culvert	1	0.91	1226	445.400	Arch	1	0.87
1165	425.650	Pipe	2	1.82	1227	445.700	Rail Frame	1	0.91
1166	425.750	Bridge/steel girder	1	2.43	1228	446.250	Bridge/steel girder	1	17.00
1167	425.950	Bridge/steel girder	1	1.37	1229	446.600	Arch	1	0.91
1168	426.800	Bridge/steel girder	1	3.53	1230	446.800	Rail Frame	1	0.91
1169	427.000	Bridge/steel girder	1	2.56	1231	447.130	Arch	1	1.77
1170	427.500	Rail Frame	1	0.91	1232	447.150	Arch	2	1.82
1171	427.600	Rail Frame	1	0.91	1233	447.700	Arch	1	0.91
1172	427.830	Bridge/steel girder	1	3.72	1234	447.900	Arch	1	0.91
1173	428.800	Bridge/steel girder	2	34.00	1235	448.100	Bridge/steel girder	1	3.66
1174	429.230	Box Culvert	1	1.40	1236	448.500	Arch	1	0.85
1175	429.300	Pipe	3	1.76	1237	448.830	Arch	2	1.82
1176	429.450	Box Culvert	1	2.44	1238	449.150	Rail Frame	1	0.87
1177	429.550	Pipe Arch	1	4.65	1239	449.800	Bridge/steel girder	1	3.59
1178	429.830	Box Culvert	1	2.70	1240	449.950	Arch	1	0.91
1179	430.550	Bridge/steel girder	1	2.67	1241	450.200	Rail Frame	1	0.91
1180	431.500	Pipe	2	1.82	1242	450.500	Rail Frame	1	0.46
1181	431.600	Box Culvert	1	2.36	1243	451.100	Bridge/steel girder	1	4.67
1182	432.100	Pipe	2	1.60	1244	451.650	Bridge/steel girder	3	51.00
1183	432.300	Box Culvert	1	2.44	1245	452.850	Bridge/steel girder	1	2.43
1184	432.500	Pipe	3	1.38	1246	453.100	Box Culvert	1	0.89
1185	432.600	Box Culvert	1	2.40	1247	453.200	Pipe	2	1.70
1186	432.800	Box Culvert	1	2.47	1248	453.500	Pipe	2	1.70
1187	433.150	Pipe	3	1.68	1249	454.100	Rail Frame	1	0.91
1188	433.400	Box Culvert	1	2.40	1250	454.150	Bridge/steel girder	1	3.52



## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Nkaya - Salima (contd.)</b>					<b>Salima - Kanengo (contd.)</b>				
1251	454.550	Rail Frame	1	0.91	1323	484.400	Pipe	1	0.91
1252	454.900	Rail Frame	1	1.30	1324	484.730	Pipe	1	1.20
1253	455.200	Rail Frame	1	2.44	1325	486.200	Pipe	1	0.91
1254	455.550	Arch	1	0.91	1326	486.850	Pipe	1	1.33
1255	456.350	Pipe	3	2.52	1327	487.050	Pipe	1	0.91
1256	456.400	Bridge/steel girder	1	2.44	1328	487.730	Pipe	1	1.22
1257	456.550	Arch	1	0.91	1329	488.200	Pipe	1	2.60
1258	456.900	Bridge/steel girder	1	7.00	1330	488.900	Pipe	1	1.22
1259	457.750	Pipe	1	0.85	1331	489.000	Pipe	1	1.22
1260	457.830	Arch	1	0.91	1332	489.150	Pipe	1	0.91
1261	457.850	Pipe	1	0.85	1333	489.250	Pipe	1	1.22
1262	458.150	Pipe	1	0.85	1334	489.350	Pipe	1	1.22
1263	458.400	Box Culvert	1	2.45	1335	489.650	Pipe	1	1.55
1264	458.700	Box Culvert	1	2.45	1336	490.050	Pipe	1	1.90
1265	458.800	Box Culvert	1	2.45	1337	490.800	Pipe	1	0.91
1266	459.200	Pipe	1	0.30	1338	491.350	Overhead Bridge	3	17.55
1267	459.700	Box Culvert	1	2.43	1339	491.600	Pipe	1	0.91
1268	459.900	Pipe	3	2.64	1340	491.950	Pipe	1	0.91
1269	459.900	Box Culvert	1	0.91	1341	493.100	Pipe	1	0.91
1270	460.100	Pipe	2	1.70	1342	493.650	Pipe	1	0.91
1271	460.400	Pipe	1	0.88	1343	493.700	Pipe	1	0.91
1272	460.600	Box Culvert	1	2.80	1344	494.100	Pipe	1	0.91
1273	460.650	Box Culvert	1	0.91	1345	494.650	Pipe	1	1.80
1274	461.200	Box Culvert	1	0.91	1346	495.600	Pipe	1	1.20
1275	461.250	Pipe	2	1.22	1347	496.100	Pipe	1	0.91
1276	461.300	Pipe	1	0.84	1348	496.300	Pipe	1	0.91
1277	461.430	Box Culvert	1	0.91	1349	496.500	Pipe	1	1.22
1278	462.100	Box Culvert	1	0.91	1350	496.800	Pipe	1	1.80
1279	462.150	Pipe	2	1.76	1351	497.100	Pipe	1	0.91
1280	462.550	Pipe	1	0.61	1352	497.300	Pipe	1	1.22
1281	462.600	Bridge/steel girder	1	3.25	1353	497.450	Pipe	1	1.22
1282	462.700	Pipe	1	0.61	1354	497.700	Pipe	1	1.80
1283	462.730	Pipe	1	0.30	1355	497.800	Pipe	1	2.44
1284	462.750	Pipe	1	0.61	1356	498.100	Pipe	1	1.22
1285	462.800	Pipe	1	0.30	1357	500.250	Pipe	1	0.91
1286	462.950	Pipe	1	0.61	1358	500.400	Pipe	1	1.22
1287	463.000	Pipe	3	0.90	1359	500.600	Overhead Bridge	1	5.10
1288	463.150	Pipe	1	0.61	1360	500.650	Pipe	1	1.50
1289	463.500	Rail Frame	1	0.91	1361	500.830	Pipe	1	0.91
1290	464.150	Pipe	2	1.82	1362	501.100	Pipe	1	1.50
1291	464.550	Pipe	2	1.82	1363	501.500	Pipe	1	1.22
1292	465.050	Rail Frame	1	0.87	1364	501.650	Pipe	1	0.91
1293	465.230	Pipe	1	0.91	1365	501.730	Pipe	1	1.50
1294	465.600	Arch	1	0.91	1366	502.000	Pipe	1	1.50
1295	466.000	Rail Frame	1	0.91	1367	502.150	Pipe	1	0.91
1296	466.400	Box Culvert	1	0.91	1368	502.530	Pipe	1	0.91
1297	467.100	Bridge/Truss spans	3	60.96	1369	502.550	Pipe	1	0.91
1298	467.900	Pipe	1	0.30	1370	502.600	Pipe	1	1.22
<b>Salima - Kanengo</b>					1371	503.030	Pipe	1	0.91
1310	475.600	Bridge/concrete deck	1	2.45	1372	503.300	Pipe	1	1.22
1311	476.150	Box Culvert	1	0.85	1373	503.600	Pipe	1	0.91
1312	476.650	Box Culvert	1	1.77	1374	503.900	Pipe	1	3.00
1313	476.900	Box Culvert	1	0.85	1375	504.200	Pipe	1	1.22
1314	478.100	Pipe	1	0.60	1376	504.700	Pipe	1	0.91
1315	478.900	Pipe	1	0.60	1377	505.000	Pipe	1	0.91
1316	479.800	Pipe	1	0.91	1378	505.250	Pipe	1	0.91
1317	481.150	Pipe	1	0.60	1379	505.400	Pipe	1	0.91
1318	481.250	Pipe	2	1.20	1380	505.800	Pipe	1	0.91
1319	481.400	Bridge/concrete deck	1	5.68	1381	505.900	Pipe	1	0.91
1320	482.250	Pipe	1	0.91	1382	506.200	Pipe	1	0.61
1321	483.300	Pipe	1	0.91	1383	506.400	Pipe	1	1.83
1322	484.300	Pipe	1	0.91	1384	506.800	Pipe	1	1.22

## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Salima - Kanengo (contd.)</b>					<b>Salima - Kanengo (contd.)</b>				
1385	507.000	Pipe	1	1.50	1447	527.900	Pipe	1	1.22
1386	507.430	Pipe	1	0.61	1448	528.200	Pipe	1	1.22
1387	507.500	Overhead Bridge	1	5.35	1449	528.400	Pipe	1	0.91
1388	507.550	Pipe	1	0.91	1450	528.600	Pipe	1	0.91
1389	507.800	Pipe	1	1.50	1451	528.900	Pipe	1	0.91
1390	508.100	Pipe	1	0.91	1452	529.200	Pipe	1	0.91
1391	508.300	Pipe	1	2.40	1453	529.700	Pipe	1	0.91
1392	508.600	Pipe	1	1.22	1454	530.100	Pipe	1	1.20
1393	508.800	Pipe	1	0.91	1455	530.750	Pipe	1	1.20
1394	508.930	Pipe	1	0.91	1456	531.400	Pipe	1	2.44
1395	509.130	Pipe	1	0.61	1457	531.830	Pipe	1	0.91
1396	509.300	Bridge/concrete deck	3	46.50	1458	532.000	Pipe	1	3.10
1397	509.500	Pipe	1	0.91	1459	532.300	Pipe	1	1.50
1398	509.650	Pipe	1	0.91	1460	532.700	Pipe	2	6.20
1399	509.900	Pipe	1	1.50	1461	533.600	Pipe	1	0.91
1400	510.250	Pipe	1	0.91	1462	534.200	Pipe	2	4.88
1401	510.600	Pipe	1	1.10	1463	534.700	Pipe	1	1.20
1402	511.200	Pipe	1	0.91	1464	535.430	Pipe	1	1.20
1403	511.400	Pipe	1	0.91	1465	535.700	Pipe	1	1.20
1404	511.700	Pipe	1	0.91	1466	535.900	Pipe	1	0.91
1405	511.830	Pipe	1	1.50	1467	536.400	Pipe	1	1.20
1406	511.900	Pipe	1	0.91	1468	536.900	Pipe	1	0.91
1407	512.200	Pipe	1	0.61	1469	537.200	Pipe	1	1.90
1408	512.500	Bridge/concrete deck	5	77.50	1470	537.400	Pipe	2	3.60
1409	513.000	Pipe	1	2.75	1471	538.150	Pipe	1	1.22
1410	513.500	Pipe	1	0.91	1472	538.300	Pipe	1	0.91
1411	513.900	Pipe	1	1.22	1473	538.800	Pipe	1	0.91
1412	513.950	Pipe	1	0.91	1474	538.900	Pipe	1	0.91
1413	514.300	Pipe	1	0.91	1475	539.300	Pipe	1	2.50
1414	514.750	Pipe	1	0.91	1476	539.800	Pipe	1	2.45
1415	515.100	Pipe	1	0.91	1477	540.130	Pipe	1	0.91
1416	515.350	Pipe	1	0.91	1478	540.500	Bridge/concrete deck	5	78.00
1417	515.900	Pipe	1	1.85	1479	541.100	Pipe	1	2.44
1418	516.150	Pipe	1	0.91	1480	541.850	Pipe	1	0.91
1419	516.230	Pipe	1	0.91	1481	542.400	Pipe	1	0.91
1420	516.830	Pipe	1	1.22	1482	542.700	Pipe	1	0.91
1421	516.950	Pipe	1	3.15	1483	543.250	Pipe	1	0.91
1422	517.200	Pipe	1	0.91	1484	543.750	Pipe	1	0.91
1423	517.600	Pipe	1	1.22	1485	544.230	Pipe	1	1.45
1424	517.850	Pipe	1	0.91	1486	545.100	Pipe	1	1.50
1425	518.100	Pipe	1	1.50	1487	545.850	Pipe	1	1.15
1426	518.450	Pipe	1	0.91	1488	546.300	Pipe	1	1.25
1427	518.650	Pipe	1	1.50	1489	547.000	Pipe	1	0.91
1428	519.100	Pipe	1	0.91	1490	547.600	Pipe	1	0.61
1429	519.400	Pipe	1	0.91	1491	547.800	Pipe	2	1.22
1430	519.600	Pipe	1	2.44	1492	548.350	Pipe	1	1.24
1431	520.000	Bridge/concrete deck	5	85.00	1493	548.750	Pipe	1	1.50
1432	520.550	Pipe	1	0.91	1494	549.150	Pipe	3	9.30
1433	520.800	Box Culvert	1	3.00	1495	549.600	Pipe	1	1.80
1434	521.000	Pipe	1	1.22	1496	550.330	Pipe	1	0.61
1435	521.300	Pipe	1	1.22	1497	551.000	Pipe	1	0.91
1436	521.500	Pipe	1	0.91	1498	553.800	Pipe	3	4.50
1437	521.600	Pipe	1	1.80	1499	554.500	Pipe	1	1.50
1438	521.950	Pipe	1	0.91	1500	554.930	Pipe	1	1.50
1439	522.450	Pipe	1	0.91	1501	555.630	Pipe	1	1.80
1440	522.900	Pipe	1	0.91	1502	556.300	Pipe	1	1.20
1441	524.400	Pipe	1	0.91	1503	557.000	Pipe	1	1.22
1442	524.900	Pipe	1	0.91	1504	557.600	Pipe	1	0.91
1443	526.000	Pipe	1	0.91	1505	557.800	Pipe	1	3.00
1444	526.600	Pipe	1	0.61	1506	558.600	Pipe	1	1.75
1445	527.200	Pipe	1	0.91	1507	559.530	Pipe	1	1.20
1446	527.600	Pipe	1	0.91	1508	559.930	Pipe	1	0.91

## Bridges and Culverts Register

## Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Salima - Kanengo (contd.)</b>					<b>Kanengo - Mchinji (contd.)</b>				
1509	560.200	Pipe	1	0.91	1568	595.600	Pipe	1	0.88
1510	560.550	Pipe	1	0.91	1569	596.300	Pipe	1	1.46
1511	561.100	Box Culvert	2	9.00	1570	597.500	Pipe	2	1.76
1512	561.800	Pipe	1	0.91	1571	598.400	Pipe	1	0.82
1513	562.500	Pipe	1	1.22	1572	599.200	Pipe	1	0.87
1514	562.800	Pipe	1	2.50	1573	600.400	Pipe	1	0.91
1515	564.200	Pipe	2	6.00	1574	601.000	Pipe	1	0.91
1516	564.700	Pipe	1	3.00	1575	601.850	Pipe	2	2.36
1517	565.600	Pipe	1	1.22	1576	602.630	Pipe	1	0.91
1518	565.900	Pipe	1	1.60	1577	603.050	Pipe	1	0.91
1519	566.300	Pipe	1	1.60	1578	603.350	Pipe	1	0.91
1520	567.130	Pipe	1	2.00	1579	604.300	Pipe	1	1.22
1521	568.000	Pipe	1	1.55	1580	604.730	Pipe	1	1.27
1522	568.300	Pipe	1	1.50	1581	605.000	Pipe	1	0.86
1523	568.950	Pipe	1	0.91	1582	606.530	Pipe	4	14.52
1524	569.500	Bridge/concrete deck	3	46.92	1583	607.600	Pipe	1	0.88
1525	570.400	Pipe	2	6.20	1584	607.750	Pipe	2	2.44
1526	570.900	Pipe	1	3.00	1585	608.050	Pipe	1	0.91
1527	571.930	Pipe	1	0.91	1586	608.600	Pipe	1	1.22
1528	573.030	Pipe	1	0.91	1587	608.930	Pipe	1	1.22
1529	573.700	Pipe	1	0.54	1588	609.100	Pipe	1	0.91
1530	573.750	Pipe	1	0.91	1589	609.150	Pipe	1	0.91
1531	573.800	Pipe	1	0.37	1590	609.230	Pipe	2	1.82
-	574.776	Bridge/concrete deck	3	46.92	1591	610.400	Pipe	2	1.82
		(Kanengo Stn.)			1592	610.850	Pipe	2	1.82
1532	573.950	Pipe	1	0.86	1593	611.500	Pipe	1	0.91
<b>Kanengo - Mchinji</b>					1594	611.900	Pipe	1	0.91
1533	574.050	Slab	1	0.50	1595	612.200	Pipe	1	0.91
1534	574.200	Pipe	1	0.50	1596	612.600	Pipe	2	1.82
1535	574.250	Pipe	1	0.88	1597	613.030	Pipe	1	0.91
1536	574.400	Pipe	1	0.60	1598	613.600	Pipe	1	0.88
1537	574.430	Pipe	1	1.05	1599	615.100	Pipe	1	0.86
1538	575.050	Pipe	1	0.88	1600	615.700	Pipe	1	0.88
1539	575.300	Pipe	1	0.88	1601	616.400	Pipe	1	0.89
1540	575.500	Overhead Bridge	1	13.14	1602	616.450	Pipe	1	0.85
1541	575.850	Pipe	1	0.85	1603	616.800	Pipe	1	0.85
1542	576.800	Pipe	3	8.64	1604	617.700	Pipe	2	3.16
1543	577.700	Pipe	1	1.40	1605	618.300	Pipe	1	0.91
1544	578.650	Pipe	1	3.00	1606	618.750	Pipe	2	3.06
1545	579.600	Pipe	1	0.91	1607	619.800	Pipe	1	1.18
1546	580.650	Pipe	3	2.73	1608	621.150	Pipe	3	2.73
1547	580.900	Overhead Bridge	1	13.40	1609	621.300	Pipe	1	0.91
1548	581.950	Pipe	1	2.54	1610	622.000	Pipe	1	0.91
1549	582.230	Pipe	1	0.91	1611	622.850	Pipe	2	1.82
1550	582.850	Pipe	5	23.05	1612	623.400	Pipe	2	1.82
1551	585.150	Pipe	1	0.91	1613	623.900	Pipe	1	0.91
1552	585.500	Pipe	4	4.88	1614	624.750	Pipe	1	0.91
1553	586.030	Pipe	3	3.66	1615	625.250	Pipe	1	0.91
1554	586.230	Pipe	2	1.22	1616	626.600	Pipe	2	1.78
1555	586.800	Pipe	2	3.84	1617	627.200	Pipe	2	2.48
1556	588.150	Pipe	1	1.22	1618	627.950	Pipe	1	1.23
1557	588.600	Pipe	4	16.80	1619	628.400	Pipe	1	0.91
1558	590.050	Pipe	1	1.19	1620	628.900	Pipe	2	2.48
1559	591.800	Pipe	1	0.91	1621	629.250	Pipe	1	1.21
1560	592.150	Pipe	1	0.61	1622	629.700	Pipe	1	0.91
1561	592.350	Pipe	1	1.18	1623	630.600	Pipe	2	2.42
1562	592.900	Pipe	1	1.18	1624	630.700	Pipe	1	1.21
1563	593.000	Pipe	1	0.61	1625	631.000	Pipe	1	1.21
1564	593.700	Pipe	3	5.58	1626	631.200	Pipe	1	0.91
1565	594.700	Pipe	1	1.52	1627	631.530	Pipe	1	0.91
1566	595.000	Bridge/concrete deck	3	47.55	1628	631.800	Pipe	1	0.91
1567	595.150	Pipe	1	1.45	1629	631.950	Pipe	1	0.91

# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Kanengo - Mchinji (contd.)</b>					<b>Nayuchi - Nkaya (contd.)</b>				
1630	632.200	Pipe	1	0.91	25	39.575	Bridge/concrete deck	4	36.58
1631	632.400	Pipe	3	2.73	26	41.400	Box Culvert		
1632	633.200	Bridge/concrete deck	3	47.55	27	41.500	Box Culvert		
1633	633.800	Pipe	1	0.91	28	41.700	Box Culvert	1	1.55
1634	633.930	Pipe	2	2.44	29	43.000	Bridge/concrete deck	1	10.67
1635	634.900	Pipe	2	2.44	30	43.300	Pipe	1	0.91
1636	635.400	Pipe	1	0.91	31	43.400	Pipe	1	0.91
1637	635.900	Pipe	1	0.91	32	43.600	Box Culvert	1	2.13
1638	638.000	Pipe	5	9.25	33	43.900	Pipe	1	0.91
1639	639.750	Pipe	1	0.91	34	44.000	Pipe	2	1.82
1640	640.400	Pipe	1	0.91	35	44.400	Pipe	2	1.82
1641	641.700	Pipe	2	1.82	36	44.800	Box Culvert	1	1.55
1642	641.900	Pipe	1	0.91	37	45.235	Bridge/concrete deck	1	10.67
1643	642.300	Pipe	1	0.91	38	45.400	Box Culvert	1	1.25
1644	643.250	Pipe	2	2.38	39	45.900	Pipe	1	0.91
1645	644.430	Pipe	2	1.22	40	45.950	Pipe	1	0.91
1646	648.300	Pipe	5	19.65	41	46.100	Box Culvert	1	1.52
1647	651.700	Bridge/concrete deck	8	126.80	42	46.400	Pipe	1	0.91
1648	653.800	Pipe	2	1.82	43	46.700	Box Culvert	1	1.60
1649	655.500	Pipe	2	1.82	44	46.900	Pipe	1	0.91
1650	657.000	Pipe	2	1.82	45	47.400	Pipe	1	0.91
1651	661.600	Pipe	2	2.48	46	47.450	Pipe	1	0.91
1652	665.550	Pipe	1	0.91	47	47.700	Box Culvert	1	1.52
1654	668.100	Pipe	1	0.91	48	47.800	Pipe	1	0.91
1655	669.200	Pipe	2	1.82	49	48.300	Box Culvert	1	2.21
1656	670.100	Pipe	1	0.91	50	48.400	Pipe	1	0.91
1657	670.900	Pipe	3	2.73	51	48.600	Box Culvert	1	1.52
1658	674.800	Pipe	3	2.73	52	49.100	Box Culvert	1	1.58
1659	675.800	Pipe	3	2.73	53	49.300	Box Culvert	1	1.60
1660	677.700	Pipe	1	0.91	54	49.600	Box Culvert	1	1.22
1661	678.350	Pipe	1	0.91	55	49.650	Box Culvert	1	1.58
1662	678.800	Pipe	2	1.82	56	49.800	Pipe	1	0.91
1663	679.900	Pipe	1	0.91	57	50.100	Box Culvert	1	2.16
1664	681.900	Pipe	1	0.91	58	50.200	Pipe	1	0.91
1665	684.100	Pipe	2	1.82	59	50.400	Box Culvert	1	1.55
1666	684.650	Pipe	1	0.91	60	50.900	Box Culvert	1	1.65
1667	684.800	Pipe	1	0.91	61	51.100	Box Culvert	1	2.16
1668	684.850	Pipe	2	1.82	62	51.400	Box Culvert	1	1.58
<b>Nayuchi - Nkaya</b>					63	51.500	Box Culvert	1	2.21
1	0.600	Box Culvert	2		64	51.600	Box Culvert	1	2.21
3	7.800	Pipe	1	0.91	65	52.000	Box Culvert	1	1.55
4	10.100	Pipe	1	0.91	66	52.400	Box Culvert	1	1.55
5	10.900	Pipe	1	0.91	67	52.500	Pipe	1	0.91
6	11.600	Pipe	1	0.91	68	52.600	Box Culvert	1	2.26
7	13.000	Pipe	1	0.91	69	52.700	Pipe	1	0.91
8	13.300	Pipe	1	0.91	70	53.000	Box Culvert	1	1.52
9	14.900	Pipe	1	0.91	71	53.300	Box Culvert	1	1.58
10	15.500	Pipe	1	0.91	72	53.600	Box Culvert	1	1.58
11	17.300	Pipe	1	0.91	73	53.800	Pipe	1	0.91
12	18.100	Pipe	1	0.91	74	53.900	Pipe	1	0.91
13	21.300	Box Culvert			75	54.000	Pipe	1	0.91
14	27.000	Pipe	2	1.82	76	54.100	Box Culvert	1	1.55
15	27.500	Pipe	1	0.91	77	54.300	Box Culvert	1	1.58
16	29.200	Pipe	1	0.91	78	54.400	Box Culvert	1	2.16
17	29.980	Bridge/concrete deck	4	36.58	79	54.500	Box Culvert	1	2.13
18	31.200	Pipe	1	0.91	80	54.900	Pipe	1	0.91
19	32.979	Bridge/concrete deck	4	36.58	81	55.000	Box Culvert	2	4.26
20	34.700	Pipe	1	0.91	82	55.200	Box Culvert	1	2.13
21	34.800	Pipe	1	0.91	83	55.400	Box Culvert	1	2.13
22	35.500	Pipe	1	0.91	84	55.700	Box Culvert	3	6.39
23	36.200	Pipe	1	0.91	85	56.700	Box Culvert	2	4.62
24	37.400	Pipe	1	0.91	86	57.100	Box Culvert		

# Bridges and Culverts Register

# Annex 2.2.5.1.1

Bridge No.	km	Type	Spans	Width [m]	Bridge No.	km	Type	Spans	Width [m]
<b>Nayuchi - Nkaya (contd.)</b>					<b>Nayuchi - Nkaya (contd.)</b>				
87	57.200	Box Culvert			149	98.248	Bridge/steel girder	9	190.23
88	57.800	Pipe	2	1.82	150	98.500	Pipe	1	0.91
89	61.800	Pipe	1	0.91	151	99.000	Box Culvert	1	2.13
90	62.500	Pipe	1	0.91	152	99.300	Pipe	2	1.82
91	62.600	Pipe	1	0.91	153	99.400	Pipe	1	0.91
92	64.400	Pipe	1	0.91					
93	65.100	Pipe	1	0.91					
94	67.900	Pipe	1	0.91					
95	68.900	Pipe	1	0.91					
96	70.800	Pipe	1	0.91					
97	71.000	Box Culvert	1	2.24					
98	71.100	Box Culvert							
99	71.369	Bridge/concrete deck	5	47.25					
100	72.600	Pipe	3	3.65					
101	73.118	Bridge/concrete deck	1	10.67					
102	73.700	Pipe	1	0.91					
103	74.292	Bridge/concrete deck	3	25.91					
104	74.600	Box Culvert	1	1.83					
105	75.000	Concrete channel							
106	75.050	Concrete channel							
107	75.200	Pipe	1	0.91					
108	75.900	Pipe	1	0.91					
109	76.487	Bridge/concrete deck	3	41.15					
110	76.400	Box Culvert	1	2.13					
111	77.200	Pipe	1	0.91					
112	77.609	Bridge/steel girder	4	110.66					
113	78.700	Pipe	1	0.91					
114	78.900	Pipe	1	0.91					
115	79.200	Box Culvert	1	2.13					
116	79.600	Box Culvert	1	2.13					
117	79.700	Pipe	2	1.82					
118	79.900	Pipe	1	0.91					
119	80.000	Pipe	1	0.91					
120	80.376	Bridge/concrete deck	1	10.67					
121	81.600	Pipe	1	0.91					
122	82.200	Pipe	1	0.91					
123	83.000	Pipe	1	0.91					
124	83.200	Box Culvert	1	2.13					
125	83.796	Bridge/concrete deck	1	10.67					
126	84.700	Pipe	2	1.82					
127	85.100	Pipe	2	1.82					
128	85.700	Box Culvert	1	2.13					
129	86.492	Bridge/concrete deck	1	10.67					
130	87.400	Box Culvert	1	2.13					
131	88.303	Bridge/concrete deck	1	7.62					
132	88.600	Box Culvert	1	2.13					
133	89.154	Bridge/concrete deck	1	10.67					
134	89.200	Box Culvert	3	6.39					
135	89.663	Bridge/concrete deck	1	10.67					
136	91.200	Box Culvert	3	7.32					
137	91.700	Pipe	2	1.82					
138	92.406	Bridge/concrete deck	1	7.62					
139	92.600	Box Culvert	2	4.26					
140	93.200	Pipe	1	0.91					
141	93.700	Pipe	1	0.91					
142	94.300	Bridge/concrete deck	1	4.57					
143	94.500	Pipe	1	0.91					
144	94.593	Bridge/concrete deck	1	7.62					
145	95.000	Box Culvert	1	2.13					
146	96.000	Box Culvert	3	6.39					
147	96.500	Box Culvert	3	6.39					
148	97.200	Pipe	2	1.82					

**Bridge data evaluation**

# Bridge Data Evaluation

# Annex 2.2.5.1.2

Section	Bridge Type	Length undefined	Length < 2.00 m						Length ≥ 2.00 m					
			Nos.			Length			Nos.			Length		
			defined	assumed	Total	defined	assumed	Total	defined	assumed	Total	defined	assumed	Total
Border - Bangula	Bridge/ steel girder	0	0	0	0	0.0	0.0	0.0	2	0	2	11.0	0.0	11.0
	Bridge/ Truss spans	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Open Top	37	0	0	0	0.0	0.0	0.0	46	38	84	252.6	218.9	471.5
	Bridge/ concrete deck	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Under Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Slab	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Twin Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Box Culvert	4	0	0	0	0.0	0.0	0.0	0	4	4	0.0	16.9	16.9
	Concrete channel	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Pipe	8	11	8	19	10.1	7.3	17.4	0	0	0	0.0	0.0	0.0
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Rail Frame	34	1	34	35	0.6	20.7	21.4	0	0	0	0.0	0.0	0.0
	Overhead Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
Bangula - Limbe	undefined		0			0.0			1			10.2		
	Bridge/ steel girder	0	0	0	0	0.0	0.0	0.0	5	0	5	110.2	0.0	110.2
	Bridge/ Truss spans	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Open Top	15	2	1	3	2.8	1.4	4.2	36	14	50	715.9	278.4	994.3
	Bridge/ concrete deck	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Under Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Slab	6	4	6	10	1.9	2.8	4.7	0	0	0	0.0	0.0	0.0
	Arch	1	5	1	6	5.5	1.1	6.6	0	0	0	0.0	0.0	0.0
	Twin Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Box Culvert	3	23	1	24	15.1	0.7	15.7	41	2	43	173.5	8.5	181.9
	Concrete channel	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Pipe	27	92	14	106	63.0	9.6	72.6	88	13	101	991.5	146.5	1137.9
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Rail Frame	26	28	27	55	24.2	23.4	47.6	0	0	0	0.0	0.0	0.0
	Overhead Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
Limbe - Nkaya	undefined	1	0			0.0			0			0.0		
	Bridge/steel girder	6	0	0	0	0.0	0.0	0.0	40	6	46	359.6	53.9	413.6
	Bridge/Truss spans	0	0	0	0	0.0	0.0	0.0	1	0	1	61.0	0.0	61.0
	Open Top	2	0	0	0	0.0	0.0	0.0	0	2	2	0.0	18.0	18.0
	Bridge/concrete deck	0	0	0	0	0.0	0.0	0.0	1	0	1	21.3	0.0	21.3
	Under Bridge	1	0	0	0	0.0	0.0	0.0	0	1	1	0.0	9.3	9.3
	Slab	29	33	29	62	21.2	18.6	39.8	0	0	0	0.0	0.0	0.0
	Arch	19	84	19	103	89.2	20.2	109.4	2	0	2	7.3	0.0	7.3
	Twin Arch	1	0	0	0	0.0	0.0	0.0	0	1	1	0.0	7.3	7.3
	Box Culvert	6	0	0	0	0.0	0.0	0.0	0	6	6	0.0	18.9	18.9
	Concrete channel	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Pipe	19	10	17	27	3.6	6.2	9.8	1	2	3	7.3	14.6	21.8
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Rail Frame	2	28	2	30	23.5	1.7	25.2	0	0	0	0.0	0.0	0.0
	Overhead Bridge	2	0	0	0	0.0	0.0	0.0	0	2	2	0.0	18.7	18.7
Nkaya - Salima	undefined		0			0.0			0			0.0		
	Bridge/steel girder	2	1	0	1	1.4	0.0	1.4	100	2	102	851.6	17.0	868.6
	Bridge/Truss spans	0	0	0	0	0.0	0.0	0.0	1	0	1	61.0	0.0	61.0
	Open Top	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Bridge/concrete deck	0	0	0	0	0.0	0.0	0.0	2	0	2	85.7	0.0	85.7
	Under Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Slab	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Arch	1	26	1	27	26.8	1.0	27.8	1	0	1	2.5	0.0	2.5
	Twin Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Box Culvert	0	55	0	55	56.6	0.0	56.6	22	0	22	61.1	0.0	61.1
	Concrete channel	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Pipe	5	87	6	93	87.1	6.6	93.7	6	0	6	16.7	0.0	16.7
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	1	0	1	4.7	0.0	4.7
	Rail Frame	25	97	21	118	97.9	21.2	119.1	16	4	20	44.5	11.1	55.6
	Overhead Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	undefined	4	1			0.6			0			0.0		

# Bridge Data Evaluation

# Annex 2.2.5.1.2

Section	Bridge Type	Length undefined Nos.	Length < 2.00 m						Length ≥ 2.00 m					
			Nos.			Length			Nos.			Length		
			defined	assumed	Total	defined	assumed	Total	defined	assumed	Total	defined	assumed	Total
Salima - Kanengo	Bridge/steel girder	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Bridge/Truss spans	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Open Top	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Bridge/concrete deck	0	0	0	0	0.0	0.0	0.0	8	0	8	389.0	0.0	389.0
	Under Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Slab	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Twin Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Box Culvert	0	3	0	3	3.5	0.0	3.5	2	0	2	12.0	0.0	12.0
	Concrete channel	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Pipe	0	184	0	184	199.5	0.0	199.5	24	0	24	85.9	0.0	85.9
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Rail Frame	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Overhead Bridge	0	0	0	0	0.0	0.0	0.0	3	0	3	28.0	0.0	28.0
	undefined		0			0.0			0			0.0		
Kanengo - Mchinji	Bridge/steel girder	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Bridge/Truss spans	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Open Top	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Bridge/concrete deck	0	0	0	0	0.0	0.0	0.0	3	0	3	221.9	0.0	221.9
	Under Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Slab	0	1	0	1	0.5	0.0	0.5	0	0	0	0.0	0.0	0.0
	Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Twin Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Box Culvert	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Concrete channel	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Pipe	0	100	0	100	110.4	0.0	110.4	29	0	29	159.9	0.0	159.9
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Rail Frame	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Overhead Bridge	0	0	0	0	0.0	0.0	0.0	2	0	2	26.5	0.0	26.5
	undefined		0			0.0			0			0.0		
Nayuchi - Nkaya	Bridge/steel girder	0	0	0	0	0.0	0.0	0.0	2	0	2	300.9	0.0	300.9
	Bridge/Truss spans	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Open Top	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Bridge/concrete deck	0	0	0	0	0.0	0.0	0.0	18	0	18	336.8	0.0	336.8
	Under Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Slab	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Twin Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Box Culvert	7	22	3	25	34.0	4.6	38.7	29	5	34	91.3	19.4	110.7
	Concrete channel	2	0	0	0	0.0	0.0	0.0	0	2	2	0.0	5.6	5.6
	Pipe	0	71	0	71	73.7	0.0	73.7	0	0	0	0.0	0.0	0.0
	Pipe Arch	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Rail Frame	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	Overhead Bridge	0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0
	undefined		0			0.0			1			3.7		



Annex 2.2.5.1.3

### **Level Crossings**

# Level Crossings

# Annex 2.2.5.1.3

LC No.	km	Length [m]	Year installed	User	LC No.	km	Length [m]	Year installed	User
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata)</b>									
1	0.850			LULWE MISSION AND MALAWI	55	242.900	5.00		BLANTYRE CITY COUNCIL
2	6.100			NSANJE DISTRICT COUNCIL	56	248.000	6.00		BLANTYRE CITY COUNCIL
3	12.300			NSANJE DISTRICT COUNCIL	57	254.400	6.00		BLANTYRE CITY COUNCIL
4	14.800			NSANJE DISTRICT COUNCIL	58	261.000	5.00		ZOMBA DISTRICT COUNCIL
5	17.300			NSANJE DISTRICT COUNCIL	59	268.800	2.75		
6	24.550			NSANJE DISTRICT COUNCIL	60	271.900	2.75		
7	25.800			NSANJE DISTRICT COUNCIL	61	275.950	5.00	1984	DRIMP UNIT LIWONDE
8	26.300			MALAWI RAILWAYS	62	281.400	2.75		
9	26.850			NSANJE CATHOLIC MISSION	63	286.600	5.90		MACHINGA DISTRICT COUNCIL
10	27.050			NSANJE DISTRICT COUNCIL	64	293.400	3.00		
11	28.500			NSANJE DISTRICT COUNCIL	65	294.850	3.00	1984	DRIMP
12	30.670			NSANJE DISTRICT COUNCIL	86	300.050	3.00	1973	MR B K PAUL
13	32.900			NSANJE DISTRICT COUNCIL	87	305.850	6.00	1984	DRIMP
14	47.500			NSANJE DISTRICT COUNCIL	88	312.540	12.00		MALAWI GOVT
15	51.350			MALAWI GOVT WATER SUPPLY	89	312.960	9.00		BALAKA DISTRICT COUNCIL
16	56.300			MALAWI GOVT WATER SUPPLY	90	313.040	3.00		
17	57.300		1977	MALAWI GOVT ROADS DEPT	91	313.675	3.00		
18	67.250		1977	MALAWI GOVT WATER SUPPLY	92	317.350		2006	BALAKA CATHOLIC CHURCH
19	72.300			MALAWI GOVT WORKS DEPT	93	319.095	3.00		
20	75.450		1972	MESSRS MANTAM LIMITED	94	322.185	3.00		
21	80.700	5.15	1971	MALAWI GOVT WORKS DEPT	95	323.750	3.00		
22	82.800	5.05		MALAWI GOVT WORKS DEPT	96	325.990	3.00		
23	85.307	6.00	1979	MR A W MPAKULA	97	332.465	3.00		NTCHEU DISTRICT COUNCIL
24	89.682	4.70	1971	MALAWI GOVT	98	335.750	3.00	1969	ADMARC
25	91.357	5.62		MALAWI GOVT	99	338.245	3.00		MR MALENGA (LATE) COM OF
26	128.375	5.00	1975	ADMARC	100	341.475	3.00		NTCHEU DISTRICT COUNCIL
27	132.300		2003	MAKAPWA CATHOLIC CHURCH	101	347.850	3.00		
28	146.794	6.00	1970	KUMADZI ESTATE	102	350.600	6.00	1971	GREEN LEAF LTD BOX 7 KASINJE
29	156.100	4.60		MANICA MAN GEORGE	103	353.500	6.00		
30	157.260	7.30		THYOLO DISTRICT COUNCIL	104	354.725	3.00	1978	LRDP BOX 34 SALIMA
31	158.100	5.00		MALAWI RAILWAYS	105	357.450	6.00		NTCHEU DISTRICT COUNCIL
32	162.177	6.00		MAKANDI ESTATE	106	364.300	6.00	1969	ADMARC
33	164.877	6.00	1977	MAKANDI ESTATE	107	368.925	3.00	1978	LRDP
34	166.429	5.00		MAKANDI ESTATE	108	375.212	6.00		NTCHEU DISTRICT COUNCIL & ADMARC
35	173.865	4.80	1972	NDATA ESTATE	109	380.080	3.00		
36	174.365	5.50	1972	NDATA ESTATE	110	384.350	6.00		MR WALLY KEMU VG CHAULUKA NTCHEU
37	177.751	4.50		THYOLO DISTRICT COUNCIL	111	390.150	3.00		DEDZA DISTRICT COUNCIL
38	178.182	7.14		MALAWI POLICE (NANSADI)	112	397.820	3.00		DEDZA DISTRICT COUNCIL
39	182.170	5.00		THYOLO DISTRICT COUNCIL	113	400.050	3.00	1979	MR M Z KANCHOWA
40	198.885	##		BLANTYRE CITY COUNCIL	114	405.105	3.00		MALAWI GOVT
41	201.180	##		BLANTYRE CITY COUNCIL	115	408.310	3.00		
42	201.700	##		BLANTYRE CITY COUNCIL	116	410.100		2003	NATIONAL ROADS AUTHORITY
43	213.200	7.50	2007	PRESS CORPORATION	117	413.590	6.00		DEDZA DISTRICT COUNCIL
44	213.600	7.50	2007	PRESS CORPORATION	118	419.580	3.00		
45	214.800	##		BLANTYRE CITY COUNCIL	119	422.475	3.00		PAUL DAMA ESTATE
46	215.900	4.20			120	423.650	3.00		MR KATHUMBA
47	216.100	4.20			121	428.530	6.00		ADMARC
48	218.000	9.60		BLANTYRE CITY COUNCIL	122	429.980	3.00	1978	LRDP
49	222.200	6.00		BLANTYRE CITY COUNCIL	123	434.250	3.00		
50	226.700	5.00	1972	MWAI ESTATE	124	438.510	3.00		
51	228.850	5.85	1975	BLANTYRE CITY COUNCIL	125	438.820	3.00		MYP
52	230.100	5.00		BLANTYRE CITY COUNCIL	126	440.815	9.00		SALIMA DISTRICT COUNCIL
53	233.850	5.00		BLANTYRE CITY COUNCIL	127	441.354	9.00		MALAWI RAILWAYS
54	236.650	5.90	1984	N R D P/C S C U BOX 242 ZOMBA	128	442.014	3.00		MALAWI GOVT (HEALTH DEPT)
					129	450.758	6.00		SALIMA DISTRICT COUNCIL

# Level Crossings

# Annex 2.2.5.1.3

LC No.	km	Length [m]	Year installed	User	LC No.	km	Length [m]	Year installed	User
<b>Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)</b>									
130	453.047	3.00		MALAWI GOVT (AGRICULTURE	191	653.100			
131	457.477	3.00			192	655.400			
132	461.585	3.00	1983	MR M LAMBO PHIRI	193	657.100			
133	464.840	6.00		ADMARC	194	658.200			
134	467.883	9.00		MALAWI GOVT (ROADS DEPT)	195	659.500			
135	475.400	9.00			196	663.700			
136	476.300		2006		197	666.450			GENERAL FARMING CO LIMITED
137	477.800			MALAWI GOVT (ROADS DEPT)	198	670.100			
138	480.900				199	673.500			
139	483.550				200	677.000			LUDZI CATHOLIC PARISH
140	484.350				201	678.300		2006	
141	485.950				202	680.450			
142	495.000			MR CHAFUMUKA	203	684.800			MALAWI RAILWAYS
143	504.050			MALAWI GOVT (WORKS DEPT)	204	685.150			
144	512.800			MALAWI ARMY	205	690.100		2007	
145	515.200			MALAWI ARMY	<b>Border - Nayuchi - Nkaya</b>				
146	547.900				85	3.850	5.00	1983	MR F YOLA
147	554.100				84	8.000	5.00	1983	M/S LUMALA CHOKANI
148	556.850				83	21.900	6.00		MACHINGA DISTRICT COUNCIL
149	562.000				82	26.550	6.00	1983	NRDP/CSCU
150	565.600				81	29.600	6.00		MACHINGA DISTRICT COUNCIL
151	573.300			MALAWI GOVT (WORKS DEPT)	80	30.200	6.00		MACHINGA DISTRICT COUNCIL
152	577.400				79	35.750	6.00		MACHINGA DISTRICT COUNCIL
153	579.400				78	41.000	5.00		MACHINGA DISTRICT COUNCIL
154	582.300				77	43.200	6.00		
155	585.050				76	67.600	7.50		MACHINGA DISTRICT COUNCIL
156	586.250				75	72.800	6.00		MACHINGA DISTRICT COUNCIL
157	587.250				74	73.400	3.00		MACHINGA DISTRICT COUNCIL
158	588.950				73	74.500	6.80		MACHINGA DISTRICT COUNCIL
159	592.150				72	76.050	3.00		MACHINGA DISTRICT COUNCIL
160	596.350			PRESS FARMING CO LIMITED	71	77.170	3.00		MACHINGA DISTRICT COUNCIL
161	597.400			PRESS FARMING CO LIMITED	70	81.590	3.00		MACHINGA DISTRICT COUNCIL
162	600.950				69	87.110	3.00		MACHINGA DISTRICT COUNCIL
163	601.850			MALAWI GOVT	68	89.250	3.00		MACHINGA DISTRICT COUNCIL
164	603.700				67	93.325	3.00		MACHINGA DISTRICT COUNCIL
165	605.000				66	99.050	3.00		MACHINGA DISTRICT COUNCIL
166	606.150								
167	607.700								
168	609.100								
169	610.850								
170	613.650								
171	614.950								
172	615.900								
173	618.000								
174	619.900								
175	621.750								
176	623.800								
177	624.800								
178	625.400								
179	628.400								
180	630.550								
181	634.700								
182	637.800								
183	639.750								
184	641.450								
185	641.995								
186	642.850								
187	644.450								
188	645.700			LIKASI ESTATE					
189	647.750			LIKASI ESTATE					
190	651.850								

**Summary of through track inventory**

## Summary of Through Track Inventory

## Annex 2.2.5.2.1

Section	Existing										
	Sleepers [track metres]			Bridge beams [Nos.]	Rails [track metres]			Turnouts in through line			
	Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length
	S	W	C	B	kg/m			[Numbers]			[m]
Border - Bangula	69,954	0	0	844	70,441	0	0	5	4	0	191
Bangula - Limbe	128,943	0	0	1,479	129,819	0	0	12	19	0	687
Limbe - Nkaya	48,631	0	47,021	816	52,044	0	44,085	11	12	2	550
Nkaya - Salima	114,314	400 <sup>1)</sup>	65,916	1,592	42,964	65,366	73,230	24	1	1	500
Salima - Kanengo	334 <sup>2)</sup>	0	105,344	0	0	0	105,678	6	0	8	323
Kanengo - Border	14	222 <sup>2)</sup>	120,810	0	0	0	121,046	11	0	15	599
Border - Nkaya	337 <sup>2)</sup>	0	98,859	0	0	0	99,497	4	0	6	233

<sup>1)</sup> Balaka Level Crossing

<sup>2)</sup> On Concrete Deck Bridges

Section	Curves with R< 201.03m [track metres]	Track metres on						Total Length of Through Line [km]
		Steel Sleepers			Concrete Sleepers			
		with Rails [kg/m]						
		30	37	40	30	37	40	
Border - Bangula	175	69,954	0	0	0	0	0	70.632
Bangula - Limbe	31,875	128,943	0	0	0	0	0	130.028
Limbe - Nkaya	16,200	48,631	0	0	3,170	0	43,851	96.063
Nkaya - Salima	1,250	18,863	36,529	58,921	23,587	28,429	13,899	171.994
Salima - Kanengo	13,900	0	0	334	0	0	105,344	105.151
Kanengo - Border	500	0	0	14	0	0	120,810	122.591
Border - Nkaya	0	0	0	337	0	0	98,859	99.730

**Detailed through track inventory**

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams {Nos.} B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata)																	
0+000	S	30		300.00	Border	300				300							
0+300	B	30		3.30	Open Top				6	3							
0+303	S	30		671.70		672				672							
0+975	B	30		3.30	Open Top				6	3							
0+978	S	30		221.70		222				222							
1+200	B	30		3.30	Open Top				6	3							
1+203	S	30		721.70		722				722							
1+925	B	30		7.17	Open Top				12	7							
1+932	S	30		617.83		618				618							
2+550	B	30		3.30	Open Top				6	3							
2+553	S	30		996.70		997				997							
3+550	B	30		3.30	Open Top				6	3							
3+553	S	30		346.70		347				347							
3+900	B	30		16.12	Open Top				27	16							
3+916	S	30		441.61		442				442							
4+358	W	30	1:8	18.71	entry point								1			18.71	
4+376	S	30		606.93	Border Station	607				607							
4+983	W	30	1:8	18.71	exit point								1			18.71	
5+002	B	30		3.70	Open Top				7	4							
5+006	S	30		2,344.23		2344				2344							
7+350	B	30		5.48	Bridge/ steel girder				10	5							
7+355	S	30		469.52		470				470							
7+825	B	30		5.48	Bridge/ steel girder				10	5							
7+830	S	30		469.52		470				470							
8+300	B	30		3.30	Open Top				6	3							
8+303	S	30		1396.70		1397				1397							
9+700	B	30		3.70	Open Top				7	4							
9+704	S	30		546.30		546				546							
10+250	B	30		3.70	Open Top				7	4							
10+254	S	30		3546.30		3546				3546							
13+800	B	30		16.12	Open Top				27	16							
13+816	S	30		208.88		209				209							
14+025	B	30		6.60	Open Top				11	7							
14+032	S	30		318.40		318				318							
14+350	B	30		6.60	Open Top				11	7							
14+357	S	30		543.40		543				543							
14+900	B	30		7.22	Open Top				12	7							
14+907	S	30		1092.78		1093				1093							
16+000	B	30		7.00	Open Top				12	7							
16+007	S	30		568.00		568				568							
16+575	B	30		7.00	Open Top				12	7							
16+582	S	30		243.00		243				243							
16+825	B	30		3.30	Open Top				6	3							
16+828	S	30		721.70		722				722							
17+550	B	30		3.30	Open Top				6	3							
17+553	S	30		496.70		497				497							
18+050	B	30		7.23	Open Top				12	7							
18+057	S	30		542.77		543				543							
18+600	B	30		7.23	Open Top				12	7							
18+607	S	30		492.77		493				493							
19+100	B	30		7.70	Open Top				13	8							
19+108	S	30		942.30		942				942							
20+050	B	30		6.30	Open Top				11	6							
20+056	S	30		1493.70		1494				1494							
21+550	B	30		7.70	Open Top				13	8							
21+558	S	30		942.30		942				942							
22+500	B	30		6.20	Open Top				11	6							
22+506	S	30		418.80		419				419							
22+925	B	30		3.30	Open Top				6	3							

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams (Nos.)	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
22+928	S	30		2531.03		2531				2531							
25+459	W	30	1:8	18.71	entry point								1				18.71
25+478	S	30		30.78	Nsanje	31				31							
25+509	W	30	1:8	18.71									1				18.71
25+528	S	30		698.55		699				699							
26+226	W	30	1:8	18.71	exit point								1				18.71
26+245	S	30		1305.20		1305				1305							
27+550	B	30		7.70	Open Top				13	8							
27+558	S	30		392.30		392				392							
27+950	B	30		2.10	Open Top				4	2							
27+952	S	30		697.90		698				698							
28+650	B	30		4.25	Open Top				7	4							
28+654	S	30		1345.75		1346				1346							
30+000	B	30		10.19	Open Top				17	10							
30+010	S	30		1289.81		1290				1290							
31+300	B	30		2.10	Open Top				4	2							
31+302	S	30		122.90		123				123							
31+425	B	30		2.10	Open Top				4	2							
31+427	S	30		272.90		273				273							
31+700	B	30		2.10	Open Top				4	2							
31+702	S	30		772.90		773				773							
32+475	B	30		2.10	Open Top				4	2							
32+477	S	30		1022.90		1023				1023							
33+500	B	30		7.70	Open Top				13	8							
33+508	S	30		667.30		667				667							
34+175	B	30		5.40	Open Top				9	5							
34+180	S	30		369.60		370				370							
34+550	B	30		7.70	Open Top				13	8							
34+558	S	30		2042.30		2042				2042							
36+600	B	30		4.24	Open Top				7	4							
36+604	S	30		595.76		596				596							
37+200	B	30		14.47	Open Top				25	14							
37+214	S	30		1935.53		1936				1936							
39+150	B	30		5.76	Open Top				10	6							
39+156	S	30		94.24		94				94							
39+250	B	30		5.76	Open Top				10	6							
39+256	S	30		844.24		844				844							
40+100	B	30		5.76	Open Top				10	6							
40+106	S	30		594.24		594				594							
40+700	B	30		5.76	Open Top				10	6							
40+706	S	30		419.24		419				419							
41+125	B	30		5.76	Open Top				10	6							
41+131	S	30		169.24		169				169							
41+300	B	30		5.76	Open Top				10	6							
41+306	S	30		2369.24		2369				2369							
43+675	B	30		5.76	Open Top				10	6							
43+681	S	30		419.24		419				419							
44+100	B	30		5.76	Open Top				10	6							
44+106	S	30		644.24		644				644							
44+750	B	30		5.76	Open Top				10	6							
44+756	S	30		769.24		769				769							
45+525	B	30		5.76	Open Top				10	6							
45+531	S	30		1469.24		1469				1469							
47+000	B	30		5.76	Open Top				10	6							
47+006	S	30		794.24		794				794							
47+800	B	30		5.76	Open Top				10	6							
47+806	S	30		394.24		394				394							
48+200	B	30		5.76	Open Top				10	6							
48+206	S	30		494.24		494				494							



# Detailed Through Track Inventory

# Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.]	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
48+700	B	30		5.76	Open Top				10	6							
48+706	S	30		794.24		794				794							
49+500	B	30		5.76	Open Top				10	6							
49+506	S	30		154.08		154				154							
49+660	W	30	1:10	24.32	entry point									1		24.32	
49+684	S	30		607.29	Tengani	607				607							
50+291	W	30	1:10	24.32	exit point									1		24.32	
50+316	S	30		284.23		284				284							
50+600	B	30		5.76	Open Top				10	6							
50+606	S	30		1194.24		1194				1194							
51+800	B	30		5.76	Open Top				10	6							
51+806	S	30		594.24		594				594							
52+400	B	30		5.76	Open Top				10	6							
52+406	S	30		594.24		594				594							
53+000	B	30		5.76	Open Top				10	6							
53+006	S	30		994.24		994				994							
54+000	B	30		5.76	Open Top				10	6							
54+006	S	30		1094.24		1094				1094							
55+100	B	30		5.76	Open Top				10	6							
55+106	S	30		794.24		794				794							
55+900	B	30		5.76	Open Top				10	6							
55+906	S	30		894.24		894				894							
56+800	B	30		5.76	Open Top				10	6							
56+806	S	30		694.24		694				694							
57+500	B	30		5.76	Open Top				10	6							
57+506	S	30		494.24		494				494							
58+000	B	30		5.76	Open Top				10	6							
58+006	S	30		1294.24		1294				1294							
59+300	B	30		5.76	Open Top				10	6							
59+306	S	30		794.24		794				794							
60+100	B	30		5.76	Open Top				10	6							
60+106	S	30		394.24		394				394							
60+500	B	30		5.76	Open Top				10	6							
60+506	S	30		594.24		594				594							
61+100	B	30		5.76	Open Top				10	6							
61+106	S	30		179.24		179				179							
61+285	B	30		5.76	Open Top				10	6							
61+291	S	30		254.24		254				254							
61+545	B	30		5.76	Open Top				10	6							
61+551	S	30		394.24		394				394							
61+945	B	30		5.76	Open Top				10	6							
61+951	S	30		207.24		207				207							
62+158	B	30		5.76	Open Top				10	6							
62+164	S	30		186.24		186				186							
62+350	B	30		5.76	Open Top				10	6							
62+356	S	30		1019.24		1019				1019							
63+375	B	30		5.76	Open Top				10	6							
63+381	S	30		119.24		119				119							
63+500	B	30		5.76	Open Top				10	6							
63+506	S	30		584.24		584				584							
64+090	B	30		5.76	Open Top				10	6							
64+096	S	30		3589.24		3589				3589							
67+685	B	30		7.60	Open Top				13	8							
67+693	S	30		500.40		500				500							
68+193	B	30		7.60	Open Top				13	8							
68+201	S	30		195.40		195				195							
68+396	B	30		4.50	Open Top				8	5							
68+401	S	30		644.50		645				645							
69+045	B	30		3.68	Open Top				7	4							

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
69+049	S	30		381.32		381				381							
69+430	B	30		4.00	Open Top				7	4							
69+434	S	30		411.00		411				411							
69+845	B	30		3.00	Open Top				5	3							
69+848	S	30		722.00		722				722							
70+570	B	30		3.30	Open Top				6	3							
70+573	S	30		10.30		10				10							
70+584	W	30	1:10	24.32	entry point									1		24.32	
70+608	W	30	1:10	24.32	Bangula									1		24.32	
70+632	S	30		518.72		519				519							
71+151	W	30	1:10	24.32										1		24.32	
71+175	W	30	1:10	24.32	exit point									1		24.32	
71+200	S	30		4654.97		4655				4655							
75+855	B	30		180.85	Chiromo Bridge				302	181							
76+035	S	30		434.57		435				435							
76+470	W	30	1:10	24.32	entry point									1		24.32	
76+494	S	30		18.35	Chiromo	18				18							
76+513	W	30	1:8	18.71									1			18.71	
76+531	S	30		483.36		483				483							
77+015	W	30	1:10	24.32	exit point									1		24.32	
77+039	S	30		3088.24		3088				3088							
80+127	W	30	1:10	24.32	entry point									1		24.32	
80+152	S	30		496.75	Makhanga	497				497							
80+648	W	30	1:10	24.32	exit point									1		24.32	
80+673	S	30		12387.30		12387				12387							
93+060	B	30		24.60	Open Top				41	25							
93+085	S	30		425.74		426				426							
93+510	W	30	1:8	18.71	entry point								1			18.71	
93+529	S	30		71.21	Sankhulani	71				71							
93+600	W	30	1:10	24.32										1		24.32	
93+625	S	30		410.08		410				410							
94+035	W	30	1:10	24.32										1		24.32	
94+059	S	30		68.16		68				68							
94+127	W	30	1:8	18.71	exit point								1			18.71	
94+146	S	30		1059.16		1059				1059							
95+205	B	30		28.10	Open Top				47	28							
95+233	S	30		2316.90		2317				2317							
97+550	B	30		1.57	Open Top				3	2							
97+552	S	30		1698.43		1698				1698							
99+250	B	30		24.00	Bridge/ steel girder				40	24							
99+274	S	30		676.00		676				676							
99+950	B	30		3.35	Bridge/ steel girder				6	3							
99+953	S	30		1171.65		1172				1172							
101+125	B	30		28.00	Open Top				47	28							
101+153	S	30		822.00		822				822							
101+975	B	30		24.54	Bridge/ steel girder				41	25							
102+000	S	30		850.46		850				850							
102+850	B	30		37.21	Bridge/ steel girder				62	37							
102+887	S	30		9112.79		9113				9113							
112+000	B	30		21.10	Bridge/ steel girder				36	21							
112+021	S	30		558.90		559				559							
112+580	B	30		20.70	Open Top				35	21							
112+601	S	30		194.98		195				195							
112+796	W	30	1:8	18.71	entry point								1			18.71	
112+814	S	30		335.65	Thekerani	336				336							
113+150	W	30	1:8	18.71	exit point								1			18.71	
113+169	S	30		1.25		1				1							
113+170	B	30		3.96	Open Top				7	4							
113+174	S	30		516.04		516				516							

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing										
						Sleepers [metres]			Bridge beams [Nos.]	Rails [metres]			Turnouts in through line			
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length
						S	W	C		B	kg/m			[Numbers]		
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																
113+690	B	30		4.06	Open Top				7	4						
113+694	S	30		3105.94		3106				3106						
116+800	B	30		17.60	Open Top				30	18						
116+818	S	30		2657.40		2657				2657						
119+475	B	30		7.27	Open Top				13	7						
119+482	S	30		272.73		273				273						
119+755	B	30		7.21	Open Top				12	7						
119+762	S	30		1005.09		1005				1005						
120+767	W	30	1:10	24.32	entry point									1		24.32
120+792	S	30		934.06	Chipho	934				934						
121+726	W	30	1:10	24.32	exit point									1		24.32
121+750	B	30		10.70	Open Top				18	11						
121+761	S	30		989.30		989				989						
122+750	B	30		29.95	Open Top				50	30						
122+780	S	30		1720.05		1720				1720						
124+500	B	30		24.60	Open Top				41	25						
124+525	S	30		3525.40		3525				3525						
128+050	B	30		5.00	Open Top				9	5						
128+055	S	30		393.36		393				393						
128+448	W	30	1:10	24.32	entry point									1		24.32
128+473	S	30		386.00	Sandama	386				386						
128+859	W	30	1:10	24.32	exit point									1		24.32
128+883	S	30		1342.00		1342				1342						
130+225	B	30		14.00	Open Top				24	14						
130+239	S	30		661.00		661				661						
130+900	B	30		67.00	Open Top				112	67						
130+967	S	30		4013.00		4013				4013						
134+980	B	30		14.33	Open Top				24	14						
134+994	S	30		2205.67		2206				2206						
137+200	B	30		43.40	Open Top				73	43						
137+243	S	30		7856.60		7857				7857						
145+100	B	30		24.75	Open Top				42	25						
145+125	S	30		1725.25		1725				1725						
146+850	W	30	1:10	24.32	entry point									1		24.32
146+874	S	30		701.36	Khonjeni	701				701						
147+576	W	30	1:10	24.32	exit point									1		24.32
147+600	B	30		31.20	Open Top				52	31						
147+631	S	30		2972.80		2973				2973						
150+604	B	30		13.50	Open Top				23	14						
150+618	S	30		3082.50		3083				3083						
153+700	B	30		7.00	Open Top				12	7						
153+707	S	30		333.00		333				333						
154+040	B	30		3.25	Open Top				6	3						
154+043	S	30		1156.75		1157				1157						
155+200	B	30		10.40	Open Top				18	10						
155+210	S	30		1430.89		1431				1431						
156+641	W	30	1:8	18.71	entry point									1		18.71
156+660	S	30		576.26	Luchenza	576				576						
157+236	W	30	1:8	18.71										1		18.71
157+255	S	30		10.06		10				10						
157+265	W	30	1:10	24.32	exit point									1		24.32
157+289	S	30		3360.65		3361				3361						
160+650	B	30		10.40	Open Top				18	10						
160+660	S	30		2689.60		2690				2690						
163+350	B	30		7.00	Open Top				12	7						
163+357	S	30		2296.17		2296				2296						
165+653	B	30		13.65	Open Top				23	14						
165+667	S	30		3.18		3				3						
165+670	W	30	1:10	24.32	Makandi entry point									1		24.32

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.1 B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
165+694	S	30		520.42	Makandi	520				520							
166+215	W	30	1:10	24.32	exit point										1		24.32
166+239	S	30		1110.94		1111				1111							
167+350	B	30		11.35	Open Top				19	11							
167+361	S	30		1458.65		1459				1459							
168+820	B	30		10.40	Open Top				18	10							
168+830	S	30		2839.60		2840				2840							
171+670	B	30		10.40	Open Top				18	10							
171+680	S	30		1359.60		1360				1360							
173+040	B	30		10.40	Open Top				18	10							
173+050	S	30		3549.60		3550				3550							
176+600	B	30		0.00	Open Top												
176+600	S	30		650.00		650				650							
177+250	B	30		0.00	Open Top												
177+250	S	30		441.22		441				441							
177+691	W	30	1:8	18.71	entry point								1				18.71
177+710	S	30		431.36	Nansadi	431				431							
178+141	W	30	1:8	18.71	exit point								1				18.71
178+160	S	30		140.00		140				140							
178+300	B	30		0.00	Open Top												
178+300	S	30		2250.00		2250				2250							
180+550	B	30		1.20	Open Top				2	1							
180+551	S	30		998.80		999				999							
181+550	B	30		2.28	Open Top				4	2							
181+552	S	30		3497.72		3498				3498							
185+050	B	30		3.65	Open Top				6	4							
185+054	S	30		846.35		846				846							
185+900	B	30		5.76	Open Top				10	6							
185+906	S	30		1644.24		1644				1644							
187+550	B	30		2.28	Open Top				4	2							
187+552	S	30		1747.72		1748				1748							
189+300	B	30		5.76	Open Top				10	6							
189+306	S	30		224.24		224				224							
189+530	W	30	1:10	24.32	entry point									1			24.32
189+554	S	30		446.96	Malabvi	447				447							
190+001	W	30	1:10	24.32	exit point									1			24.32
190+026	S	30		724.40		724				724							
190+750	B	30		2.28	Open Top				4	2							
190+752	S	30		547.72		548				548							
191+300	B	30		5.76	Open Top				10	6							
191+306	S	30		1494.24		1494				1494							
192+800	B	30		5.76	Open Top				10	6							
192+806	S	30		2494.24		2494				2494							
195+300	B	30		5.76	Open Top				10	6							
195+306	S	30		644.24		644				644							
195+950	B	30		5.76	Open Top				10	6							
195+956	S	30		344.24		344				344							
196+300	B	30		5.76	Open Top				10	6							
196+306	S	30		1294.24		1294				1294							
197+600	B	30		5.76	Open Top				10	6							
197+606	S	30		1269.24		1269				1269							
198+875	B	30		5.76	Open Top				10	6							
198+881	S	30		19.24		19				19							
198+900	B	30		5.76	Open Top				10	6							
198+906	S	30		1716.90		1717				1717							
200+623	W	30	1:8	18.71	entry point (L21)								1				18.71
200+641	W	30	1:8	18.71	Limbe								1				18.71
200+660	W	30	1:8	18.71	L4								1				18.71
200+679	S	30		459.05		459				459							

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
201+138	W	30	1:8	18.71	Limbe L5									1			18.71
201+157	W	30	1:8	18.71	L3									1			18.71
201+175	S	30		169.91		170				170							
201+345	W	30	1:8	18.71	L16									1			18.71
201+364	S	30		127.41		127				127							
201+491	W	30	1:8	18.71	exit point (L1)									1			18.71
201+510	S	30		1590.00		1590				1590							
203+100	B	30		8.99	Bridge/steel girder				15	9							
203+109	S	30		1441.01		1441				1441							
204+550	B	30		8.99	Bridge/steel girder				15	9							
204+559	S	30		1291.01		1291				1291							
205+850	B	30		8.99	Bridge/steel girder				15	9							
205+859	S	30		241.01		241				241							
206+100	B	30		8.99	Bridge/steel girder				15	9							
206+109	S	30		1171.01		1171				1171							
207+280	W	30	1:10	24.32	entry point										1		24.32
207+304	W	30	1:8	18.71	Mudi									1			18.71
207+323	S	30		426.97		427				427							
207+750	W	30	1:8	18.71										1			18.71
207+769	W	30	1:8	18.71										1			18.71
207+787	W	30	1:10	24.32	exit point										1		24.32
207+812	S	30		1048.26		1048				1048							
208+860	W	30	1:8	18.71	entry point									1			18.71
208+879	W	30	1:10	24.32	Blantyre										1		24.32
208+903	S	30		378.76		379				379							
209+282	W	30	1:10	24.32											1		24.32
209+306	W	30	1:8	18.71	exit point									1			18.71
209+325	S	30		5175.18		5175				5175							
214+500	C	40		100.00				100				100					
214+600	B	40		8.99	Open Top				15			9					
214+609	C	40		391.01				391				391					
215+000	S	30		1400.00		1400				1400							
216+400	B	30		22.56	Bridge/steel girder				38	23							
216+423	S	30		1477.44		1477				1477							
217+900	B	30		12.19	Bridge/steel girder				21	12							
217+912	S	30		887.81		888				888							
218+800	B	30		12.19	Bridge/steel girder				21	12							
218+812	S	30		2587.81		2588				2588							
221+400	B	30		51.82	Bridge/steel girder				87	52							
221+452	S	30		3198.18		3198				3198							
224+650	B	30		33.52	Bridge/steel girder				56	34							
224+684	S	30		3716.48		3716				3716							
228+400	B	30		21.33	Bridge/steel girder				36	21							
228+421	S	30		1278.67		1279				1279							
229+700	C	40		450.00				450				450					
230+150	B	40		3.66	Bridge/steel girder				7			4					
230+154	C	40		115.31				115				115					
230+269	W	30	1:10	24.32	entry point										1		24.32
230+406	C	40		294.18	Maleule			294				294					
230+700	W	30	1:10	24.32	exit point										1		24.32
230+807	S	30		10993.36		10993				10993							
241+800	C	40		400.00				400				400					
242+200	S	30		2100.00		2100				2100							
244+300	B	30		3.66	Bridge/steel girder				7	4							
244+304	S	30		946.34		946				946							
245+250	B	30		3.66	Bridge/steel girder				7	4							
245+254	S	30		546.34		546				546							
245+800	C	40		1400.00				1400				1400					
247+200	S	30		778.67		779				779							

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
247+979	B	30		42.67	Bridge/steel girder				72	43							
248+021	S	30		4.28		4				4							
248+026	W	30	1:8	18.71	entry point								1				18.71
248+044	W	30	1:10	24.32	Lirangwe									1			24.32
248+069	S	30		398.32		398				398							
248+467	W	30	1:8	18.71									1				18.71
248+486	W	30	1:10	24.32	exit point									1			24.32
248+510	S	30		2290.00		2290				2290							
250+800	B	30		3.66	Bridge/steel girder				7	4							
250+804	S	30		896.34		896				896							
251+700	C	30		70.00				70		70							
251+770	S	30		150.00		150				150							
251+920	C	30		480.00				480		480							
252+400	C	40		30.00				30				30					
252+430	S	30		180.00		180				180							
252+610	C	40		90.00				90				90					
252+700	C	30		100.00				100		100							
252+800	S	30		110.00		110				110							
252+910	C	30		110.00				110		110							
253+020	S	30		170.00		170				170							
253+190	C	30		2410.00				2410		2410							
255+600	C	40		270.00				270				270					
255+870	S	30		250.00		250				250							
256+120	C	40		880.00				880				880					
257+000	B	40		27.42	Bridge/steel girder				46			27					
257+027	C	40		1772.58				1773				1773					
258+800	B	40		3.66	Bridge/steel girder				7			4					
258+804	C	40		1396.34				1396				1396					
260+200	B	40		3.66	Bridge/steel girder				7			4					
260+204	C	40		596.34				596				596					
260+800	B	40		3.66	Bridge/steel girder				7			4					
260+804	C	40		296.34				296				296					
261+100	S	30		210.00		210				210							
261+310	W	30	1:10	24.32	entry point									1			24.32
261+334	S	30		535.95	Namatunu	536				536							
261+870	W	30	1:10	24.32	exit point									1			24.32
261+895	S	30		5.41		5				5							
261+900	C	40		1500.00				1500				1500					
263+400	B	40		3.66	Bridge/steel girder				7			4					
263+404	C	40		1396.34				1396				1396					
264+800	B	40		3.35	Bridge/steel girder				6			3					
264+803	C	40		1296.65				1297				1297					
266+100	B	40		3.66	Bridge/steel girder				7			4					
266+104	C	40		1496.34				1496				1496					
267+600	B	40		3.66	Bridge/steel girder				7			4					
267+604	C	40		996.34				996				996					
268+600	B	40		2.44	Bridge/steel girder				4			2					
268+602	C	40		1897.56				1898				1898					
270+500	B	40		12.18	Bridge/steel girder				21			12					
270+512	C	40		687.82				688				688					
271+200	B	40		3.35	Bridge/steel girder				6			3					
271+203	C	40		596.65				597				597					
271+800	B	40		2.44	Bridge/steel girder				4			2					
271+802	C	40		797.56				798				798					
272+600	B	40		8.22	Bridge/steel girder				14			8					
272+608	C	40		391.78				392				392					
273+000	B	40		2.89	Bridge/steel girder				5			3					
273+003	C	40		97.11				97				97					
273+100	B	40		2.44	Bridge/steel girder				4			2					

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.]	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		B	kg/m			[Numbers]			[m]
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
273+102	C	40		597.56				598				598					
273+700	B	40		2.89	Bridge/steel girder				5			3					
273+703	C	40		1608.59				1609				1609					
275+311	B	40		67.04	Bridge/steel girder/truss				112			67					
275+379	W	30	1:10	24.32	entry point									1			24.32
275+403	C	40		433.55	Shire North			434				434					
275+836	W	30	1:10	24.32	exit point									1			24.32
275+861	C	40		3839.29				3839				3839					
279+700	B	40		2.44	Bridge/steel girder				4			2					
279+702	C	40		2297.56				2298				2298					
282+000	B	40		2.44	Bridge/steel girder				4			2					
282+002	C	40		597.56				598				598					
282+600	B	40		2.44	Bridge/steel girder				4			2					
282+602	C	40		1297.56				1298				1298					
283+900	B	40		7.32	Bridge/steel girder				13			7					
283+907	C	40		3792.68				3793				3793					
287+700	B	40		3.66	Bridge/steel girder				7			4					
287+704	C	40		1496.34				1496				1496					
289+200	B	40		3.35	Bridge/steel girder				6			3					
289+203	C	40		496.65				497				497					
289+700	B	40		2.44	Bridge/steel girder				4			2					
289+702	C	40		2397.56				2398				2398					
292+100	B	40		12.50	Bridge/steel girder				21			13					
292+113	C	40		287.50				288				288					
292+400	B	40		3.66	Bridge/steel girder				7			4					
292+404	C	40		396.34				396				396					
292+800	B	40		8.99	Bridge/steel girder				15			9					
292+809	C	40		391.01				391				391					
293+200	B	40		3.35	Bridge/steel girder				6			3					
293+203	C	40		896.65				897				897					
294+100	B	40		8.99	Bridge/steel girder				15			9					
294+109	C	40		1191.01				1191				1191					
295+300	B	40		3.66	Bridge/steel girder				7			4					
295+304	C	40		1356.63				1357				1357					
296+660	W	40	1:12	26.40	entry point (7)										1		26.40
296+687	C	40		10.00	Nkaya			10				10					
296+697	W	40	1:12	26.40											1		26.40
296+723	C	40		830.52				831				831					
297+554	W	40	1:12	26.40	exit point										1		26.40
297+580	C	40		1920.00				1920				1920					
299+500	B	40		3.66	Bridge/steel girder				7			4					
299+504	C	40		4696.34				4696				4696					
304+200	B	40		3.66	Bridge/steel girder				7			4					
304+204	C	40		1896.34				1896				1896					
306+100	C	30		800.00				800		800							
306+900	B	30		3.66	Bridge/steel girder				7	4							
306+904	C	30		2696.34				2696		2696							
309+600	C	40		800.00				800				800					
310+400	S	30		1600.00		1600				1600							
312+000	B	30		3.66	Bridge/steel girder				7	4							
312+004	S	30		296.34		296				296							
312+300	W	30		400.00			400			400							
312+700	S	30		236.79		237				237							
312+937	S	30		18.71	entry point (5)	19				19							
312+956	S	30		9.00	Balaka	9				9							
312+965	W	30	1:8	18.71									1				18.71
312+983	S	30		366.47		366				366							
313+350	W	30	1:8	18.71	(20)								1				18.71
313+368	S	30		18.15		18				18							

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.]	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		B	kg/m			[Numbers]			[m]
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
313+387	W	30	1:8	18.71	Balaka (18)									1			18.71
313+405	S	30		18.15		18				18							
313+423	W	30	1:8	18.71 (14)										1			18.71
313+442	S	30		179.96		180				180							
313+622	W	30	1:8	18.71 (1)										1			18.71
313+641	W	30	1:10	24.32	exit point (13)										1		24.32
313+665	C	30		1034.90				1035		1035							
314+700	B	30		3.66	Bridge/steel girder				7	4							
314+704	C	30		3296.34				3296		3296							
318+000	B	30		8.52	Bridge/steel girder				15	9							
318+009	C	30		741.48				741		741							
318+750	B	30		2.89	Bridge/steel girder				5	3							
318+753	C	30		1147.11				1147		1147							
319+900	B	30		5.78	Bridge/steel girder				10	6							
319+906	C	30		7194.22				7194		7194							
327+100	B	30		6.08	Bridge/steel girder				11	6							
327+106	C	30		3093.92				3094		3094							
330+200	S	30		400.00		400				400							
330+600	C	30		300.00				300		300							
330+900	B	30		19.08	Bridge/steel girder				32	19							
330+919	C	30		1380.92				1381		1381							
332+300	S	30		3000.00		3000				3000							
335+300	B	30		2.40	Bridge/steel girder				4	2							
335+302	S	30		5.00		5				5							
335+307	S	30	1:8	18.71	entry point									1			18.71
335+326	S	30		373.89	Bilila	374				374							
335+700	B	30		2.90	Bridge/steel girder				5	3							
335+703	S	30		121.19		121				121							
335+824	S	30	1:8	18.71	exit point									1			18.71
335+843	S	30		457.20		457				457							
336+300	C	30		1200.00				1200		1200							
337+500	S	30		2000.00		2000				2000							
339+500	B	30		17.00	Bridge/steel girder				29	17							
339+517	S	30		2283.00		2283				2283							
341+800	B	30		28.30	Bridge/steel girder				48	28							
341+828	S	30		2421.70		2422				2422							
344+250	B	30		3.53	Bridge/steel girder				6	4							
344+254	S	30		2646.47		2646				2646							
346+900	B	30		3.22	Bridge/steel girder				6	3							
346+903	S	30		96.78		97				97							
347+000	B	30		3.22	Bridge/steel girder				6	3							
347+003	S	30		1596.78		1597				1597							
348+600	S	40		3000.00		3000						3000					
351+600	B	40		3.20	Bridge/steel girder				6			3					
351+603	S	40		2596.80		2597						2597					
354+200	B	40		2.40	Bridge/steel girder				4			2					
354+202	S	40		997.60		998						998					
355+200	B	40		2.40	Bridge/steel girder				4			2					
355+202	S	40		1947.60		1948						1948					
357+150	B	40		17.00	Bridge/steel girder				29			17					
357+167	S	40		1533.00		1533						1533					
358+700	B	40		4.58	Bridge/steel girder				8			5					
358+705	S	40		1245.42		1245						1245					
359+950	B	40		17.00	Bridge/steel girder				29			17					
359+967	S	40		833.00		833						833					
360+800	B	40		7.05	Bridge/steel girder				12			7					
360+807	S	40		1892.95		1893						1893					
362+700	B	40		3.00	Bridge/steel girder				5			3					
362+703	S	40		1197.00		1197						1197					



## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.]	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		B	kg/m			[Numbers]			[m]
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
363+900	S	30		32.06		32				32							
363+932	S	30	1:8	18.71	entry point									1			18.71
363+951	S	30		511.02	Sharpevale	511				511							
364+462	S	30	1:8	18.71	exit point									1			18.71
364+480	S	30		119.50		120				120							
364+600	S	40		2400.00		2400						2400					
367+000	B	40		2.40	Bridge/steel girder				4			2					
367+002	S	40		247.60		248						248					
367+250	B	40		4.00	Bridge/steel girder				7			4					
367+254	S	40		846.00		846						846					
368+100	B	40		3.90	Bridge/steel girder				7			4					
368+104	S	40		296.10		296						296					
368+400	B	40		2.40	Bridge/steel girder				4			2					
368+402	S	40		597.60		598						598					
369+000	B	40		3.90	Bridge/steel girder				7			4					
369+004	S	40		3196.10		3196						3196					
372+200	B	40		2.42	Bridge/steel girder				4			2					
372+202	S	40		797.58		798						798					
373+000	B	40		2.42	Bridge/steel girder				4			2					
373+002	S	40		997.58		998						998					
374+000	B	40		45.33	Bridge/steel girder				76			45					
374+045	S	40		554.67		555						555					
374+600	B	40		10.27	Bridge/steel girder				18			10					
374+610	S	40		1689.73		1690						1690					
376+300	B	40		15.24	Bridge/steel girder				26			15					
376+315	S	40		1284.76		1285						1285					
377+600	B	40		2.70	Bridge/steel girder				5			3					
377+603	S	40		897.30		897						897					
378+500	B	40		2.50	Bridge/steel girder				5			3					
378+503	S	40		197.50		198						198					
378+700	S	37		1400.00		1400					1400						
380+100	B	37		3.60	Bridge/steel girder				6			4					
380+104	S	37		1796.40		1796						1796					
381+900	B	37		2.45	Bridge/steel girder				4			2					
381+902	S	37		597.55		598						598					
382+500	B	37		2.45	Bridge/steel girder				4			2					
382+502	S	37		1597.55		1598						1598					
384+100	B	37		11.10	Bridge/steel girder				19			11					
384+111	S	37		1988.90		1989						1989					
386+100	B	37		2.60	Bridge/steel girder				5			3					
386+103	S	37		397.40		397						397					
386+500	B	37		2.80	Bridge/steel girder				5			3					
386+503	S	37		497.20		497						497					
387+000	B	37		3.25	Bridge/steel girder				6			3					
387+003	S	37		3112.65		3113						3113					
390+116	S	30	1:8	18.71	entry point									1			18.71
390+135	S	37		440.20	Golomoti	440						440					
390+575	S	30	1:8	18.71	exit point									1			18.71
390+594	S	37		1406.48		1406						1406					
392+000	B	37		50.75	Bridge/steel girder				85			51					
392+051	S	37		749.25		749						749					
392+800	B	37		49.60	Bridge/steel girder				83			50					
392+850	S	37		250.40		250						250					
393+100	B	37		4.58	Bridge/steel girder				8			5					
393+105	S	37		145.42		145						145					
393+250	B	37		7.00	Bridge/steel girder				12			7					
393+257	S	37		6543.00		6543						6543					
395+400	B	37		2.45	Bridge/steel girder				4			2					
395+402	S	37		4397.55		4398						4398					

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
396+400	B	37		2.45	Bridge/steel girder				4		2						
396+402	S	37		3397.55		3398					3398						
396+800	B	37		2.45	Bridge/steel girder				4		2						
396+802	S	37		197.55		198					198						
397+000	B	37		2.45	Bridge/steel girder				4		2						
397+002	S	37		1997.55		1998					1998						
399+000	B	37		2.50	Bridge/steel girder				5		3						
399+003	S	37		797.50		798					798						
399+800	C	37		1750.00				1750			1750						
401+550	B	37		2.40	Bridge/steel girder				4		2						
401+552	C	37		5197.60				5198			5198						
406+750	B	37		51.00	Bridge/steel girder				85		51						
406+801	C	37		999.00				999			999						
407+800	B	37		34.00	Bridge/steel girder				57		34						
407+834	C	37		866.00				866			866						
408+700	S	37		1750.00		1750					1750						
410+450	B	37		2.50	Bridge/steel girder				5		3						
410+453	S	37		747.50		748					748						
411+200	B	37		3.60	Bridge/steel girder				6		4						
411+204	S	37		596.40		596					596						
411+800	B	37		6.90	Bridge/steel girder				12		7						
411+807	S	37		677.61		678					678						
412+485	S	30	1:8	18.71	entry point (2)								1			18.71	
412+503	S	30		15.29	Mtakataka	15				15							
412+519	S	30	1:8	18.71	(4)								1			18.71	
412+537	S	37		62.78		63					63						
412+600	B	37		2.00	Bridge/steel girder				4		2						
412+602	S	37		284.91		285					285						
412+887	W	30	1:8	18.71	(1)								1			18.71	
412+906	S	30		6.10		6				6							
412+912	S	30	1:8	18.71	exit point (3)								1			18.71	
412+930	C	37		1219.57				1220			1220						
414+150	B	37		3.65	Bridge/steel girder				6		4						
414+154	C	37		846.35				846			846						
415+000	B	37		8.52	Bridge/steel girder				15		9						
415+009	C	37		541.48				541			541						
415+550	B	37		47.25	Bridge/steel girder				79		47						
415+597	C	37		552.75				553			553						
416+150	B	37		3.25	Bridge/steel girder				6		3						
416+153	C	37		1176.75				1177			1177						
417+330	B	37		2.73	Bridge/steel girder				5		3						
417+333	C	37		117.27				117			117						
417+450	B	37		2.45	Bridge/steel girder				4		2						
417+452	C	37		1447.55				1448			1448						
418+900	B	37		2.45	Bridge/steel girder				4		2						
418+902	C	37		427.55				428			428						
419+330	B	37		4.00	Bridge/steel girder				7		4						
419+334	C	37		616.00				616			616						
419+950	B	37		4.00	Bridge/steel girder				7		4						
419+954	C	37		596.00				596			596						
420+550	B	37		4.00	Bridge/steel girder				7		4						
420+554	C	37		796.00				796			796						
421+350	B	37		2.46	Bridge/steel girder				5		2						
421+352	C	37		1877.54				1878			1878						
423+230	B	37		14.00	Bridge/steel girder				24		14						
423+244	C	37		156.00				156			156						
423+400	B	37		3.66	Bridge/steel girder				7		4						
423+404	C	37		2346.34				2346			2346						
425+750	B	37		2.43	Bridge/steel girder				4		2						

# Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.]	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		B	kg/m			[Numbers]			[m]
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
425+752	C	37		197.57				198			198						
425+950	B	37		1.37	Bridge/steel girder				3		1						
425+951	C	37		848.63				849			849						
426+800	B	37		3.53	Bridge/steel girder				6		4						
426+804	C	37		196.47				196			196						
427+000	B	37		2.56	Bridge/steel girder				5		3						
427+003	C	37		827.44				827			827						
427+830	B	37		3.72	Bridge/steel girder				7		4						
427+834	C	37		966.28				966			966						
428+800	B	37		34.00	Bridge/steel girder				57		34						
428+834	C	37		1716.00				1716			1716						
430+550	B	37		2.67	Bridge/steel girder				5		3						
430+553	C	37		2147.33				2147			2147						
432+700	S	37		700.00		700					700						
433+400	S	40		250.00		250						250					
433+650	B	40		3.25	Bridge/steel girder				6			3					
433+653	S	40		46.75		47						47					
433+700	B	40		3.66	Bridge/steel girder				7			4					
433+704	S	40		1696.34		1696						1696					
435+400	B	40		2.46	Bridge/steel girder				5			2					
435+402	S	40		397.54		398						398					
435+800	B	40		3.62	Bridge/steel girder				6			4					
435+804	S	40		96.38		96						96					
435+900	B	40		3.62	Bridge/steel girder				6			4					
435+904	S	40		596.38		596						596					
436+500	B	40		14.00	Bridge/steel girder				24			14					
436+514	S	40		986.00		986						986					
437+500	B	40		3.58	Bridge/steel girder				6			4					
437+504	S	40		1196.42		1196						1196					
438+700	B	40		3.25	Bridge/steel girder				6			3					
438+703	S	40		426.75		427						427					
439+130	B	40		7.00	Bridge/steel girder				12			7					
439+137	S	40		163.00		163						163					
439+300	B	40		3.25	Bridge/steel girder				6			3					
439+303	S	40		2046.75		2047						2047					
441+350	W	30	1:8	18.71	entry point								1				18.71
441+369	S	40		362.58	Chipoka	363						363					
441+731	W	30	1:8	18.71	exit point								1				18.71
441+750	S	40		180.00		180						180					
441+930	B	40		19.80	Bridge/steel girder				33			20					
441+950	S	40		380.20		380						380					
442+330	B	40		7.00	Bridge/steel girder				12			7					
442+337	S	40		1463.00		1463						1463					
443+800	B	40		14.00	Bridge/steel girder				24			14					
443+814	S	40		2436.00		2436						2436					
446+250	B	40		17.00	Bridge/steel girder				29			17					
446+267	S	40		1833.00		1833						1833					
448+100	B	40		3.66	Bridge/steel girder				7			4					
448+104	S	40		1696.34		1696						1696					
449+800	B	40		3.59	Bridge/steel girder				6			4					
449+804	S	40		1296.41		1296						1296					
451+100	B	40		4.67	Bridge/steel girder				8			5					
451+105	S	40		545.33		545						545					
451+650	B	40		51.00	Bridge/steel girder				85			51					
451+701	S	40		1149.00		1149						1149					
452+850	B	40		2.43	Bridge/steel girder				4			2					
452+852	S	40		1297.57		1298						1298					
454+150	B	40		3.52	Bridge/steel girder				6			4					
454+154	S	40		2246.48		2246						2246					

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
456+400	B	40		2.44	Bridge/steel girder				4			2					
456+402	S	40		497.56		498						498					
456+900	B	40		7.00	Bridge/steel girder				12			7					
456+907	S	40		5693.00		5693						5693					
462+600	B	40		3.25	Bridge/steel girder				6			3					
462+603	S	40		696.75		697						697					
463+300	C	40		3800.00				3800				3800					
467+100	B	40		60.96	Bridge/Truss spans				102			61					
467+161	C	40		785.98				786				786					
467+947	W	30	1:8	18.71	entry point (5)								1			18.71	
467+966	W	30	1:8	18.71	Salima								1			18.71	
467+984	C	30		18.15				18		18							
468+003	W	30	1:8	18.71 (24)									1			18.71	
468+021	C	30		524.94				525		525							
468+546	W	30	1:8	18.71 (3)									1			18.71	
468+565	S	30		15.29		15				15							
468+580	W	30	1:8	18.71 (4)									1			18.71	
468+599	S	30		18.15		18				18							
468+617	S	30	1:8	18.71 (2)									1			18.71	
468+636	C	30		62.79				63		63							
468+699	W	30	1:8	18.71 (1)									1			18.71	
468+717	C	30		96.32				96		96							
468+814	W	30	1:8	18.71 (25)									1			18.71	
468+832	C	40		156.06				156				156					
468+988	W	30	1:8	18.71 exit point (27)									1			18.71	
469+007	C	40		16244.56				16245				16245					
485+252	W	40	1:12	26.40	entry point										1	26.40	
485+278	C	40		595.61	Nanjoka			596				596					
485+874	W	40	1:12	26.40	exit point										1	26.40	
485+900	C	40		20880.52				20881				20881					
506+781	W	40	1:12	26.40	entry point										1	26.40	
506+807	C	40		505.67	Chipala			506				506					
507+313	W	40	1:8	18.71									1			18.71	
507+331	C	40		77.23				77				77					
507+409	W	40	1:12	26.40	exit point										1	26.40	
507+435	C	40		1841.83				1842				1842					
509+277	S	40		46.50	Bridge/concrete deck	47						47					
509+323	C	40		3138.00				3138				3138					
512+461	S	40		77.50	Bridge/concrete deck	78						78					
512+539	C	40		7418.75				7419				7419					
519+958	S	40		85.00	Bridge/concrete deck	85						85					
520+043	C	40		20418.50				20419				20419					
540+461	S	40		78.00	Bridge/concrete deck	78						78					
540+539	C	40		6440.38				6440				6440					
546+979	W	40	1:12	26.40	entry point										1	26.40	
547+006	C	40		487.07	Nankhanga			487				487					
547+493	W	40	1:8	18.71									1			18.71	
547+512	C	40		77.23				77				77					
547+589	W	40	1:12	26.40	exit point										1	26.40	
547+615	C	40		5816.30				5816				5816					
553+431	W	40	1:12	26.40	entry point										1	26.40	
553+458	C	40		505.06	Balang'ombe			505				505					
553+963	W	40	1:8	18.71									1			18.71	
553+982	C	40		77.23				77				77					
554+059	W	40	1:12	26.40	exit point										1	26.40	
554+085	C	40		15391.26				15391				15391					
569+477	S	40		46.92	Bridge/concrete deck	47						47					
569+523	C	40		4326.54				4327				4327					
573+850	S	40	1:8	18.71	Kanengo entry point								1			18.71	

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																	
573+869	C	40		946.07	Kanengo			946				946					
574+815	S	40	1:8	18.71	exit point								1				18.71
574+833	C	40		4816.51				4817				4817					
579+650	S	40	1:8	18.71	entry point								1				18.71
					Lilongwe Passenger Station												
579+669	S	40	1:8	18.71									1				18.71
579+687	C	40		456.44				456				456					
580+144	S	40	1:8	18.71									1				18.71
580+163	C	40		100.00				100				100					
580+263	S	40	1:8	18.71									1				18.71
580+281	S	40	1:8	18.71	exit point								1				18.71
580+300	C	40		12006.84				12007				12007					
592+307	W	40	1:12	26.40	entry point											1	26.40
592+333	C	40		125.79	Mweziwawala			126				126					
592+459	W	40	1:8	18.71									1				18.71
592+478	C	40		481.19				481				481					
592+959	W	40	1:12	26.40	exit point											1	26.40
592+985	C	40		1990.90				1991				1991					
594+976	W	40		47.55	Bridge/concrete deck		48					48					
595+024	C	40		13196.23				13196				13196					
608+220	W	40	1:12	26.40	entry point											1	26.40
608+246	C	40		442.15	Vubwe			442				442					
608+689	W	40	1:8	18.71									1				18.71
608+707	C	40		118.35				118				118					
608+826	W	40	1:12	26.40	exit point											1	26.40
608+852	C	40		19996.00				19996				19996					
628+848	W	40	1:12	26.40	entry point											1	26.40
628+874	C	40		146.60	Nyanja			147				147					
629+021	W	40	1:8	18.71									1				18.71
629+040	C	40		413.89				414				414					
629+454	W	40	1:12	26.40	exit point											1	26.40
629+480	C	40		3696.22				3696				3696					
633+176	W	40		47.55	Bridge/concrete deck		48					48					
633+224	C	40		11226.23				11226				11226					
644+450	W	40	1:12	26.40	entry point											1	26.40
644+476	C	40		401.78	Nathyola			402				402					
644+878	W	40	1:8	18.71									1				18.71
644+897	C	40		160.71				161				161					
645+058	W	40	1:12	26.40	exit point											1	26.40
645+084	C	40		6552.60				6553				6553					
651+637	W	40		126.80	Bridge/concrete deck		127					127					
651+763	C	40		13488.60				13489				13489					
665+252	W	40	1:12	26.40	entry point											1	26.40
665+278	C	40		160.57	Kamwendo			161				161					
665+439	W	40	1:8	18.71									1				18.71
665+458	C	40		400.93				401				401					
665+859	W	40	1:12	26.40	exit point											1	26.40
665+885	C	40		16871.00				16871				16871					
682+756	W	40	1:12	25.23	entry point											1	25.23
682+781	W	40	1:12	25.23	Mchinji											1	25.23
682+806	W	40	1:12	26.40												1	26.40
682+833	C	40		488.43				488				488					
683+321	W	40	1:12	26.40												1	26.40
683+348	S	40		13.92		14						14					
683+362	W	40	1:12	26.40	exit point											1	26.40
683+388	C	40		13072.00				13072				13072					
696+460					Border												

## Detailed Through Track Inventory

## Annex 2.2.5.2.2

from km	Sleepers	Rails	Turnouts	Length [m]	Location	Existing											
						Sleepers [metres]			Bridge beams [Nos.] B	Rails [metres]			Turnouts in through line				
						Steel	Wood	Concr.		30	37	40	1:8	1:10	1:12	Length	
						S	W	C		kg/m			[Numbers]			[m]	
Border - Nayuchi - Nkaya																	
0+000	C	40		1320.00	Border			1320			1320						
1+320	W	40	1:12	26.40	entry point										1	26.40	
1+346	W	40	1:8	18.71	Nayuchi							1				18.71	
1+365	C	40		719.03				719			719						
2+084	W	40	1:12	26.40											1	26.40	
2+111	W	40	1:8	18.71	exit point							1				18.71	
2+129	C	40		27832.59				27833			27833						
29+962	S	40		36.58	Bridge/concrete deck	37					37						
29+998	C	40		2962.65				2963			2963						
32+961	S	40		36.58	Bridge/concrete deck	37					37						
32+998	C	40		6559.29				6559			6559						
39+557	S	40		36.58	Bridge/concrete deck	37					37						
39+594	C	40		1453.89				1454			1454						
41+047	W	40	1:12	26.40	entry point										1	26.40	
41+074	C	40		761.02	Lambulila			761			761						
41+835	W	40	1:12	26.40	exit point										1	26.40	
41+861	C	40		1133.43				1133			1133						
42+995	S	40		10.67	Bridge/concrete deck	11					11						
43+005	C	40		2224.09				2224			2224						
45+229	S	40		10.67	Bridge/concrete deck	11					11						
45+240	C	40		26105.20				26105			26105						
71+345	S	40		47.25	Bridge/concrete deck	47					47						
71+393	C	40		1720.59				1721			1721						
73+113	S	40		10.67	Bridge/concrete deck	11					11						
73+124	C	40		1155.19				1155			1155						
74+279	S	40		25.91	Bridge/concrete deck	26					26						
74+305	C	40		292.80				293			293						
74+598	W	40	1:12	26.40	entry point										1	26.40	
74+624	W	40	1:8	18.71	Liwonde							1				18.71	
74+643	C	40		722.08				722			722						
75+365	W	40	1:8	18.71								1				18.71	
75+384	W	40	1:12	26.40	exit point										1	26.40	
75+410	C	40		1055.94				1056			1056						
76+466	S	40		41.15	Bridge/concrete deck	41					41						
76+507	C	40		1046.22				1046			1046						
77+553	-	40		110.66	Bridge/steel girder						111						
77+664	C	40		2706.46				2706			2706						
80+370	S	40		10.67	Bridge/concrete deck	11					11						
80+381	C	40		3409.19				3409			3409						
83+790	S	40		10.67	Bridge/concrete deck	11					11						
83+801	C	40		2685.29				2685			2685						
86+486	S	40		10.67	Bridge/concrete deck	11					11						
86+497	C	40		1801.98				1802			1802						
88+299	S	40		7.62	Bridge/concrete deck	8					8						
88+307	C	40		842.16				842			842						
89+149	S	40		10.67	Bridge/concrete deck	11					11						
89+159	C	40		498.35				498			498						
89+658	S	40		10.67	Bridge/concrete deck	11					11						
89+668	C	40		2734.06				2734			2734						
92+402	S	40		7.62	Bridge/concrete deck	8					8						
92+410	C	40		1887.69				1888			1888						
94+298	S	40		4.57	Bridge/concrete deck	5					5						
94+302	C	40		286.45				286			286						
94+589	S	40		7.62	Bridge/concrete deck	8					8						
94+596	C	40		3556.85				3557			3557						
98+153	-	40		190.23	Bridge/steel girder						190						
98+343	C	40		1386.57				1387			1387						
99+730					Nkaya entry point (7)												

**Rolling Stock: Technical data**

## Main Line Locomotives: Technical Data

		Malawi (CEAR)		Mozambique (CDN)	
Type		Bombardier MX615		GE U20C	
Adhesive Mass		90 t		87.5 t	
Rated Output		1,500 HP		2,000 HP	
Bogie Wheelbase		3,404 mm		3,442 mm	
Speed	max.	72 km/h		103 km/h	
	min.	15.3 km/h		no data	
Starting Load and Speed at a Line Resistance of [N/kN]	2	2,609 t	37.5 km/h	2,551 t	47.9 km/h
	11	1,381 t	21.4 km/h	1,343 t	29.0 km/h
	18	996 t	18.7 km/h	969 t	25.4 km/h
	20	921 t	18.2 km/h	895 t	24.8 km/h
	23	825 t	17.7 km/h	803 t	24.1 km/h
	27	723 t	17.1 km/h	703 t	23.3 km/h

## Wagons and Coaches: Technical Data

Type	Tare [kg]	Max. Load [kg]	Resulting max. axle load [t]	Overall Length [mm]	Wheelbase [mm]	Average age [years]
Covered	22,724	36,314	14.8	13,614	1,676	40
Low sided	19,091	38,100	14.3	14,531	1,753	40
High sided	20,410	39,545	15.0	13,614	1,753	35
Tank	20,094	40,298	15.1	13,767	1,753	40
Flat	13,490	40,000	13.4	13,155	1,753	30
Ballast hoppers	27,500	40,500	17.0	12,967	1,676	30
Goods vans	20,412	7,257	6.9	11,633	1,676	63
Coaches <sup>1)</sup>	34,500	8,320	10.7	20,917	2,058	33
Passenger vans	30,640	15,270	11.5	15,824	1,854	57



## **Voice Communicated Train Proceeding Authority**

**THE CENTRAL EAST AFRICAN RAILWAYS COMPANY LIMITED****VOICE COMMUNICATED TRAIN PROCEEDING AUTHORITY****(A) IDENTIFICATION**

1. ORDER NUMBER .....
2. DATE .....
3. TIME .....
4. TRAIN CONTROL OFFICER .....
5. IDENTIFICATION .....
6. DRIVER .....
7. IDENTIFICATION .....
8. TRAIN ASSISTANT/COMPETENT EMPLOYEE .....
9. IDENTIFICATION .....
10. TRAIN NUMBER .....
11. LOCOMOTIVE/TROLLEY NUMBER .....

**(B) AUTHORITY**

1. From Kilometer .....
2. To Kilometer .....
3. Reporting Train Position. ....
4. Crossing / Passing at Kilometer ..... Yes/No .....
5. Crossing / Passing Train..... Axleage .....  
Number of last vehicle. ....

**(C) TRAIN CONTROL OFFICER'S INSTRUCTIONS**

.....

.....

.....

.....

**(D) SIGNATURES**

- i. Train Control Officer .....
- ii. Driver .....
- iii. Train Assistant/Competent Employee.....

**Section speed and speed restrictions**

# Section Speed and Speed Restrictions

# Annex 3.3.1.1.1

from km	Permissible Speed [km/h]		reduced due to									from km	Permissible Speed [km/h]		reduced due to							
			Turnouts	Curvature	Condition of										Turnouts	Curvature	Condition of					
	Section	reduced			Bridges	Culverts	Track	Ballast	Sleepers	Wingwalls			Section	reduced			Bridges	Culverts	Track	Ballast	Sleepers	Wingwalls
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata)																						
80.400	25	15	x								213.000	40	25					x				
80.673	25										230.269	40	15	x								
93.510	25	15	x								230.807	40	25					x				
94.146	25										248.026	40	15	x								
111.300	25	15				x					248.510	40	25					x				
111.900	25										261.310	40	15	x								
112.796	25	15	x								261.895	50	30					x				
113.200	25	15					x				268.800	50	15				x	x				
113.800	25										271.100	50	30					x				
114.600	25	15				x					273.800	50	10			x		x				
115.200	25										275.379	50	15	x								
120.767	25	15	x								275.861	50	30					x				
121.600	25	15				x					291.700	50	10			x						
122.200	25										292.400	50	30					x				
124.700	25	15				x					293.000	50	15				x					
125.300	25										293.800	50	30					x				
128.448	25	15	x								296.660	50	15	x								
128.883	25										297.580	50										
132.000	25	10				x					312.937	50	15	x								
132.600	25										313.665	50	25					x	x	x		
138.200	25	15				x					315.000	50	10			x						
138.900	25										316.000	50	25					x	x	x		
139.400	25	15				x					318.000	50	15				x				x	
140.400	25										321.000	50	25					x	x	x		
144.100	25	15				x					328.000	50	15				x				x	
145.000	25										329.000	50	25					x	x	x		
146.850	25	15	x								330.000	50	15			x					x	
147.304	25										331.000	50	25					x	x	x		
149.600	25	15				x					335.307	50	15	x		x					x	
150.200	25										335.900	50	25					x	x	x		
156.641	25	15	x								336.800	50	15				x					
157.289	25										337.200	50	25					x	x	x		
162.400	25	15				x					339.000	50	15			x						
163.000	25										340.000	50	25					x	x	x		
163.100	25	10			x						340.500	50	15			x						
163.700	25										341.500	50	25					x	x	x		
165.670	25	15	x								343.000	50	15				x	x				
166.239	25										345.000	50	25					x	x	x		
166.700	25	10					x				350.500	50	15				x					
167.300	25										351.500	50	25					x	x	x		
177.691	25	15	x								359.000	50	15				x					
178.160	25										361.000	50	25					x	x	x		
187.800	25	15				x					361.500	50	10			x						
189.000	25										362.500	50	25					x	x	x		
189.530	25	15	x								363.932	50	15	x								
190.026	25										364.480	50	25					x	x	x		
195.600	25	10			x						368.000	50	15				x					
196.200	25										369.000	50	25					x	x	x		
200.623	25	15	x								374.000	50	15			x						
201.510	25										376.500	50	25					x	x	x		
205.600	25	10			x						384.000	50	15					x				
206.200	25										387.000	50	25					x	x	x		
207.280	25	15	x								390.116	50	15	x								
207.812	25										391.000	50	15			x						
208.860	25	15	x								392.000	50	25					x	x	x		
209.325	40	25					x				397.000	50	15					x				
211.400	40	10					x				399.000	50	25					x	x			

# Section Speed and Speed Restrictions

## Annex 3.3.1.1.1

from km	Permissible Speed [km/h]		reduced due to									from km	Permissible Speed [km/h]		reduced due to							
	Section	reduced	Turnouts	Curvature	Condition of								Section	reduced	Turnouts	Curvature	Condition of					
					Bridges	Culverts	Track	Ballast	Sleepers	Wingwalls							Bridges	Culverts	Track	Ballast	Sleepers	Wingwalls
Southern Border - Limbe - Nkaya - Kanengo - Mchinji (- Chipata) (contd.)																						
406.000	50	10			x							541.000	50	35		x						
407.500	50	25							x	x	x	546.979	50	15	x							
410.000	50	10				x						547.615	50	35		x						
411.500	50	25								x	x	x	553.431	50	15	x						
412.485	50	15	x									554.200	50	10				x				
412.930	50	25								x	x	x	555.000	50	35		x					
414.000	50	10			x							565.500	50	10				x				
420.000	50	25								x	x	x	567.000	50	35		x					
423.000	50	15			x							568.400	50	10				x				
423.500	50	25								x	x	x	569.200	50	35		x					
428.000	50	10				x						573.850	50	15	x							
429.500	50	25								x	x	x	574.833	50								
435.500	50	15			x							579.650	50	15	x							
436.500	50	25								x	x	x	580.300	50								
439.000	50	15							x			587.700	50	15				x				
441.000	50	25								x	x	x	588.500	50								
441.350	50	15	x									592.307	50	15	x							
441.750	50	15						x				592.985	50									
443.850	50	25							x	x	x	595.400	50	15			x					
446.100	50	15			x							595.500	50									
446.300	50	25								x	x	x	608.220	50	15	x						
449.500	50	15							x			608.852	50									
449.900	50	25								x	x	x	628.848	50	15	x						
450.800	50	15			x			x				629.480	50									
451.800	50	25							x	x	x	631.600	50	15				x				
456.000	50	15							x			632.200	50									
461.000	50	25								x	x	x	633.700	50	15				x			
467.947	50	15	x									634.100	50									
469.007	50											634.500	50	15				x				
485.252	50	15	x									635.300	50									
485.900	50											644.450	50	15	x							
486.400	50	10				x						645.084	50									
486.500	50											665.252	50	15	x							
487.600	50	10					x					665.885	50									
487.800	50											682.756	50	15	x							
489.000	50	15				x						683.388										
490.000	50	35		x								Border - Nayuchi - Nkaya										
492.000	50	35		x								0.000	50									
497.300	50	10				x						1.320	50	15	x							
497.700	50	35		x								2.000	50	15					x			
502.000	50	20				x						4.300	50	10					x			
503.000	50	35		x								5.100	50	15					x			
506.781	50	15	x									25.400	50									
507.435	50	35		x								41.047	50	15	x							
507.900	50	10					x					41.861	50									
508.700	50	35		x								74.598	50	15	x							
509.400	50	10					x					75.410	50									
510.600	50	35		x								76.900	50	25				x				
519.000	50	10							x			77.900	50									
519.800	50	35		x								83.300	50	10					x			
520.400	50	10					x					85.000	50									
521.200	50	35		x								97.500	50	15				x				
522.000	50	10							x			98.500	50									
522.900	50	35		x								99.730	50	15	x							
537.500	50	20					x	x				100.218										
538.000	50	10								x												
538.200	50	20					x	x														

Annex 3.3.1.1.2

**Speed summary**

## Speed Summary

## Annex 3.3.1.1.2

Section	Total Length [km]	Section Speed [km/h]	Sections with restricted speed [km, %, No. of sections]										
			Total	due to				Speed restricted to					
				Turnouts	Curvature	Condition of		10 km/h	15 km/h	20 km/h	25 km/h	30 km/h	35 km/h
						Bridges and Culverts	Track and Substructure						
Makhanga - Limbe - Blantyre	128.9	25	18.1	7.1		9.8	1.2	3.0	15.1				
			14%	5.5%		7.6%	0.9%	2.3%	11.7%				
			29	13		14	2	5	24				
Blantyre - Namatunu	52.6	40	52.6	1.6			51.0	1.6	1.6		49.4		
			100%	3.1%			96.9%	3.0%	3.1%		93.9%		
			8	3			5	1	3		4		
Namatunu - Nkaya	35.7	50	35.7	1.4		5.4	28.9	2.3	4.5			28.9	
			100%	3.9%		15.1%	81.0%	6.4%	12.6%			81.0%	
			11	2		4	5	2	4			5	
Nkaya - Salima	171.4	50	156.1	4.1		32.7	119.3	12.5	38.8		104.8		
			91%	2.4%		19.1%	69.6%	7.3%	22.6%		61.1%		
			67	6		23	38	6	29		32		
Salima - Kanengo	105.8	50	86.8	3.7	69.3	11.9	1.9	8.5	4.7	4.3			69.3
			82%	3.5%	65.5%	11.2%	1.8%	8.0%	4.4%	4.1%			65.5%
			36	5	15	13	3	12	6	3			15
Kanengo - Mchinji	108.6	50	7.2	4.5		2.7			7.2				
			7%	4.1%		2.5%			6.6%				
			12	7		5			12				
Chipata - Nkaya	100.2	50	29.9	2.8		2.0	25.1	2.5	26.4		1.0		
			30%	2.8%		2.0%	25.0%	2.5%	26.3%		1.0%		
			10	4		2	4	2	7		1		
TOTAL	703.2		386.3	25.2	69.3	64.5	227.4	30.4	98.2	4.3	155.2	28.9	69.3
			55%	3.6%	9.9%	9.2%	32.3%	4.3%	14.0%	0.6%	22.1%	4.1%	9.9%
			173	40	15	61	57	28	85	3	37	5	15

## **Travelling time and travelling speed**



## Freight Trains 2008

Relation	Limbe- Luchenza	Luchenza- Limbe	Blantyre- Liwonde	Liwonde- Blantyre	Liwonde- Cuamba	Cuamba- Liwonde	Liwonde- Kanengo	Kanengo- Liwonde
<i>Distance [km]</i>	44,0		121,6		120,1		310,7	
Januar	3:03	3:25	6:00	6:30	10:20	10:32	no service	
	14.4 km/h	12.9 km/h	20.3 km/h	18.7 km/h	11.6 km/h	11.4 km/h		
Februar	2:04	3:20	7:15	9:21	11:21	12:30		
	21.3 km/h	13.2 km/h	16.8 km/h	13.0 km/h	10.6 km/h	9.6 km/h		
März	2:47	3:26	6:40	7:17	10:40	10:02	18:27	13:18
	15.8 km/h	12.8 km/h	18.3 km/h	16.7 km/h	11.3 km/h	12.0 km/h	16.8 km/h	23.4 km/h
April	2:09	2:34	6:15	7:07	9:20	10:01	16:16	14:18
	20.4 km/h	17.1 km/h	19.5 km/h	17.1 km/h	12.9 km/h	12.0 km/h	19.1 km/h	21.7 km/h
Mai	2:42	3:00	6:30	7:12	10:18	10:36	18:34	14:29
	16.3 km/h	14.7 km/h	18.7 km/h	16.9 km/h	11.7 km/h	11.3 km/h	16.7 km/h	21.5 km/h
Juni	2:00	2:42	5:30	6:02	9:15	9:10	14:27	15:19
	22.0 km/h	16.3 km/h	22.1 km/h	20.2 km/h	13.0 km/h	13.1 km/h	21.5 km/h	20.3 km/h
Juli	2:01	2:30	7:31	5:49	10:35	10:21	20:02	29:06
	21.9 km/h	17.6 km/h	16.2 km/h	20.9 km/h	11.3 km/h	11.6 km/h	15.5 km/h	10.7 km/h
August	1:32	2:25	6:09	9:14	11:04	11:07	13:13	17:18
	28.7 km/h	18.2 km/h	19.8 km/h	13.2 km/h	10.8 km/h	10.8 km/h	23.5 km/h	18.0 km/h
September	1:48	2:02	6:06	8:14	10:01	11:30	16:13	16:24
	24.4 km/h	21.7 km/h	19.9 km/h	14.8 km/h	12.0 km/h	10.4 km/h	19.2 km/h	18.9 km/h
Oktober	2:44	2:16	6:39	7:20	9:34	10:12	24:50	24:39
	16.0 km/h	19.4 km/h	18.3 km/h	16.6 km/h	12.6 km/h	11.8 km/h	12.5 km/h	12.6 km/h
November	3:28	2:56	7:29	8:09	11:30	12:17	25:39	26:37
	12.7 km/h	15.0 km/h	16.3 km/h	14.9 km/h	10.4 km/h	9.8 km/h	12.1 km/h	11.7 km/h
Dezember	3:42	3:00	7:36	8:00	12:06	11:54	26:06	27:06
	11.9 km/h	14.7 km/h	16.0 km/h	15.2 km/h	9.9 km/h	10.1 km/h	11.9 km/h	11.5 km/h
<i>Maximum</i>	<i>28.7 km/h</i>	<i>21.7 km/h</i>	<i>22.1 km/h</i>	<i>20.9 km/h</i>	<i>13.0 km/h</i>	<i>13.1 km/h</i>	<i>23.5 km/h</i>	<i>23.4 km/h</i>
<i>Minimum</i>	<i>11.9 km/h</i>	<i>12.8 km/h</i>	<i>16.0 km/h</i>	<i>13.0 km/h</i>	<i>9.9 km/h</i>	<i>9.6 km/h</i>	<i>11.9 km/h</i>	<i>10.7 km/h</i>
<i>Average</i>	<i>18.8 km/h</i>	<i>16.1 km/h</i>	<i>18.5 km/h</i>	<i>16.5 km/h</i>	<i>11.5 km/h</i>	<i>11.2 km/h</i>	<i>16.9 km/h</i>	<i>17.0 km/h</i>

## Passenger Trains 2008

Relation	Limbe- Makhanga	Makhanga- Limbe	Balaka- Limbe	Limbe- Balaka	Balaka- Nayuchi	Nayuchi- Balaka
<i>Distance [km]</i>	120,6		112,2		114,5	
Januar	no service		9:22	7:25	5:03	5:18
			12.0 km/h	15.1 km/h	22.7 km/h	21.6 km/h
Februar	6:18	10:09	10:08	8:18	5:28	6:00
	19.1 km/h	11.9 km/h	11.1 km/h	13.5 km/h	21.0 km/h	19.1 km/h
März	7:53	12:21	9:23	6:42	5:55	5:54
	15.3 km/h	9.8 km/h	12.0 km/h	16.7 km/h	19.4 km/h	19.4 km/h
April	6:32	11:25	10:27	9:08	5:19	5:30
	18.5 km/h	10.6 km/h	10.7 km/h	12.3 km/h	21.5 km/h	20.8 km/h
Mai	7:18	12:00	10:51	8:33	5:18	5:48
	16.5 km/h	10.1 km/h	10.3 km/h	13.1 km/h	21.6 km/h	19.7 km/h
Juni	8:12	12:33	12:14	9:25	6:07	6:12
	14.7 km/h	9.6 km/h	9.2 km/h	11.9 km/h	18.7 km/h	18.5 km/h
Juli	6:32	9:32	14:13	10:12	5:33	6:22
	18.4 km/h	12.7 km/h	7.9 km/h	11.0 km/h	20.6 km/h	18.0 km/h
August	6:23	13:15	13:15	10:33	6:12	7:27
	18.9 km/h	9.1 km/h	8.5 km/h	10.6 km/h	18.5 km/h	15.4 km/h
September	6:16	8:31	13:03	9:05	6:13	6:26
	19.2 km/h	14.2 km/h	8.6 km/h	12.4 km/h	18.4 km/h	17.8 km/h
Oktober	7:38	10:08	10:43	5:00	6:02	5:47
	15.8 km/h	11.9 km/h	10.5 km/h	22.4 km/h	19.0 km/h	19.8 km/h
November	7:16	8:54	10:04	6:20	5:19	7:08
	16.6 km/h	13.6 km/h	11.1 km/h	17.7 km/h	21.6 km/h	16.1 km/h
Dezember	7:36	9:30	10:18	7:00	6:06	7:30
	15.9 km/h	12.7 km/h	10.9 km/h	16.0 km/h	18.8 km/h	15.3 km/h
<i>Maximum</i>	<i>19.2 km/h</i>	<i>14.2 km/h</i>	<i>12.0 km/h</i>	<i>22.4 km/h</i>	<i>22.7 km/h</i>	<i>21.6 km/h</i>
<i>Minimum</i>	<i>14.7 km/h</i>	<i>9.1 km/h</i>	<i>7.9 km/h</i>	<i>10.6 km/h</i>	<i>18.4 km/h</i>	<i>15.3 km/h</i>
<i>Average</i>	<i>17.2 km/h</i>	<i>11.4 km/h</i>	<i>10.2 km/h</i>	<i>14.4 km/h</i>	<i>20.1 km/h</i>	<i>18.5 km/h</i>

Annex 3.3.1.3

**Train services**

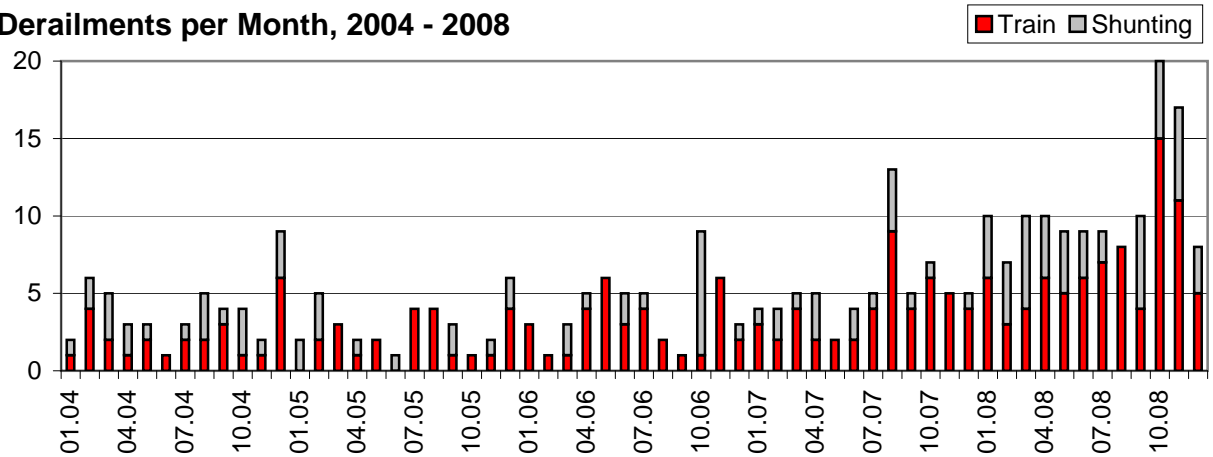
**Train Services**  
*Number of Trains (up and down)*  
*and Train Kilometres 2008*

**Annex 3.3.1.3**

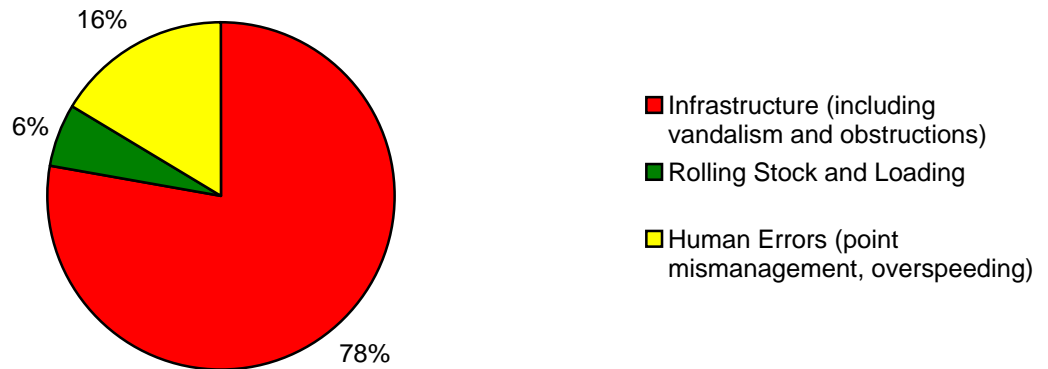
Section	km	Type	Jan	Feb	Mrz	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	Train km
Makhanga - Luchenza	76.7	Passenger		12	19	15	17	9	13	13	12	8	16	10	11,038
		Freight													0
		Trains per day	0.0	0.4	0.6	0.5	0.5	0.3	0.4	0.4	0.4	0.3	0.5	0.3	
Luchenza - Limbe	44.0	Passenger		12	19	15	17	9	13	13	12	8	16	10	6,329
		Freight	8	25	42	33	16	20	17	15	29	25	21	21	11,954
		Trains per day	0.3	1.3	2.0	1.6	1.1	1.0	1.0	0.9	1.4	1.1	1.2	1.0	
Limbe - Blantyre	8.1	Passenger	15	17	18	17	17	10	7	4	8	8	8	9	1,115
		Freight													0
		Trains per day	0.5	0.6	0.6	0.6	0.5	0.3	0.2	0.1	0.3	0.3	0.3	0.3	
Blantyre - Nkaya	88.1	Passenger	15	17	18	17	17	10	7	4	8	8	8	9	12,154
		Freight	23	26	37	39	39	45	38	34	45	40	40	27	38,134
		Trains per day	1.2	1.5	1.8	1.9	1.8	1.8	1.5	1.2	1.8	1.5	1.6	1.2	
Nkaya - Liwonde	25.2	Passenger	16	16	18	18	18	8	8	4	8	6	8	8	3,429
		Freight	24	26	43	46	48	62	57	50	63	59	52	34	14,220
		Trains per day	1.3	1.4	2.0	2.1	2.1	2.3	2.1	1.7	2.4	2.1	2.0	1.4	
Liwonde - Nayuchi	73.3	Passenger	16	16	18	18	18	8	8	4	8	6	8	8	9,966
		Freight	19	27	31	45	26	33	29	30	39	45	39	23	28,287
		Trains per day	1.1	1.5	1.6	2.1	1.4	1.4	1.2	1.1	1.6	1.6	1.6	1.0	
Nayuchi - Cuamba	80.3	Passenger													0
		Freight	19	27	31	45	26	33	29	30	39	45	39	23	31,012
		Trains per day	0.6	0.9	1.0	1.5	0.8	1.1	0.9	1.0	1.3	1.5	1.3	0.7	
Nkaya - Balaka	16.1	Passenger	31	33	36	35	35	18	15	8	16	14	16	17	4,398
		Freight	1		6	7	9	17	19	16	18	19	12	7	2,103
		Trains per day	1.0	1.1	1.4	1.4	1.4	1.2	1.1	0.8	1.1	1.1	0.9	0.8	
Balaka - Kanengo	261.1	Passenger													0
		Freight	1		6	7	9	17	19	16	18	19	12	7	34,210
		Trains per day	0.0	0.0	0.2	0.2	0.3	0.6	0.6	0.5	0.6	0.6	0.4	0.2	
Kanengo - Mchinji	108.7	Passenger													0
		Freight			1	4	6	2	2	2	1				1,957
		Trains per day	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	
Total Train Kilometres												Passenger	48,428		
												Freight	161,877		

**Derailments and line closures**

Derailments per Month, 2004 - 2008

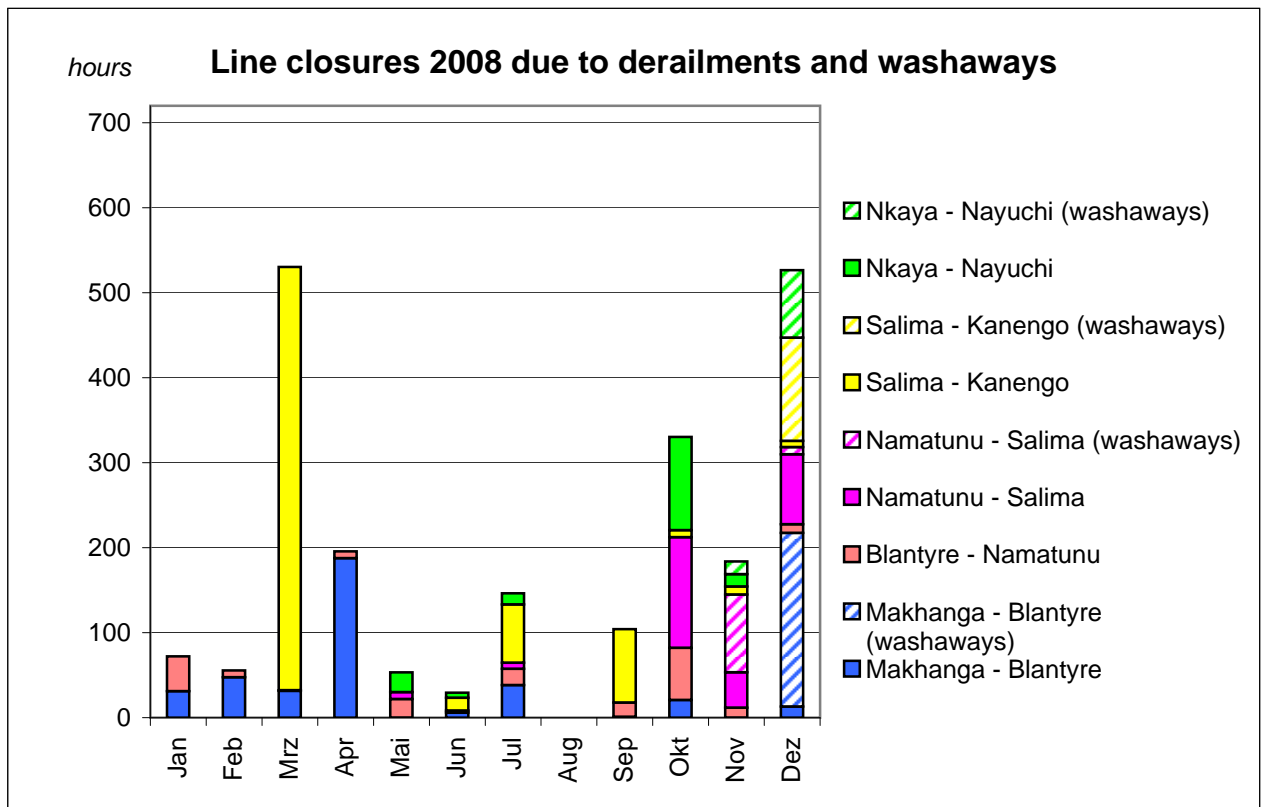


Causes of Train Derailments 01.2004 - 08.2008



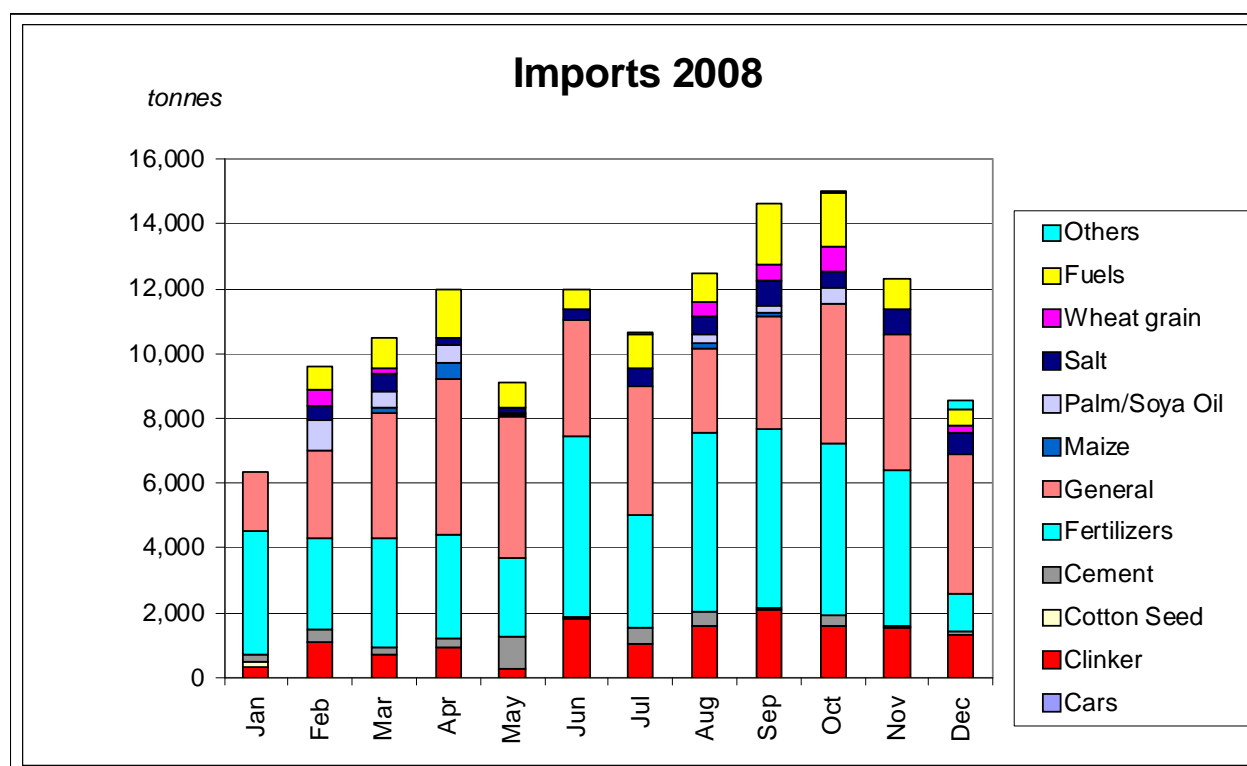
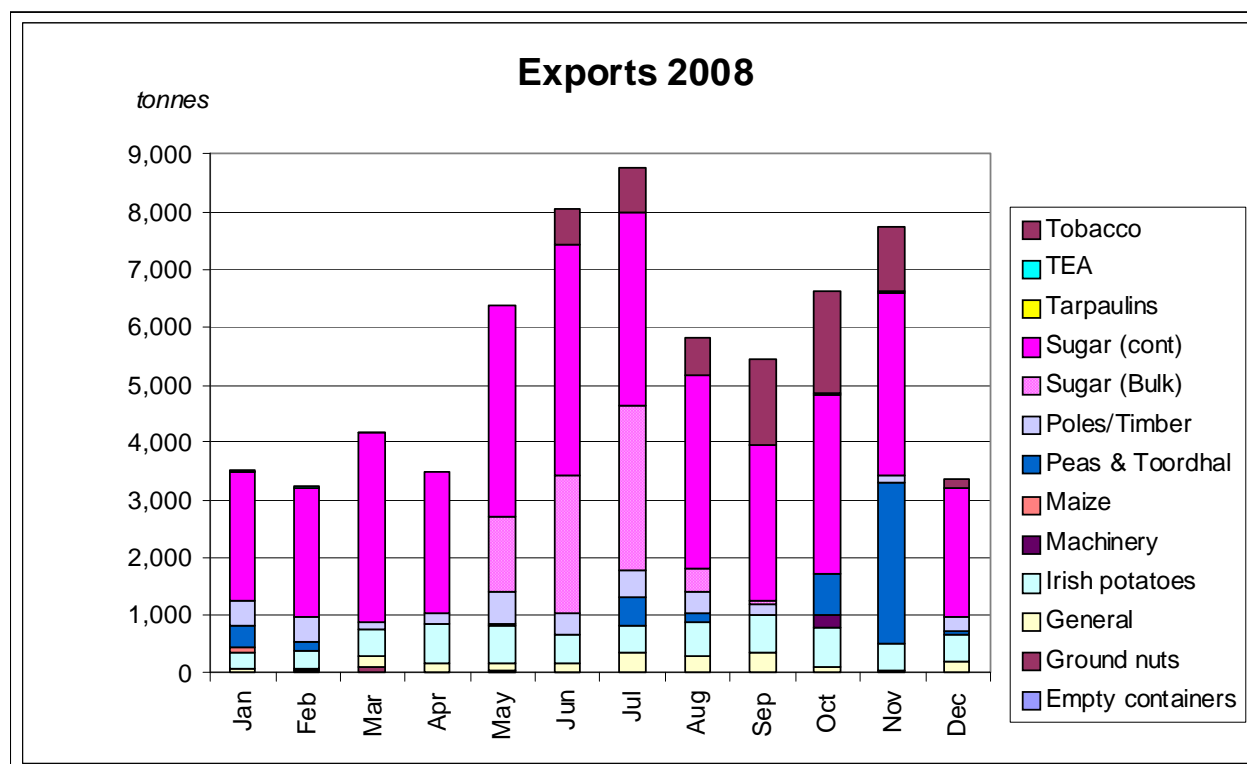
Train Derailments 2008 sectionwise

Section	Jan	Feb	Mrz	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	2008	Derailments per 10,000 Train kms
Makhanga - Blantyre	4	2	2	4	0	2	1	2	1	2	0	1	21	6.9
Blantyre - Namatunu	2	1	0	2	3	0	3	2	2	5	2	2	24	8.0
Namatunu - Balaka	0	0	1	0	0	0	0	2	0	0	0	0	3	1.3
Balaka - Salima	0	0	0	0	1	1	1	0	0	3	7	1	14	6.9
Salima - Kanengo	0	0	1	0	0	2	1	0	1	1	1	1	8	5.8
Kanengo - Mchinji	0	0	0	0	0	0	0	2	0	0	0	0	2	10.2
Chipata - Nkaya	0	0	0	0	1	1	1	0	0	4	1	0	8	1.4
<i>Malawi</i>	6	3	4	6	5	6	7	8	4	15	11	5	80	4.5



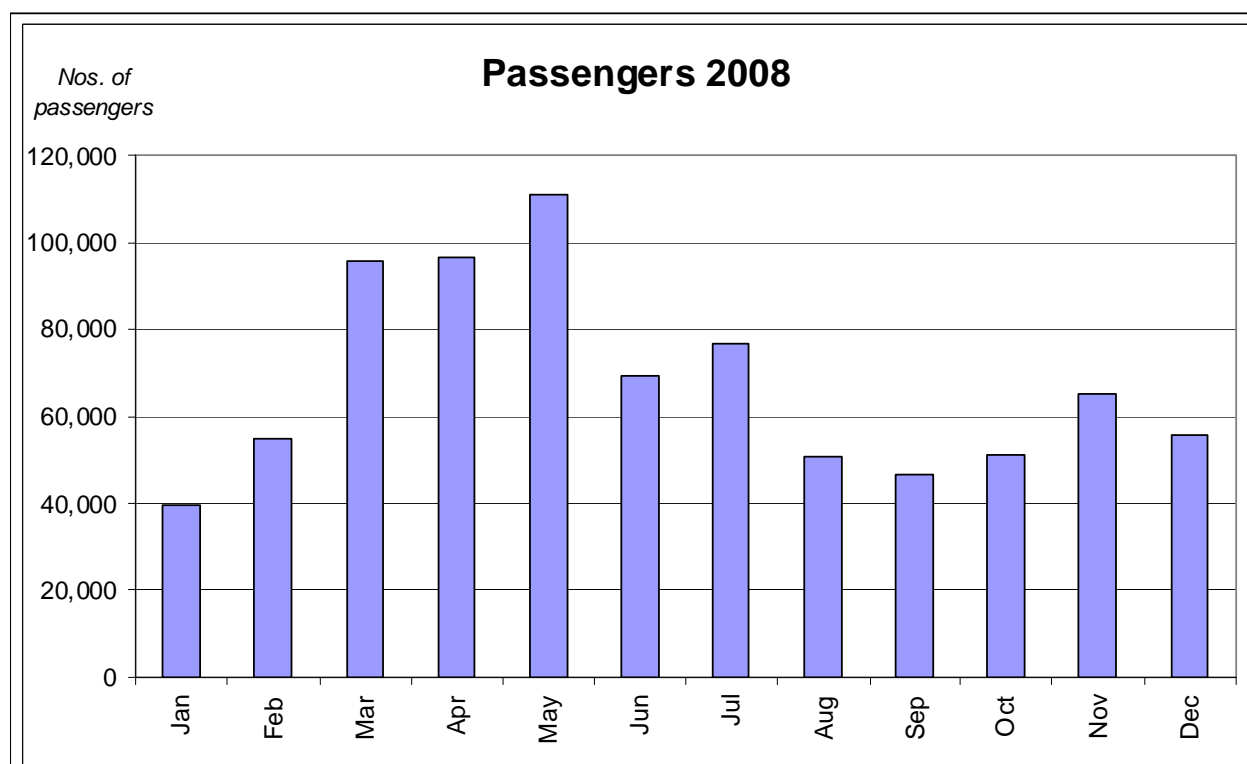
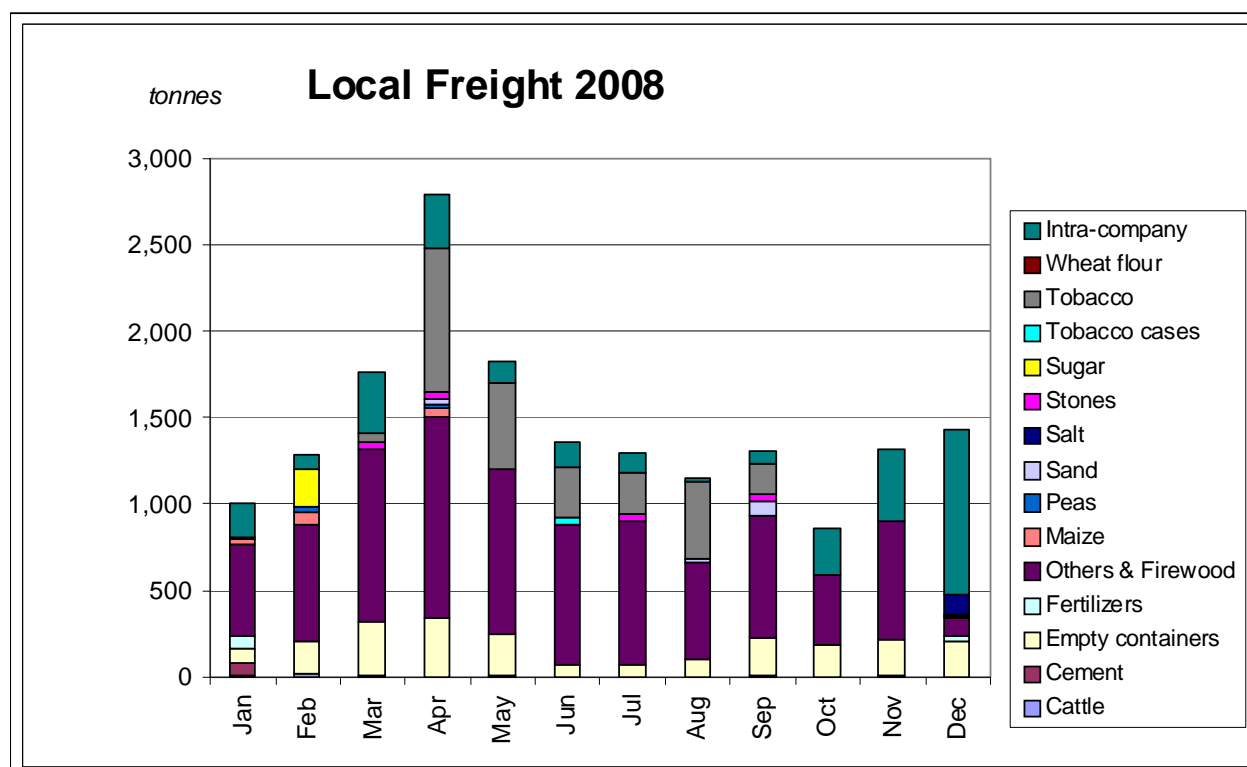
**CEAR traffic 2008**

## CEAR Traffic 2008





## CEAR Traffic 2008



**Emergency programme**

## Emergency programme

### 1 Background, Motive and Objective

Transport infrastructure development is one of the priority areas for intervention by the Government under the Malawi Growth and Development Strategy (MGDS). Functionality of the rail sub-sector which is capable of transporting large volumes of goods and more cost-effective than road transportation is of vital importance to Malawi. But the condition of the railways has deteriorated during recent years, and the system has become inefficient and unreliable. A Railway Master Plan is being set up in the framework of Malawi's Transport Sector Programme aiming at revitalising the rail sector.

Rehabilitation of the railways will take several years, however, and the present condition of the rail infrastructure suggests that operations may collapse as early as during next rainy season. To prevent this, an emergency programme shall be launched.

Overall objective of the emergency programme is to keep infrastructure condition on a level that enables the railways to carry on operations until completion of rehabilitation.

### 2 Approach, Methodology and Overall Scope of Work

The emergency programme shall bring the deterioration of the rail infrastructure to a halt, and in particular prevent any further line closures in order to allow continuous operations until rehabilitation is complete.

Work shall first concentrate on the most critical sections and bring those under control before the rainy season 2009/2010, and then continue in each section until renewal or rehabilitation starts.

The emergency programme shall be planned, organised and executed in the following steps:

- Inspect and survey the entire rail network,
- Define works required in detail,
- Document and verify the above,
- Ascertain priority for each work, and sort jobs accordingly,
- Prepare cost estimate and budget plan,
- Prepare tender documents and issue *limited* invitation,
- Evaluate bids and conclude contract,
- Monitor and approve programming and time schedule,
- Supervise execution of works.

The technical department of the concessionaire has partly carried out the first four steps (see Section 5). A limited invitation to tender is recommended for time reasons.

For both inspection / supervision and execution of works, the lost-know-how problem must be taken into account. Inspection and supervision should be supported by Technical Assistance as suggested. For execution of works, foreign technical support is indispensable, and the following options may be considered:

- Foreign railway construction company, or
- Concessionaire supported by a foreign railway construction company, or a respective partnership, or
- Local road construction company in partnership with or supported by a foreign railway construction company.

The overall scope of work shall comprise

- To clear the structure gauge,
- To repair all drainages,
- To stabilise the substructure, in particular in the vicinity of bridges and culverts,
- To correct all critical and unstable sections of the permanent way.

### 3 Standards and Means of Work

As basic standard for the emergency programme, the Permanent Way Instructions, Malawi Railways Ltd., 1969 (PWI) shall apply. Where the PWI do not contain standards as required, such standards shall be established temporarily by the Monitoring Authority.

To execute works in time, basic machinery and tools will be required such as rail/road excavator(s), long-boom excavator, flat compactors, earthwork machinery for river beds, disc rail cutting machines, small gantry cranes, lifting jacks, material / push trolleys, tamping machine with leveling and lining unit, hand tampers and miscellaneous hand tools. Number and type of machinery required at the least should be specified in the tender documents, as well as minimum qualification and experience of the contractor and his staff.

Tender documents must also specify quality standards for materials to be used for track and bridge / culvert works. Only proven and accepted material must be used, such as stone ballast for the track and compactable / drainable materials for the pavements and substructure.

### 4 Detailed Scope of Work

#### 4.1 Clear structure gauge

*Purpose:*

To clean the railway from weed and shrubbery within the structure gauge as defined in the PWI

*Scope of work:*

- Mark the structure gauge out
- Clean with machines and simultaneously by small gangs, namely
  - manually within the track (sleeper length), without opening or cleaning the ballast which will be done in the course of rehabilitation,
  - with machines at the cess and further outside

#### 4.2 Repair drainages

*Purpose:*

To bring all drainage systems into working order, with cuttings as first priority.

*Precondition:*

Clear structure gauge according to 4.1.

*Scope of work in cuttings and level areas:*

- Define the approximate profile of catchwater drains,
- Mark the profile out,

- Determine the runoff direction,
- Decide where to store excavated materials,
- Consider level crossings and parallel roads,
- Start work from the track and continue outwards,
- Upon completion, take care of slope protection.

*Scope of work at embankments:*

- Define the cross section,
- Mark the cross section out,
- Determine the runoff direction,
- Decide where to store excavated materials,
- Re-profile bridge transitions, prepare the for paving and mark their runoff direction,
- Upon completion, take care of slope protection.

### 4.3 Stabilise substructure

*Purpose 1:*

To repair and stabilise embankments in the vicinity of bridges and culverts.

*Scope of work:*

- Define the inclination of the embankment according to standards, also taking into account the prevailing subsoil characteristics,
- Mark the section and the embankment profile out,
- Extend culverts on both sides if necessary to achieve the profile as marked out,
- Protect the river banks, if necessary by stone pavement,
- Rebuild the embankment starting from the bottom, layer by layer,
- Compact each layer by flat compactor,
- Finally re-profile formation,
- Take care of slope protection,
- Ballast the track,
- Tamp and realign the track by hand-tamper or small machinery if available.

*Purpose 2:*

To stabilise riverbeds at bridges and culverts endangered to wash-aways.

*Scope of work:*

- Review the design of, and if necessary re-design
  - the river channel on both sides of the bridge or culvert,
  - the culvert width under aspects of quantum and velocity of water,
  - the protection of pillars and abutments of bridges
- Re-profile the river banks over a sufficient length on both sides of the bridge or culvert,
- Protect the river banks
  - with stone pavements on both sides of the bridge or culvert and in curves,
  - with planting on other sections,
- Modify culvert, pillars or abutments if required according to re-design

*Purpose 3:*

To restore formation at other sections endangered to sliding or wash-out.

*Scope of work:*

- Mark the section length and the cross section out,
- Remove any material upto 0.30 m underneath sleeper bottoms,
- Re-profile formation with width and inclination according to standard,
- Compact formation,
- Ballast the track,
- Tamp and realign the track by hand-tamper or small machinery if available.

*Purpose 4:*

To redo repair of sections that have not been properly done previously

*Scope of work:*

As described under purpose 1 , 2 and 3 above.

#### 4.4 Correct critical and unstable permanent way sections

*Purpose:*

To stabilise permanent way through ballasting and tamping, and / or correct erroneous track alignments where errors have reached a critical level.

*Preconditions:*

- a) Structure gauge cleared according to 4.1, drainage repaired according to 4.2, and substructure stabilised according to 4.3 if applicable.
- b) Any correction of alignment must be done only if rail temperature allows in order to prevent buckling of the track; it is, therefore, recommended to schedule such works for the cold season.

*Scope of work:*

- Survey and mark out the track, paying special attention to transition and circular curves, and to fixed points such as bridges and level crossings,
- Remove any material upto 0.30 m underneath sleeper bottoms,
- Re-profile formation as far as required,
- Compact formation,
- Bring the track into the marked out position,
- Ballast the track,
- Tamp and realign the track by hand-tamper or small machinery if available,
- Profile the ballast shoulder.

## 5 CEAR input data

## SCOPE OF WORKS - RAILWAY EMERGENCY PROGRAMME

Section and Description of Works	Unit	Quantity	Duration (days)	Execution
<b>Limbe - Blantyre</b>				
✓ Increase hydraulic capacity of culvert at Km 201.6 and repair eroded embankment:			30	CEAR
1. Install 1 - 900mm diameter concrete culvert	m	8		
2. Formation of embankment	cubic m	50		
✓ Replace worn and derailment damaged steel sleepers.	no	1,000	10	
✓ Re-form embankment shoulders on three (3) bridge approaches.	cubic m	360	15	
<b>Blantyre - Nkaya</b>				
✓ Repair eroded embankment sections between Km211.5 and Km252.7.	cubic m	16,000	120	
✓ Replace decayed timber stringer beams on bridge at Km275.2, size 3.0m x 295mm x 215mm.	no	50	5	CEAR
✓ Replace worn and derailment damaged steel sleepers at Km209.3 - Km218.5, Km224.8 - Km225.3, Km228.4 - Km229.2, Km237.3 - Km238.0, Km238.4 - Km239.1, Km240.0 - Km240.8, Km241.0 - Km241.9, Km247.8 - Km248.1 and Km249.4 - Km251.7.	no	18,500	180	CEAR to replace 4000.
✓ Replace derailment damaged concrete sleepers between Km274.1 and Km274.6.	no	900	90	
✓ Repair bridge abutments and provide wingwalls on bridge at Km291.1.	no	2	60	CEAR
✓ Provide wingwalls on bridge abutments at Km 296.7.	no	2	90	
✓ Add ballast between Km220.1 and Km246.6 to stabilise track.	cubic m	7,000	90	
✓ Provide protection works on bridges at Km217.6, Km218.8, Km247.2, Km260.1 and Km269.9.	no	5	180	
<b>Nayuchi - Nkaya</b>				
✓ Repair eroded formation/embankment sections.	cubic m	2,280	30	
✓ Repair eroded embankment sections on bridge approaches at Km33.0, Km35.5, Km77.4 and Km98.0.	cubic m	900	15	
✓ Replace derailment damaged concrete sleepers at various locations between Nkaya and Nayuchi.	no	3,250	180	CEAR
✓ Install concrete rings complete with protection works at sixteen (16) locations where steel pipe culverts have been vandalised.	m	280	60	
✓ Add stone ballast to stabilise track.	cubic m	18,500	240	
<b>Nkaya - Salima</b>				
✓ Construct new drainage structure/bridge at Km376.3 (Kasinje Bridge)	no	1	150	
✓ Construct wingwalls on southern abutment on bridges at Km362.6, Km406.8 and Km451.6.			180	
1. Formation of embankment	cubic m	2700		

CEAR input data (contd.)

## SCOPE OF WORKS - RAILWAY EMERGENCY PROGRAMME

Section and Description of Works	Unit	Quantity	Duration (days)	Execution
✓ Construct wingwalls on both abutments on bridges at Km339.5 and Km423.2:			120	
✓ Pave wash-out endangered riverbed and re-form embankment at six (6) locations, Km314.1, Km328.5, Km353.0, Km360.8, Km429.5 and Km437.0.			180	
1. Formation of embankment	cubic m	1400		
✓ Construct protection works upstream and downstream of culvert and re-form embankment at Km 315.7, Km 320.1, Km337.0:			90	
1. Formation of embankment	cubic m	330		
✓ Construct protection works on exposed piles on two piers of bridge at Km341.8.			60	
✓ Construct wingwalls on rail frame culverts at Km316.4, Km324.7, Km325.5, Km327.1, Km332.4, Km345.1 and Km359.9.	no	7	180	
✓ Repair eroded embankment sections on bridge approaches at Km318.0, Km 330.9, Km335.7, Km362.6, Km374.0	cubic m	900	15	
✓ Repair eroded formation/embankment sections between Km321.1 and Km459.9.	cubic m	7,700	60	
✓ Install 1 - 0.9m dia concrete rings complete with protection works at Km353.3.	m	8	15	CEAR
✓ Replace rotten bridge timbers on bridges.	no	1,350	90	
✓ Replace derailment damaged steel sleepers between Km319.5 and Km467.5.	no	7,400	75	
✓ Replace derailment damaged concrete sleepers between Km319.5 and Km467.5.	no	1,150	30	
✓ Increase hydraulic capacity of culvert by constructing box culvert at Km411.3.	no	1	60	
✓ Add stone ballast between Km314.2 and Km469.0 to stabilise track.	cubic m	70,000	360	
<b>Salima - Kanengo</b>				
✓ Install concrete rings complete with protection works at thirty-two (32) locations where steel pipe culverts have been vandalised.	m	540	150	
✓ Install additional concrete rings, provide protection works and re-create cross section of embankment on fifteen (15) culverts:			60	
1. Concrete rings	m	142		
2. Formation of embankment	cubic m	5,100		
✓ Provide protection works upstream and downstream on fifteen (15) culverts.	no	37	60	CEAR
✓ Repair eroded embankment sections between Km 476.7 and Km 573.7.	cubic m	2,750	30	

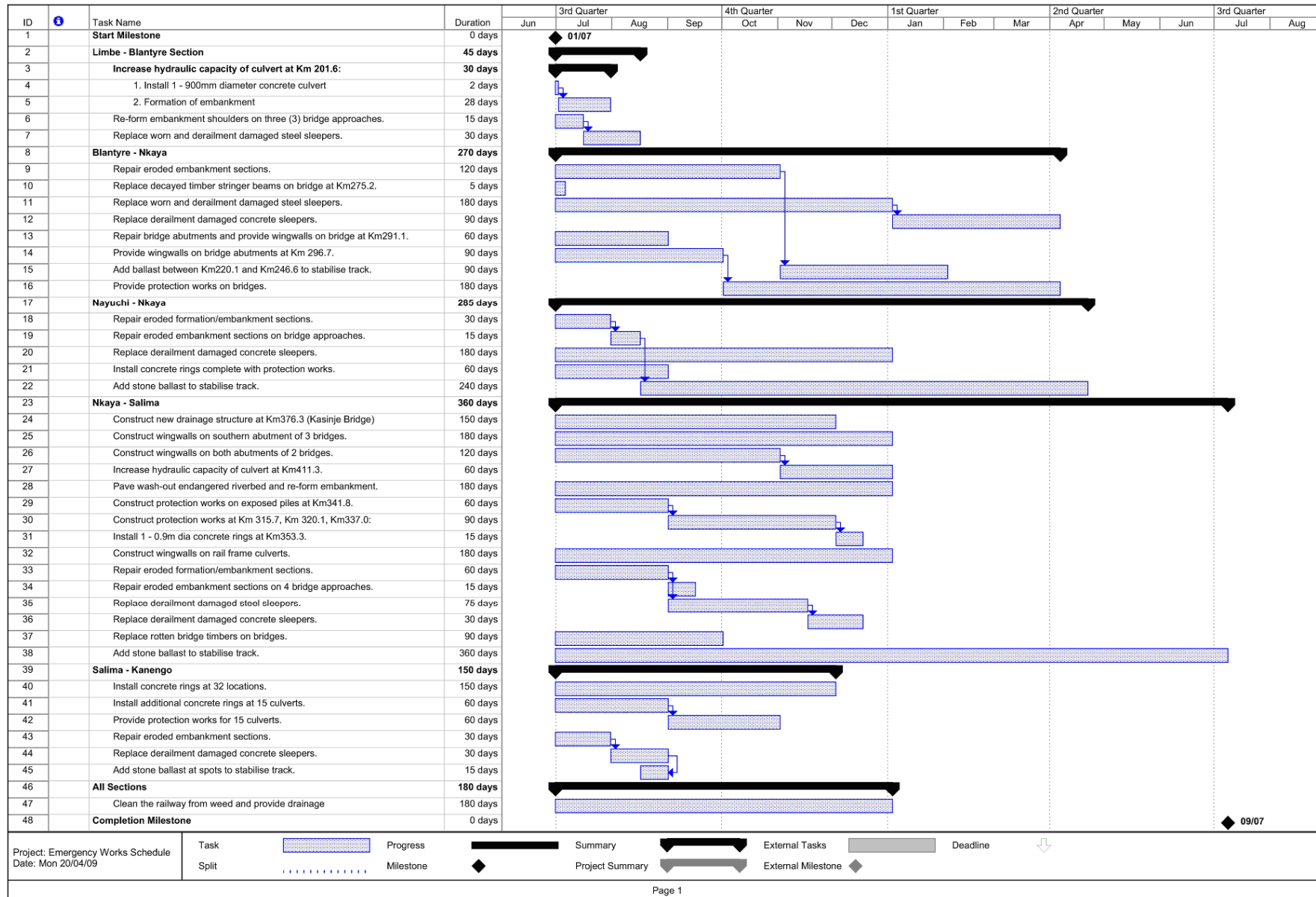


CEAR input data (contd.)

### SCOPE OF WORKS - RAILWAY EMERGENCY PROGRAMME

Section and Description of Works	Unit	Quantity	Duration (days)	Execution
✓ Replace derailment damaged concrete sleepers between Km497.2 and Km573.7.	no	1,900	30	CEAR
✓ Add stone ballast at spots to stabilise track.	cubic m	950	15	
<b>All Sections</b>				
✓ Clean the railway from weed and shrubbery	ha	717	180	
✓ Repair all drainage systems especially in cuttings using machinery.			180	
<b>Track Equipment Requirement:</b>				
✓ Railroad excavator	no	1		

CEAR input data (contd.)



**Quantity structure track renewal and track rehabilitation**

## Quantity Structure Track Renewal and Track Rehabilitation

Section		Inventory of through track							Complete Renewal				Rehabilitation			
		Steel Sleepers <sup>1)</sup>		Concrete Sleepers		Total track length [metres]	Curves with R ≤ 201 m [track metres]	Turn-outs [Nos.]	I	II	III	Total	I	Ia	II	Total
		with														
		30	37/40	30	37/40											
		kg/m rail [track metres]														
1	Kanengo - Border	0	236	0	120,810	121,046	500	26	0	0	0	0	121,046	36,314	0	121,046
2	Salima - Kanengo	0	334	0	105,344	105,678	13,900	14	0	42,138	0	42,138	31,937	0	31,603	63,540
3	Nkaya - Salima	19,263	95,451	23,587	42,328	180,629	1,250	26	42,850	8,466	95,451	146,767	33,863	0	0	33,863
4	Border - Nkaya	0	337	0	98,859	99,196	0	10	0	0	0	0	59,652	0	39,544	99,196
5	Limbe - Nkaya	48,631	0	3,170	43,851	95,652	16,200	25	51,801	8,770	0	60,571	35,081	0	0	35,081
6a	Bangula - Limbe	128,943	0	0	0	128,943	31,875	31	128,943	0	0	128,943	0	0	0	0
6b	Border - Bangula	69,954	0	0	0	69,954	175	9	69,954	0	0	69,954	0	0	0	0

1) including wooden sleepers on concrete deck bridges and at Balaka level crossing

### Criteria

<i>Complete Renewal I:</i>	All tracks with 30 kg/m rails regardless of sleeper type
<i>Complete Renewal II:</i>	Tracks where condition requires renewal, in particular with broken sleepers due to derailments or manufacturing faults
<i>Complete Renewal III:</i>	Tracks with 37.5 and 40 kg/m rails on steel sleepers, except on concrete deck bridges
<i>Rehabilitation I:</i>	Cleaning ballast, reprofiling substructure, adding ballast, tamping; optional sleeper re-spacing and welding
<i>Rehabilitation Ia:</i>	Partly renewal of sleepers with manufacturing faults during Rehabilitation I
<i>Rehabilitation II:</i>	Reprofiling substructure, adding ballast, tamping; optional sleeper re-spacing and welding
<i>Turnouts:</i>	Complete renewal in course of track renewal / rehabilitation
<i>Curves with R ≤ 201 m:</i>	In course of renewal, use of head-hardened rails recommended

**Quantity structure bridge renewal and bridge rehabilitation**

## Quantity Structure Bridge Renewal and Bridge Rehabilitation

Section		Bridge Inventory																			
		Open Top (steel girder / truss spans)						Concrete Deck						Rail Frame						Other Culverts 1)	
		Nos.			Length			Nos.			Length			Nos.			Length			Nos.	Length
		defined	assumed	Total	defined	assumed	Total	defined	assumed	Total	defined	assumed	Total	defined	assumed	Total	defined	assumed	Total		
1	Kanengo - Border	0	0	0	0	0	0	3	0	3	222	0	222	0	0	0	0	0	0	130	271
2	Salima - Kanengo	0	0	0	0	0	0	8	0	8	389	0	389	0	0	0	0	0	0	213	301
3	Nkaya - Salima	102	2	104	914	17	931	2	0	2	86	0	86	113	25	138	142	32	175	205	263
4	Border - Nkaya	2	0	2	301	0	301	18	0	18	337	0	337	0	0	0	0	0	0	132	229
5	Limbe - Nkaya	41	8	49	421	72	493	1	1	2	21	9	31	28	2	30	24	2	25	204	214
6a	Bangula - Limbe	43	15	58	829	280	1,109	0	0	0	0	0	0	28	27	55	24	23	48	290	1,419
6b	Border - Bangula	48	38	86	264	219	482	0	0	0	0	0	0	1	34	35	1	21	21	23	34

1) Costs for culvert rehabilitation can be estimated on basis of a detailed survey only

Section		Rehabilitation			Replacement / Renewal		
		Concrete Banks Repair	Corrosion Protection	Concrete Deck	Bridge Beams	Rail Frames	Steel Bridges
		[Nos.]	[metres]	[metres]	[Nos.]	[Nos.]	[metres]
1	Kanengo - Border			222			
2	Salima - Kanengo			389			
3	Nkaya - Salima	103	870	86	1,592	138	
4	Border - Nkaya			337			
5	Limbe - Nkaya	48	432	21	816	30	
6a	Bangula - Limbe				1,479	55	1,109
6b	Border - Bangula				844	35	482

**Unit cost matrix**

## Unit Cost Matrix

Item		Unit	US\$	Complete Track Renewal	In addition for R ≤ 201 m	Turnout Renewal	Track Rehabilitation I	Track Rehabilitation Ia	Track Rehabilitation II	Rehabilitation Option	Steel Bridge Rehabilitation	Concrete Bridge Rehabilitation	Rail frame replacement	Steel bridge renewal
Emergency Programme		lump sum	8,000,000.00											
Tracks	Concrete Sleeper + Fastening	piece	60.00											
		track metre	92.31	100%				100%		7.7%				
	Rail UIC54	track metre	106.00	100%	15%									
	Ballast	track metre	90.00	100%			80%		60%					
	Welding	track metre	94.00	100%						100%				
	Turnout UIC54-300-1:12	piece	80,000.00			100%								
	Ballast for turnout	turnout	5,000.00			100%								
	Remove old track	track metre	12.00	100%										
	Substructure works	track metre	15.00	100%			100%							
	Track laying	track metre	19.00	100%						7.7%				
	Ballasting and tamping	track metre	29.00	100%			100%		100%					
	Ballast cleaning	track metre	25.00				100%							
	Turnout (work)	turnout	12,000.00			100%								
Bridges	Concrete banks repair	bridge	55,000.00								100%			
	Corrosion protection	span metre	500.00								100%			
	Concrete deck rehabilitation	span metre	680.00									100%		
	Bridge beam	piece	240.00								100%			
	Bridge beam mounting	piece	175.00								100%			
	Rail frame replacement	bridge	21,000.00										100%	
	Steel bridge renewal	span metre	130,000.00											100%



**Cost estimate track renewal and track rehabilitation**

## Cost Estimate Track Renewal and Track Rehabilitation (Million US\$)

Section		Complete Renewal <sup>1)</sup>														
		I			II			III			Turnouts			Total Renewal		
	Unit Cost [US\$]	Material	Work	Total	Material	Work	Total	Material	Work	Total	Material	Work	Total	Material	Work	Total
		382.31	75.00	457.31	382.31	75.00	457.31	382.31	75.00	457.31	85,000	12,000	97,000			
1	Kanengo - Border	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.210	0.312	2.522	2.210	0.312	2.522
2	Salima - Kanengo	0.000	0.000	0.000	16.198	3.160	19.358	0.000	0.000	0.000	1.190	0.168	1.358	17.388	3.328	20.716
3	Nkaya - Salima	16.387	3.214	19.601	3.237	0.635	3.872	36.502	7.159	43.661	2.210	0.312	2.522	58.337	11.320	69.656
4	Border - Nkaya	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.850	0.120	0.970	0.850	0.120	0.970
5	Limbe - Nkaya	19.944	3.885	23.829	3.377	0.658	4.034	0.000	0.000	0.000	2.125	0.300	2.425	25.445	4.843	30.288
6a	Bangula - Limbe	49.803	9.671	59.474	0.000	0.000	0.000	0.000	0.000	0.000	2.635	0.372	3.007	52.438	10.043	62.481
6b	Border - Bangula	26.747	5.247	31.994	0.000	0.000	0.000	0.000	0.000	0.000	0.765	0.108	0.873	27.512	5.355	32.867

1) Estimates - but not unit costs - include costs of head-hardened rails where applicable

Section		Rehabilitation																				
		I							II							Total Rehabilitation						
	Unit Cost [US\$]	I	Ia	I		Optional <sup>2)</sup> <sup>3)</sup>		Total 2	Material	Work	Total 1	Optional <sup>2)</sup> <sup>3)</sup>		Total 2	Material	Work	Total					
		Material		Work	Total 1	Material	Work					Material	Work					Total 2				
		72.00	92.31	69.00		101.11	1.46												54.00	29.00	101.11	1.46
						7.11															7.11	
1	Kanengo - Border	8.715	3.352	8.352	20.420	12.239	0.177	32.835	0.000	0.000	0.000	0.000	0.000	0.000	24.306	8.529	32.835					
2	Salima - Kanengo	2.299	0.000	2.204	4.503	3.229	0.047	7.779	1.707	0.916	2.623	3.195	0.046	5.865	10.430	3.213	13.644					
3	Nkaya - Salima	2.438	0.000	2.337	4.775	3.424	0.050	8.248	0.000	0.000	0.000	0.000	0.000	0.000	5.862	2.386	8.248					
4	Border - Nkaya	4.295	0.000	4.116	8.411	0.424	0.087	8.922	2.135	1.147	3.282	0.281	0.058	3.621	7.135	5.408	12.543					
5	Limbe - Nkaya	2.526	0.000	2.421	4.946	3.547	0.051	8.545	0.000	0.000	0.000	0.000	0.000	0.000	6.073	2.472	8.545					

2) Sleeper re-spacing and continuous welding

3) Section 4 is already continuously welded

**Cost estimate bridge renewal and bridge rehabilitation**

**Cost Estimate Bridge Renewal and Bridge Rehabilitation**  
(Million US\$)

**Annex 4.3.3**

Section		Rehabilitation			Total Rehabilitation	Replacement / Renewal			Total Replacement / Renewal	Grand Total
		Concrete Banks Repair	Corrosion Protection	Concrete Deck		Bridge Beams	Rail Frames	Steel Bridges <sup>1)</sup>		
	<i>Unit Cost [US\$]</i>	55,000	500	680		415	21,000	130,000		
1	Kanengo - Border	0.000	0.000	0.151	<b>0.151</b>	0.000	0.000	0.000	0.000	<b>0.151</b>
2	Salima - Kanengo	0.000	0.000	0.264	<b>0.264</b>	0.000	0.000	0.000	0.000	<b>0.264</b>
3	Nkaya - Salima	5.665	0.435	0.058	<b>6.158</b>	0.661	2.898	0.000	3.559	<b>9.717</b>
4	Border - Nkaya	0.000	0.000	0.229	<b>0.229</b>	0.000	0.000	0.000	0.000	<b>0.229</b>
5	Limbe - Nkaya	2.640	0.216	0.015	<b>2.870</b>	0.339	0.630	0.000	0.969	<b>3.839</b>
6a	Bangula - Limbe	0.000	0.000	0.000	<b>0.000</b>	0.614	1.155	144.127	145.896	<b>145.896</b>
6b	Border - Bangula	0.000	0.000	0.000	<b>0.000</b>	0.350	0.735	62.717	63.802	<b>63.802</b>

1) Estimate is subject to detailed engineering assessment

**Network rehabilitation cost summary**

**Network Rehabilitation  
Cost Summary**  
(Million US\$)

**Annex 4.3.4**

Section	Track			Bridges			Grand Total
	Renewal	Rehabilitation	Total	Renewal/ Replacement	Rehabilitation	Total	
1 Kanengo - Border	2,522	32,835	35,357	0,000	0,151	0,151	<b>35,508</b>
2 Salima - Kanengo	20,716	13,644	34,360	0,000	0,264	0,264	<b>34,624</b>
3 Nkaya - Salima	69,656	8,248	77,904	3,559	6,158	9,717	<b>87,621</b>
4 Border - Nkaya	0,970	12,543	13,513	0,000	0,229	0,229	<b>13,742</b>
5 Limbe - Nkaya	30,288	8,545	38,833	0,969	2,870	3,839	<b>42,671</b>
1-5 Emergency Programme							<b>8,000</b>
<i>Subtotal 1-5</i>	<i>124,152</i>	<i>75,815</i>	<i>199,967</i>	<i>4,527</i>	<i>9,673</i>	<i>14,200</i>	<b><i>222,167</i></b>
6a Bangula - Limbe	62,481	0,000	62,481	145,896	0,000	145,896	<b>208,377</b>
6b Border - Bangula	32,867	0,000	32,867	63,802	0,000	63,802	<b>96,669</b>
<i>Subtotal 6</i>	<i>95,347</i>	<i>0,000</i>	<i>95,347</i>	<i>209,698</i>	<i>0,000</i>	<i>209,698</i>	<b><i>305,046</i></b>
<b>Grand Total</b>	<b>219,499</b>	<b>75,815</b>	<b>295,314</b>	<b>214,226</b>	<b>9,673</b>	<b>223,899</b>	<b>527,213</b>

**Time schedule for network rehabilitation**

### Time Schedule for Network Rehabilitation

[illegible]



**Traffic forecast**

## Forecast on long-distance freight traffic

## Annex 5.2.1

Commodity				Net Tonnes (*10 <sup>-3</sup> )																			
Code	Type	Relation		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
		from	to																				
004	Sugar (Bulk)	Limbe	Nacala	36.2	37.9	39.2	40.6	42.0	43.5	45.0	45.9	46.8	47.8	48.7	49.7	50.7	51.7	52.7	53.8	54.9	56.0	57.1	58.2
012	Sugar (Cont)	Luchenza	Nacala	29.6	30.7	31.8	32.9	34.0	35.2	36.4	37.2	37.9	38.7	39.4	40.2	41.0	41.9	42.7	43.5	44.4	45.3	46.2	47.1
012	Sugar (Cont)	Blantyre	Nacala	10.4	10.7	11.1	11.5	11.9	12.3	12.7	13.0	13.2	13.5	13.8	14.0	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.5
008	Cotton lint (Cont)	Blantyre	Nacala	5.2	5.4	5.5	5.7	5.9	6.1	6.4	6.5	6.6	6.8	6.9	7.0	7.2	7.3	7.5	7.6	7.8	7.9	8.1	8.2
002	Pigeon peas (Bulk)	Blantyre	Nacala	10.4	10.7	11.1	11.5	11.9	12.3	12.7	13.0	13.2	13.5	13.8	14.0	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.5
011	Pigeon peas (Cont)	Blantyre	Nacala	2.1	2.1	2.2	2.3	2.4	2.5	2.5	2.6	2.6	2.7	2.8	2.8	2.9	2.9	3.0	3.0	3.1	3.2	3.2	3.3
016	Used machinery	Blantyre	Nacala	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6
013	Tea	Blantyre	Nacala	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8
005	Toor Dhal (Bulk)	Blantyre	Nacala	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0
015	Toor Dhal (Cont)	Blantyre	Nacala	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1
014	Tobacco	Kanengo	Nacala	15.6	16.1	16.7	17.2	17.8	18.5	19.1	19.5	19.9	20.3	20.7	21.1	21.5	22.0	22.4	22.8	23.3	23.8	24.2	24.7
008	Cotton lint (Cont)	Salima	Nacala	3.2	3.3	3.4	3.5	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1
006	Iron Ore	Nkaya	Nacala	24.8	25.7	26.6	27.5	28.5	29.5	30.5	31.1	31.8	32.4	33.0	33.7	34.4	35.1	35.8	36.5	37.2	38.0	38.7	39.5
007	Potatoes	Balaka	Nacala	6.8	7.1	7.3	7.6	7.8	8.1	8.4	8.6	8.7	8.9	9.1	9.3	9.5	9.6	9.8	10.0	10.2	10.4	10.6	10.9
001	Eggs	Liwonde	Nacala	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8
010	Machinery	Blantyre	Nacala	2.5	2.6	2.7	2.8	2.8	2.9	3.1	3.1	3.2	3.2	3.3	3.4	3.4	3.5	3.6	3.6	3.7	3.8	3.9	3.9
003	Plastic Ware	Blantyre	Nacala	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8
107	Clinker	Nacala	Blantyre	24.8	25.7	26.6	27.5	28.5	29.5	30.5	31.1	31.8	32.4	33.1	33.7	34.4	35.1	35.8	36.5	37.2	38.0	38.7	39.5
111	General cargo (Cont)	Nacala	Blantyre	49.7	51.4	53.2	55.1	57.0	59.0	61.1	62.3	63.5	64.8	66.1	67.4	68.8	70.1	71.6	73.0	74.4	75.9	77.4	79.0
106	Fertiliser (Hopper)	Nacala	Blantyre	55.9	57.8	59.9	62.0	64.1	66.4	68.7	70.1	71.5	72.9	74.4	75.9	77.4	78.9	80.5	82.1	83.7	85.4	87.1	88.9
102	Fertiliser (Bulk)	Nacala	Blantyre	6.2	6.4	6.7	6.9	7.1	7.4	7.6	7.8	7.9	8.1	8.3	8.4	8.6	8.8	8.9	9.1	9.3	9.5	9.7	9.9
103	Salt	Nacala	Blantyre	6.2	6.4	6.7	6.9	7.1	7.4	7.6	7.8	7.9	8.1	8.3	8.4	8.6	8.8	8.9	9.1	9.3	9.5	9.7	9.9
109	Fuel (Diesel)	Nacala	Blantyre	78.0	80.7	83.6	86.5	89.5	92.6	95.9	97.8	99.8	101.8	103.8	105.9	108.0	110.1	112.3	114.6	116.9	119.2	121.6	124.0
105	Wheat grain	Nacala	Blantyre	86.9	90.0	93.1	96.4	99.8	103.3	106.9	109.0	111.2	113.4	115.7	118.0	120.4	122.8	125.2	127.7	130.3	132.9	135.5	138.2
104	Soap noodles	Nacala	Blantyre	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6
101	Cement (Bulk)	Nacala	Kanengo	4.1	4.3	4.4	4.6	4.7	4.9	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	6.0	6.1	6.2	6.3	6.5	6.6
102	Fertiliser (Bulk)	Nacala	Kanengo	3.1	3.2	3.3	3.4	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.7	4.8	4.9
110	Fertiliser (Cont)	Nacala	Kanengo	9.3	9.6	10.0	10.3	10.7	11.1	11.4	11.7	11.9	12.2	12.4	12.6	12.9	13.2	13.4	13.7	14.0	14.2	14.5	14.8
111	General cargo (Cont)	Nacala	Kanengo	5.2	5.4	5.5	5.7	5.9	6.1	6.4	6.5	6.6	6.8	6.9	7.0	7.2	7.3	7.5	7.6	7.8	7.9	8.1	8.2
103	Salt	Nacala	Kanengo	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6
105	Wheat grain	Nacala	Kanengo	2.1	2.1	2.1	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.1
104	Soap noodles	Nacala	Kanengo	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
101	Cement (Bulk)	Blantyre	Kanengo	8.3	8.6	8.9	9.2	9.5	9.8	10.2	10.4	10.6	10.8	11.0	11.2	11.5	11.7	11.9	12.2	12.4	12.7	12.9	13.2
203	Wheat Flour (Bulk)	Limbe	Kanengo	16.7	17.3	17.9	18.5	19.2	19.9	20.5	21.0	21.4	21.8	22.2	22.7	23.1	23.6	24.1	24.6	25.0	25.5	26.1	26.6
202	Quarystones	Limbe	Sandama	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
203	Wheat Flour (Bulk)	Limbe	Kanengo	8.3	8.6	8.9	9.2	9.5	9.8	10.2	10.4	10.6	10.8	11.0	11.2	11.5	11.7	11.9	12.2	12.4	12.7	12.9	13.2
102	Fertiliser (Bulk)	Liwonde	Kanengo	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6
103	Salt	Liwonde	Limbe	1.8	1.9	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7
103	Salt	Liwonde	Kanengo	2.3	2.4	2.5	2.6	2.7	2.7	2.8	2.9	3.0	3.0	3.1	3.1	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.7
900	Empty Containers	Blantyre	Kanengo	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1
900	Empty Containers	Blantyre	Kanengo	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8
110	Fertiliser (Cont)	Nacala	Chipata			30.0	75.0	78.8	82.7	86.8	88.6	90.3	92.1	94.0	95.9	97.3	98.8	100.2	101.7	103.3	104.8	106.4	108.0
109	Fuel (Diesel)	Nacala	Chipata			60.0	100.0	105.0	110.3	115.8	118.1	120.4	122.8	125.3	127.8	129.7	131.7	133.6	135.7	137.7	139.8	141.9	144.0
111	General cargo (Cont)	Nacala	Chipata			10.0	40.0	42.0	44.1	46.3	47.2	48.2	49.1	50.1	51.1	51.9	52.7	53.5	54.3	55.1	55.9	56.7	57.6
012	Sugar (Cont)	Chipata	Nacala			100.0	150.0	200.0	250.0	255.0	260.1	265.3	270.6	276.0	281.5	285.8	290.1	294.4	298.8	303.3	307.8	312.5	317.2
008	Cotton lint (Cont)	Chipata	Nacala			30.0	70.0	73.5	77.2	81.0	82.7	84.3	86.0	87.7	89.5	90.8	92.2	93.6	95.0	96.4	97.8	99.3	100.8
301	Maize (Cont)	Chipata	Nacala			20.0	30.0	31.5	33.1	34.7	35.4	36.1	36.9	37.6	38.3	38.9	39.5	40.1	40.7	41.3	41.9	42.6	43.2
009	Groundnuts (Cont)	Chipata	Nacala			20.0	30.0	31.5	33.1	34.7	35.4	36.1	36.9	37.6	38.3	38.9	39.5	40.1	40.7	41.3	41.9	42.6	43.2
302	Other Agro Prod. (Cont)	Chipata	Nacala			30.0	40.0	42.0	44.1	46.3	47.2	48.2	49.1	50.1	51.1	51.9	52.7	53.5	54.3	55.1	55.9	56.7	57.6
303	Mineral Ores	Chipata	Nacala			100.0	100.0	100.0	100.0	100.0	102.0	104.0	106.1	108.2	110.4	112.6	114.9	117.2	119.5	121.9	124.3	126.8	129.4
	Totals			524	543	962	1,217	1,306	1,397	1,445	1,474	1,504	1,534	1,565	1,596	1,624	1,652	1,682	1,711	1,741	1,772	1,803	1,835

## Forecast on long-distance freight traffic

## Annex 5.2.1

Commodity				Million Tonne-kilometres																			
Code	Type	Relation		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
		from	to																				
004	Sugar (Bulk)	Limbe	Nacala	29.3	30.6	31.7	32.8	34.0	35.2	36.4	37.1	37.9	38.6	39.4	40.2	41.0	41.8	42.6	43.5	44.4	45.3	46.2	47.1
012	Sugar (Cont)	Luchenza	Nacala	25.3	26.1	27.1	28.0	29.0	30.0	31.1	31.7	32.3	33.0	33.6	34.3	35.0	35.7	36.4	37.1	37.9	38.6	39.4	40.2
012	Sugar (Cont)	Blantyre	Nacala	8.3	8.6	8.9	9.2	9.5	9.8	10.2	10.4	10.6	10.8	11.0	11.2	11.5	11.7	11.9	12.2	12.4	12.7	12.9	13.2
008	Cotton lint (Cont)	Blantyre	Nacala	4.1	4.3	4.4	4.6	4.8	4.9	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	6.0	6.1	6.2	6.3	6.5	6.6
002	Pigeon peas (Bulk)	Blantyre	Nacala	8.3	8.6	8.9	9.2	9.5	9.8	10.2	10.4	10.6	10.8	11.0	11.2	11.5	11.7	11.9	12.2	12.4	12.7	12.9	13.2
011	Pigeon peas (Cont)	Blantyre	Nacala	1.7	1.7	1.8	1.8	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6
016	Used machinery	Blantyre	Nacala	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3
013	Tea	Blantyre	Nacala	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
005	Toor Dhal (Bulk)	Blantyre	Nacala	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8
015	Toor Dhal (Cont)	Blantyre	Nacala	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9
014	Tobacco	Kanengo	Nacala	15.4	15.9	16.5	17.1	17.7	18.3	18.9	19.3	19.7	20.1	20.5	20.9	21.3	21.7	22.2	22.6	23.1	23.5	24.0	24.5
008	Cotton lint (Cont)	Salima	Nacala	2.8	2.9	3.0	3.1	3.2	3.4	3.5	3.5	3.6	3.7	3.8	3.8	3.9	4.0	4.1	4.2	4.2	4.3	4.4	4.5
006	Iron Ore	Nkaya	Nacala	17.7	18.3	19.0	19.6	20.3	21.0	21.7	22.2	22.6	23.1	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.6	28.1
007	Potatoes	Balaka	Nacala	5.0	5.1	5.3	5.5	5.7	5.9	6.1	6.2	6.4	6.5	6.6	6.8	6.9	7.0	7.2	7.3	7.5	7.6	7.8	7.9
001	Eggs	Liwonde	Nacala	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6
010	Machinery	Blantyre	Nacala	2.0	2.1	2.1	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.8	2.8	2.9	2.9	3.0	3.0	3.1	3.2
003	Plastic Ware	Blantyre	Nacala	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
107	Clinker	Nacala	Blantyre	19.9	20.6	21.3	22.0	22.8	23.6	24.4	24.9	25.4	25.9	26.5	27.0	27.5	28.1	28.6	29.2	29.8	30.4	31.0	31.6
111	General cargo (Cont)	Nacala	Blantyre	39.8	41.2	42.6	44.1	45.6	47.2	48.9	49.9	50.9	51.9	52.9	54.0	55.0	56.1	57.3	58.4	59.6	60.8	62.0	63.2
106	Fertiliser (Hopper)	Nacala	Blantyre	44.7	46.3	47.9	49.6	51.3	53.1	55.0	56.1	57.2	58.4	59.5	60.7	61.9	63.2	64.4	65.7	67.0	68.4	69.7	71.1
102	Fertiliser (Bulk)	Nacala	Blantyre	5.0	5.1	5.3	5.5	5.7	5.9	6.1	6.2	6.4	6.5	6.6	6.7	6.9	7.0	7.2	7.3	7.4	7.6	7.8	7.9
103	Salt	Nacala	Blantyre	5.0	5.1	5.3	5.5	5.7	5.9	6.1	6.2	6.4	6.5	6.6	6.7	6.9	7.0	7.2	7.3	7.4	7.6	7.8	7.9
109	Fuel (Diesel)	Nacala	Blantyre	62.4	64.6	66.9	69.2	71.6	74.1	76.7	78.3	79.8	81.4	83.1	84.7	86.4	88.2	89.9	91.7	93.5	95.4	97.3	99.3
105	Wheat grain	Nacala	Blantyre	69.6	72.0	74.5	77.1	79.8	82.6	85.5	87.2	89.0	90.8	92.6	94.4	96.3	98.3	100.2	102.2	104.3	106.4	108.5	110.7
104	Soap noodles	Nacala	Blantyre	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3
101	Cement (Bulk)	Nacala	Kanengo	4.1	4.2	4.4	4.5	4.7	4.9	5.0	5.1	5.2	5.3	5.4	5.6	5.7	5.8	5.9	6.0	6.1	6.3	6.4	6.5
102	Fertiliser (Bulk)	Nacala	Kanengo	3.1	3.2	3.3	3.4	3.5	3.6	3.8	3.9	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5	4.6	4.7	4.8	4.9
110	Fertiliser (Cont)	Nacala	Kanengo	9.2	9.5	9.9	10.2	10.6	10.9	11.3	11.6	11.8	12.0	12.3	12.5	12.8	13.0	13.3	13.5	13.8	14.1	14.4	14.7
111	General cargo (Cont)	Nacala	Kanengo	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.4	6.5	6.7	6.8	7.0	7.1	7.2	7.4	7.5	7.7	7.8	8.0	8.1
103	Salt	Nacala	Kanengo	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.6
105	Wheat grain	Nacala	Kanengo	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.9	2.9	3.0	3.0	3.1
104	Soap noodles	Nacala	Kanengo	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
101	Cement (Bulk)	Blantyre	Kanengo	3.0	3.1	3.2	3.4	3.5	3.6	3.7	3.8	3.9	3.9	4.0	4.1	4.2	4.3	4.4	4.4	4.5	4.6	4.7	4.8
203	Wheat Flour (Bulk)	Limbe	Kanengo	6.2	6.5	6.7	6.9	7.2	7.4	7.7	7.8	8.0	8.1	8.3	8.5	8.6	8.8	9.0	9.2	9.4	9.5	9.7	9.9
202	Quarystones	Limbe	Sandama	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
203	Wheat Flour (Bulk)	Limbe	Kanengo	3.1	3.2	3.3	3.4	3.5	3.7	3.8	3.9	4.0	4.0	4.1	4.2	4.3	4.4	4.5	4.5	4.6	4.7	4.8	4.9
102	Fertiliser (Bulk)	Liwonde	Kanengo	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
103	Salt	Liwonde	Limbe	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
103	Salt	Liwonde	Kanengo	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1
900	Empty Containers	Blantyre	Kanengo	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
900	Empty Containers	Blantyre	Kanengo	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
110	Fertiliser (Cont)	Nacala	Chipata			33.9	84.7	88.9	93.4	98.0	100.0	102.0	104.0	106.1	108.2	109.9	111.5	113.2	114.9	116.6	118.4	120.1	121.9
109	Fuel (Diesel)	Nacala	Chipata			67.8	112.9	118.6	124.5	130.7	133.3	136.0	138.7	141.5	144.3	146.5	148.7	150.9	153.2	155.5	157.8	160.2	162.6
111	General cargo (Cont)	Nacala	Chipata			11.3	45.2	47.4	49.8	52.3	53.3	54.4	55.5	56.6	57.7	58.6	59.5	60.4	61.3	62.2	63.1	64.1	65.0
012	Sugar (Cont)	Chipata	Nacala			112.9	169.4	225.8	282.3	288.0	293.7	299.6	305.6	311.7	317.9	322.7	327.5	332.4	337.4	342.5	347.6	352.8	358.1
008	Cotton lint (Cont)	Chipata	Nacala			33.9	79.0	83.0	87.1	91.5	93.3	95.2	97.1	99.0	101.0	102.5	104.1	105.6	107.2	108.8	110.5	112.1	113.8
301	Maize (Cont)	Chipata	Nacala			22.6	33.9	35.6	37.3	39.2	40.0	40.8	41.6	42.4	43.3	43.9	44.6	45.3	46.0	46.6	47.3	48.1	48.8
009	Groundnuts (Cont)	Chipata	Nacala			22.6	33.9	35.6	37.3	39.2	40.0	40.8	41.6	42.4	43.3	43.9	44.6	45.3	46.0	46.6	47.3	48.1	48.8
302	Other Agro Prod. (Cont)	Chipata	Nacala			33.9	45.2	47.4	49.8	52.3	53.3	54.4	55.5	56.6	57.7	58.6	59.5	60.4	61.3	62.2	63.1	64.1	65.0
303	Mineral Ores	Chipata	Nacala			112.9	112.9	112.9	112.9	112.9	115.2	117.5	119.8	122.2	124.7	127.2	129.7	132.3	135.0	137.7	140.4	143.2	146.1
	Totals			409	423	890	1,171	1,265	1,360	1,407	1,435	1,464	1,493	1,523	1,553	1,580	1,607	1,635	1,663	1,692	1,721	1,750	1,781

**Additional traffic potentials**

## Additional traffic potentials

## Annex 5.2.2

Project	Origin	Destination	tonnes p.a.
<b>Short-term projects</b>			
Kanankunde Rare Earth Minerals	Balaka	Nacala	96,000
Balaka Limestone Deposits For Cement + Pharmaceutical Lime	Balaka	Nacala	5,000
	Balaka	Blantyre / Kanengo	50,000
Heavy Mineral Sands - Senga Bay	Chipoka	Nacala	35,000
Heavy Mineral Sands - Halala-Namanja Deposit	Liwonde	Nacala	175,000
Tobacco Flue Cured Expansion	Kanengo	Nacala	8,000
Kayerekera Uranium Mine	Chipoka	Nacala	1,500
Coal Mine - Luferi Open Cast	Chipoka	Blantyre	20,000
	Chipoka	Kanengo	10,000
Forestry Concessions - Vipya Plateau	Chipoka	Nacala	70,500
<b>Total Short-term projects</b>	<b>Local</b>		<b>80,000</b>
	<b>Export via Nacala</b>		<b>391,000</b>
<b>Mid- and long-term projects</b>			
Tandulu Phosphates	Liwonde	Nacala	20,000
	Liwonde	Chipata	40,000
Pyrite To Sulphuric Acid Plant - Dowa	Kanengo	Chipoka	3,500
	Kanengo	Blantyre	4,000
	Kanengo	Nacala	20,000
	Kanengo	Chipata	10,000
Heavy Mineral Sands - Makanjila Deposit	Chipoka	Nacala	24,375
Heavy Mineral Sands - Chipoka Smelter	Chipoka	Nacala	130,000
Bwanje Valley - Lime Deposit For Cement + Pharmaceutical Industry	Chipoka	Blantyre / Kanengo	40,000
Heavy Mineral Sands - Nkhotakota Deposit	Chipoka	Nacala	14,725
Consolidated Resources and Mining, Zambia	Chipata	Nacala	1,000,000
Ngana Colliery And Power Plant (250 MW)	Chipoka	Blantyre / Kanengo	25,000
<b>Total Mid- and long-term projects</b>	<b>Local</b>		<b>72,500</b>
	<b>Export via Chipata</b>		<b>50,000</b>
	<b>Export via Nacala</b>		<b>1,209,100</b>

**Commodity parameters**

## Commodity Parameters

## Annex 5.3.3

Code	Export / Import / Transit <sup>*)</sup> / Local	Commodity	Density [tonnes/m <sup>3</sup> ]	CEAR/ CDN Code	International Code (UIC 438-2)	Capacity usage [%]	Effective Load [tonnes/unit]	
							Scenario I	Scenario II
001	E	Eggs	0.600	CB	Ga	75%	22.1	22.1
002	E	Pigeon peas (Bulk)	1.320	CB	Ga	85%	36.3	49.0
003	E	Plastic Ware	0.200	CB	Ga	85%	8.3	8.3
004	E	Sugar (Bulk)	0.849	CB	Ga	85%	35.4	35.4
005	E	Toor Dhal (Bulk)	1.320	CB	Ga	85%	36.3	49.0
006	E	Iron Ore	2.500	HSB	Ea	100%	39.5	51.5
007	E	Potatoes	0.769	HSB	Ea	100%	30.0	30.0
008	E / T	Cotton lint (Cont)	0.472	CC	TEU	100%	13.2	13.2
009	E / T	Groundnuts (Cont)	0.641	CC	TEU	100%	17.0	17.9
010	E	Machinery	0.800	CC	TEU	80%	17.0	17.9
011	E	Pigeon peas (Cont)	1.320	CC	TEU	100%	17.0	24.2
012	E / T	Sugar (Cont)	0.849	CC	TEU	100%	17.0	23.8
013	E	Tea	0.520	CC	TEU	100%	14.6	14.6
014	E	Tobacco	0.320	CC	TEU	100%	9.0	9.0
015	E	Toor Dhal (Cont)	1.320	CC	TEU	100%	17.0	24.2
016	E	Used machinery	0.800	CC	TEU	80%	17.0	17.9
101	I / L	Cement (Bulk)	1.500	CB	Ga	85%	36.3	49.0
102	I	Fertiliser (Bulk)	0.960	CB	Ga	85%	36.3	40.0
103	I / L	Salt	1.200	CB	Ga	85%	36.3	49.0
104	I	Soap noodles	0.714	CB	Ga	85%	29.8	29.8
105	I	Wheat grain	0.769	CB	Ga	85%	32.0	32.0
106	I / L	Fertiliser (Hopper)	0.960	BB	Tag	100%	38.4	38.4
107	I	Clinker	1.922	HSB	Ea	100%	39.5	51.5
108	I	General cargo (Cont)	0.500	CC	TEU	80%	11.2	11.2
109	I / T	Fuel (Diesel)	0.900	FT	Za	100%	36.0	51.3
110	I / T	Fertiliser (Cont)	0.960	CC	TEU	100%	17.0	24.2
111	I / T	General cargo (Cont)	0.500	CC	TEU	80%	11.2	11.2
201	L [ / I*]	Green Tobacco	0.320	CB	Ga	65%	10.2	10.2
202	L	Quarystones	1.400	HSB	Ea	100%	39.5	51.5
203	L	Wheat Flour (Bulk)	0.593	CB	Ga	85%	24.7	24.7
301	T	Maize (Cont)	0.721	CC	TEU	100%	17.0	20.2
302	T	Other Agro Prod. (Cont)	0.700	CC	TEU	100%	17.0	19.6
303	T	Mineral Ores	2.400	HSB	Ea	100%	39.5	51.5
900	L	Empty Containers	-	U/LS	Sg	-	4.2	4.2

<sup>\*)</sup> Chipata

**Time-table 2012**



# Time-table 2012

# Annex 5.4.2.1

Train No.	from	to	Loco	tonnes	metres	Train composition	Timetable	
							Departure	Arrival
1001	Nacala	Nayuchi	U20C	584	293	1. Chipata	01 - 01:20	02 - 07:51
	Nayuchi	Chipata	MX615				02 - 09:21	03 - 05:16
1002	Chipata	Nayuchi	MX615	666	186	1. Nacala	01 - 19:00	02 - 14:29
	Nayuchi	Nacala	U20C				02 - 15:59	04 - 02:32
1003	Nacala	Cuamba	U20C+U20C	1002	429	1. Kanengo	01 - 04:32	02 - 08:14
	Cuamba	Nayuchi	U20C			2. Chipata		02 - 13:04
	Nayuchi	Nkaya	MX615			3. Nkaya	02 - 14:34	02 - 18:12
	Nkaya	Kanengo	MX615(+MX615)	720	289	4. Blantyre for 2002	02 - 19:00	03 - 05:49
	Kanengo	Chipata	MX615(+MX615)	413	207		03 - 06:49	03 - 11:55
1004	Chipata	Nayuchi	MX615	666	186	1. Nacala	01 - 21:33	02 - 19:41
	Nayuchi	Nacala	U20C				02 - 21:11	04 - 10:19
1005	Nacala	Cuamba	U20C+U20C	1002	251	1. Blantyre for 2006	01 - 11:47	02 - 16:33
	Cuamba	Nayuchi	U20C(+U20C)			2. Blantyre for 2004		02 - 22:06
	Nayuchi	Nkaya	MX615(+MX615)				02 - 23:36	03 - 03:15
1006	Chipata	Kanengo	MX615	458	128	<i>ex Kanengo</i>	01 - 08:31	01 - 13:55
	Kanengo	Nkaya	MX615	742	227	1. Nacala	01 - 15:21	02 - 01:40
	Nkaya	Nayuchi	MX615	666	204	2. Nkaya	02 - 04:10	02 - 07:52
	Nayuchi	Nacala	U20C(+U20C)	666	204		02 - 09:52	03 - 20:58
1007	Nacala	Nayuchi	U20C	638	211	1. Blantyre for 2004	01 - 06:33	02 - 16:19
	Nayuchi	Nkaya	MX615			2. Blantyre for 2002	02 - 19:46	02 - 23:20
1008	Nkaya	Nayuchi	MX615	666	212	1. Nacala	01 - 18:50	01 - 22:39
	Nayuchi	Nacala	U20C	666	212		02 - 00:09	04 - 05:46
1010	Nkaya	Nayuchi	MX615	607	193	1. Nacala	01 - 05:41	01 - 09:16
	Nayuchi	Nacala	U20C	607	193		01 - 12:42	03 - 13:00
2001	Blantyre	Nkaya	MX615	759	274	1. Nkaya	01 - 00:45	01 - 03:51
						2. Nacala for 1010		
2002	Nkaya	Blantyre	MX615	615	154	1. Blantyre	01 - 00:34	01 - 03:50
2003	Blantyre	Nkaya	MX615	524	190	1. Nkaya	01 - 14:54	01 - 18:00
						2. Nacala for 1008		
2004	Nkaya	Blantyre	MX615	615	154	1. Blantyre	01 - 04:00	01 - 07:16
2006	Nkaya	Blantyre	MX615	615	154	1. Blantyre	01 - 04:59	01 - 08:15

**Locomotive rosters 2012**

# Locomotive Rosters 2012

# Annex 5.4.2.2

Type	Roster	Details							
U20C	1	NAC	1001(1)	01 - 01:20 NAY	02 - 07:51	02 - 09:52	1006(1)	NAC	03 - 20:58
	2	NAC	1001(2)	02 - 01:20 NAY	03 - 07:51	03 - 09:52	1006(2)	NAC	04 - 20:58
	3	NAC	1001(3)	03 - 01:20 NAY	04 - 07:51	04 - 09:52	1006(3)	NAC	05 - 20:58
	4	NAC	1003(1)	01 - 04:32 NAY	02 - 13:04	02 - 15:59	1002(1)	NAC	04 - 02:32
	5	NAC	1003(2)	02 - 04:32 NAY	03 - 13:04	03 - 15:59	1002(2)	NAC	05 - 02:32
	6	NAC	1003(3)	03 - 04:32 NAY	04 - 13:04	04 - 15:59	1002(3)	NAC	06 - 02:32
	7	NAC	1005(1)	01 - 11:47 NAY	02 - 22:06	03 - 00:09	1008(1)	NAC	05 - 05:46
	8	NAC	1005(2)	02 - 11:47 NAY	03 - 22:06	04 - 00:09	1008(2)	NAC	06 - 05:46
	9	NAC	1005(3)	03 - 11:47 NAY	04 - 22:06	05 - 00:09	1008(3)	NAC	07 - 05:46
	10	NAC	1005(4)	04 - 11:47 NAY	05 - 22:06	06 - 00:09	1008(4)	NAC	08 - 05:46
	11	NAC	1007(1)	01 - 06:33 NAY	02 - 16:19	02 - 21:11	1004(1)	NAC	04 - 10:19
		NAC	1005II(1)	04 - 11:47 NAY	05 - 22:06	06 - 12:42	1010(1)	NAC	08 - 13:00
	12	NAC	1007(2)	02 - 06:33 NAY	03 - 16:19	03 - 21:11	1004(2)	NAC	05 - 10:19
		NAC	1005II(2)	05 - 11:47 NAY	06 - 22:06	07 - 12:42	1010(2)	NAC	09 - 13:00
	13	NAC	1007(3)	03 - 06:33 NAY	04 - 16:19	04 - 21:11	1004(3)	NAC	06 - 10:19
		NAC	1005II(3)	06 - 11:47 NAY	07 - 22:06	08 - 12:42	1010(3)	NAC	10 - 13:00
	14	NAC	1007(4)	04 - 06:33 NAY	05 - 16:19	05 - 21:11	1004(4)	NAC	07 - 10:19
		NAC	1005II(4)	07 - 11:47 NAY	08 - 22:06	09 - 12:42	1010(4)	NAC	11 - 13:00
	15	NAC	1007(5)	05 - 06:33 NAY	06 - 16:19	06 - 21:11	1004(5)	NAC	08 - 10:19
		NAC	1005II(5)	08 - 11:47 NAY	09 - 22:06	10 - 12:42	1010(5)	NAC	12 - 13:00
	16	NAC	1007(6)	06 - 06:33 NAY	07 - 16:19	07 - 21:11	1004(6)	NAC	09 - 10:19
		NAC	1005II(6)	09 - 11:47 NAY	10 - 22:06	11 - 12:42	1010(6)	NAC	13 - 13:00
	17	NAC	1007(7)	07 - 06:33 NAY	08 - 16:19	08 - 21:11	1004(7)	NAC	10 - 10:19
		NAC	1005II(7)	10 - 11:47 NAY	11 - 22:06	12 - 12:42	1010(7)	NAC	14 - 13:00
	18	NAC	1007(8)	08 - 06:33 NAY	09 - 16:19	09 - 21:11	1004(8)	NAC	11 - 10:19
		NAC	1005II(8)	11 - 11:47 NAY	12 - 22:06	13 - 12:42	1010(8)	NAC	15 - 13:00
	19	NAC	1003II(1)	01 - 04:32 CUA	02 - 08:14	03 - 14:43	1006II(1)	NAC	03 - 20:58
	20	NAC	1003II(2)	02 - 04:32 CUA	03 - 08:14	04 - 14:43	1006II(2)	NAC	04 - 20:58
	21	NAC	1003II(3)	03 - 04:32 CUA	04 - 08:14	05 - 14:43	1006II(3)	NAC	05 - 20:58
MX615	1	NAY	1001(1)	01 - 09:21 CHI	02 - 05:16	02 - 08:31	1006(1)	NAY	03 - 07:52
	2	NAY	1001(2)	02 - 09:21 CHI	03 - 05:16	03 - 08:31	1006(2)	NAY	04 - 07:52
	3	NAY	1003(1)	01 - 14:34 CHI	02 - 11:55	02 - 19:00	1002(1)	NAY	03 - 14:29
		NAY	1007(1)	03 - 19:46 NKY	03 - 23:20	04 - 00:34	2002(1)	BLZ	04 - 03:50
		BLZ	2003(1)	04 - 14:54 NKY	04 - 18:00	04 - 18:50	1008(1)	NAY	04 - 22:39
		NAY	1005(1)	04 - 23:36 NKY	05 - 03:15	05 - 05:41	1010(1)	NAY	05 - 09:16
	4	NAY	1003(2)	02 - 14:34 CHI	03 - 11:55	03 - 19:00	1002(2)	NAY	04 - 14:29
		NAY	1007(2)	04 - 19:46 NKY	04 - 23:20	05 - 00:34	2002(2)	BLZ	05 - 03:50
		BLZ	2003(2)	05 - 14:54 NKY	05 - 18:00	05 - 18:50	1008(2)	NAY	05 - 22:39
		NAY	1005(2)	05 - 23:36 NKY	06 - 03:15	06 - 05:41	1010(2)	NAY	06 - 09:16
	5	NAY	1003(3)	03 - 14:34 CHI	04 - 11:55	04 - 19:00	1002(3)	NAY	05 - 14:29
		NAY	1007(3)	05 - 19:46 NKY	05 - 23:20	06 - 00:34	2002(3)	BLZ	06 - 03:50
		BLZ	2003(3)	06 - 14:54 NKY	06 - 18:00	06 - 18:50	1008(3)	NAY	06 - 22:39
		NAY	1005(3)	06 - 23:36 NKY	07 - 03:15	07 - 05:41	1010(3)	NAY	07 - 09:16
	6	NAY	1003(4)	04 - 14:34 CHI	05 - 11:55	05 - 19:00	1002(4)	NAY	06 - 14:29
		NAY	1007(4)	06 - 19:46 NKY	06 - 23:20	07 - 00:34	2002(4)	BLZ	07 - 03:50
		BLZ	2003(4)	07 - 14:54 NKY	07 - 18:00	07 - 18:50	1008(4)	NAY	07 - 22:39
		NAY	1005(4)	07 - 23:36 NKY	08 - 03:15	08 - 05:41	1010(4)	NAY	08 - 09:16
	7	NKY	1003II(1)	01 - 19:00 CHI	02 - 11:55	02 - 21:33	1004(1)	NAY	03 - 19:41
		NAY	1005II(1)	03 - 23:36 NKY	04 - 03:15	04 - 04:00	2004(1)	BLZ	04 - 07:16
		BLZ	2003II(1)	04 - 14:54 NKY	04 - 18:00				
	8	NKY	1003II(2)	02 - 19:00 CHI	03 - 11:55	03 - 21:33	1004(2)	NAY	04 - 19:41
		NAY	1005II(2)	04 - 23:36 NKY	05 - 03:15	05 - 04:00	2004(2)	BLZ	05 - 07:16
		BLZ	2003II(2)	05 - 14:54 NKY	05 - 18:00				
	9	NKY	1003II(3)	03 - 19:00 CHI	04 - 11:55	04 - 21:33	1004(3)	NAY	05 - 19:41
		NAY	1005II(3)	05 - 23:36 NKY	06 - 03:15	06 - 04:00	2004(3)	BLZ	06 - 07:16
		BLZ	2003II(3)	06 - 14:54 NKY	06 - 18:00				
	10	BLZ	2001	01 - 00:45 NKY	01 - 03:51	01 - 04:59	2006	BLZ	01 - 08:15

**Time-table 2016**

# Time-table 2016

# Annex 5.4.3.1

Train No.	from	to	Locos	tonnes	metres	Train composition	Timetable	
							Departure	Arrival
1001	Nacala	Nkaya	2	1890	624	1. Chipata	01 - 16:50	02 - 17:25
	Nkaya	Chipata	1 (2)	1029	443	2. Blantyre		03 - 06:25
1002	Chipata	Nkaya	1	986	246	1. Nacala	01 - 19:00	00 - 00:00
	Nkaya	Nacala	1	986	275	2. Nkaya	02 - 06:55	03 - 04:59
1003	Nacala	Nkaya	2	1890	624	1. Kanengo	01 - 05:18	02 - 05:30
	Nkaya	Salima	2	1316	535	2. Chipata	02 - 06:30	
	Salima	Kanengo	2	1316	535	3. Nkaya		02 - 13:55
	Kanengo	Chipata	1	832	358	4. Blantyre	02 - 14:40	02 - 18:15
1004	Chipata	Kanengo	1	1.211	302	<i>Ex Kanengo</i>	01 - 10:10	01 - 13:44
	Kanengo	Nkaya	2	1.528	411	1. Nacala	01 - 15:04	01 - 22:41
	Nkaya	Nacala	2	1973	550	2. Nkaya	02 - 00:01	03 - 02:44
1005	Nacala	Nkaya	1	338	112	1. Nkaya	01 - 12:40	02 - 13:32
1006	Nkaya	Nacala	1	986	275	1. Nacala	01 - 12:00	02 - 11:47
1008	Chipata	Nkaya	1	873	243	1. Nacala	01 - 08:25	00 - 00:00
	Nkaya	Nacala	1	932	260		01 - 20:26	02 - 22:56
2001	Blantyre	Nkaya	1	728	244	1. Nkaya	01 - 21:01	01 - 23:14
						2. Nacala		
2002	Nkaya	Blantyre	1	1058	251	1. Blantyre	02 - 18:30	02 - 20:56
2003	Blantyre	Nkaya	1	728	244	1. Nkaya	01 - 08:52	01 - 11:05
						2. Nacala		
2004	Nkaya	Blantyre	1	1007	239	1. Blantyre	02 - 06:20	02 - 08:46

**Locomotive rosters 2016**

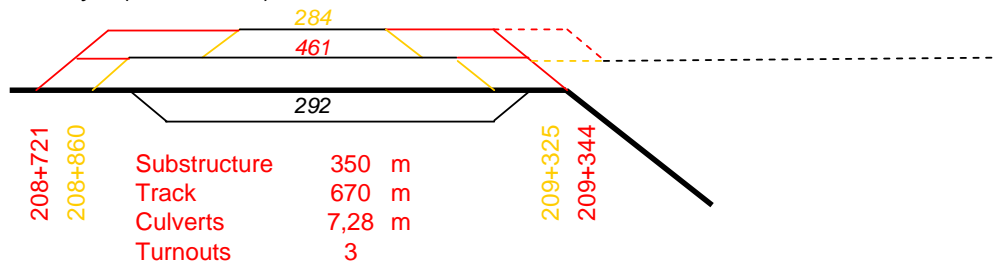
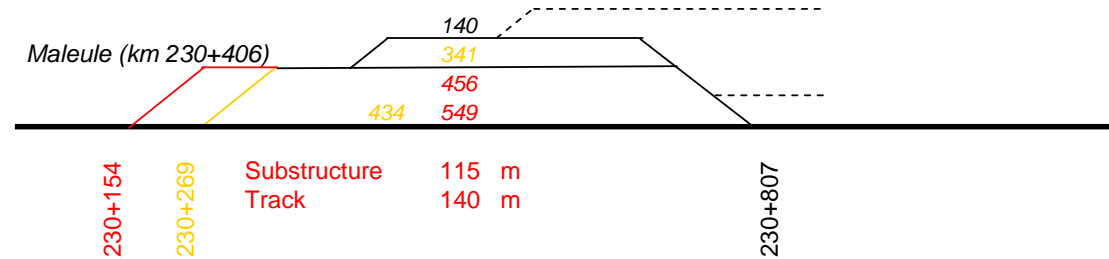
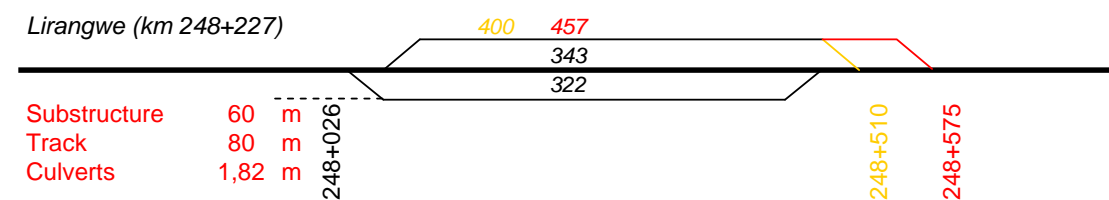
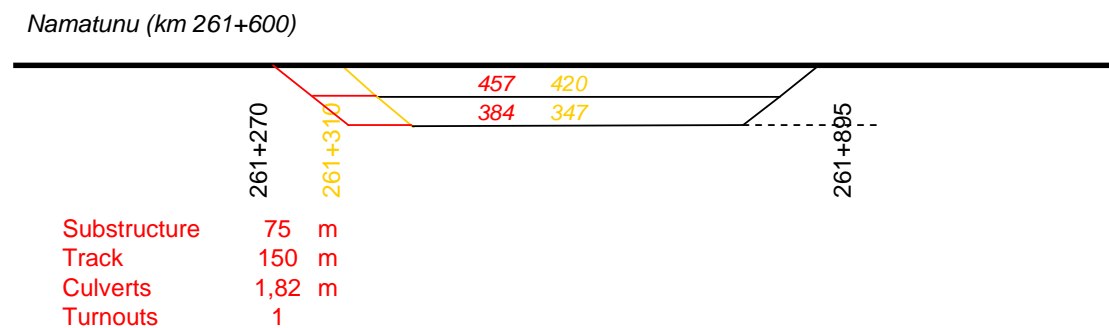
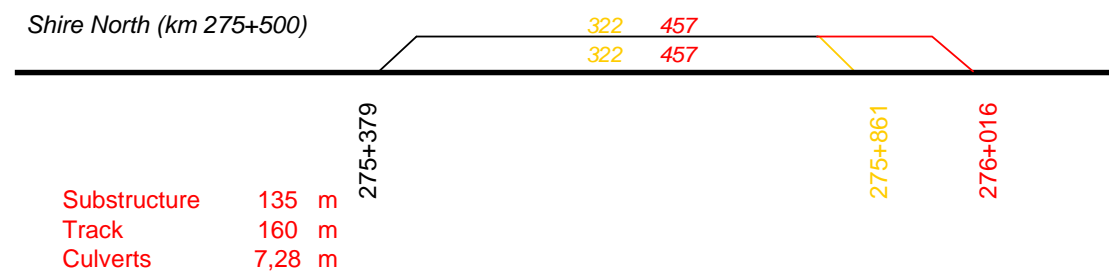
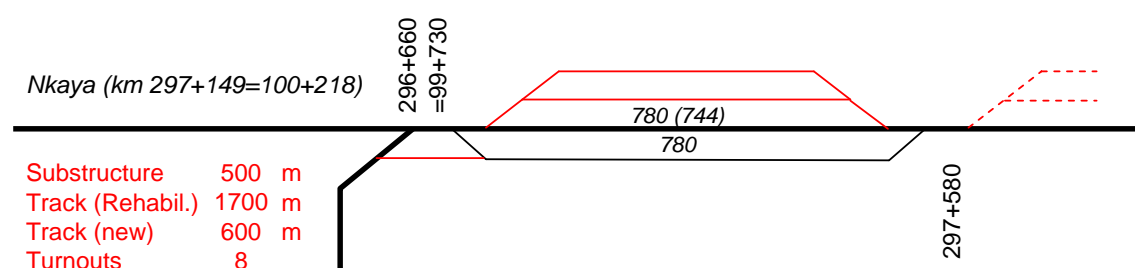
# Locomotive Rosters 2016

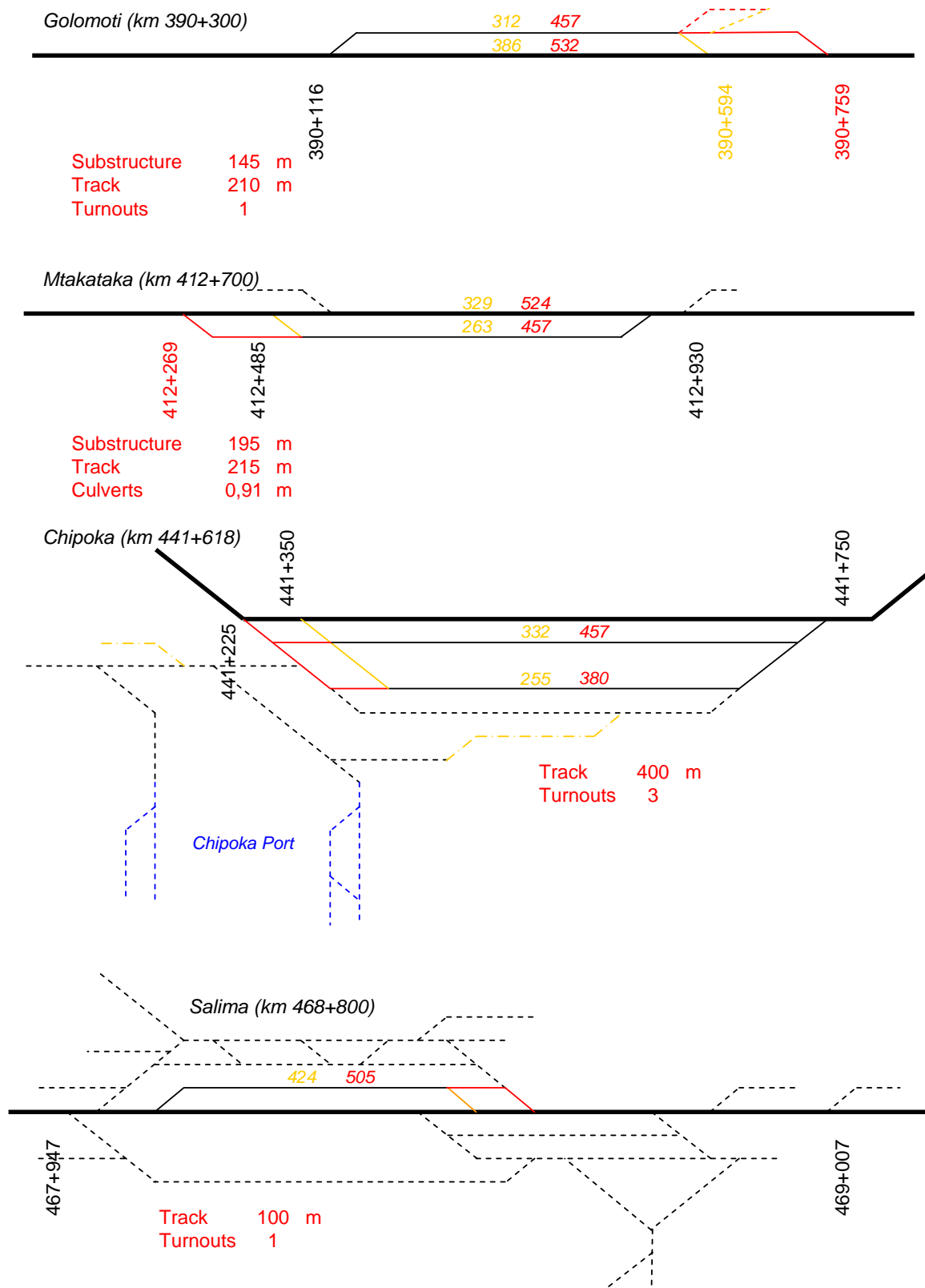
# Annex 5.4.3.2

Roster	Details										
1	NAC	1001(1)	01 - 16:50	CHI	03 - 06:25	03 - 10:10	1004(1)	NAC	05 - 02:44	05 - 05:18	1003(1)
				CHI	06 - 18:15	06 - 19:00	1002(1)	NAC	08 - 04:59		
2	NAC	1001(2)	02 - 16:50	CHI	04 - 06:25	04 - 10:10	1004(2)	NAC	06 - 02:44	06 - 05:18	1003(2)
				CHI	07 - 18:15	07 - 19:00	1002(2)	NAC	09 - 04:59		
3	NAC	1001(3)	03 - 16:50	CHI	05 - 06:25	05 - 10:10	1004(3)	NAC	07 - 02:44	07 - 05:18	1003(3)
				CHI	08 - 18:15	08 - 19:00	1002(3)	NAC	10 - 04:59		
4	NAC	1001(4)	04 - 16:50	CHI	06 - 06:25	06 - 10:10	1004(4)	NAC	08 - 02:44	08 - 05:18	1003(4)
				CHI	09 - 18:15	09 - 19:00	1002(4)	NAC	11 - 04:59		
5	NAC	1001(5)	05 - 16:50	CHI	07 - 06:25	07 - 10:10	1004(5)	NAC	09 - 02:44	09 - 05:18	1003(5)
				CHI	10 - 18:15	10 - 19:00	1002(5)	NAC	12 - 04:59		
6	NAC	1001(6)	06 - 16:50	CHI	08 - 06:25	08 - 10:10	1004(6)	NAC	10 - 02:44	10 - 05:18	1003(6)
				CHI	11 - 18:15	11 - 19:00	1002(6)	NAC	13 - 04:59		
7	NAC	1001(7)	07 - 16:50	CHI	09 - 06:25	09 - 10:10	1004(7)	NAC	11 - 02:44	11 - 05:18	1003(7)
				CHI	12 - 18:15	12 - 19:00	1002(7)	NAC	14 - 04:59		
8	NAC	1001II(1)	01 - 16:50	CHI	03 - 06:25	03 - 08:25	1008(1)	NAC	04 - 22:56	05 - 12:40	1005(1)
				NKY	06 - 13:32	06 - 18:30	2002(1)	BLZ	06 - 20:56	07 - 08:52	2003(1)
				NKY	07 - 11:05	07 - 12:00	1006(1)	NAC	08 - 11:47		
9	NAC	1001II(2)	02 - 16:50	CHI	04 - 06:25	04 - 08:25	1008(2)	NAC	05 - 22:56	06 - 12:40	1005(2)
				NKY	07 - 13:32	07 - 18:30	2002(2)	BLZ	07 - 20:56	08 - 08:52	2003(2)
				NKY	08 - 11:05	08 - 12:00	1006(2)	NAC	09 - 11:47		
10	NAC	1001II(3)	03 - 16:50	CHI	05 - 06:25	05 - 08:25	1008(3)	NAC	06 - 22:56	07 - 12:40	1005(3)
				NKY	08 - 13:32	08 - 18:30	2002(3)	BLZ	08 - 20:56	09 - 08:52	2003(3)
				NKY	09 - 11:05	09 - 12:00	1006(3)	NAC	10 - 11:47		
11	NAC	1001II(4)	04 - 16:50	CHI	06 - 06:25	06 - 08:25	1008(4)	NAC	07 - 22:56	08 - 12:40	1005(4)
				NKY	09 - 13:32	09 - 18:30	2002(4)	BLZ	09 - 20:56	10 - 08:52	2003(4)
				NKY	10 - 11:05	10 - 12:00	1006(4)	NAC	11 - 11:47		
12	NAC	1001II(5)	05 - 16:50	CHI	07 - 06:25	07 - 08:25	1008(5)	NAC	08 - 22:56	09 - 12:40	1005(5)
				NKY	10 - 13:32	10 - 18:30	2002(5)	BLZ	10 - 20:56	11 - 08:52	2003(5)
				NKY	11 - 11:05	11 - 12:00	1006(5)	NAC	12 - 11:47		
13	NAC	1001II(6)	06 - 16:50	CHI	08 - 06:25	08 - 08:25	1008(6)	NAC	09 - 22:56	10 - 12:40	1005(6)
				NKY	11 - 13:32	11 - 18:30	2002(6)	BLZ	11 - 20:56	12 - 08:52	2003(6)
				NKY	12 - 11:05	12 - 12:00	1006(6)	NAC	13 - 11:47		
14	NAC	1001II(7)	07 - 16:50	CHI	09 - 06:25	09 - 08:25	1008(7)	NAC	10 - 22:56	11 - 12:40	1005(7)
				NKY	12 - 13:32	12 - 18:30	2002(7)	BLZ	12 - 20:56	13 - 08:52	2003(7)
				NKY	13 - 11:05	13 - 12:00	1006(7)	NAC	14 - 11:47		
15	NKY	2004(1)	01 - 06:20	BLZ	01 - 08:46	01 - 21:01	2001(1)	NKY	01 - 23:14		
16	NAC	1003II(1)	01 - 05:18	KGO	02 - 13:55	02 - 15:04	1004II(1)	NAC	04 - 02:44		
17	NAC	1003II(1)	02 - 05:18	KGO	03 - 13:55	03 - 15:04	1004II(1)	NAC	05 - 02:44		
18	NAC	1003II(1)	03 - 05:18	KGO	04 - 13:55	04 - 15:04	1004II(1)	NAC	06 - 02:44		

**Draft layouts for network development**



*Blantyre (km 209+079)**Maleule (km 230+406)**Lirangwe (km 248+227)**Namatunu (km 261+600)**Shire North (km 275+500)**Nkaya (km 297+149=100+218)*



**Cost estimate network development**

Loop line extension and Nkaya station upgrade

Station	Substructure		Track (new)		Turnouts		Track (Rehabil.)		Culverts		Miscellaneous		Total US\$
	metres @ US \$	450.00	metres @ US \$	457.31	Nos. @ US \$	97,000	metres @ US \$	141.00	metres @ US \$	23,000	Item	US\$	
Blantyre	350	157,605	670	306,504	3	291,000			7.28	167,440			755,109
Maleule	115	51,855	140	64,130									115,985
Lirangwe	60	27,000	80	36,585					1.82	41,860			63,585
Namatunu	75	33,750	150	68,597	1	97,000			1.82	41,860			199,347
Shire North	135	60,672	160	73,090					7.28	167,440			133,762
Nkaya	500	225,000	600	274,386	8	776,000	1,700	239,700			Access Road	800,000	
											Buildings	300,000	
											Power Supply	350,000	
											Fuel Station	78,000	3,043,086
Golomoti	145	65,472	210	96,261	1	97,000							258,734
Mtakataka	195	87,868	215	98,442					0.91	20,930			186,310
Chipoka	400	180,000			3	291,000							471,000
Salima			100	45,731	1	97,000							142,731
<b>Total</b>													<b>5,369,648</b>

Signalling

Equipments		Total Network [US \$]	Malawi [US \$]
at	Nos.		
Control Office	5	485,000	189,150 (39%)
Mozambique	32	3,104,000	
Malawi	27	2,619,000	2,619,000
Zambia	1	97,000	
Locomotives	25	2,425,000	945,750 (39%)
<b>Total</b>		<b>8,730,000</b>	<b>3,753,900</b>

Unit cost = 97,000 US \$

**Additional investments for rolling stock 2017 – 2029**

**Additional Investments  
for Rolling Stock 2017-2029**

**Annex 5.7.2.1**

Year	Loco hrs per day	No of locos required	No of wagons required	Additional investments		
				Locos	Wagons	Total
2016	351.5	19	732			
2017	358.5	19	747		1.35	1.35
2018	365.7	20	762	5.00	1.35	6.35
2019	373.0	20	777		1.35	1.35
2020	380.4	21	793	5.00	1.44	6.44
2021	388.0	21	809		1.44	1.44
2022	395.8	21	825		1.44	1.44
2023	403.7	23	842	10.00	1.53	11.53
2024	411.8	23	859		1.53	1.53
2025	420.0	24	876	5.00	1.53	6.53
2026	428.4	24	894		1.62	1.62
2027	437.0	24	912		1.62	1.62
2028	445.7	25	930	5.00	1.62	6.62
2029	454.7	25	949		1.71	1.71
<b>Total</b>				<b>30.00</b>	<b>19.53</b>	<b>49.53</b>

Loco = 5,000,000 US \$

Wagon = 90,000 US \$

**Investments and Depreciation 2009 – 2029**

## Network

	Infrastructure																		Rolling Stock						Total capital costs	
	Track						Network Development						Bridges						Locomotives			Wagons				
	Rehabilitation			Renewal			Infrastructure			S & T			Rehabilitation			Renewal			t =	35 years	Residual value	t =	50 years	Residual value		
	t =	20 years	years	t =	40 years	years	t =	40 years	years	t =	25 years	years	t =	50 years	years	t =	100 years	years								
	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value								
2009-	159.0			144.5			22.0			8.7			19.5			9.1			95.0			65.9				
2009	6.0		6.0																						6.0	0.0
2010	23.6	-0.3	29.3	20.6	0.0	20.6	3.1	0.0	3.1	1.2	0.0	1.2	2.8	0.0	2.8	1.3	0.0	1.3							52.7	0.0
2011	43.2	-1.5	71.0	41.3	-0.5	61.4	6.3	-0.1	9.3	2.5	0.0	3.7	5.6	-0.1	8.3	2.6	0.0	3.9	23.8	0.0	23.8	16.5	0.0	16.5	101.4	40.2
2012	43.2	-3.6	110.5	41.3	-1.5	101.1	6.3	-0.2	15.4	2.5	-0.1	6.0	5.6	-0.2	13.7	2.6	0.0	6.5	23.8	-0.7	46.8	16.5	-0.3	32.6	101.4	40.2
2013	43.2	-5.8	147.8	41.3	-2.6	139.8	6.3	-0.4	21.3	2.5	-0.2	8.3	5.6	-0.3	19.0	2.6	-0.1	9.0	23.8	-1.4	69.2	16.5	-0.7	48.4	101.4	40.2
2014		-8.0	139.9		-3.6	136.2		-0.5	20.7		-0.3	7.9		-0.4	18.6		-0.1	8.9	23.8	-2.0	90.9	16.5	-1.0	63.9	0.0	40.2
2015		-8.0	131.9		-3.6	132.6		-0.5	20.2		-0.3	7.6		-0.4	18.2		-0.1	8.8		-2.7	88.2		-1.3	62.6	0.0	0.0
2016		-8.0	124.0		-3.6	129.0		-0.5	19.6		-0.3	7.2		-0.4	17.8		-0.1	8.7		-2.7	85.5		-1.3	61.3	0.0	0.0
2017		-8.0	116.0		-3.6	125.4		-0.5	19.1		-0.3	6.9		-0.4	17.4		-0.1	8.6		-2.7	82.8	1.4	-1.3	61.3	0.0	1.4
2018		-8.0	108.1		-3.6	121.8		-0.5	18.5		-0.3	6.5		-0.4	17.1		-0.1	8.6	5.0	-2.7	85.1	1.4	-1.3	61.3	0.0	6.4
2019		-8.0	100.1		-3.6	118.1		-0.5	18.0		-0.3	6.2		-0.4	16.7		-0.1	8.5		-2.9	82.2	1.4	-1.4	61.3	0.0	1.4
2020		-8.0	92.2		-3.6	114.5		-0.5	17.4		-0.3	5.8		-0.4	16.3		-0.1	8.4	5.0	-2.9	84.4	1.4	-1.4	61.3	0.0	6.4
2021		-8.0	84.2		-3.6	110.9		-0.5	16.9		-0.3	5.5		-0.4	15.9		-0.1	8.3		-3.0	81.4	1.4	-1.4	61.3	0.0	1.4
2022		-8.0	76.3		-3.6	107.3		-0.5	16.3		-0.3	5.1		-0.4	15.5		-0.1	8.2		-3.0	78.4	1.4	-1.5	61.3	0.0	1.4
2023		-8.0	68.3		-3.6	103.7		-0.5	15.8		-0.3	4.8		-0.4	15.1		-0.1	8.1	10.0	-3.0	85.4	1.5	-1.5	61.4	0.0	11.5
2024		-8.0	60.4		-3.6	100.1		-0.5	15.2		-0.3	4.4		-0.4	14.7		-0.1	8.0		-3.3	82.1	1.5	-1.5	61.4	0.0	1.5
2025		-8.0	52.4		-3.6	96.5		-0.5	14.7		-0.3	4.1		-0.4	14.3		-0.1	7.9	5.0	-3.3	83.8	1.5	-1.5	61.4	0.0	6.5
2026		-8.0	44.5		-3.6	92.9		-0.5	14.1		-0.3	3.7		-0.4	13.9		-0.1	7.8		-3.4	80.4	1.6	-1.6	61.4	0.0	1.6
2027		-8.0	36.5		-3.6	89.3		-0.5	13.6		-0.3	3.4		-0.4	13.5		-0.1	7.7		-3.4	76.9	1.6	-1.6	61.4	0.0	1.6
2028		-8.0	28.5		-3.6	85.6		-0.5	13.0		-0.3	3.0		-0.4	13.2		-0.1	7.6	5.0	-3.4	78.5	1.6	-1.6	61.4	0.0	6.6
2029		-8.0	20.6		-3.6	82.0		-0.5	12.5		-0.3	2.7		-0.4	12.8		-0.1	7.6		-3.6	74.9	1.7	-1.7	61.4	-138.1	-134.7

## Malawi

	Infrastructure																		Rolling Stock						Total capital costs	
	Track						Network Development						Bridges						Locomotives			Wagons				
	Rehabilitation			Renewal			Infrastructure			S & T			Rehabilitation			Renewal										
	t =	20	years	t =	40	years	t =	40	years	t =	25	years	t =	50	years	t =	100	years	t =	35	years	t =	50	years		
	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Investments	Depreciation	Residual value	Infrastructure	Rolling Stock
2009-	83.8			124.2			5.4			3.8			9.7			4.5			37.1			25.8				
2009	6.0		6.0																						6.0	0.0
2010	12.8	-0.3	18.5	17.7	0.0	17.7	0.8	0.0	0.8	0.5	0.0	0.5	1.4	0.0	1.4	0.6	0.0	0.6							33.9	0.0
2011	21.7	-0.9	39.3	35.5	-0.4	52.8	1.5	0.0	2.3	1.1	0.0	1.6	2.8	0.0	4.1	1.3	0.0	1.9	9.3	0.0	9.3	6.4	0.0	6.4	63.8	15.7
2012	21.7	-2.0	58.9	35.5	-1.3	86.9	1.5	-0.1	3.8	1.1	-0.1	2.6	2.8	-0.1	6.8	1.3	0.0	3.2	9.3	-0.3	18.3	6.4	-0.1	12.7	63.8	15.7
2013	21.7	-3.1	77.4	35.5	-2.2	120.2	1.5	-0.1	5.2	1.1	-0.1	3.6	2.8	-0.1	9.4	1.3	0.0	4.5	9.3	-0.5	27.1	6.4	-0.3	18.9	63.8	15.7
2014		-4.2	73.3		-3.1	117.1		-0.1	5.1		-0.2	3.4		-0.2	9.2		0.0	4.4	9.3	-0.8	35.5	6.4	-0.4	25.0	0.0	15.7
2015		-4.2	69.1		-3.1	114.0		-0.1	4.9		-0.2	3.3		-0.2	9.0		0.0	4.4		-1.1	34.5		-0.5	24.5	0.0	0.0
2016		-4.2	64.9		-3.1	110.8		-0.1	4.8		-0.2	3.1		-0.2	8.8		0.0	4.3		-1.1	33.4		-0.5	23.9	0.0	0.0
2017		-4.2	60.7		-3.1	107.7		-0.1	4.7		-0.2	3.0		-0.2	8.7		0.0	4.3		-1.1	32.4	1.4	-0.5	24.8	0.0	1.4
2018		-4.2	56.5		-3.1	104.6		-0.1	4.5		-0.2	2.8		-0.2	8.5		0.0	4.2	5.0	-1.1	36.3	1.4	-0.5	25.6	0.0	6.4
2019		-4.2	52.3		-3.1	101.5		-0.1	4.4		-0.2	2.7		-0.2	8.3		0.0	4.2		-1.2	35.1	1.4	-0.6	26.4	0.0	1.4
2020		-4.2	48.1		-3.1	98.4		-0.1	4.3		-0.2	2.5		-0.2	8.1		0.0	4.2	5.0	-1.2	38.9	1.4	-0.6	27.2	0.0	6.4
2021		-4.2	43.9		-3.1	95.3		-0.1	4.1		-0.2	2.4		-0.2	7.9		0.0	4.1		-1.3	37.5	1.4	-0.6	28.0	0.0	1.4
2022		-4.2	39.7		-3.1	92.2		-0.1	4.0		-0.2	2.2		-0.2	7.7		0.0	4.1		-1.3	36.2	1.4	-0.7	28.8	0.0	1.4
2023		-4.2	35.5		-3.1	89.1		-0.1	3.9		-0.2	2.1		-0.2	7.5		0.0	4.0	10.0	-1.3	44.9	1.5	-0.7	29.7	0.0	11.5
2024		-4.2	31.3		-3.1	86.0		-0.1	3.7		-0.2	1.9		-0.2	7.3		0.0	4.0		-1.6	43.2	1.5	-0.7	30.5	0.0	1.5
2025		-4.2	27.2		-3.1	82.9		-0.1	3.6		-0.2	1.8		-0.2	7.1		0.0	3.9	5.0	-1.6	46.6	1.5	-0.7	31.3	0.0	6.5
2026		-4.2	23.0		-3.1	79.8		-0.1	3.5		-0.2	1.6		-0.2	6.9		0.0	3.9		-1.8	44.8	1.6	-0.8	32.1	0.0	1.6
2027		-4.2	18.8		-3.1	76.7		-0.1	3.3		-0.2	1.5		-0.2	6.7		0.0	3.8		-1.8	43.0	1.6	-0.8	32.9	0.0	1.6
2028		-4.2	14.6		-3.1	73.6		-0.1	3.2		-0.2	1.3		-0.2	6.5		0.0	3.8	5.0	-1.8	46.3	1.6	-0.8	33.7	0.0	6.6
2029		-4.2	10.4		-3.1	70.5		-0.1	3.0		-0.2	1.2		-0.2	6.3		0.0	3.7		-1.9	44.3	1.7	-0.9	34.5	-95.2	-77.2



**Economic benefits by commodity**

## Economic Benefits by Commodity

Commodity	Origin/ Destination	Commercial value 1)	Rail Transport, average			Corridor 2)		Comparative Values				Benefits			
			Dis- tance	lead time	Cost @ 0.06 US\$/ tonne-km			Road Transport		Sea transport		Transport costs	Time costs		Total
								Cost 3)	Lead time difference	Cost 4)	Lead time difference		Land	Sea	
		US\$/tonne	kms	days	US\$/tonne	US\$/tonne	days	US\$/tonne	days	US\$/tonne					
Exports															
Tobacco	Malawi	1,889	990	2.0	59.37	Beira	29%								
						Durban	71%	245.71	3.8	-58.55	-4.1	127.79	5.96	-3.21	130.55
Sugar	Malawi	229	824	2.4	49.46	Nacala	51%								
						Beira	49%	101.81	4.2	12.72	-1.0	65.07	0.78	-0.09	65.76
	Zambia		1,129	2.0	67.75	Dar es Salaam	100%	175.97	2.0	19.46	2.0	127.68	0.38	0.19	128.24
Tea	Malawi	808	800	2.0	48.02	Nacala	14%								
						Beira	24%								
						Durban	61%	240.44	4.5	32.95	-3.6	225.37	2.96	-1.18	227.15
Cotton	Malawi	896	800	2.0	48.02	Nacala	100%	80.04	8.0	0.00	0.0	32.02	5.89	0.00	37.91
	Zambia		1,129	2.0	67.75	Dar es Salaam	100%	175.97	2.0	19.46	2.0	127.68	1.47	0.74	129.89
Food Crops	Malawi	420	775	2.0	46.53	Nacala	100%	77.55	8.0	0.00	0.0	31.02	2.76	0.00	33.78
	Zambia		1,129	2.0	67.75	Dar es Salaam	100%	175.97	2.0	19.46	2.0	127.68	0.69	0.35	128.72
Other	Malawi	100	725	2.0	43.48	Nacala	28%								
						Durban	72%	220.96	5.8	-3.04	-3.6	174.44	0.48	-0.15	174.77
	Zambia	500	1,129	2.0	67.75	Dar es Salaam	100%	175.97	2.0	19.46	2.0	127.68	0.82	0.41	128.91
Imports															
Fuel	Malawi	358	800	2.0	48.02	Dar es Salaam	26%								
						Nacala	14%								
						Beira	60%	266.81	2.2	0.31	-0.7	219.10	0.66	-0.10	219.66
	Zambia		1,129	2.0	67.75	Dar es Salaam	100%	329.71	2.0	3.15	2.0	265.11	0.59	0.29	265.99
Fertilizer	Malawi	250	832	2.0	49.91	Dar es Salaam	12%								
						Nacala	53%								
						Beira	35%	152.63	4.9	12.78	-0.5	115.50	1.00	-0.05	116.45
	Zambia		1,129	2.0	67.75	Dar es Salaam	100%	175.97	2.0	3.50	2.0	111.72	0.41	0.21	112.34
Other	Malawi	300	813	2.0	48.80	Nacala	43%								
						Durban	57%	107.64	6.3	-4.20	-2.8	54.64	1.55	-0.35	55.84
	Zambia		1,129	2.0	67.75	Dar es Salaam	100%	175.97	2.0	19.46	2.0	127.68	0.49	0.25	128.42
Local Traffic															
	Malawi		330		19.83			33.05				13.22			13.22
	Mozambique		260		15.63			26.05				10.42			10.42

1) Source: TERA Transport Cost Study and consultant's estimate

2) According to TERA Transport Cost Study; do-nothing-case for Nacala Corridor

3) Basis: TERA Transport Cost Study and consultant's estimate (2.34 US \$ / truck km)

4) Basis: TERA Transport Cost Study and consultant's estimate (140% of 2003 cost)

**Annual economic benefits**

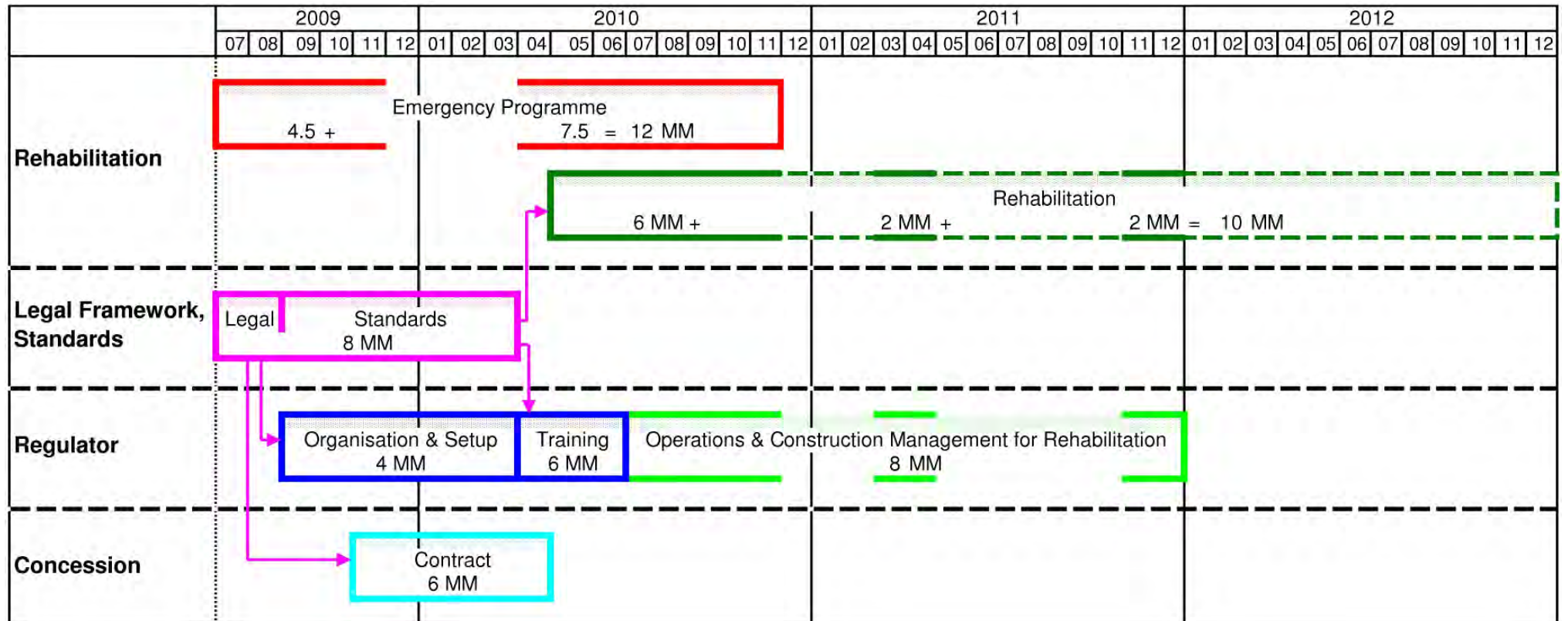
## Annual Economic Benefits

Year	Zambia								Malawi										Mozambique	
	Sugar	Cotton	Food Crops	Other Exports	Fuel	Fertiliser	Other Imports	Total	Tobacco	Sugar	Tea	Cotton	Food Crops	Other Exports	Fuel	Fertiliser	Other Imports	Local	Total	Local
	128.24	129.89	128.72	128.91	265.99	112.34	128.42		130.55	65.76	227.15	37.91	33.78	174.77	219.66	116.45	55.84	13.22		10.42
2009 tonnes	0	0	0	0	0	0	0		15,028	73,638	500	8,006	20,377	27,900	60,000	72,000	175,116	47,400		38,953
m US \$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	4.84	0.11	0.30	0.69	4.88	13.18	8.38	9.78	0.63	44.76	0.41
2010 tonnes	0	0	0	0	0	0	0		15,554	76,215	517	8,375	21,089	28,879	78,000	74,522	181,245	39,929		40,316
m US \$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.03	5.01	0.12	0.32	0.71	5.05	17.13	8.68	10.12	0.53	49.70	0.42
2011 tonnes	0	0	0	0	0	0	0		16,098	79,295	535	8,668	21,825	29,888	80,730	77,130	187,585	41,325		41,727
m US \$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.10	5.21	0.12	0.33	0.74	5.22	17.73	8.98	10.48	0.55	51.46	0.43
2012 tonnes	100,000	30,000	70,000	100,000	60,000	30,000	10,000		16,661	82,068	553	8,970	22,586	30,933	83,556	79,828	194,048	42,668		43,188
m US \$	12.82	3.90	9.01	12.89	15.96	3.37	1.28	59.24	2.18	5.40	0.13	0.34	0.76	5.41	18.35	9.30	10.84	0.56	53.26	0.45
2013 tonnes	150,000	70,000	100,000	100,000	100,000	75,000	40,000		17,244	84,942	572	9,284	23,379	32,015	86,480	82,621	200,838	44,159		44,699
m US \$	19.24	9.09	12.87	12.89	26.60	8.43	5.14	94.25	2.25	5.59	0.13	0.35	0.79	5.60	19.00	9.62	11.22	0.58	55.12	0.47
2014 tonnes	200,000	73,500	105,000	100,000	105,000	78,750	42,000		17,848	87,915	592	9,609	24,197	33,135	89,507	85,513	207,867	45,705		46,264
m US \$	25.65	9.55	13.52	12.89	27.93	8.85	5.39	103.77	2.33	5.78	0.13	0.36	0.82	5.79	19.66	9.96	11.61	0.60	57.05	0.48
2015 tonnes	250,000	77,175	110,250	100,000	110,250	82,688	44,100		18,472	90,992	613	9,945	25,044	34,295	92,640	88,506	215,143	47,304		47,883
m US \$	32.06	10.02	14.19	12.89	29.33	9.29	5.66	113.45	2.41	5.98	0.14	0.38	0.85	5.99	20.35	10.31	12.01	0.63	59.05	0.50
2016 tonnes	255,000	81,034	115,763	100,000	115,763	86,822	46,305		19,119	94,177	634	10,293	25,921	35,495	95,882	91,603	222,673	48,960		49,559
m US \$	32.70	10.53	14.90	12.89	30.79	9.75	5.95	117.51	2.50	6.19	0.14	0.39	0.88	6.20	21.06	10.67	12.43	0.65	61.11	0.52
2017 tonnes	260,100	82,654	118,078	102,000	118,078	88,558	47,231		19,501	96,060	647	10,499	26,439	36,205	97,800	93,435	227,126	49,939		50,550
m US \$	33.36	10.74	15.20	13.15	31.41	9.95	6.07	119.86	2.55	6.32	0.15	0.40	0.89	6.33	21.48	10.88	12.68	0.66	62.34	0.53
2018 tonnes	265,302	84,308	120,439	104,040	120,439	90,329	48,176		19,891	97,981	660	10,709	26,968	36,929	99,756	95,304	231,669	50,938		51,561
m US \$	34.02	10.95	15.50	13.41	32.04	10.15	6.19	122.26	2.60	6.44	0.15	0.41	0.91	6.45	21.91	11.10	12.94	0.67	63.58	0.54
2019 tonnes	270,608	85,994	122,848	106,121	122,848	92,136	49,139		20,289	99,941	673	10,923	27,507	37,668	101,751	97,210	236,302	51,957		52,593
m US \$	34.70	11.17	15.81	13.68	32.68	10.35	6.31	124.70	2.65	6.57	0.15	0.41	0.93	6.58	22.35	11.32	13.20	0.69	64.85	0.55
2020 tonnes	276,020	87,714	125,305	108,243	125,305	93,979	50,122		20,695	101,940	686	11,142	28,057	38,421	103,786	99,154	241,028	52,996		53,644
m US \$	35.40	11.39	16.13	13.95	33.33	10.56	6.44	127.20	2.70	6.70	0.16	0.42	0.95	6.71	22.80	11.55	13.46	0.70	66.15	0.56
2021 tonnes	281,541	89,468	127,811	110,408	127,811	95,858	51,124		21,109	103,979	700	11,365	28,619	39,190	105,861	101,138	245,849	54,056		54,717
m US \$	36.11	11.62	16.45	14.23	34.00	10.77	6.57	129.74	2.76	6.84	0.16	0.43	0.97	6.85	23.25	11.78	13.73	0.71	67.47	0.57
2022 tonnes	285,764	90,810	129,728	112,616	129,728	97,296	51,891		21,531	106,058	714	11,592	29,191	39,974	107,979	103,160	250,766	55,137		55,812
m US \$	36.65	11.80	16.70	14.52	34.51	10.93	6.66	131.76	2.81	6.97	0.16	0.44	0.99	6.99	23.72	12.01	14.00	0.73	68.82	0.58
2023 tonnes	290,050	92,172	131,674	114,869	131,674	98,756	52,670		21,961	108,179	728	11,824	29,775	40,773	110,138	105,223	255,781	56,240		56,928
m US \$	37.20	11.97	16.95	14.81	35.02	11.09	6.76	133.81	2.87	7.11	0.17	0.45	1.01	7.13	24.19	12.25	14.28	0.74	70.20	0.59
2024 tonnes	294,401	93,555	133,649	117,166	133,649	100,237	53,460		22,401	110,343	743	12,060	30,370	41,588	112,341	107,328	260,897	57,364		58,066
m US \$	37.76	12.15	17.20	15.10	35.55	11.26	6.87	135.89	2.92	7.26	0.17	0.46	1.03	7.27	24.68	12.50	14.57	0.76	71.60	0.61
2025 tonnes	298,817	94,958	135,654	119,509	135,654	101,741	54,262		22,849	112,550	758	12,301	30,978	42,420	114,588	109,475	266,114	58,512		59,228
m US \$	38.32	12.33	17.46	15.41	36.08	11.43	6.97	138.00	2.98	7.40	0.17	0.47	1.05	7.41	25.17	12.75	14.86	0.77	73.04	0.62
2026 tonnes	303,299	96,382	137,689	121,899	137,689	103,267	55,076		23,306	114,801	773	12,548	31,597	43,269	116,880	111,664	271,437	59,682		60,412
m US \$	38.90	12.52	17.72	15.71	36.62	11.60	7.07	140.15	3.04	7.55	0.18	0.48	1.07	7.56	25.67	13.00	15.16	0.79	74.50	0.63
2027 tonnes	307,849	97,828	139,754	124,337	139,754	104,816	55,902		23,772	117,097	789	12,798	32,229	44,134	119,217	113,897	276,865	60,875		61,621
m US \$	39.48	12.71	17.99	16.03	37.17	11.77	7.18	142.33	3.10	7.70	0.18	0.49	1.09	7.71	26.19	13.26	15.46	0.80	75.99	0.64
2028 tonnes	312,466	99,295	141,851	126,824	141,851	106,388	56,740		24,247	119,439	804	13,054	32,874	45,017	121,601	116,175	282,403	62,093		62,853
m US \$	40.07	12.90	18.26	16.35	37.73	11.95	7.29	144.55	3.17	7.85	0.18	0.49	1.11	7.87	26.71	13.53	15.77	0.82	77.51	0.65
2029 tonnes	317,153	100,785	143,978	129,361	143,978	107,984	57,591		24,732	121,828	820	13,316	33,531	45,917	124,033	118,499	288,051	63,335		64,110
m US \$	40.67	13.09	18.53	16.68	38.30	12.13	7.40	146.80	3.23	8.01	0.19	0.50	1.13	8.02	27.25	13.80	16.09	0.84	79.06	0.67

**Further Technical Assistance**

## Further Technical Assistance

### Overview and schedule



## Rehabilitation of infrastructure

### *Objective of the TA*

- To ensure that works are executed according to the defined quality standards and economically
- To transfer the know-how required

### *Scope of work*

- Cost estimate and budget plan
- Tendering
- Bid evaluation and contract conclusion
- Monitoring and approving programming and time schedule
- Supervision of execution of works and acceptance
- Know-how transfer to contractors

### *Time frame*

- Emergency programme: July 2009 through November 2010 (intermittent)
- Rehabilitation: May 2010 through December 2011 (intermittent)

### *Interdependency with other TA*

- Legal framework, standards, rules, regulations must be complete before commencement of rehabilitation
- Inspectors of the Regulatory Authority must be trained before rehabilitation works start
- Close co-ordination with the Operations & Construction Management (TA Regulatory Authority)

### *Expert's profile*

- University degree in civil engineering
- Comprehensive experience in substructure and permanent way

### *Deployment*

- Emergency programme: 12 man-months
- Rehabilitation: 10 man-months

## **Legal framework, standards, rules, regulations**

### ***Objective of the TA***

- To assist the Government of Malawi in enacting a Railway Act and the by-laws required, and in setting up comprehensive standards, rules and regulations
- To co-ordinate these activities with the respective teams in Mozambique and Zambia

### ***Scope of work***

- Railway Act defining basic issues such as network ownership, network access, concessions, regulatory body
- By-law containing basic standards for construction, operation and maintenance of railways
- Detailed standards, rules and regulations for
  - Infrastructure
  - Rolling Stock
  - Operations and safety
  - Border procedures
  - Commerce, finance and audit, administration

### ***Time frame***

- July 2009 through March 2010

### ***Interdependency with other TA***

Results of this TA will be precondition for

- Rehabilitation of infrastructure
- The Regulatory Authority
- The concession contract

### ***Expert's profiles***

- University degrees in engineering, transport economics, management or appropriate related disciplines
- Comprehensive experience in the rail sector

### ***Deployment***

- 8 man-months (2 experts intermittent)



## Regulatory Authority

### *Objective of the TA*

- To assist MOTPW in setting up the Regulatory Authority
- To transfer the know-how required and to train Regulator's Inspectors
- To assist the Regulatory Authority in setting up and executing Operations & Construction Management

### *Scope of work*

- Define tasks, organisation and work flows of the Regulatory Authority with departments for Technology and Inspection, Legal issues, Commerce / Finance / Audit
- Support the Regulatory Authority from startup in the day-to-day work (training on the job)
- Execute comprehensive Inspector's training focusing on technical acceptance and inspection of infrastructure but also including aspects of maintenance, surveying and workforce training
- Support contractors through know-how transfer
- Set up Operations & Construction Management within the Technology Department, and support the job during the starting period

### *Time frame*

- September 2009 through December 2011 (intermittent)

### *Interdependency with other TA*

- A functional Regulatory Authority including Operations & Construction Management is precondition for the network rehabilitation
- Close co-ordination with the Rehabilitation TA

### *Expert's profiles*

- University degrees in engineering, transport economics, management or appropriate related disciplines
- Comprehensive experience in the rail sector

### *Deployment*

- |   |                          |
|---|--------------------------|
| • Set up Regulatory Authority:          | 4 man-months             |
| • Inspector's training:                 | 6 man-months (2 experts) |
| • Operations & Construction Management: | 8 man-months             |

## **Concession**

### ***Objective of the TA***

- To assist MOTPW in effectuating a practicable and satisfactory concession contract

### ***Scope of work***

- Define key items of the contract on basis of international experience
- In co-operation with the Privatisation Commission, consider country-specific features
- Elaborate a structured draft contract
- Support MOTPW in contract negotiations

### ***Time frame***

- November 2009 through April 2010 (intermittent)

### ***Interdependency with other TA***

- The legal framework is precondition for a successful concession contract

### ***Expert's profiles***

- University degrees in law, transport economics, management, engineering or appropriate related disciplines
- Comprehensive experience in rail concessions

### ***Deployment***

- 6 man-months (2 experts intermittent)