03 RAIL DEVELOPMENT PLAN

FOREWORD

South Africa and the region require an effective and efficient rail system to support economic development. The LTPF 2014 is a visionary and credible 30-year development planning document describing how the rail network, terminals and rolling stock should evolve and what interventions and investments are required. It demonstrates how rail can grow market share and fulfil its rightful role in the regional freight transport sector and where future capacity developments should be focused.

The framework provides a fully integrated supply chain development view from regional, national, provincial and Transnet perspectives. It goes beyond solely public or private interests to facilitate the realisation of broad regional macroeconomic development strategies.

The LTPF 2014 offers the building blocks for the modernisation of rail and related industries in South Africa and all stakeholders are urged to support and use it to guide development in the years ahead.

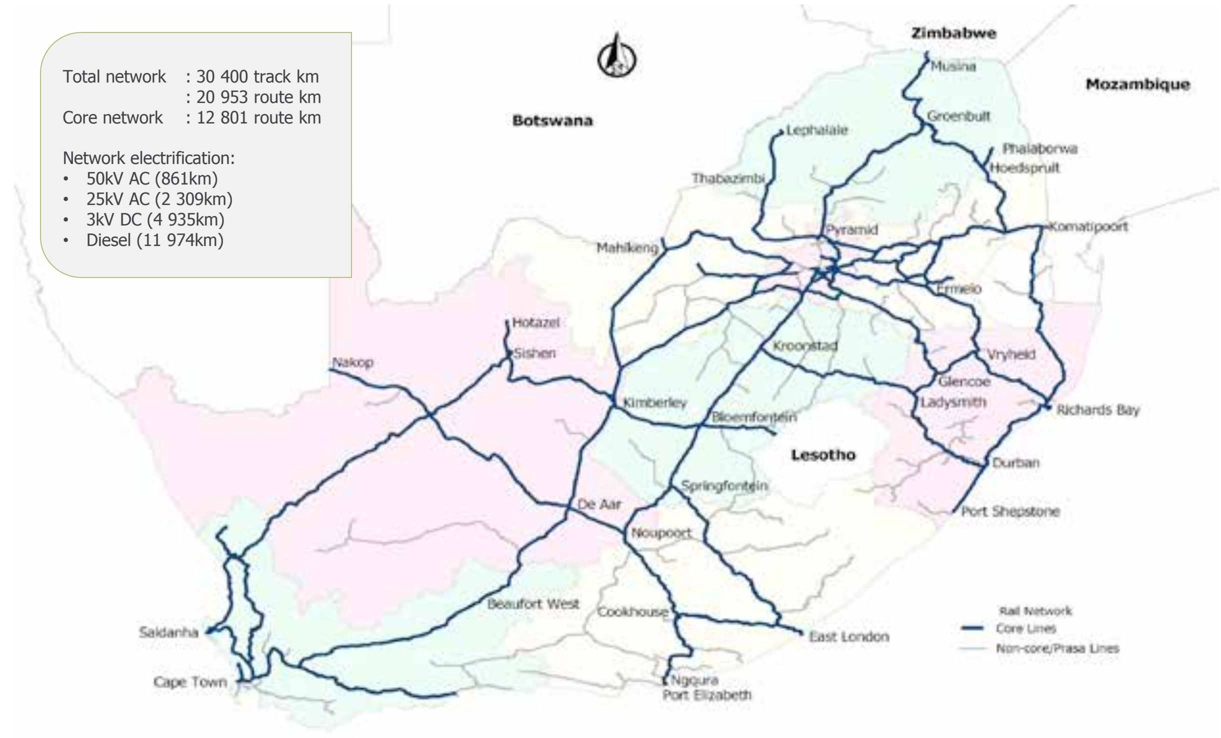
Mr Siyabonga Gama
Chief Executive: Transnet Freight Rail

TABLE OF CONTENTS

1. INTRODUCTION

The rail section of the Long-term Planning Framework (LTPF) provides development plans for the rail network, terminals and rolling stock. It is based on providing the required capacity to meet both the unconstrained demand and development of a strategic network to enhance economic development within South Africa and its neighbouring states.

Figure 1: Infrastructure overview map



1.1 INFRASTRUCTURE OVERVIEW

The LTPF has evolved over the last few years to a far more comprehensive and aligned long-term view and subsequently the rail development plans have also been adapted accordingly.

Rail developments must support and facilitate business imperatives such as operational efficiencies and safety.

Insufficient standardisation creates increased operational complexity and maintenance cost due to increased stock levels and training requirements.

The LTPF seeks to develop rail corridors with a substantially increased level of standardised operating principles and applied infrastructure technologies, such as:

- Development of consistent train operating principles throughout the whole corridor as far as possible for dominant traffic flows;
- Replace 3kV DC traction infrastructure and rolling stock with 25kV AC;
- Developing infrastructure for longer trains with heavier axle loads where justified. This is achieved by allowing for increased axle load rail infrastructure and increasing train crossing loop lengths and easing critical curves and gradients;
- Focus on pit-to-port unit train loads with minimal shunting along the route. This minimises yard requirements and results in reduced consignment throughput times and increased rolling stock efficiencies; and
- Standardised centralised train control (CTC) and track warrant train control systems.

The following development areas are included in the LTPF 2014:

Infrastructure

- Infrastructure condition assessment allows for the effect of increased maintenance on corridors where condition is not to the required standards;
- Installed and desired future technologies are considered in developing future infrastructure with a view to standardise technology wherever it makes business sense and will improve operational efficiencies and safety; and
- An improved capacity determination model gives more accurate views of future capacity constraints and what interventions are required to increase capacity.

Capacity

- A newly developed costing model allows for more accurate estimates of interventions required than in previous years;
- Branch lines require different commercial and operational strategies to that of main lines and have been included; and
- The SADC shares a comprehensive Cape gauge rail network and cross-border trade is essential for regional development. A macro-assessment of regional rail initiatives was undertaken to facilitate suitable rail development corridors.

1. INTRODUCTION (continued)

Rolling stock

- Rolling stock deployment and acquisition strategies have been independently developed to show an ideal scenario;
- Investments required for more standardisation and the use of more appropriate rolling stock technologies have been accommodated;

Hubs and terminals

- Updated hubs and terminal views indicate the continued growth in the container, automotive and palletised goods markets.

The rail network consists of more than 30 000km of track, including lifted and closed lines. The actual route distance is about 20 900km. The network provides excellent coverage of most of South Africa from a freight demand point of view and links all of the major mining and primary production areas with the port system. The network also covers all of the major commercial and consumer areas.

Roughly 60% of the network can be classified as the 'Core Network' with about 7 300km of lines classified as 'Branch Lines,' with the potential to service communities and activities not directly on the main corridors.

With the formation of a unified rail system in 1910, the South Africa Railways and Harbours was mandated to be a stimulus for growth, and by 1930 much of the network that we see today was already built. Since the end of the 1970s hardly any new lines were built and freight concentration considerations influenced the focus on main corridors maintenance and capacity enhancements.

Network electrification:	50kV AC (861km) 25kV AC (2 309km) 3kV DC (4 935km)
Axle loading:	Main lines at 20t/axle Coal and ore lines 30t/axle (coal line operates at 26t/axle)

1.2 DEVELOPMENT PLANNING PRINCIPLES

In order to guide and direct the development of the rail plan, certain planning principles were adopted. Although all the principles are applicable, the most fundamental principle used in the plan is that of matching capacity to demand, (see Figure 2).

Principle 1

Rail demand is derived from the surface demand forecast and market share strategies, and applied to the rail network in terms of the number of trains required.

Principle 2

Used to consider when to change lines to heavy haul standards or even to upgrade to higher speeds due to the type of freight that needs to be moved.

Principle 3

Considers changes to the network to improve operability, even if capacity is not a constraint. This may include the elimination of crossovers, repositioning of signals and new links or reconfigurations to improve reliability, maintainability and operational costs. The South African rail system provides connectivity of the hinterland with the ports and also supports connectivity to the southern African railway system.

Principle 4

Emphasises the need to retain the current connectivity to support further developments.

Principle 5

Supports the need to standardise the infrastructure in order to improve safety of operations, enhance maintainability and increase operational performance. This principle is also used with the development of rail terminals to provide a standardised design that will be cost effective to replicate and predictable from an end-user and operator perspective.

Principle 6

Highlights the need for integrated planning with other agencies such as PRASA and branch line operators. Alignment with PRASA will be applicable on the rail networks that are currently shared or planned to be shared in future.

Figure 2: Development planning principles

Principle 1: Match capacity to demand
Provide adequate corridor and terminal capacity at the right place ahead of demand.

Principle 2: Align infrastructure to freight type
Heavy haul or light industrial standards depending on the freight type.

Principle 3: Improve operational characteristics
Reconfigure line infrastructure and layouts to remove bottlenecks.

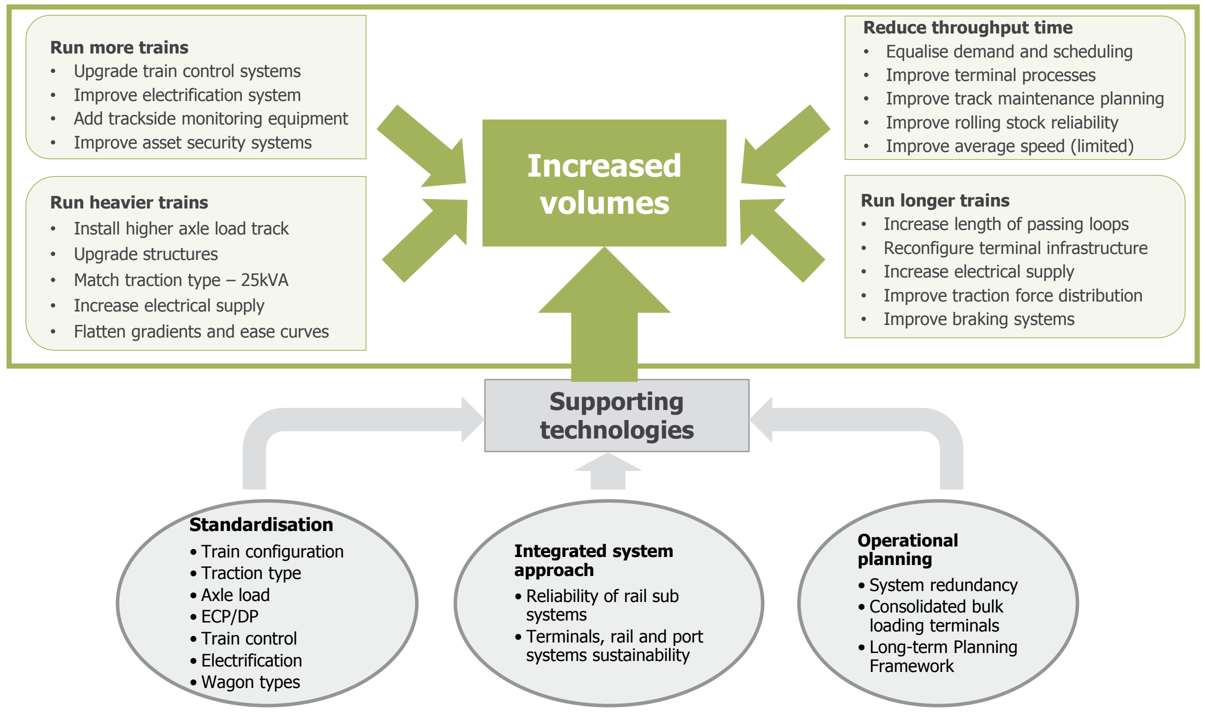
Principle 4: Ensure network connectivity
Link complementary ports with inland connections. Support connectivity to SADC/regional railways.

Principle 5: Standardise infrastructure
Use similar technologies across the network to improve safety, maintainability and operational performance.

Principle 6: Align with PRASA/non-Transnet operator requirements
Separate, re-route and enhance services where needed. Consider interoperability with branch-line services.

1.3 OPTIONS FOR CAPACITY CREATION (PRINCIPLE 1)

Figure 3: Options for capacity creation diagram



There are four steps to increase volume throughput on a rail network (not in order of priority):

- Reduce throughput time;
- Run longer trains;
- Run heavier trains; and
- Run more trains.

Therefore, the supporting operating levers need to be explored during the early system design stage. For example, to run more trains on the system, the operating levers should include upgrading of both train control systems and electrification systems, improving asset security systems and enhancing trackside monitoring systems.

Standardisation

In order to improve train operation efficiency, optimise maintenance slots and maximise operational revenues, the following train operational requirements underpin the train operating models and standardisation of the rail system:

- Run longer trains where possible;
- Convert the 3kV DC sections to 25kV AC or dieselise to eliminate islands;
- Axle loading across feeder system and main lines to be standardised;
- The utilisation of diesel DP/ECP electronically controlled pneumatic to overcome gradient challenges; and
- Deploy dual voltage locomotives where appropriate.

The utilisation of distributed power technology allows for the operation of longer trains, but has a major impact on the siding and yard layouts. It is preferred if locomotives are positioned at the front or the back of the train.

Heavier axle loading on existing infrastructure can be achieved by merely replacing the loose components (ballast, sleepers and rail). The formation, however, needs to be suited for the bearing capacity of trains. It is possible to increase from 20t/axle to 26t/axle loading, but not from 20t/axle to higher than 26t/axle.

Communication-based authorisation (CBA) in-cab signalling has a major impact on line capacity as this technology reduces headway between trains and increases the number of slots on a line. The CBA technology is not yet ready to be deployed.

1. INTRODUCTION (continued)

An integrated system approach

- Integration of the various rail subsystems to develop an integrated rail operation and capacity expansion plan;
- Port, rail and terminals systems need to be integrated to ensure that supply chain elements are aligned with the required throughput volumes; and
- Reliability and sustainability of both fixed infrastructure and rolling stock.

Operational planning

- Build redundancy into the rail system capacity to enable catch-up and flexibility of the system;
- Consolidated loading terminals to support junior miners, small scale producers and simplify loading operations; and
- Develop capacity within the parameters of the LTPF.

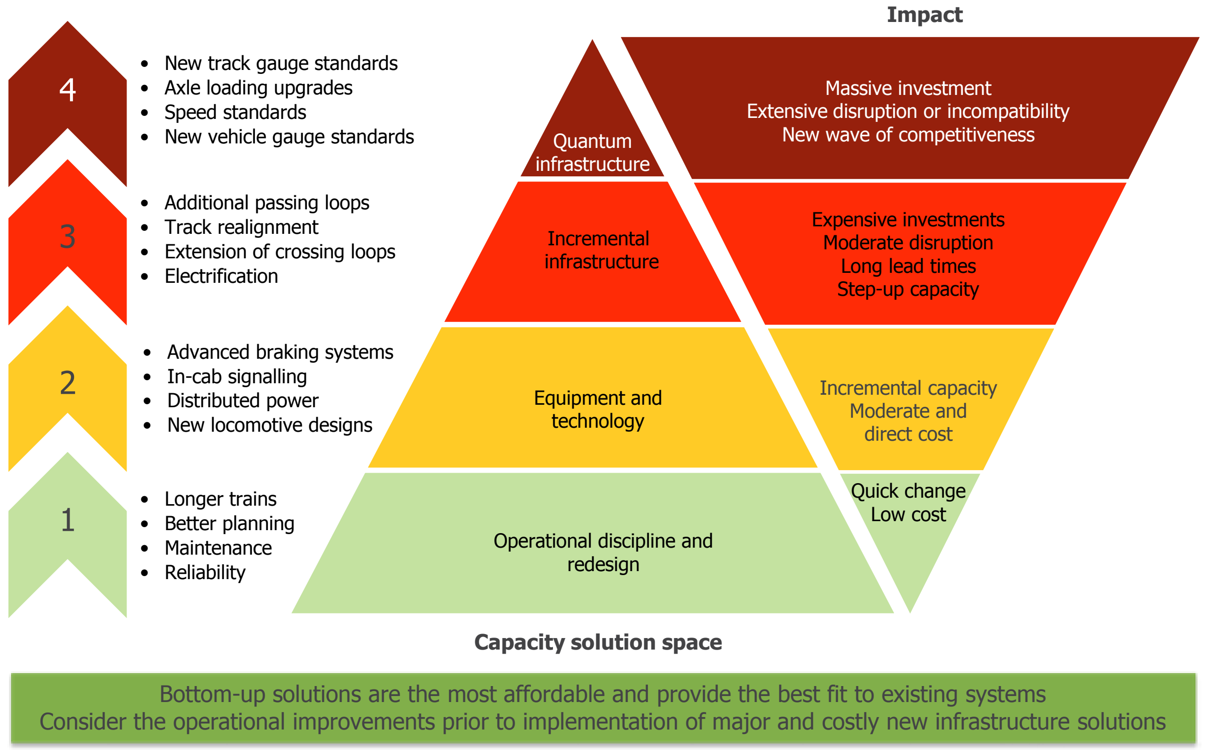
The illustration (Figure 4) demonstrates the application of the principles of finding practical solutions for infrastructure ahead of demand. It considers the operational improvements prior to implementation of major and costly new infrastructure solutions. The impact of the bottom-up capacity solution pyramid is that quick changes derived from operational discipline and redesign are in most cases affordable, whereas quantum infrastructure is only required for a high demand forecast.

Cognisance should be taken that the implementation of quantum infrastructure development is associated with massive investment and extensive disruption of operations.

It may be appropriate to jump straight to the top of the pyramid, but in most cases an incremental approach offers the best cost-to-benefit ratio.

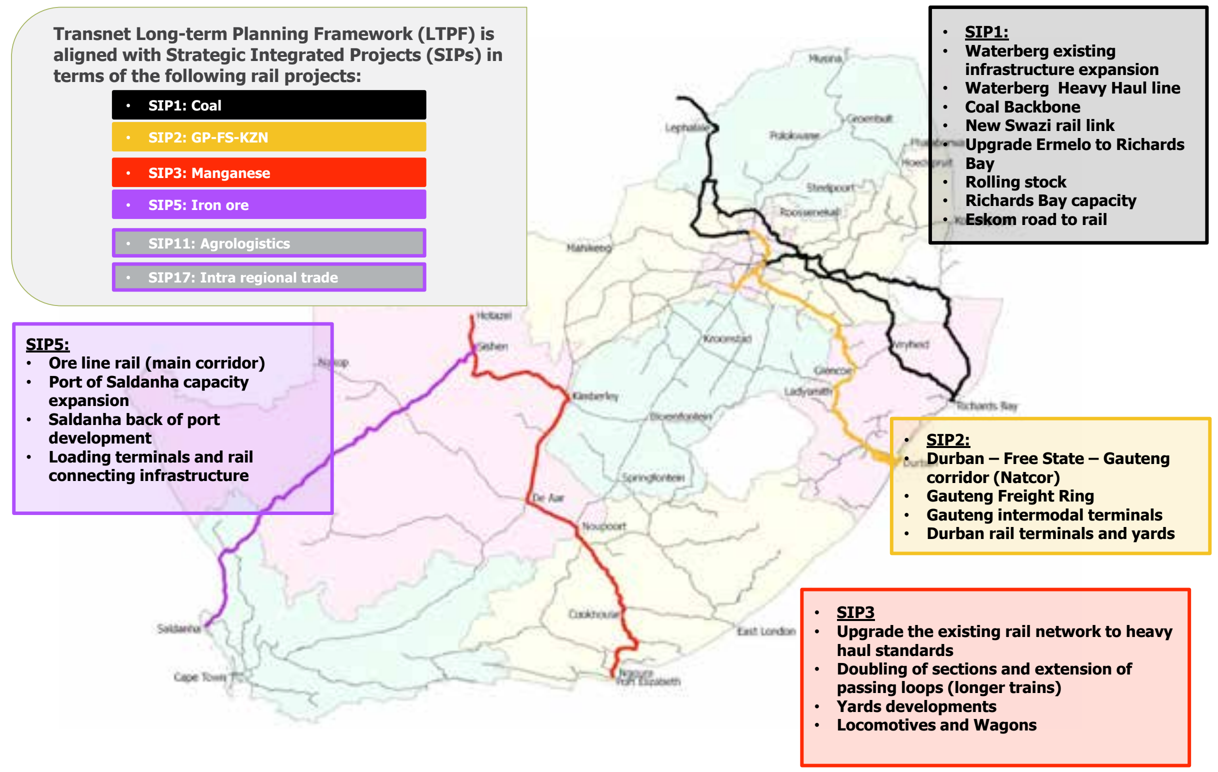
1.4 CAPACITY CREATION LOGIC

Figure 4: Capacity creation logic diagram



1.5 INFRASTRUCTURE DEVELOPMENT ALIGNMENT TO STRATEGIC INTEGRATED PROJECTS (SIPs)

Figure 5: Infrastructure development alignment to SIPs map



During the recent Presidential Infrastructure Coordination Committee (PICC) plan for South Africa, it emerged that State-owned Companies (SOCs) are required to participate meaningfully and also lead some of the identified SIPs. Transnet has identified projects that would support this initiative in the following SIPs:

- SIP 1: Unlocking the northern mineral belt with Waterberg as the catalyst. This will include the SA coal transportation system development, export coal line, Waterberg link development, Swazi rail link, coal backbone capacity and Eskom road to rail migration plan;
- SIP 2: Durban-Free State-Gauteng Logistics and Industrial Corridor. Projects identified include the Port of Durban expansions, new Dig-out Port, Port of Durban rail terminals and yards development, Natal Corridor rail capacity expansion, Gauteng hubs and terminals development, and the Gauteng freight ring;
- SIP 3: South-eastern node and corridor development. Ngqura transshipment hub, Integrated Coega Development Corporation (CDC) development and manganese export corridor development forms the project supporting the SIP;
- SIP 5: Saldanha-Northern Cape Development Corridor. Identified projects include the iron ore export capacity expansion and the oil and gas port capacity development to support the proposed Industrial Development Zone (IDZ);
- SIP 10: Electricity transmission and distribution. Transnet future energy demand and energy supply plan;
- SIP 11: Agri-logistics and rural infrastructure. Rail and port capacity to support agri-logistics including branch lines development; and
- SIP 17: Regional integration for African cooperation and development. Transnet's Africa strategy for trans-continental economic transport corridors (see chapter 6, Africa Transport Infrastructure).

2. NETWORK DEMAND

2.1 PLANNED DEMAND

These maps show rail network tonnage demand per section as per the road-to-rail migration strategy and market share targets planned for the next 30 years. The line colours reflect traffic density flowing over the section for 2014, 2024, 2034 and 2043 respectively.

Figure 6: 2014 Flows map

Figure 7: 2024 Flows map

The demand per section ranges from less than 1mtpa to more than 60mtpa for the export coal system to Richards Bay and the export iron ore from Sishen to Saldanha. Large differences are evident and a substantial part of the total volumes are concentrated on only a few of the corridors.

The Cape, Natal and Lephalale corridors show significant growth due to increased containers, domestic coal to Tutuka power station and Waterberg coal respectively. The volume growth along the central port corridor from Hotazel to Ngqura is largely due to high forecast of the export manganese and container businesses.

Figure 8: 2034 Flows map

Figure 9: 2043 Flows map

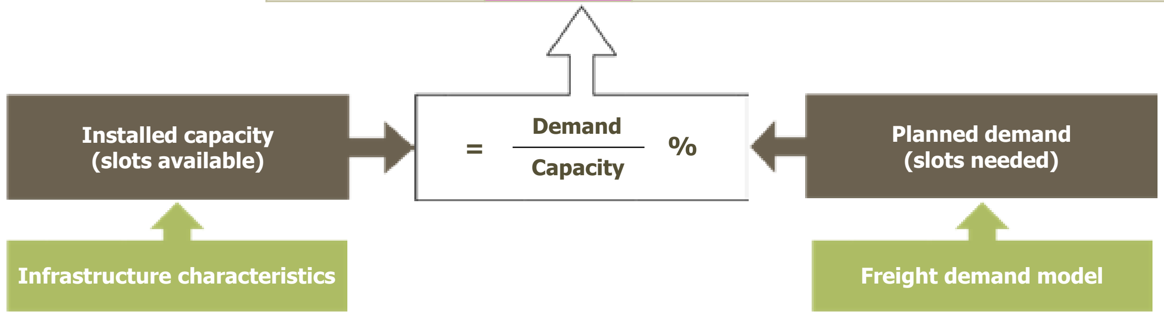
2.2 TRANSLATING TONNAGE TO CAPACITY UTILISATION

Figure 10: Translating tonnage to capacity utilisation

Network utilisation is an indicator of how hard each section is working.
This is used to determine when and where capacity improvements are required.

Utilisation

Light utilisation:	<60%	No action required
Moderate utilisation:	60 – 80%	Consider operational reengineering
Heavy utilisation:	80 – 95%	Operational redesign. Limited infrastructure upgrades
Utilisation limit:	95 – 105%	Operational redesign limit. Infrastructure upgrades
Over-utilisation:	105 – 130%	New infrastructure needed. New operational plan
System failure:	>130%	Significant infrastructure upgrades. Doubling or new lines



As indicated earlier, network analysis requires matching capacity with demand. The diagram indicates how these functions relate to each other and are used to determine network capacity utilisation.

Capacity: following the conversion of traffic demand to train requirements per day, the installed network capacity per line segment is determined. This is the number of trains able to run along a defined section of infrastructure per direction per day and is generally referred to as theoretically available train slots. Line capacity calculations are based on several infrastructure characteristics: passing opportunities, operating speeds, headways and train control systems. The calculation varies, depending on whether the section is single or double line. This high-level capacity utilisation calculation is based on the assumption that only 65% of the theoretically available train slots can be used for normal train operations, as the remaining 35% will be used for track maintenance activities and business recovery purposes.

Double lines: the capacity of a double track railway line is determined by the headway between two trains and therefore is typically a function of signal spacing and running speeds.

Single lines: on single track lines, the capacity is governed by the available opportunities to pass trains at crossing loops that are long enough to accommodate them. Running longer trains on single lines can actually reduce capacity, if sufficient crossing loops that are long enough, are not available.

Mixed traffic capacity calculation on single lines: where more than one train length is operated on single line section, capacity is calculated as a combination of short and long train capacity, each with its own limits. Some passing loops cannot accommodate long trains, so where there is a significant number of commodities that run in long trains over a single track section, the operational capacity of that section will be affected. The constraining distance between passing loops for each train length is then used to calculate headway and ultimately, a weighted average of the overall operational capacity of that section.

Metro and mainline passenger services: the capacity calculations for freight sharing sections with Metro or long-distance passenger services make allowance for the number of slots used by them. These passenger trains run at relatively higher speeds than freight trains, resulting in them using more capacity than freight trains. It was assumed that a passenger train uses about one and a half freight train operational slots when sharing the network.

Individual train loads are a function of commodities transported, wagon types and train lengths, resulting in total loaded train slots required per section. Since traffic flows are usually not balanced, trains running in the non-dominant direction normally have less traffic than in the dominant direction. A loading efficiency, expressed as the average train load per commodity in both directions combined, is used to determine percentage slot utilisation.

Utilisation: the formula for calculating capacity utilisation is quite simple: demand/installed capacity. This results in a percentile figure, which is then classified in terms of use, ranging from light traffic to system failure. The utilisation figure is the key driver in determining when a section of line should be reviewed or upgraded.

The calculated capacity utilisation per segment is displayed for the whole network showing the effect of increased train traffic on the system if the required investments were not made.

2.3 NETWORK CONDITION

Network condition is classified in terms of its remaining life and ability to permit the safe and efficient running of trains.

Poor sections are often older designs with steep gradients, sharp curves and long tunnels, in most cases, have low remaining infrastructure life with high wear and tear resulting in excessive maintenance. Some may have reduced remaining life resulting from traffic levels exceeding the original design parameters.

Good sections were usually designed to much higher standards with flatter gradients, longer curves and better train control systems, supported by proactive and well executed maintenance programmes.

Condition assessment colour coding (legend) for all the discipline (train control, perway and electrification) is as follows:

- Green – good: full operational capacity achievable;
- Orange – acceptable: required operational capacity achievable; and
- Red – not acceptable: less than 20% remaining life.

Perway condition

The main problematic perway sections are as follows:

- Groenbult – Hoedspruit: old line standards – difficult terrain (low volumes);
- Gauteng – Maputo: track geometry – difficult terrain;
- Durban – Gauteng: old line standards – difficult terrain (high volumes); and
- Komati – Richards Bay: poor alignment, maintenance and geology.

Figure 11: Condition – perway

Overhead Track Equipment (OHTE) condition

The main problematic OHTE sections are as follows:

- Richards Bay – Port Shepstone: corroded overhead equipment due to humidity;
- Natcor: insufficient power supply for long heavy trains; and
- Eastcor: insufficient power supply at Greenview.

Figure 12: Condition – OHTE (Electrical)

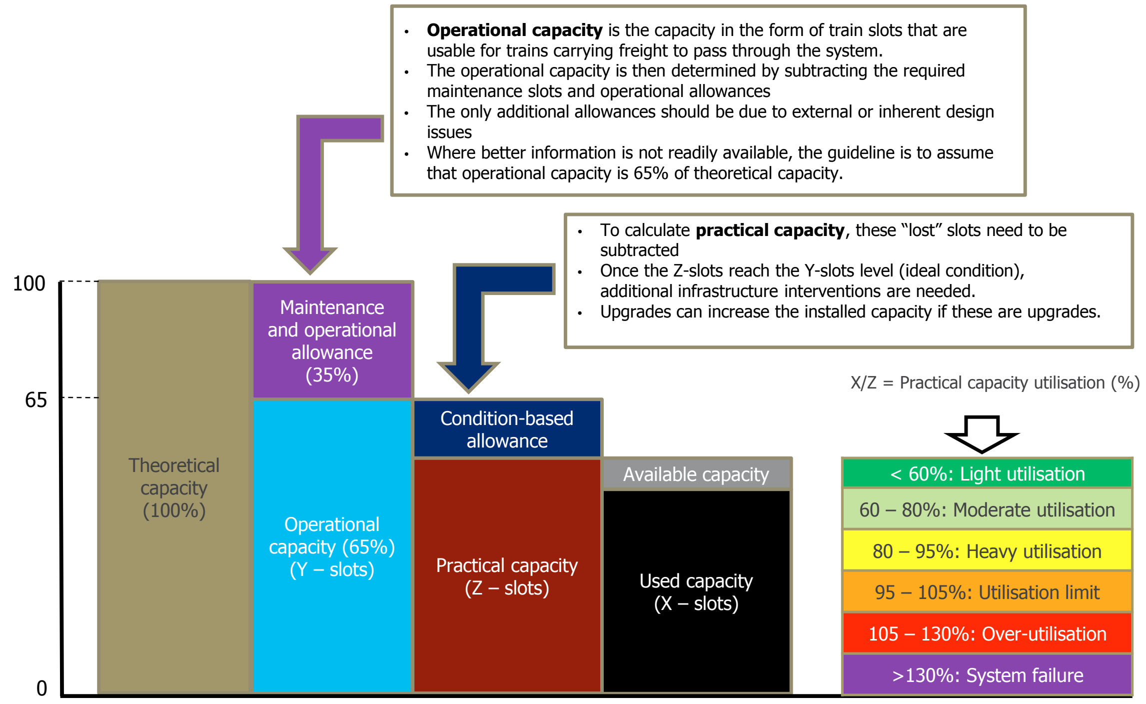
Train control condition

The main problematic train control sections are mainly along the Richards Bay to Port Shepstone route due to obsolete signalling system.

Figure 13: Condition – train control

2.4 LINE CAPACITY

Figure 14: Line capacity diagram



- Operational capacity is the capacity in the form of train slots that are usable for trains to pass through the system;
- The operational capacity is then determined by subtracting maintenance slots and operational allowances assuming that the infrastructure is in optimal condition;
- When calculating operational capacity, it may be tempting to allow for additional maintenance slots or operational failures due to poor condition. This should be avoided;
- The only additional allowance should be due to external or inherent design; issues eg installed alignment, clay conditions or difficult operational regimes;
- Where better information is not readily available, the guideline is to assume that operational capacity is 65% of theoretical capacity. This assumption is tried and tested and is safe to use under most conditions;
- The current condition may be below the threshold, where it negatively impacts on the installed capacity due to speed restrictions, increased failure rates and corrective maintenance;
- To calculate the condition-based or practical capacity, these 'lost' slots need to be subtracted;
- By comparing the capacity needed (demand driven) with the practical capacity; it is possible to determine the minimum condition level that a line would need to be maintained at in order not to impact on volumes. (Don't let the Z-slots drop below the X-slots);
- Once the Z-slots reach the Y-slots level (ideal condition), additional infrastructure interventions are needed;
- It is indeed more complex since assets have an age to condition relationship (lifecycle) and refurbishments and replacements need to be considered as well; and
- End of life replacements and refurbishments can increase the installed capacity if these are upgrades.

2. NETWORK DEMAND (continued)

2.5 NETWORK UTILISATION: IF NO INVESTMENTS ARE MADE

The calculated capacity utilisation per segment is displayed for the whole network, showing the effect of increased train traffic on the system if the required investments were not made.

Figure 15: Network utilisation in 2014

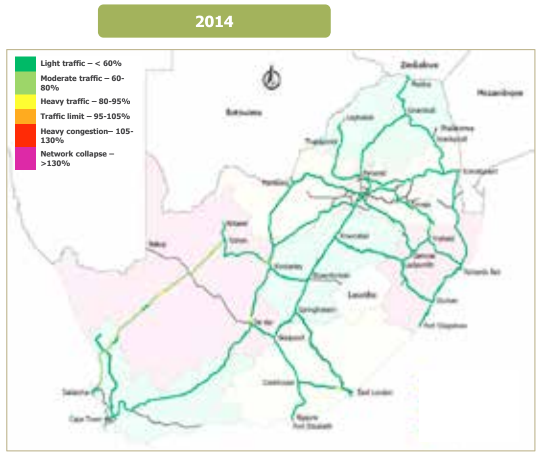
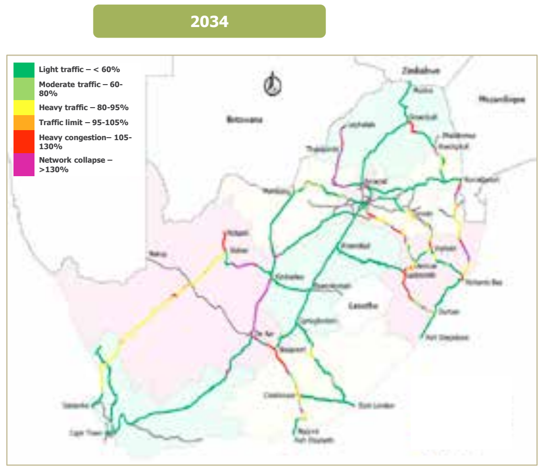


Figure 16: Network utilisation in 2024



The majority of sections have adequate capacity. Major constraints are apparent on the line from Kimberley to Port Elizabeth. This is due to it being a single line with few passing opportunities, as well as handling a mixture of heavy freight (manganese ore) and passenger services running at different speeds, thereby consuming a greater number of slots.

The line running through Swaziland also shows heavy utilisation. Although demand is not as significant as on the Port Elizabeth line, the installed capacity is low due to very few passing opportunities. Similarly, the section from Lephalale to Thabazimbi is also heavily congested due to insufficient passing opportunities and the lengthening of the loop at Matlabas will resolve this issue. There are constraints over some smaller sections in the metropolitan areas of Gauteng and Durban, which are due to Metro Rail services sharing the line with freight traffic.

By 2034, most corridors in the core network show constraints. The forecast aggressive growth in the railed container market will create constraints on all the routes between Gauteng and South Africa's major ports (except East London), as well as some over-border traffic into the rest of Africa. Increased domestic iron ore from the Sishen area and magnetite from Phalaborwa to Richards Bay will also require substantial capacity upgrades.

Figure 17: Network utilisation in 2034

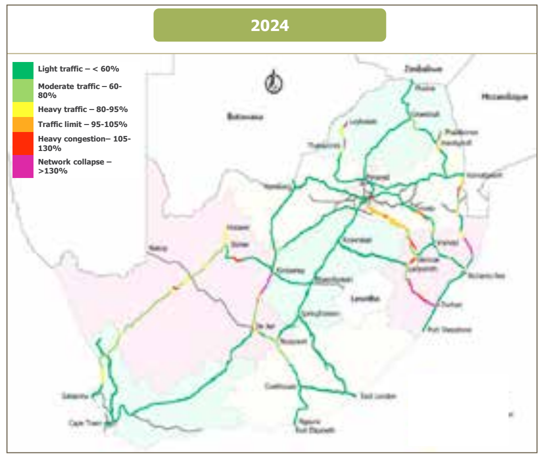
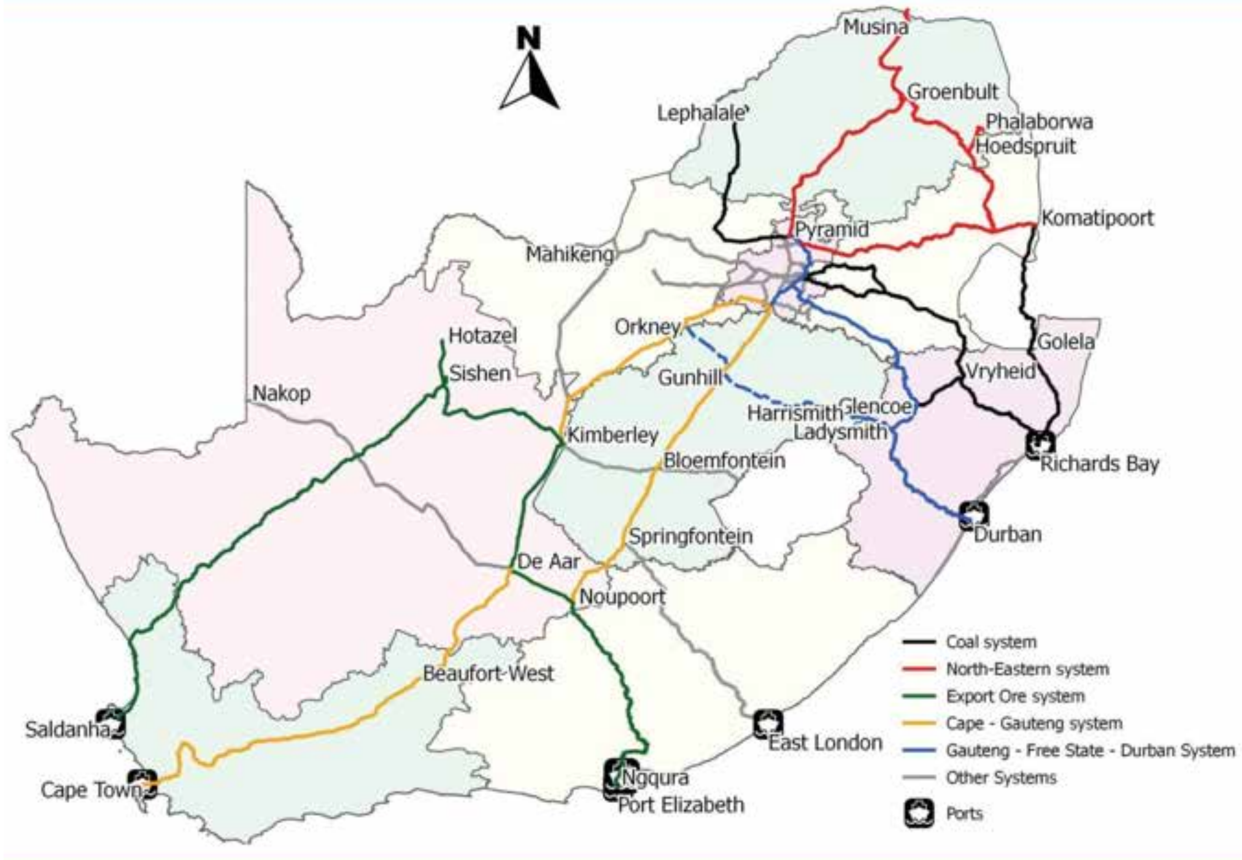


Figure 18: Network utilisation in 2043

Much like the previous 2034 view, the network utilisation picture in 2043 shows that the demand is far greater than current installed capacity. This clearly shows that capacity upgrades will be required on most parts of the core network over the next 30 years and that these investments must be made ahead of demand.

Figure 19: Core network systems



The core network is made up of 18 individual sections that can be rolled up to five systems:

Gauteng to Durban system

- Predominantly a general freight route with containers, domestic coal, fuel and other general freight traffic; and
- Train size is light to medium.

North-eastern system

- General freight traffic with predominantly agricultural products and fuel. Limpopo coal, magnetite and other minerals are expected to increase tonnage on this system; and
- Train size is light to medium.

Coal system

- Feeder lines from the Mpumalanga and Lephalale areas to domestic destinations, Richards Bay and Maputo, including the proposed Swaziland link;
- Predominantly export and domestic coal, as well as domestic iron ore to steel plants. Substantial component of existing trains convey bulk traffic and the proposed Swaziland link will be aligned to this; and
- Train size is medium to heavy.

Export ore system

- Heavy haul lines linking the Northern Cape with Saldanha and Port Elizabeth/Ngqura;
- Predominantly export iron ore to Saldanha and domestic iron ore to steel plants as well as export manganese ore to Port Elizabeth/Ngqura; and
- Train size is predominantly heavy.

Gauteng to Cape Town system

- Links between the Gauteng, Western Cape and Free State provinces;
- Traffic is predominantly containers, domestic coal to Saldanha and other general freight. Some container and automotive traffic to Port Elizabeth also flow on part of the route; and
- Trains are mostly light to medium.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS

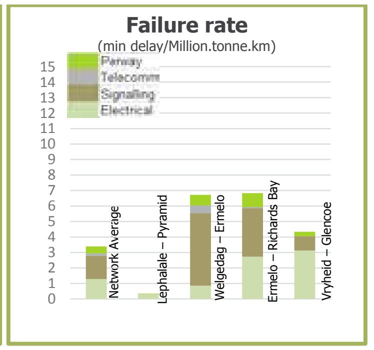
3.1 COAL SYSTEM

Figure 20: Coal system network

- The CAMS network serves a substantial part of the overall rail traffic. The system needs to be considered holistically as it serves general freight, minerals, domestic coal and export coal on a common infrastructure platform and therefore requires an integrated system view. Any change in one sector will have an immediate impact on the other.
- A substantial number of interrelated developments are anticipated over the medium term to:
  - Unlock the coal and other minerals potential of the Waterberg.
  - Unlock the Botswana coal fields by providing a cost effective rail export alternative to the ports of Richards Bay and Maputo.
  - Ensure long term availability of suitable coal for Eskom power generation.
  - Assist with new emerging and large scale mining developments.

Coal system status quo

Figure 21: Coal system status quo



Notes

- The system consists of both heavy haul and light axle load capacity sections
- Section 3 is a heavy-haul coal export line from Ermelo to Richards Bay
- Clay soil formation on parts of Section 1 inhibits axle load capacity increase on that section
- Planned maintenance activities on the Welgedag – Richards Bay section will address the Perway condition through the replacement of rail, sleepers, ballast and turnouts
- The outdated telecoms infrastructure needs to be replaced in the next seven years

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
1. Lephalale – Pyramid	Single	20t	Diesel/25kV AC	TWS	200m	1:75
2. Pyramid – Ermelo	Double(20)/Single(26)	20/26t	3kV DC	CTC	153m	1:100
3. Ermelo – Richards Bay	Double (loaded/empty)	26t	25kV AC	CTC	550m	1:160
4. Glencoe – Vryheid	Single	20t	3kV DC	RTO	200m	1:66
5. Komatipoort – Richards Bay	Single	20t	Diesel/25kV AC	TWS	250m	1:120

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
1. Lephalale – Pyramid	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (red)	● (yellow)
2. Welgedag – Ermelo	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)
3. Ermelo – Richards Bay	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)
4. Glencoe – Vryheid	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)		● (yellow)
5. Komatipoort – Richards Bay	● (yellow)	● (yellow)	● (yellow)					● (yellow)

The coal system includes Lephalale to Pyramid, Pyramid to Ogies, Ogies to Ermelo (coal backbone) and Ermelo to Richards Bay. Although the section from Komatipoort to Richards Bay is not yet part of the coal system, it is included here as it is expected to have an impact on the coal system once the Swazi link is constructed. The network status quo includes the following attributes:

- Network layout – representation of the system on the geographical map showing the rail network per province;
- Failure rate – the scale represents a measure of delay, in minutes per million tons km, due to track component failures in the section compared to the network average. The right-hand bars show that delay due to section failures is above the network average;
- Line properties – describe the physical properties in terms of line type, axle load, traction, train control, curvature and gradient; and
- Condition – high-level infrastructure components condition indicators for good (green), average (yellow) or poor (red).

The status quo of major sections is summarised below:

(a) Lephalale to Pyramid

Status quo

- The Lephalale to Pyramid link is a single-tracked general freight line. The section from Lephalale to Thabazimbi is non-electrified, while that from Thabazimbi to Pyramid is energised at 25kV AC. Both sections are designed to carry axle tonnage of up to 20t/axle.

General issues

- Slot capacity: constrained due to electrification and short passing loops; and
- Formation: accelerated sleeper replacement required, extensive clay formation issue prevents increase to 26t/axle design.

Section performance

- The section performance of the line is better than the network average. The clay soil conditions prevalent on this section inhibit its ability to effectively absorb future traffic or increases in axle load.
- Plans are being developed to construct a new heavy haul section to bypass the poor soil condition area, thereby producing significant extra capacity.

(b) Welgedag to Ermelo

Status quo

- The Welgedag to Ermelo railway line is a coal heavy haul double railway line, energised at 3kV DC, carrying axle loads of 20 to 26t/axle. It has one 26t/axle line and two 20t/axle lines.

General issues

- Eskom power supply inadequacies due to the running of heavy trains on the 3kV DC network.

Section performance

- The performance of this section is below the network average. Power supply issues need immediate attention in order to satisfactorily handle current traffic levels and accommodate future traffic demand.

(c) Ermelo to Richards Bay

Status quo

- The Ermelo to Richards Bay section forms the southern part of the coal line, carrying mainly heavy haul traffic with some general freight. The line section is double, with the exception of the Overvaal tunnel, which is currently single. The line is electrified to 25kV AC and supports 26t/axle loading; and
- Up and down line one separated, different gradients.

General issues

- Electrical: when volumes increase, more capacity may be required, single tunnel at Overvaal; and
- Link at Glencoe requires turn around. No run through at Vryheid, requires diesel shunting.

Section performance

- The performance of this section is below the network average.

(d) Glencoe to Vryheid

Status quo

- This section is a general freight line that connects Glencoe on the Natcor line and Vryheid on the coal line. It is a single line with an axle load capacity of 20t/axle. It is electrified at 3kV DC. It carries general freight and shorter coal trains from Glencoe to Vryheid. The shorter coal trains are compiled into 200-wagon coal trains at Vryheid and sent to Richards Bay.
- Link at Glencoe requires run around. No run through at Vryheid, requires diesel shunting.

Section performance

- The performance of this section is worse than the network average. Delay of trains caused by faults on the section is lower than the network average.

(e) Komatipoort to Richards Bay

Status quo

- The Komatipoort to Richards Bay section is a general freight, single line, which connects Komatipoort to the port at Richards Bay through Swaziland. It has an axle load carrying capacity of 20 tonnes; and
- Overall condition of the existing railway line infrastructure is 'acceptable' and all infrastructure disciplines are performing adequately, with the exception of formation and perway, which are performing poorly, relative to network averages.

General issues

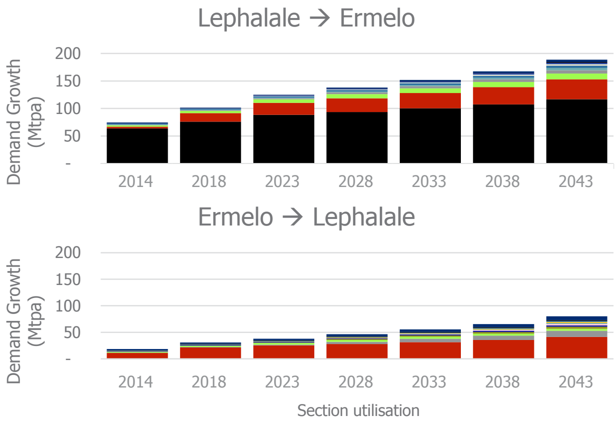
- Line use: maintenance alignment with Swaziland Rail – mechanised maintenance;
- Slot capacity: single line slot utilisation for longer trains at limits – competing with maintenance, which can only take place properly during a shutdown;
- Train control: Nsezi yard has challenges in terms of radio communications due to size of the yard and availability of frequencies; and
- Formation: introduction of speed restrictions necessary to manage formation problems: geometry maintenance challenging due to capacity utilisation.

Section performance

- The performance of the line is better than the network average.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

Figure 22: Coal system – demand and current capacity



Top 10 commodities (Mtpa)			
Commodity	2014	2030	2043
Export coal	64,00	93,60	116,90
Domestic coal	11,10	27,90	41,30
Containers	0,30	4,10	11,50
Chrome	2,40	7,80	10,60
Industrial chemicals	0,62	1,50	4,30
Ferrochrome	1,50	2,80	4,30
Processed foods	0,03	1,58	3,80
Cement	0,95	1,60	2,80
Other agriculture	0,010	0,19	2,60
Iron and steel	0,06	0,94	2,10

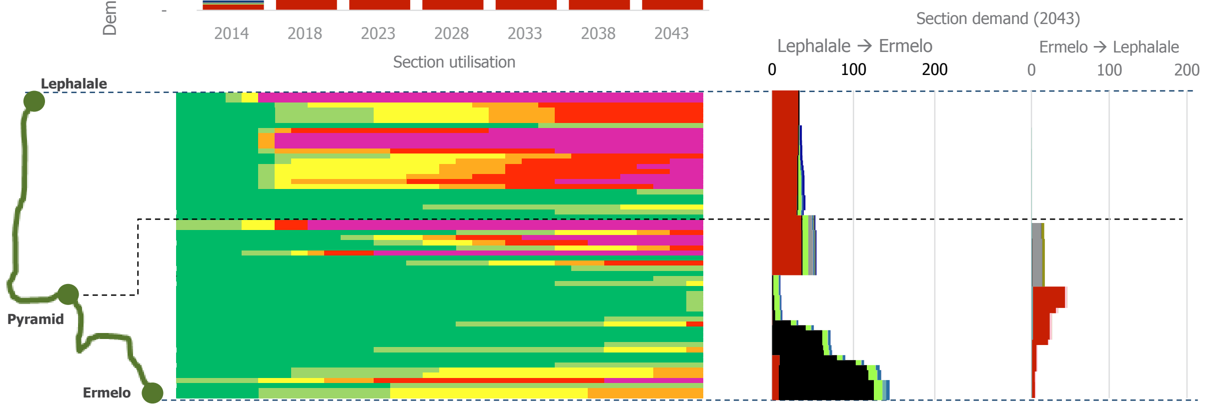
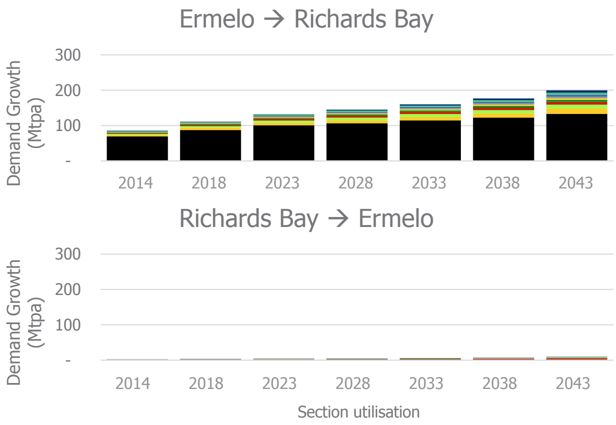
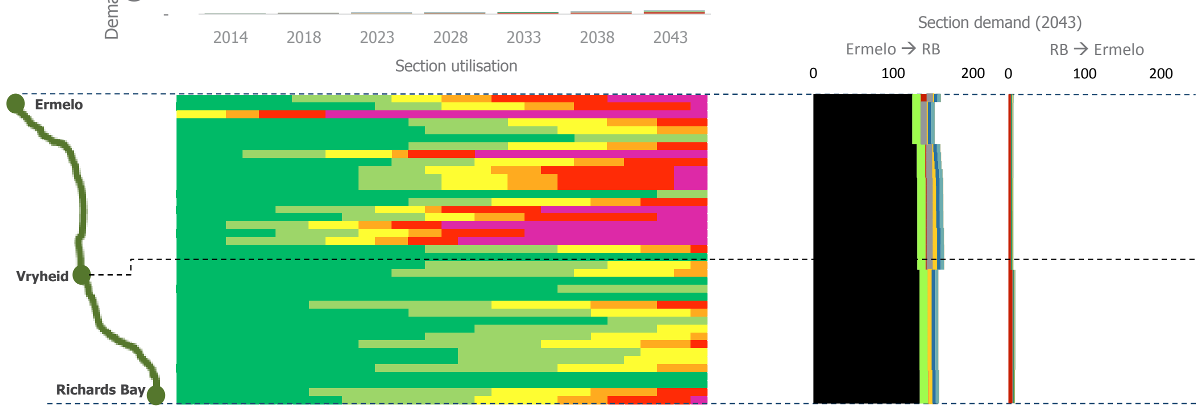


Figure 23: Coal system – demand and current capacity



Top 10 commodities (Mtpa)			
Commodity	2014	2030	2043
Export coal	69,5	106,4	132,9
Chrome	2,4	7,8	10,6
Domestic coal	2,3	5,8	8,3
Containers	0	2,2	4,6
Wood and wood products	1,6	2,7	4,7
Ferrochrome	1,6	2,9	4,4
Industrial chemicals	0,6	1,5	4,3
Iron and steel	0,1	0,9	2,1
Ferromanganese	0,2	0,9	1,5
Other agriculture	0	0,1	1,4



In the Figure 23, the bar graphs show the demand forecast for both directions of the section from Ermelo to Richards Bay. The top right table presents the actual volumes in mtpa of the top 10 commodities reflected for the base year 2013 and projected for 2030 and 2043 in the dominant direction.

The bottom part of the figure shows a line diagram of the railway section, corresponding capacity utilisation chart and segmented view of the commodities in both directions of the network by the year 2043.

The aim is to illustrate the effect of growth in commodity volumes on the network in relation to the installed infrastructure capacity. The colour coding is based on the description provided above in section 2.2 Translating tonnage to capacity utilisation. A short summary description of the demand and capacity requirements is given below:

(a) Lephalale to Pyramid

Demand

The section displays the ramp up in Waterberg coal exports, which provides the majority of the tonnage over the section. Volumes of export coal reach 132mtpa, as they gradually replace Mpumalanga coal. Domestic coal and chrome are also volume contributors and travel the length of the section.

In the opposite direction, volumes are considerably lower and are made up of a variety of mining products and container traffic.

(b) Welgedag to Ermelo

Demand

The line volumes are dominated by export coal in the direction towards Richards Bay and domestic coal in the opposite direction to power stations. General freight and containers show some growth, but this is constrained by the huge volumes of coal. Export coal ramps up from 60mtpa to 132mtpa on this section over the next 30 years.

(c) Ermelo to Richards Bay

Demand

Like the northern section, volumes are dominated by export coal in the direction of Richards Bay. Export coal ramps up from 73 to 133mtpa, where it is capped. The opposite direction shows much lower projections than north of Ermelo, as it is not impacted by power stations demands. Containers and other non-iron based mining show quick growth, although ultimate tonnages are low.

In the segmented view, export coal volumes increase along the section, while still in mining areas, but there is little added thereafter. In the opposite direction, containers are added to the line at Vryheid, mostly coming from Natcor across the Glencoe link.

Condition affected capacity

In instances where maintenance and operational inefficiencies have negatively affected the utilisation, the perception of Transnet Freight Rail was obtained and is shown in the following graphs:

Figure 24: Pyramid to Ermelo

Figure 25: Lephalale to Pyramid

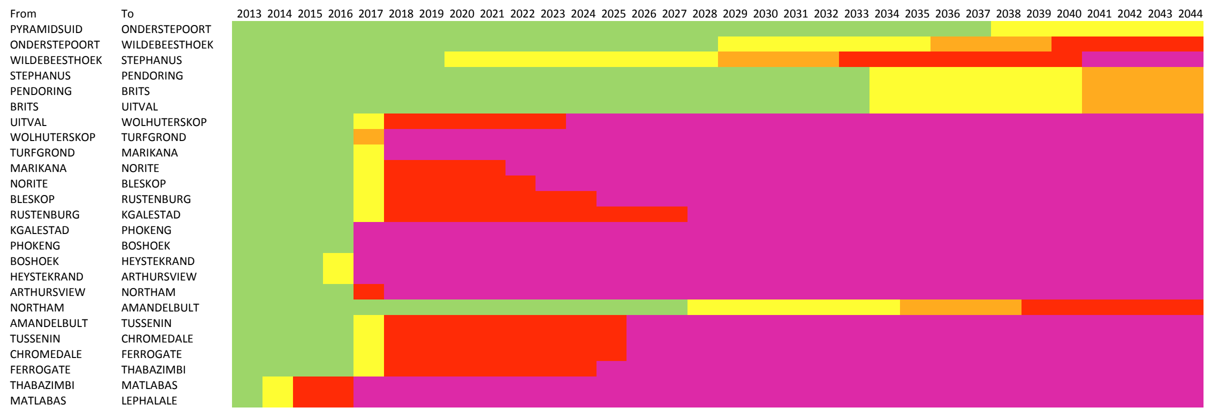


Figure 26: Ermelo to Richards Bay

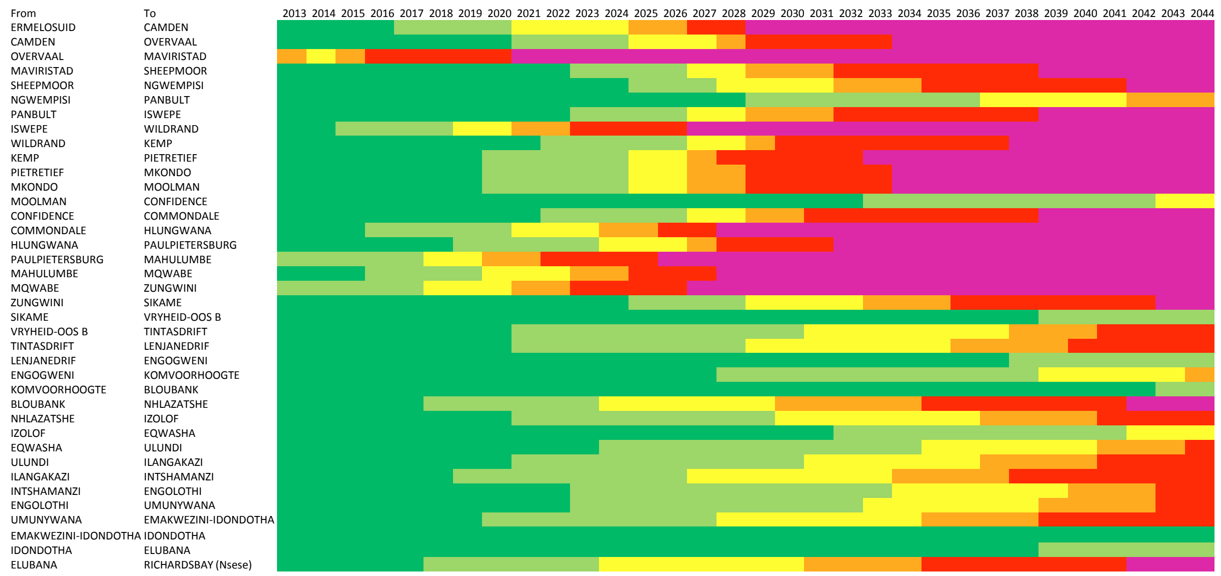
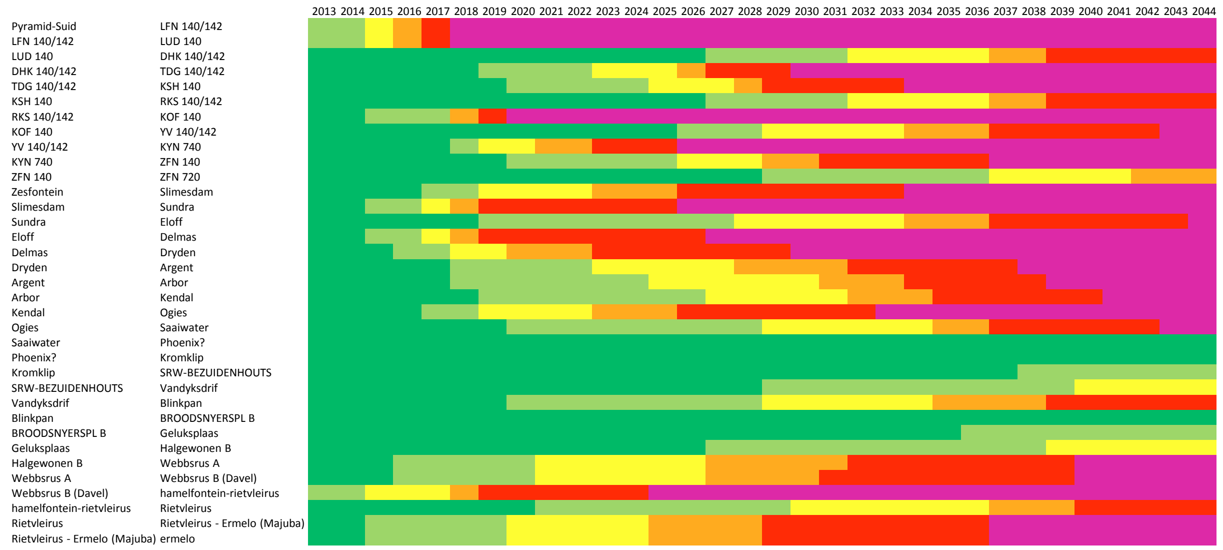


Figure 27: Pyramid to Ogies to Ermelo



The implication here is that due to short-term limitations, the systems are not operating at optimum efficiency. The first step to achieving the planned capacities is to operate at the best possible efficiency, which will facilitate achieving the designed capacity planned in the interventions.

Capacity overview

The utilisation chart shows capacity constraints at Camden and Overvaal in 2017.

(d) Komatipoort to Richards Bay

Demand

This line carries magnetite and rock phosphate to Richards Bay via Swaziland.

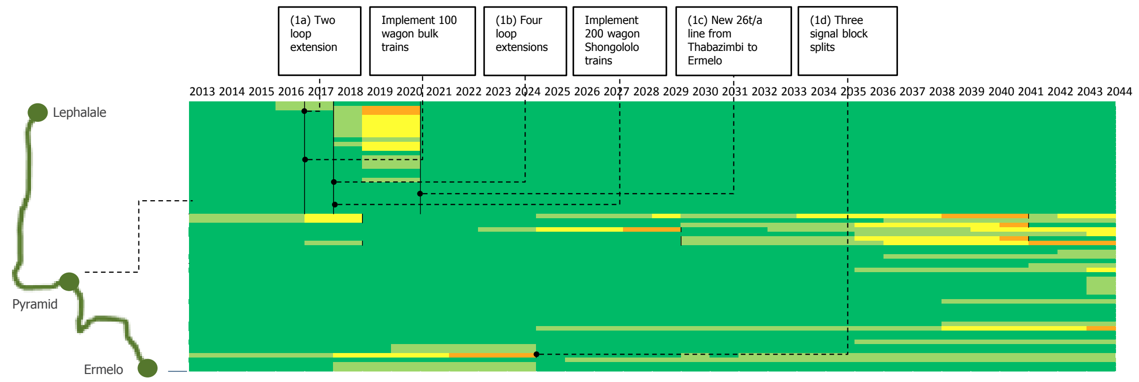
These two commodities contribute to over half the total tonnage on this section over the 30-year forecast. It is a strategic connection through Swaziland and will carry considerably more general freight traffic diverted from the coal export line through the proposed Swaziland rail link.

Coal system: results after capacity interventions

Figure 28: Coal system: capacity interventions

Notes

- Plans to alleviate congestion on the coal system include upgrades to sections of the existing network and construction of new infrastructure to handle future demand. The first aspect of the plan is aimed at the northern section of the system, Lephalale to Pyramid. Additional crossing loops as well as extensions of existing loops to accommodate 200wagon distributed power "Shongololo" coal trains are planned
- A new heavy haul line from Thabazimbi to Ermelo will be constructed by 2020 to carry domestic and export coal



3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

The interventions shown in the figure above serve to alleviate congestion on the coal line. They include upgrades to sections of the existing line as well as the construction of new infrastructure to handle future demand. As is apparent on the graph, the interventions move the graph back to a green state when implemented, meaning that sufficient capacity has been created by these interventions to handle the demand ramp up.

Additional crossing loops as well as extensions of existing loops to accommodate 100-wagon dry bulk and 200-wagon coal trains are proposed for the northern section of the line, Lephalale to Pyramid. A new heavy haul line from Lephalale to Ermelo is planned to be constructed by 2021 to carry domestic and export coal traffic. This would overcome the current load restriction due to the poor load carrying capacity of the existing line resulting from its clayey formation. Heavier, longer trains may therefore be run in order to meet the required demand.

The existing line is double tracked from the Welgedag region through to Richards Bay, with the exception of the Overvaal tunnel, which is a significant bottleneck. Doubling of the tunnel is planned to alleviate the bottleneck.

Furthermore, a new line is planned from Lothair in Mpumalanga to Swaziland. Construction of this link, which is planned to be completed by 2017, would enable rerouting of general freight traffic through Swaziland to Richards Bay, thereby freeing up capacity on the coal line for coal traffic.

The proposed interventions with their corresponding costs and yearly cash flows are shown in the development plan section below.

Coal system: development plan

Figure 29: Coal system: development plan

Strategy

Axle	Train control	Electrical	Capacity expansion	Alignments
Upgrade to 26 t/axle	New system	Upgrade to 25 kV AC	Tunnel doubling, Swazi link	Ease grades and curves

Expansion and Investment

Section	Phase	Station	Intervention	ETC (Rm)	Completion by
Lephalale to Pyramid	1a	Lephahale to Matlabas	2 new loops	180	2017
Lephalale to Pyramid	1b	Phokeng, Boshoek, Heystekrand and Groblersvlyt	4 Loop extensions	208	2018
Thabazimbi to Ermelo	1c	-	New 26t/a line from Thabazimbi to Ermelo	32000	2021
Zesfontein to Ermelo	1d	Websrus to Hameelfontein	3 Signal blocksplits	75	2025
Ermelo to Richards Bay	3a	Overvaal	Double the Overvaall tunnel	6623	2019
Ermelo to Richards Bay	3b	Entire Line	Swaziland link, reroute GFB Traffic	14000	2019
Ermelo to Richards Bay	3c	Iswepe, Mahulumbe, Mqwabe, Zingwini	4 Signal blocksplits	100	2035
Lephalale to Thabazimbi	1e	Thabazimbi	Thabazimbi yard expansion	541,66	2017
Lephalale to Thabazimbi	1f	-	Electrify 25kV AC	1106,64	2019
Ogies to Ermelo	2a	-	Upgrade selected line sections to 26t/a	1600,6	2019
Ogies to Ermelo	2b	-	Conversion to 25kV AC	1382,24	2019
Ogies to Ermelo	2c	Broodsnyersplaas to Ermelo	Add a 3rd line from Broodsnyersplaas to Ermelo	4216,19664	2019
Ermelo to Richards Bay	3a	Overvaal	Upgrade electrical supply system and double the Overva	9841,04	2019

Development Plan

Section	Phase	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Lephalale to Pyramid	1a			3	30	147										
Lephalale to Pyramid	1b			1	3	41	164									
Thabazimbi to Ermelo	1c		128	400	687	1 922	9 127	14 581	5 154							
Zesfontein to Ermelo	1d											1	74			
Ermelo to Richards Bay	3a		26	83	344	3 146	3 023									
Ermelo to Richards Bay	3b		56	175	728	6 650	6 390									
Ermelo to Richards Bay	3c															
Lephalale to Thabazimbi	1e			275	170	95										
Lephalale to Thabazimbi	1f			5,3	16	587	381	116								
Ogies to Ermelo	2a			20	134	348	585	514								
Ogies to Ermelo	2b			18	114	300	506	444								
Ogies to Ermelo	2c			86	852	1 277	1 576	426								
Ermelo to Richards Bay	3a			124	928	2 166	3572	3051								

Section	Phase	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Lephalale to Pyramid	1a															
Lephalale to Pyramid	1b															
Thabazimbi to Ermelo	1c															
Zesfontein to Ermelo	1d															
Ermelo to Richards Bay	3a															
Ermelo to Richards Bay	3b															
Ermelo to Richards Bay	3c				0,4	1	20	79								
Lephalale to Thabazimbi	1e															
Lephalale to Thabazimbi	1f															
Ogies to Ermelo	2a															
Ogies to Ermelo	2b															
Ogies to Ermelo	2c															
Ermelo to Richards Bay	3a															

(a) Lephalale to Pyramid

Axle loading

- Maintain 20t/axle in the short term; and
- Provide a new heavy haul (26t/axle) alignment from Lephalale to Ermelo via Hammanskraal with a link to the existing line at Atlanta and possible further line upgrades.

Train control

- Maintain current system.

Electrical

- Electrify Lephalale to Thabazimbi section to 25kV AC.

Capacity expansion options

- Invest in the current line by extending passing loops and upgrading electrification;
- Provide a new 26t per axle heavy haul line from Lephalale to Ermelo; and
- If Botswana coalfields expand, a possible new alignment to connect Lephalale to Mahalapye or Mamabula may be required.

Alignments

- A new alignment from Lephalale to Ermelo.

Intervention thought process

- Considered lengthening existing loops for 100-wagon trains – creates insufficient capacity in the long term.
- Considered constructing new loops for 100-wagon trains – not practical on an operational level.
- Considered doubling (primarily southern section near Onderstepoort) – possible but very costly.
- Decision to include a small number of loop extensions to support longer trains in the short term; and construct new loops between Matlabas and Lephalale to reduce the section times – but ultimately capacity capped at 23mtpa and the overflow is routed on the Waterberg Heavy Haul Line (Informed by Waterberg Expansion Programme).

(b) Welgedag to Ermelo

Axle loading

- Upgrade selected line sections to 26t/axle.

Train control

- Provide signal infill scheme to reduce the train running times.

Electrical

- Maintain 3kV DC system until the long term 25kV AC plan is implemented on the adjacent network; and
- Build third line at 25kV AC from Geluksplaas to Ermelo.

Capacity expansion options

- Provide demand flexibility by adding a fourth line between Ogies and Ermelo.

Alignments

- Sufficient at the current 1:100 gradient.

(c) Ermelo to Richards Bay

Axle loading

- Maintain 26t/axle loading.

Train control

- New signalling system for the proposed Lothair – Swaziland link route.

Electrical

- Provide 25kV AC for the Overvaal tunnel doubling.

Capacity expansion options

- Provide new link from Lothair to Sidvokodvo in Swaziland.
- Also upgrade the section from Sidvokodvo to Phuzumoya; and
- Double the Overvaal tunnel and track.

Alignments

- Provide grade separations at Sikame and Ilangakazi.

Intervention thought process

- Considered reduction in headways (signal spacing) – only practical on isolated block sections;
- Decision to double the Overvaal tunnel as it is the current bottleneck; and
- Decision to reroute GFB traffic via Swaziland; thereby freeing up coal capacity

(d) Komatipoort to Richards Bay

Axle loading

- Doubling and upgrade to 26t/axle for 200-wagon trains.

Train control

- Provide signal infill scheme to reduce the running time over the section.

Electrical

- Keep existing diesel system.

Capacity expansion options

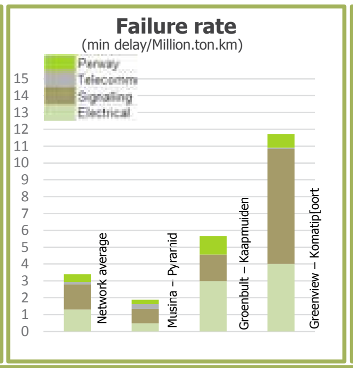
- Extend the existing crossing loops and add eight new crossing loops between Komatipoort and Phuzumoya.

Alignments

- Grade flattening and curve easing between Phuzumoya and Nsezi.

3.2 NORTH-EASTERN SYSTEM

Figure 30: North-eastern system status quo



Notes

- The system includes the Musina to Pyramid, Groenbult to Kaapmuiden and Greenview to Komatipoort as major sections
- The Greenview to Komatipoort section's capacity is limited to 50-wagon trains due to the very sharp curves and steep gradients of the horseshoe at Waterval Boven
- The section north of Polokwane is constrained by the few opportunities for crossing trains
- Poor infrastructure condition on the Groenbult to Hoedspruit section relating to sharp curves, steep gradients, poor telecoms coverage and obsolete perway materials impacts severely on train operations
- The Phalaborwa to Kaapmuiden section's capacity is constrained by sharp curves

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
1. Musina – Pyramid	Single/double	20t	Diesel/25kV AC	TWS/CTC	200m	1:50
2. Groenbult – Kaapmuiden	Single/double	18,5t/20t	Diesel/3kV DC	TWS/CTC	160m	1:66
3. Greenview – Komatipoort	Single	20t	3kV DC	CTC	250m	1:66

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
1. Musina – Pyramid	Yellow	Yellow	Yellow	Green	Green	Red	Red	Yellow
2. Groenbult – Kaapmuiden	Yellow	Yellow	Red	Yellow	Red	Yellow	Yellow	Yellow
3. Greenview – Komatipoort	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow	Yellow

The north-eastern system includes Musina to Pyramid, Groenbult to Kaapmuiden and Greenview to Komatipoort. The status quo of the three major sections is summarised below:

(a) Musina to Pyramid

Status quo

Musina to Pyramid is a general freight line, consisting of single and double line sections. The double-line section is energised at 25kV AC and is from Polokwane to Pyramid. The single-line section is non-electrified and is from Musina to Polokwane. Both sections carry 20t/axle loads.

General issues

- Line use: section north of Polokwane has a low train frequency resulting in increased incidents of theft and vandalism of perway materials and informal line crossings;
- Train control: low frequency of trains has resulted in theft and vandalism of signalling equipment being rife;
- Electrical: low frequency of trains south of Polokwane has resulted in rampant theft and vandalism of OHTE;
- Commuters: plans to expand service on the Hammanskraal section – segregated freight and passenger;
- Shosholoza Meyl: increased traffic between Polokwane and Pretoria, plus service running to Musina and Zimbabwe; and
- Commuters: plans to expand service to this section. Segregation of lines is recommended.

Section performance

- The section performance of the line is better compared to the network average.
- This section must be closely monitored because of anticipated increase in passenger rail traffic (suburban to Hammanskraal and long distance between Musina and Pretoria) as well as freight traffic resulting from future mining developments planned in the Limpopo province.

(b) Groenbult to Kaapmuiden

Status quo

Groenbult to Kaapmuiden carries general freight and is a single-line section with passing loops. The section operates in two main sections; non-electrified section from Groenbult to Hoedspruit, carrying axle tonnages of up to 18,5t/axle, and a 3kV DC electrified section from Phalaborwa to Kaapmuiden carrying axle tonnages of up to 20t/axle.

General issues

- Line use: forecast increase based on aggressive magnetite volume growth;
- Slot capacity: slot utilisation for longer trains at limits – competing with maintenance demands; and
- Axle loading: Groenbult to Hoedspruit to be upgraded to 20t/axle.

Section performance

- The performance of the line is poor compared to the network average; and
- This section is considered a strategic network link to address anticipated aggressive magnetite and coal traffic increases from planned future mining developments in Phalaborwa and Musina respectively.

(c) Greenview to Komatipoort

Status quo

Greenview to Komatipoort is a general freight single-line section, electrified at 3kV DC and carrying 20t/axle. This section links Gauteng with Mozambique and Richards Bay via Swaziland.

General issues

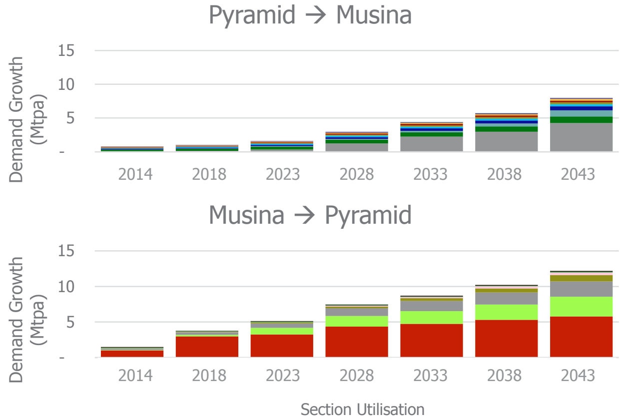
- Line use: commuter traffic increasing between Mamelodi and Pienaarspoort;
- Slot capacity: capacity needs to be created on the Mozambique side for increased volumes to be transported to and from Maputo;
- Perway: upgrading of the line required between Uitkyk and Witbank to increase axle load capacity to 26t/axle as a feeder line for the coal line;
- Commuters: PRASA is increasing services on the Mamelodi to Pienaarspoort section;
- Shosholoza Meyl: provision of a link from the south freight ring to the Maputo corridor is required – contention with PRASA developments;
- Horseshoe at Waterval Boven, single line; and
- Short loops up to Raapmuinden.

Section performance

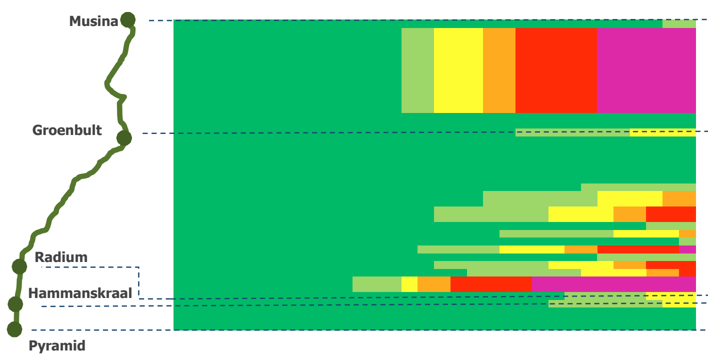
Overall condition of the existing railway line infrastructure is 'poor'.

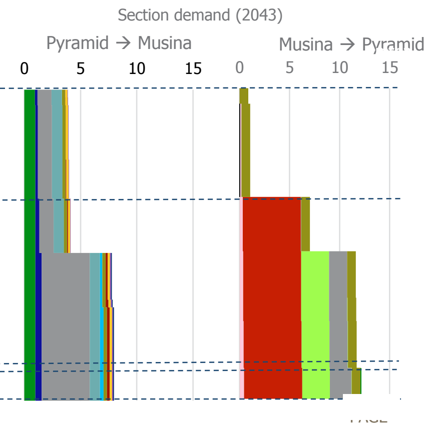
North-eastern system: demand and current capacity
(a) Pyramid to Musina

Figure 31: Musina to Pyramid – demand and current capacity



Top 10 commodities (Mtpa)			
Commodity	2014	2030	2043
Domestic Coal	1	4,4	5,8
Containers	0,1	1,2	4,3
Chrome	0,1	1,5	2,8
Rock Phosphate and Fertiliser Minerals	0,2	0,5	1
Industrial Chemicals	0	0,1	0,9
Processed Foods	0	0,1	0,3
Cement	0,1	0,3	0,6
Vegetables	0	0,1	0,4
Fuel	0,1	0,2	0,3
Maize	0,1	0,2	0,3





Demand

The section from Pyramid to Musina links South Africa and the rest of southern Africa. Entering Gauteng is mainly coal and containers. These commodities all show a keen market share up take, with total volumes rising from 1mtpa to 8mtpa by 2043. Most commodities coming into the country are destined for Gauteng or further inland and therefore travel the length of the section.

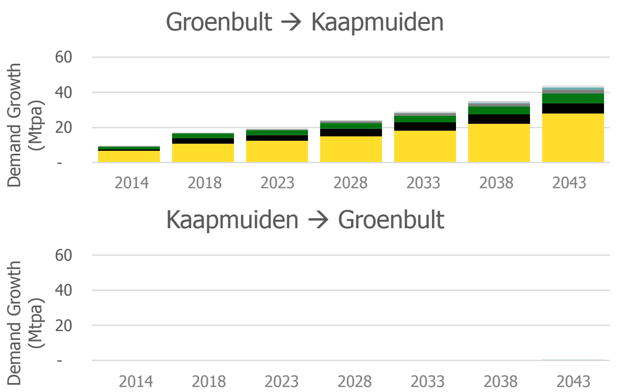
In the opposite direction, fuel, containers and agricultural goods travel north from Gauteng. There is little over-border traffic, however, with only 1mtpa (mainly fuel) going into Zimbabwe in 2043. Again, market share ambitions are high for these commodities on this section.

Capacity overview

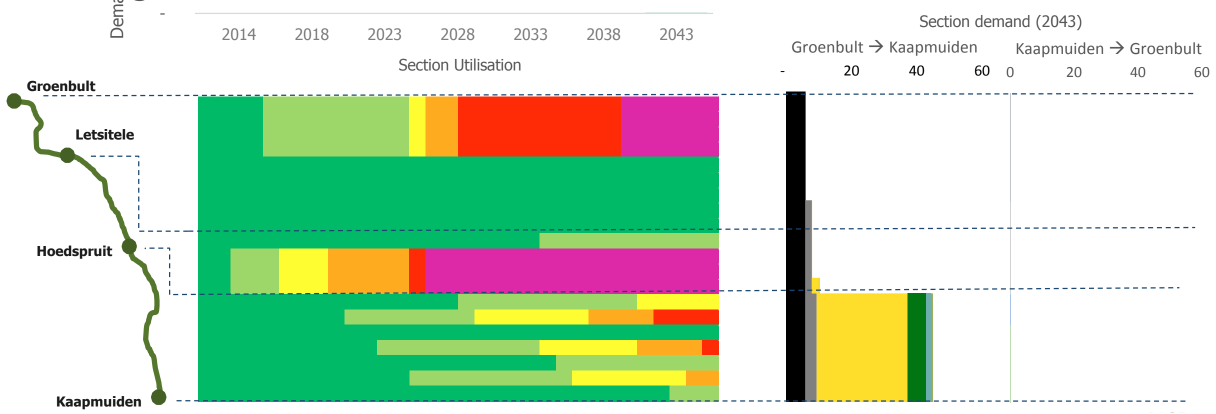
The capacity analysis shows that the section will be constrained in 2033 between Groenbult and Radium. Bottlenecks can be attributed to the long running times caused by severe track gradients and curvatures.

(b) Groenbult to Kaapmuiden

Figure 32: Groenbult to Kaapmuiden – demand and current capacity



Top 10 commodities (mtpa)			
Commodity	2014	2030	2043
Magnetite	6,80	14,90	27,90
Export coal	0,70	4,40	5,90
Rock phosphate and Fertiliser minerals	1,70	3,20	5,60
Containers	0,10	1,43	2,09
Industrial chemicals	0,01	0,10	1,50
Non-ferrous metal products	0,01	0,10	0,50
Vegetables	0,01	0,04	0,20
Cement	0,01	0,10	0,10
Fertiliser	0,01	0,03	0,10
Subtropical fruit	0,01	–	–



Demand

Volumes on the Groenbult to Kaapmuiden section are very low until Hoedspruit, where the line to Phalaborwa connects. Further south, the same ramp up as in the previous section can be seen with magnetite and rock phosphate going to Richards Bay. Magnetite volumes depend on global iron ore market developments and Port of Richards Bay dry-bulk terminal (DBT) expansion programmes.

Capacity overview

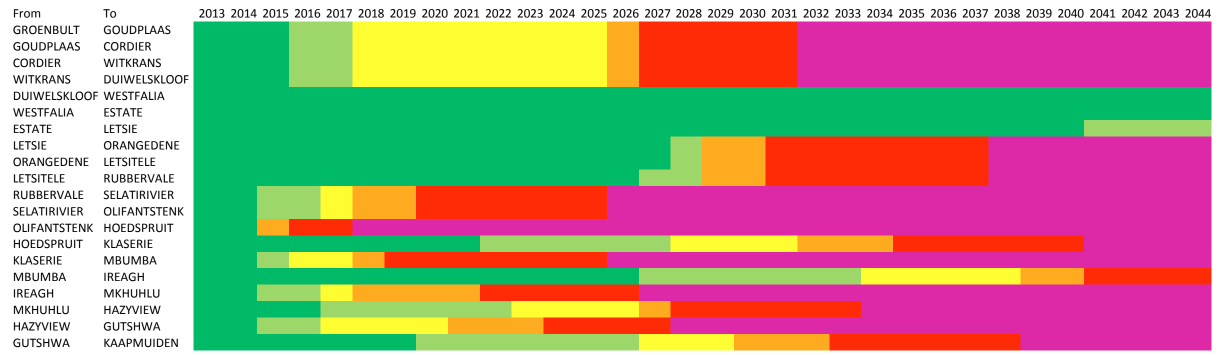
In the opposite (northern) direction, volumes remain low for the whole section. At Hoedspruit most of the traffic exits the line.

The implication here is that due to short-term limitations, the systems do not operate at optimum efficiency. The first step to achieving the planned capacity is to operate at the best possible efficiency, which will facilitate achieving the designed capacity planned through the interventions.

Condition affected capacity

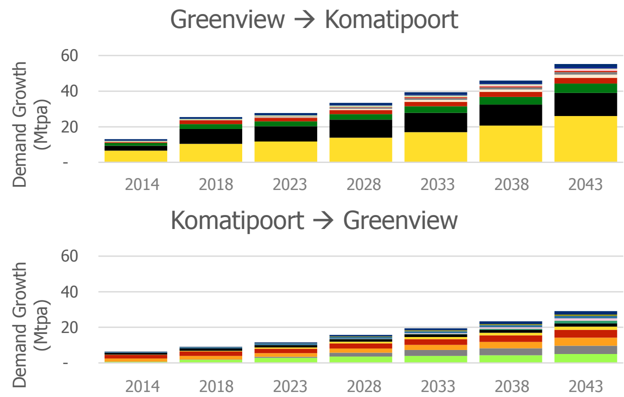
In instances where maintenance and operational inefficiencies have negatively affected the utilisation, the view of Transnet Freight Rail was obtained and is shown in Figure 33.

Figure 33: Network and operational constraints – Groenbult to Kaapmuiden

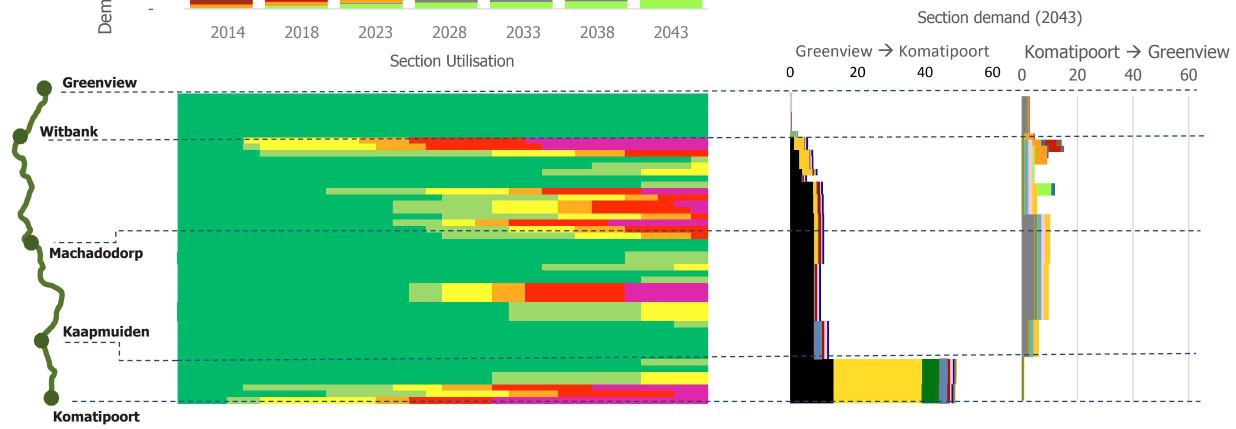


(c) Greenview to Komatipoort

Figure 34: Greenview to Komatipoort – demand and current capacity



Top 10 commodities (mtpa)			
Commodity	2014	2030	2043
Magnetite	6,60	13,90	26,10
Export coal	2,70	10,10	12,90
Containers	–	2,20	4,6
Rock phosphate and Fertiliser minerals	1,60	3,10	5,30
Chrome	0,69	3,50	5,00
Export iron ore	1,84	2,40	4,50
Domestic coal	0,02	2,22	3,20
Iron and steel	0,03	0,80	1,80
Industrial chemicals	0,01	0,12	1,50
Other agriculture	0,04	0,17	0,80



Demand

Demand and capacity utilisation for the Greenview to Komatipoort section is higher than that of the Pyramid to Musina and Groenbult to Hoedspruit sections. Demand on this corridor constitutes of a variety of commodities, most of which only travel on certain sections of the whole corridor. Magnetite in particular show aggressive growth in the first seven years of the forecast period, but slows thereafter. Magnetite is a special commodity, requiring a specific buyer, as it is relatively abundant and therefore does not have much margin for profit, especially when transported over long distances. These commodities come from Phalaborwa and are destined for Richards Bay, meaning that it only travel on the short section of Kaapmuiden to Komatipoort. Export coal destined for Matola (Maputo) makes up a considerable portion of the traffic.

The opposite direction shows a similar pattern and with similar total tonnages beginning with 7mtpa and reaching up to 35mtpa. Containers, although not a major contributor to total tonnages, are targeted as a key commodity for market share increased.

Capacity overview

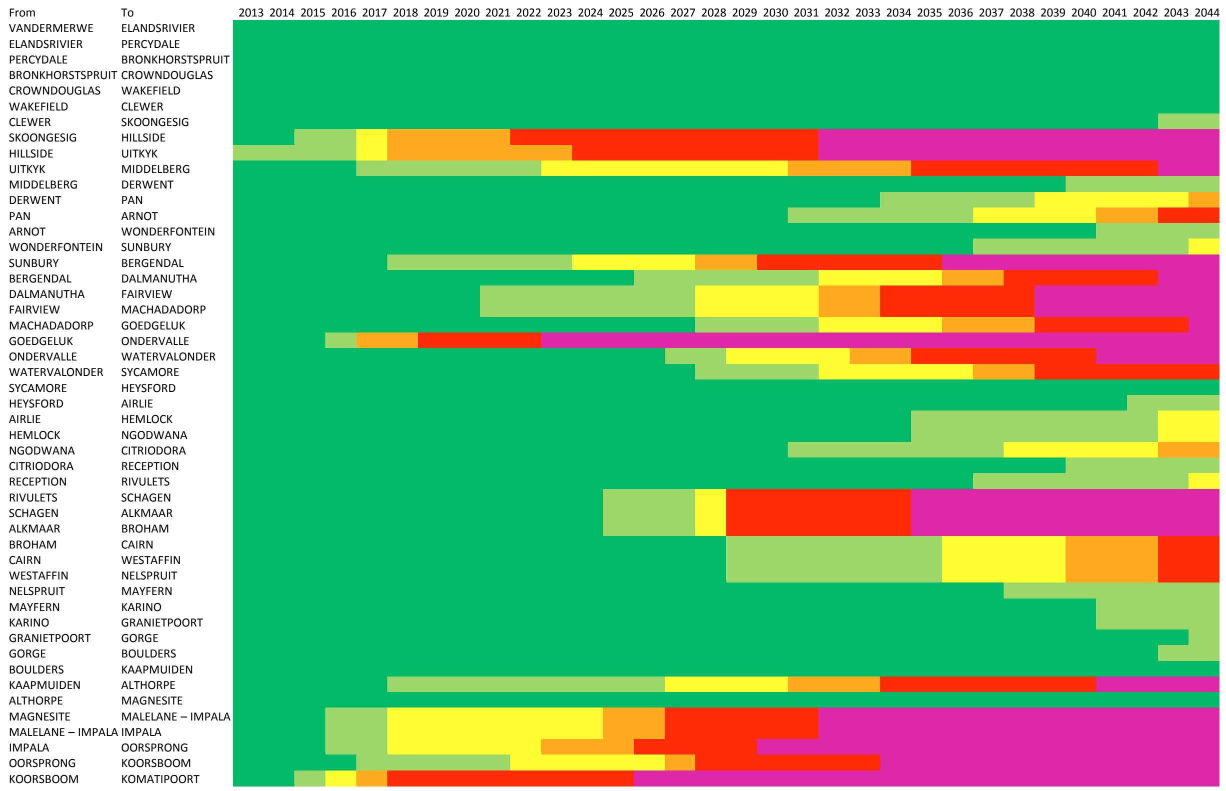
- Magnetite coming from Phalaborwa, as well as new coal from Groenbult, highlight constraints on the Kaapmuiden to Komatipoort section around 2030; and
- Another major constraint is the section from Waterval Boven to Waterval Onder, where trains of not more than 50 wagons can operate safely.

Condition affected capacity

In instances where maintenance and operational inefficiencies have negatively affected the utilisation, the view of Transnet Freight Rail was obtained and is shown in Figure 35.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

Figure 35: Greenview to Komatipoort



The implication here is that due to short-term limitations, the systems do not operate at optimum efficiency. The first step to achieving the planned capacity is to operate at the best possible efficiency, which will facilitate achieving the designed capacity planned in the interventions.

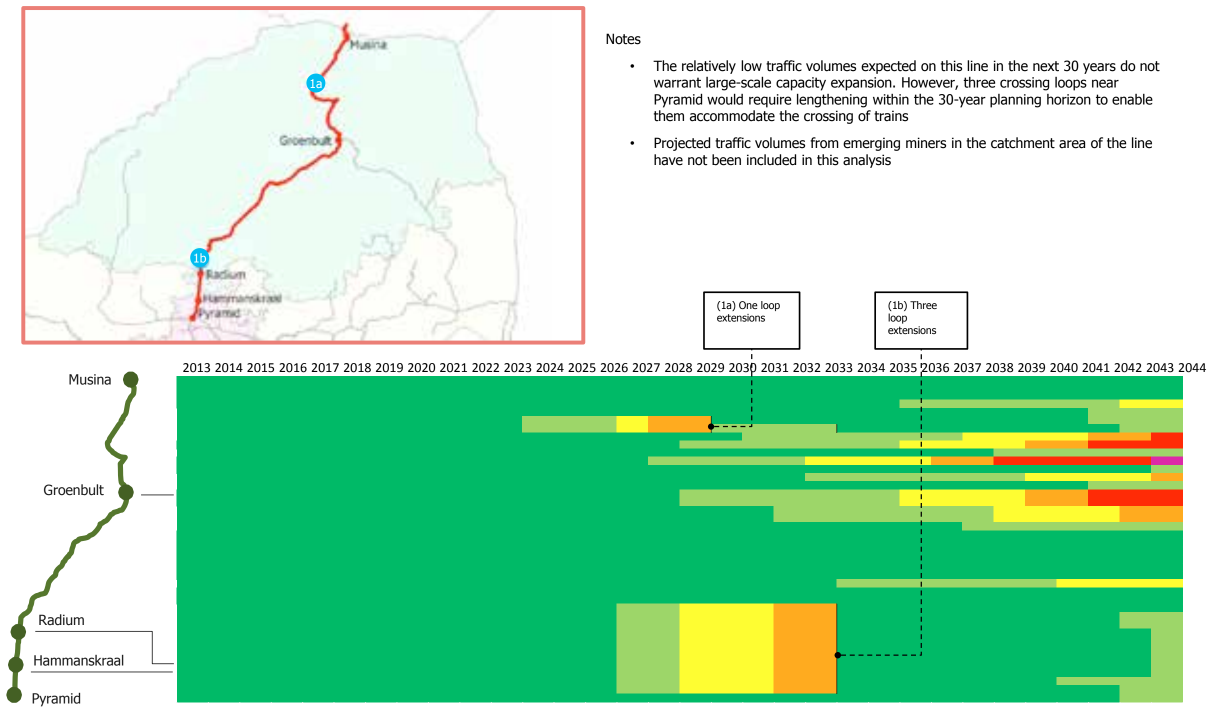
North-eastern system: Results after capacity interventions

(a) Musina to Pyramid

Figure 36 shows the locations of planned interventions and the respective impact on capacity utilisation on the Musina to Pyramid line.

The relatively low traffic volumes expected on this line in the next 30 years do not require large-scale capacity expansion. However, four crossing loops would require lengthening within the 30-year planning horizon to accommodate the crossing of 50-wagon trains.

Figure 36: Musina to Pyramid – results after capacity interventions



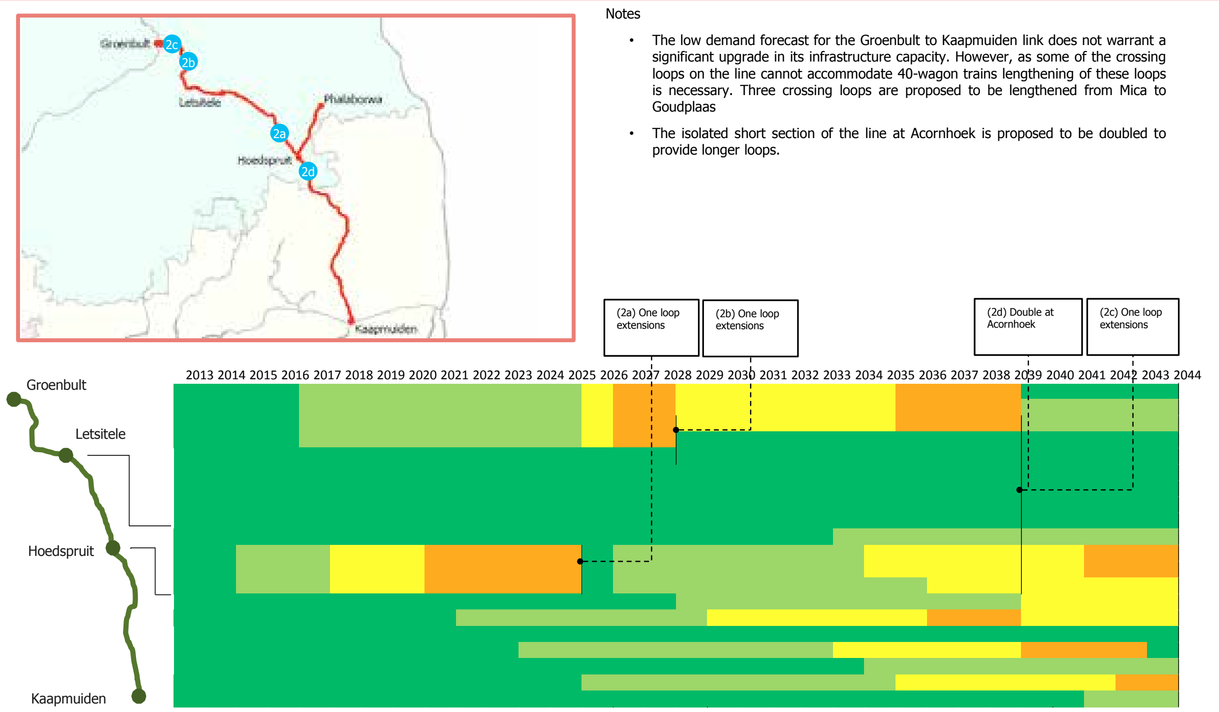
(b) Groenbult to Kaapmuiden

The figure below shows the locations of planned interventions and the impact on capacity utilisation on the Groenbult to Kaapmuiden line.

The low demand forecast for the Groenbult to Kaapmuiden line does not warrant a significant upgrade in its infrastructure capacity. However, as some of the crossing loops on the line cannot accommodate 40-wagon trains, lengthening of these loops is necessary.

Four crossing loops are proposed to be lengthened. Isolated short sections of the line are proposed to be doubled to create long loops. If required in future, the southern section of the line may be doubled by doubling the few remaining single sections.

Figure 37: Groenbult to Kaapmuiden – capacity interventions



3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

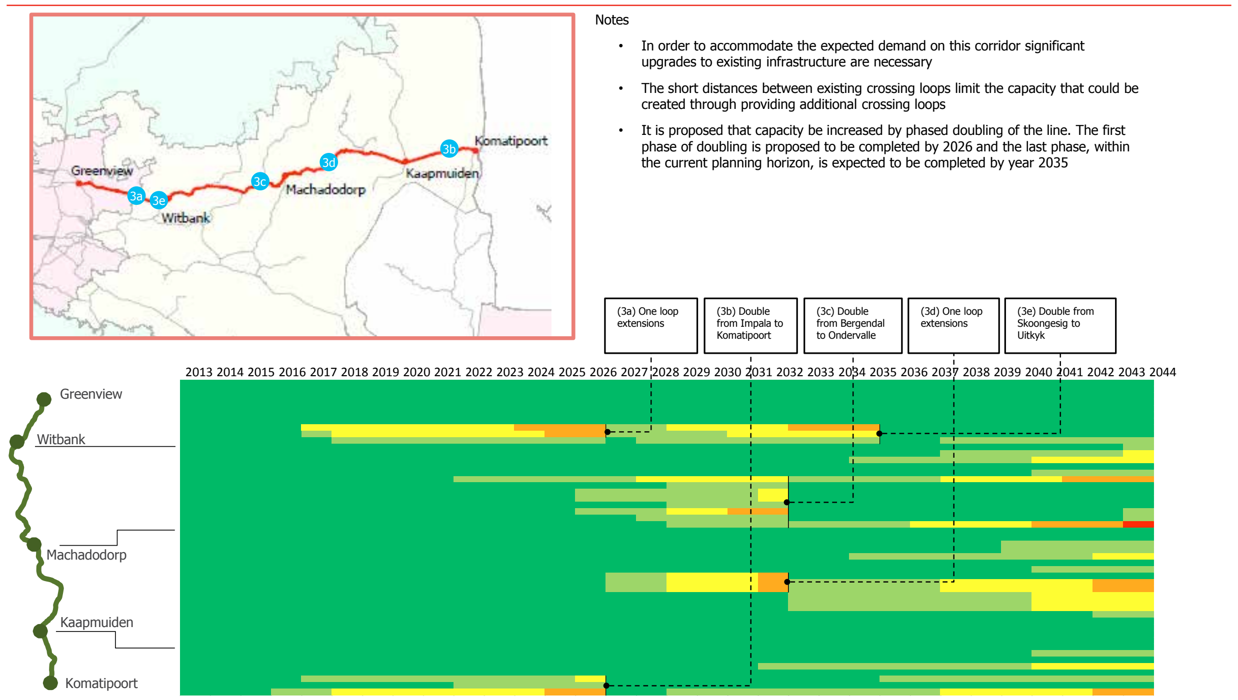
(c) Greenview to Komatipoort

The figure below shows the location of planned interventions and the impact on capacity utilisation on the Greenview to Komatipoort line.

In order to accommodate the expected demand on this corridor, significant upgrades to existing infrastructure is necessary. The short distances between existing crossing loops limit the capacity that could be created through constructing additional crossing loops.

It is proposed that capacity be increased by phased doubling of the line. The first phase of doubling is proposed to be completed by 2016 and the last phase, within the current planning horizon of 30 years, is expected to be completed by year 2035.

Figure 38: Greenview to Komatipoort – capacity interventions



North-eastern system: development plan

Figure 39: North-eastern system: development plan and cash flow

Strategy

Axle	Train control	Electrical	Capacity expansion	Alignments
Standardise to 20t	Optimise	Optimise	Loops and doubling	Ease grades and curves

Expansion and investment

Section	Phase	Location	Intervention	ETC (Rm)	Completion by
Pyramid to Musina	1a	Willem	1 Loop extension from 599m to 800m	14	2027
Pyramid to Musina	1b	Louistrichardand Lilliput and Bela Bela	3 Loop extension from 599m to 800m	41	2031
Groenbult to Kaapmuiden	2a	Mica	1 Loop extension from 440m to 750m	15	2025
Groenbult to Kaapmuiden	2b	Witkrans	1 Loop extension from 547m to 750m	15	2038
Groenbult to Kaapmuiden	2c	Goudplaas	1 Loop extension from 569m to 750m	15	2039
Groenbult to Kaapmuiden	2d	Acornhoek to Cottondale	Double track at Acornhoek	207	2039
Greenview to Komatipoort	3a	Hillside	1 Loop extension from 599m to 800m	14	2024
Greenview to Komatipoort	3b	Impala to Komatipoort	Double Track	603	2024
Greenview to Komatipoort	3c	Bergendal to Ondervalle	Double Track	1 129	2030
Greenview to Komatipoort	3d	Schagen	1 Loop extension from 600m to 800m	14	2030
Greenview to Komatipoort	3e	Skoongesig – Uitkyk	Double Track	640	2033

Development plan

Section	Phase	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Pyramid to Musina	1a													0,1	0,2	13,5
Pyramid to Musina	1b													0,2	0,5	40,4
Groenbult to Kaapmuiden	2a												0,3	14,9		
Groenbult to Kaapmuiden	2b															0,3
Groenbult to Kaapmuiden	2c															
Groenbult to Kaapmuiden	2d															
Greenview to Komatipoort	3a										0,1	0,2	13,5			
Greenview to Komatipoort	3b							2,4	7,5	16,3	102	314	160,7			
Greenview to Komatipoort	3c													4,5	14,1	30,4
Greenview to Komatipoort	3d															
Greenview to Komatipoort	3e															

Section	Phase	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Pyramid to Musina	1a															
Pyramid to Musina	1b															
Groenbult to Kaapmuiden	2a															
Groenbult to Kaapmuiden	2b	14,9														
Groenbult to Kaapmuiden	2c											0,3	14,9			
Groenbult to Kaapmuiden	2d								0,8	2,6	10,8	98,4	94,5			
Greenview to Komatipoort	3a															
Greenview to Komatipoort	3b															
Greenview to Komatipoort	3c	191	588	300,9												
Greenview to Komatipoort	3d	0,1	0,2	13,5												
Greenview to Komatipoort	3e	2,6	8,0	17,3	108	334	170,7									

FEL – 1: Concept study
FEL – 2: Feasibility
FEL – 3 + Construction

The network development strategies for the North-eastern system are summarised as follows:

(a) Pyramid to Musina

Axle loading
Keep existing 20t/axle.

Train control
Signalling of Hammanskraal to Groenbult.

Electrical
Keep existing system.

Capacity expansion options
Doubling and loops extensions.

Alignments
Keep existing alignments.

(b) Groenbult to Kaapmuiden

Axle loading
Upgrade Groenbult to Hoedspruit section to 20t/axle.

Train control
Maintain existing systems.

Electrical
Maintain existing systems.

Capacity expansion options
Doubling and loops extensions.

Alignments
Keep existing alignments

Intervention thought process
- Considered doubling – unnecessary quantum leap in capacity when applied to the entire line; and
- Decision to extend a number of loops to support longer trains.

(c) Greenview to Komatipoort

Axle loading
Keep existing 20t/axle.

Train control
Provide signal infill scheme to reduce running time.

Electrical
Tie stations are being upgraded at Greenview.

Capacity expansion options
Link to Waterberg feasibility study options and proposed timing of investments.

Alignments
Easing of curves between Waterval Boven and Waterval Onder would be beneficial, but will most probably be too costly.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

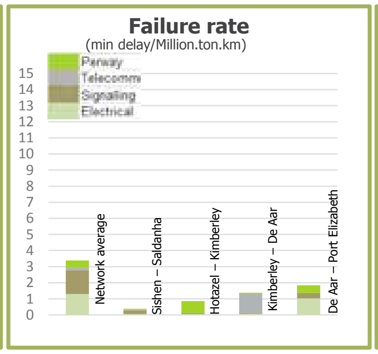
3.3 THE ORE SYSTEM

Figure 40: Ore system network

- The Northern Cape province has substantial mineral resources. Iron ore and manganese ore are the most prominent.
- Large mining developments for domestic and export purposes are being investigated and transport requirements are anticipated to grow substantially.
- Due to the large tonnages and relatively long transport distances, heavy haul corridors are required to minimise logistics costs.
- The iron ore line to Saldanha operates 342 wagon trains at 30 t/axle, resulting in more than 34 000 t of ore per train.
- It is also planned to operate the manganese ore line to Ngqura with 200 wagon trains at 26 t/axle, resulting in about 16 800 t per train.

Export ore system

Figure 41: Export ore system: status quo



Notes

- The Sishen – Saldanha line is the only section of the railway network energised at 50kV AC, carrying axle loads of up to 30 tons. The overall condition of the line infrastructure is good and its performance is well above the network average. A planned maintenance shutdown in August 2014 will focus on the replacement of Perway items
- The manganese corridor's capacity is constrained by the 3kV DC system from Hotazel to Kimberley, single line from Kimberly to De Aar and both steep gradients and sharp curves on the De Aar to Port Elizabeth section. A planned maintenance shutdown in September 2014 will focus on the replacement of Perway items

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
1. Sishen – Saldanha	Single	30t	50kV AC	CTC	800m	1:250
2. Hotazel – Kimberley	Single/double	20t	3kV DC	CTC/RTO	302m	1:100
3. Kimberley – De Aar	Single	20t	25kV AC	CTC	805m	1:80
4. De Aar – Port Elizabeth	Single	20t	25kV AC	CTC	300m	1:100

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
1. Sishen – Saldanha	● (green)	● (green)	● (yellow)	● (green)	● (green)	● (green)	● (yellow)	● (green)
2. Hotazel – Kimberley	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (yellow)	● (green)	● (yellow)
3. Kimberley – De Aar	● (green)	● (green)	● (yellow)	● (green)	● (green)	● (green)	● (green)	● (green)
4. De Aar – Port Elizabeth	● (yellow)	● (yellow)	● (yellow)	● (green)	● (green)	● (yellow)	● (green)	● (yellow)

The export ore system consists of Sishen to Saldanha, Hotazel to Kimberley, Kimberley to De Aar and De Aar to Port Elizabeth. The status quo of the three major sections is characterised as follows:

(a) Sishen to Saldanha

Status quo

- The Sishen to Saldanha railway line is an 861km long, heavy haul, single railway line, which connects iron ore mines near Sishen in the Northern Cape with the port at Saldanha Bay in the Western Cape. The line is energised at 50kV AC, carrying axle loads of up to 30t/axle. It has crossing loops designed for 342-wagon trains.
- Overall condition of the line infrastructure is good taking into consideration that it carries the heaviest axle tonnage (30t/axle). It represents a high standard of maintenance, all infrastructure components are performing well.

General issues

Restrictions on line capacity at present are associated with:

- The operations of Sishen and Salkor yards. Current infrastructure and operating procedures do not permit sufficiently quick turnaround of trains to meet the demands of increased service levels; and
- Power distribution capacity is inadequate. Current service is based on a mix of diesel and electric traction. Although it is not fully utilising the quantity of power which Eskom is contracted to supply, significant capacity improvement depends on the ability of Eskom to supply more power.

Section performance

The performance of the section is well above network average; however, there are plans (resignalling project or SIMIS-S) to achieve quicker turnaround of trains to meet increased traffic demands.

(b) Hotazel to Kimberley

Status quo

The Hotazel to Kimberley line is a heavy haul link, consisting of double and single-line sections. It is electrified to 3kV DC, and carries axle tonnages of up to 20t/axle. Crossing loops on the single-line section are designed to allow for the crossing of 104-wagon manganese ore trains.

General issues

- Slot capacity: close to its limits, operations and maintenance competing for available train slots;
- Train control: systematic component replacements have already been undertaken between Kamfersdam and Postmasburg section requires interlocking replacement. Elim to Hotazel section's track warrant train control system require replacement;
- Formation: signs of subsidence are evident due to mining at Lime Acres. The section from Fieldsview to Kamfersdam has significant drainage problems – groundwater levels have risen;
- Telecoms: optical fibre replacements are required all along the route. Equipment is at the end of its service life; and
- Perway: in the section north of Sishen, old material has been used during maintenance, making material replacement essential to any upgrade.

Section performance

The performance of this section is higher than the network average. Efforts are directed towards addressing critical network bottlenecks that degrade present service and inhibit the ability to effectively absorb future traffic increases. Current slots are reaching capacity limits.

(c) Kimberley to De Aar

Status quo

Kimberley to De Aar is a general freight section that also caters for passenger services. It consists of a single line electrified at 25kV AC with an axle load capacity of 20t per axle. Crossing loops are designed to allow for the passing of 104-wagon manganese ore trains.

General issues

- Line use: this is increasing due to increased manganese ore demand through Port Elizabeth (current) and Ngqura (future);
- Shosholoza Meyl: three to four passenger trains are run per day. This severely disrupts operations due to the different running speeds of passenger and freight trains; and
- Maintenance: restricted due to high utilisation.

Section performance

The performance of this section is higher than the network average. Efforts are being directed towards addressing critical network bottlenecks that degrade present service and inhibit the line's ability to effectively absorb future traffic increases. Current slots are reaching capacity limits.

(d) De Aar to Port Elizabeth

Status quo

The De Aar to Port Elizabeth section operates as a general freight line, but also accommodates some passenger services. It is the main link between Gauteng and the Eastern Cape and is a single line section. It is electrified to 25kV AC with a 20t/axle capacity. Crossing loops allow for 104-wagon manganese ore trains.

General issues

- Shosholoza Meyl: varying speed profiles between passenger and freight trains results in inefficient utilisation of slots on an already highly constrained section;
- Maintenance: slots are restricted due to high utilisation; and
- Line use: this is increasing due to increased manganese ore export through Port Elizabeth/ Ngqura.

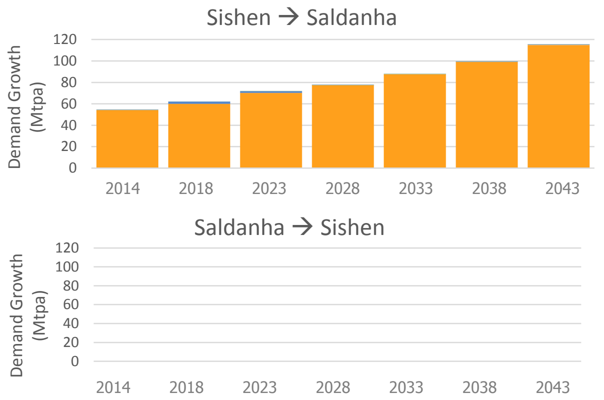
Section performance

The performance of the line is good compared to the network average.

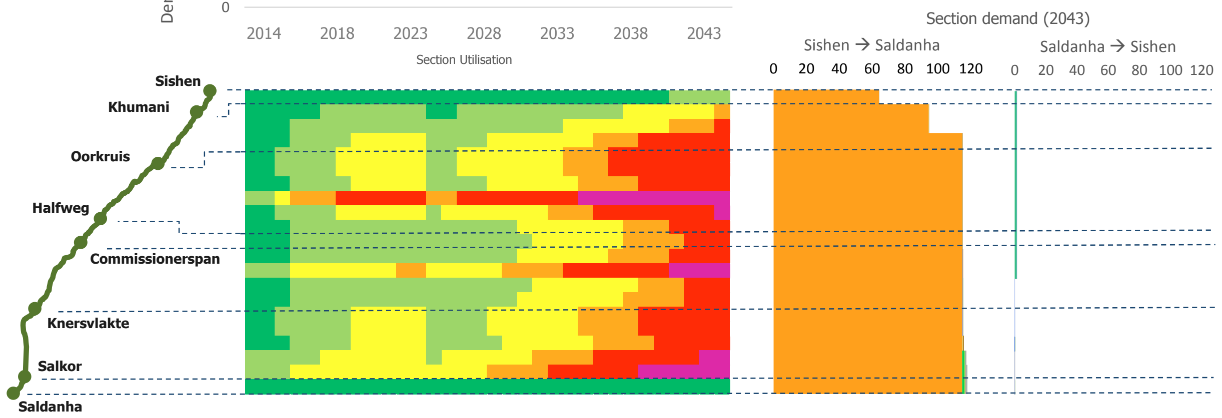
3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

(a) Sishen to Saldanha

Figure 42: Sishen to Saldanha – demand and current capacity



Top 10 commodities (mtpa)			
Commodity	2014	2030	2043
Iron ore: exports	54,2	77,3	114,7
Titanium	0,5	0,8	1,6
Stone	0,3	0,7	1,4
Vegetables	0	0,2	0,5
Non-metallic mineral products	0	0	0,4
Non-ferrous metal products	0,07	0,1	0,2
Domestic coal	0,08	0,13	0,2
Non-ferrous metal mining	0,12	0,1	0,1
Zinc	0,06	0,09	0,1
Export manganese	0,27	0,03	0,1



Demand

The dominant direction sees export iron ore being transported to the Port of Saldanha from the mines in the Sishen area. Volumes for iron ore rise from 54mpta up to 115mtpa in 2043. The segmented view shows that nearly all the traffic is loaded near Sishen and travels the length of the line. Some coal and iron ore for domestic use leave the line at Salkor.

The opposite direction shows relatively low volume, made up of stone, cement and industrial chemicals, most of which is used in the mines at Sishen. Some domestic iron ore also travels up the line from Khumani, which is destined for domestic plants.

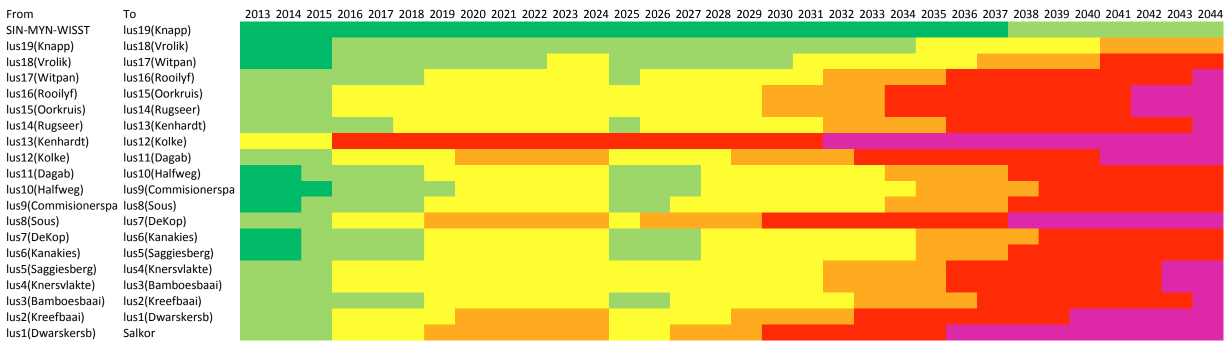
Capacity overview

The assessment shows that very little surplus capacity exists. A phased introduction of new capacity closely matching expected demand can be seen in the capacity development plans.

Condition-affected capacity

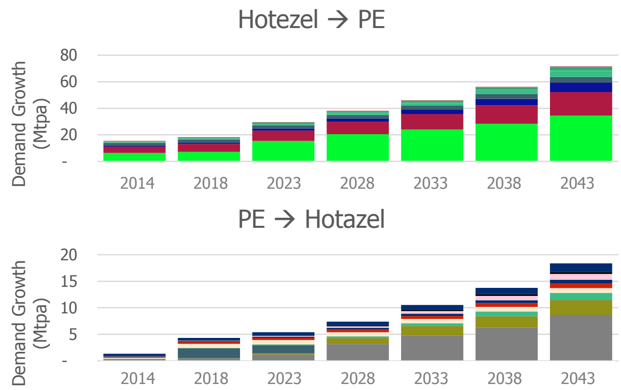
In instances where maintenance and operational inefficiencies have negatively affected the utilisation, the view of Transnet Freight Rail was obtained and is shown in the following graph:

Figure 43: Network and operational constraints: Sishen to Saldanha

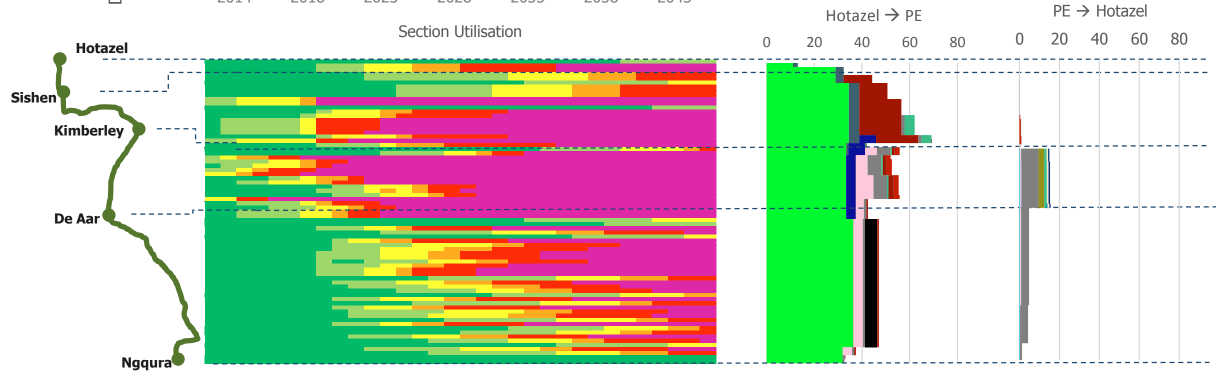


The implication here is that due to short-term limitations, the systems do not operate at optimum efficiency. The first step to achieving the planned capacity is to operate at the best possible efficiency, which will facilitate achieving the designed capacity planned in the interventions.

Figure 44: Hotazel to Ngqura – demand and current capacity



Top 10 commodities (mtpa)			
Commodity	2014	2030	2043
Export manganese	6,7	21,6	36,4
Domestic iron ore	4,7	9,4	17,7
Containers	0,2	3,2	8,7
Other agriculture	0,1	0,7	7,4
Cement	0,91	2,4	7,1
Export coal	0	3,5	5
Domestic manganese	1,99	2,73	4,3
Limestone	0,37	1,1	4,2
Processed foods	0,01	1,11	2,8
Maize	0,48	1,32	2,6



(a) Hotazel to Kimberley

Demand

Export manganese ore and domestic iron ore are the major commodities on this line in the Fieldsview direction. Manganese ore ramps up quickly when Ngqura becomes fully operational. Iron ore is destined for Bijlkor and Newcastle and shows high growth over the forecast period. In the opposite direction, coal for use at the mine is the main commodity to be transported. The demand forecast for this is fairly steady and is related to the productivity of the iron ore and manganese ore mines.

(b) Kimberley to De Aar

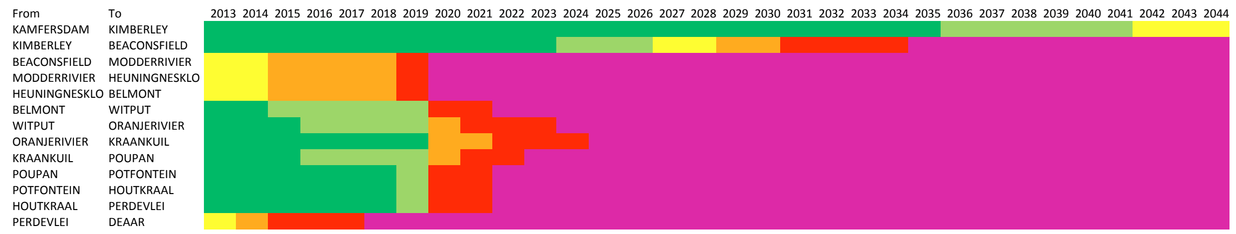
Demand

Predominantly manganese ore exports, run this section. There is very little variation in tonnages over the section in 2043, implying that most tonnages are travelling between Gauteng and the coast.

Condition affected capacity

In instances where maintenance and operational inefficiencies have negatively affected the utilisation, the view of Transnet Freight Rail was obtained and is shown in the following graph:

Figure 45: Kimberley to De Aar



3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

The implication here is that due to short-term limitations, the systems do not operate at optimum efficiency. The first step to achieving the planned capacity is to operate at the best possible efficiency, which will facilitate achieving the designed capacity planned in the interventions.

(c) De Aar to Port Elizabeth

Demand

The dominant direction on this section is from De Aar to Port Elizabeth, with an aggressive ramp up in manganese ore, reaching more than 20mtpa. After 2019, the corridor shows a growth in container traffic ramping up from 0,22 to 4,4mtpa. The remainder of the tonnage in this direction includes lime, fuel, chemicals and agricultural products.

In the opposite direction, containers also show a high growth rate, making up more than half of the total traffic in 2042. Motor vehicles are a commodity of note on this section with relatively large growth as well as non-iron mining and mining products.

The segmented view shows most containers originate from or are destined for the port. The lime, coal, fuel and chemicals among other commodities are consumed within the greater Port Elizabeth area. Motor vehicles are built near the port, but the majorities are destined for Gauteng.

Export ore system: results after capacity interventions

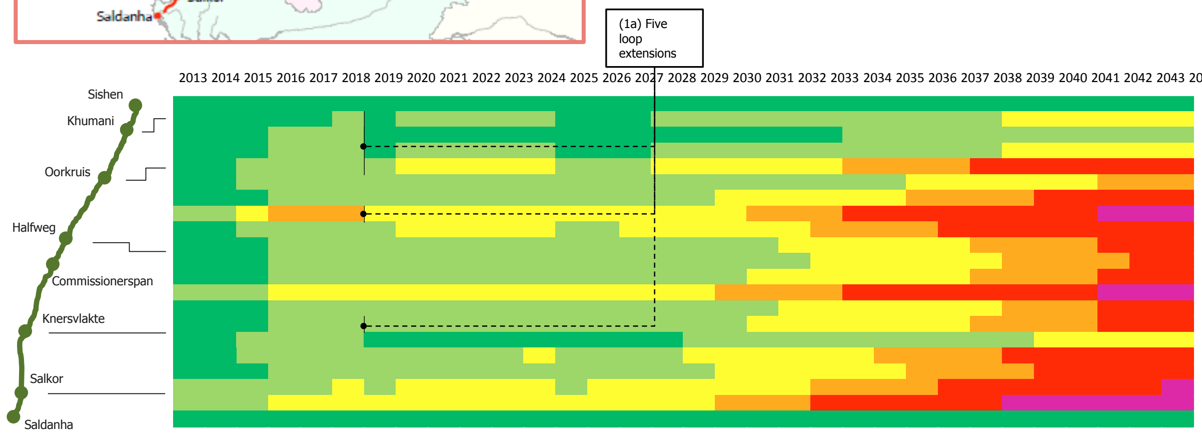
(a) Sishen to Saldanha

The figure below shows the locations of planned interventions and their impact on capacity utilisation on the line from Sishen to Saldanha.

Figure 46: Sishen to Saldanha – results after capacity intervention

Notes

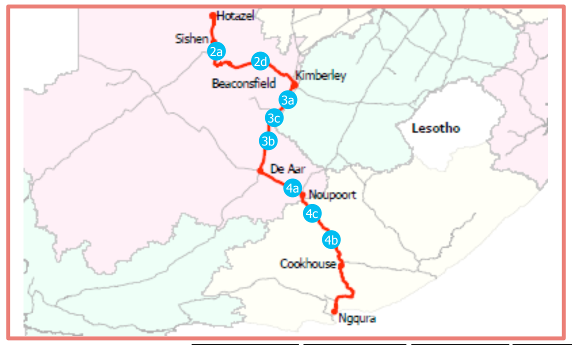
- The need for additional Ore train capacity on the Sishen Saldanha line can be achieved by implementing 5 loop extensions.
- The consolidation and/or rerouting of general freight trains on the line which otherwise occupy slots that may be more efficiently utilised by the longer ore trains is being pursued
- Upgrades to the electrical supply system are also proposed to make more power available to electric locomotives



(b) Hotazel to Port Elizabeth

The figure below shows the locations of planned interventions and their impact on capacity utilisation on the line from Hotazel to Ngqura.

Figure 47: Sishen to Saldanha – results after capacity interventions



Notes

- To create additional capacity on the manganese export line, heavier and longer trains are proposed from 2024.
- As an interim solution to generate capacity, it is proposed to extend two loops along the Kimberley to De Aar line.
- It is proposed to double the remainder of the lines from Spytfontein to De Aar. Several crossing loop extensions are required to accommodate the proposed increased train length.
- Loop extensions are required from 2015 on an as-and-when required basis
- Seven new crossing loops are also planned at suitable locations to reduce the section lengths and thereby increase line capacity.

To expand capacity on the manganese export line, heavier and longer trains are proposed. Crossing loops are earmarked to be lengthened to accommodate the proposed increased train length. Manganese trains of 208 wagons are planned; loop extensions are required from 2015 on an as-and- when required basis.

New crossing loops are also planned at suitable locations to reduce section lengths and thereby increase line capacity. These new loops are required from 2019 onwards.

To further expand capacity and ensure maintainability, the Beaconsfield to De Aar section of the line will require doubling within the next 30 years.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

Export ore system: development plan

Figure 48 (a): Export ore system development summary

Strategy

Axle	Train control	Electrical	Capacity expansion	Alignments
Standardise to 20t	Optimise	Optimise	Loops and doubling	Ease grades and curves

Expansion and investment

Section	Phase	Location	Intervention	ETC (Rm)	Completion by
Pyramid to Musina	1a	Willem	1 Loop extension from 599m to 800m	14	2027
Pyramid to Musina	1b	Louistrichard, Lilliput and Bela Bela	3 Loop extension from 599m to 800m	41	2031
Groenbult to Kaapmuiden	2a	Mica	1 Loop extension from 440m to 750m	15	2025
Groenbult to Kaapmuiden	2b	Witkrans	1 Loop extension from 547m to 750m	15	2038
Groenbult to Kaapmuiden	2c	Goudplaas	1 Loop extension from 569m to 750m	15	2039
Groenbult to Kaapmuiden	2d	Acornhoek to Cottondale	Double track at Acornhoek	207	2039
Greenview to Komatipoort	3a	Hillside	1 Loop extension from 599m to 800m	14	2024
Greenview to Komatipoort	3b	Impala to Komatipoort	Double Track	603	2024
Greenview to Komatipoort	3c	Bergendal to Ondervalle	Double Track	1 129	2030
Greenview to Komatipoort	3d	Schagen	1 Loop extension from 600m to 800m	14	2030
Greenview to Komatipoort	3e	Skoongesig – Uitkyk	Double Track	640	2033

Development plan

Section	Phase	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Pyramid to Musina	1a													0,1	0,2	13,5															
Pyramid to Musina	1b													0,2	0,5	40,4															
Groenbult to Kaapmuiden	2a												0,3	14,9																	
Groenbult to Kaapmuiden	2b															0,3	14,9														
Groenbult to Kaapmuiden	2c																										0,3	14,9			
Groenbult to Kaapmuiden	2d																							0,8	2,6	10,8	98,4	94,5			
Greenview to Komatipoort	3a										0,1	0,2	13,5																		
Greenview to Komatipoort	3b							2,4	7,5	16,3	102	314	160,7																		
Greenview to Komatipoort	3c													4,5	14,1	30,4	191	588	300,9												
Greenview to Komatipoort	3d																0,1	0,2	13,5												
Greenview to Komatipoort	3e																2,6	8,0	17,3	108	334	170,7									

FEL – 1: Concept study
FEL – 2: Feasibility
FEL – 3 + Construction

Figure 48 (b): Export ore system development summary

Strategy

Axle	Train control	Electrical	Capacity expansion	Alignments
Upgrade to 26 t/axle	Optimise	Optimise	Doubling and Loop extensions	Gradients and curves easing

Expansion and investment

Section	Phase	Station	Intervention	ETC (Rm)	Completion by
Hotazel – Port Elizabeth					
TFR (rail infra)	1		As per manganese business case	2 374	2020
TFR (rail infra)	2		As per manganese business case	9 400	2020
Sishen – Saldanha					
Sishen to Saldanha	1a	Loop 5	1 Loop extension by 11km (to Port)	247,07	2018
Sishen to Saldanha	1a	Loop 12	1 Loop extension by 7km (to Erts)	162,95	2018
Sishen to Saldanha	1a	Loop 14	1 Loop extension by 9km (to Erts)	205,01	2018
Sishen to Saldanha	1a	Loop 17	1 Loop extension by 9km (to Port)	205,01	2018
Sishen to Saldanha	1a	Loop 18	1 Loop extension by 12km (to Port)	268,09	2018
Sishen to Saldanha	1b	Salkor	Expand the Salkor yard and add additional power supply to the line. Alterations to access third tippler	6 849,72	2019

The network development strategies for the export ore system include the following:

(a) Sishen to Saldanha

Axle loading
Maintain existing 30t/axle.

Train control
Maintain current system.

Electrical
Upgrade power supply system.

Capacity expansion options
Additional 20 loops, expand the Salkor yard and make alterations to access lines to third tippler.

Intervention thought process
Informed by FEL 2 (long loops 5, 12, 14, 17, 18).

Alignments
Maintain existing alignments.

(b) Hotazel to Kimberley

Axle loading
- Short-term: Operate as 20t from Hotazel to Kimberley; and
- Long-term: Migrating to 26t/axle.

Train control
Short-term: Upgrade piecemeal, candidate for electronic interlocking.

Electrical
Long-term: Hotazel to Kimberley 25kV AC.

Train lengths
Informed by FEL 2 (lengthened loops and migrated to 208 wagon manganese trains).

Capacity expansion options
- Additional passing loops; and
- Doubling of the line; only when commodity growth supports it. In order to be consistent with long-term aims, all passing loop upgrades or track additions should be built to 26t/axle standards.

Alignments
Maintain the current ruling gradient of 1:100 in the dominant flow direction.

Capacity expansion options
- Additional passing loops;
- Doubling of the line – only when commodity growth supports it. In order to be consistent with long-term aims, all passing loop upgrades or track additions should be built to 26t axle load standards; and
- Axle load – new sections based on 26t specification in view of long-term line upgrade.

Alignments
Maintain the current ruling gradient of 1:100 in the dominant flow direction.

(c) Kimberley to De Aar.

Axle loading
Maintain existing 20t/axle, build second line at 26t/axle.

Train control
Maintain as is (CTC) and upgrade to CBA as volumes grow.

Electrical
Maintain the 25kV AC traction power on existing line and apply same to the second line.

Capacity expansion
Carry out the line doubling to create capacity.

Alignments
Maintain existing alignments; and
De Aar to Port Elizabeth.

Axle loading
Up to about 16 manganese, the existing 20 tons per axle formation may be retained, but thereafter 26 tons per axle would be required.

Train control
Maintain as is (CTC) until volumes justify upgrade.

Electrical
Maintain 25kV AC.

Capacity expansion options
Extend crossing loops to accommodate longer trains.

3.4 GAUTENG TO CAPE TOWN SYSTEM

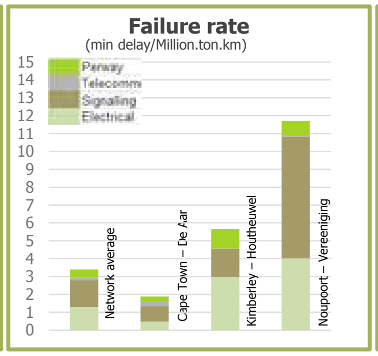
Figure 49: Gauteng to Cape Town system network

- The Gauteng to Cape Town corridor remains one of the main rail corridors on the network.
- It serves both freight and inter city passenger traffic and parts of the network have to be shared.
- Alternative routes via Kimberley and Bloemfontein ensure operational flexibility for much of the corridor and allow for some separation of freight and passenger traffic if necessary.
- Due to the relatively long haulage distance the corridor is one of Transnet's main focus areas for successful implementation of its road to rail strategy.
- Strong container traffic will support a development strategy for a light industrial and passenger rail corridor.
- The shared single line section between Kimberley and De Aar will be doubled and electrified to heavy haul standards as part of the manganese ore project.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

Gauteng to Cape Town system: status quo

Figure 50: Gauteng to Cape Town system: status quo



Notes

- The system consists of mixed use general freight and long distance passenger services
- Implementation of state-of-the-art traffic control and safety systems can greatly improve operational performance on the entire system. The performance of the system is below the network average. Major maintenance activities for 2014 will focus on rail and sleeper replacement
- The sharing of the lines of the system by both freight and passenger rail services, as well as longer manganese trains is currently preventing optimal utilisation of the existing network train slots. Capacity creation initiatives are being considered

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
1. Cape Town – De Aar	Single	20t	3kV DC/25kV AC	CTC	250m	1:66
2. Kimberley – Houtheuwel	Double/single	20t	3kV DC	CTC	402m	1:72
3. Noupoort – Vereeniging	Single/double	20t	Diesel/3kV DC	TWS/CTC	200m	1:100

General condition

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
1. Cape Town – De Aar	● (green)	● (green)	● (amber)	● (amber)	● (amber)	● (amber)	● (green)	● (amber)
2. Kimberley – Houtheuwel	● (amber)	● (amber)	● (amber)	● (green)	● (amber)	● (green)		● (amber)
3. Noupoort – Vereeniging	● (amber)	● (amber)	● (amber)	● (green)	● (green)	● (amber)		● (green)

The Gauteng to Cape Town system includes Cape Town to De Aar, Kimberley to Houtheuwel and Noupoort to Vereeniging. The status quo of the major sections is summarised below:

(a) Cape Town to De Aar

Status quo

Cape Town to De Aar is a general freight and long distance passenger single railway line, which connects Gauteng to the Western Cape. This section is electrified to 3kV DC from Cape Town to Beaufort West and 25kV AC from Beaufort West to De Aar, carrying axle tonnages of up to 20t/axle.

General issues

- Train control: some very old train control systems are still in use on the section between Worcester and Kraaifontein. These need to be replaced with CTC;
- Substations and electrical supply: this is a constraining factor on capacity. 25kV AC system has more capacity than the 3kV system that suffers from low voltage problems;
- Shosholoza Meyl: shared infrastructure can lead to operational challenges; and
- Telecoms: signalling to be connected with optic fibre along the whole route.

Section performance

The performance of the line is the network average. Implementation of state-of-the-art traffic control and safety systems can greatly improve operational performance that degrade present service and inhibit the ability to effectively absorb future traffic. This would also enhance the ability of the section to carry mixed (passenger and freight) traffic.

(b) Kimberley to Vereeniging

Status quo

Kimberley to Vereeniging line is used for both heavy haul and passenger services, it consists of both double and single-line sections. The line is electrified to 3kV DC and carries axle tonnages of up to 20 tonnes. Crossing loops on the single line sections allow for the crossing of 104 wagon trains.

General issues

- Line use: mixed use heavy haul and passenger services, which incur incompatibility problems operationally. Maintenance requirements on single-line sections cause a reduction in capacity;
- Electrical: theft of OHTE and cables is rife on single-line sections; and
- Shosholoza Meyl: poor punctuality, which makes for difficult operational planning.

Section performance

- The performance of this section is substantially below the performance of the network average despite generally being in a fair condition. Signal theft and vandalism are the main contributors to section failures and require special attention; and
- The capacity of this entire section is severely limited by mixed use by heavy haul and passenger services and electrical related network failures. Train control planning effort should be directed towards minimising conflict between passenger and freight requirements. This would improve logistical efficiency and secure railway network capacity and reliability gains for the benefit of all users.

(c) Vereeniging to Noupoort

Status quo

The Vereeniging to Noupoort line carries general freight traffic and consists of double and single-line sections. The line is electrified to 3kV DC between Bloemfontein and Gauteng, with diesel operations south of Bloemfontein. The whole section supports axle tonnages of up to 20t/axle.

General issues

- Slot capacity: Viljoensdrift possible slipway to get faster access to private siding;
- Train control: old technology overdue for replacement; and
- Shosholoza Meyl: option for rerouting for Cape Town and Port Elizabeth routes.

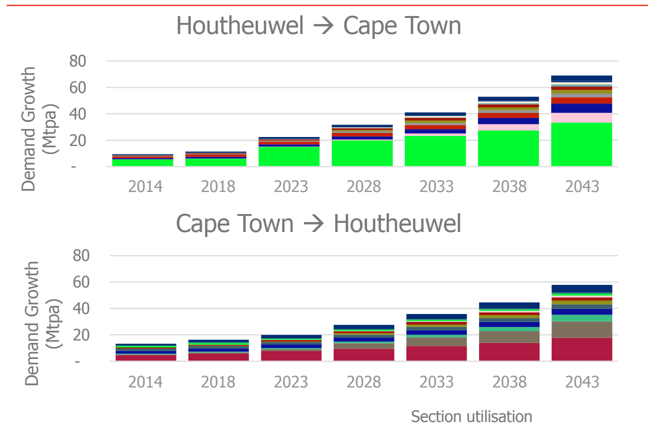
Section performance

- The performance of this section is substantially below the network average. Theft is a major issue on the line and can be held accountable for much of the electrical and signalling failures; and
- The capacity of this entire section is severely limited mainly by an old interlocking and aging track circuits technology overdue for replacement. Effort should be directed towards rerouting passenger traffic to Cape Town and Port Elizabeth along alternative routes where possible in order to increase capacity until train control systems are replaced.

Gauteng to Cape Town: demand and current capacity

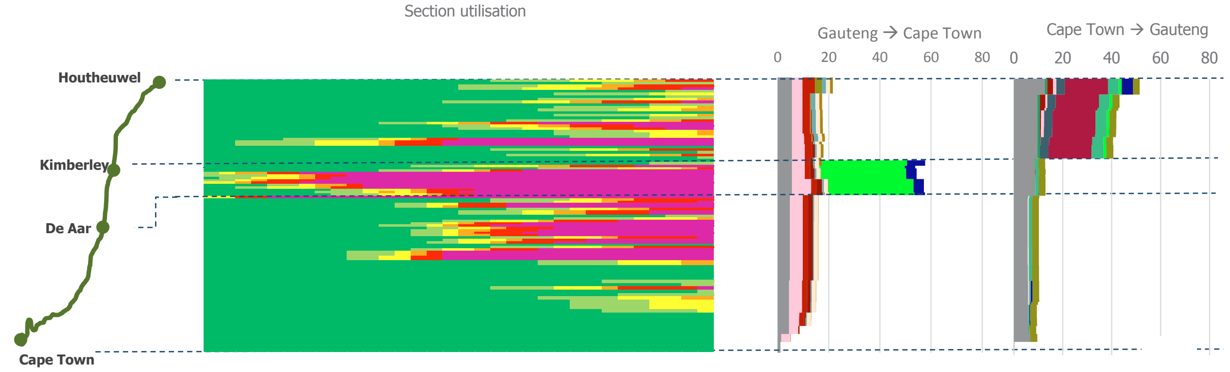
The short summary description of the demand and capacity requirements is given below:

Figure 51: Gauteng to Cape Town system – demand and current capacity



Top 10 commodities (Mtpa)			
Commodity	2014	2030	2043
Export manganese	5,50	19,90	33,30
Domestic iron ore	4,70	9,40	17,60
Containers	0,30	4,10	12,60
Other agriculture	0,10	0,70	7,40
Cement	0,91	2,40	7,10
Limestone	0,36	1,20	4,90
Domestic coal	1,26	2,49	4,90
Domestic manganese	1,80	2,20	3,40
Processed foods	–	1,07	2,70
Maize	0,48	1,32	2,60

Section demand (2043)



(a) Cape Town to De Aar

Demand

Containers have a high growth forecast. This section sees relatively similar flows in either direction, with large potential growth, particularly in containers. Rail volumes in both directions and are mainly made up of containers, coal and agricultural products. Whilst most commodities see steady growth, container growth is forecast to be considerable.

The segmented demand views show a similar picture in both directions. Over half of the 2 043 tonnages are destined or originating in, the greater Cape Town area, with the remainder of volumes destined for and originating from the port itself.

(b) Kimberley to Houtheuwel

Demand

The line's demand is made up of traffic travelling between the Western Cape, Northern Cape and Eastern Cape and the rest of the country. The tonnage flowing over this section, relative to the network, is very high, with a very high growth rate expected. Dry bulk commodities make up the major constituent of the tonnage and the section also accommodates PRASA traffic.

Iron ore shows a very aggressive growth curve, which should be closely monitored. Some container growth in the long term on the Cape corridor is driven by (a) Cape Town-Gauteng volumes and (b) the development of Ngqura as a container port. Export manganese ore to Richards Bay and Durban is currently relatively high, but may not be sustainable. Demand for Shosholoza Meyl trains is significantly reducing capacity.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

(c) Vereeniging to Noupoort

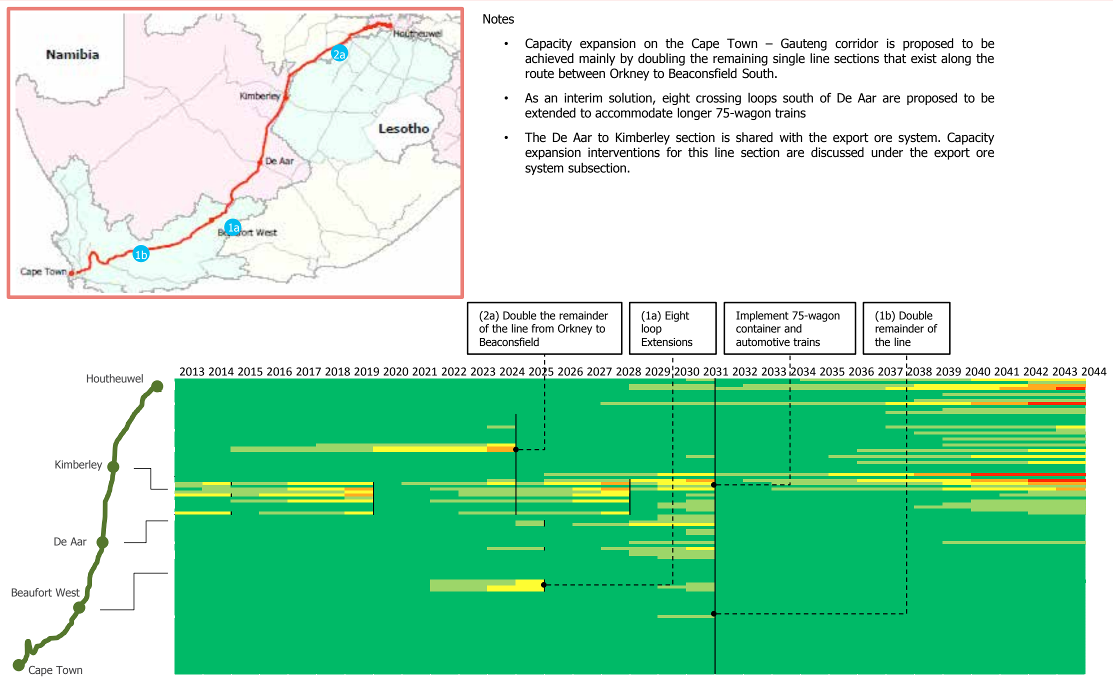
Demand

- The dominant direction from Vereeniging to Noupoort sees initial volumes of 1,5mtpa, which then ramps up to 7,5mtpa by the end of the forecast period.
- In the opposite direction the growth in fuel ensures total demand rising from 1,4mtpa to 7mtpa by 2043; and
- Volumes show variation across the section where feeder lines and junctions meet, but most volumes move the length of the corridor. However, volumes are considerably higher in both directions between Gauteng and Sasolburg, as fuel, refined products and coal are transported to and from the plant.

Cape Town to Gauteng: results after capacity interventions

The figure 52 below shows the locations of planned interventions and its impact on capacity utilisation on the line from Cape Town to Houtheuwel.

Figure 52: Cape Town to Gauteng – capacity interventions



Cape Town to Gauteng system: development plan

Figure 53: Cape Town to Gauteng – development summary

Strategy

Axle	Train control	Electrical	Capacity expansion	Alignments
Upgrade selected sections to 26 t/axle	Maintain existing	Maintain existing	Doubling	Ease grades and curves

Expansion and investment

Section	Phase	Station	Intervention	ETC (Rm)	Completion by
Cape Town to De Aar	1a	Konstabel	1 Loop extension from 700m to 900m	27	2025
Cape Town to De Aar	1a	Merriman and Droerivier	2 Loop extension from 700m to 900m	54	2025
Cape Town to De Aar	1a	Gemsbok and Leeugamka	2 Loop extension from 700m to 900m	54	2025
Cape Town to De Aar	1a	Quarry, Matjiesfontein, and Vleifontein	3 Loop extension from 700m to 900m	81	2025
Cape Town to De Aar	1b	De Aar to Malan	Double the remainder of the line	64 046	2031
Houtheuwel to Kimberley	2a	Orkney to Beaconsfield South	Double remaining single lines	3061	2021

Development plan

Section	Phase	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Cape Town to De Aar	1a										0,1	0,3	5,3	21,3																	
Cape Town to De Aar	1b										0,2	0,7	10,6	42,5																	
Cape Town to De Aar	1c										0,2	0,7	10,6	42,5																	
Cape Town to De Aar	1d										0,3	1,0	15,9	63,8																	
Cape Town to De Aar	1e												257	801	3 409	8 201	15 056	18 925	15 086	2 311											
Houtheuwel to Kimberley	2a				50,5	65,7	183,9	873,1	1 394,8	493,1																					

FEL – 1: Concept study
FEL – 2: Feasibility
FEL – 3 + Construction

The network development strategies for the Cape Town-Gauteng system are given below per section:

(a) Cape Town to De Aar

Axle load

Maintain existing 20t/axle.

Electrical

- Cheaper to add more 3kV DC substations rather than convert to 25kV AC; and
- Sharing 3kV DC network with commuter trains, therefore rather not upgrade electrification.

Train control

Provide signal infill scheme to reduce the running time when doubling the line.

Train length

Increased to 57-wagon automotive trains, 75-wagon container trains and 75-wagon dry bulk trains.

Intervention thought processes

- Considered doubling – unwarranted quantum leap in capacity; and
- Decision to lengthen a number of loops to support longer trains for required capacity.

(b) Kimberley to Houtheuwel

Axle loading

- Short term: maintain the current 20t/axle and consider 26t/axle migration in the long term; and
- In order to be consistent with long-term aims, all passing loop upgrades or track additions should be built to 26 tons axle load standards.

Train control

Optimise existing system.

Electrical

Long term: this section is a strong candidate for migrating to 25kV AC, but this must be done in conjunction with the sequencing interface with Natcor north and the proposed 25kV upgrade of the Hotazel to Kimberley section.

Capacity expansion

- Interim capacity increases will be achieved by additional passing loops and line doubling of some sections; and
- All new loops or loop extensions to be based on 100-wagon general freight and 75-wagon anaconda container train lengths.

Intervention thought processes

- Considered lengthening of crossing loops, however majority of the loops are adequately long;
- Considered construction of additional crossing loops, however, the loop spacing is already adequate; and
- Decision to double the remaining isolated sections of the line for operational efficiency.

(c) Vereeniging to Noupoort

Axle loading

Maintain the 20t/axle load as this line has no heavy haul potential.

Train control

- Medium term: track warrant (+) on the Bloemfontein – Vereeniging section if rationalised to a single line;
- Keep track warrant on Noupoort to Bloemfontein and Bloemfontein to Kimberley sections; and
- New sets of self-normalising points machines on all loop extensions.

Electrical

Electrify Bloemfontein to Noupoort.

Capacity expansion

Interim capacity increases would be achieved by additional passing loops and line doubling of some sections.

3.5 GAUTENG TO DURBAN SYSTEM

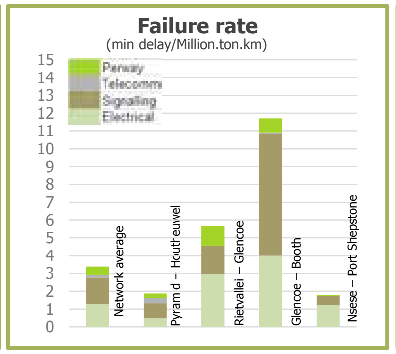
Figure 54: Gauteng – Durban system network

- The Gauteng to Durban section is a general freight line, but carries substantial high volumes tonnages.
- The volumes on the northern section (Gauteng to Glencoe) of Natcor are dominated by coal, iron ore and containers.
- Capacity interventions involves train control upgrading, axle load (heavy haul) upgrading, new links, Cato ridge bypass, upgrading of the electrification, doubling of single lines, and improving the connectivity of the rail network with existing and proposed intermodal terminals

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

Gauteng to Durban system: status quo

Figure 55: Gauteng to Durban – status quo



Notes

- The system consists of the Gauteng Freight Ring (Pyramid to Houtheuwel), Natcor (Gauteng to Durban) and the KZN North and South coast lines (Nsese to Port Shepstone)
- Natcor infrastructure is heavily utilised but constrained by poor alignment design. Poor formation and tunnel design infringe capacity development opportunities
- Gauteng freight ring capacity is constrained by single line sections. OHTE theft and obsolete train control technology impacts severely on its train operations
- KZN North and South coast signalling equipment is obsolete and must be replaced

Line properties

Section	Line type	Axle load	Traction	Train control	Sharpest curve	Steepest gradient
1. Pyramid – Houtheuwel	Single/double	20t	3kV DC	CTC	305m	1:100
2. Rietvallei – Glencoe	Double	20t	3kV DC	CTC	285m	1:60
3. Glencoe – Booth	Double	20t	3kV DC	CTC	220m	1:45
4. Nsese – Durban	Single/double	18.5t/20t	3kV DC/25kV AC	CTC/TWS	250m	1:66
5. Durban – Port Shepstone	Single/double	18.5t	3kV DC	CTC/RTO	250m	1:66

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
1. Pyramid – Houtheuwel	● (amber)	● (amber)	● (amber)	● (amber)	● (red)	● (amber)	● (amber)	● (amber)
2. Rietvallei – Glencoe	● (amber)	● (amber)	● (amber)	● (amber)	● (red)	● (amber)	● (amber)	● (amber)
3. Glencoe – Booth	● (amber)	● (amber)	● (red)	● (amber)	● (amber)	● (amber)	● (amber)	● (amber)
4. Nsese – Port Shepstone	● (amber)	● (red)	● (amber)	● (red)	● (red)	● (red)		● (red)

The Gauteng to Durban system consists of the Gauteng Freight Ring, Natal Corridor (Natcor) and both the south and north KwaZulu-Natal coast railway lines. The status quo of the three major sections is summarised below:

(a) Natcor (Rietvallei to Booth)

Status quo

- The Rietvallei to Booth section is a general freight line, but carries substantial heavy haul tonnages of coal to the Majuba power station and iron ore to the Newcastle AMSA plant. The section is double track with 3kV DC electrification. Axle loads are currently supported up to 20t/axle, but there are plans to upgrade one of the two tracks of the line from Rietvallei to Glencoe into heavy haul or 26t/axle operations due to high demand of iron ore destined for Newcastle; and
- Overall condition of the existing network infrastructure is not acceptable with formation, bridges and tunnels requiring more attention.

General issues

- Train operation: heavy coal trains to Majuba problematic with very limited redundancy;
- Electrical: OHTE cable theft, steelwork in the process of being replaced, high corrosion on rails in tunnels due to stray currents;
- Line use: single-line section from Rooikop to Rietvallei and the line configuration to Jupiter are causing bottlenecks. High cube containers cannot be accommodated safely due to height restrictions;
- Slot capacity: current capacity is sufficient, further expansion will be expensive due to difficult topography;
- Train control: theft of signal cables result in major service disruptions. Migration from copper is a priority. Obsolete interlocking and track circuit components need to be replaced;
- Formation: Rietvallei to Booth is problematic due to poor drainage in tunnels and weak formation;
- Shosholoza Meyl trains: significant freight and passenger train scheduling, planning and operations challenges; and
- Commuter trains: high frequency of commuter trains on the Cato Ridge to Booth section impacting on capacity utilisation.

Demand validation: There is a possibility that the power stations may be mothballed as they are nearing the end of their design life in the next decade. This would render the planned heavy haul operation redundant. This possibility must be observed as it will affect the end state of the system and affect efficiencies if not executed in this fashion. The demand has been capped after 10 years and may in fact decrease.

Performance

- Section performance is worse than the network average. Most failure delays are caused by electrical faults; and
- Effort on this section should be directed towards removing bottlenecks, handling the conflict between passenger and freight trains capacity requirements, securing railway network capacity and reliability, and implementing state- of-the-art train control and safety systems.

(a) Gauteng Freight Ring

Status quo

- Gauteng Freight Ring carries general freight and has single- and double-line sections. It supports tonnages of up to 20t/axle. The ring is composed of three main sections; 25kV AC from Rustenburg to Pyramid, 3kV DC from Pyramid to Sentrarand and 3kV DC from Sentrarand to Houtheuwel; and
- Overall condition of the line infrastructure is acceptable, but electrical and signalling infrastructure are in poor condition.

General issues

- Gauteng Freight Ring carries general freight and has single and double-line sections. It supports tonnages of up to 20t/axle. The ring is composed of three main sections; 25kV AC from Rustenburg to Pyramid, 3kV DC from Pyramid to Sentrarand and 3kV DC from Sentrarand to Houtheuwel; and
- Overall condition of the line infrastructure is acceptable, but electrical and signaling infrastructures are in poor condition.

Performance

The section performance is significantly above the network average with about half less delay due to faults recorded on the section compared to the network average.

(b) KZN north and south coast lines

Status quo

- The KZN north and south coast lines connecting Port Shepstone, Durban and Richards Bay carry general freight and passenger traffic and consist of single and double-line sections. It is a 3kV DC system designed for 20t/axle capacity; and
- Overall condition of the line infrastructure is 'not acceptable'. The prevailing humid coastal environment contributes chiefly to poor infrastructure condition. Affected infrastructure should be programmed for replacement or upgrade.

General issues

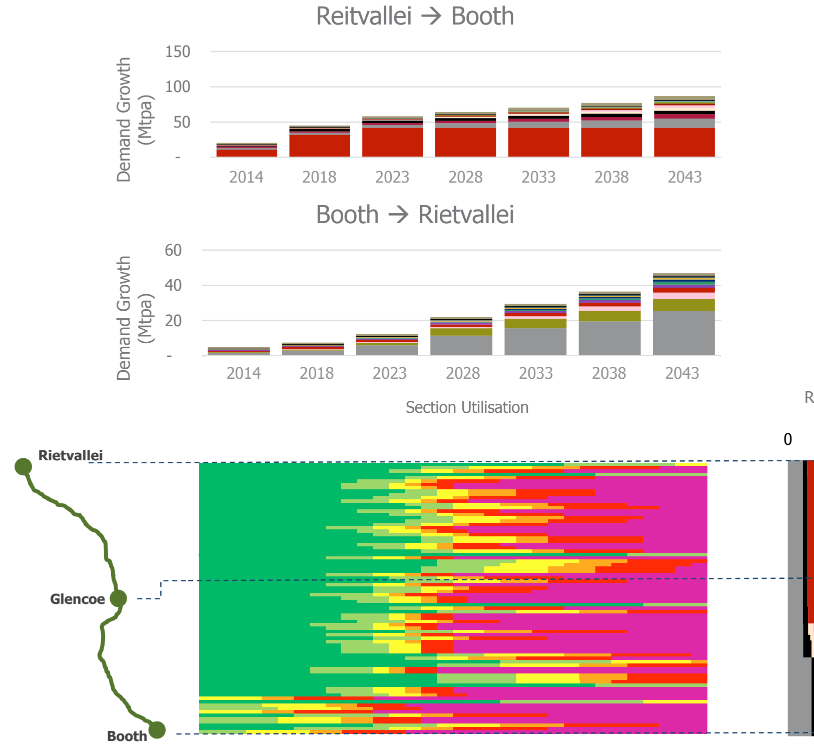
- Electrical: high corrosion on rails in tunnels due to stray currents;
- Formation: problematic, material loss due to erosion resulting from heavy rainfall; and
- Shosholoza Meyl: Durban to Stanger section needs replacing of its signalling system.

Performance

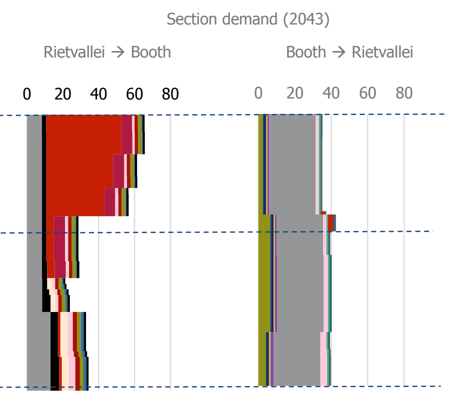
The performance of this section is above the network average. Delay due to failure on the section is less than the network average. The poor performance is mainly due to the aggressive coastal environment conditions.

Gauteng to Durban: demand and current capacity

Figure 56: Gauteng to Durban – demand and current capacity



Top 10 commodities (mtpa)			
Commodity	2014	2030	2043
Domestic coal	10,8	41,7	41,7
Containers	1,8	11,5	25,6
Processed foods	0,2	4,1	6,6
Domestic iron ore	2,1	3,3	6,3
Export coal	0,93	3,9	4,9
Iron and steel	0,47	1,6	4
Other agriculture	0,06	0,43	3,6
Maize	0,75	1,5	2,6
Automotive	0,12	0,6	1,9
Wheat	0,5	1,09	1,8



3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

Gauteng to Durban: results after capacity interventions

The figure below shows the locations of planned interventions and their impact on capacity utilisation on the line from Rietvallei to Booth.

Figure 57: Rietvallei to Glencoe– capacity interventions

Notes

- The volumes along the Natal corridor are expected to increase dramatically within the next 20 years. Since the line is completely double, the strategy proposed to create additional capacity is to increase the container trains length to 75 wagons by 2021.
- By 2027, it is necessary to increase all train lengths along the Rietvallei to Booth section to 75 wagons or equivalent. As well as increase the container train lengths to 150 wagons.

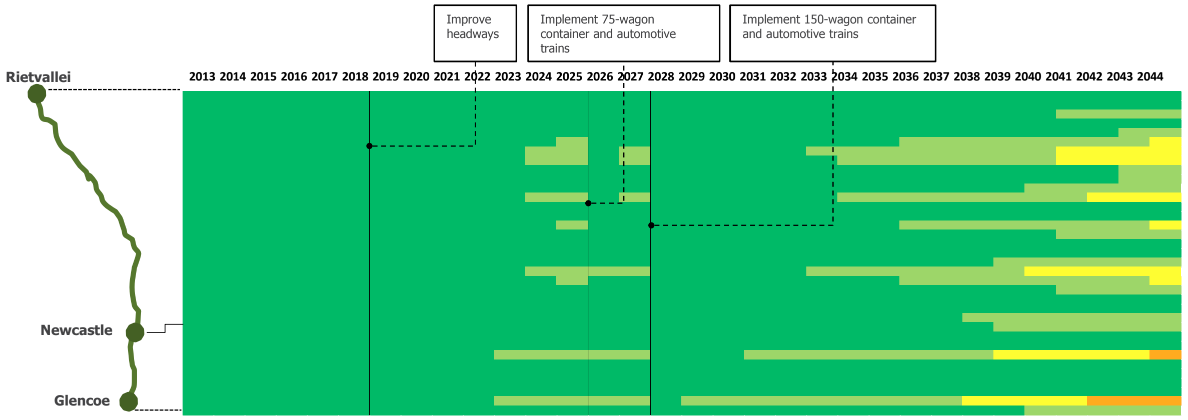
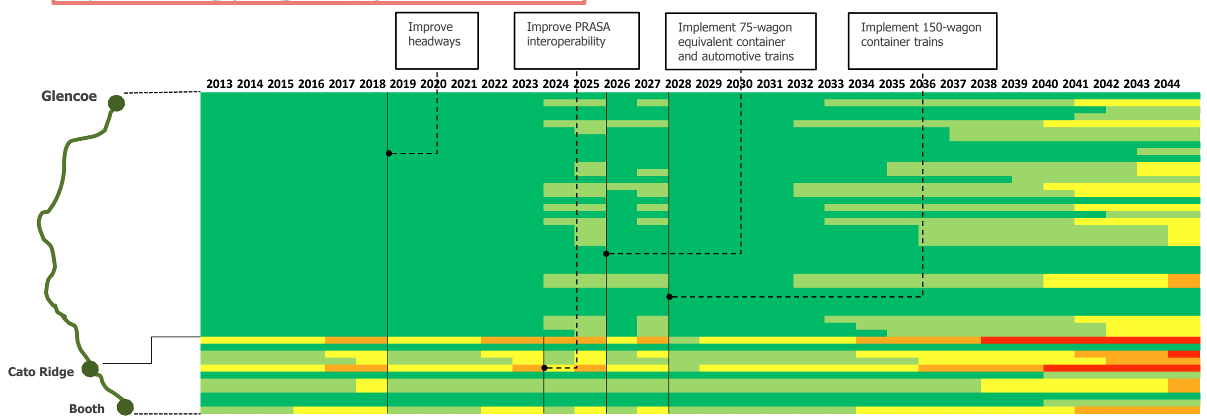


Figure 58: Glencoe to Booth – results after capacity interventions

Notes

- The volumes along the Natal Corridor are expected to increase dramatically within the next 20 years. Since the line is completely double, the strategy proposed to create additional capacity is to increase the container trains length to 75 wagons by 2025.
- By 2027, it is necessary to increase all train lengths along the Rietvallei to Booth section to 75 wagons or equivalent. As well as increase the container train lengths to 150 wagons.
- A Greenfields line between Cato Ridge and Durban is under consideration to bypass on the difficult terrain of the Glencoe to Booth line and create additional capacity for container and automotive traffic



Analysis of the line at Cato Ridge to Booth indicates severe constraint by 2017 if shuttle service is to operate from the port to Cato Ridge.

Intervention can stretch capacity to 2027 but increased volumes will require a separation of metro and freight lines. The proposed Cato Ridge bypass would address this to an extent.

Gauteng to Durban system: development plan

Figure 59: Gauteng to Durban – cost summary

Strategy

Axle	Train control	Electrical	Capacity expansion	Alignments
Upgrade selected sections to 26 t/axle	Maintain existing	Maintain existing	Doubling	Ease grades and curves

Expansion and investment

Section	Phase	Station	Intervention	ETC (Rm)	Completion by
Cape Town to De Aar	1a	Konstabel	1 Loop extension from 700m to 900m	27	2025
Cape Town to De Aar	1a	Merriman and Droerivier	2 Loop extension from 700m to 900m	54	2025
Cape Town to De Aar	1a	Gemsbok and Leeugamka	2 Loop extension from 700m to 900m	54	2025
Cape Town to De Aar	1a	Quarry, Matjiesfontein, and Vleifontein	3 Loop extension from 700m to 900m	81	2025
Cape Town to De Aar	1b	De Aar to Malan	Double the remainder of the line	64 046	2031
Houtheuwel to Kimberley	2a	Orkney to Beaconsfield South	Double remaining single lines	3061	2021

Development plan

Section	Phase	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Cape Town to De Aar	1a										0,1	0,3	5,3	21,3																	
Cape Town to De Aar	1b										0,2	0,7	10,6	42,5																	
Cape Town to De Aar	1c										0,2	0,7	10,6	42,5																	
Cape Town to De Aar	1d										0,3	1,0	15,9	63,8																	
Cape Town to De Aar	1e												257	801	3 409	8 201	15 056	18 925	15 086	2 311											
Houtheuwel to Kimberley	2a				50,5	65,7	183,9	873,1	1 394,8	493,1																					

FEL – 1: Concept study
FEL – 2: Feasibility
FEL – 3 + Construction

The network development strategies for the Gauteng to Durban system are summarised as follows:

(a) Natcor (Rietvallei to Booth)

Axle loading

- Upgrade to 26t/axle, initially on the loaded track from Rietvallei to Glencoe, by replacement of existing sleepers with heavier ones at 650mm spacing and augmenting ballast to increase its depth to 300mm. Axle load capacity on the section from Glencoe to Booth is to remain at 20t/axle; and
- Based on the high investment requirements for 26t/axle loads it is proposed to continue with the 20t/axle load in the short term until increased volumes are confirmed and capacity shortfalls become visible or a viable business case becomes apparent.

Train control

Optimise existing CTC.

Electrical

- Rietvallei to Glencoe to be upgraded to 25kV AC to support heavy haul (coal and iron ore) requirements; and
- On the southern part of Natcor, optimise the current 3kV DC system as the dimensional envelope of the existing tunnels cannot be easily increased.

Capacity expansion options

Upgrade the Cato Ridge to Booth section by providing a new bypass to match demand. The existing line may be utilised by PRASA.

Alignments

Relieve gradients and curves between Glencoe and Cato Ridge.

Train lengths

Increased to 57 wagons for automotive trains and 75 wagons for container trains.

Increased to 150 wagons for container trains and 75 wagons for dry bulk.

Running times

Running times improved so that the constraining section is 20 minutes.

Reduced Prasa slot utilisation

25 slots to 17 slots (17 actual trains are scheduled, use of 25 slots is due to interoperability issues).

These interventions are found to be necessary to accommodate the increased demand as planned.

Intervention thought processes

- Considered reduction in headways (signal spacing) – not practical on an operational level;
- Considered 100-wagon container trains – found to be insufficient in the long term; and
- Decision to integrate the DRiP FEL 1 interventions to lengthen to 75-wagon and later 150-wagon trains.

3. DEVELOPMENT PLANS: CORE NETWORK SYSTEMS (continued)

(b) Gauteng Freight Ring

Axle loading

Keep existing 20t/axle.

Train control

Provide a signal infill scheme to reduce train running times.

Electrical

Tie stations at Greenview are being upgraded to 3kV DC substations. Possible conversion of this section to 25kV AC is dependent on the Waterberg coal developments.

Capacity expansion options

- Double remainder of Gauteng Freight Ring lines and implement CTC signal infill system. The construction of a proposed new double tracked rail link connection between Skansdam and Houtheuwel (PRASA bypass) to be informed by Freight Rail and PRASA joint planning strategy; and
- Construction of a new single tracked chord from south to east to facilitate the routing of freight traffic travelling north from Sentrarand onto the Maputo corridor.

Alignments

Maintain existing alignments.

(c) KZN north and south coastal lines

Axle loading

Keep existing 20t/axle.

Train control

- South coast line: maintain as RTO, frequency is an issue to be resolved with Neotel; and
- North coast line: convert to TWS. Maintain colour light signals from Kelso to Stanger due to passenger service, major signalling replacement to be considered to do away with the obsolete signalling equipment.

Electrical

South coast line:

- Maintain 3kV DC from Durban to Kelso due to passenger train service requirements;
- Little benefit will be derived in using electrical traction for freight trains running from Kelso to Port Shepstone. Run diesel trains but do not de-electrify at this stage; and
- Rail access to the proposed DIA development site is to be aligned with the DIA study. Further consideration should be given to the requirement for rail access to the automotive terminal at Isipingo.

(d) North coast line

Maintain 3kV DC system from Durban to Stanger and introduce diesel operation in case of low volume forecast from Stanger to Nsezi. If higher volumes are projected, then electrify the entire system to 25kV AC.

Capacity expansion options

PRASA interface within eThekwini area, choices include an option involving grade separation.

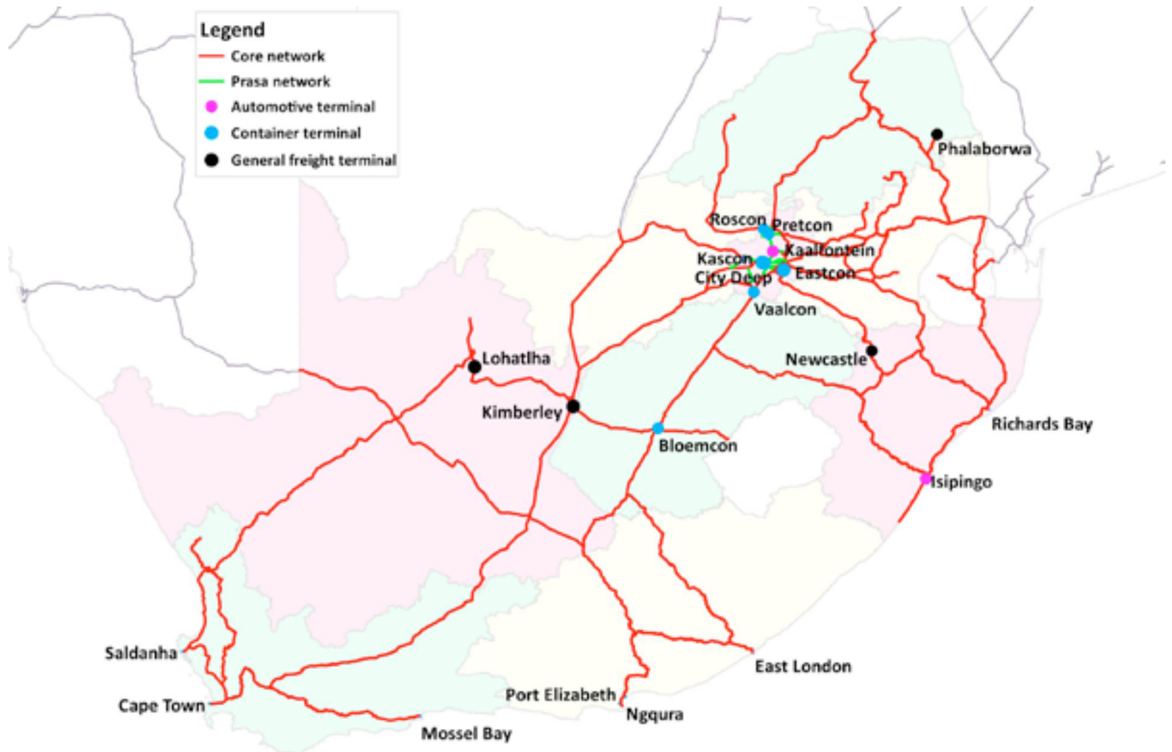
Alignments

Maintain existing alignment.

4. HUBS AND TERMINALS

4.1 HUBS AND TERMINALS: STATUS QUO

Figure 60: Status quo (current terminals)



The hubs and terminals status quo map shows the positions of automotive, container and general freight terminals. The position of each terminal is linked to its purpose:

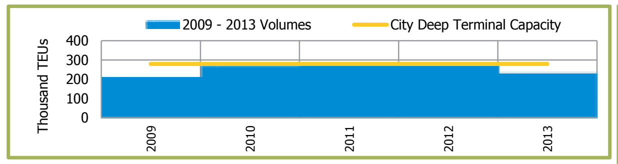
- The container terminals consist of inland and port container terminals serving the container business;
- General freight terminals are small terminals used for repackaging of commodities (and also handle containers); and
- Containerised freight traffic will increase globally by up to 8% per annum and in some developing countries, such as South Africa, the growth in port container handling is expected to be even greater. The increased national economic growth and global container trends have resulted in a steep increase in the demand for container handling capacity throughout South African ports.

The traffic in the ports on the east coast of South Africa has recently increased by up to 14% annually and it is expected to increase more rapidly in the near future.

Transnet's long-term aim is to achieve 80% market share of rail suitable transportation of containerised traffic, representing a significant modal shift over existing levels. Therefore to accommodate the expected significant growth of container demand in the short-, medium- and long-term existing infrastructure, facilities, and operational planning for the accommodation and movement of this traffic by rail requires improvement. To this end, existing container terminals have been identified for expansion and in the longer term the development of new additional facilities have been identified.

4. HUBS AND TERMINALS (continued)

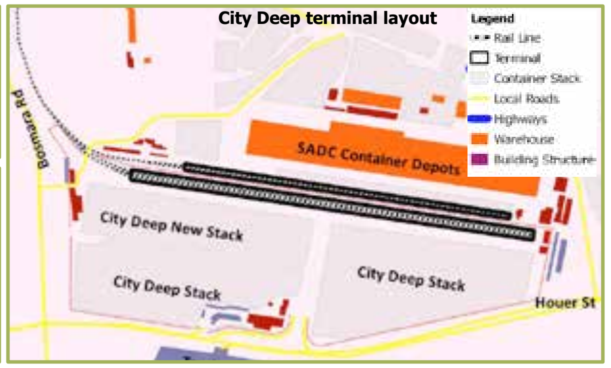
Figure 61: City Deep terminal



City Deep container terminal is Transnet's primary intermodal terminal, located south of central Johannesburg.

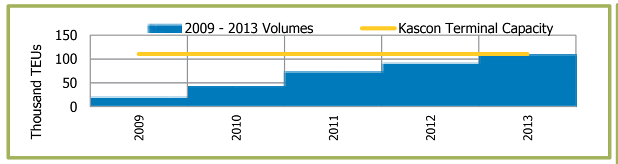
Infrastructure characteristics:
Four handling tracks (50 wagon terminal) served by Rail Mounted Gantries (RMGs)
- 8 100 TEU stacking area
- 280 000 TEUs terminal capacity (per annum) with 232 000 TEU's handled during 2013

General issues:
- Limited slot capacity on the mainline (access line shared with Prasa)
- Road traffic congestion (accessing the terminal) and truck staging area



City Deep terminal is undergoing an upgrade to increase its capacity in the next two years. The current capacity and volumes have dropped due to these upgrades.

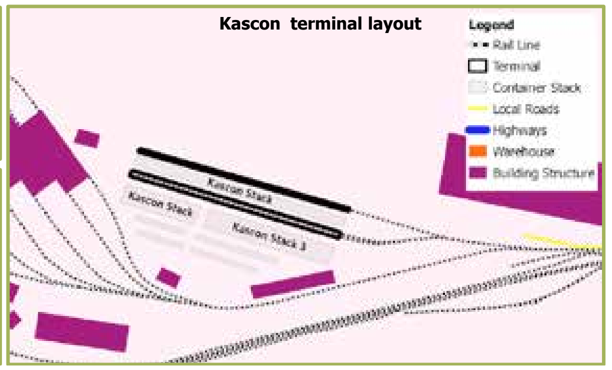
Figure 62: Kascon terminal



Kascon is located in the Kaserne area (3km from City Deep), adjacent to Kaserne West station in Johannesburg.

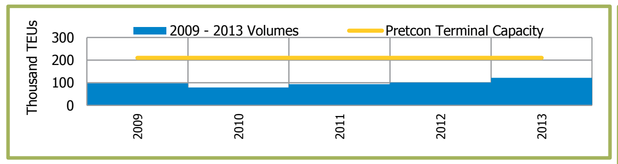
Infrastructure characteristics:
- Three handling tracks, served by reach stackers
- 3 900 TEU stacking area
- 110 000 TEUs terminal capacity (per annum) with 108 000 TEU's handled during 2013

General issues:
- Private sidings in the vicinity are causing road congestion in the adjacent areas.
- The terminal is within a PRASA area restricting access during morning and afternoon peak periods



Kascon terminal has experienced an increase in volumes in the last two years due to the upgrades at City Deep terminal; some of the traffic destined for City Deep has been handled at Kascon terminal for the last two years.

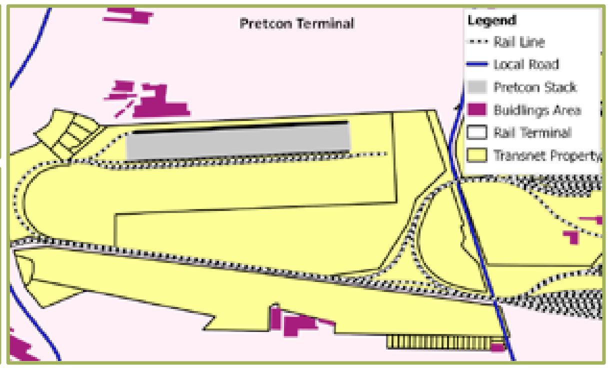
Figure 63: Pretcon terminal



Pretcon is in the Pretoria area and is accessed via R101 Mansfield Avenue, just west of Capital Park.

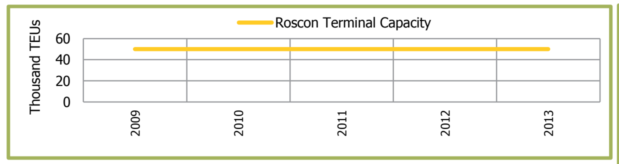
Infrastructure characteristics:
- Two handling tracks (50 wagon terminal) served by served by reach stackers
- 8 100 TEU stacking area
- 210 000 TEUs terminal capacity (per annum) with 121 000 TEU's handled during 2013

General issues:
- Delays in sidings as trains access the terminal via a single track from Capital Park and commuter services curtail freight train movement during peak commuter hours.



An upgrade is underway at Pretcon to refurbish the terminal, the upgrades include the refurbishment of the container handling area, the building of a new car storage and a truck staging area. The terminal access volumes will be moved to a larger terminal beyond 2021 with the introduction of the new mega intermodals terminal in Gauteng.

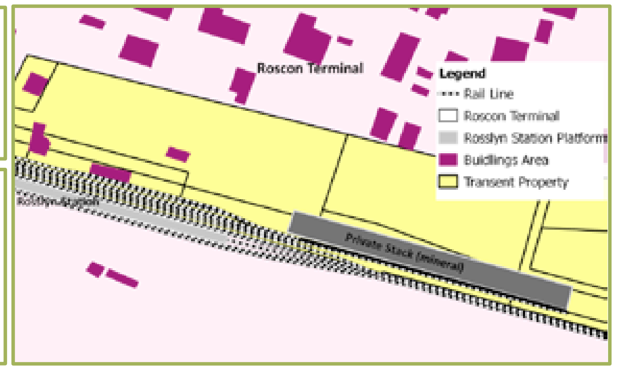
Figure 64: Roshcon terminal



The site is located in the Rosslyn area of Pretoria, close to the R80 freeway, with rail access via a single line on the eastern side of Rosslyn Marshalling yard and road access from the adjacent R556.

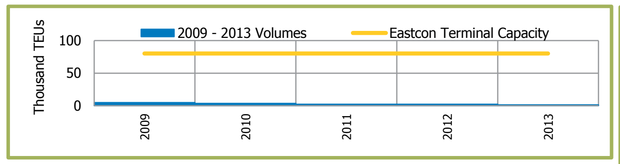
Infrastructure characteristics:
- One handling track (25 wagon terminal)
- The terminal is currently not handling any volumes

General issues:
- Transnet Freight Rail owns the Roscon site, but it is currently leased.
- Problems with the private sidings agreement, the stacking constraints and issues with the interaction with the PRASA services are limiting.



The yard runs alongside a PRASA line and Rosslyn station lies adjacent to the yard, a short and narrow hardstanding area is available for container storage. There are currently no container operations in the area.

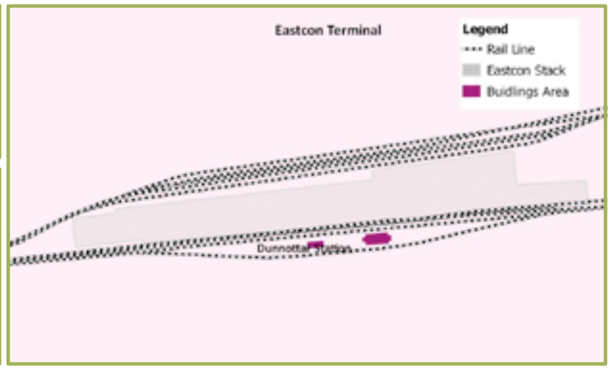
Figure 65: Eastcon terminal



The Eastcon terminal is located in Dunnottar area, east of Gauteng.

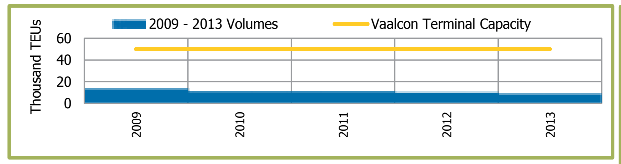
Infrastructure characteristics:
- Four handling tracks (50 wagon terminal) served by served by reach stackers
- 5 967 TEU stacking area
- 80 000 TEUs terminal capacity (per annum) with 1 200 TEU's handled during 2013

General issues:
- The terminal operates as a satellite terminal used to reduce the lead road distance of containers (outward full containers are sent to Kaserne to add to Durban bound trains).



There are no current plans for the terminal and access volumes destined for the terminal will be moved to a larger terminal by 2016.

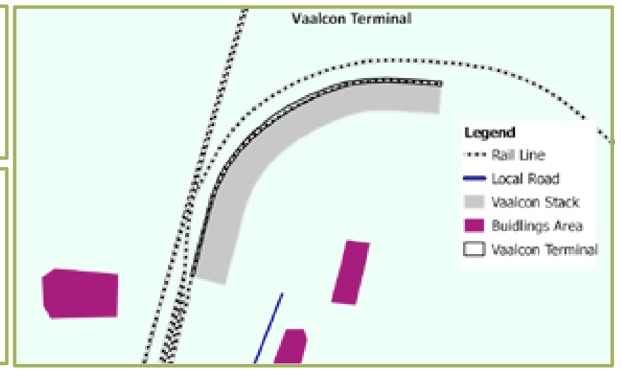
Figure 66: Vaalcon terminal



Vaalcon is located close to the former Viljoensdrif station, South of Vereeniging and Leeuhof and North of Sasolburg.

Infrastructure characteristics:
- Two handling tracks (35 wagon terminal) served by served by reach stackers
- 350 TEU stacking area
- 50 000 TEUs terminal capacity (per annum) with 9 000 TEU's handled during 2013

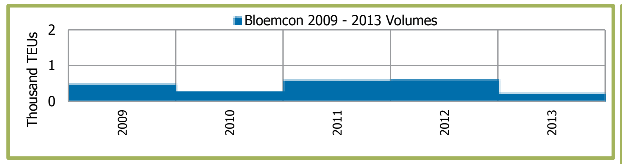
General issues:
- Road access, it is difficult to access the site from the N3 freeway.
- The curved shape of the terminal constrains operations and reduces the stacking area significantly.

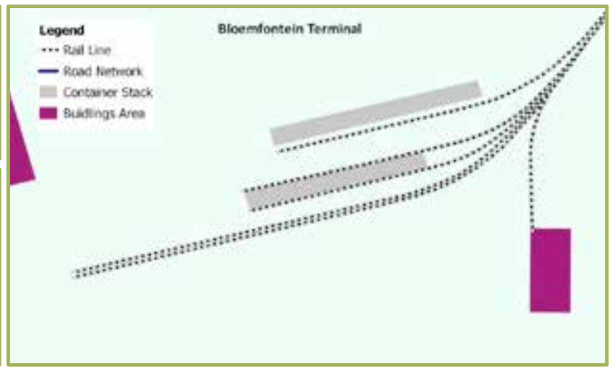


There are no current plans for the terminal and volumes handled in the terminal have been declining over the years, to this end terminal will not handle containers from 2016.

4. HUBS AND TERMINALS (continued)

Figure 67: Bloemcon terminal





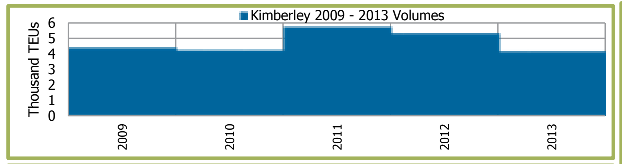
Bloemcon terminal is located in Bloemfontein and is used as a low volume container terminal. The terminal is on a main line to Gauteng via Kroonstad and Vereeniging.

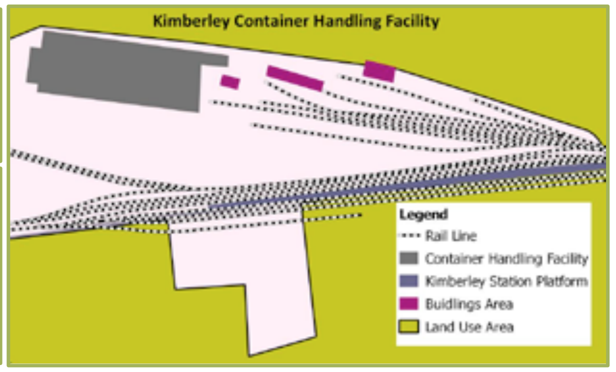
Infrastructure characteristics:
- Two handling tracks (10 wagon terminal) served by served by reach stackers
- 8 000 TEU stacking area
- Approximately 27 000 TEUs terminal capacity (per annum) with 214 TEU's handled during 2013

General issues:
- Current tracks are limited to 10 wagons
- Limited storages space.

The existing Bloemcon terminal is undergoing refurbishment, and a new Bloemcon terminal is under construction in a new site.

Figure 68: Kimberley container handling facility





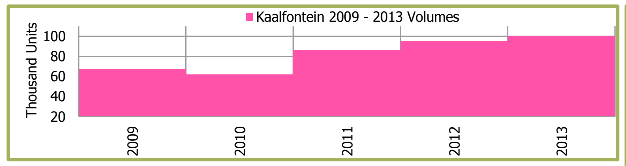
The facility is located west of the main yard (Beaconsfield yard). The containers are handled at the old goods shed opposite the Kimberley passenger station.

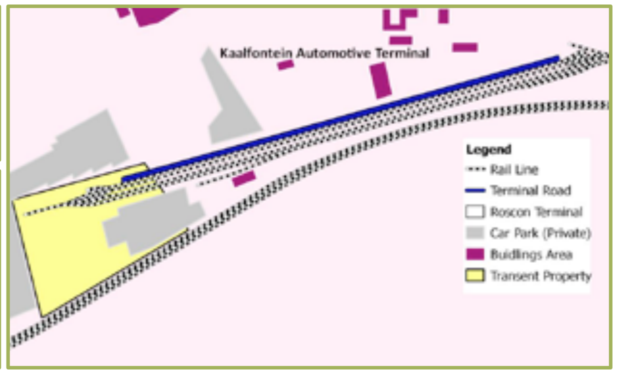
Infrastructure characteristics:
- Four handling tracks (50 wagon terminal), 1 x Mobile Crane; 1 x forklift
- 5 967 TEU stacking area
- 80 000 TEUs terminal capacity (per annum) with 4 201 TEU's handled during 2013

General issues:
- No ability for expansion due to adjacent property and existing railway station.

This container handling facility is located in the center of Kimberley with short tracks, minimal stacking space and no ability for expansion.

Figure 69: Kaalfontein automotive terminal





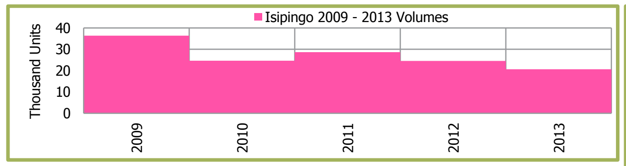
Kaalfontein is located south of Olifantsfontein on the north-south PRASA mainline between Johannesburg and Pretoria. It is used mainly for import of cars from Durban (Point and Isipingo terminals) and Port Elizabeth.

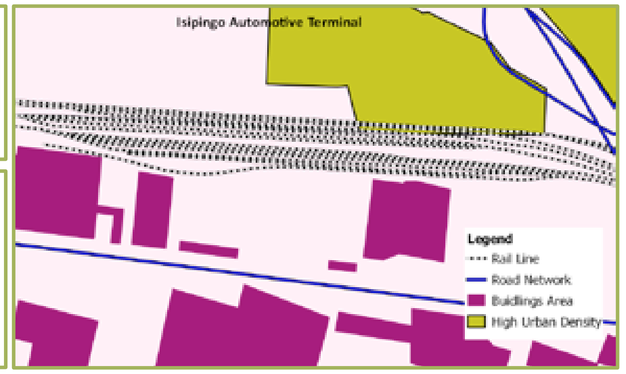
Infrastructure characteristics:
- Three handling tracks (45 wagon terminal), loading ramps are used to offload and load cars

General issues:
- Yard accessibility via the PRASA lines is a problem

Various options have been developed to separate Transnet Freight Rail (TFR) operation from Passenger Rail Agency of South Africa (PRASA) in Kaalfontein to increase capacity in the terminal through increased throughput. A reconfiguration option for the separation is under investigation.

Figure 70: Isipingo automotive terminal





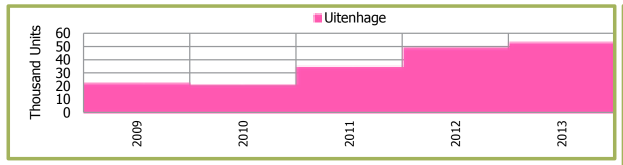
The Isipingo terminal is located approximately 12km south of Durban, adjacent to the Toyota assembly plant.

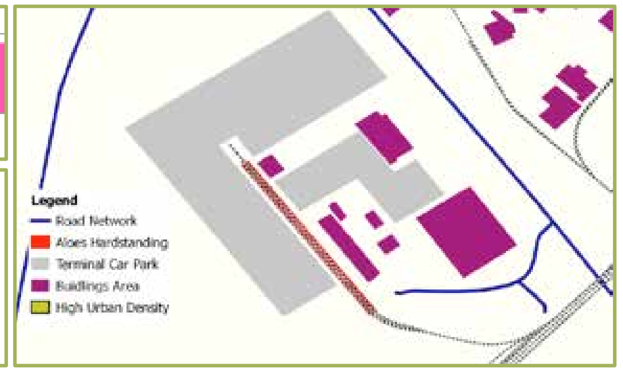
Infrastructure characteristics:
- Three handling tracks (25 wagon terminal), served by fork-lifts

General issues:
- The site is bounded by Factory Road to the north, railway tracks to the west, and Jeffels/Old Main Roads to the south and east.

The automotive terminal services the adjacent Toyota automotive assembly plant, which assembles motor cars at this location for distribution and export. A new design layout has been proposed for the terminal.

Figure 71: Aloes automotive terminal





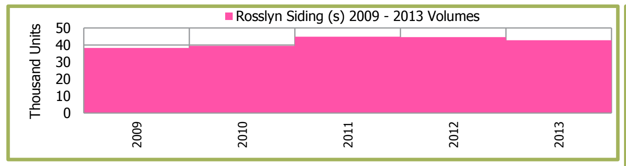
The assembly point is located in Uitenhage (24km north west of Port Elizabeth and 18km west of Aloes). Assembled Volkswagen cars (from Uitenhage) are loaded onto trains for transport to Kaalfontein, Bellville and Durban.

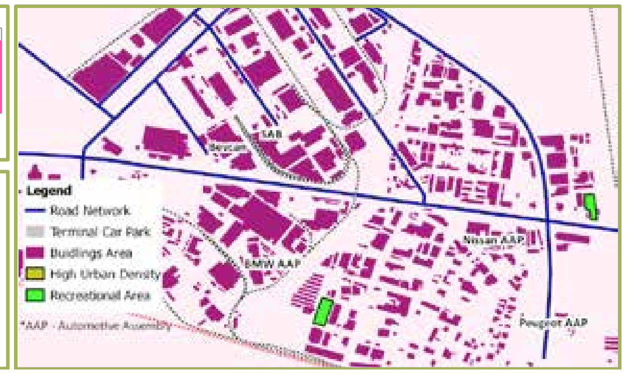
Infrastructure characteristics:
- Four tracks of circa 1km in length.
- Three can be used for automotive loading with hardstanding alongside.
- Three handling tracks (45 wagon terminal), loading ramps are used to offload and load cars

General issues:
- Some residential area to the east of the site.

There is land available for hardstanding and parking for expansion but currently there are no plans to expand the terminal.

Figure 72: Rosslyn automotive assembly siding(s)





The private sidings servicing the automotive plants are located just north of Rosslyn PRASA station. Various car manufacturing companies have their own private rail sidings within five kilometres north of the station.

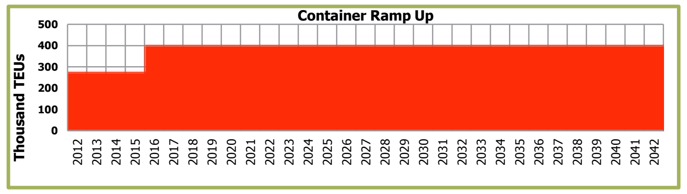
Infrastructure characteristics:
- Handling tracks and equipment unknown

General issues:
- There is not automotive terminal in the area to consolidate and distribute the vehicles, all plants are serviced by private sidings.

The Rosslyn sidings mainly service the BMW and Nissan plants in the area. The trains are broken up in the Rosslyn station yard and sent through in different consists to different siding. The site is constrained by industry around it; therefore it has limited expansion potential.

4. HUBS AND TERMINALS (continued)

Figure 73: City Deep terminal upgrade



The City Deep terminal is undergoing an upgrade, with the introduction of Rubber Tyre Gantries (RTGs) and the creation of a modern inland container terminal with a sustainable operational capacity of 400 000 TEU per annum.

Estimated Capacity created:

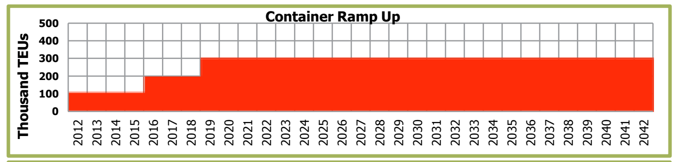
- 400 000 TEU per annum

Development plan

Terminal type	Capacity created	ETC (Rm)	2014	2015	2016	2017	2018
Container	400 000	**558**	210	247	101	Construction	
Total cash flow (Rm)		**558**	**201**	**247**	**101**		

City Deep upgrades started early in 2012 with the installation of new cranes, all the new cranes have been commissioned and are operational. The current City Deep upgrade is the construction of a new slab for container stacking (phase 1 completed). By 2019 with all the upgrades completed City Deep will have a handling capacity of 400 000 TEUs per annum.

Figure 74: Kascon terminal upgrade



Kascon terminal will be upgraded to 200 000 TEUs by 2016 and 300 000 TEUs by 2019.

Estimated Capacity created:

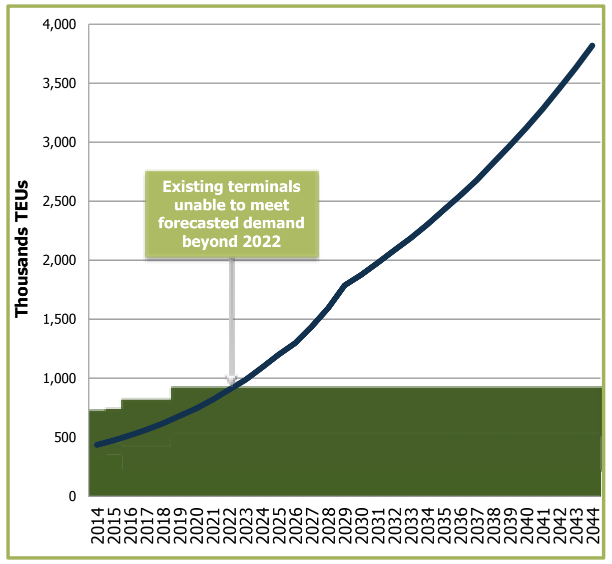
- 300 000 TEU per annum at Kascon

Development plan

Terminal type	Capacity created	ETC (Rm)	2014	2015	2016	2017	2018	2019	2020
Container	300 000	67	20	25	22			Construction	
Total cash flow (Rm)		**67**	**20**	**25**	**22**				

Kascon terminal upgrades include the construction of two 25-wagon lines together with a concrete slab on either side of line; the construction of a new access road to the landfill site; and two weigh bridges. By 2019 Kascon handling capacity will be 300 000 TEUs.

Figure 75: Capacity versus demand

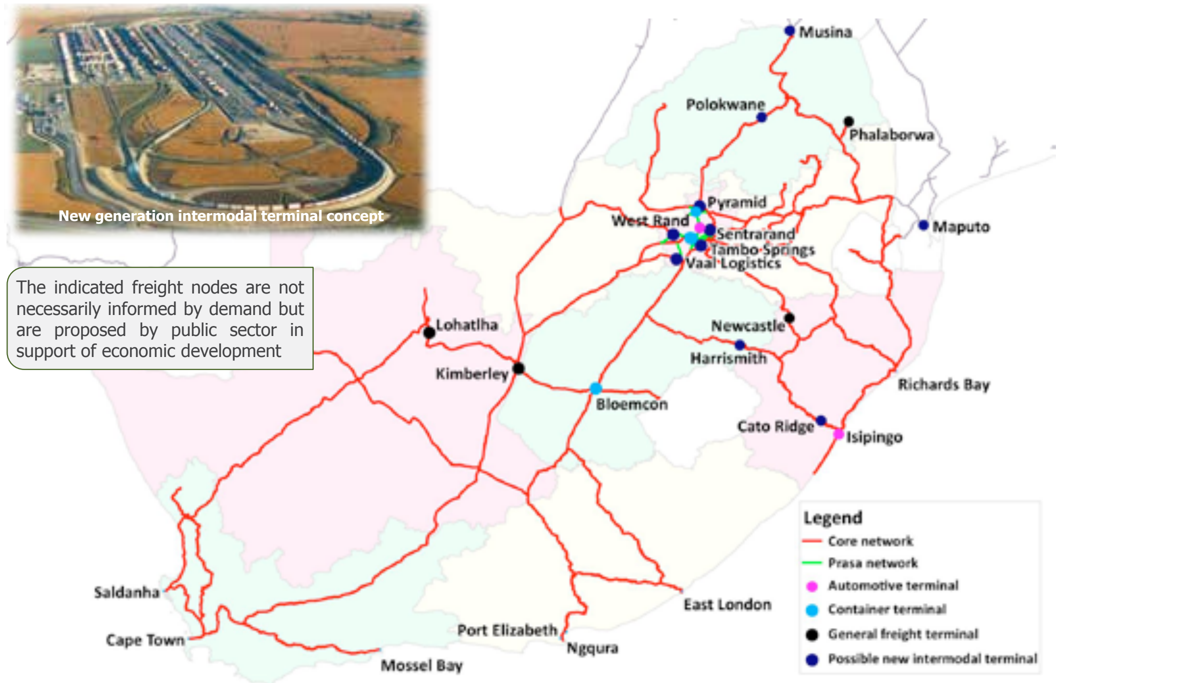


The demand for container transportation will increase rapidly over the next 30 years and TFR aims to significantly increase its market share.
The graph reveals rail's planned increase in container TEU volumes over the next 30 years.

Even with major City Deep and Kascon terminal capacity upgrades, the forecasted container volumes will exceed the current terminal capacity by 2022, thus additional terminal capacity is required in order to meet rail's desired market share.

4.2 HUBS AND TERMINALS: PROPOSED LOCATIONS 2044

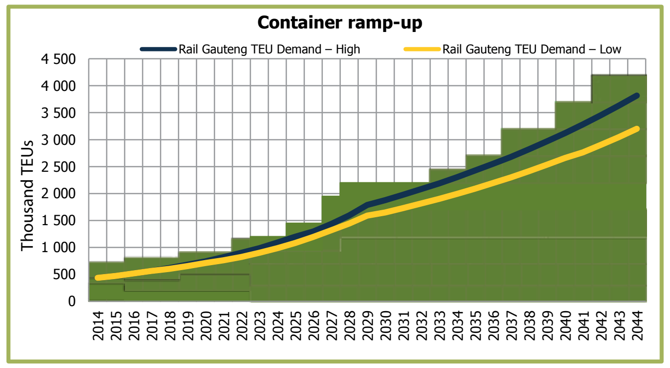
Figure 76: Proposed new terminal locations



The location of future intermodal terminals as well as the respective typical sizes and nature are shown on this map. The existing terminals are unlikely to disappear altogether but may continue to serve niche market requirements. In this illustration the philosophy of hub-to-hub long-haul rail operations is supported by mega terminals with direct links with the port systems. Of particular importance will be the development of mega terminals in the Gauteng and Durban areas to cope with the growth in container demand along this corridor.

4.3 HUBS AND TERMINALS STRATEGY: DEVELOPMENT SEQUENCE

Figure 77: Terminal development sequence



Development plan

Location	Terminal type	Capacity created	ETC (Rm)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Tambo Springs	Container	500 000	2 903		14	29	286	715	1001	572	286																							
Pyramid	Container	500 000	1 833			9	18	181	451	632	361	181																						
Pyramid	Automotive	558 000	417					4	44	111	155	89	14																					
Pyramid	Container	500 000	1 723									8	17	340	849	509																		
Sentrarand	Container	500 000	1 702													8	17	168	419	587	335	168												
Sentrarand	Container	500 000	1 904																			9	19	375	938	563								
Sentrarand	Container	500 000	2 552																						13	25	503	1 257	754					
Sentrarand	Container	500 000	1 695																								8	17	334	835	501			
Total cash flow (Rm)			14 729		14	38	304	900	1 496	1 315	802	278	31	340	849	517	17	168	419	587	335	177	19	375	951	588	511	1 274	1 088	835	501			

FEL-2: Pre-feasibility
FEL-3: Feasibility
Construction

4. HUBS AND TERMINALS (continued)

The container strategy study commissioned by Transnet completed in April 2011 estimated that in order for rail to achieve its desired market share, an additional 4 million TEU handling capacity will be required in the Gauteng area by 2044.

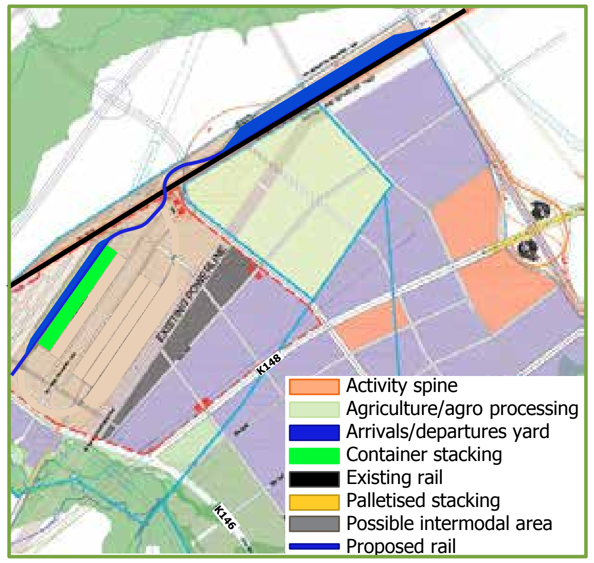
It is envisaged that Gauteng will require seven standard container terminals, one or two standard automotive terminals and four standard terminals for palletised goods by 2044. The study also determined that it would be operationally more efficient to develop a few mega terminals rather than many smaller terminals. At least three locations (Pyramid, Sentrarand and Tambo Springs) were identified for the development of these few super terminals.

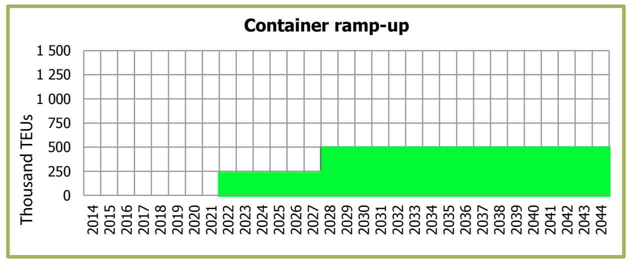
Terminals development strategy includes:

- The development of a mega intermodal terminal in Tambo Springs, located in the south-east of the province, ideally located to connect with major national rail and road networks (N3, Natcor and the Gauteng Freight Ring). Tambo Springs will be developed to accommodate two standard container terminals (500 000 TEUs per annum design) and one terminal for palletised goods (4,5 million pallets per annum design);
- Developing a mega intermodal terminal in Pyramid, that is located in the north of Pretoria, to serve the northern Gauteng region. Pyramid will be developed to accommodate one container terminal, one palletised terminal and one automotive terminal. Initially a small container terminal is to be constructed at Pyramid to replace the current Pretcon terminal. Once the demand exists Pyramid can be upgraded to operate at full capacity (500 000 TEUs per annum); and
- Develop a mega intermodal terminal at Sentrarand to handle both container and palletised freight. The intermodal terminal will consist of two terminals for palletised goods and four container terminals. The development of Sentrarand will increase Gauteng's total intermodal terminal handling capacity to a total of 4 million TEUs per annum by 2040.

These new developments are planned in conjunction with the phasing over of Eastcon (2015), Vaalcon (2015) and Pretcon (2021) excess volumes to large terminal operations. To maximise the efficiency, flexibility and utilisation of the new intermodal terminals, the terminals will be developed in a standardised methodology (layouts, designs and operations).

Figure 78: Tambo Springs intermodal concept





Tambo Springs is one of the locations identified as ideal (on the urban edge and close to the Gauteng-Durban corridor) for a large scale intermodal terminal to accommodate the forecasted container demand.

The site is strategically located close to the road network and in an optimal position to access the Gauteng Freight Ring and Natcor line.

Potential demand for the site is estimated as follows:

- Container terminal: 250 000 TEUs/pa (8 Trains/day) by 2022 and a ramp up to 500 000 TEUs/pa (16 trains/day) by 2028

Development plan

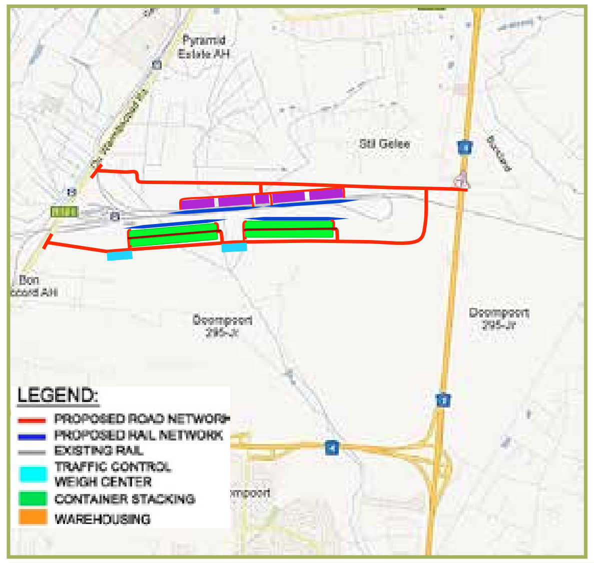
Location	Terminal type	Capacity created	ETC (Rm)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Tambo Springs	Container	500 000	2 903		14	29	286	715	1001	572	286										
Total cash flow (Rm)			2 903		14	29	286	715	1001	572	286										

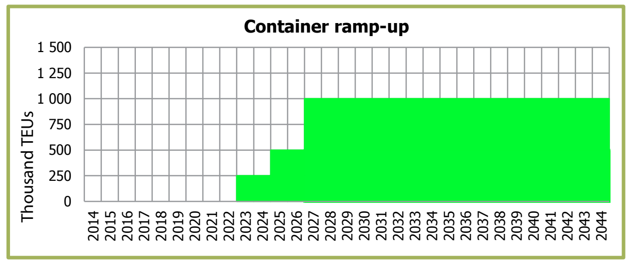
FEL-2: Pre-feasibility
FEL-3: Feasibility
Construction

Tambo Springs will be developed to handle two container terminals and a terminal for palletised goods. Each container terminal will have a capacity of 500 000 TEUs per annum (1 million TEUs per annum by 2027) and the palletised terminal handle 4 500 000 pallets per annum by 2025.

As the demand gradually increases and other terminal volumes are phased, the first container terminal (Phase 1) will initially handle 250 000 TEUs per annum from 2019 and ramped up to 500 000 TEUs per annum in 2020. The second terminal will handle 500 000 TEUs by 2027.

Figure 79: Pyramid intermodal concept





The Doornpoort site is well connected to the road network and the existing railway lines at Pyramid South, and is well placed to capture freight for the North West, Limpopo and North of Gauteng.
It can pick up freight for the Maputo corridor and can be a location to consolidate freight to Botswana and Zimbabwe.

Potential demand for the site is estimated as follows:

- Container (Phase 1): 500 000 TEUs/pa (16 trains/day) by 2025, starting with 250 000 TEUs/pa from 2023 to 2025
- Automotive terminal (P2): 558 000 Units/pa (12 trains/day) by 2024
- Container (P3): 500 000 TEUs/pa (16 trains/day) by 2027

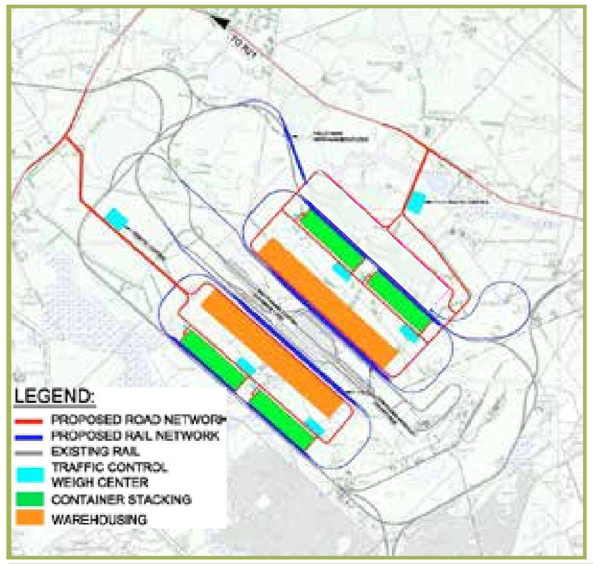
Development plan

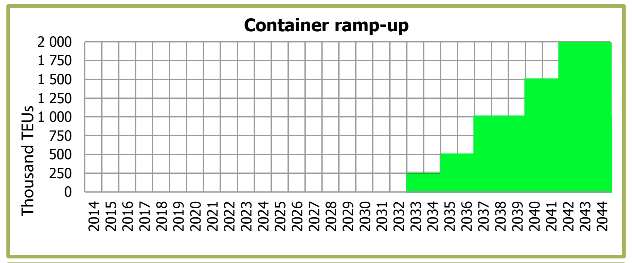
Location	Terminal type	Capacity created	ETC (Rm)	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Pyramid	Container	500 000	1 833			9	18	181	451	632	361	181									
Pyramid	Automotive	558 000	417					4	44	111	155	89	14								
Pyramid	Container	500 000	1 723									8	17	340	849	509					
Total cash flow (Rm)			3 973			9	18	185	495	743	516	278	31	340	849	509					

FEL-2: Pre-feasibility
FEL-3: Feasibility
Construction

Pyramid intermodal terminal will handle container, palletised and automotive traffic and it will be developed in three phases. The first phase of the development will be an automotive terminal with a capacity of 558 000 units per annum by 2019. The second phase will be a container terminal with a capacity of 500 000 TEUs per annum (initial capacity will be 250 000 TEUs and ramped up to 500 000 TEUs by 2026). The last phase of the development will be a terminal for palletised goods with a capacity of 4 500 000 pallets per annum by 2032.

Figure 80: Sentrarand intermodal concept





The site is well positioned to have direct access to the proposed Gauteng Freight Ring and the NatCor.
There is sufficient land available for a mega intermodal terminal. The land is largely in Transnet's ownership which is a benefit to the development of the site.

Potential demand for the site is estimated as follows:

- Container terminal (P1): 500 000 TEUs/pa (16 trains/day) by 2035, starting with 250 000 TEUs/pa from 2033 to 2035
- Container terminal (P2): 500 000 TEUs/pa (16 trains/day) by 2037
- Container terminal (P3): 500 000 TEUs/pa (16 trains/day) by 2040
- Container terminal (P4): 500 000 TEUs/pa (16 trains/day) by 2042

Development plan

Location	Terminal type	Capacity created	ETC (Rm)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Sentrarand	Container	500 000	1 702			8	17	168	419	587	335	168										
Sentrarand	Container	500 000	1 904									9	19	375	938	563						
Sentrarand	Container	500 000	2 552												13	25	503	1 257	754			
Sentrarand	Container	500 000	1 695														8	17	334	835	501	
Total cash flow (Rm)			7 853			8	17	168	419	587	335	177	19	375	951	588	511	1274	1088	835	501	

FEL-2: Pre-feasibility
FEL-3: Feasibility
Construction

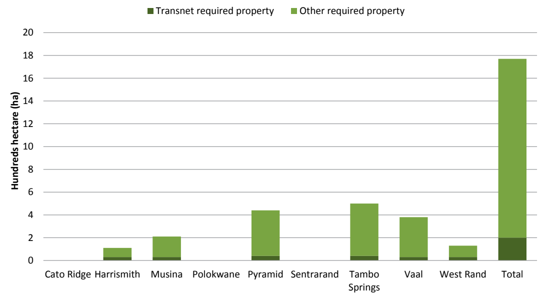
Sentrarand intermodal terminal development will handle up to an estimated 2 million TEUs of container traffic per annum, with four container terminals each with a capacity of 500 000 TEUs per annum. The development will also include two terminals for palletised goods, each with a capacity of 4 500 000 pallets per annum.

Sentrarand intermodal terminal will have a four phase container terminal development (Phase 1 to 4 by 2030, 2032, 2037 and 2040 respectively). The intermodal terminal will include two terminals for palletised goods developed in two phases (Phase 1 and 2 by 2020 and 2038 respectively.)

4.4 PROPERTY REQUIREMENT

Transnet aims to effect a substantial modal shift of cargo haulage from road onto rail and increase its market share of the long distance transportation of mineral exports, containerised traffic and general freight business. International trends indicate that one of the main drivers to achieve and capture such market share is through the development of mega-terminals and super-terminals in strategically located corridors.

Figure 81: Property requirement summary



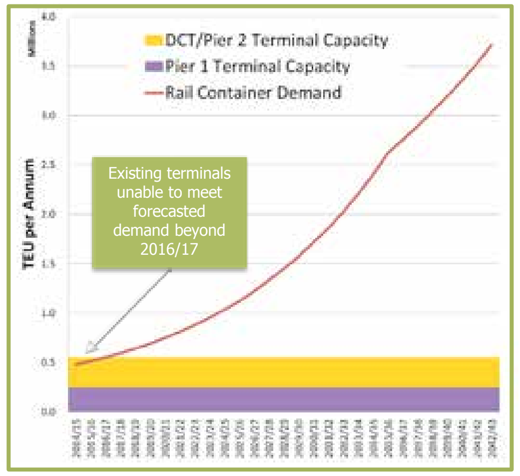
The proposed new mega intermodal terminals and general freight terminal will require the acquisition of new property. An estimated total of 1 520 hectares (shown in figure 81 above) is required to support the hubs and terminals strategy, this includes 140 hectares required for Transnet operations.

The following properties are required to support the development of new terminals:

- Harrismith Intermodal Terminal ± 80 hectares (30ha for Transnet operations)
- Musina Multi-purpose Terminal ± 180 hectares (30ha for Transnet operations)
- Pyramid Intermodal Terminal ± 400 hectares (40ha for Transnet operations)
- Tambo Springs Intermodal Terminal ± 460 hectares (40ha for Transnet operations)
- Vaal Logistics Hub ± 350 hectares (30ha for Transnet operations)
- West Rand Logistics Hub ± 100 hectares (40ha for Transnet operations)

4.5 DURBAN CONTAINER TERMINALS: STATUS QUO

Figure 82: Durban container terminals: status quo



The Port of Durban has two rail container terminals at Pier 1 and DCT/Pier 2 with 250 000 and 300 000 TEUs per annum capacity respectively after some optimisation of current operations.

A buffer stack exists at Kings Rest yard which is used to temporarily buffer containers unable to enter the port terminals upon arrival. This enables trains to be fully offloaded and turned around rapidly. The buffer does not provide additional container handling capacity.

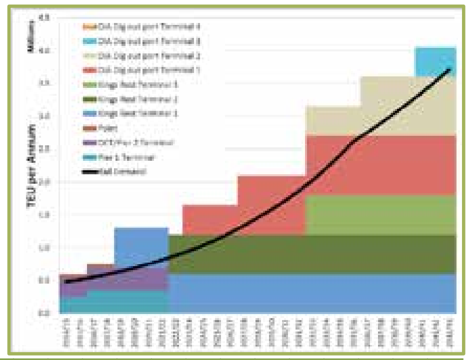
Both Bayhead and Kings Rest yards are configured to handle 50-wagon container trains which presented a challenge for the recent 75-wagon Anaconda trains along the corridor. With the increase in container traffic forecasted over the next 30 years it is vital to increase the port's current rail intermodal capacity to match the corridor and inland capacities, including longer train configurations.

At present the Port of Durban has two container terminals and a buffer stack which provide a combined capacity of 450 000 TEUs. The existing yards and terminals can only handle 50-wagon container trains. This constraint was highlighted with the 75-wagon anaconda trains, which fouled turnouts in Kings Rest Yard, thereby drastically impacting on handling capacity into the container terminals. The anaconda service was recently discontinued.

Durban is considered South Africa's most significant port in terms of container and automotive imports and exports. Future port developments are being assessed in order to increase South Africa's economic competitiveness. From a previous study it is envisaged that in order for rail to meet its desired market share it is necessary for Durban to increase its intermodal terminal capacity to approximately 3,7 million TEUs by 2043. This means that approximately six to eight standard container intermodal terminals (depending on length) and two standard automotive terminals are required by 2043.

4.6 DURBAN FUTURE TERMINALS: DEVELOPMENT PLAN

Figure 83: Durban future terminals: Development plan



Work Package Description	Package Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Rail/Port Terminals																
Pier 1 decommissioning	3							0,6	2,3							
DCT/Pier 2 decommissioning	3							0,6	2,3							
Kings Rest 1	824		18	50	239	382	135									
Kings Rest 2	824				18	50	239	382	135							
Kings Rest 3	824															
Intermodal (road-rail)	395			21	191	183										
Island View Upgrade	250															
DDOP 1	826						15	29	121	278	307	76				
DDOP 2	824															
DDOP 3/4	824															
Isipingo Automotive	421															
Yards																
Short term upgrades	54	21	33													
Bayhea first stage	427		12	73	226	116										
Bayhead second stage	321												8,8	55	170	87
DDOP yard	534						9,7	19	78	180	198	49				
Cato creek	279			0,2	1,4	1,4										
Isipingo	311															
Link Lines																
Bayhead to Kings Rest	60				3,2	29	28									
Mainline to DDOP	284							3,7	10	49	79	28				2,5
Contingencies	2 605	13	9	61	227	156	56	161	238	242	70	5	18	88	166	75
Total Costs (unescalated)	**10 892**	**34**	**72**	**205**	**906**	**917**	**483**	**596**	**587**	**749**	**654**	**158**	**27**	**143**	**336**	**165**

Work Package Description	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Rail/Port Terminals														
Pier 1 decommissioning														
DCT/Pier 2 decommissioning														
Kings Rest 1														
Kings Rest 2														
Kings Rest 3	18	50	239	382	135									
Intermodal (road-rail)														
Island View Upgrade			6,9	43	132	68								
DDOP 1														
DDOP 2	18	50	239	382	135									
DDOP 3/4									18	50	239	382	135	
Isipingo Automotive											12	72	223	114
Yards														
Short term upgrades														
Bayhea first stage														
Bayhead second stage														
DDOP yard														
Cato creek			15	133	128									
Isipingo										6,8	19	90	144	51
Link Lines														
Bayhead to Kings Rest														
Mainline to DDOP	7	33	53	19										
Contingencies	25	119	204	146	59		7	24	120	225	90			
Total Costs (unescalated)	**68**	**252**	**757**	**1 105**	**589**	**68**	**7**	**24**	**138**	**282**	**360**	**544**	**502**	**165**

FEL-1 & FEL-2
FEL-3
FEL-4

Durban's back of port rail development plans are as follows:

- 2016 – Improve efficiencies in Pier 1 and DCT/Pier 2 terminals. These are system upgrades, not capital interventions.
- 2019 – Adapt Kings Rest as a rail terminal and reconfigure Bayhead yard to handle 75-wagon trains. Establish domestic terminal at Durban Goods.
- 2022 – Construct second Kings Rest terminal. Decommission Pier 1 and DCT/Pier 2 terminals.
- 2024 – Construct first DDOP terminal and DDOP yard aligned to DDOP port development.
- 2028 – Expand Bayhead Yard handling capacity.
- 2033 – Construct Kings Rest third terminal. Construct second DDOP terminal. Expand Cato Creek to handle longer automotive trains.
- 2034 – Upgrade Island View terminal to improve train turnaround times.
- 2041 – Construct third DDOP terminal.
- 2042 – Construct automotive terminal/facility in Isipingo, near DDOP.

Additional actions:

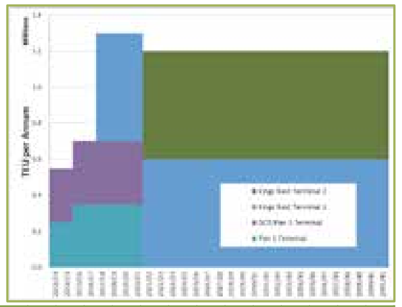
- Separate freight and passenger/Metro traffic as far as feasible to streamline operations and capacity;
- Develop the airport link;
- Consider a terminal on Natcor at the urban edge (Cato Ridge or Umlaas Road);
- Consider a terminal in the vicinity of the new airport (Dube Trade Port);
- Consider new high capacity bypass line (such as Cato Ridge Bypass) to complement Natcor line; and
- Consider longer trains, such as 150 wagons on Natcor.

4. HUBS AND TERMINALS (continued)

4.7 DURBAN HUBS AND TERMINALS: INITIAL KINGS REST TERMINALS

Figure 84: Durban hubs and terminals: Initial Kings Rest terminals

Sequencing:
- 2015/16 – Improve Pier 1 efficiency
- 2017/18 – Kings Rest 75-wagon terminal
  – Bayhead 75-wagon yard
  – Durban Goods domestic terminal
- 2021/22 – Decommission Pier 1 and DCT Pier 2
- 2022/23 – Second Kings Rest terminal



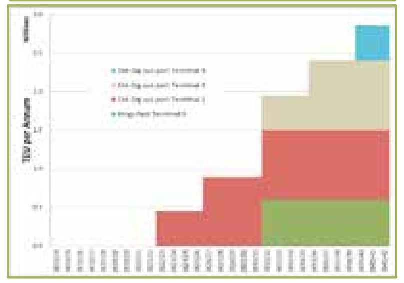
Work Package Description	Package Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Pier 1 Decommissioning	3							0,6	2,3																					
DCT/Pier 2 Decommissioning	3							0,6	2,3																					
Kings Rest 1	824		18	50	239	382	135																							
Kings Rest 2	824				18	50	239	382	135																					
Intermodal (Road-Rail)	395			21	191	183																								
Short Term Upgrades	54	21	33																											
Bayhead 1st Stage	427		12	73	226	116																								
Cato Creek	3			0,2	1,4	1,4																								
Bayhead to Kings Rest	60				3,2	29	28																							

In the short- to medium-term, prior to development of the DDOP, the 50-wagon Pier 1 and DCT/Pier 2 terminals inside the port of Durban will be retracted to make way for two new 75-wagon terminals on the area currently occupied by the Kings Rest arrival departure yard. These terminals will be supported by new yard developments in Bayhead, as well as a domestic terminal at Durban goods.

4.8 DURBAN FUTURE TERMINALS: DDOP AND DURBAN PORT EXPANSION

Figure 85: Durban future terminals: DDOP and Durban port expansion

Sequencing:
- 2024/25 – DDOP Terminal 1
  – DDOP rail link and DDOP yard
- 2028/29 – Bayhead 75-wagon yard expansion
- 2032/33 – Third Kings Rest 75-wagon terminal
  – Island View TAT upgrade
  – Second DDOP Terminal and link upgrade
  – Cato Creek lengthening
- 2040+ – Future DDOP expansion
  – Isipingo Automotive terminal



Work package description	Package total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Kings Rest 3	824																18	50	239	382	135									
Island View Upgrade	250																		6,9	43	132	68								
DDOP 1	826						15	29	121	278	307	76																		
DDOP 2	824																18	50	239	382	135									
DDOP 3/4	824																								18	50	239	382	135	
Isipingo Automotive	421																										12	72	223	114
Bayhead 2nd Stage	321												8,8	55	170	87														
DDOP Yard	534						9,7	19	78	180	198	49																		
Cato Creek	276																		15	133	128									
Isipingo	311																									6,8	19	90	144	51
Mainline to DDOP	284							3,7	10	49	79	28				2,5	7	33	53	19										

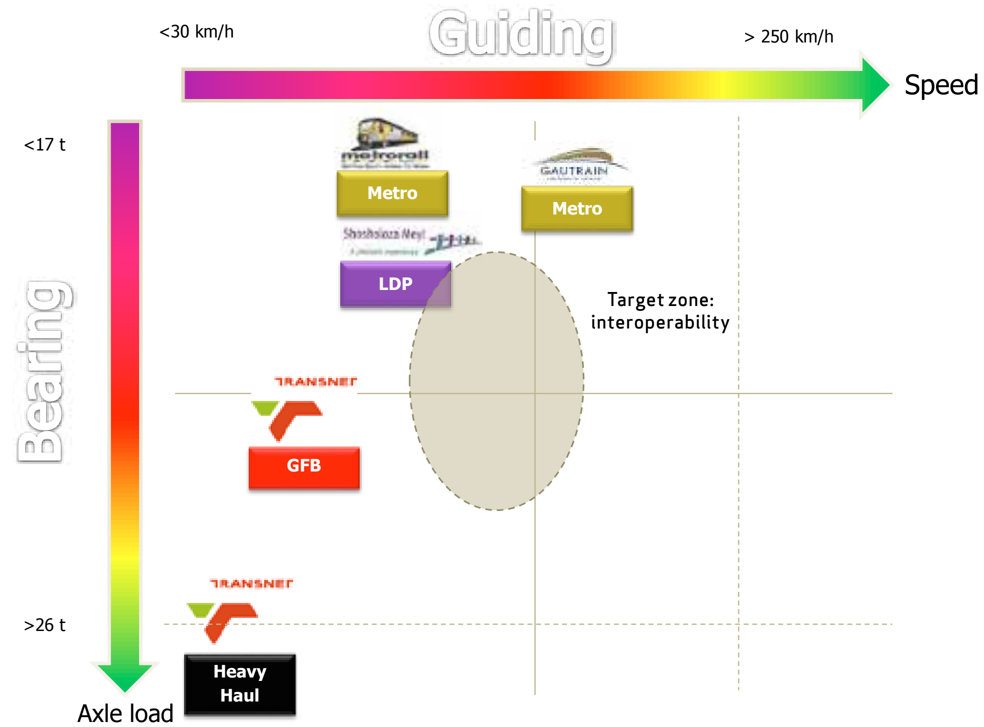
Capacity of the Durban rail system will expand to meet capacity developments in both ports, ie the newly developed DDOP as well as future expansions of the Port of Durban. Bayhead yard will be enlarged and a dedicated DDOP yard will be established to receive and dispatch trains to and from the Natcor.

Other capacity interventions include lengthening of the Cato Creek automotive terminal and/or development of a new automotive terminal at Isipingo supported by the DDOP, and improved turnaround times at Island View liquid bulk terminal.

5. FREIGHT AND PASSENGER PLANNING ALIGNMENT

5.1 INTEROPERABILITY – OPERATIONAL CONCEPTS

Figure 86: Operational concepts



South African passenger and freight trains typically operate in different speed, axle load, curve and gradient zones.

For light freight such as containers, a zone of co-existence with passenger trains is being investigated on the non- heavy haul network lines (120 – 160km/h zone). Co-existence of freight and passengers in the true high-speed zone (+200km/h) is not feasible.

Across the globe, transport systems and infrastructure have been recognised as critical strategic assets and vitally important in allowing countries to develop and advance. Technological and operational advances, have also changed the way that transport infrastructure is planned, managed and integrated with greater requirements for volume, efficiency and speed. Within this, one of the major challenges becomes how to efficiently use existing infrastructure (that was planned and developed based on previous generation transport philosophy) within the framework of the current transport management models and technological possibilities. This is particularly relevant within the rail sector where technological improvements have led to rapidly diverging requirements in the freight and passenger traffic areas.

Transnet Freight Rail and Shosholoza Meyl passenger trains share the same rail network on the long distance routes between major cities. The different natures of passenger and freight traffic, specifically their speed, has a significant impact on slot availability, with passenger trains requiring between 1,5 and 3 equivalent freight slots. As the demand for the transportation of bulk freight commodities such as coal and ore increases, the negative impact introduced by the passenger trains becomes more severe. The current strategy is therefore to separate the passenger and freight traffic in the long term.

There have been various investigations into new high-speed routes for intercity passenger services, particularly on the Johannesburg-Durban Corridor. These investigations have however shown that it may be exorbitantly expensive to implement such a system and that it would be difficult to recover the costs from relatively low passenger volumes.

The solution appears to be to migrate long distance rail passenger transport to road, but before this is done Transnet and PRASA have agreed that an alternative be considered. The alternative should consider utilising some of the low-density freight routes and upgrade these to a medium-speed standard. This alternative may allow passenger services to compete effectively with road-based transport, and at the same time may also allow Transnet to introduce rapid freight services for time-sensitive freight traffic.

Test routes

Two routes have been selected during an FER level study for evaluation of freight/passenger interoperability.

1.1 The Cape Route

Following from the line assessments a number of interventions have been proposed to upgrade the Cape Corridor mainline to support higher speeds. Two categories of interventions have been used:

(i) curve easing and

(ii) construction of bypasses.

5. FREIGHT AND PASSENGER PLANNING ALIGNMENT (continued)

Table 1 below shows the estimated cost for the Cape Route interventions.

Table 1: Capital cost estimate (Rand billion)

Section	Curve easements	Curve easements and bypasses	New construction
Cape Town to De Aar	7,74	30,12	43,21
De Aar to Colesberg	3,62	3,62	3,62
Colesberg to Vereeniging	4,35	5,81	13,44
Total	15,71	39,56	60,28

1.2 The Eastern Mainline

As with the Cape Route, two categories of interventions have been used:

(i) curve easing and

(ii) construction of bypasses.

The table below shows the estimated costs for the Eastern Mainline interventions.

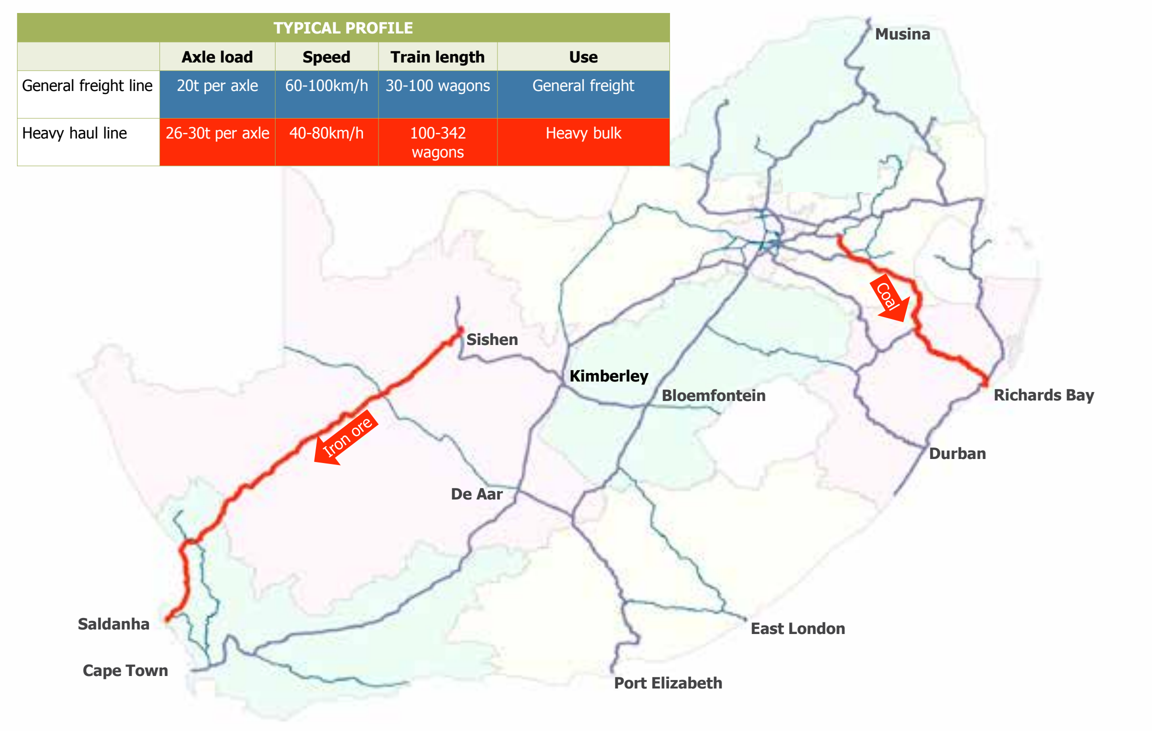
Table 2: Capital cost estimate (Rand billion)

Section	Curve easements	Curve easements and bypasses	New construction
Greenview to Komatipoort	5,2	87,6	91,1
Total	5,2	87,6	91,1

Further studies are necessary and a decision must be taken whether to implement freight/passenger interoperability on a selected route.

5.2 CURRENT NETWORK

Figure 87: Current network status quo

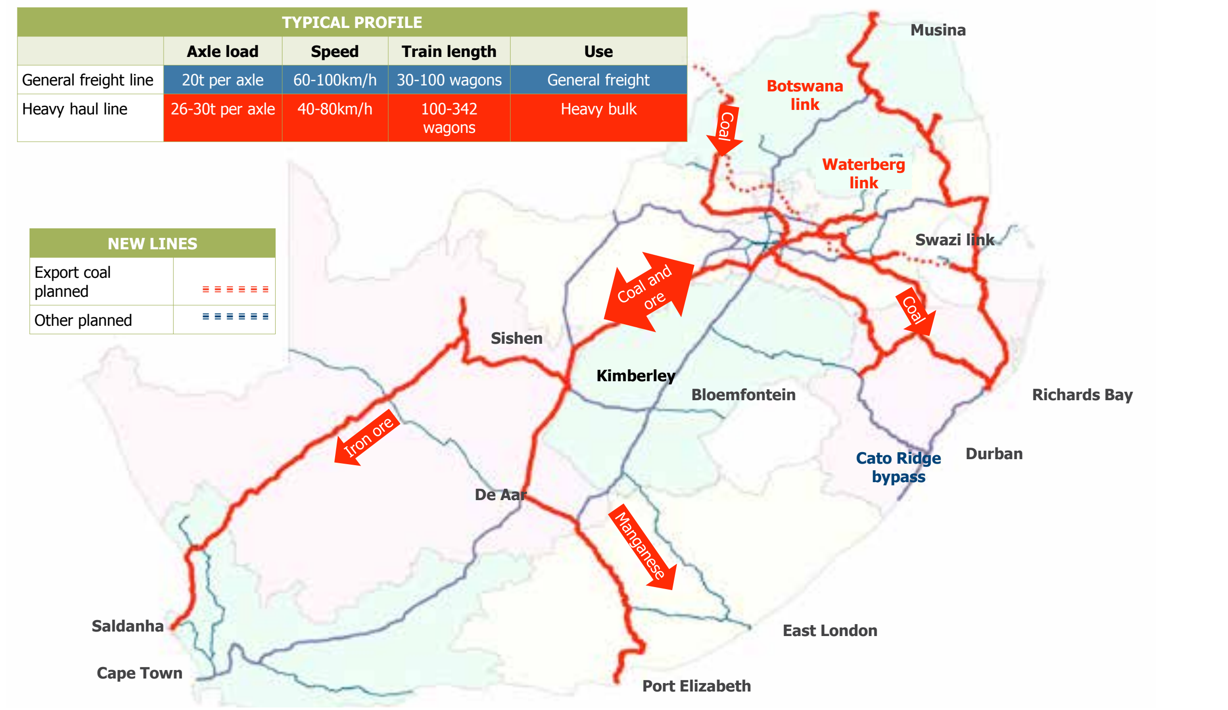


The current rail network profile is dominated by the general freight network with only two heavy haul lines, namely:

- Iron ore export line from Sishen to Saldanha; and
- Coal export line from Ogies to Richards Bay.

5.3 PLANNED NETWORK (30 YEARS)

Figure 88: 30-year planned network (heavy haul)



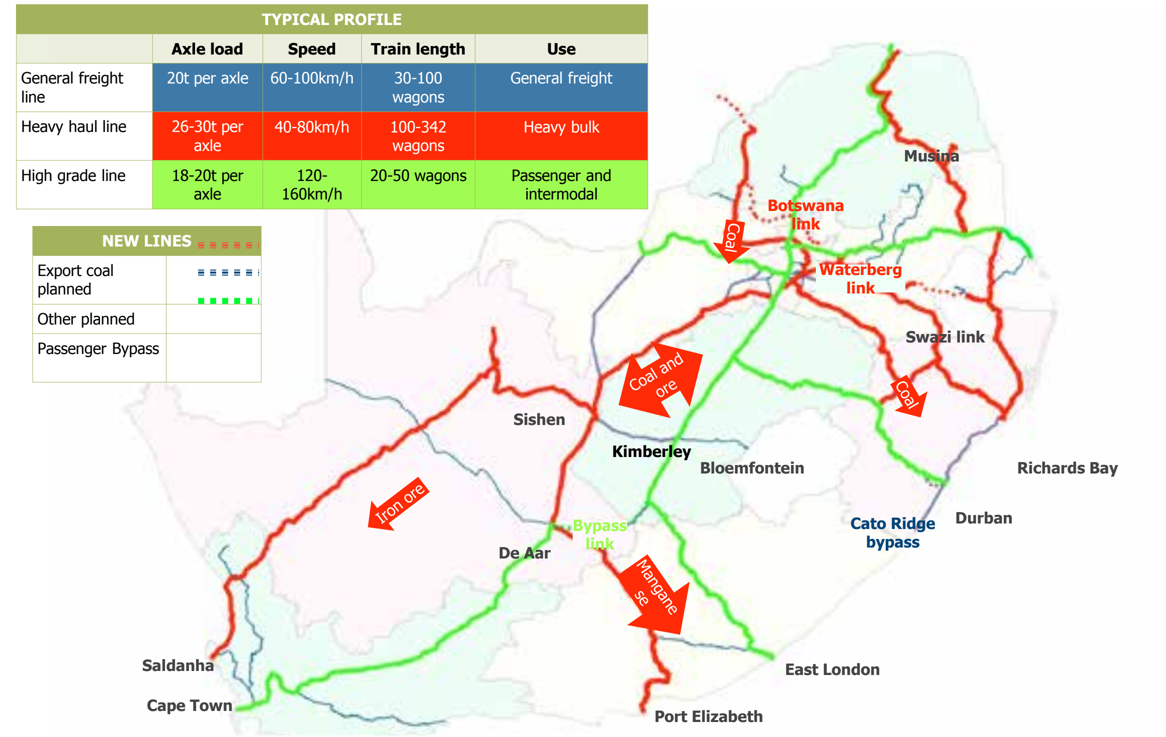
In the next 30 years the identified sections should be converted to heavy haul status, with axle load increased to 26t/axle and electrification system upgraded to 25kV AC. These sections comprise the following rail segments:

- Lephalale to Ermelo – extension of the export coal line to the Waterberg coalfields. Based on the demand forecast exceeding 30mtpa, a new line may need to be constructed to be able to run 200-wagon trains between Richards Bay and the Waterberg coalfields. A link to Botswana will be necessary to connect the South African network with the Botswana rail network, thereby allowing the railage of coal from the Botswana coalfield to South Africa for consumption or export purposes;
- Hotazel to the Port of Ngqura – manganese export corridor from the Northern Cape to the deep sea Port of Ngqura in the Eastern Cape;
- Hotazel to Newcastle – iron ore, manganese and coal corridor. The iron ore and manganese is mainly transported to the steel plants in Vanderbijlpark and Newcastle;
- Ogies to Ermelo – the coal back bone handling most of the domestic coal to the Eskom power stations in the Mpumalanga area. The joint Eskom and Transnet strategy to migrate coal from road to rail will be major contributor to the system expansion requirements; and
- Pyramid to Houtheuwel – this section forms part of the Freight Ring, which will receive traffic from Waterberg, Northern Cape, Limpopo and Mpumalanga coalfields. The general freight traffic is also high in this area.

5. FREIGHT AND PASSENGER PLANNING ALIGNMENT (continued)

5.4 LONG-TERM SHARED NETWORK

Figure 89: Long-term shared network – PRASA/Transnet (interoperations)



TYPICAL PROFILE	Axle load	Speed	Train length	Use
General freight line	20t per axle	60-100km/h	30-100 wagons	General freight
Heavy haul line	26-30t per axle	40-80km/h	100-342 wagons	Heavy bulk
High grade line	18-20t per axle	120-160km/h	20-50 wagons	Passenger and intermodal

NEW LINES	
Export coal planned	
Other planned	
Passenger Bypass	

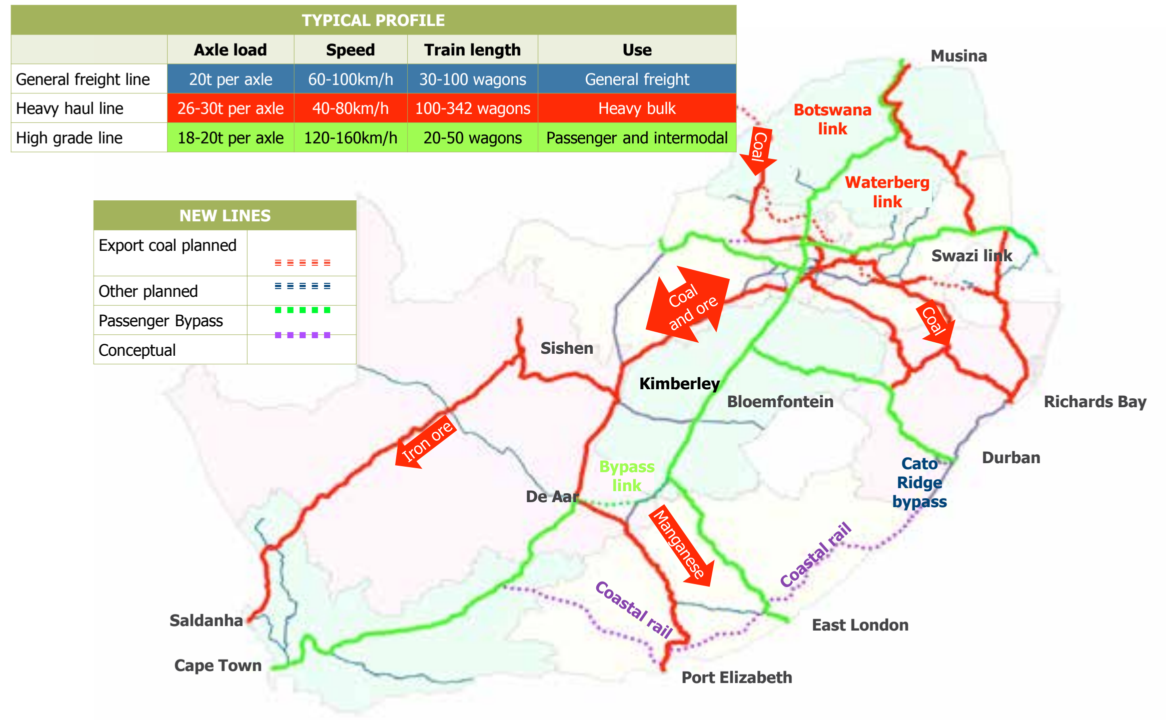
Due to different train operating speeds, required track standards and the impact on capacity, passenger and freight traffic are not compatible on a shared network. Transnet and PRASA have initiated joint planning sessions to resolve the incompatibility of both passenger and freight traffic on specific networks. Considering traffic density by 2043 as well as the freight type on specific routes, Transnet has developed a series of capacity creation interventions, including the upgrade of some lines to heavy haul standards. By 2043 the heavy haul lines will cover the routes shown here in red. On these routes, compatibility with passenger services will become problematic.

There are other routes, which are not as highly utilised as the heavy haul lines, which can serve as alternate routes for light industrial traffic, containers and passenger trains.

These lines are indicated on the map as upgraded passenger and light industrial routes. Due to the nature of the traffic it is believed that these traffic types are interoperable at a medium speed of approximately 160km/h. The track standard will have to be improved on these specific routes to support the light industrial medium speed traffic types. By developing another corridor for light industrial traffic, additional capacity is released or created for heavy haul, light industrial and passenger traffic.

5.5 LONG-TERM NETWORK POTENTIAL

Figure 90: Beyond 30 years



TYPICAL PROFILE	Axle load	Speed	Train length	Use
General freight line	20t per axle	60-100km/h	30-100 wagons	General freight
Heavy haul line	26-30t per axle	40-80km/h	100-342 wagons	Heavy bulk
High grade line	18-20t per axle	120-160km/h	20-50 wagons	Passenger and intermodal

NEW LINES	
Export coal planned	
Other planned	
Passenger Bypass	
Conceptual	

In the long-term, it is highly likely to introduce the high-speed passenger service between Gauteng and Durban.

Other regional and strategic connections are also considered, such as:

- Coastal Rail – rail connection from the Western Cape to KwaZulu-Natal via the Eastern Cape province;
- Sishen Link – rail link connecting the iron ore network to Gauteng, Botswana and the Waterberg coalfields using the existing West Rand to Mahikeng section; and
- Trans Kalahari – regional rail link from Walvis Bay in Namibia to link with the South African network via Botswana.

The network future state is defined by the long-term strategy, resource planning and the principle of standardisation. As shown, the bulk mineral export and feeder lines will be upgraded to heavy haul status; preferably with axle loading of 26t/axle, incab signalling and electrification at 25kV AC. The low capacity lines will retain 20t/axle, 3kV DC or de-electrified and track warrant train control system.

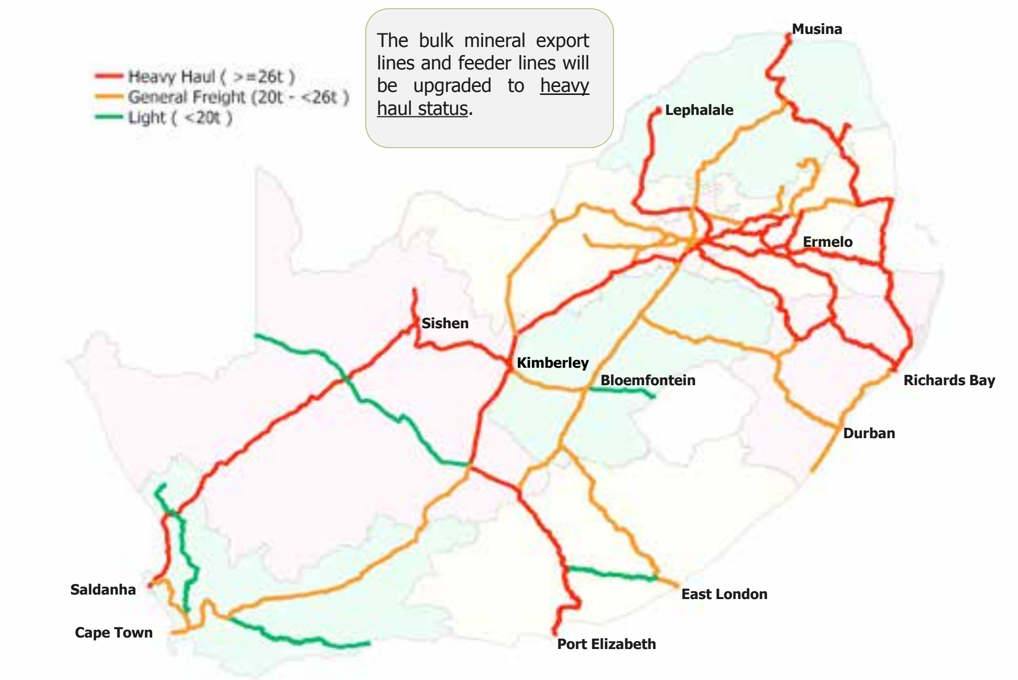
6. NETWORK FUTURE STATE: 2043

6.1 AXLE LOAD

The sections for upgrading axle loading depend heavily on commodity flows, even more so than the two disciplines of electrification and train control. The ore line remains at 30t/axle. The new Waterberg alignment and Swazi link will be built at 26t/axle and the route from Sishen to Gauteng via Kimberley will also be upgraded to 26t/axle.

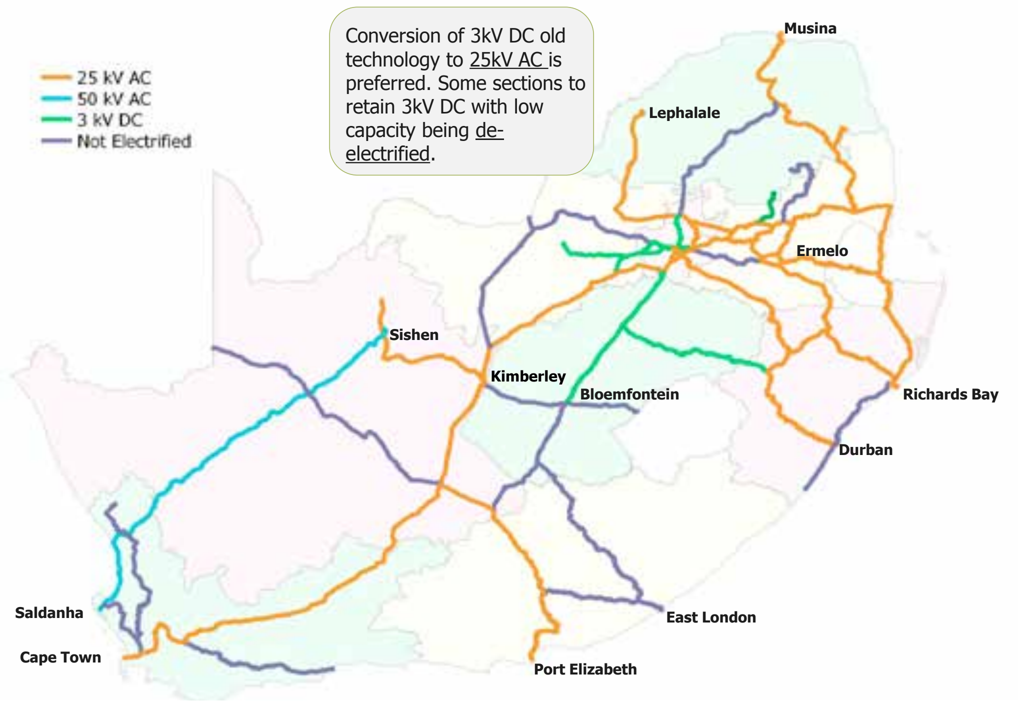
Gauteng to Newcastle line will also be upgraded to 26t/axle due to the nature of the heavy haul bulk commodities that utilise the route. The Hotazel to Port Elizabeth via Kimberley and De Aar line will also be upgraded to 26t/axle to accommodate increased manganese volumes on the route.

Figure 91: Future axle load (standardised)



6.2 ELECTRIFICATION

Figure 92: Future electrification



The network future state map for electrification shows the impact of specific corridor upgrades and a general shift towards 25kV AC electrification of the core network. The ore line remains at 50kV AC. The new alignment from Waterberg to Ermelo and Swazi link will be installed with 25kV AC traction, as well as the northern coal line, and Maputo corridor. The route from Hotazel to Gauteng via Kimberley is converted to support the commodity flows that utilise the sections, in particular iron ore.

The Beaufort West to Cape Town and Gauteng to Durban via Newcastle lines will also be upgraded to 25kV AC. The standardised view shows the remainder of the core network will be 3kV DC and non-electrified. Some of the existing electrified lines that have low volumes will be de-electrified, with the view that the future volumes do not support the electrical maintenance or upgrade.

6.3 FUTURE TRACTION ENERGY STRATEGIES

It is clear that the current network configuration has a number of required traction change-over points, where locomotives must be changed in order to accommodate the different traction supply system. Operations are negatively affected by the number of traction changes. Evaluation of the different traction energy types is given in summary format in Table 3 below:

Table 3: Evaluation of different traction energy types

Future freight traction energy evaluation	3kV DC	25kV DC	Diesel
Efficiency	Acceptable	Good	Acceptable
Heavy haul suitable	Acceptable	Good	Acceptable
Flexibility of use	Acceptable	Acceptable	Acceptable
Latest technology	Acceptable	Good	Acceptable
Best practice	Acceptable	Good	Acceptable
Regen into grid	Not acceptable	Good	Not acceptable

Legend Good | Acceptable | Not acceptable

Based on this high-level evaluation, it is clear that the 25kV traction type should be the choice for the Transnet future network where volumes are significant.

The strategy adopted:

- High-volume lines to be converted to 25kV (ore line will remain at 50kV);
- Standardisation to 25kV to avoid traction changes; and
- Low volume lines to be de-electrified and operated with diesel locomotives.

6.4 TRAIN CONTROL

Figure 93: Future train control

The core network and lines with substantial volumes are upgraded to CTC signalling train control. The necessity for upgrading train control is primarily a factor for the volumes running over a section, with high volume forecast being the most eligible candidates.

The standardised view eliminates all of the old train control systems such as wooden train staff and telegraph order and replaces them with two types: CTC and track warrant.

This is done with the view of simplifying operations on the network and improves turnaround times. CTC signalling to be rolled out firstly on heavy haul lines to maximise throughput and improve system safety, secondary lines to track warrant and minor lines to radio train order.

7. ROLLING STOCK

Rolling stock is an essential and integral part of a rail system with interdependence on the infrastructure. It also contributes significantly to the required expansion capital with infrastructure and rolling stock being the largest portions thereof.

The rolling stock plan considers traffic demand projections for rail transported origins and destinations.

The Freight Rail 10-year MDS is used as a yardstick for assessing and adjusting the plan derived from traffic projections over the next 10 years. A 30-year long-term view is then derived from the corrected base to determine approximate requirements for rolling stock. Certain assumptions are made about reliability, availability and performance improvements to allow for continuous improvement, re-engineering and technological developments that would inevitably be required to remain competitive.

(a) Key planning principles for locomotives

Impact area: Capacity planning

- Refine to detail train and route level;
- Optimise train length and mass with locomotive allocation;
- Allocate locomotives to the required train service;
- Apply optimal locomotive allocation rather than historic use;
- Apply design cycle times rather than historic cycle times with improvement target; and
- As the operational plan is deemed to have the most significant impact on the required locomotive fleet, the optimum fleet should be determined by applying various operational strategies. It is believed that a large proportion (up to 80%) of the train plan should tend towards ring-fenced locomotives for dedicated services and eventually for unitised trains where the volumes are supportive. This should give the benefit of reduced locomotive requirements due to the increased utilisation, and is also the basis of the current proposed revised operating philosophy.

Impact area: Infrastructure impact

- Match and optimise locomotive characteristics with infra capacity ie number of locomotives in consist, tangential force sustainable by the rail crown, power available for traction, axle load and train lengths; and
- Investigate the medium- and long-term optimum for the electrification configuration of the network in relation to locomotive type. (Eg 25 kV future network with interim dual voltage 3 kV DC/25 kV AC locomotives, with a medium-term conversion programme to 25 kV AC).

Impact area: Maintenance

- Review and update maintenance strategy to optimise asset availability for operations, and reliability in service;
- Align maintenance strategy to asset lifecycle and operations strategy to maximise utilisation of assets made available for service;
- Pursue the benefits of newer technologies to minimise maintenance interventions and maximise operational efficiency, eg remote monitoring of locomotives; and
- To the extent that the age of the technology permits, the result of maintenance review should increase availability and reliability, as well as increase energy- and cost efficiency;

Impact area: Technology

It is essential to raise the competitiveness bar regularly, to work old equipment that is no longer competitive out of the fleet, thereby to make space for new technologies and the refreshed competitiveness that they bring. Apply the latest proven technology where relevant and as far as economically justifiable, as follows;

- Design train loads and services to exploit fully the increased adhesion of which the AC traction motors in TFR's new locomotives are capable;
- Specify dual-voltage AC-DC capability when electric locomotives are acquired;
- Evolve to 25 kV AC where electrification is justified;
- Standardise equipment attributes as far as possible for flexibility of deployment and operational efficiency, but with due regard for specific service design requirements;
- Endeavour to standardise locomotive characteristics to minimise the number of classes;
- Ensure interoperability among locomotive classes as last resort by means of distributed power where native protocols cannot support interoperability; and
- Implement ECP braking and distributed power, mainly on heavy haul operations in the short term, as well as on other ringfenced operations to which rolling stock is dedicated.

Impact area: Traction plan

- As the locomotives (and wagons) are the means of production of a railway, it is crucial to ensure the future availability, reliability and cost effectiveness thereof;
- A consolidated medium- to long-term plan should therefore avoid knee jerk reactions that result in ineffective locomotive procurement when viewed within the complete system. The lack of a committed investment plan can also lead to severe under-investment as was experienced in the past 12 to 15 years and which was relieved through the recently announced tender awards for 1 064 diesel and electric locomotives; and
- Because of the relatively long lead times for new locomotives, it is imperative that a continuous annual investment plan be followed. Financial provision must be made to support this programme under various financial conditions. Financial constraints on an annual basis can be accommodated by adjusting annual order volumes, but the replacement or renewal programme must continue without interruption.

(b) Key planning principles for wagons

Impact area: Capacity planning

- Refine to detail commodity and route level;
- Apply optimal commodity and wagon matching rather than historic use;
- Apply design cycle times rather than historic cycle times with improvement target;
- Endeavour to smooth demand as far as possible;
- Employ ringfenced unit trains to increase efficiency;
- Optimise required fleet size with frequency of volumes to be transported; and
- Perform final system cost review and optimisation.

Impact area: Infrastructure

- Ensure that wagon designs are maximised within moving structure gauge, with due regard for the density of the commodity or lading for which they are intended, and for physical constraints such as clearance marks;
- Maximise train lengths within infra capacity (optimise longer trains), while also prioritising uniform train lengths, which impact on yard and crossing loop lengths, so that a short yard road or crossing loop somewhere on the route does not constrain train length over its entire line haul journey; and
- Wagon design and commodity allocation must achieve maximum payload and capacity utilisation in terms of allowable axle load.

Impact area: Maintenance

- Review and update maintenance strategy to optimise asset availability for operations, and reliability in service;
- Align maintenance strategy to asset lifecycle and operations strategy to maximise utilisation of assets made available for service;
- Pursue the benefits of newer technologies to minimise maintenance interventions and maximise operational efficiency.

Impact area: Technology

- Apply the latest technology as far as possible and where relevant (ie white metal bearings and vacuum brakes to be converted at increased rate);
- Use new improved materials to increase body component life;
- Improve load-to-tare ratio;
- ECP braking;
- Bogie mounted brakes; and
- Ensure optimal wagon design per commodity or commodity group.

For general freight the optimal flexibility of wagon types must be applied.

(c) New rolling stock

A set of key planning principles was used for compiling the long-term plans. The intent is that whenever the plans are compiled or revised, these plans are tested against the key planning principles in order to ensure alignment within the business as a whole, and also that all the important aspects are addressed. Listed below are the key planning principles for wagons and locomotives.

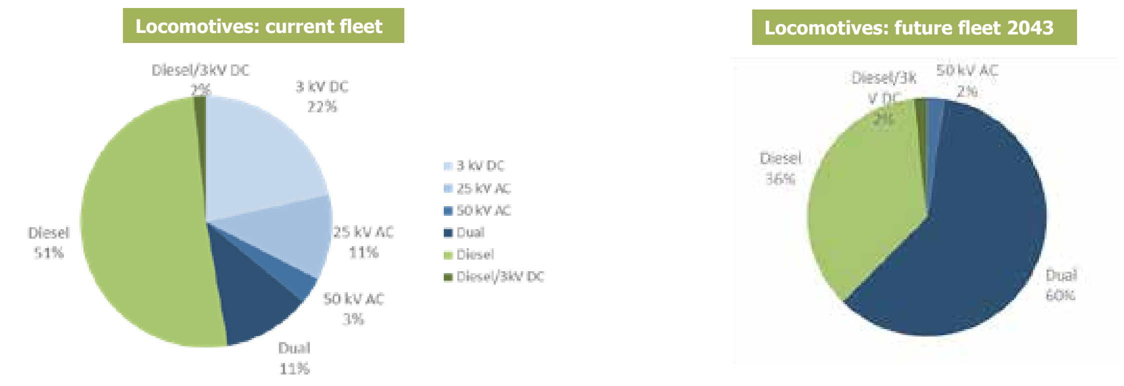
7.1 LOCOMOTIVES CURRENT FLEET

(a) Locomotive fleet size

The locomotive fleet consists of three main traction types namely 3kV DC (22%), 25kV AC (11%) and Diesel Electric (51%). The remainder of the fleet includes 3kV/diesel electric dual traction locos, 3kV/25 kV dual voltage locos and 50kV AC locos, the latter operating only on the iron ore export line from Sishen to Saldanha harbour.

The future-state image clearly shows Freight Rail's strategy to migrate towards greater use of electrical traction as the network infrastructure is upgraded and expanded.

Figure 94: Locomotive fleet



(b) Locomotive availability and reliability

Figure 95: Locomotive availability and reliability

Availability and reliability data includes an adjusted target, which is derived from an international benchmark but adjusted for local conditions and the current fleet.

Availability is defined as the percentage of the total active rolling stock fleet, which is available for operational deployment. The non-available locomotives are typically receiving scheduled or unscheduled maintenance. The active fleet is defined as the total fleet less the rolling stock damaged in accidents and derailments or staged.

Reliability is measured as a failure rate in units of faults per million vehicle kilometres. The lower the failure rate, the higher the reliability.

From the figures for availability and reliability it is clear that the current performance of the fleet is on par with that of international benchmarks and the future targets that are set (90% availability and less than 20 faults per million kilometres). The reason for this poor performance is twofold:

- The protracted lack of investment in new rolling stock, which led to old technology remaining in service beyond its design life; and
- The postponement of major repair programmes due to cash flow constraints, which ruled out opportunities for technology upgrades.

Most of the old technology has inherently lower reliability (design reliability) and availability when compared to newer technology. It is therefore important to note that the reliability cannot necessarily be improved by increasing maintenance interventions but more readily by upgrading components to newer technologies or by acquiring new rolling stock. While the reinstatement of the postponed major repair programmes will improve the fleet, it cannot bridge the gap completely to meet best practice targets without technology upgrades or new rolling stock.

(a) Locomotive age distribution

Figure 96: Locomotives age distribution

There are two prominent peaks in the locomotive age distribution.

The first peak represents reasonably new or upgraded locos up to 10 years old, and comprises mainly 18Es, a locomotive upgraded from old 6E1s. The programme started in 2004 with locomotives retaining their 3kV-only capability. The sub-group up to five years shows the inflow of the new Classes 19E, 15E and 20E electric locomotives, upgraded Class 39 and new Class 43 diesel locomotives.

The second peak represents locomotives of 20 to 40 years of age. They are mainly diesel locomotives plus a large proportion of the remaining AC-only and DC-only electric locomotives.

The chart displays a serious lack of investment during the 11 to 25 years age group, with only some 50 locomotives being procured during that period.

7.2 LOCOMOTIVES FUTURE CLASSIFICATION STRATEGY

Table 4: Locomotive types

Locomotive type	Locomotive application		Sample
Electric Heavy Haul – 50 kV	Specifically used on the iron ore line	15E	
Electric Heavy Haul – 3 kV/25 kV Dual Voltage 26 ton per axle	Operations on the Coal line or GFB corridor where this axle load is permitted	19E	
Electric General Purpose – 3 kV/25 kV Dual Voltage 21 ton per axle	To be used on GFB corridors	20E	
Electric General Purpose – 3 kV/25 kV Dual Voltage 21 ton per axle	To be used on GFB corridors	22E	
General Purpose Diesel – 349kN 21 ton per axle with AC traction motors	To be used across all corridors including the coal and ore export line	43D	
General Purpose Diesel – 349kN 21 ton per axle with AC traction motors	To be used across all corridors including the coal and ore export line	44D	
Trip and Shunting Loco – Dual Voltage 25 kV/3 kV, Diesel 750 kW, Double Cab	Light hauler and shunt locomotive on branch lines and in yards: 18 t/axle		Still to be procured

The following new locomotives have been delivered or are currently in the procurement process:

15E Electric locomotive (50kV AC).

New high-powered, high-technology locomotives procured for replacing the 9E and diesel locomotives on the ore line. Continuous tractive effort of the 15E is rated at 454kN compared with the 388kN of the existing 9E. The first prototype locomotives were delivered by mid-2010, with final delivery of the complete fleet of 76 locomotives in 2013.

19E Dual voltage electric locomotive (3kV DC and 25kV AC)

These new high-technology dual-voltage locomotives were procured to displace the 7E AC-only and 10E DC-only locomotives on the coal line and its electrified feeders. The first prototype locomotives were delivered during 2009, with the complete fleet in service in 2013. By virtue of the dual-voltage capability, 19E locomotives support through running from the Mpumalanga coalfields to the Port of Richards Bay.

In conjunction with wire distributed power, it is now workable to compile 200-wagon trains in the coalfields and run them direct to Richards Bay, bypassing Ermelo Yard and the loss of productivity that the latter incurs. In this way the 200 jumbo wagon Shongololo train powered by eight 19E locomotives saves two hours on the loaded trip.

20E Dual voltage general freight locomotives (3kV DC and 25kV AC)

An order was placed during 2012 for 95 of these new general freight locomotives. The first six have been successfully commissioned and placed in service.

22E Dual voltage general freight locomotives (3kV DC and 25kV AC)

An order for 599 new electric locomotives was placed in March 2014, for delivery within three and a half years, with manufacturers from China and Europe. These will be of the Co-Co configuration and will take duty on the general freight lines.

39D Diesel electric locomotive

These as-new locomotives were upgraded from 34D diesel-electric locomotives by providing new control systems to extend life and increase efficiency. The tractive effort was improved from the former 218kN to 273kN, while retaining original power rating of 2 470kW. The first prototype locomotives were delivered during 2009, with the full fleet of 50 in service in 2011.

43D Diesel electric locomotive

In total 143 new General Electric locomotives have been procured to replace older diesel locomotives. First prototype locomotives were received during 2011 with final delivery in 2013. An order for a further 60 locomotives has been placed, and delivery is expected during 2014/2015. The rated power is 3 000kW.

44D Diesel electric locomotive

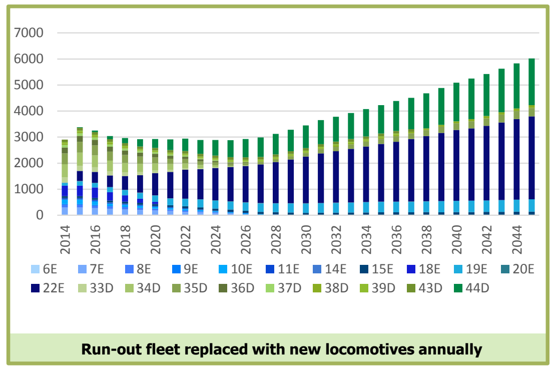
Orders for 465 new diesel locomotives were recently placed. These locomotives are similar to the abovementioned 43D locomotives, but with increased power output (3 300kW).

7. ROLLING STOCK (continued)

The foregoing descriptions attest to Freight Rail acquiring locomotives with which to compete in the heavy haul market, as well as at the heavy end of the general freight market. As a whole, the acquisition programme indicates a positioning shift to significantly higher power and tractive effort compared to its previous locomotives.

7.3 LOCOMOTIVES FUTURE REQUIRED FLEET

Figure 97: Locomotives: future required fleet



(a) Methodology

The future requirement for rolling stock is determined from traffic projections. This task is complicated by the multitude of origin destination pairs as well as the variety in the current locomotive and wagon fleets. The 10-year MDS plan is used as a base and is integrated with the 30-year LTPF in order to determine the fleet sizes.

The methodology employed in determining rolling stock demand includes consideration of:

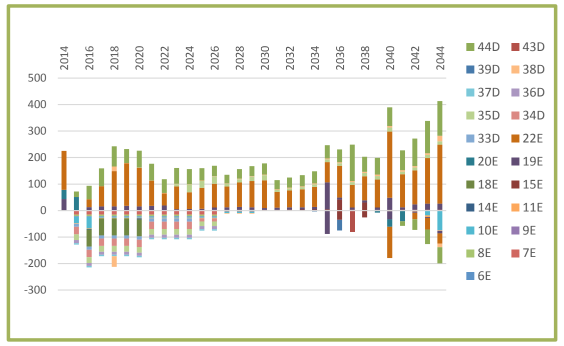
- The infrastructure constraints impacting on locomotive distribution and wagon deployment;
- The location of maintenance facilities;
- The operating philosophy of siding to siding block loads and/or consolidation traffic in a hub and spoke system;
- The traffic volume demand per origin-destination pair;
- The payload and train capability of the wagons;
- The total vehicle turnaround times;
- The crewing requirements and crew change over points;
- The existing rolling stock fleets, run-outs and upgrades and new builds in process; and
- Improved utilisation targets for locomotives and wagons.

The outcome of the rolling stock demand process indicates the total fleet required including the fleet shortages and new rolling stock to be procured.

In addition to the pure commodity demand for rolling stock, the technical fleet plans address the requirement in terms of sustaining the fleet and ensuring technology benefits are achieved. This could imply that new rolling stock needs to be procured without a growth in volume demand.

(b) Locomotives required

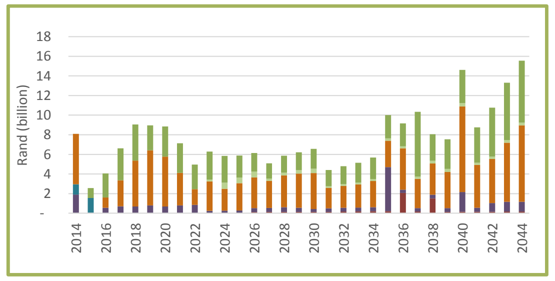
Figure 98: Acquisitions and retirements



The locomotive requirement is shown per locomotive type and category. General freight fleet sees a significant growth, as evidenced by the newly ordered 22E and 44D (or equivalent) locomotives, which is related to the expected demand growth of these commodities into the 30-year forecasting horizon. Also, in the short term there is a need for additional 19E locomotives on the coal line.

(C) Locomotives investment

Figure 99: Locomotives investment - 30 years



The required locomotive fleet size per year as calculated from traffic demand projections.

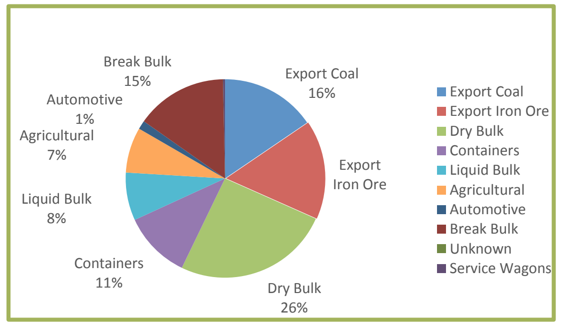
The future required fleet is calculated from traffic demand for the full 30-year period. As the locomotive fleet plan is currently being refined, it is expected that better alignment of these figures will flow from this exercise.

What is important to note from the long-term values, is that provision is to be made for a continuous investment in sustaining the fleet and providing for the annual volume growth.

7.4 WAGONS CURRENT FLEET

(a) Wagon fleet size

Figure 100: Wagons: current fleet



Wagon fleet size status quo shows that although coal and iron ore are moved in substantial tonnages, the majority of the fleet is used for transporting general freight.

C-type (34%) (including CCL/CCR) and CR-type (17%) make up over 40% of the current fleet. These wagons are typically used for coal and ore respectively, but are also used for a wide variety of general freight commodities such as coke, magnetite and rock phosphate.

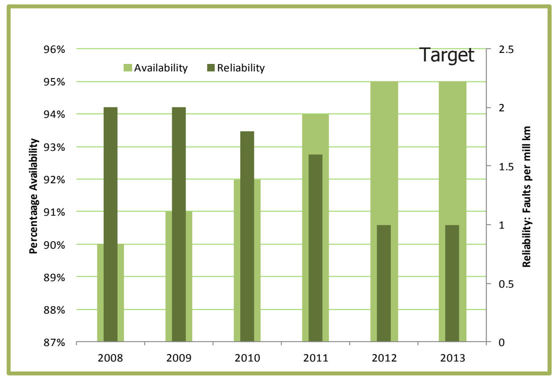
D-type wagons make up 3% of the fleet and carry break-bulk goods. They are preferred to other break- bulk types due to the drop side door system allowing for easier loading/unloading.

FG-type wagons are used for grain and make up 3% of the current fleet and SH-type wagons are flat-beds used for transporting containers, making up 11% of the fleet. The remainder (32%) of wagons are a mixture of timber, fuel, and other break-bulk carrying wagons.

The heavy haul lines have mainly one or two types of wagons while the general freight business has approximately 66-wagon groupings with even more detail types within each group. This is largely due to the variety of commodities that are transported in the general freight business.

(b) Wagon availability and reliability

Figure 101: Wagon availability and reliability



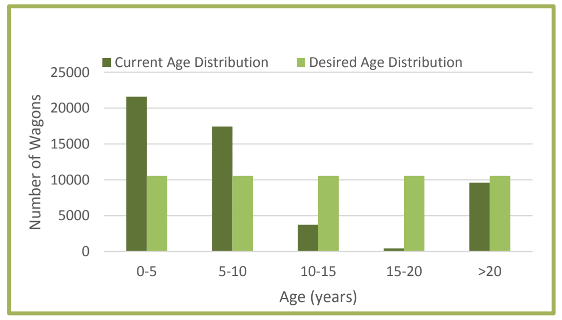
Regarding utilisation, the most severe infrastructure limitation for wagons is allowable axle loading, especially for dry bulk commodities such as coal, iron ore, and manganese. Although it is possible to reduce wagon payload to accommodate sections with lighter axle load, the practice leads to sub-optimal use of rolling stock, and of line capacity on sections that are so constrained. Typically, the network accommodates these requirements with the coal and ore lines as heavy haul lines at a higher axle loading of respectively 26- and 30t/axle in order to achieve the high train capacity for the high throughput demand. The core of the general freight network is currently at 20t/axle with some of the branch and feeder lines as low as 16t/axle.

Other important infrastructure factors to consider for wagons include:

- Vehicle gauge – this is the maximum allowable profile for wagons and their respective lading not to interfere with fixed structures such as platforms, tunnels, bridges as well as other trackside and overhead equipment. This is especially important to consider for longer wagons such as motorcar wagons. On electrified portions of the network, overhead traction equipment will limit the vertical height of moving loads and constrain double stacking of containers unless it is raised as has been done in other parts of the world. The narrow track gauge also limits centre of gravity height, thereby rendering the double stacking of containers unsafe; and
- Train length – this is typically determined by the number of wagons and the individual wagon lengths and may be influenced by train braking system limitations (such as inherent in vacuum and air brakes) and by train dynamics considerations (such as coupler and drawgear characteristics, optimum load per locomotive, availability of distributed power, etc). Train lengths influence the provision of passing loops on single line sections as well as yard configurations and setup facilities.

(c) Wagon age distribution

Figure 102: Wagon age distribution



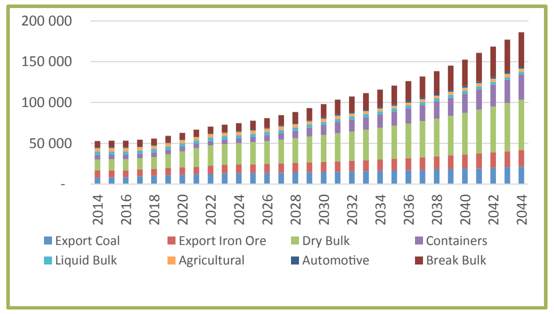
The rolling stock fleets are relatively old when compared with international benchmarks. From the graph it is clear that little or no investment occurred for approximately 15 years.

7. ROLLING STOCK (continued)

The effect of relatively old rolling stock fleets manifests in lower availability and reliability when compared to younger fleets, mainly because the benefits of newer technology were not introduced in the Transnet fleet during the last 15 to 20 years. For the wagon fleet, the shifts in commodity volumes created a mismatch between the wagon designs in terms of the specific commodity to be transported. Thus there is currently a relative large volume of commodities transported in less than ideal wagons.

7.5 WAGON FUTURE REQUIRED FLEET

Figure 103: Future wagon fleet required

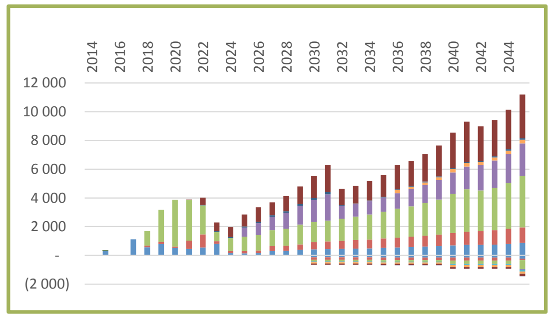


The figure indicates the total wagon fleet demand for the 30-year forecast as from the Freight Demand Model. The efficiency parameters of Freight Rail were applied for the 10-year period and the improvement in efficiencies cause wagon requirement to increase at a lower rate than traffic demand.

The coal line shortfall to build Jumbo wagons in order to cascade the smalls to General Freight Business, was addressed by means of approval of a business case recently. The new container wagons requirement need to be addressed. The conversion of BA wagons to C-type wagons will be alleviated by the influx of smalls (CCR1/3) wagons from the coal line cascading programme. The new jumbo wagons required the coal line volume growth are essentially in process and will also be addressed with the 81mtpa expansion plan. The ore line fleet is sufficient for the current volumes and additional wagons will be procured as ore line projected traffic grows.

(a) Wagon acquisitions and retirements

Figure 104: New wagon committed investment



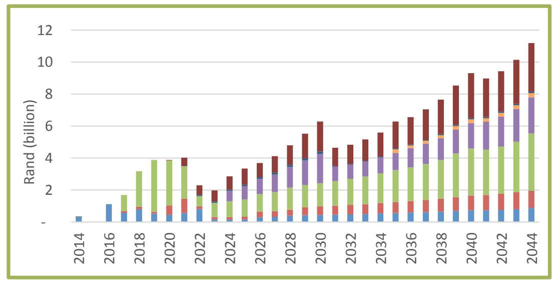
New wagons that are being procured include Jumbo wagons (CCR11) for the coal line, container wagons and some CR wagons for general freight.

During the ongoing refurbishment programme for wagons, container wagons are being upgraded to 60 tons payload and C and D type wagons are upgraded to 60 tons payload with volumetric capacity for coal transport at 60 tons per wagon.

Ore line wagons will be procured as future volume demand is confirmed.

(b) Wagon investment

Figure 105: Wagon investment – 30 years



The wagon investment plan is indicated by the wagon investment figure above. The need for investment in additional Jumbo wagons for the growth in coal traffic is evident, as is the need for new CR wagons for use in transporting dry bulk commodities.

7.6 ROLLING STOCK TECHNOLOGIES

Currently available technology, including Distributed Power (DP) and Electronically Controlled Pneumatic (ECP) braking, enable longer and heavier trains on the existing network.

The ore export line has already employed most of latest technologies. The coal export line can still benefit from distributed power and dual-voltage locomotives, which are now being delivered.

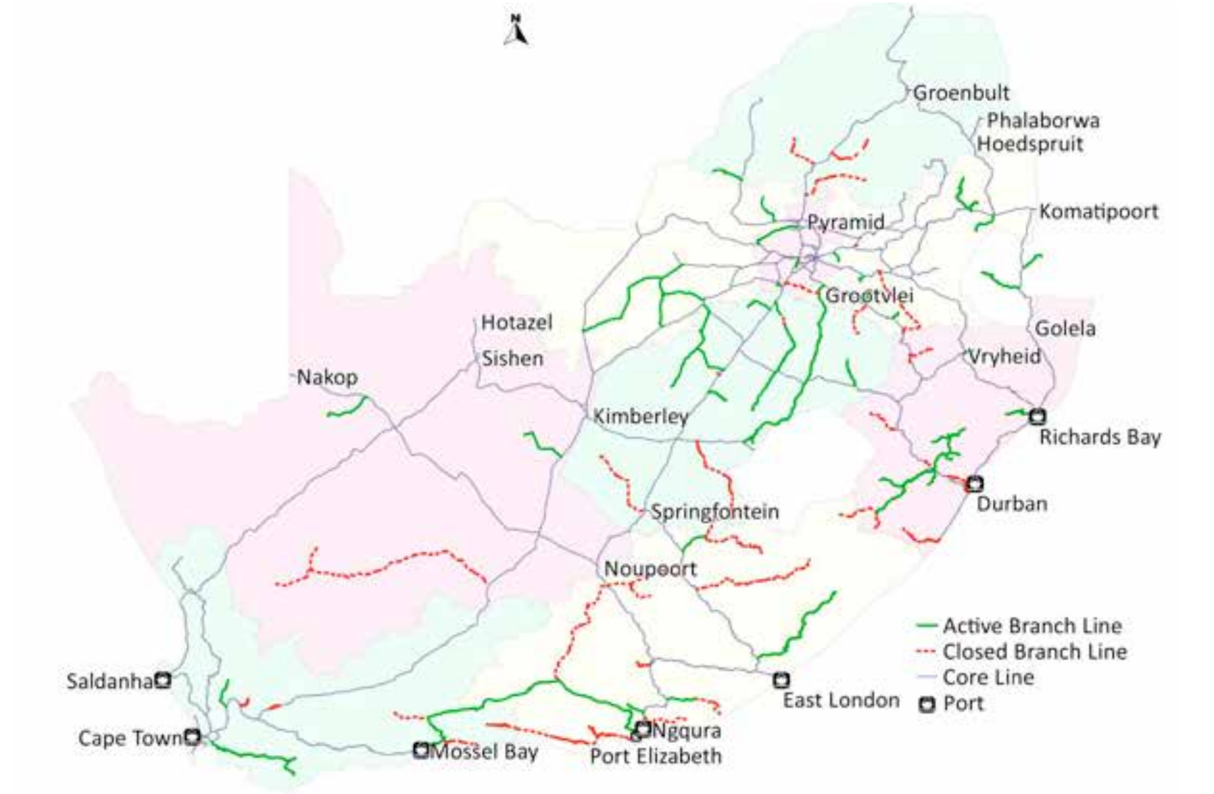
General Freight operations can benefit significantly from the latest technological advances to achieve:

- Longer trains – 100-wagon trains or more as standard is possible by employing DP and ECP braking;
- Heavier trains – by increasing maximum axle load to 30 tonnes;
- Higher energy-efficiency trains through highly improved traction control technologies, AC traction motors, regenerative braking and improved diesel engine technology;
- Safer trains due to improved train-handling technology through ECP braking systems as a first priority; then the addition of DP where train length, mass and the terrain warrant it;
- Environmentally friendlier trains through reduced energy consumption and lower diesel engine emissions.
- Increased line capacity with benefits available from CBA (Communications Based Authorisation);
- Reduced theft, vandalism and service disruptions due to less track side equipment; and
- Improved train trip reliability with improved on-board and wayside train condition monitoring.

8. BRANCH LINES

8.1 BRANCH LINES CONTEXT AND STATUS QUO

Figure 106: Branch lines status quo



Many of the current branch lines have been in existence for nearly 100 years and nearly all have not been operating profitably.

By 1935 most branch lines were already constructed and are now a substantial part of the total network. They are found in all provinces.

About 7 500km of the South African network is classified as 'branch lines' with the potential to service communities and activities not directly on the main corridors. Branch lines are important links to rural areas of the country and when active contribute to main line tonnages. This network is a combination of lifted and stolen lines, closed lines and active lines.

8.2 BRANCH LINE STRATEGY

Efficiently operating branch lines is crucial for economic development of particularly rural areas of the country, and to reopen and operate them sustainably require different strategic, funding and operating models to that of main lines.

Transnet's strategy supports development of economic activity within rural areas and to recapture traffic back from road to rail requires renewed focus on revitalising many of these branch lines.

Transnet and Government have initiated a branch line revitalisation programme to provide opportunities for refurbishment and, where desirable, for external operators on these lines. Transnet Freight Rail will, however, continue to operate through an independent unit called Branch Line Operations and Management Unit (BLOM).

This has resulted in the:

- Commencement of refurbishment of some branch lines and allocation of funds to refurbish others in the next few years;
- Confirmation of market interest to operate branch lines; and
- Commencement of a process to select operators and to conclude the necessary agreements.

Since branch lines serve as feeder routes to the core rail network, strategic clusters have been identified to serve specific commodities:

- Grain is the predominant commodity on most of the central branch lines;
- Other commodities are mainly timber, fuel, fertiliser, cement, coal, gold ore and containers; and
- Many branch lines have the potential to attract additional traffic not handled in the past.

8.3 CURRENT BRANCH LINE OPERATIONS MODEL

The branch lines currently adhere to the same planning and operations principles as the rest of Transnet Freight Rail. This implies the following:

- Trains are designed to run as so-called full trains of either 40 or 50 wagons, depending on whether it will be vacuum or air braked;
- Locomotive resources are often allocated based on maximum train designs and not in accordance with actual traffic requirements on the line;

8. BRANCH LINES (continued)

- Operational deployment is not focused on maximising time utilisation of assets for branch line operations;
- Operations management responsible for the branch lines are focused on main line operations to the detriment of branch lines;
- There is a perception that branch lines have a shortage of assets, especially locomotives;
- Branch line costs and revenue are often not available or transparent; and
- No special cost management processes exist to actively reduce costs on branch lines.

8.4 COST DRIVERS AND ESSENTIALS FOR BRANCH LINE PROFITABILITY

The main cost drivers for the branch line operations include train operating costs as well as the network maintenance costs. Train operating costs include:

- Diesel fuel or electrical energy;
- Locomotive and wagon capital depreciation or leasing;
- Locomotive and wagon maintenance;
- Train crews;
- Shunting teams;
- Terminal operations; and
- Commercial (includes support costs, vehicle rentals, communication etc).

Network maintenance costs include:

- Material costs (rails, sleepers, ballast, fasteners etc);
- Maintenance crews;
- Contracted services (weed control, fire breaks etc); and
- Commercial.

Essential (basic) issues for branch line profitability are:

- Focus on and design services for maximum asset utilisation;
- Know costs and design services that will allow reduction of operational costs; and
- Identify opportunities to reduce fixed costs.

8.5 LTPF BRANCH LINE APPROACH

- Revitalisation of branch lines;
- Align services of feeders into and from the core network;
- Different operations models aimed at:
  - Focus on and design services for maximum asset utilisation;
  - Know costs and design services that will allow reduction of operational costs;
  - Identify opportunities to reduce fixed costs;
  - Initially limited opportunity for heavy investment to upgrade to core network or heavy haul standards; and
  - Focus will be to rebuild and sustain current design capacity.

8.6 TRANSNET BRANCH LINE INITIATIVES

8.6.1 Reinstatement of the Magaliesburg-Hercules, Redan-Grootvlei and Grootvlei-Balfour North lines

Figure 107: Magaliesburg-Hercules and Grootvlei power station

Project description
- Potential reinstatement of the railway line between Magaliesburg and Hercules that has been closed for 8 years, and adjustment of gradients between Magaliesburg and Zeerust.
- Standard of the line to be upgraded to 20t/axle on cement sleepers and continuously welded rails or, alternative on 'slab-track'

Costs
- R450m – R700m (Copex)

Timelines
- 18 – 24 months from commencement to completion.
- Study and report finalised: Nov/Dec 2013.

Traffic potential
- Coal: 3,5mtpa by 2015/16 increasing to 7,5mtpa by 2019/20 from Botswana to Maputo, Richards Bay and Durban. (New business).
- Containers: All Botswana – Durban container traffic may potentially flow over this line and not via Krugersdorp.
- Grain: 0,35mtpa from Swartruggens, Zeerust and Koster to Pretoria mills – all currently on road.

Project description
- Possible re-instatement of the 70km rail line between Redan and Grootvlei (to be sequenced with Grootvlei – Balfour North line and terminal and needs assessment)

Costs
- R250m – R300m to reinstate the line at heavy haul standards with recovered rails from the iron ore line.

Timelines
- Target commencement: 2014 – 2015.
- Target completion: 2016.

Traffic potential
- Coal to the Grootvlei power station.
- The line will also create an alternative for the flow of iron ore to New Castle as well as manganese to Cato Ridge and all Sasolburg and Vereeniging traffic when service disruptions are experienced on the Natcor.

Other benefits
- The reinstatement will create an alternative for the movement of coal to Grootvlei power station at lower gradients with resultant reduced locomotive requirements and energy costs than via Balfour North.

Project description
- Re-instatement of 21km rail line between Grootvlei and Balfour North.

Costs
- Budget of R125m – fully funded from capital investment budget.

Project expansion costs
- Additional investment required: Terminal at Grootvlei for container solution – estimated cost R175m (including skiptainers, funkies, crane, etc.).

Timelines
- Commencement: 7 Jan 2013 (rail re-instatement).
- Target completion: March – June 2014.
- First limited train service: April – June 2014.

Traffic potential
- Assuming terminal readiness (even interim), coal to the Grootvlei power station will be:
  - 2014/15 – 2mtpa
  - 2015/16 – 3,5mtpa
  - 2017/18 – 5,5 – 6,0mtpa for 10 – 15 years

8.6.2 Reinstatement of the Amabele-Mthatha and Alicedale-Grahamstown lines and the proposed KwaZulu-Natal rail link

Figure 108: Eastern Cape (north) cluster and proposed KwaZulu-Natal rail link

Project description
- The upgrading of the line between Mthatha and Amabele commenced in 2012 after a commitment by Transnet to the Premier of the Eastern Cape to assist in getting the line operationally safe. (The Eastern Cape province cancelled the lease of the line towards the end of 2012 and before its expiry).
- Transnet Freight Rail targets resumption of operations on the line.

Costs
- Estimated total costs are R100m.

Timelines
- The major interventions and investment catch-up was June 2013.

Traffic potential
- Estimated 0,6mtpa in 2016/17 (project postponed by two years).
- Mainly made up of Canola seeds to be transported to the new Biofuel plant in Coega being developed by PhytoEnergy.

Project description
- Reinstatement of the rail line between Allicedale and Grahamstown to 18,5t/axle by performing backlog maintenance.

Costs
- R3,5m Copex.

Timelines
- Completed during latter part of 2013 (line). (Grahamstown station investment to be made by PRASA)

Traffic potential
- Limited to the local farming community's needs for the supply of fuel, fertilizer, parts as well as the movement of agricultural products towards Port Elizabeth.

Other benefits
- The line will be re-opened as part of an initiative to ensure that the passenger services to Grahamstown can be resumed.
- The Blue Train will run annually on the line as part of the Grahamstown arts festival.

Project description
- The scope of this proposal is to link the existing rail network in the Eastern Cape province to that of KZN.

Project detail & issues
- Various potential routes have to be evaluated.
- Will be a strategic option only at this stage, as volume justification has not been verified.
- Exceptionally high infrastructure costs due to topography.
- Volume expectations may be too low to support investment.
- Will compete with road and coastal shipping.

8.6.3 Reinstatement of the KwaZulu-Natal branch lines

Figure 109: KwaZulu-Natal branch line cluster

Project description
- The development of a new line to link the Makatini flats with the Golela – Richards Bay line in support of the National Planning Commission and New Growth Path.

Project detail and issues
- This area is renowned for its agriculture potential and especially genetically modified crops.
- The immediate traffic potential is 0,2mtpa of sugar cane for Felixston, and can grow substantially.
- The Umkhanyakude District Municipality is investigating potential future linkages with Mozambique and the proposed new deep water port at Techobanine (22km from the KZN border) are contemplated.

Project description
- Upgrade and re-instatement of the line from Mt. Alida to Greytown, Donnybrook to Kokstad and potentially Pietermaritzburg to Richmont.

Project detail and issues
- The focus will be to increase timber traffic from 0,2mtpa to 1,5mtpa and to develop other agricultural and general freight opportunities.
- Current interaction with Forestry SA to regain business.

Project description
- Possible re-instatement of the line between Somkele and Mtubatuba closed in 1928.
- Re-instatement of the line between Mtubatuba and Riverview (Umfolozi sugar mill).

Project detail and issues
- To be used for the export of 2,5mtpa for the next 20 years of antracite from Somkele through the Port of Richards Bay.
- Alternatively, the creation of a loading facility at Mtubatuba or Dukuduku.
- Transport of potentially 0,2mtpa of Umfolozi sugar and molasses to Durban.

Project description
- Development of loading facilities at Mkhuze (on the Golela – Richards Bay coal line) for 0,8mtpa of sugar cane destined for the Felixston sugar mill.

Project detail and issues
- The Senekal Family and their Employee Empowerment Trust within the Umkhanyakude District Municipality (KZN), have a 20 year agreement with the sugar mill at Felixston for the exclusive supply of sugar cane.

Project description
- Potential reinstatement of the line and safeguard the right of way.

Project detail and issues
- Potential re-opening of the Banana Express (passengers) and some timber.
- Investigate the potential for dual gauge to promote regional and business integration.
- Potential rail link between KZN and the Eastern Cape provinces through a proposed connection with Umtata.

8. BRANCH LINES (continued)

8.6.4 Reinstatement of the Wolseley-Prince Alfred Hamlet, Klipplaat-Rossmead and Sterkstroom-Maclear lines

Figure 110: Western Cape and Eastern Cape clusters

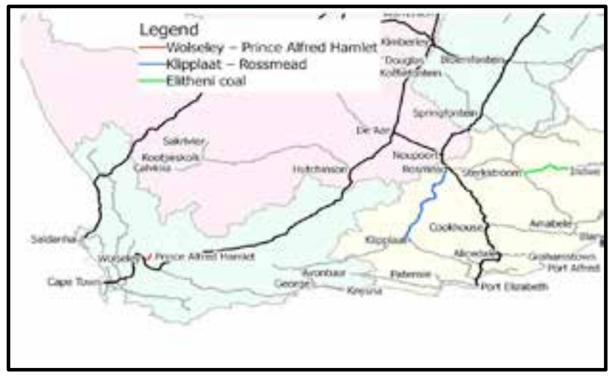
Project description
- Re-instatement of the Wolseley – Prince Alfred Hamlet rail line, which is in a relatively good condition and will require minimum backlog investment, to 16t/axle.

Costs
- Target R15m Copex.
- More or less R5m – R8m for the line and R10m for a container terminal in the station precinct of Ceres – to be funded as a PSP and to leverage third party involvement in the terminal.

Timelines
- Target commencement for line and terminal re-instatement and operations during 2014/15

Traffic potential
- Refrigerated and normal containerised soft fruit exports from the Ceres valley and the distribution of fruit juice, onions, potatoes and cereals.
- Backhaul traffic such as coal, fertilizer, fuel and empty containers

Other benefits
- Strong heritage, tourism and movie potential
- Resuscitation of small and rural towns.



Project description
- Reinstatement of the rail line between Klipplaat and Rossmead.

Costs
- R52m Copex.

Timelines
- Target completion: 2014/15.

Traffic potential
- Containers, motor vehicles, manganese in containers, traffic to and from the Southern Cape.

Other benefits
- This line will be upgraded as part of the Manganese ore project and will enable the diversion of GFB freight (excluding loaded bulk Manganese trains and passengers for now) off the Port Elizabeth main line to create capacity during the upgrade.
- The re-instatement will create opportunities for a Canola producing area for use in Biofuel, as well as the production of Canola oil. The potential production of Canola in the area to be railed to Port Elizabeth is estimated to be >0,3mtpa.

Project description
- Rail logistics solutions to transport 2mtpa of export coal from the Indwe mine to the Port of East London.

Project detail and issues
- The reinstatement of the railway line between Sterkstroom and Maclear that was opened in 1896, acquired by the CGR in 1900 and closed in 2001.
- Sub standard branch line rail profile of existing line. (16ton/axle, sharp curves and ruling gradient of 1:30)
- Maximum speed of 30km/h resulting in cycle time between Sterkstroom and Indwe of about 12 hours.
- Potential PSP transaction to re-instate and upgrade the network, acquire locomotives, other rolling stock and other investments such as containers, facilities, etc. as a total turnkey project.
- Potential to blend and washing plant facilities that could also potentially accommodate Botswana coal.
- The above highly dependent on mine investments for exploitation of coal volumes.

8.6.5 Reinstatement of the Graskop-Sabie, Mogopong-Zebediela and Pienaarsrivier-Marble Hall lines

Figure 111: Limpopo and Mpumalanga clusters

Project description
- Potential re-instatement of line between Sabie and Graskop and Nelspruit and Plaston for the forestry industry.

Project detail and issues
- Current interaction with Forestry SA (FSA) to regain business.

Project description
- Potential re-instatement of this branch line for the development of the limestone, agricultural and other citrus industries.

Project detail and issues
- Potential source of 3mtpa of limestone for Eskom for the Kusile and Medupi power stations to clean the exhaust fumes.
- Government intention to re-establish large scale citrus farming.
- This project also links to the Limpopo Citrus Hub.

Project description
- Potential re-instatement of this branch line for the development of the limestone, cement, agricultural and fluorspar industries.

Project detail and issues
- Potential source of 3mtpa of limestone for Eskom for the Kusile and Medupi power stations to clean the exhaust fumes. (Alternative source for the Zebediela branch line)
- WIPHold secured funding from the China Construction Bank for a cement plant in Marble Hall.
- Fluorspar can be loaded at Marble Hall and migrate from the current road haulage between Marble Hall and Pienaarsrivier.

8.6.6 Reinstatement of the Belmont-Douglas, Orkney-Vierfontein and Springfontein-Koffiefontein lines

Figure 112: Free State and Northern Cape clusters

Project background & description
- The line was built to 11t/axle. This created severe cost and service implications for clients at Douglas. Grain wagons could only be filled to half of their capacities and topped-up at Modderrivier.
- In 2007/08 the Northern Cape Government funded the upgrade of only the section between Douglas and Salt Lake to 20tons per axle.

Timelines
- Upgrading of the remaining 41km commenced in 2012/13.
- Completion targeted for March – April 2014.

Traffic potential
- Grain to increase from the current 0,085mtpa to >0,25mtpa.
- Other commodities up to a total of about 0,1mtpa:
  - Phosphoric acid in tank wagons currently to Christiana will continue to Douglas: 0,02mtpa
  - Irrium now on road from Port Elizabeth in containers: 0,03mtpa
  - Lucerne in containers from Douglas: 0,02mtpa
  - Ground and macadamia nuts: 0,012mtpa
  - Tyres for the mining industry and farmers from Port Elizabeth in containers: 0,02mtpa

Project description
- Reinstatement of the rail line between Orkney and Vierfontein to 20t/axle and rehabilitation of the Milner Bridge over the Vaal River.

Costs
- R42m Copex.

Timelines
- Completed: April 2013.

Traffic potential
- Volumes targeted is mainly grain exports from Klerksdorp to Durban and East London via Kroonstad and grain from the Western Free State to Randfontein.

Other benefits
- The rail distance between the Bothaville area and Randfontein will be shorter that traffic to Randfontein may be targeted in future.
- The reinstatement of the line will facilitate a more efficient distribution of grain wagons by creating a direct link between the two most important maize producing areas in South Africa, Kroonstad and Klerksdorp.
- Movement of network materials to decongest the core network.

Project description
- Potential re-instatement and rehabilitation of this branch line in support of agricultural business with the potential extension of this line to either Belmont or Modderrivier (both will require about 60km of new track).

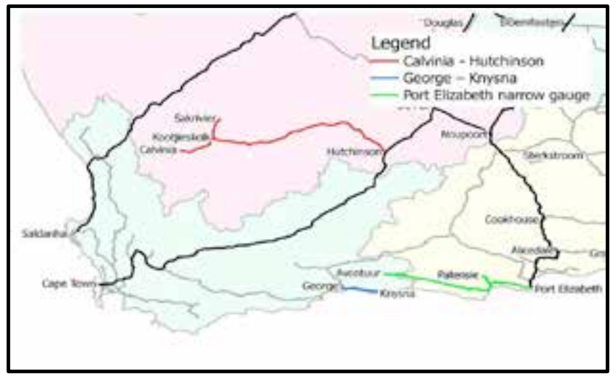
Project detail and issues
- The Free State provincial government together with GWK is establishing small scale and emerging farmers in the Oppermansgronde area on farmland now established through successful land claims.
- The link to Belmont or Modderrivier will reduce the distance to East London substantially.

8.6.7 Reinstatement of the Calvinia-Hutchinson, George-Knysna, and Port Elizabeth-Avontuur lines

Figure 113: Western Cape, Eastern Cape and Northern Cape clusters

Project description
- Potential re-instatement of the line from Calvinia to Hutchison in support of the SKA (Square kilometre array radio telescope).

Project detail and issues
- The construction and operation of >3 000 radio telescope dishes for the SKA may create a unique opportunity for the reopening of this line.
- This will serve the multimodal terminal to be created by the successful bidder.
- The SKA construction is anticipated to endure for about 15 years.
- Costs are likely to be substantial due to the length of more than 400km.



Project description
- Potential re-instatement and rehabilitation of the line between George and Knysna.

Project detail and issues
- To be developed as a concession with potential investment from the WCPG and local District Municipality.
- This will be in support of tourism and mobility projects, eg coastal tram services between Mosselbay and Knysna.

Project description
- Potential re-instatement the Port Elizabeth narrow gauge line.
- Investigate the potential for dual gauge.

Project detail and issues
- Potential re-opening of the Apple Express and potential Airport – City link tram service with limited freight (fruit, timber) opportunities.
- TFR prime land bordering the port is available for future development of tourism, fishing, housing, mixed use (hotel, shopping malls, restaurants) and public access into the port.

9. ALTERNATIVE DEMAND SCENARIOS

9.1 INTRODUCTION

The beneficiation scenarios considered a range of alternate scenarios for beneficiation of raw materials that are not included in the Freight Demand Model (FDM). These are not included, because it is believed that the necessary capacity in the economy around especially the availability of finance, skills and entrepreneurship does not exist to execute these over the short term. Beneficiation over the long term, especially by around 2025 to 2030, is included in the FDM, to the extent that it is believed that it could be achieved.

But in the light of the importance of the issue and the attention that it receives, the work was necessary. It can, however, only be seen as an extremely optimistic scenario.

Therefore this section considers the effect of the probable beneficiation scenarios on the network capacity.

9.2 APPROACH

Scenarios for six large beneficiation facilities were considered, these were:

1. Another steel mill at Saldanha;
2. Another chrome smelter at Rustenburg;
3. Another aluminium smelter at Richards Bay;
4. Another ferromanganese smelter at Cato Ridge;
5. Sasol 4 at Koppies; and
6. A definite go for the oil refinery at Coega.

In most of the cases the volumes due to beneficiation was negligible compared to the existing volumes on those sections and they were deemed not to breach the existing capacity tranches as planned. However, the volumes on the Sishen-Saldanha section and the Lephalale-Pyramid section were selected for further analysis as they may have an impact on capacity and interventions.

9.3 AFFECTED SECTIONS

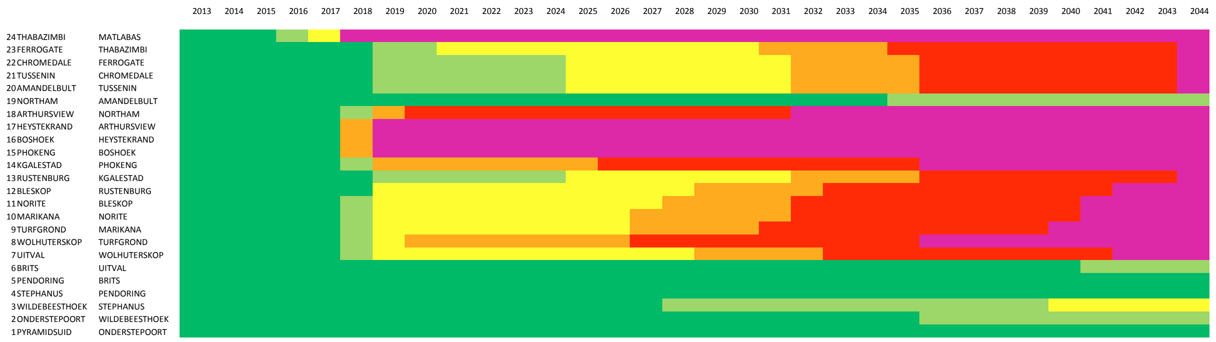
9.3.1 Another steel mill at Saldanha (Sishen-Saldanha section)

Figure 114: Sishen-Saldanha current scenario

Current scenario

Figure 115: Sishen-Saldanha beneficiation scenario

Beneficiation scenario



The effect of the beneficiation is to run out of capacity (from the planned interventions) one year earlier. Depending on the eventual timing of this beneficiation scenario, Transnet shall consider the option of bringing the interventions to execution one year earlier.

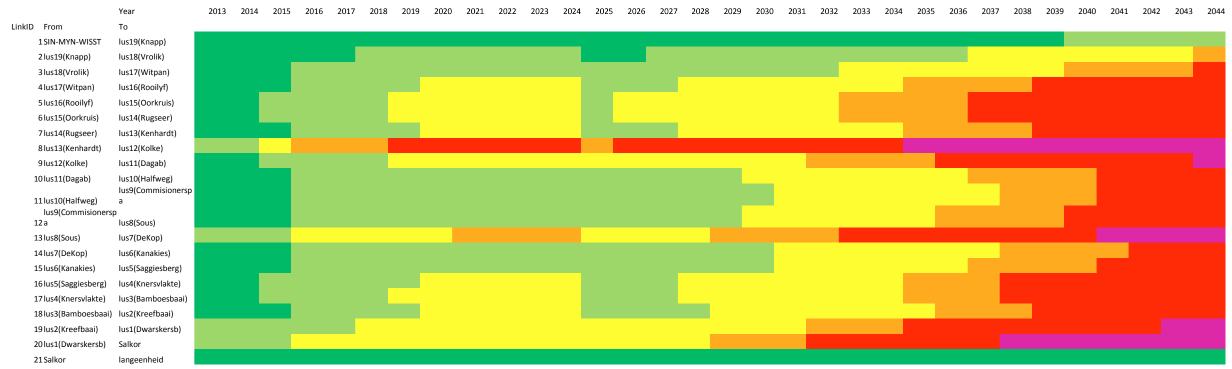
9.3.2 Another chrome smelter at Rustenburg (Lephalale-Pyramid section)

Figure 116: Lephalale-Pyramid current scenario

Current scenario

Figure 117: Lephalale-Pyramid beneficiation scenario

Beneficiation scenario



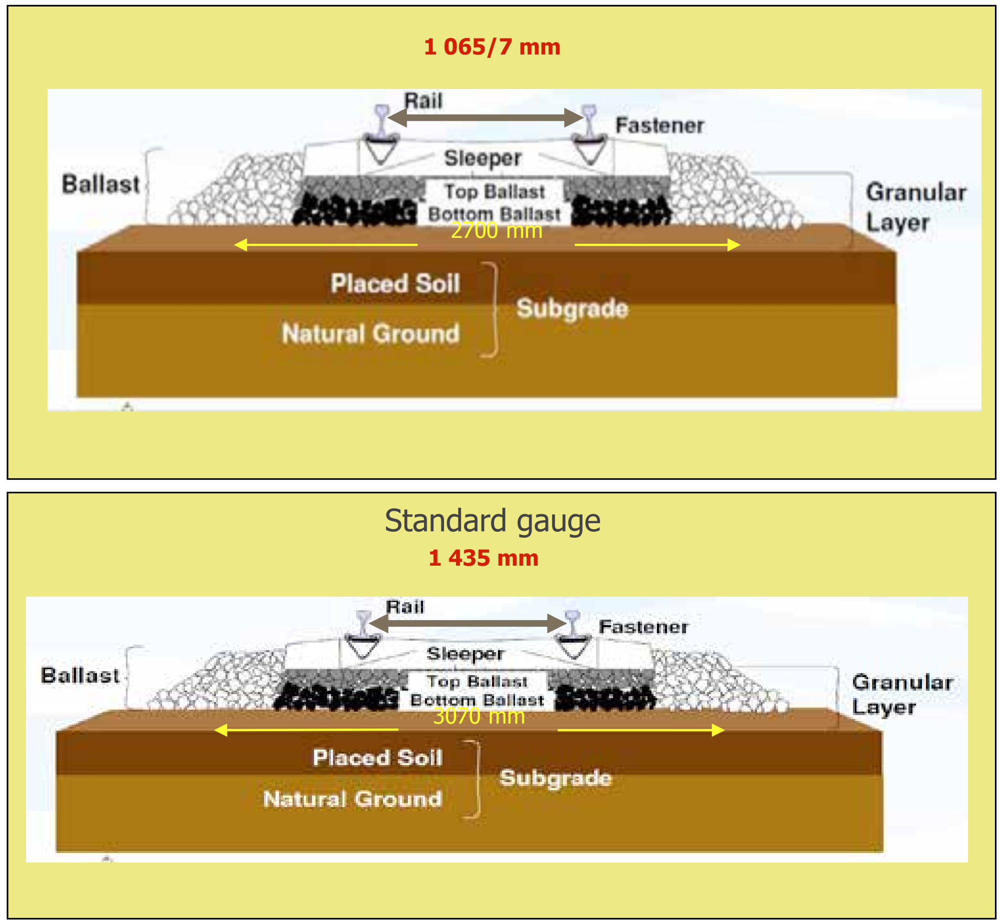
The volume changes due to beneficiation on the Lephalale-Pyramid section are so negligible as to not affect the planned interventions.

10. TECHNOLOGICAL ADVANCES/EMERGING TECHNOLOGIES

10.1 RAIL GAUGE CONTEXT: WHAT IS IT AND WHY IS IT IMPORTANT?

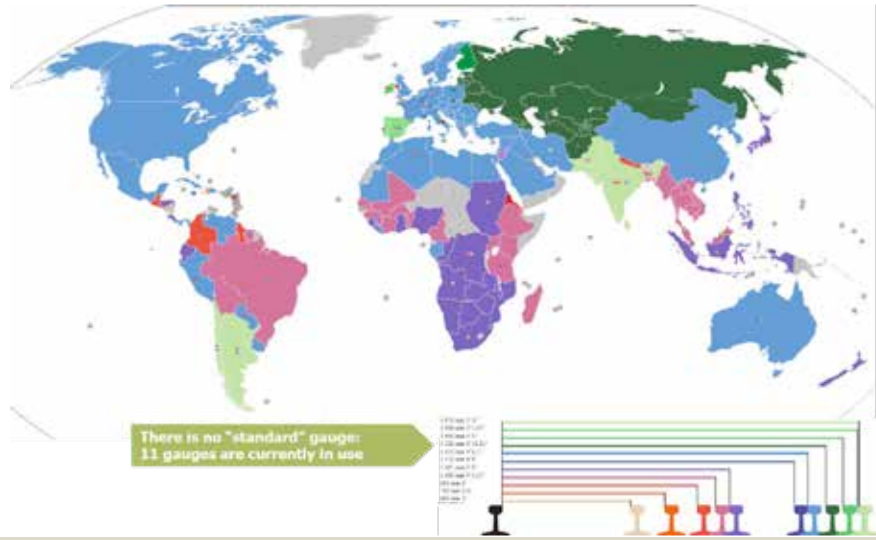
- Rail gauge is the distance between the inner sides of the two parallel rails;
- It affects train axle load, maximum speeds and stability; and
- Wider gauges are more expensive to construct but are more suited to heavier axle loads and faster train services as:
  - Forces are spread over a larger surface area;
  - Train stability is enhanced due to the greater distance between wheels; and
  - Larger rolling stock with higher carrying capacity can be deployed.
- Two of the more commonly found gauges are:
  - Cape gauge: 1 065/7mm; and
  - Standard gauge: 1 435mm.

Figure 118: Rail gauge context diagram



10.2 GLOBAL RAIL GAUGES

Figure 119: Global rail gauges



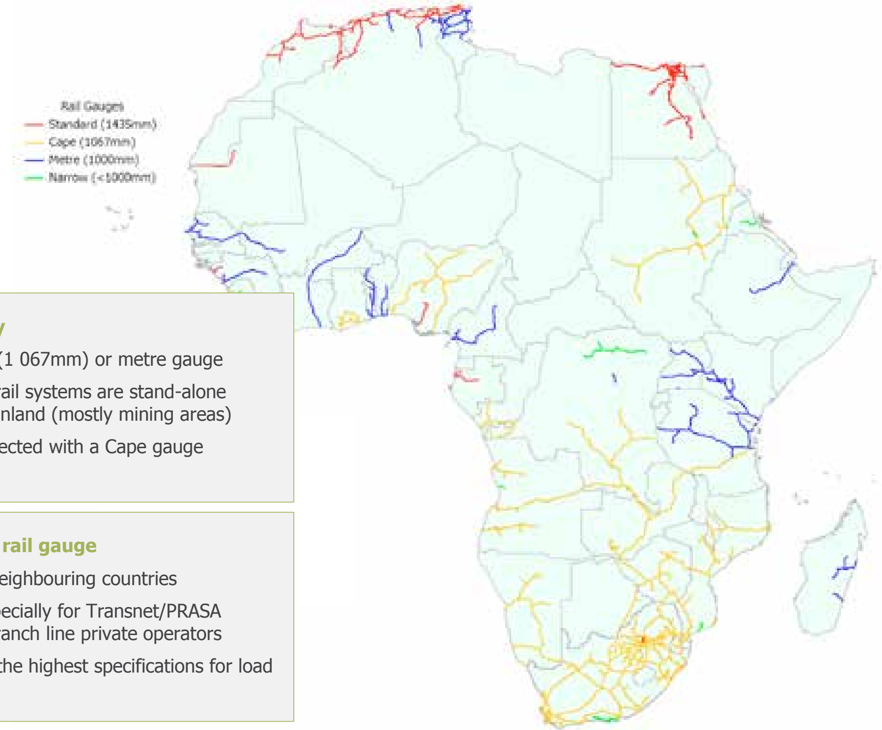
- Although the term 'standard gauge' has become a popular term to refer to the gauge used in parts of Europe and the United States of America, it is by no means the common gauge of choice in the world. There are many different gauges, ranging from about 610mm to 1 676mm, each with its own characteristics and origins.

Rail gauge is defined as the distance between the inner sides of the two parallel rails. This distance then determines the wheel spacing on the rolling stock that can be safely operated on the line and has a major impact on vehicle dynamics, permissible axle load and vehicle size. In South Africa there are basically three gauges, namely:

- Standard gauge at 1 435mm – only the Gautrain passenger network;
- Cape gauge at 1 067mm – the core network plus the majority of the branch line network; and
- Narrow gauge at 610mm – some isolated lines on the branch line network.

10.3 RAIL CONNECTIVITY AND GAUGES IN AFRICA

Figure 120: Rail connectivity and gauges in Africa map



Rail gauge and connectivity

- Predominantly Cape gauge (1 067mm) or metre gauge
- North and Western African rail systems are stand-alone links from coastal towns to inland (mostly mining areas)
- Southern Africa is well connected with a Cape gauge system

Key factors for selection of rail gauge

- Network connectivity with neighbouring countries
- Network interoperability especially for Transnet/PRASA shared infrastructure and branch line private operators
- Stand-alone lines – choose the highest specifications for load or speed

10. TECHNOLOGICAL ADVANCES/EMERGING TECHNOLOGIES (continued)

The South African rail system is gauge-wise well connected to the southern African region and any gauge change will certainly disconnect the network from its neighbours. On the other hand, selective consideration of wider gauge for high axle load (in the case of freight) or high speed (in the case of passengers) applications should be considered where new lines and services are to be introduced, since the benefits could be significant.

The selection of gauge needs to be considered against the backdrop of:

- Regional and overborder connectivity – an important consideration for regional interoperability and economic development;
- Application – certain applications such as high-speed passenger services benefit from wider gauges;
- Ease of procurement – it is sometimes easier and cheaper to procure systems and rolling stock from providers with an established gauge specification – Gautrain is a good example; and
- Installed legacy systems – to change the gauge for a whole network may be impractical nor economically viable.

From a freight perspective alone, the opportunities for development on a different gauge are considered as limited. However, consideration should be given to future high speed intercity passenger services, where a broader gauge may be viable and also be used for freight services. Such plans are under consideration and may very well reveal the need for major conversions or upgrades.

10.4 SIGNALLING INITIATIVES

The international trend for signalling has been to migrate part or all of the system onto the locomotive. In Europe which is largely passenger based railway, European Railway Traffic Management System (ERTMS) level 2 has been largely adopted as the standard for the core passenger network. In the United States of America, Positive Train Control (PTC) is being utilised as an overlay to the existing signalling system to obtain this additional safety. The additional safety is inherent to both systems. Improved safety combined with a system that could potentially provide minimum infrastructure, which decreases the opportunity for theft and vandalism, as well as ensure better headway management, are attractive features which make a locomotive-based signalling system a technology that will become the future standard.

One of the significant challenges that exists within the railway environment with regard to the deployment of signalling on low density lines is the prohibitive cost of a traditional lineside signalling system. This usually results in the deployment of technologies such as the track warrant system which are more cost effective and result in sections which are commonly referred to as dark territories. The use of these systems on their own result in additional challenges which include the inability to provide real time tracking of movements of trains as well as resulting in additional authorisation methodologies which have to be maintained within Freight Rail. As a result of these challenges, the traditional authorisation methodology has been adapted to allow for more cost-effective solutions to be implemented for low density lines. This new technology combined with the existing on-board computer (OBC) technology is perceived to improve safety and efficiency in the dark territories. The new technology has been developed and the first deployment of the technology is planned for 2014/2015 which will test the effectiveness of the new solution.

10.5 HISTORIC DEVELOPMENT

Figure 121: Railway network development before 1910

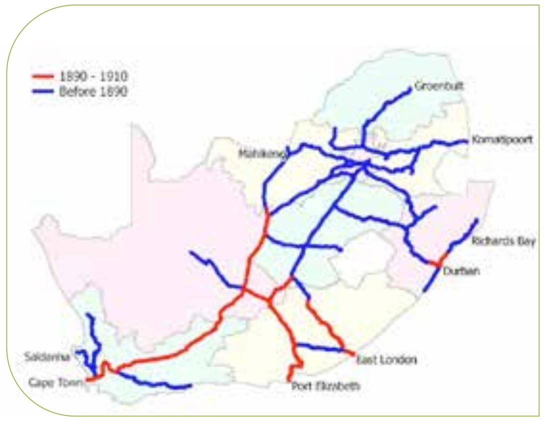
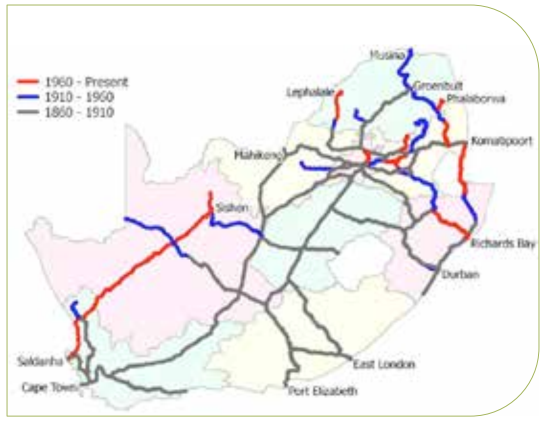


Figure 122: Railway network development after 1910



South Africa's railway system started with two pioneer railways in Cape Town and Durban, connected to the ports. Between 1872 and 1877, these lines became Government property. The discovery of diamonds and later gold and coal in Kimberley and the then Transvaal Republic respectively, triggered the building of the lines between Cape Town and Johannesburg via Kimberley as well as Durban and Johannesburg.

At that stage, the narrower rail gauge of 1 067mm (now referred to as 'Cape Gauge') was chosen for its advantages in construction costs and also its suitability to the mountainous topography in the areas of South Africa in which it was to be installed. As the map shows, the majority of what is now termed the 'Core Network' was developed by 1910, with links between Gauteng and Cape Town, Durban, Port Elizabeth, East London and Maputo having been established.

In 1910, the Union of South Africa was established and with it a decision to use railways to unify the country's widespread towns and cities. The SAR&H administration was also established. By the 1930s, a network of rail lines covered most of South Africa, and the big cities were serviced by metropolitan commuter rail.

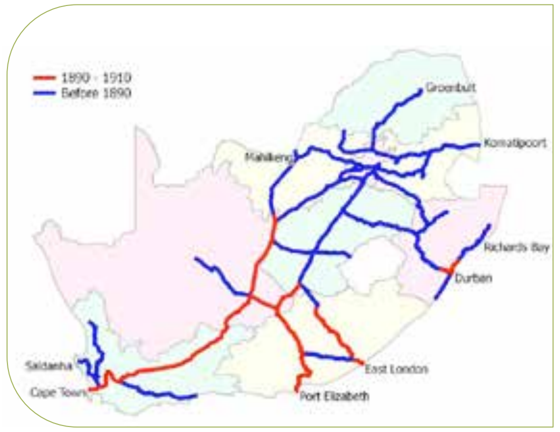
The SAR&H was restructured in the 1970s and network expansion now turned to capacity enhancement with many projects aimed at realigning and upgrading lines to modern standards. During this time, considerable portions of the lines were electrified to the much more advanced 25kV AC standard, and new train control standards were also introduced.

Since the early 1980s, investment in infrastructure has been declining steadily and with it Transnet has seen a huge loss of market share. Since 2000, both Transnet and its Shareholder (Government) realised that a major investment programme would be required to get rail back on track, and in 2006 this negative trend was reversed for the first time.

10.6 INSTALLED TECHNOLOGY

Figure 123: Electrification development map

Figure 124: Electrification installed technology map



Electric traction exists in three forms in South Africa: 3kV DC, 25kV AC and 50kV AC. Electrification of the network in South Africa was initialised in 1925, when a portion of the section between Ladysmith and Pietermaritzburg on the Natal Mainline was upgraded to 3kV DC traction. Shortly thereafter in the Cape, the inner city line was electrified from Monument to Sea Point.

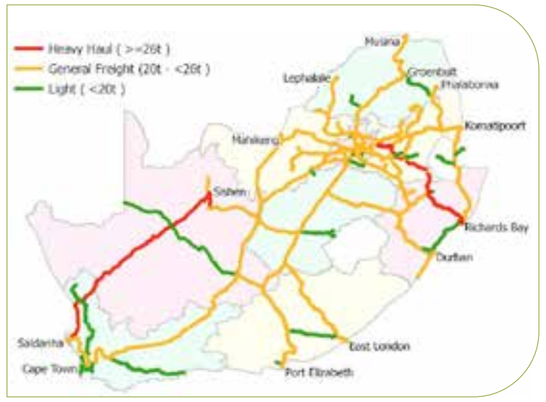
Over the following decade, these sections and areas of electrification were extended and the inner Johannesburg network was electrified. The 1950s and 1960s saw major 3kV DC electrification of the core network corridors connecting Johannesburg to Durban and Cape Town. This system is especially suitable for light traffic and urban applications, with short distances between stations.

Electrification of the Sishen-Saldanha line, as well as the Richards Bay Corridor was completed in the late 1970s and the majority of the remaining core network was upgraded into the 1980s. During this stage of development, the more advanced 25kV AC system was introduced. It is currently the international standard for freight railways and can cover much longer distances without significant line losses.

Traction on the rail network is either diesel (non-electrified), 3kV DC, 25kV AC or 50kV AC. The 3kV DC is the older system with the substations at relatively shorter intervals. The network comprises approximately 20 800 route kilometres of Cape gauge lines (1 067mm), of which 4 900km (24%) are electrified at 3kV DC, 2 300km (11%) at 25kV AC, and 861km (4%) at 50kV AC.

The latter is the Sishen to Saldanha Ore line, which is the only route electrified by this system. In addition there are 15 switchable route kilometres electrified at either 3kV DC or 25kV AC. These are changeover locations, where the voltage can be switched from one system to the other to permit through working by dual voltage locomotives, or a locomotive change without the need to use diesel traction to haul the train through an intermediate non-electrified section.

Figure 125: Axle load map



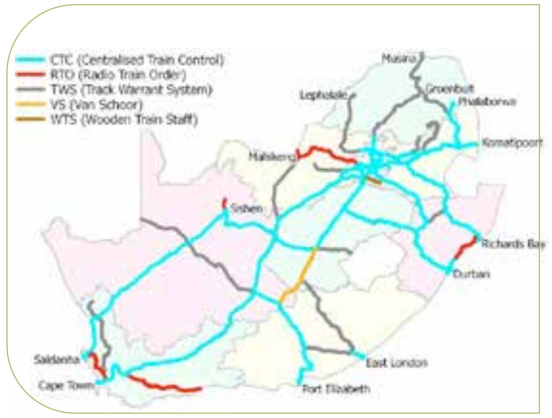
The carrying capacity of any line section is related to the maximum allowable axle load. Transnet strategy allows for key sections of the network to be upgraded to 26t/axle to cater for increased future rail demand. As a result, a 26t/axle load has been specified as the minimum for all new rail constructions projects.

Bridge loading characteristics are closely aligned to the axle loading characteristics of the line. The enhancements required to accommodate increased axle loads are generally limited to a decrease in the

10. TECHNOLOGICAL ADVANCES/EMERGING TECHNOLOGIES (continued)

spacing between sleepers, use of heavier rail sections and an increase in live loading on bridges. The latter can be offset to only a small degree by a reduction in permissible speed. A significant issue with increasing axle loads is the disproportionate increase in track damage, which results in increased maintenance and asset renewal programmes. These costs can outweigh the benefits of the heavier haul loads, in extreme cases.

Figure 126: Train control installed technology



Quite a few different types of train control is still used. Track Warrant is mainly used on single lines and is a radio-based system usually controlled from a central location that is often remote from the section itself.

10.7 STANDARDISATION

This section identifies the key issues and constraints based on the current network installed technology configuration, which must be standardised in the network development plans.

Table 5: Status quo assessment heat map

Status quo assessment heat map		
Topic	**Comments**	**Status**
Gauge	Single gauge on main lines	Good
Axle load	Main corridors 20t/axle.	Acceptable
Traction types	Corridors not standardised	Not acceptable
Gradients and curves	Corridors not standardised	Not acceptable
Train control	Corridors not standardised	Not acceptable
Locomotives	±20 main classes	Not acceptable
Wagons	>80 groups	Not acceptable
Operating philosophy	Unit loads, wagon loads	Acceptable
Customer base	>800 Consolidate	Acceptable
Commodity base	Substantial	Acceptable

Legend

Good	Acceptable	Not acceptable

A high-level standardisation status assessment was taken to establish and to understand the extent of the rail standardisation activities required and to determine the approach of the LTPF:

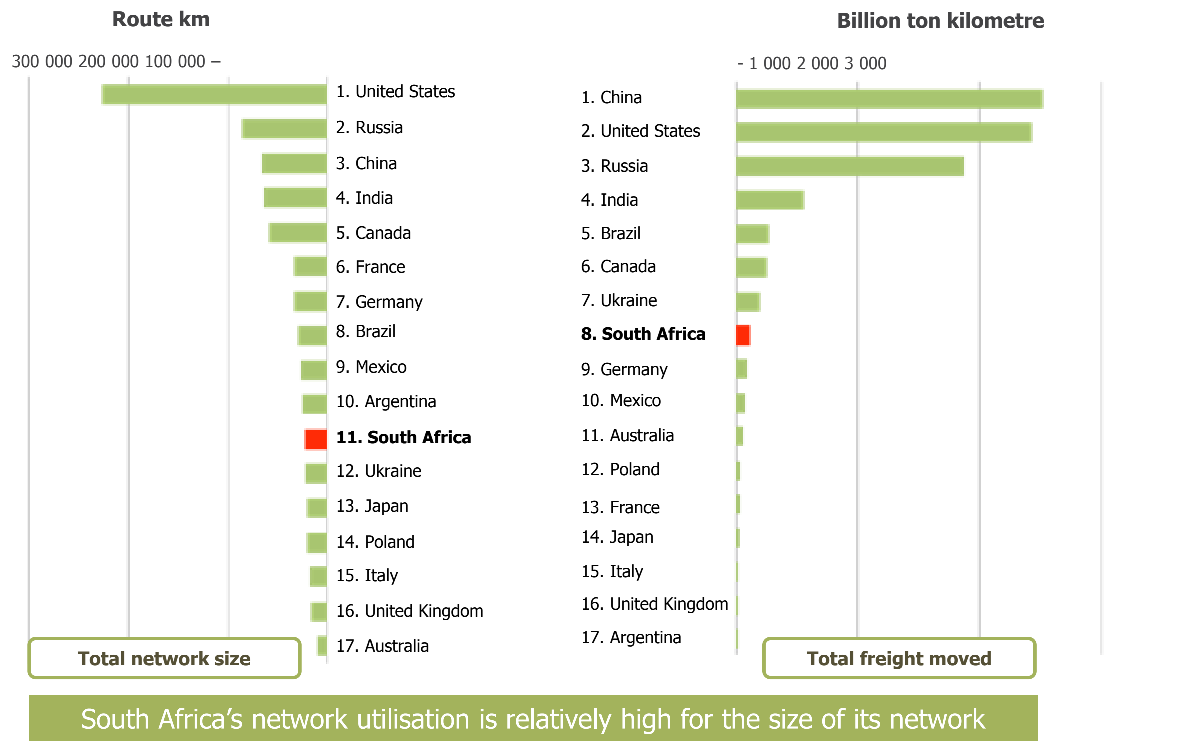
- Axle load: Axle load on virtually all the main corridors is at 20t/axle or more. Most branch lines are at less than 20t/axle, but have sufficient capacity if maintained in good condition.
- A long-term goal would be to operate more 'heavy haul' trains on corridors with heavy traffic densities and large parcel sizes, where construction of new lines with a 26t/axle (and renewals of existing lines to the same value) would make economic sense;
- Traction types: Many main corridors are a mixture of 3kV DC, 25kV AC and diesel. This detrimentally affects consignment throughput times and locomotive utilisation as substantial time is lost during locomotive changeovers. Consideration has been given to standardising electrification along key routes as this improves journey times and reliability by removing the need to change over locomotives during a journey. Over time standardising electrification adds significant benefits such as standardised parts, spares and maintenance. Switching to AC electrification is also becoming an operational and practical consideration, since the DC electrification (the older system) is nearing the end of its lifecycle and traction requirements are exceeding DC's ability. This migration needs to be carefully coordinated with PRASA on the line sections shared with passenger services;
- Gradients and curves: many corridor design characteristics are not standardised, resulting in underutilisation of locomotives as traction power on trains are provided to cope with the steepest gradients along the route and are not required for most of the time. Non-standardised curves result in different speed profiles between trains that further limit line capacity;
- Train control: old or obsolete train control systems are to be replaced with Centralised Traffic Control (CTC) or track warrant systems as part of a standardisation initiative, especially corridors or sections with growing traffic densities;
- Locomotives: the large number of different locomotive types in use increase maintenance training and spares requirements;
- Wagons: different wagon types are required deal to with the large number of commodities transported. Dedicated wagons are most suited for bulk flows such as iron ore and coal, but multi-purpose wagons are more suitable where flow variations are greater;
- Operating philosophy: Freight Rail traffic is categorised in megaRAIL (large, regular consignments), accessRAIL (regular wagon loads handled on a hub-and-spoke principle) and flexi RAIL (irregular ad-hoc consignments). These allow tailor made designs for all customer and traffic types; and
- Customer and commodity base: consolidation will result in lost revenues, but may increase profitability. Many smaller consignments are not rail friendly and transported at a loss. Reduction will significantly reduce operational complexities, but result in further loads on and deterioration of the road network. This will be contrary to our mandate as an enabler to economic development.

LTPF standardisation approach:

- Network and rolling stock standardisation along logical corridors to be pursued as far as is practical and justified;
- Focus on regional standardisation;
- Current gauge to be retained, except for unconnected and standalone heavy haul or passenger lines where standard gauge will be considered;
- As indicated earlier, separating the network for heavy haul and light industrial (containers, automotive) and passenger trains is being pursued; and
- Develop consolidated loading sites to obtain economies of scale and increase unit load traffic, (eg junior miners).

10.8 NETWORK COMPARATIVE PERFORMANCE

Figure 127: Network comparative performance



In the global context, the South African rail system is ranked number 11 in terms of route km. However, the route distance does not directly translate to the measure of freight volumes railed in tons kilometre (ton-km). For example, the above illustration shows that China transported the most traffic, even though its rail network is less than a third of that of the United States of America.

A ton-kilometre, abbreviated as ton-km, is a unit of measure of rail freight transportation, which represents the transport of one tons of goods over a distance of one kilometre.