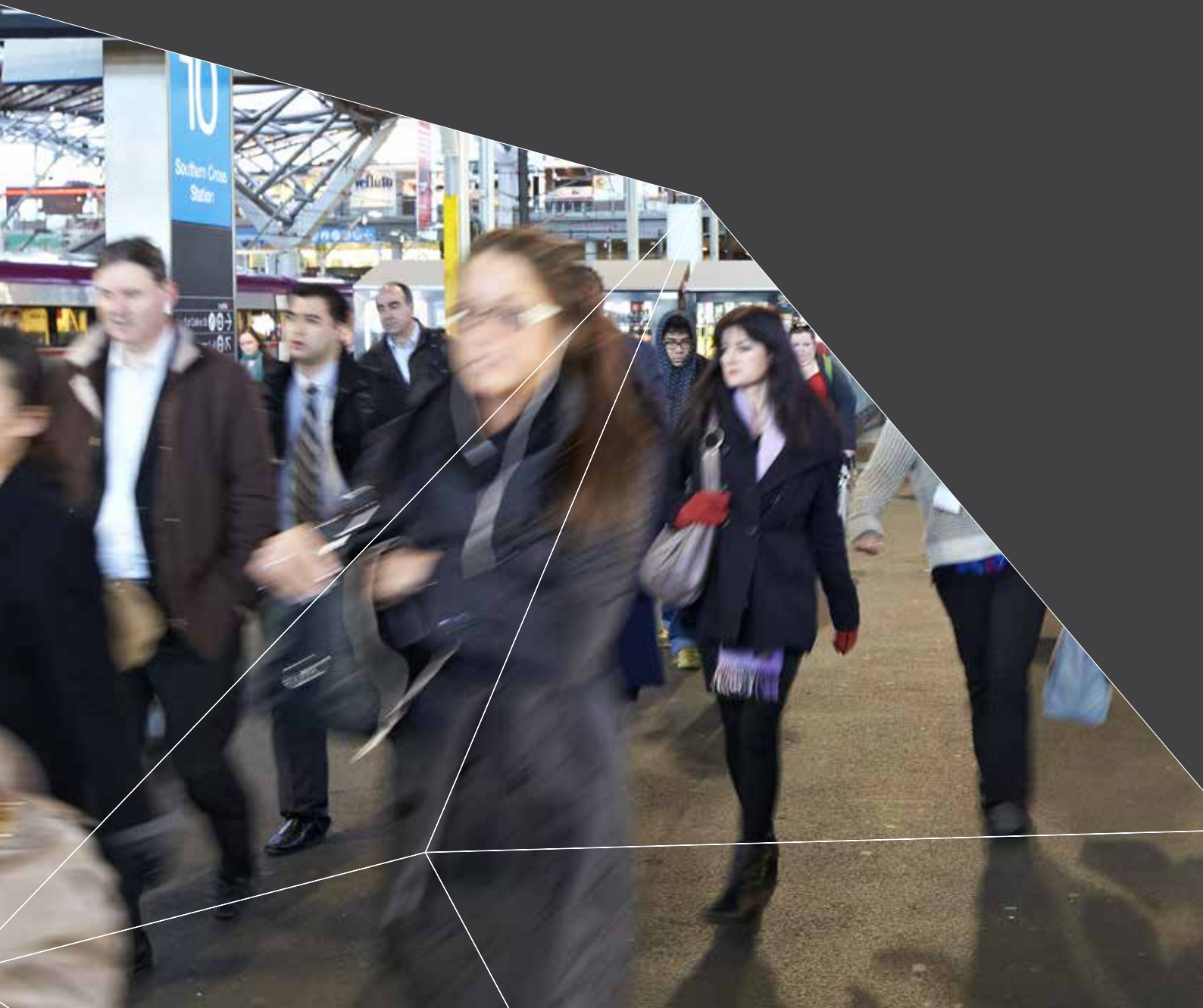# Network Development Plan – Metropolitan Rail

December 2012

Network Development Plan – Metropolitan Rail

Public Transport Victoria letter of presentation to the Minister for Public Transport

The Hon Terry Mulder
Minister for Public Transport
Minister for Roads

Dear Minister,

I am pleased to present the attached Network Development Plan – Metropolitan Rail.

Consistent with the objectives of its formation in April this year, Public Transport Victoria (PTV) has completed a detailed examination of how Melbourne's train system needs to evolve to meet the needs of the city and of train passengers in the short, medium and long-term.

PTV has examined how travel needs are likely to change as Melbourne grows and how the demand for train travel will evolve. We have examined alternative ways of expanding the network to meet these needs and identified the most cost-effective way forward.

This plan is intended to inform government in its process of policy formulation and PTV recognises that government will set its priorities accordingly.

We have been mindful of government policy priorities and cognisant of the fact that delivery of this plan is dependent on the ability of the Victorian and Australian governments to fund a program of rail projects. All projects in this plan will be subject to rigorous and detailed testing according to normal government requirements including an analysis of the costs and benefits of each project.

The plan is designed to:
- expand the capacity of the existing network to meet the growing needs of the city;
- re-design train services to maximise opportunities for seamless coordination with buses and trams; and
- extend the network to areas currently not served by metropolitan rail.

I believe that this plan represents the most comprehensive strategy for Melbourne's rail system in 40 years and is intended to maintain and enhance Melbourne's reputation as one of the world's most liveable cities. PTV will continually update the plan as market conditions change.

Ian Dobbs
Chief Executive Officer
Public Transport Victoria
18 December 2012

Table of contents

Index of figures

Index of tables

Executive Summary

Overview

Patronage on Melbourne's rail network has grown at unprecedented rates over the last decade and strong growth is anticipated in the years ahead. Major investments have already been made in response to these growth pressures and further projects are being delivered. However, significant challenges still lie ahead if the rail network is to meet the current and future travel needs of a rapidly growing city.

Most of Melbourne's population growth is projected to occur in the north, west and south-east of the city, with population in Melbourne's west expected to nearly double by 2030. At the same time, employment is expected to grow significantly in the central business district (CBD) and inner south-east areas, increasing the need for travel to and through inner Melbourne.

Population growth, road congestion, petrol price rises and greater environmental awareness have all contributed to more Melburnians using public transport. There has been an unprecedented 70 per cent growth in train patronage in the last decade, which has stretched the capacity of the current network.

Detailed transport modelling undertaken by Public Transport Victoria (PTV) shows that public transport boardings are expected to increase strongly over the next two decades, with weekday patronage more than doubling from 1.8 million to 3.8 million.

Average weekday boardings on metropolitan trains are expected to more than double to 1.7 million by 2031, while tram and bus boardings will both be near one million per day by 2031.

Annual patronage across all modes is forecast to grow from 517 million passengers in 2010-11 to more than one billion passengers in 2031.

Patronage growth is strongest along those corridors that serve Melbourne's key growth areas, which include the Werribee, Sunbury, Craigieburn, Upfield, South Morang and Dandenong lines. There is a pressing need to plan for significant improvements to capacity along these corridors, while strengthening the network as a whole to meet the overall growth in demand.

The Network Development Plan – Metropolitan Rail (the plan) is built upon the aforesaid transport modelling and is a bottom-up, suburb-by-suburb, line-by-line, demand-led strategy for planning Melbourne's rail system over the next two to three decades.

The plan aims to meet four objectives that will be critical to providing Melbourne with a responsive and efficient 21st century train service that will deliver benefits in travel time, reliability, convenience and comfort for passengers.

1. Overcome existing network constraints and provide a strong foundation for further expansion of capacity in the future	Addressing current constraints will give passengers more frequent, reliable and convenient services, as well as maximising the use of existing infrastructure and providing the basis for future growth.
2. Introduce a metro-style train system for Melbourne	Moving to a metro-style operation will provide more high capacity, high frequency services, allowing passengers to 'turn up and go'.
3. Extend the network into growth areas and existing areas without good access to rail services	New lines and the electrification of existing lines will support Melbourne's high growth areas and places currently not served by the rail network.
4. Prepare for further growth and protect future options	As the city continues to grow and travel needs change, future options for the metropolitan rail network will be investigated, planned and protected.

The delivery of the plan will provide a 50 per cent increase in peak hour capacity within 10 years and a 130 per cent increase within 20 years. This will allow more than 130,000 additional passengers to be carried into the city in the morning peak hour and make the reverse journey in the afternoon peak. This is equivalent to the capacity that would be provided by more than 100 freeway lanes.

Over the next 20 years, 200 kilometres of new track will be added to the existing 837 kilometres of metropolitan network. Nearly 130 kilometres of new track will be built to extend the network to bring service to some 300,000 people in areas like Doncaster and Rowville that do not currently have a rail service. Additionally, up to 300 kilometres of existing non-metropolitan track will be electrified to bring metropolitan services to growth areas at and beyond Melbourne's fringe such as Melton, Geelong and Wallan.

A central focus of the plan is to regularly overhaul and simplify timetables and train operations, getting every extra service possible out of the existing system at zero or low cost, before turning to more costly infrastructure solutions.

The rail network's 100-year-old signalling system will be gradually replaced with new high capacity signalling to allow more trains to run on the network and Melbourne will shift to new, high capacity trains that can carry up to 1100 passengers.

The plan also proposes a major program of track duplications and electrification projects, major rail extensions and important supporting works such as new stabling and maintenance facilities.

A new approach to modal coordination will improve the consistency and frequency of services with improved timing of services to meet the travel needs of passengers and make changing between travel modes easier and more convenient.

Just as importantly, the plan is built around a fundamental shift in timetabling and train operations as Melbourne moves to a modern metro-style network common in major cities around the world – essentially a 'turn up and go' service across the network every day of the week.

A metro-style system for Melbourne

The plan charts the way for transforming Melbourne's rail network into a metro-style system. This is the central solution to strengthening and securing Melbourne's rail network into the future. However, before this can be done, existing constraints and capacity requirements on the network need to be addressed. This will provide the foundations for a metro-style system to be implemented. Once metro-style operations begin to be introduced progressively across the network, attention can turn to building on the network's core capacity and providing further rail extensions.

Metro-style systems are passenger-focused and characterised by:
- Simple timetables with 'turn up and go' frequency and consistent stopping patterns
- Stand-alone, end-to-end lines that do not intersect or merge with other lines to prevent any service disruptions cascading across other lines
- Separate train fleets, maintenance and stabling facilities for each line
- Modern high capacity signalling technology to maximise the numbers of trains that can operate on each line
- Modern high capacity trains designed to minimise boarding and alighting times by use of wide doors and clear areas around doors
- Frequent services designed to facilitate connections between trains at junction stations and with connecting buses and trams
- Grade separations of level crossings.

Moving Melbourne to a metro-style rail system will require:
- The capacity to run more frequent peak and off-peak services
- Ongoing changes to timetables including simple, consistent stopping patterns and changes to how the existing City Loop is used
- Modifications to existing trains to increase their capacity and their ability to load and unload more efficiently
- The Melbourne Metro rail tunnel project – which will run through the heart of Melbourne to remove bottlenecks and provide critical capacity to the inner core of the rail network
- The purchase of new high capacity trains
- Moving to high capacity signalling, replacing aging signalling systems that limit the number of trains that can be run
- Low-cost infrastructure upgrades, including fixing single-line sections of track, eliminating at-grade junctions and providing new maintenance and stabling facilities.

A metro-style system for Melbourne's rail network will shift operations to independent end-to-end running lines capable of carrying significantly more passengers. It will also contribute to a better integrated public transport system across the city, making connections between trains, trams and buses easier and more convenient for passengers and supporting the changing travel patterns of Melburnians.

A staged approach

The Network Development Plan – Metropolitan Rail sets out a staged approach to strengthening and securing Melbourne's rail network.

Stage 1 – Overcoming constraints

The first stage of the plan, to be in place by 2016, focuses on overcoming immediate critical network constraints and providing the foundation for the future expansion of capacity. Stage 1 includes the following major changes:

Key projects
- Regional Rail Link (RRL), including Tarneit and Wyndham Vale stations, Southern Cross platforms 15/16
- Seven new trains and associated stabling and power upgrades
- Hurstbridge line upgrade and Eltham stabling
- An initial order for up to 33 new high capacity trains, each capable of initially carrying up to 1100 passengers and capable of being extended up to 220 metres in length
- 40 new V/Locity carriages
- Williams Landing Station
- Grovedale Station
- Southland Station
- High capacity signalling trial on the Sandringham line.

Supporting works and operational changes
- Further timetable changes to maximise use of existing infrastructure
- Calder Park stabling
- Geelong stabling upgrade
- Ballarat maintenance upgrade
- Network operational changes (loop access)
- Restrict train stabling moves at peak times
- Changes to crew changeover arrangements
- Train interior modifications.

At the completion of this stage, V/Line operations will have been largely separated from metropolitan train operations – a major step toward segregated operations. This will allow a substantial uplift in capacity and reliability across most of the suburban and regional rail networks to cater for train services running through Melbourne's west and north.

Stage 2 – Commencing the introduction of a metro-style system: within 10 years

The second stage of the plan will introduce a metro-style system to Melbourne's rail network. This stage will be implemented within 10 years and includes:

Key projects
- The Melbourne Metro rail tunnel project
- Duplication of the rail line to Melton
- Dandenong Rail Corridor Upgrade
- Deliver initial order of up to 33 high capacity trains, order and deliver a further 70 trains
- Installation of high capacity signalling on the Sandringham line, between Clifton Hill and the city and between Sunbury and South Yarra.

Supporting works and operational changes
- Carry out associated maintenance, stabling and power upgrades for high capacity trains, including at Pakenham East
- Major changes to timetables to adopt metro-style operations
- Werribee signalling upgrade
- Essendon turnback
- Brighton Beach turnback
- Upfield second platform
- Clifton Hill junction changes
- Heidelberg to Rosanna duplication
- North Melbourne stabling and Lilydale stabling
- Toolern Station
- Burnley junction changes
- Black Forest Road Station.

At this stage, the Melbourne Metro rail tunnel project will have allowed all rail corridors to be segregated from one another, except in locations where there is the need to move trains to and from maintenance facilities. There will be a further major uplift in capacity on all key growth area lines and improved reliability across the network.

Stage 3 – Extending the network: within 15 years

The third stage of the plan, to be implemented within 15 years, will focus on extending the metropolitan rail network to growth areas and existing areas not serviced by metropolitan rail, utilising the core capacity created in Stages 1 and 2. This stage includes:

Key projects
- A new line to Melbourne Airport
- A new line to Rowville
- South Morang services diverted into a new tunnel between Clifton Hill and Southern Cross, allowing construction of a new line to Doncaster
- Electrification to Melton
- Order and deliver extra high capacity trains
- High capacity signalling (Northern and Cross-City groups)
- Continuation of Dandenong Rail Corridor Upgrades.

Supporting works and operational changes
- Reinstatement of the Somerton to Upfield link
- Duplication from Dandenong to Cranbourne
- Baxter extension and maintenance facility
- Duplication from Greensborough to Eltham
- Truganina Station
- Sayers Road Station
- Davis Road Station
- Retirement of all remaining Comeng trains.

Stage 4 – Preparing for further growth: within 20 years

The fourth stage of the plan will capitalise on the benefits already delivered and prepare for more growth. To be implemented within 20 years, this stage includes:
- Order and deliver further high capacity trains
- Reconfiguration of the City Loop to provide seven separate, independently operated suburban lines through the Melbourne CBD
- Quadruplication of the line between Burnley and Camberwell
- Duplication from Altona Junction to Seaholme and grade separation of Altona Junction
- Electrification projects to Geelong and Wallan
- Extension to Mernda and new stabling facilities
- Duplication from Mooroolbark to Lilydale and new stabling
- Extension from Werribee to Wyndham Vale
- Extension of the South Morang – Southern Cross Line to Fishermans Bend.

Long-term

Beyond Stage 4, the plan will continue to complete the rollout of high capacity signalling across the metropolitan network. The plan also anticipates the need for capacity expansion in subsequent decades, based on the current best understanding of growth needs through to 2050. The focus of further planning is to protect potential options that could form part of the long-term vision for Melbourne's rail network.

Funding

Critical to the delivery of this plan is the availability of funding for the identified initiatives. The plan also contains a range of low-cost operational improvements that can generate capacity while business cases and other development works continue for major projects that require significant investment.

Major projects such as RRL and Melbourne Metro are either fully funded or have significant planning money allocated to them to enable construction.

Detailed planning work will continue to allow major rail projects such as Rowville, Doncaster and Melbourne Airport to begin as soon as necessary key infrastructure and supporting works are in place and as funding becomes available. While a rail link to Avalon Airport is not part of the metropolitan network at this time and not considered as part of this plan, the Victorian Government is committed to protecting a reservation and is currently undertaking planning and design for a rail link to be built within the next five years.

The ability to deliver these projects will depend on funding from Commonwealth and State governments, which may include new funding models currently being examined by Infrastructure Australia and the Council of Australian Governments (COAG).

PTV will continue to work with both State and Commonwealth governments to provide sound business cases for the implementation of these projects.

Guide to this document

This document sets out a comprehensive development plan for Melbourne's rail network. This plan is both a high-level strategy for the development of the rail network and a detailed list and staging of projects to support that strategy.

Chapter 2 provides context and background for the plan, including a description of the operation and performance of the current network and forecasts for future patronage growth.

Chapters 3 outlines the approach taken and the operational basis behind the initiatives and projects adopted for the plan.

Chapters 4 to 7 set out broader strategies and approaches, including the overall shift to a metro-style train system for Melbourne, better coordination and connections with other public transport modes, strategies to maximise the capability of existing and new infrastructure and necessary changes to the network's configuration.

Chapters 8 to 16 describe the actions to be taken under each of the plan's four stages. Chapter 17 explores some potential longer term options, and Chapter 18 looks at the rolling stock, stabling and maintenance requirements to support the plan.

Giving Melburnians the train services they want and need

For many Melburnians, the city's train network is an important part of their daily lives, using it to commute to and from work in the central city and beyond. An increasing number of Melburnians use the network on weekends, travelling to sporting and other events and visiting family and friends.

The changes and projects being delivered through this plan are strongly passenger-focused and aim to deliver positive and lasting benefits to Melburnians as they move around the city for education, work, business and leisure. Over the course of the plan, passengers will see significant improvements in the rail network, including:

- A high quality rail network across the city that provides more frequent, more comfortable and highly punctual and reliable services

- More peak hour services on high demand lines

- Easier and more convenient changing between trains and other modes of transport

- More travel choices that meet people's transport requirements

- Better access to jobs, education, services and other activities for residents in the city's fastest growing areas

More broadly, the implementation of the plan will help to relieve congestion on Melbourne's roads by encouraging more people to use public transport.

More efficient train services will contribute to improve business productivity and help to boost Melbourne's reputation as a growing centre for knowledge-based businesses and as an attractive city in which to live and invest.

The plan will also benefit Victorians travelling to Melbourne from regional areas by train, improving service reliability and travel times from regional centres such as Geelong, Ballarat and Bendigo.

1 Introduction

1.1 Overview

PTV was established in April 2012 with the aim of improving public transport and with a particular focus on expanding the network and ensuring better coordination between transport modes. The release of the Network Development Plan – Metropolitan Rail (the plan) is a first step in defining the future needs for public transport across Victoria and will be expanded progressively as planning for the rest of the network advances.

The purpose of the plan is to establish a basis for PTV's planning for the development of the metropolitan railway to meet needs over the next 20 years and beyond. As these needs will continue to evolve, this plan will be refreshed annually.

While focused on rail's role in moving people around Melbourne, the plan is also informed by and responsive to rail's role in freight movement to, from and within Melbourne. It also recognises the increasing impact of trains at level crossings on the performance of the road network.

This plan takes into account Melbourne's expected growth over the coming decades. As set out in *Victoria in Future*, Melbourne will grow from a population of four million people to 6.5 million over the next 40 years. The plan is also informed by the emerging discussion about the Victorian Government's new *Metropolitan Planning Strategy,* to be completed in 2013. The anticipated growth in demand for metropolitan passenger train services is described in a separate report, also to be refreshed annually.

By establishing investment priorities for the metropolitan rail network, the plan will underpin the sequencing of system enhancements and the consideration of individual projects within the plan. It will also guide the train operator (Metro Trains Melbourne) in preparing its Strategic Operations Plan for short-term management of the metropolitan rail network.

1.2 The role of urban rail

As a transport mode, urban rail is designed to do the 'heavy lifting'. With trains able to carry more than 1000 passengers, modern signalling to maximise the number of trains that can use a section of track and an exclusive right-of-way, urban rail can carry more than 40,000 passengers per hour on a single line. The same right-of-way used as a light railway or busway could carry 10,000 passengers per hour or 2,000 passengers per hour in a traffic lane.

Therefore, the role of urban rail in Melbourne is to move high volumes of people into and out of the central city and between major suburban centres along rail lines, with a complementary role of moving crowds to and from special events. Without rail providing this function, road congestion would be unmanageable.

The role of urban rail in Melbourne is also characterised by the geographic size of the city, with commutes of more than 50 kilometres and by the existence of one of the world's largest tram networks.

Melbourne's railway underpins the city's economic development. Employment in the City of Melbourne has grown from an estimated 210,000 in the early 1990s to a current 475,000, providing the base for the rapidly growing knowledge-based industries that have underpinned Victoria's economic growth in recent years. This growth has been accommodated with little or no growth in traffic on inner-city roads over the past decade, as train patronage has grown at unprecedented rates. Employment in the City of Melbourne is projected to reach between 800,000 and 1.2 million over the next 40 years.

Melbourne's metropolitan rail network is large by world standards with 837 kilometres of track and 217 stations. This size provides a solid base for meeting needs in future decades, but the network needs to be expanded to meet growing demands.

1.3   Strategic objectives

With Melbourne's population expected to continue to grow strongly, and public transport patronage also forecast to increase substantially, the city's rail network will need to keep pace with this growth. This document establishes a clear plan for the development of Melbourne's metropolitan rail network over the next 20 years and beyond.

The key strategic objectives of the plan are:
- To expand the capacity of the existing network to meet the growing needs of the city
- To redesign train services to maximise opportunities for seamless coordination with buses and trams
- To extend the network to areas not currently serviced by metropolitan rail.

2 Context

2.1   Our growing city

Patronage on Melbourne's trains has grown at unprecedented rates over the last decade and strong growth is anticipated in the years ahead. Population growth, road congestion, petrol price rises and greater environmental awareness are all factors that have contributed to more Melburnians making the shift to public transport.

Major investments have already been made in response to these growth pressures and further projects are being delivered. However, significant challenges still lie ahead if Melbourne's rail network is to meet the future travel needs of a rapidly growing city.

Most of Melbourne's population growth is projected to occur in the north, west and south-east of the city, with population in Melbourne's west expected to nearly double by 2030. At the same time, employment is expected to grow significantly in the CBD and inner south-east areas, increasing the need for travel to and through inner Melbourne.

The level and rate of growth in patronage on the rail network has been unprecedented in Melbourne and among the highest in the world. The network now carries more than 220 million passengers each year ⏃ around 680,000 each weekday. Growth of 70 per cent in train patronage in the last decade has resulted in rail demand approaching the capacity of the current network.

2.2   Investment in Melbourne's rail network over the past 30 years

The first line in Melbourne's rail network was built in 1854 and much of the existing network was developed over the following 80 years. The last piece of major rail infrastructure constructed was the City Loop, which was opened in the early 1980s and was built to relieve excessive crowding at Flinders Street by providing additional access points to the Central Business District (CBD). The City Loop comprises of four tunnels known as the Caulfield, Burnley, Northern and Clifton Hill Underground Loops.

Other projects in the last decade have extended the metropolitan rail network from St Albans to Sydenham, Broadmeadows to Craigieburn and Epping to South Morang. The extension of the electrified network to Sunbury was completed in November 2012.

Regional Rail Link (RRL) is under construction and expected to be operational in 2016. RRL will provide double tracks and supporting infrastructure between West Werribee and Southern Cross. This will allow for the full separation of Geelong, Ballarat and Bendigo (except Sunshine to Sunbury) regional services from metropolitan services on the Werribee, Williamstown, Sunbury, Craigieburn and Upfield lines.

New stations at Lynbrook and Cardinia Road in Melbourne's growth areas opened in April 2012 and the new Williams Landing station will be opened in April 2013.

New track and associated infrastructure has been progressively introduced to untangle bottlenecks at Clifton Hill Junction, Westall and Laverton.

Additional stabling has been added to the network at Newport, Upfield and Craigieburn to support the delivery of Melbourne's 45 new trains, which started coming into service in 2010. Further stabling at Calder Park is planned for construction in 2013.

May 2011 marked the first major overhaul of timetables in Melbourne for more than 20 years, improving capacity and reliability on a number of lines. This is the first stage in a planned roll-out of 'back to basics' timetable upgrades to 2015 that will simplify the operations of the network and ensure as many services as possible can be added ahead of the completion of major construction projects.

2.3   The current network

Melbourne's metropolitan rail network is large by world standards with 837 route kilometres of track and 217 stations. It is a relatively complex network that caters for many different service types.

Metropolitan rail lines

Metropolitan trains run on 16 lines via the City Loop or direct to Flinders Street – some express, some semi-express and some stopping all stations. Regional trains terminate at Southern Cross and run largely express through the metropolitan area. In addition, broad gauge freight trains share tracks with passenger trains on some occasions and standard gauge freight and passenger trains share rail reserves at times.

Most lines comprise double track for the majority of their length, enabling typical two-way operations. Two lines, the Frankston and Lilydale / Belgrave lines have sections of triple track, which provide two tracks in the peak direction (one stopping and one express track) and one for counter-peak trains. Sections of single track also exist on the system, located on the Werribee (via Altona), Williamstown, Upfield, Hurstbridge, Lilydale, Belgrave, Alamein, Cranbourne and Sandringham lines, limiting the two-way capacity of these lines.

Melbourne's rail network was designed as a 'hub and spoke' commuter style network, carrying people to and from the central city with connecting branches and junctions.

The 16 lines converge on the Melbourne CBD, which is served by five stations located on the Melbourne Underground Rail Loop (MURL) – also known as the City Loop – at Flinders Street, Southern Cross, Flagstaff, Melbourne Central and Parliament.

The area commonly referred to as the City Loop and Inner Core (CLIC) covers all track work within the boundary of the gateway or cordon stations of North Melbourne, Richmond and Jolimont. This area comprises 12 operational platforms at Flinders Street, 15 at Southern Cross (soon to be 17) and four at each of the remaining City Loop stations.

The 16 lines are managed in 'groups', which comprise two to four lines that merge at particular junctions and share sections of track and platforms at inner-city stations. The lines are grouped as follows:

- Clifton Hill Group – South Morang and Hurstbridge lines
- Dandenong Group – Pakenham and Cranbourne lines
- Northern Group – Craigieburn, Sunbury, Upfield and Flemington lines
- Cross-City Group – Werribee, Williamstown, Frankston and Sandringham lines
- Burnley Group – Alamein, Belgrave, Lilydale and Glen Waverley lines.

Metropolitan train fleet

The train fleet comprises a variety of rolling stock types:
- Hitachi, c.1970s, 536 seats, 7 x six-car sets in service
- Comeng, c.1980s, 536-556 seats, 93.5 x six-car sets in service
- X'Trapolis, 2002/Present, 528 seats, 74 x six-car sets in service
- Siemens, 2002, 528 seats, 36 x six-car sets in service.

Network operations

The system operates between 5am and midnight Monday to Thursday, extending to 1am on Friday and Saturday nights. Sunday hours are 8am to midnight. Current service frequencies vary widely between lines with average peak frequencies ranging from 3 to 20 minutes, although some lower frequencies are provided for some outer stations.

Off-peak frequencies are 10 to 15 minutes on the Burnley, Caulfield and Cross City Groups and 20 minutes for the Clifton Hill and Northern Groups. Evening frequencies are generally 20 or 30 minutes. Weekend frequencies are 10 minutes on the Dandenong, Frankston and Ringwood lines and 20 minutes on remaining lines for most of the day.

Management of the different rail lines in their respective groups is complex, especially during peak periods. Trains for each line depart from a variety of platforms at Flinders Street, Southern Cross, Richmond and North Melbourne. On some lines, service frequencies continue to be irregular and services follow a number of different stopping patterns (running express through some stations). The mixture of service patterns is currently being rationalised across the network.

The different stopping patterns reduce the network's capacity to run more trains as longer gaps need to be provided between stopping and express services. This is a particular challenge for tracks shared by metropolitan and regional services, as the latter generally run express through most suburban stations and can be held up by late-running metropolitan stopping trains.

Conversely, providing an express train path for regional services can result in timetable gaps for metropolitan services, leading to greater overcrowding and more unreliable journey times on the first train following a regional service.

Until 2011, train timetables had not been redesigned holistically since the City Loop was opened in the 1980s. Rather, additional services were generally added into the timetable incrementally, often by only changing the times of adjacent trains to accommodate new services. This has resulted in the complex, irregular and inefficient stopping patterns and service headways currently still in use on some lines.

Although the signalling and track work in many areas provides for a theoretically high frequency, the need to operate these different service types and merge them in the central area constrains the practical capacity of the network and heightens the risk of unreliability.

Signalling system

Most of Melbourne's signalling system, known as an Automatic Block system, currently uses coloured lights next to train tracks to advise the driver of what speed it is safe to travel – essentially the same technology introduced a century ago. The signalling capability in the city and inner suburbs, where two or more lines share tracks, typically allows for average two to three minute headways (the time between trains), extending to three to five minutes on each suburban line.

Safe distance between trains is ensured by providing a signal sighting / driver reaction time, a minimum breaking distance and a safety margin.

The existing system typically operates at around 15 trains per hour and could operate at up to 24 trains per hour in an ideal operating environment. In reality, a frequency of 22 trains per hour is seen as the practical achievable capacity to ensure an acceptable level of reliability can be attained. The primary reason that a higher practical capacity is currently not considered possible is because of the long dwell times at the City Loop stations, along with the irregular arrival of trains from different lines at the loop portals due to outer suburban network constraints.

2.4   System performance

The unprecedented level of rail patronage and its rate of growth are testing the capacity of the current system in several areas of the network. There are emerging issues with the ability of the predominantly surface rail system to operate at higher service frequencies without unduly constraining the surface road system. The lines under greatest pressure service rapidly growing areas of Melbourne and coincidentally, these lines also have to cope with a mix of metropolitan and regional train services. A number of operational and infrastructure constraints also affect the system's performance.

Passenger growth

Rapid patronage growth has major consequences for the performance of the rail system, as shown in Figure 2.1. Patronage growth affects crowding, which if not addressed – reduces service reliability. In turn, this reduces network capacity and limits opportunities to add network extensions.

Figure 2-1: Passenger growth and impact on system performance
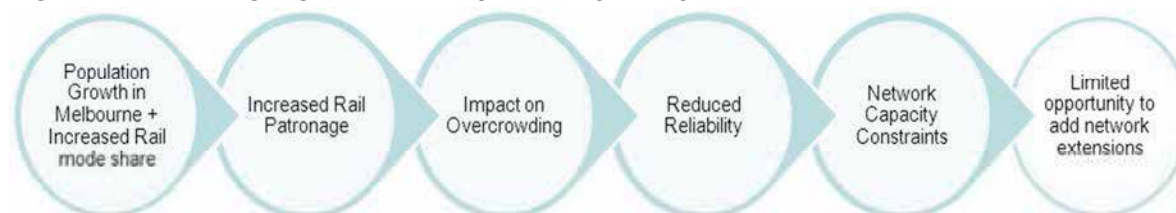
Figure 2-2 and Figure 2-3 chart performance over the past decade in terms of patronage, train-kilometres of services operated, overcrowding (load breaches) and service punctuality. These figures show that:

- Despite a 70 per cent growth in patronage over the last decade, major service disruptions led to an immediate loss of discretionary off-peak travel and a decline in total patronage in 2011-12
- However, peak patronage continued to grow by four per cent and by the last quarter of 2011-12, total patronage was growing again by 4.3 per cent per annum consistent with long run growth forecasts.
- Train kilometres have increased by 30 per cent
- The number of load breaches (the average load per train exceeding 798 in any hour) grew to a peak of 38 in 2008 but reduced to eight in May 2012 as a result of extra services being introduced and a range of operational changes
- Service punctuality declined steadily through most of the decade as the system operated closer and closer to its capacity, manifesting in longer loading and unloading times and a reduced ability to recover from service disruptions once they had occurred. New timetables, introduced in 2011 and 2012, have led to better performance over the past 12 months. Train operator Metro's recent punctuality is the best in many years.

Figure 2-2: Metropolitan train patronage and train-kilometres
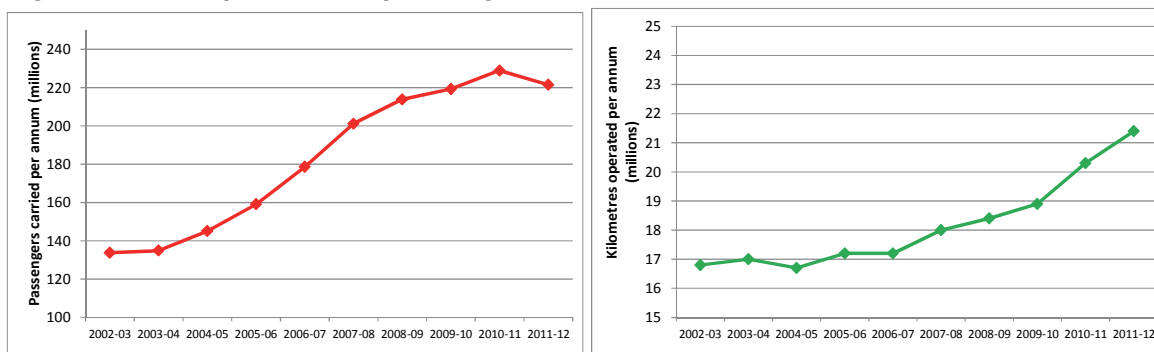
Figure 2-3: Performance of metropolitan services (trains on time to 4:59 and load breaches)
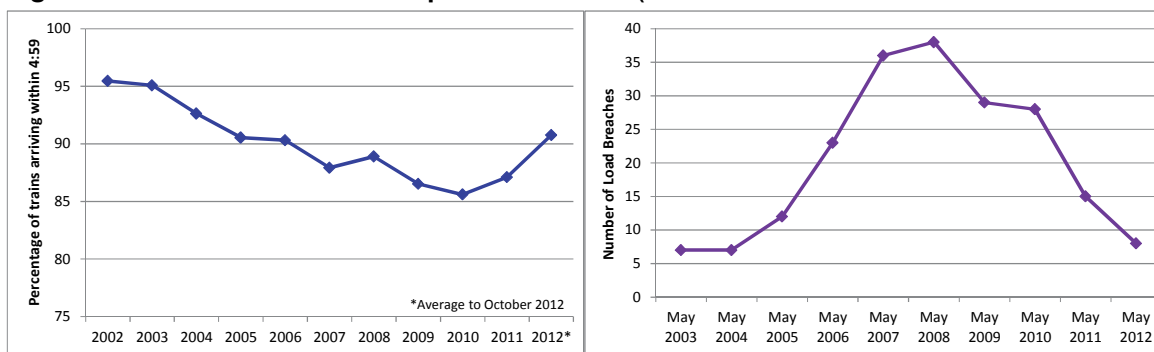
Constraints

The capacity of Melbourne's metropolitan rail network is currently limited by a number of operational and infrastructure constraints. Figure 2-4 highlights sections of the network where extra capacity cannot be added due to:

- Signalling constraints
- At-grade junction constraints where two or more lines merge or intersect with each other
- Interaction between regional and metropolitan trains on shared tracks

- Sections of single track
- Capacity constraints at end-of-line termini
- Other operational / timetable constraints.

This diagram shows that creating more capacity requires a whole-of-network approach, with constraints needing to be addressed before new timetables and ways of operating, new technology or a new generation of high capacity trains can be introduced.

Figure 2-4: Key network constraints
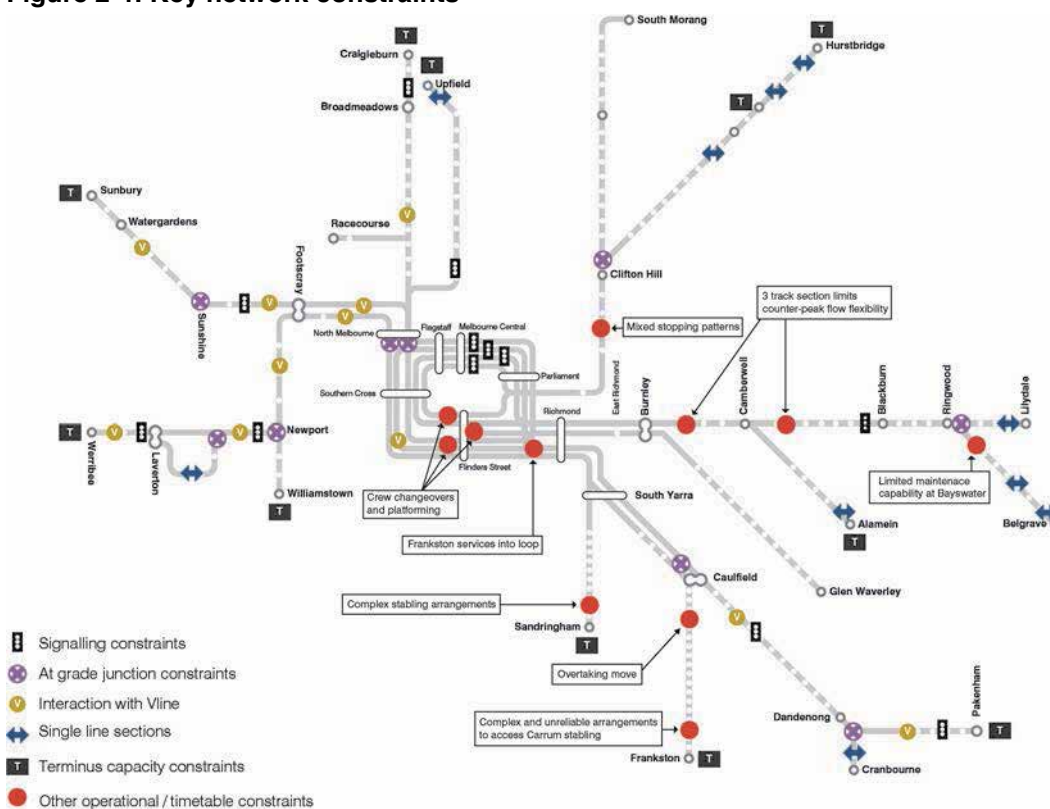
2.5 Future growth in rail patronage

Forecasts for growth in demand for public transport services across Melbourne have recently been updated and are reported separately in the *Metropolitan Public Transport Demand Forecast Report 2012*.

Detailed modelling undertaken by PTV shows that overall public transport boardings are expected to increase strongly over the next two decades. This modelling demonstrated that:
- Weekday patronage across modes will more than double from 1.8 million to 3.8 million
- Annual patronage across modes is forecast to grow from 517 million passengers in 2010-11 to more than one billion passengers in 2031.

The current and forecast patronage levels for each mode of transport are set out in Table 1.

Table 1: Average weekday boardings by mode 2011 to 2031
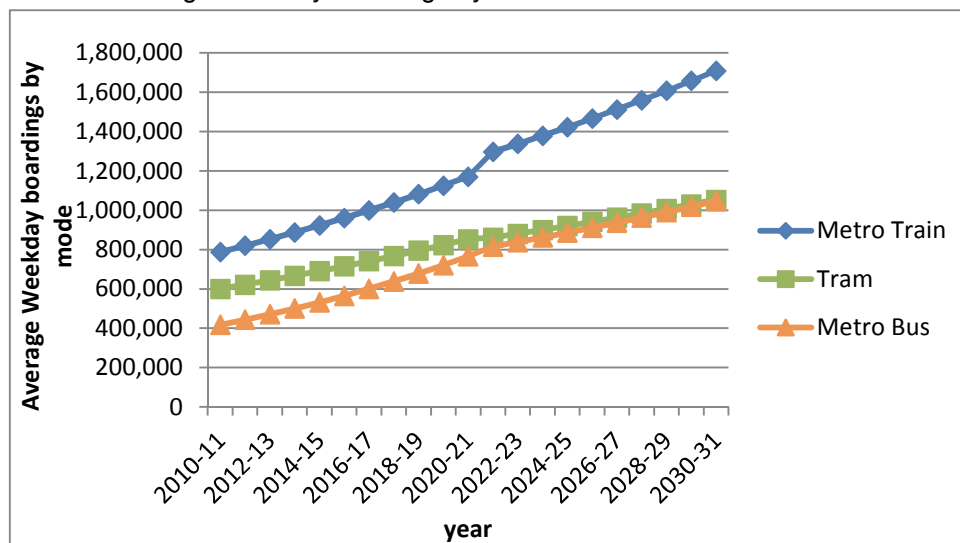
The main drivers of demand for metropolitan train travel include:

- Economic conditions
- The public transport service offering
- Train service delivery
- Employment growth in central Melbourne
- Population growth in rail corridors
- Petrol prices
- Road congestion and parking costs
- Consumer preferences for sustainable and active travel choices.

PTV's modelling showed that:

- On metropolitan rail, average weekday boardings are expected to more than double to 1.7 million by 2031
- The annual average growth rate in weekday rail boardings is forecast to be four per cent per annum from 2011 to 2021 and 3.9 per cent per annum for the following decade to 2031 – an increase of more than 850,000 boardings per day between 2011 and 2031
- Patronage growth is strongest along those corridors that serve Melbourne's key growth areas, which include the Sunbury, Craigieburn, Upfield, Werribee and Dandenong lines.

There is a pressing need to plan for significant improvements to capacity in these high growth corridors, while strengthening the network as a whole to meet the overall forecast growth in patronage.

3 A strategic and considered approach

In developing this plan, PTV has adopted a strategic and considered approach – supported by sound evidence and analysis – identifying, investigating and implementing network and operational changes and advancing new rail projects.

3.1 Principles

The plan and each of its initiatives must satisfy four principles:
- Consistency with the objectives of the Victorian *Transport Integration Act (2010)*
- Meet demonstrable market needs
- Represent value for money in the use of taxpayer funds
- Addressing existing constraints.

As noted in Chapter 2 – and illustrated in Figure 2-4 – a number of key constraints limit the capacity of the metropolitan rail network. These constraints are resolved over the course of this plan. The proposed solutions to these constraints, and their timing, are dependent on when each constraint becomes a critical bottleneck in terms of meeting capacity requirements.

Where the ability to extend the network is constrained in some cases by the lack of a planning reservation, the proposed solution or project must be able to justify the cost and disruption caused by construction.

3.2 A comprehensive development process

This plan is both a high level strategy for the development of the Melbourne rail network and a detailed description and staging of projects that will most likely be needed to support that strategy.

The plan has been developed on a line-by-line basis; constraints and bottlenecks have been identified at a local level; and long-term solutions are proposed for the network as a whole.

This plan develops staged service plans to meet patronage growth on each corridor and the central city area. Where existing operational and/or infrastructure constraints are currently limiting the ability to deliver the required services, new operational solutions have been considered first.

Where no suitable operational solution could be identified to deliver the required capacity, infrastructure solutions have been proposed. All infrastructure solutions proposed have been continually re-assessed as the plan was developed, with shorter term projects reconsidered against longer term requirements.

The capacity constraints identified have included consideration of the interaction of metropolitan services with regional services and freight operations in the metropolitan area. As a result, some analysis has been undertaken on the required upgrades for regional corridors, as well as consideration of the availability of freight train paths over the metropolitan network (although they are not the core focus of this plan).

3.2.1 Project sequencing

The sequencing of projects is based on current demand forecasts and resulting sectional capacity requirements. During the development of the plan, demand forecasts were used to highlight when and where existing corridors will be unable to sustain future operations.

Where there is more than one way to address a particular problem, project alternatives have been identified together with the identification of a preferred option. In these cases, a brief examination of the strengths and weaknesses of the project options is provided, but options will need to be tested in future plans.

3.3   Identification of realistic strategic responses

Any strategic project option proposed for the rail network must be comprehensively tested and evaluated before it is adopted. The benefits of any rail capacity project can only be achieved if a workable timetable can be implemented that fully utilises the new infrastructure and thereby enhances capacity.

As such, detailed timetable analysis has been undertaken with each of the key capacity enhancement schemes proposed in this plan to test the outcomes. It is only when timetable level analysis is completed that the most critical constraints can be identified.

As a result, the scoping of most capacity projects includes a number of smaller, less obvious infrastructure works to enable full utilisation. For example, the construction of the Melbourne Metro rail tunnel on its own will provide significant benefits. However, when combined with new turn-backs, platforms and signalling enhancements the project will enable generational changes to many lines on the network.

4 A metro-style system for Melbourne

The purpose of the plan is to establish a firm basis for planning for the development of Melbourne's metropolitan rail network over the next 20 years and beyond.

Patronage growth in recent years means that many key sections of the city's rail network are now operating at or near capacity. Pricing initiatives such as the Early Bird ticket and a series of timetable changes have stretched the network's capacity to accommodate peak demands, but further capacity can only be delivered through some fundamental operational changes and cost-effective new investments.

The plan aims to expand the capacity of the existing network to meet growing demands, providing the basis for much needed extensions to areas of Melbourne not serviced by metropolitan rail, as well as improving coordination with buses and trains.

Ultimately, the plan charts the way for transforming Melbourne's rail network into a metro-style system. This is the central solution to strengthening and securing Melbourne's rail network into the future.

However, before this can be done, existing constraints on the network need to be addressed and modal coordination needs to be improved. This will provide the foundations for a metro-style system to be implemented. Once metro-style operations begin to be introduced progressively across the network, attention can turn to building on the network's core capacity and providing further rail extensions.

4.1 Expanding capacity of the existing network

To date, Melbourne's rail network has largely operated as a commuter railway rather than as a metro-style system. Increasingly, it will be necessary to adopt metro-style operations in Melbourne to significantly lift capacity without jeopardising service reliability. Metro systems are characterised by:

- Simple timetables with 'turn up and go' frequency and consistent stopping patterns
- Stand-alone, end-to-end lines that do not intersect or merge with other lines to prevent any service disruptions or delays cascading across other lines
- Separate train fleets, maintenance and stabling facilities for each line to support trains and systems being tailored to each line's requirements
- Modern high capacity signalling technology to maximise the numbers of trains that can operate on each line
- Modern high capacity trains designed to minimise boarding and alighting times by use of wide doors and clear areas around doors
- Frequent services designed to match with connecting buses and trams
- Grade separations of level crossings where increasing train numbers are causing unacceptable traffic delays.

The plan outlines how these concepts can be progressively introduced to provide the necessary uplifts in capacity where and when they are needed.

4.2 Improving modal coordination

Convenient and frequent intermodal connections are a key feature of a metro-style system. A significant number of Melbourne's public transport trips involve such transfers – 50 per cent of all bus trips, 40 per cent of tram trips and 35 per cent of train trips. Moreover, good multi-modal connections are important for the following groups:

- While 85 per cent of Melburnians are within walking distance from some form of public transport, only 30 per cent have local access to the train network. The remainder rely on two modes to complete journeys by public transport
- 40 per cent of Melbourne's rail passengers currently access the network by car. Improved coordination will make access by other public transport modes more attractive
- Many public transport users have difficulty making multi-modal trips at off-peak times due to a complex network structure and a variety of inconsistent and non-harmonised off-peak and weekend service levels, including a combination of 15, 20, 30 and 40 minute frequencies
- Many passengers choose not to make multi-modal trips because the service frequencies of feeder routes are too low. In 80 per cent of existing bus-tram transfer pairings, transfers over 100 per day occurred only when one of the transfer routes had a headway of or better than 10 minutes.

With existing parking at stations continuing to come under pressure, there is a growing need to encourage – and make more accessible – modal transfer between bus and train services. Coordinating trains with buses and trams is made complex by the large numbers of connections to be maintained, with most of Melbourne's 300 bus routes connecting with the rail network at one or more points. A framework for managing co-ordination is provided in Chapter 5

4.3 Extending the network

While Melbourne already has an extensive rail network by most standards, some suburbs have no direct access to heavy rail and the continuing outward growth of Melbourne's suburbs will require electrification of some existing lines or the construction of new lines. This plan identifies needs for:

- A new line to Melbourne Airport
- A new line to Rowville
- A new line to Doncaster
- Electrification to Melton
- Electrification of the Upfield line to Wallan
- An extension of the South Morang line to Mernda
- An extension of the Cranbourne line to Clyde
- Electrification of the Frankston line to Baxter
- Electrification of RRL through to Wyndham Vale and ultimately Geelong
- An extension to Fishermans Bend.

These extensions will extend the reach of the network to Melbourne's growth areas and existing areas that are currently not serviced by metropolitan rail. However, this plan has to be delivered sequentially and network extensions in stages 3 and 4 are only possible once stages 1 and 2 are delivered, as additional capacity has to be created through the CBD before new lines can be opened.

More information about the scope and timing of these extensions is provided where they appear in the various stages of the plan (Chapters 8 to 17).

5 Public transport modal coordination

5.1   Overview

In developing the plan, there has been careful consideration given to protecting and enhancing multi-modal service options and recognising the interrelationships between all public transport modes.

PTV has developed a Multi-Modal Coordination policy that supports the consistent and integrated development of service planning across all modes. This policy covers all Victorian public transport modes, with the initial phases of the policy targeted towards improving bus-train and tram-train connections in metropolitan Melbourne.

The objectives of the Multi-Modal Coordination Policy are to:
- Establish a multi-modal service coordination framework to guide service design elements such as scheduling and network planning
- Establish reliable connections with trains as a core service proposition for metropolitan bus users in Melbourne's middle and outer suburbs
- Reduce passenger wait times for transfer connections across the network
- Establish a framework to guide investment priorities for interchange infrastructure
- Improve the availability and quality of information to assist passengers in making transfers across the network
- Establish priorities for the policy's staged implementation across the network.

5.2   Context

As noted in Chapter 4, a significant number of Melbourne's public transport trips involve multi-modal transfers. Improving multi-modal service options and making it easier and more convenient to transfer from the rail network to bus and tram services encourages passengers to use buses instead of private cars to access the rail network. This will also have the effect of making public transport attractive to new passengers whose origin or destination of travel is beyond walking distance from the rail network.

Figure 5-1 shows the relationships between public transport trips and intermodal transfers in Melbourne. The coloured boxes represent the number of weekday passenger journeys involving each of the three public transport modes – rail (681,000), tram (516,000) and bus (346,000). For each mode, the areas within each box represent the combined access and egress mode.

The white hatched areas within each box show the number of trips that are accessed and egressed exclusively by walking – a total of 36 per cent of train journeys.

The grey hatched area shows that 40 per cent of train trips are accessed using car, including park and ride, station drop-off and car passengers. The intermodal boxes show the relationships between modes. Approximately 94,000 tram-train journeys are made, equivalent to 14 per cent of

train journeys and 18 per cent of tram journeys. A further 99,000 bus-train journeys are made, which is equivalent to about 15 per cent of train journeys and 29 per cent of bus journeys.

Figure 5-1: Weekday public transport passenger journeys and inter-modal transfers ('000s)
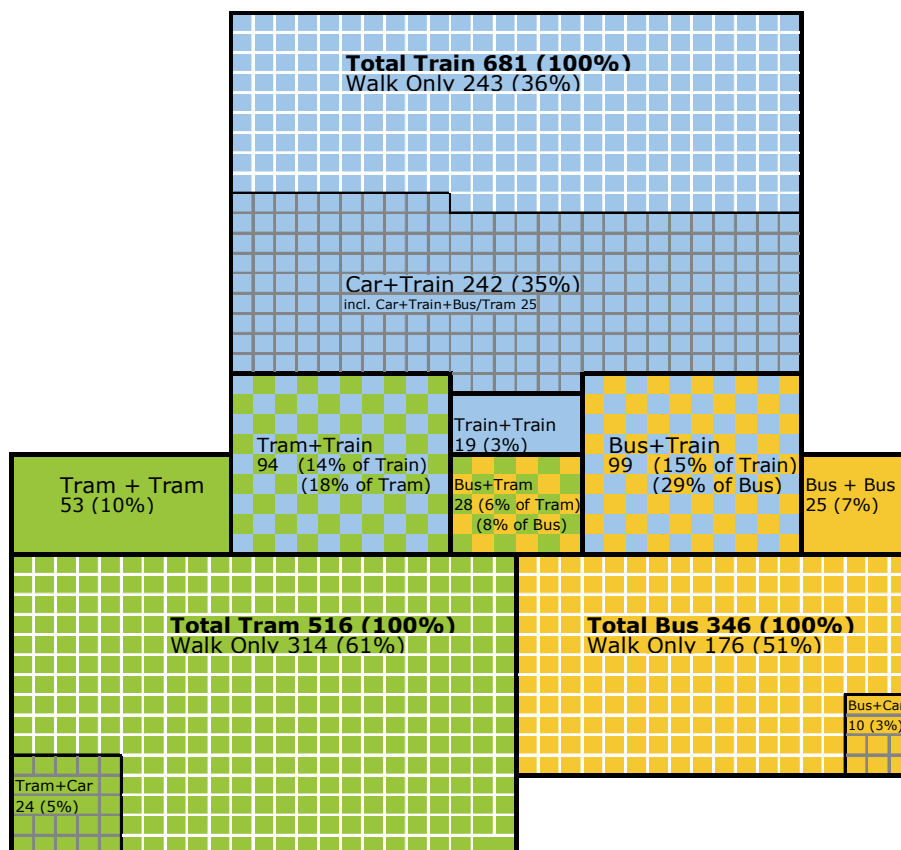
The diagram illustrates that:

- Train is heavily reliant on access by private car
- Bus plays a substantial feeder role, especially for train
- Tram predominantly serves end-to-end trips (with no transfers)
- Tram offers 'last mile' connections from train
- There is significant take up of tram-tram transfers
- The overall volume of bus trips is small compared to the other modes and the geographic significance of the bus network.

5.3   Extending access to the rail network

The trunk train network provides high capacity long-haul access to central Melbourne. However, the walk-up catchment of the train network is limited. Conversely, the bus network provides coverage across the majority of the urban area. While nearly 90 per cent of Melbourne households are within reasonable walking distance of public transport, local access to the train network is limited to only 30 per cent of households (see Figure 5-2).

This is demonstrated spatially in Figure 5-3 and Figure 5-4 using Public Transport Access Levels (PTAL). PTAL's are a way of measuring ease of access to public transport by combining distance to a public transport route with the frequency of services on the route. As these figures show, multi-modal journeys using bus and train offer a vastly more extensive network of travel options than those available using the train network alone.

Figure 5-2: Network coverage by mode

Significance of Multi-Modal Networks
Melbourne Dwellings with Walking Access to Public Transport

Source: PTAL 2010, SGS Economics
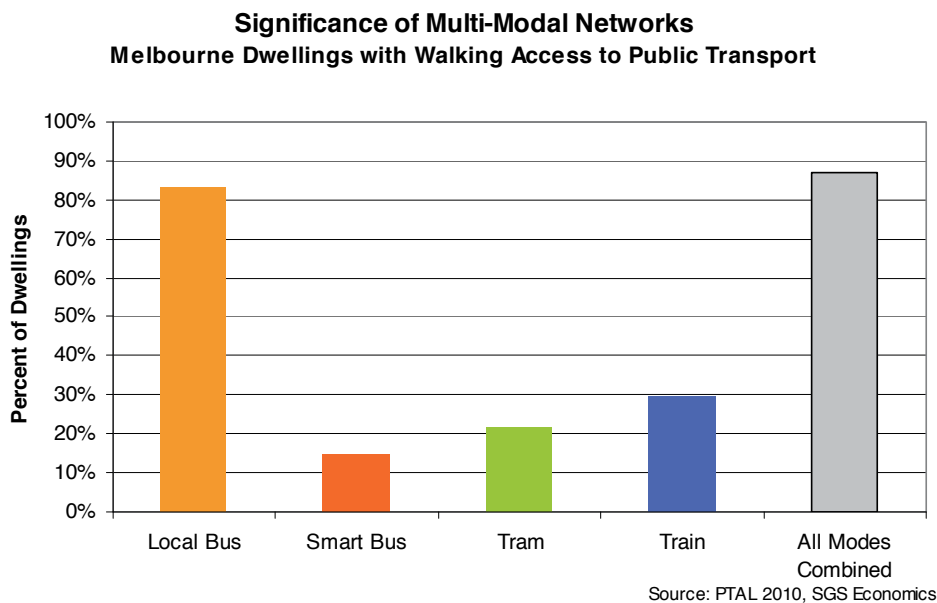
Figure 5-3: Train network coverage (PTAL)
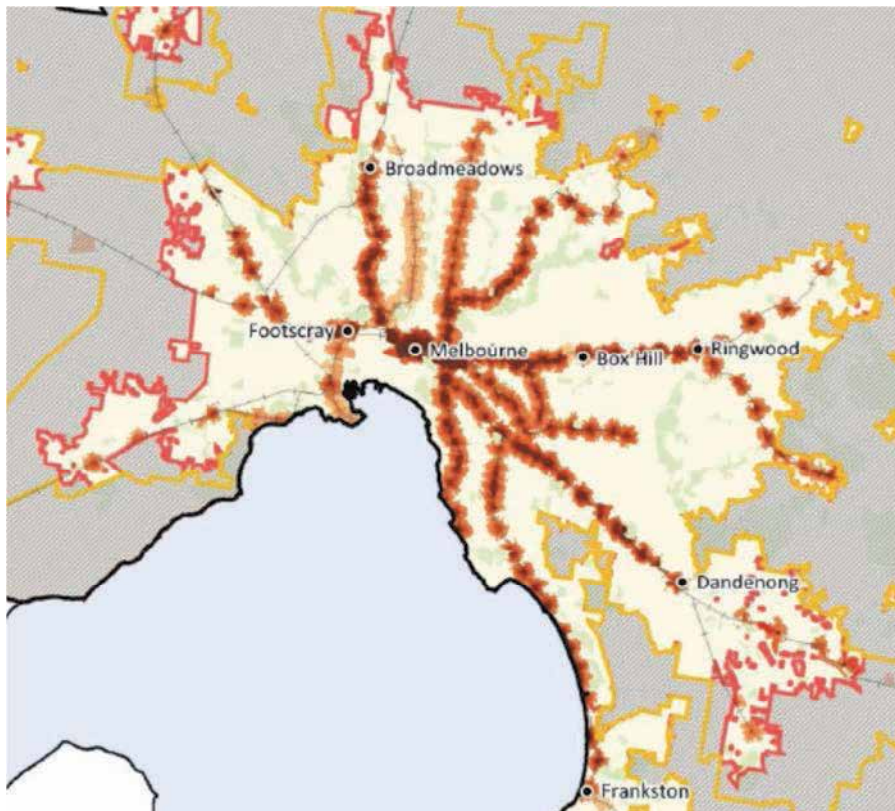
Figure 5-4: Bus network coverage (PTAL)
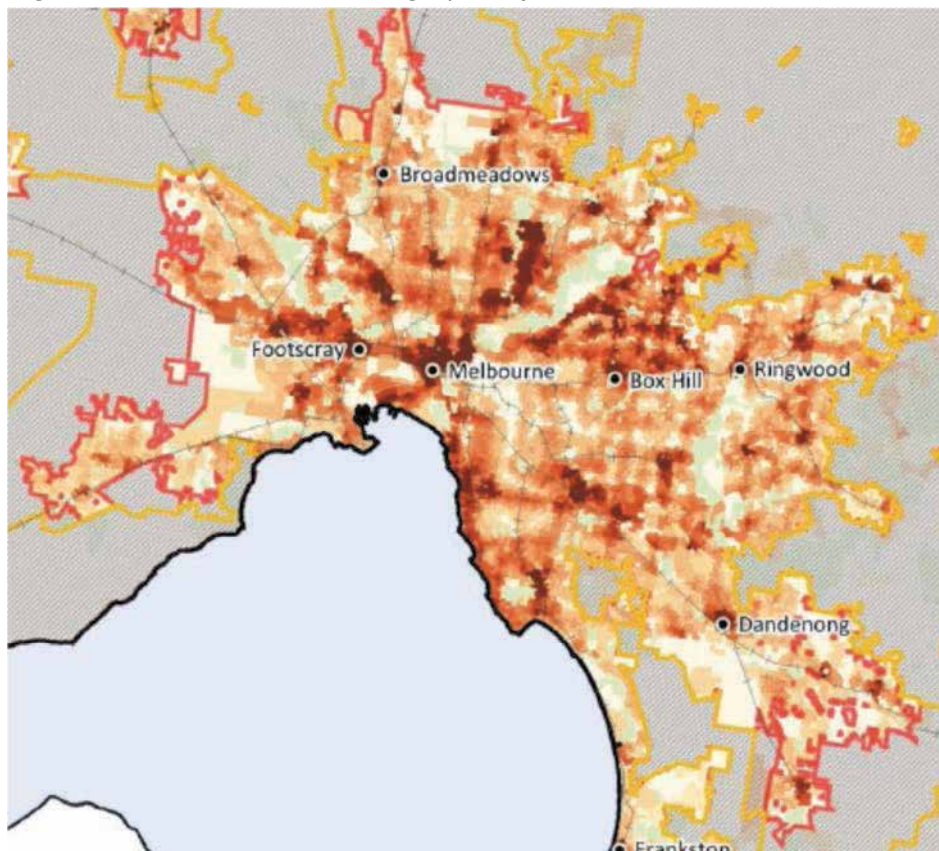
5.4 Integrated service planning and coordination framework

The most efficient way to deliver a high level of service to dispersed travel markets such as Melbourne is via a network of services that offer travel options to a wide range of destinations throughout the metropolitan area.

To be successful, this requires coordination of individual services. Alone, each rail line offers limited travel opportunity between two destinations, whereas the 'network effect' occurs when the sum of the individual routes forms a whole that is greater than single routes.

Increasing service frequency on a single line provides benefits for only a limited catchment – regardless of frequency, the line only serves a small segment of overall travel demand. Conversely, linked lines offer network-wide travel opportunities. Above the network effect threshold (10 minutes), patronage is induced on other linked lines due to the reduced time period involved in making a transfer and travel opportunities within the network increase exponentially.

Central to the success of such an approach is defining the types of services required in certain areas and along key rail corridors to support travel needs, as well as standardising the connection types and frequencies provided where routes intersect. These measures give certainty to passengers about what to expect when they need to transfer between modes.

Coordination framework

A service coordination framework has been developed to deliver a well-coordinated network in Melbourne. This framework sets the objectives for service design, scheduling and operations across all modes. Key features include:

- An emphasis on service standardisation throughout the network, based on four service areas: Inner, Tier 1, Tier 2 and Tier 3
- Establishment of a service coordination hierarchy consisting of feeder services that are scheduled to meet trunk services, which applies to all lines or routes on the network
- Defined connection types for all intersecting services, for example 'turn up and go', 'timed' and 'harmonised'
- Use of standard frequencies across the network: for example, set to multiples of 10 or 20 minutes
- Definition of consistent service periods (for example, 'day', 'peak' and 'night') applied throughout the week and weekends and across all modes.

The framework specifies an approach to achieving coordination of services based on the system operating conditions on different parts of the network, as shown in Figure 5-5 and described in more detail in Table 5-1.

Figure 5-5: Service areas and tiers of coordination
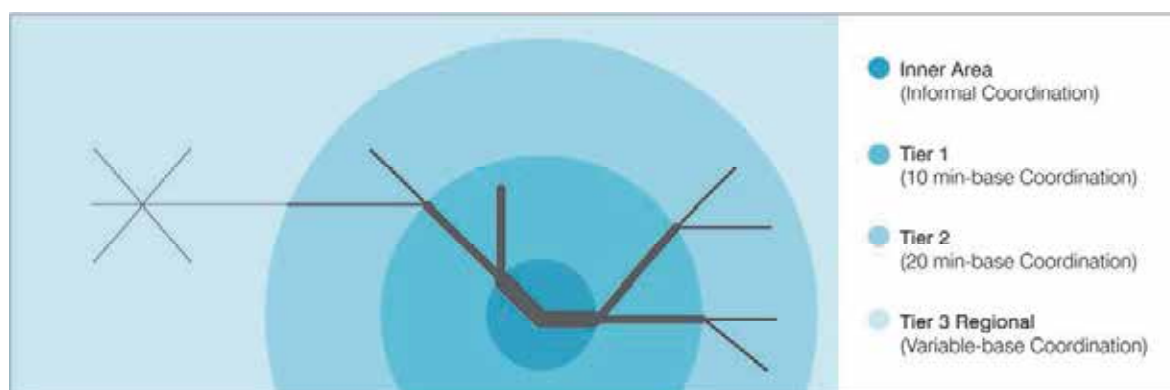
Table 5-1: Service areas - description

Service area	Trunk routes	Feeder routes
Inner	Inner train and tram corridors with very high (5 min) service levels	Not applicable
Tier 1	Train, tram and SmartBus corridors where demand and infrastructure will support 10 min headways	All non-trunk tram and bus services which intersect Tier 1 trunk services
Tier 2	Train, tram and SmartBus corridors not included in Tier 1	All non-trunk bus services which intersect Tier 2 trunk services
Tier 3	Regional train corridors with 30 to 60 min services	Regional coach lines Selected suburban bus routes in regional areas

Connection types

The service coordination framework defines a set of connection types for intersecting trunk and feeder services.

Table 5-2 and Figure 5-6 describe the combination of connecting services that exist in the Melbourne network, defined by their frequency.

For example, on the left side of Figure 5-6, connections exist between a trunk service operating every 20 minutes and a through-running bus service operating every 20 minutes. In this scenario, no formal connection exists but services are scheduled as closely as possible to minimise waiting times between services.

Table 5-2: Connection types – description

Connection Types	Network Design	Timetable Design	Operations Policy	Passenger Outcome
Turn up and go	Intersecting lines both operating 10 min frequency or better	No special consideration	No holding policy for bus	Max 10 min wait in any direction, plus walk time
Tier 1 Harmonised	Trunk line operating 10 mins or better connecting to through running connector	Bus connector to operate every 20 mins or better and timetable optimised to connect with train from city	No holding policy for bus	Typically max 10 min wait to or from CBD, plus walk time
Tier 1 Timed	Trunk line operating 10 mins or better connecting with terminating feeder service	Bus feeder scheduled to depart 5 mins after arrival of train from city, plus walk time	If low frequency, hold bus until arrival of down train if operationally feasible	Max 10 min wait for bus to train Max 10 min wait for outbound train to bus, plus walk time
Tier 2 Harmonised	Trunk line operating every 20 mins connecting to through-running connector	Bus connector to operate every 20 min or better and optimised to connect with peak direction train	No holding policy for bus	Typically max 10 min wait to CBD in AM and from CBD in PM
Tier 2 Timed	Trunk line operating every 20 mins connecting with terminating feeder service	Bus feeder service scheduled to arrive 5 min prior to departure of train to city and depart 5 min after arrival of train from city, plus walk time	If low frequency, hold bus until arrival of down train if operationally feasible	Max 2-3 min wait for connections to or from the CBD, plus walk time

Figure 5-6: Connection types

| Trunk 20 mins Frequency | Trunk 20 mins Frequency | | Trunk 10 mins Frequency | Trunk 10 mins Frequency | Trunk 10 mins Frequency |
| Through Running 20 mins Frequency | Feeder Services 20/40/60 mins | | Feeder Services 20/30/40/60 mins | Through Running 20 mins Frequency | Trunk 10 mins Frequency |

Harmonised Tier 2 | Timed Tier 2 | Timed Tier 1 | Harmonised Tier 1 | 'Turn-up and Go' connection

| No formal connection but services optimised to minimize waiting times in peak direction | Formal connection from down trunk to down bus and up bus to up train | Formal connection from down trunk to down bus services | No formal connection but services scheduled to ensure waiting times of no more than 10 mins | No formal connection. Waiting times of no more than 10 mins |

Tier 2 Area: Metropolitan train network beyond Newport, Sunshine, Coburg, Greensborough, Ringwood and Dandenong

Tier 1 Area: Tram and SmartBus routes as well as train network between City and Newport, Sunshine, Craigieburn, Coburg, South Morang, Greensborough, Ringwood, Glen Waverley, Dandenong, Frankston and Sandringham

5.5 Delivering the train network components of the service coordination framework

Service plans developed for the plan adhere to the multi-modal service coordination framework wherever possible. In particular, service plans have been designed to achieve the following objectives:

- Operate simple and legible service patterns at all times of the day with no routing alterations at any time of the week
- Operate 10 minute services at off-peak times on trunk sections of the network and 20 minute services on branch sections of the network.

New timetables will have been implemented across the network by 2014, delivering simpler and consistent service patterns on all lines. This plan also seeks to implement improved off-peak services over the next few years, where operationally achievable, affordable and required. Figure 5-7 and Figure 5-8 show the planned improvements in services across all corridors between 2012 and 2038.

Figure 5-7: Planned service improvements (trunk sections)
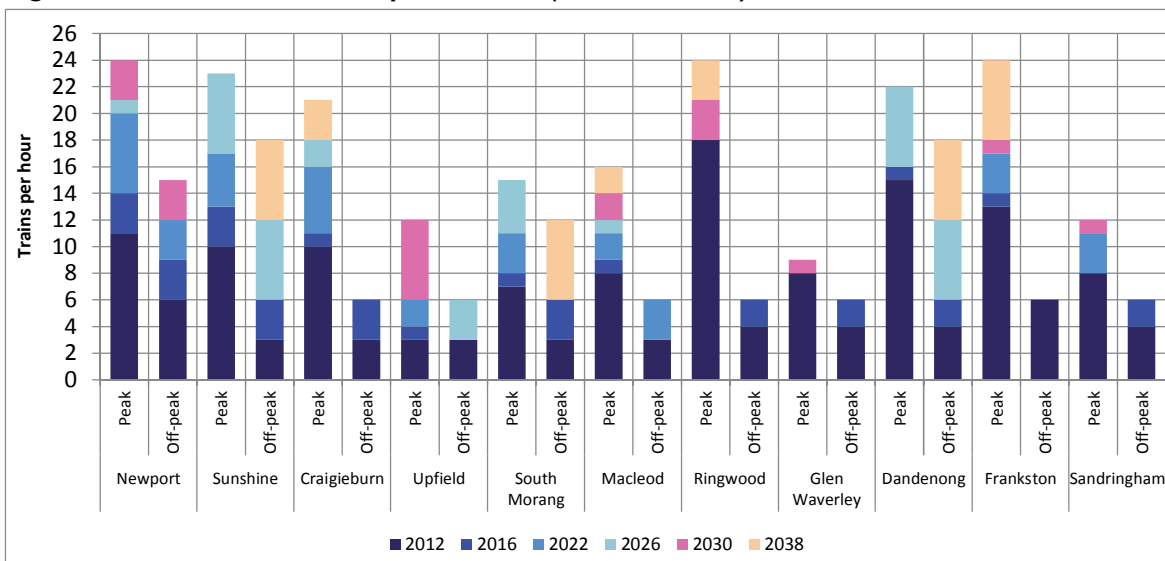
Figure 5-8: Planned service improvements (branch sections)
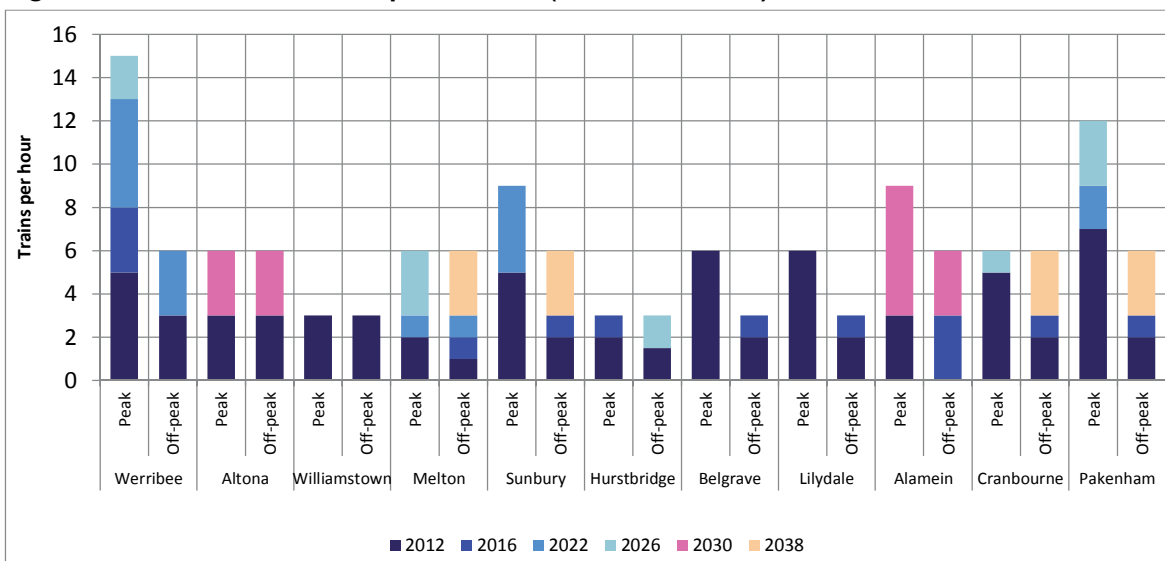
6 Making the best use of existing and new infrastructure

A core element in this plan is adopting the changes necessary to make the best use of existing and new infrastructure.

6.1   Introducing high capacity trains

As noted in Chapter 2, a range of train types are used on the Melbourne metropolitan rail network. Comeng, Alstom and Siemens trains comprise the majority of the fleet, which is completed by a small number of older Hitachi trains (reintroduced into service for a limited time period).

Table 6-1: Type and number of electric trains in the Metropolitan fleet

Train type	Introduced	Number in fleet (6 car trains)
Comeng	1981-1989	93.5
X'Trapolis*	2002-2012	74
Siemens	2003-2006	36
Hitachi	1972-1981	7
Total	**1972-2012**	**210.5**

* The number of X'Trapolis trains includes the current fleet and the new trains that are scheduled to be delivered prior to the end of 2013.

Additional fleet will be needed over the next 15 years to:
- Provide the expanded number of services required to meet the future service demand outlined in this plan
- Retire the ageing Hitachi and Comeng fleets. Funding of $210 million was allocated in the 2011-12 State budget to begin the purchase of this additional fleet.

Currently, trains in the Melbourne fleet are not dedicated to operate on specific lines and need to have a 'multi-purpose' nature in terms of their seating configuration and standing provision. These trains have to provide sufficient seating for passengers on long suburban lines as well as accommodate a high number of standing passengers through the inner suburbs.

In the future, the planned segregation of the Melbourne network will enable trains to be designated to particular lines. As a result, they will be able to be better configured to meet the particular characteristics of each line. New rolling stock will be designed to allow flexible arrangements of seats, enabling the rail network to transition from a multi-purpose railway to a metro-style system.

The current train fleet is designed to offer a high number of seats at the expense of standing capacity and does not fully utilise the available length of platforms. Accordingly, the plan proposes that the form for future trains will be a metro-style single deck train. These trains will provide additional capacity by modifying the design and extending the length of the trains to make use of the full platform length available.

The design of the new high capacity trains will provide additional capacity by including the following elements, all of which have been implemented successfully in other cities:

- Longer saloon areas by removing centre cabs
- Fixed car consists with no intermediate cars
- Specific design for the efficient operation of the Melbourne's rail network
- More vestibule area for standing passengers
- Additional door space to enable quicker boarding and alighting.

Sufficient seating will be provided to minimise standing time for patrons boarding or alighting at outer suburban stations at all times and for most passengers at off-peak times.

Overall, it is anticipated that the operation of high capacity trains will enable average train loads of up to 1100 passengers, compared to the existing 798 standard capacity, with the ability to be lengthened further to 220 metres to carry more than 1600 passengers if needed.

While the high capacity trains will improve carrying capacity per train path, other options have also been considered:

Double deck trains: There is potential for substantial additional seating in double deck trains; however, a typical design only provides two sets of doors per car. Given the high volume of passengers per car, the resulting dwell time at train stations would be significantly higher than those currently experienced at Melbourne's busiest stations and would reduce the number of trains that can operate on a line.

220 metre trains: Trains in the current fleet are 143 metres in length, but stations on the Melbourne network can generally accommodate trains up to 155 metres in length. The operation of longer 220 metre trains would require infrastructure works to extend suburban and inner-city platforms to accommodate the extra length.

The Melbourne Metro rail tunnel will provide five new inner-city stations that will allow 220 metre trains to operate; however, the existing inner-city stations are unable to accommodate 220 metre trains. Operating 220 metre trains through the existing inner-city network is highly problematic as trains would need to bypass the City Loop stations and challenging infrastructure works would be required to reconfigure platforms at major inner-city stations such as Flinders Street and Richmond.

More station capacity would also be required to serve the higher train loads. Therefore, this plan limits the operation of 220 metre trains to the Sunshine and Dandenong corridors following the opening of the Melbourne Metro rail tunnel.

6.2   Moving to high capacity signalling

A railway signalling system is required to control the movement of trains safely. The choice of signalling system is a major factor in determining the numbers of trains that can be safety operated and therefore is important in maximising the utilisation of the available track infrastructure. Most of Melbourne's existing signalling system is 'three aspect signalling' (proceed, caution, stop) using trackside coloured lights to advise the driver of what speed it is safe to travel, as was originally introduced a century ago. Safe separation between trains is ensured by providing a signal sighting / driver reaction time, a minimum breaking distance and a safety margin.

The existing system typically operates at around 15 trains per hour and could operate at up to 24 trains per hour in an ideal operating environment.

It is common practice in new railways, and as a retrofit to old railways, to move signals from the trackside to the driver's cabin for easier sighting and to use computers to control acceleration and deceleration times. As high capacity signalling is computer driven it allows the gap between trains to be optimised by adopting a dynamic separation method. With high capacity signalling systems in place, it becomes possible to operate up to or beyond 30 trains per hour (where train capacity is not otherwise constrained by junctions or platform dwell times).

As well as enabling higher capacity, modern signalling systems can improve safety by automatically applying brakes to avoid a dangerous situation.

6.3   Scheduling realistic dwell times

Dwell refers to the amount of time that a train remains stationary at a station stop. Dwell time includes the times taken for doors to open, passengers to alight / board and for the driver to confirm it is safe to depart and close the doors. It is important to ensure that realistic dwell times are scheduled in a timetable, as extended dwell times can limit the capacity of railway corridors and may also result in poor operational performance.

Passenger loads on the Melbourne network are surveyed in May and October each year. A comparison of the results from 2006 to 2012 is depicted in Figure 6-1 and shows that train loads on the Melbourne rail network peaked around 2008. Overall, the patronage growth that has occurred since 2006 has been met with an increased number of services. As a result of these extra services, typical loads on the network in 2006 are generally similar to those experienced in 2012.

Figure 6-1: 7:31 to 8:30 AM rolling hour train loadings, May 2006-2012
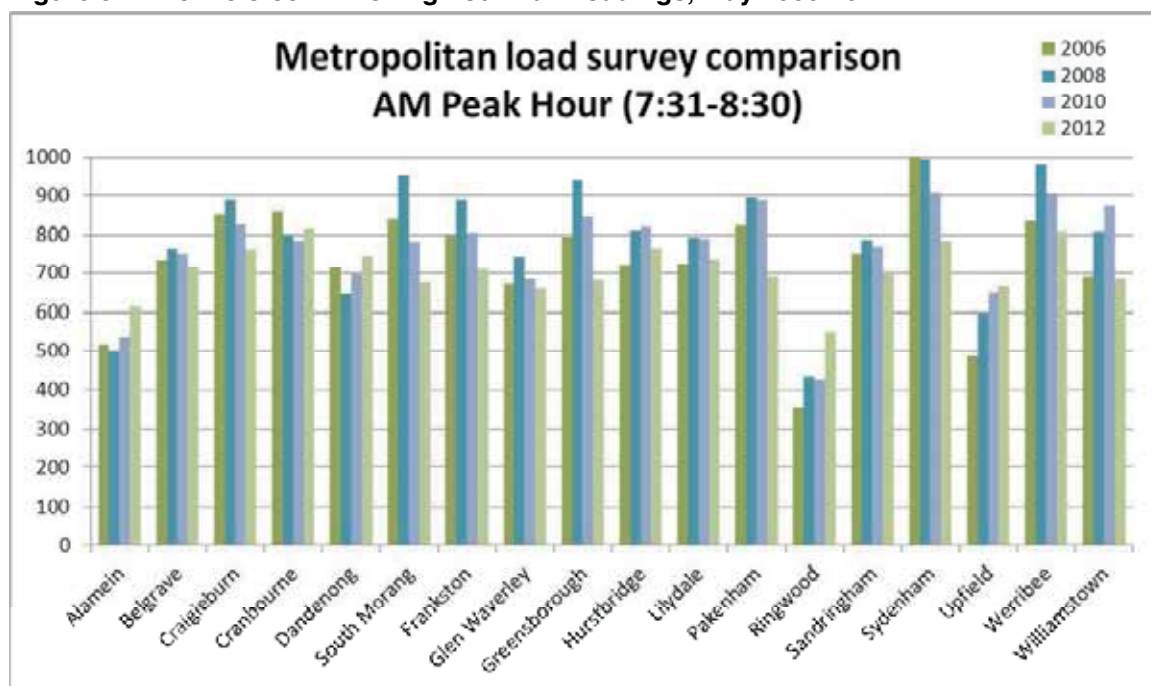
In particular, the number of services added to the Sydenham / Sunbury, South Morang, Frankston and Pakenham lines has exceeded the number of services required to meet increased demand. This has led to reductions in average loads that are below the load standard threshold. For example, in the 7:31 to 8:30 AM rolling hour, the number of metropolitan services on the Sydenham (Sunbury) line has increased from six to nine trains per hour, and the rolling hour train load has decreased from 1,010 in 2006 to 785 in 2012.

Conversely, the average loads on the Alamein, Ringwood and Upfield sectors have increased over this period as a result of patronage growth. These sectors have only had minor timetable changes, which have not included additional services. The average load on these lines is still well below the load standard, meaning that they still contain capacity to accommodate further growth without the need for additional services.

Historically, dwell times at City Loop stations have averaged 30 to 40 seconds. However, higher average dwells (of up to 55 seconds) have occurred for some service groups at North Melbourne and Richmond stations. These higher dwells result from the significant levels of passenger interchange that occur at these locations. More broadly, variability in observed dwell times across each station and across the different service groups is primarily a result of a different number of passenger movements (alightings, boardings and interchanges) occurring at each location and different train loading levels between each of the service groups.

PTV has developed a model to assist with the prediction of dwell times at inner-city stations for a given number of passenger movements. This model allows future operational scenarios to consider the impact of dwell times on operational performance, helping to ensure that maximum performance is extracted from existing assets and configurations.

The impact of signalling and dwell times on train throughput

Signalling systems and dwell times impact the ability to operate a high level of service frequency through the inner areas of the network on a sectional basis. It is important to note that the sectional capacity described is the maximum possible throughput of the given section. Further constraints on the ability to present trains to the section can mean that, in practice, operational capacity is lower than this level.

For a railway to achieve a high level of operational performance, it is important to ensure that both:

- Journey times are appropriate to allow services to recover from the typical delays that occur on a day to day basis
- The number of services scheduled is within the capacity of the railway.

Sectional capacity describes the number of trains that can reliably operate through a section of track in a given time period and is typically measured as the maximum number of trains passing through a given point per hour.

The smallest time interval at which a train can follow (without being slowed by) the train in front is known as the minimum headway and has a critical impact on operational capacity. With a lower minimum headway, trains can run closer together and more trains can pass a given point in the same time period.

The two primary roles of railway signalling systems are to:

- Maintain a safe separation between trains
- Enable operation of the required throughput of trains in a reliable manner.

Figure 6-2 below outlines the three basic components that determine the scheduled spacing required between trains in order to provide punctual operations on a railway.

Figure 6-2: Basic components of the scheduled train headway required to achieve a high level of operational performance.
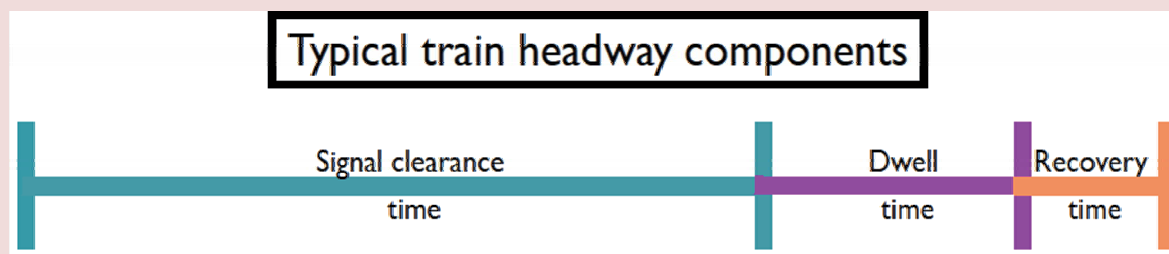
Signal clearance time

On a passenger railway, the first component considered in determining the scheduled headway is the signal clearance time (the technical minimum time following the departure of a train before a subsequent train is allowed to arrive into the same platform). For safety, a buffer is required to ensure that (when required) a train can safely come to rest at a point clear of the train in front. The length of this buffer varies according to the type and precision of the signalling system that is employed (conventional, automatic train protection, moving block).

The signal clearance time represents the time taken to traverse the safety buffer. The headway also needs to be extended at stations where the train in front stops (because it is then travelling at a lower speed, due to deceleration into and acceleration out of the platform, than the train behind).

Dwell time

The technical minimum headway can be calculated by adding the scheduled station dwell time to the signal clearance time. The minimum headway can be used to calculate the theoretical capacity of the railway, although to achieve an acceptable level of performance there is a need to space trains further apart.

Recovery time

Finally, for reliable operations, there is a need to provide recovery time to enable the railway to accommodate typical delays that occur on the network. Delays may be due to slight differences in day to day conditions or driver behaviour between stations and/or extended dwell times at busy stations. Analysis of dwell profiles on the Melbourne network indicates that at each inner-city station, 25 seconds of recovery time is required to accommodate the typical level of delays that occur on a day to day basis.

The above model has been applied to some key operational scenarios to develop insight into the future levels of capacity that can be provided by undertaking rolling stock, signalling and infrastructure upgrades across the Melbourne network.

Table 6-2: Scheduled headway components and resulting throughput: key scenarios

Component \ Future scenario	2012 Northern loop: Existing signalling		2031 Northern loop: HCS		2031 Melbourne Metro rail tunnel: HCS	
	Six-car existing	155m HCT	Six-car existing	155m HCT	Nine-car existing	220m HCT
Signal clearance time (sec)	107	107	53	53	56	56
Dwell time (sec)	43	30	48	34	71	50
Recovery time (sec)	25	25	25	25	25	25
Resultant headway (sec)	175	162	126	112	152	131
Capacity (trains per hour)	20.6	22.2	28.6	32.1	23.7	27.5

It is clear that while high capacity trains provide some ability to run additional trains through each city loop per hour, there is a need for further enhancements to the system to cater for future demand projections. These enhancements include the implementation of:

- A high capacity signalling system with the potential to achieve sectional throughputs of up to or beyond 30 trains per hour in the inner areas (provided suitable dwell times can be achieved)

- The Melbourne Metro rail tunnel to provide an additional route through the inner city. The Melbourne Metro rail tunnel project will also assist the aim of network segregation.

The next section explores the potential for the Melbourne network to utilise the above capacity.

6.4 Developing a workable timetable

The concept of sectional capacity described above represents a measure of the maximum achievable throughput of a railway section under ideal conditions. However, when developing a timetable there is a need to consider the ability to schedule trains across the entire network. Network considerations introduce a number of additional factors (such as line lengths, single line sections, at-grade conflicts and timetable constraints) that can reduce the achievable level of capacity below the level that might otherwise be expected based on a sectional analysis.

Overseas, it is typical for metro systems to operate with frequencies as high as 30 trains per hour, but in general the configuration of these systems is different to those found on the Melbourne network. Some examples of high frequency lines are:
- The Victoria Line in London (a 21 km end-to-end double track railway)
- Line 2 on the Beijing subway (a 23 km continuous loop line).

The respective end-to-end double track and continuous loop configurations of these systems enable simple operational regimes to be employed, facilitating services that are highly frequent and highly reliable.

The Melbourne network contains five lines that are of similar length to the above examples – the Alamein, Glen Waverley, Sandringham, Upfield and Williamstown lines are less than 22 kilometres in length. However, following Sunbury electrification, the average length of the ten remaining lines will be 40 kilometres from the suburban terminus to Flinders Street station, which is significantly greater than a line on a typical metro system.

Having long lines increases the difficulty of being able to reliably achieve high levels of train throughput on a regular basis. Primarily, this is because the risk of incurring infrastructure and rolling stock delays increases along with the length of the line. Infrastructure and rolling stock incidents often have a major impact on operational performance, so shorter lines are more likely to provide a higher level of operational performance.

In central Melbourne, each of the city underground loops form a trunk section that is fed by trains originating from multiple branch lines. The branches merge in the inner area and present a risk that incident delays will 'cross contaminate' the network. Increasing the degree of segregation by providing additional routes through the inner-city has the ability to enhance performance by removing merges between lines, confining delays to a particular line.

Ultimately, the operational performance (punctuality and capacity) of a trunk section is dictated by the ability of trains to regularly present at the right time at the beginning of the trunk section. Right-time presentation in the Melbourne network is constrained by:
• Geographical constraints associated with being a network of long interacting lines
• Existence of single line sections and at-grade conflicts on the network
• Interactions between metropolitan and regional services.

These factors restrict timetable flexibility, increase the risk of accumulating operational delay on the network and limit the ability to utilise the full sectional capacity that might otherwise be achieved on the network.

6.5   Improving network and service outcomes

Developing a fully segregated network

This plan proposes a segregated metropolitan rail network composed initially of five independent lines and rising to eight lines. Each line will have its own tracks, platforms and rolling stock but will be well-integrated into the overall network through good quality interchanges. Segregation of metropolitan and regional lines will occur across most of the network upon completion of RRL by 2016. Figure 6-3 shows the proposed segregated network in Stage 4.

Figure 6-3: Schematic diagram of Stage 4 Network Development Plan

Network Development Plan: Rail
Proposed Network Structure and
Peak Service Levels in Stage 4
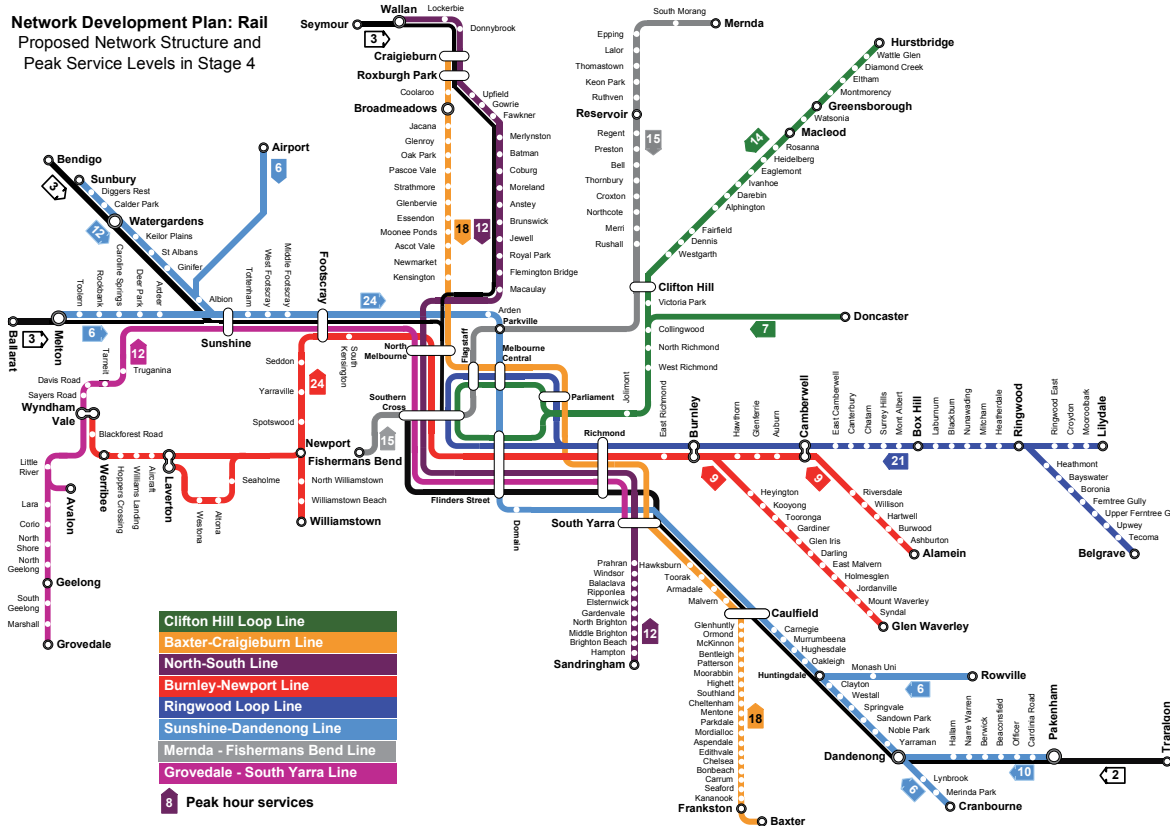
Delivering capacity to meet patronage growth

This plan will deliver a metropolitan rail system that meets the capacity requirements of a growing city by increasing capacity when and where required in accordance with patronage growth. Figure 6-4 shows the impact on peak hour overcrowding between 2012 and 2038 under three scenarios:

- The continuation of the current timetable
- The operation of the improved services with the completion of the committed works only (for example, up to and including RRL)
- The completion of all projects in the plan.

As shown, the number of passengers travelling in overcrowded conditions quickly increases in the first two scenarios. However, in implementing the plan, overcrowding is managed down to between 10 and 20 per cent at all times except in short periods immediately before the delivery of a major project.

Figure 6-4: Forecast levels of overcrowding in the peak hour under three scenarios
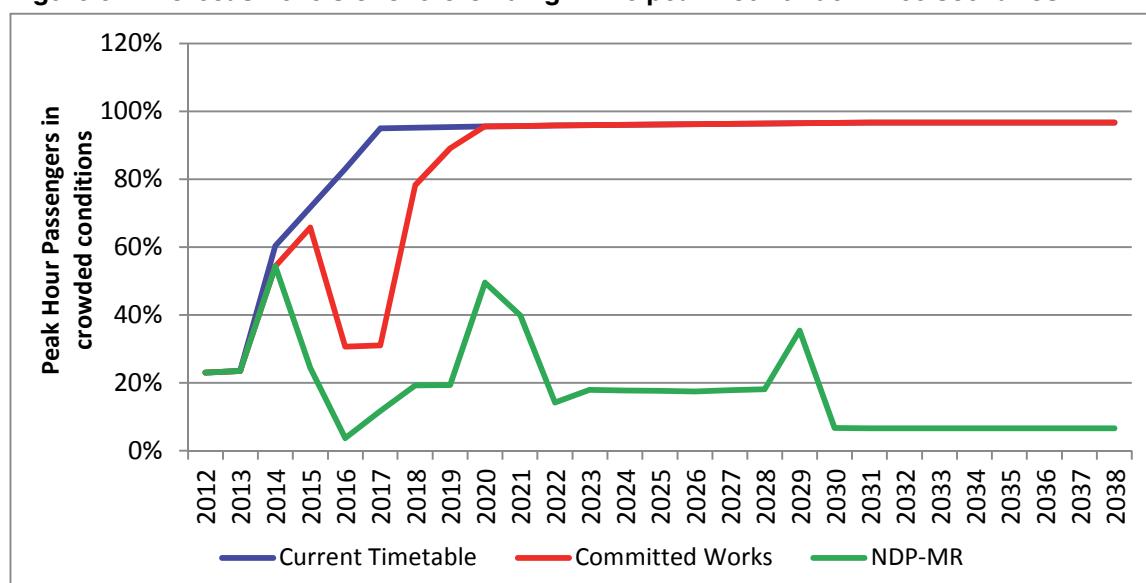
As shown in Table 6-3, the overall delivery of the projects in this plan will provide a 50 per cent increase in peak hour capacity within 10 years and a 130 per cent increase within 20 years. This will allow more than 130,000 additional passengers to be carried into the city in the morning peak hour and reverse in the afternoon peak. This is equivalent to the capacity that would be provided by more than 100 freeway lanes.

Table 6-3: Capacity increases delivered by this plan

	Current services	Capacity increase within 10 Years	Capacity increase within 20 Years
Number of peak hour train services into the city	116	34%	76%
Peak hour capacity into the city	96,500	51%	131%
Extra passengers that can be carried in peak hour	-	50,000	130,000

Providing longer peak services and higher off-peak frequencies

This plan will deliver frequent services at all times of the week on most sections of the network, encouraging passengers to use the train network out of peak times and improving coordination with tram and bus services. Shoulder peak periods will also benefit from close to peak-hour service levels on most lines, providing commuters with more flexibility and encouraging peak spreading.

Figure 6-5 shows the planned minimum services levels to be in operation across the network from 2016 onwards. These service levels will apply to most times of the week and be significantly higher at peak times.

Figure 6-5: Minimum service levels on the metropolitan network from the end of Stage 1 onwards
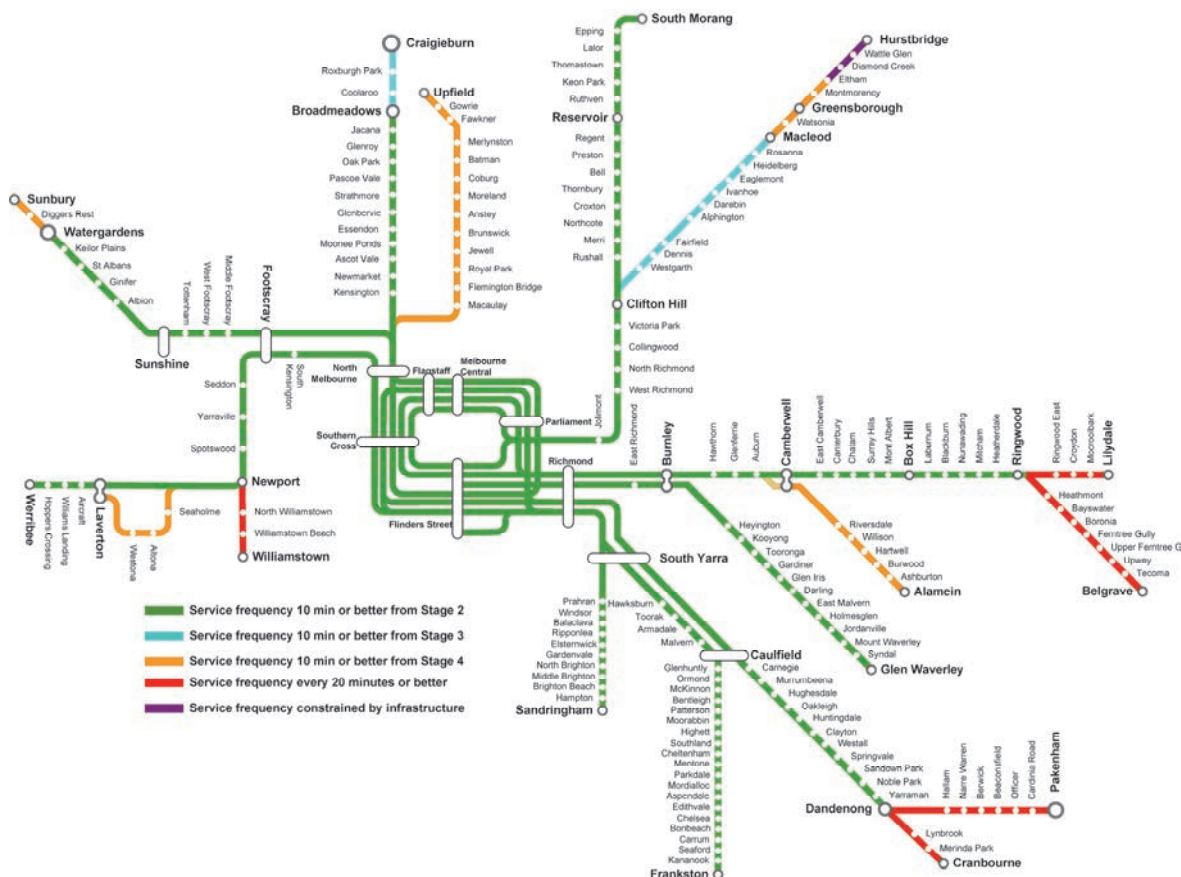
Providing capacity for freight

The plan has carefully considered the needs of the freight network and ensured that existing freight services on the broad gauge network can be accommodated even with the increase in service numbers on the passenger network, especially in the next decade. Opportunities to expand freight services on several corridors have also been identified. Nevertheless, in the longer term, anticipated growth in rail freight will be likely to require separate rail freight infrastructure to be constructed. In particular, opportunities to develop a separate freight line to Hastings in the Dandenong corridor are being examined.

6.6   Passenger-focused service principles

The following table summarises the key principles that have been used to underpin the design of the service plans developed for the plan. Many of these principles are common to metro-style operations and are widely applied in other cities.

Table 6-4: Service principles

Design feature	Key criteria to be achieved	Current	Stage 1	Stage 2	Stages 3&4
Service patterns	Simple and homogenous: No mixture of stopping patterns, peak and off-peak services always operate to the same pattern in both directions. This helps to balance out train loadings and optimise train path utilisation. Trains to be scheduled at regular headways on each service route, resulting in consistent presentation of trains. To support even headway distribution and junction management where more than one branch line is served, trains to be scheduled to alternate between lines evenly or in a 2 to 1 or 3 to 1 split.	Achieved in some places	Achieved in most places	Fully achieved	Fully achieved
Service provision	A metro service should offer all passengers on trunk sections of the train network a service at least every 10 minutes between 0700 and 2100. Service levels at any given station should ideally not be reduced with a timetable change.	Limited provision	Achieved in most places	Fully achieved	Fully achieved
Capacity distribution	Sufficient carrying capacity to meet demand to be provided on all sections. Passengers should ideally not have to stand for more than 25 minutes to or from the cordon stations (for the Sunshine – Dandenong Line, the cordon stations are assumed to be Arden and Domain stations). Capacity required to serve maximum load point on trunk section to be distributed as evenly as possible between all services (for example, loads to be balanced between trains operating through the maximum load point).	Not achievable in all places	Achieved in most places	Fully achieved	Fully achieved

Reliability / Recovery	Total recovery time for each train's round trip to equal around 6 per cent of total trip time. Recovery provided in the form of suburban layover and short recovery 'holds' at stations preceding major junctions. Some peak services should terminate at intermediate locations to avoid overloading of termini, improve rolling stock efficiency and some turn-back locations should be reserved for use at times of disruption. Avoid the terminating of trains on trunk sections, especially if train inspection is required.	Achieved in most places	Achieved in most places	Fully achieved	Fully achieved
Integration with regional lines	Service patterns to run on a cycle time that coordinates with single line sections on the regional rail corridors in order for services to coordinate appropriately at key junctions and on shared sections.	Not achievable	Fully achieved	Fully achieved	Fully achieved
Rolling stock efficiency	Efficient rolling stock utilisation should be sought, but must not be at expense of capacity requirements or reliability and recovery principles. Short starters to be used where possible to enable quicker cycle times, but should commence from locations that enable load balancing to occur through the maximum load point (for example, a short starter from Sunshine is unlikely to be as heavily loaded as other trains from the Sunbury and Melton lines, whereas short starters from Sydenham should carry similar loads).	Achieved in some places	Achieved in most places	Fully achieved	Fully achieved

Segregation	To operate an efficient railway with metro-style characteristics and high frequencies and reliability, the network needs to be segregated into smaller units or 'sectors'. This avoids the need for timetables on each group to be influenced by constraints on other groups and prevents delays on one part of the network from spreading to other parts. Initially, segregation needs to be achieved from a service design perspective. Longer term, it should encompass the full segregation of rolling stock, stabling and maintenance facilities.	Limited sectorisation	Sectorisation from most regional services	Full group sectorisation except for occasional non-passenger moves	Complete sectorisation achieved

7 Network changes

As discussed earlier, patronage on the Melbourne rail network will grow strongly over the next decade and beyond. To respond to this growth and support the transition to a metro-style network, the configuration of the network structure will need to be altered over a number of stages. These changes will provide more capacity where and when it is needed and will improve system reliability and simplify connections with other modes.

The key aim of the restructuring process will be to improve network sectorisation, leading to the creation of stand-alone train lines that can operate independently of one another but which, at the same time, offer frequent and reliable interchanges.

Specifically, the development of a segregated railway will result in the following benefits:
- Daily operations will be divided into smaller groups, enabling the impact of any incidents to be contained to one network group – protecting the reliability of the overall network and enabling a more focused approach to on-time running
- Each group will be designed so it has its own tracks and platforms with no need to share vital capacity with trains from any other sector. This will create more capacity and a higher level of reliability
- Each group will be designed so a timetable can be constructed that maximises its capacity potential free of the constraints of inter-connecting with other lines.

It should be noted that a truly segregated railway requires each network group to be permanently self-contained, including the availability of separate stabling and maintenance facilities. The plan has been designed to achieve this objective in the longer term. In the short and medium terms, some groups will need to share maintenance and stabling facilities in a bid to avoid excessive immediate infrastructure requirements and underutilisation of assets. To protect the benefits of segregation, no more than two groups will share facilities and the movement of trains between groups will be limited and carefully scheduled.

7.1   Network configuration stages

As described in detail across Chapters 8 to 16, the plan has identified four key network reconfiguration phases that will alter the connection and routing of rail corridors through the city. These changes require new infrastructure to improve capacity, reliability and network segregation. A number of routing and connection options were considered in the development of the plan and the preferred solutions were selected having been assessed against the following criteria:
- Feasibility to connect existing corridors without significant engineering constraints
- Ability to utilise the existing infrastructure as far as practical
- Balancing of service frequencies between connected corridors where lines through-run
- Minimisation of the number of services that need to turn-back in the city
- Logical staging and avoidance of redundant infrastructure
- Minimisation of the number of route changes for each corridor across the life of the plan.

Table 7-1 summarises the routing of each metropolitan corridor in each phase of the plan. All corridors except the Hurstbridge and Ringwood corridors will incur at least one change in routing; however, in some cases (such as the Newport, Alamein and Glen Waverley lines) the routing through the city remains unchanged and only the suburban connection changes. The Sunshine and Dandenong corridors incur a fundamental change within the next 10 years as they are diverted away from their respective City Loops and connected together via the new Melbourne Metro rail tunnel.

Table 7-1: Inner-city routing from each corridor under each stage

Line	Current	Stage 1	Stage 2	Stage 3	Stage 4
Werribee & Williamstown	Direct to Frankston	Direct to Frankston	Direct to Sandringham	Direct to Sandringham	Direct to Burnley
Melton	V/line to Sth'n Cross	V/line to Sth'n Cross	V/line to Sth'n Cross	MM Tunnel	MM Tunnel
Sunbury	Northern Loop	Northern Loop	MM Tunnel	MM Tunnel	MM Tunnel
Airport	N/A	N/A	N/A	MM Tunnel	MM Tunnel
Craigieburn	Northern Loop	Northern Loop	Northern Loop	Northern Loop	Frankston via Loop
Upfield	Northern Loop	Northern Loop	Northern Loop	Northern Loop	Direct to Sandringham
South Morang	Clifton Hill Loop	Clifton Hill Loop	Clifton Hill Loop	Clifton Hill-City Tunnel	Clifton Hill-City Tunnel
Hurstbridge	Clifton Hill Loop	Clifton Hill Loop	Clifton Hill Loop	Clifton Hill Loop	Clifton Hill Loop
Doncaster	N/A	N/A	N/A	Clifton Hill Loop	Clifton Hill Loop
Belgrave & Lilydale	Burnley Loop	Burnley Loop	Burnley Loop	Burnley Loop	Burnley Loop
Alamein	Burnley Loop	Burnley Loop	Burnley Loop	Burnley Loop	Direct to Newport
Glen Waverley	Direct to Flinders St	Direct to Flinders St	Direct to Flinders St	Direct to Flinders St	Direct to Newport
Cranbourne & Pakenham	Caulfield Loop	Caulfield Loop	MM Tunnel	MM Tunnel	MM Tunnel
Rowville	N/A	N/A	N/A	MM Tunnel	MM Tunnel
Frankston	Caulfield Loop/Direct	Caulfield Loop/Direct	Caulfield Loop	Caulfield Loop	Craigieburn via Loop
Sandringham	Direct to Flinders St	Direct to Flinders St	Direct to Newport	Direct to Newport	Direct to Upfield

8 Current network and service levels

The plan focuses in the first instance on overcoming existing constraints and expanding the capacity of Melbourne's rail network. Along with key projects already underway, there will be major timetabling and operational changes to get the most out of the current network.

8.1   Background

In May 2011, a new timetable was implemented on the metropolitan rail network. This was the first 'greenfield' timetable introduced in Melbourne for more than 20 years and was focused on establishing a new operating group known as the Cross-City Group.

The May 2011 timetable improved capacity and reliability on the Werribee / Williamstown, Frankston, Sandringham and Glen Waverley lines and is the first stage in a planned roll-out of successive greenfield timetables that will streamline the network. The key changes implemented in May 2011 included:

- Implementing longer peak services: Since May 2011, the Werribee and Sandringham lines operate a flat peak level of service for two hours in each peak
- Maximising peak hour capacity: The alteration of service patterns in May 2011 enabled additional services to be scheduled at the height of the peak on each of the Werribee, Sandringham and Glen Waverley lines
- Standardising stopping patterns: In advance of the May 2011 timetable change, there were seven different stopping patterns during the two-hour peak on the Werribee / Williamstown line; the new timetable reduced this to a single stopping pattern from each of the three train originating points
- Implementing realistic running times: A significant amount of analysis was undertaken by the rail operator to establish realistic train run times, taking account of rolling stock performance, achievable average dwell times at each station and the impact of temporary and permanent speed restrictions.

The second of the new greenfield timetables was introduced in April 2012 with a focus on improving the capacity and reliability of the Clifton Hill Group (mainly through optimising services around the new infrastructure between Keon Park and South Morang) and rolling out the first of many planned improvements to weekend service levels.

Similar timetable changes will be implemented between 2012 and 2016, with a focus on making better use of existing assets across all lines as well as boosting off-peak service levels. By the end of 2016, at least one greenfield timetable will have been introduced on each line and a clear capacity base-line will have been set for future capacity projects.

In November 2012, the Sunbury Electrification Project was completed and a new timetable implemented on the Northern Group to utilise the benefits of this project, as well as prepare for the delivery of the first stage of RRL, which will provide new platforms 15 and 16 at Southern Cross and new lines from those platforms to South Kensington.

Figure 8-1 provides a schematic representation of the peak period network configuration at the end of 2012, with peak hour service numbers shown on each corridor. Detailed service levels in peak, shoulder and off-peak times are described line by line in the following sections.

Figure 8-1: Network at the end of 2012
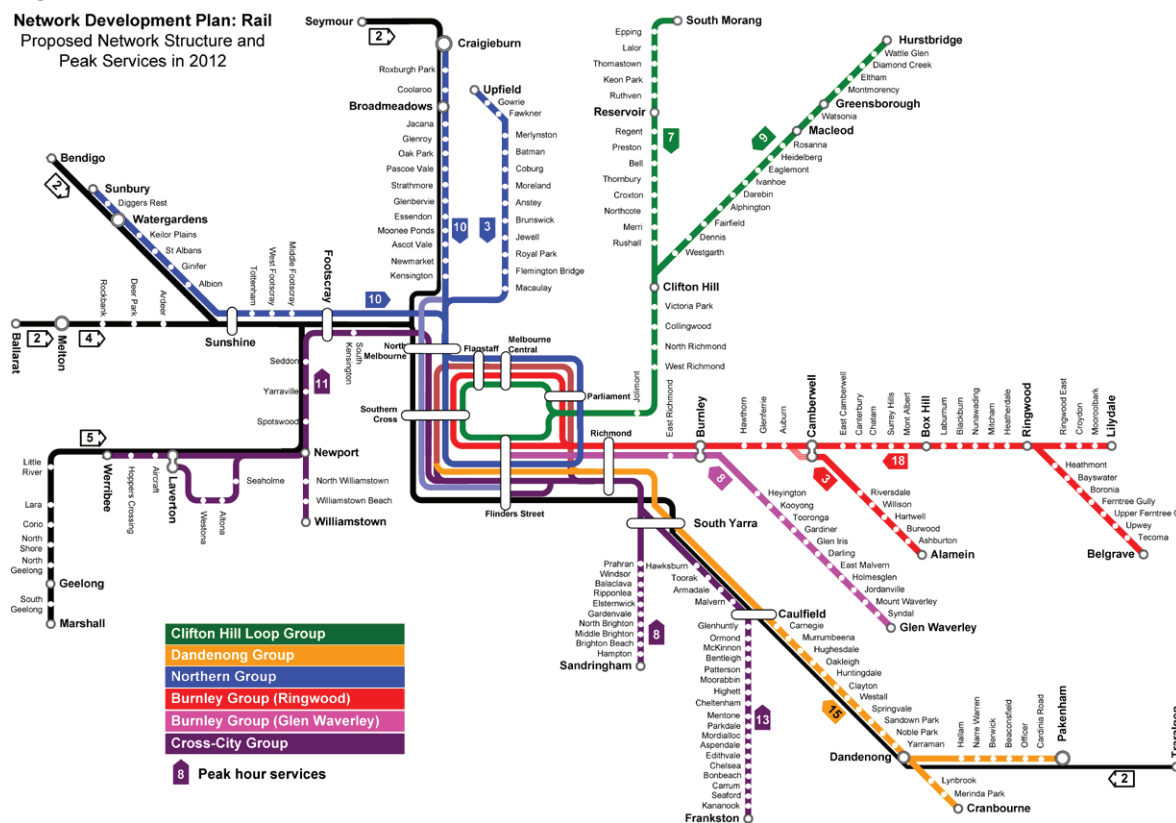
8.2   Clifton Hill Group

Summary

The Clifton Hill Group incorporates the South Morang and Hurstbridge rail lines. All services from both lines merge together and operate via a common trunk between Clifton Hill and the city where they operate clockwise around the City Loop. Operations on the Clifton Hill Group are already well segregated with no scheduled interaction with other lines; however, the presence of a major maintenance depot on the line at Epping has resulted historically in numerous transfers occurring to and from the line from other groups.

The delivery of the new Craigieburn maintenance depot will lead to a significant reduction in the number of transfers to Epping, with the Epping facility becoming generally limited to only managing the X'Trapolis fleets for the Clifton Hill and Burnley Groups. This change will be a key step towards achieving full segregation of the Clifton Hill Group in the medium term and will result in improved reliability and fewer instances of trains being terminated at Flinders Street.

Figure 8-2: Schematic diagram of Clifton Hill Group

Key service changes

A new timetable was introduced onto the Clifton Hill Group in April 2012 following the completion of the South Morang project. This timetable delivered a more efficient, consistent and higher frequency service on the South Morang line (formerly the Epping line) at peak times. This change has also reduced operational congestion on the group and enables the flexibility to provide more services on the Hurstbridge line. A full Greenfield timetable will be introduced on the group in 2013 following the completion of the Hurstbridge line upgrades.

2012 Service Plan

Clifton Hill Group Service Provision (trains per hour except where noted)	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
South Morang to City Loop via Flinders Street Stops All Stations	7	13	3	2	3	2
Hurstbridge to City Loop via Flinders Street Peak: Limited Stop Off-peak: Stops All Stations	3	4	1.5	1	1.5	1
Eltham to City Loop via Flinders Street Peak: Limited Stop Off-peak: Stops All Stations	1	4	1.5	1	1.5	1
Greensborough to City Loop via Flinders Street Peak: Limited Stop Off-peak: N/A	5	8	-	-	-	-
*= Some services may originate at an intermediate location City Loop Operation: Clockwise at all times (from April 2013)						

8.3   Dandenong Group

Summary

The Dandenong Group was established when the new Cross-City group was created as part of the May 2011 timetable change. The Dandenong Group includes the Cranbourne and Pakenham lines, the corridor from Dandenong to Caulfield, the 'Caulfield Local Lines' between Caulfield and Richmond and the Caulfield Underground Rail Loop.

While Dandenong services are fully segregated from other metropolitan lines at weekday off-peak times, at present the loop is shared with some Frankston line services at peak times and Sandringham and Frankston services on weekends.

The Dandenong Group tracks are also used by V/Line services from Traralgon between Pakenham and Richmond.

Figure 8-3: Schematic diagram of Dandenong Group

Key service changes

The timetable on the Dandenong Group was significantly re-built in 2010 and a new Greenfield weekend timetable was introduced in April 2012. The November 2012 timetable change added an additional peak period service and further reduced the interaction with Cross-City Group services by terminating one peak hour Latrobe Valley V/line service at Flinders Street platform 6/7.

Dandenong Group Service Provision (trains per hour except where noted)	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Pakenham to City Loop Most Times: Limited Stop Other Off-peak: Stops All Stations	7	11	2	3	3	3
Cranbourne to City Loop Most Times: Limited Stop Other Off-peak: Stops All Stations	5	9	2	-	3	-
Dandenong to City Loop Most Times: Limited Stop	3	5	-	-	-	-
Cranbourne to Dandenong Shuttle Stops All Stations	-	-	-	3	-	3
*= Some services may originate at an intermediate location City Loop Operation: Anti-Clockwise except weekday PM						

8.4   Northern Group

Summary

The Northern Group includes the Craigieburn, Sydenham / Sunbury and Upfield lines as well as the 'east suburban' and 'main suburban' lines between North Melbourne and Southern Cross and the Northern Underground Rail Loop.

Since the May 2011 timetable change, the Werribee and Williamstown lines no longer form part of the Northern Group and have been incorporated into the Cross-City Group. This means that Werribee / Williamstown services have no interaction with Northern Group lines on weekdays, with all those services running direct via the 'through suburban lines' in parallel with Northern Group services. However, services from Werribee still utilise the Northern Loop on weekends and currently cross onto the main suburban lines in order to access the loop portals.

While the transfer of the Werribee / Williamstown lines to the Cross City Group significantly improved network segregation, reduced conflicts and improved capacity, two key challenges remain for the group:

- Mixed operation with V/Line on the Craigieburn and Sunbury lines
- Limited peak hour capacity in the City Loop to accommodate the increasing patronage needs on all Northern Group lines.

Both of these issues will be largely addressed for the medium term with the implementation of Regional Rail Link, of which the first section between Southern Cross and South Kensington is anticipated to be ready in 2013. This new infrastructure will allow Geelong services to be diverted from the metropolitan lines, releasing critical capacity for some Craigieburn services to operate direct to Flinders Street and enabling more overall inner core capacity for the Northern Group lines.

Figure 8-4: Schematic Diagram of Northern Group
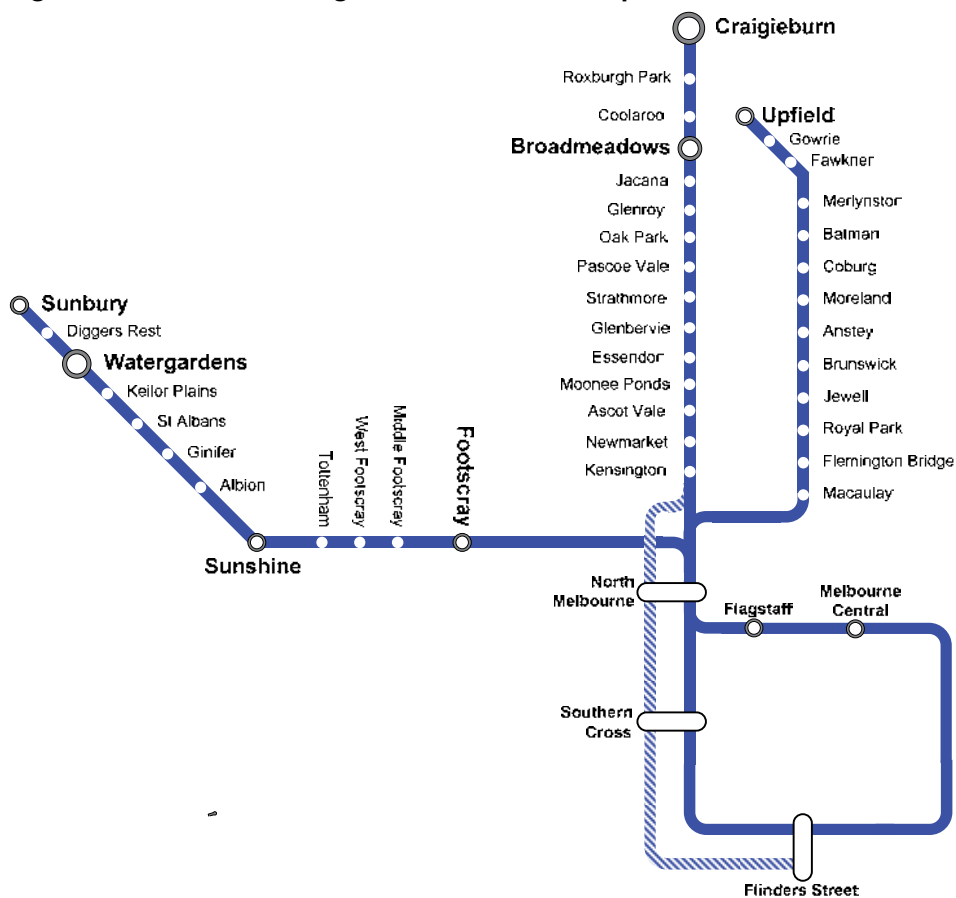
Key service changes

The following key service changes were introduced for the Northern Group in the November 2012 timetable:

- Electrification to Sunbury, enabling capacity on the Sydenham / Sunbury line currently being used by Sunbury V/Line services to be re-allocated to operate additional metropolitan services (half of which will commence at Sunbury) and an additional V/Line service from Bacchus Marsh
- New greenfield timetable introduced on the Northern Group to take advantage of the new capacity delivered by electrification to Sunbury, enabling the addition of new services on the Craigieburn and Sydenham / Sunbury lines.

2012 Service Plan

Northern Group Service Provision (trains per hour except where noted)	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Sunbury to City Loop Peak: Limited Stop Off-peak: Stops All Stations	5	8	1.5	1	1.5	1
Sydenham to City Loop Stops All Stations	5	8	1.5	1	1.5	1
Craigieburn* to City Loop Stops All Stations	7	13	3	2	3	2
Craigieburn* to Flinders St via Southern Cross Stops All Stations	3	3	-	-	-	-
Upfield to City Loop Stops All Stations	3	6	3	2	3	2
*= Some services may originate at an intermediate location City Loop Operation: Clockwise except weekday PM						

8.5   Burnley Group

Summary

The Burnley Group includes the Alamein, Belgrave, Lilydale and Glen Waverley lines as well two routes through to Flinders Street: one via the Burnley Underground Rail Loop and one direct line between Richmond and Flinders Street. While patronage growth is low on the Burnley Group and sufficient capacity is available to meet demand for the next decade, there is a growing need to streamline operations on the group to improve service reliability and provide a more legible and consistent service offering to passengers.

The May 2011 timetable change started this process by rationalising routing into Flinders Street during the AM period. Instead of a mixture of services from all lines running occasional direct trains, the timetable change simplified the arrangement by removing all Glen Waverley trains from the loop. This resulted in a simpler operation at Burnley with the removal of several merges and de-merges in the area, as well as the avoidance of delays from Belgrave and Lilydale trains onto Glen Waverley line trains and vice versa.

Figure 8-5: Schematic Diagram of Burnley Group

Flagstaff · Melbourne Central · Parliament · Southern Cross · Richmond · Flinders Street · East Richmond · Burnley · Hawthorn · Glenferrie · Auburn · Camberwell · East Camberwell · Canterbury · Chatham · Surrey Hills · Mont Albert · Box Hill · Laburnum · Blackburn · Nunawading · Mitcham · Heatherdale · Ringwood · Ringwood East · Croydon · Mooroolbark · Lilydale

Heathmont · Bayswater · Boronia · Ferntree Gully · Upper Ferntree Gully · Upwey · Tecoma · Belgrave

Riversdale · Willison · Hartwell · Burwood · Ashburton · Alamein

Peyinglor · Kooyung · Tooronga · Gardiner · Glen Iris · Darling · East Malvern · Holmesglen · Jordanville · Mount Waverley · Syndal · Glen Waverley

2012 Service Plan

Burnley Group Service Provision (trains per hour except where noted)	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Belgrave* to City Loop Peak & Morning Off-peak: Limited Stop Other Off-peak: Stops All Stations	6	12	2	2	3	2
Lilydale* to City Loop Peak & Morning Off-peak: Limited Stop Other Off-peak: Stops All Stations	6	12	2	2	3	2
Ringwood# to City Loop Stops All Stations except East Richmond	2	4	-	-	-	-
Blackburn# to City Loop Stops All Stations except East Richmond	4	6	4AM	-	-	-
Alamein# to City Loop Stops All Stations except East Richmond	3	6	-	-	-	-
Alamein to Camberwell Shuttle Stops All Stations	-	-	4	2	3	2
Glen Waverley to Flinders Street Stops All Stations	8AM	14AM	4AM	-	-	-
Glen Waverley to City Loop Stops All Stations	8PM	14PM	4PM	2	-	2
*= Some services may originate at an intermediate location; #= Outbound services run Direct AM= Morning Only; PM= Afternoon Only City Loop Operation: Clockwise except weekday AM						

8.6   Cross-City Group

Summary

The Cross-City Group was established with the May 2011 timetable change and includes the Werribee / Williamstown, Frankston and Sandringham lines. In terms of inner area tracks, the group includes the through suburban lines that run from North Melbourne to Flinders Street via Southern Cross platforms 13 and 14 as well as the Caulfield through lines from Caulfield to Flinders Street and the 'Special and Sandringham Lines' into Flinders Street. The Cross-City Group was established to achieve the following:

- Create operational separation from the Northern and Dandenong groups to reduce the impact of delays cascading between groups
- Create additional capacity for all Cross-City lines as well as cascading further capacity increases to Northern and Dandenong Group trains
- Set up the network to operate as five distinct railway groups in a segregated manner
- Deliver through running from Newport to Caulfield to enhance customer options for travel, in particular for an increasing number of journeys that cross the CBD
- Service future stations at Williams Landing and Southland.

As noted earlier, the Cross-City Group is in operation during weekdays. During peak periods, some Frankston services utilise the Dandenong loop. On weekends, the Cross-City Group does not operate at all, with all lines using the Northern and Dandenong loops.

Figure 8-6: Schematic diagram of Cross-City Group
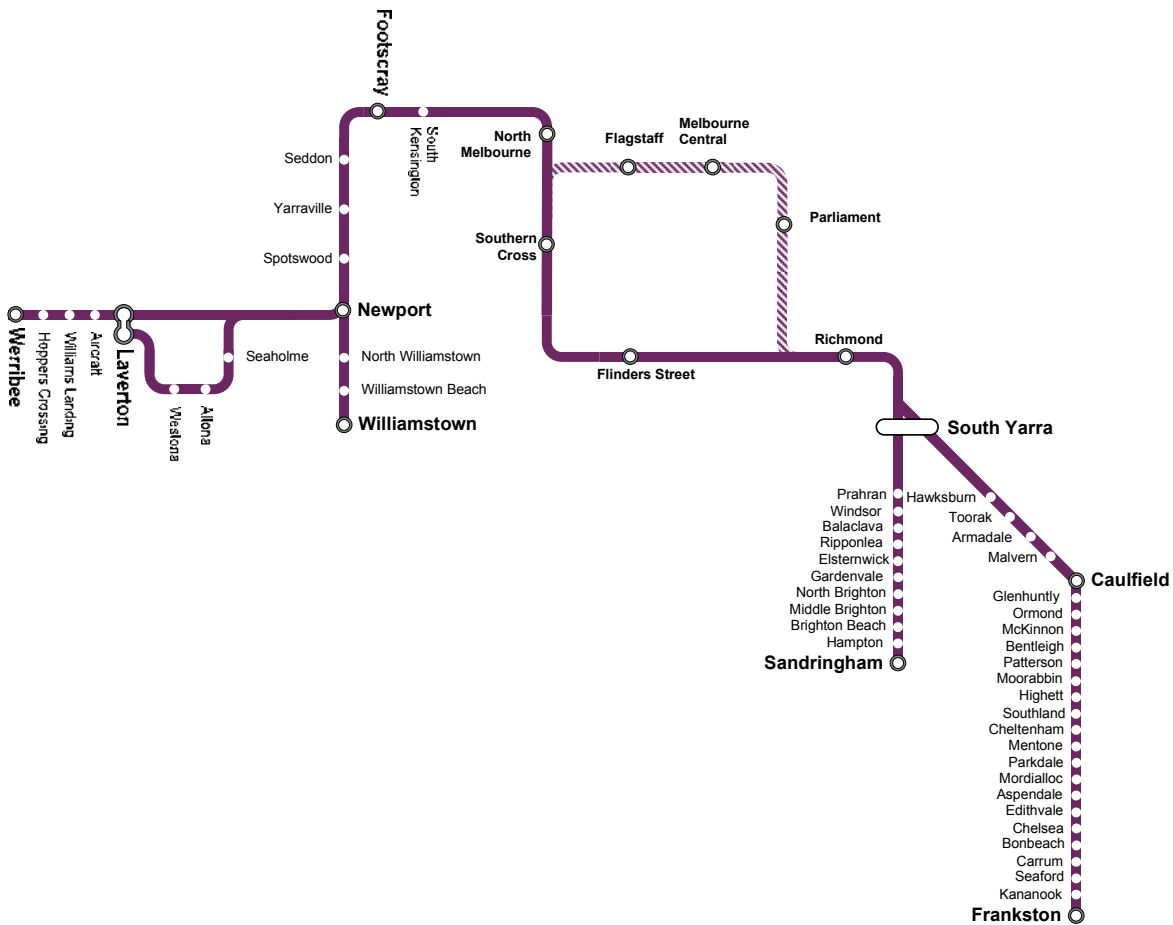
Key service changes

The May 2011 timetable change significantly increased capacity on the Cross-City Group at peak times and in the case of the Werribee / Williamstown line, has maximised the reliable capacity of the group until RRL is fully implemented. As a result, most of the service changes planned for the Cross-City Group over the next few years are focused on off-peak changes.

2012 Service Plan

Cross-City Group Service Provision (trains per hour except where noted)	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Werribee to Flinders Street via Main Line Peak: Limited stops; most continue to Frankston line Off-peak: Stops all stations; continue to Frankston line	5	11	3	-	-	-
Werribee to Flinders Street via Altona Stops all stations; continue to Frankston line	-	-	-	3	-	2w/d
Werribee to City Loop via Altona Stops all stations	-	-	-	-	3	2w/e
Laverton to Flinders Street via Altona Stops all stations except South Kensington; some continue to Frankston line	3	6	-	-	-	-
Laverton to Newport via Altona Stops all stations	-	-	3	-	-	-
Williamstown to Flinders Street Stops all stations except South Kensington at peak times, continue to Frankston line	3	5	3	3	-	-
Williamstown to Newport Stops all stations	-	-	-	-	3	2
Frankston to Flinders Street Peak: Limited stops; continue to Werribee / Williamstown Off-peak: Stops all stations, continue to Werribee / Williamstown	6	9	6	3	-	-
Frankston* to City Loop Stops all stations	7	12	-	-	6	3
Sandringham to Flinders Street Stop all stations	8	15	4	3	-	-
Sandringham to City Loop Stop all stations	-	-	-	-	3	3
*= Some services may originate at an intermediate location Through services operate via Flinders Street and Southern Cross						

9 Stage 1 – Network plan and service levels to 2016

9.1   Background

Upon completion of RRL, the metropolitan network will enter a new paradigm with far greater sectorisation from regional services, significantly more capacity available to lines in the western suburbs and improved reliability for most of the rest of the network. While route structures will remain consistent with the end of the previous phase, new greenfield timetables will be introduced in this period on all groups and additional services will be added to all groups at peak times.

The Cross-City and Northern Groups will be the main beneficiaries of RRL, with additional services added to the Werribee, Sunbury, Craigieburn and Upfield lines. This service change will include the provision of a mixed direct / City Loop operation on the Craigieburn line to accommodate more Sunbury and Upfield services via the loop.

By 2016, a new greenfield timetable will have been implemented on every metropolitan corridor as well as on all regional lines. Simplified stopping patterns and timetable structures will be in place.

Figure 9-1 provides a schematic representation of the peak period network configuration after the implementation of RRL in 2016, with peak hour service numbers shown on each corridor. Detailed service levels in peak, shoulder and off-peak times are described line by line in the following sections.

Figure 9-1: Schematic diagram of 2016 network (following commissioning of RRL)
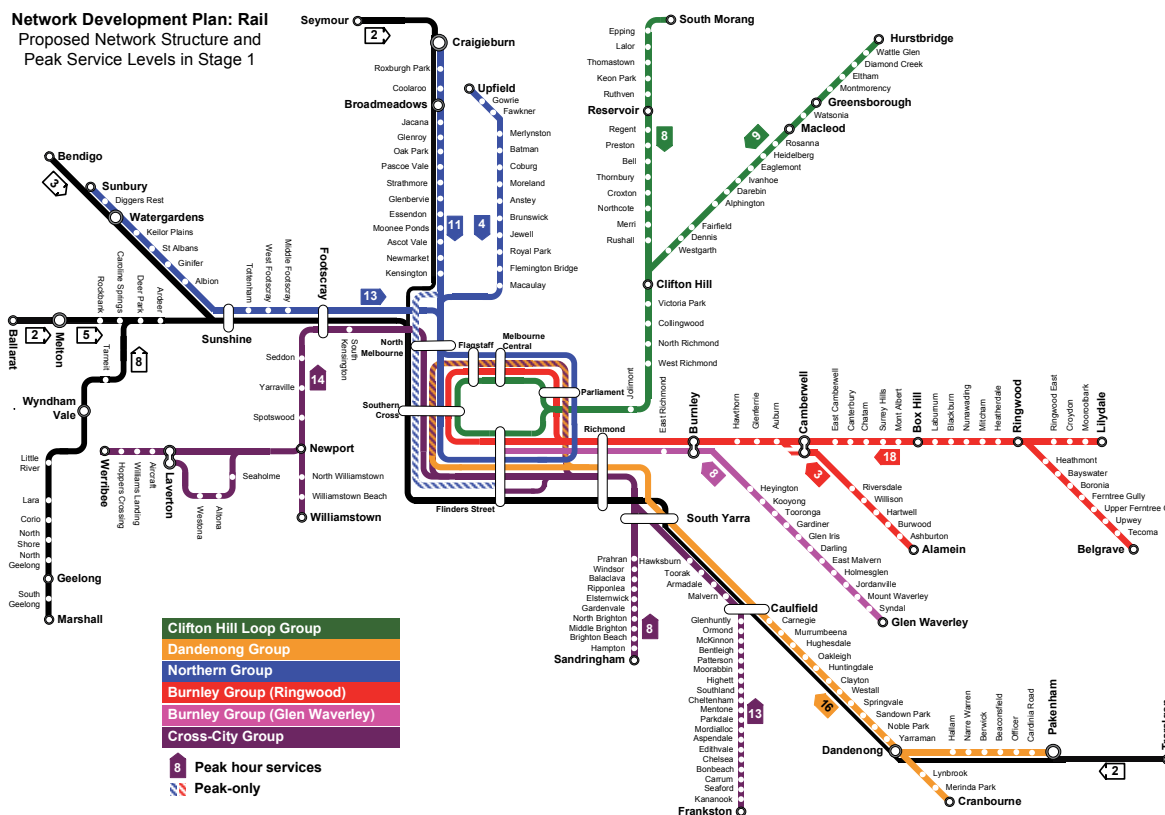
9.2   Clifton Hill Group

Summary

The composition of the Clifton Hill Group will remain unchanged in 2016. However, continuing growth in patronage on the group, in particular on the South Morang corridor, will lead to a need to fully utilise the remaining capacity of the existing system. Services will be added progressively between 2012 and 2016, with a major timetable re-design enabled by the Hurstbridge line upgrades. These upgrades include new signalling and stabling facilities at Eltham, which are currently in construction and will to be completed in 2013.

Key service changes

The following key service changes are planned for the Clifton Hill Group by 2016:

- New timetable following the implementation of new stabling at Eltham and signalling upgrade between Greensborough and Hurstbridge
- Altered operation of City Loop at weekends to provide consistent routing with trains running clockwise at all times of the week, enabling a more legible service offer
- Addition of new peak hour services on the South Morang and Hurstbridge lines in line with patronage growth
- Implementation of 10 minute off-peak services on South Morang line.

2016 Service Plan

Clifton Hill Group Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
South Morang to City Loop via Flinders Street Stops All Stations	**8**	**14**	**6**	**3**	3	2
Hurstbridge to City Loop via Flinders Street Peak: Limited Stop Off-peak: Stops All Stations	3	5	1.5	**1.5**	1.5	2
Eltham to City Loop via Flinders Street Peak: Limited Stop Off-peak: Stops All Stations	**3**	**7**	1.5	**1.5**	1.5	-
Greensboro' to City Loop via Flinders Street Peak: Limited Stop Off-peak: N/A	3	5	-	-	-	-
*= Some services may originate at an intermediate location City Loop Operation: Clockwise at all times						

9.3   Dandenong Group

Summary

There will be a critical requirement to introduce the first new high capacity train on the Dandenong Group by about 2017 to address overcrowding on the line. The following constraints exist on the line:

- Existing signalling systems preclude reliably operating more than 18 trains per hour including V/Line services
- Numerous level crossings on the corridor make it unrealistic to operate more than 18 trains per hour
- Operating nine-car trains will require significant rolling stock procurement, major upgrades to platforms and concourses at Flinders Street and the removal of Dandenong corridor services from the City Loop.

In advance of the delivery of the Melbourne Metro rail tunnel, high capacity trains will enable average loads of up to 1100 passengers to be carried without adversely affecting dwell times or performance. As a result, planning for the new fleet of trains is focused around the initial deployment occurring on the Dandenong corridor in line with a new maintenance and stabling facility at Pakenham East.

Key service changes
The following key service changes are planned for the Dandenong Group by 2016:

- New greenfield timetable to fully sectorise Dandenong services from Frankston and Sandringham services at all times of the week

- Provision of longer peak service with peak hour service levels operating for around 100 minutes to encourage peak spreading and accommodate rapid growth in patronage arriving in the city after 8.45am
- Adjusted peak stopping patterns to improve load balancing – final option to be determined in consultation with the rail operator
- Implementation of 10 minute service to Dandenong during weekday inter-peak periods and 20 minute services to Cranbourne and Pakenham – this will match the service provision introduced on weekends in April 2012
- All trains to operate consistently as express services between Malvern and South Yarra at all times (except late night) to improve travel times for all passengers on the Dandenong Group and V/Line services from the Latrobe Valley.

2016 Service Plan

Dandenong Group Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Pakenham to City Loop Most Times: Limited Stop Other Off-peak: Stops All Stations	7	**14**	**3**	3	3	3
Cranbourne to City Loop Most Times: Limited Stop Other Off-peak: Stops All Stations	5	9	**3**	-	3	-
Dandenong to City Loop Most Times: Limited Stop	**4**	7	-	-	-	-
Cranbourne to Dandenong Shuttle Stops All Stations	-	-	-	3	-	3
*= Some services may originate at an intermediate location City Loop Operation: Anti-Clockwise except weekday PM						

9.4   Northern Group

Summary

In 2016, the Northern Group will continue to include the Craigieburn, Sunbury and Upfield lines. The completion of RRL will fundamentally alter the operation of the group, with improved capacity and reliability delivered on all lines as a result of the segregation of regional services between Sunshine and Southern Cross.

New services will be introduced as soon as RRL is fully operational and further additional services will be added progressively in pathways enabled by RRL as new rolling stock becomes available and in-line with patronage requirements.

As noted in the 2012 period, the Northern Group remains challenged by a lack of inner-city capacity to accommodate all services from each of the three lines. While the solution to the

problem will be the delivery of the Melbourne Metro rail tunnel project (see Stage 2), an interim solution will be needed in the medium term while construction of the tunnel is completed.

As such, following the full implementation of RRL there is an opportunity to operate alternate peak hour Craigieburn services direct to Flinders Street to release capacity for more Sunbury and Upfield services to operate via the City Loop. This operation will require the peak hour Northern Group timetable to be constructed and operated in conjunction with the Cross-City Group timetable, as direct Craigieburn services would share tracks with the Cross-City Group between North Melbourne and Flinders Street. Concept timetables developed by PTV demonstrate that this operation can work effectively and reliably.

Key service changes
The following key service changes are planned for the Northern Group by 2016:
- Full sectorisation of the Northern Group from the Cross-City Group at all off-peak times, with the full removal of the Werribee / Williamstown line from the Northern loop at weekends. This will provide more consistent and legible service provision, improve reliability through reduced conflicts and containment of delays and improve travel opportunities with the provision of through services from Newport to Caulfield on weekends
- Removal of Ballarat, Bacchus Marsh and Bendigo V/Line services from the Northern Group lines between Sunshine and Southern Cross, releasing capacity for more metropolitan services and improving reliability
- New greenfield timetable to be introduced upon completion of RRL, delivering more services on all lines and improved reliability
- New service pattern on the Craigieburn line at peak times, with half of the services running via the City Loop and half direct to Flinders Street via Southern Cross
- Extra peak hour service on the Upfield line
- Implementation of 10 minute off-peak services to Craigieburn and Sydenham and 20 minute evening services to all stations.

2016 Service Plan

Northern Group Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Sunbury to City Loop Peak: Limited Stop Off-peak: Stops All Stations	**6**	**9**	**3**	**3**	**3**	**2**
Sydenham to City Loop Stops All Stations	**7**	**12**	**3**	-	-	-
Craigieburn* to City Loop Stops All Stations	5	11	**6**	**3**	3	2
Craigieburn* to Flinders St via Southern Cross Stops All Stations	**6**	**9**	-	-	-	-
Upfield to City Loop Stops All Stations	**4**	**7**	3	**3**	3	2
*= Some services may originate at an intermediate location City Loop Operation: Clockwise except weekday PM						

9.5   Burnley Group

Summary

A new Greenfield timetable will be introduced on the Burnley Group to deliver a more consistent, legible and reliable service outcome that better utilises rolling stock by spreading passenger loads. The PM peak operation will be designed to mirror the current AM peak services and the Glen Waverley line will be separated as a stand-alone sub-group, similar to the Sandringham line, with trains operating from platform 4 at Flinders Street. These changes, coupled with the improvement in off-peak service levels, will result in a more metro-style service provision where the majority of passengers will have access to a 'turn up and go' system at most times of the week.

Key service changes

The following key service changes are planned for the Burnley Group by 2016:
- Separation of Glen Waverley line from the remainder of the Burnley Group
- Implementation of 10 minute weekday off-peak frequencies to Glen Waverley and Ringwood and 20 minute weekday off-peak frequencies to Belgrave and Lilydale – the Ringwood changes will match the recent service improvements implemented on weekends
- New greenfield timetable for the entire group, resulting in a more efficient and customer-focused service offer and improved overall reliability
- Alteration of stopping patterns to improve balance of train loadings and make better use of short starting services.

2016 Service Plan

Burnley Group Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Belgrave* to City Loop Peak: Limited Stop Off-peak: Stops All Stations	6	12	**3**	2	3	2
Lilydale* to City Loop Peak: Limited Stop Off-peak: Stops All Stations	6	12	**3**	2	3	2
Ringwood to City Loop Stops All Stations except East Richmond	2	**5**	-	-	-	-
Box Hill to City Loop Stops All Stations except East Richmond	4	6	-	-	-	-
Alamein# to City Loop Stops All Stations except East Richmond	3	6	-	-	-	-
Alamein to Camberwell Shuttle Stops All Stations	-	-	3	2	3	2
Glen Waverley to Flinders Street Stops All Stations	8	**15**	**6**	2	3	2
*= Some services may originate at an intermediate location; City Loop operation: Clockwise except weekday AM						

9.6   Cross-City Group

Summary

Following the introduction of RRL, the Cross-City Group will be fully segregated from regional services at all times of the week, creating significant additional capacity and improved reliability on the Werribee / Williamstown line with flow-on benefits to the Frankston and Sandringham lines. While the timetable design will not alter significantly, the removal of Geelong services from the corridor will lead to the immediate introduction of three additional Werribee peak hour services which will ease crowding and cater for rapid growth on the corridor. As demand continues to grow and new rolling stock becomes available, further services will be added from Werribee up to the capacity of the existing infrastructure.

Capacity will also become available for off-peak services to be enhanced with the ability to remove the Laverton-Newport shuttle and operation of Laverton (via Altona) services through to Flinders Street. This will remove the need for passengers to interchange at Newport.

At this time a review will be necessary of the operation of the Frankston services running via the Dandenong loop at peak times. This will need to strike a balance between the convenience of direct access to underground loop stations and the simplicity (and consequent increased reliability) of routing all services onto the Cross-City Group.

Key service changes

The following key service changes are planned for the Cross-City Group by 2016:

- Removal of Geelong V/Line services from the Werribee / Williamstown corridor, enabling new metropolitan services to be added from Werribee at peak times and operation of Laverton (via Altona) services through to Flinders Street at off-peak times
- Introduction of Cross-City operations on weekends delivering a consistent service offer at all times of the week and through running from Newport to Caulfield
- Introduction of 10 minute trunk services to Newport and Sandringham on weekends
- Introduction of 10 minute trunk services to Sandringham during weekday inter-peaks
- Removal of all shuttle operations with through services offered from Altona to the city on weekday inter-peaks and from Williamstown to the city on weekends and other off-peak times.

2016 Service Plan

Cross-City Group Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Werribee to Flinders Street via Main Line Peak: Limited stops; most continue to Frankston line Off-peak: Stops all stations; continue to Frankston line	**8**	**15**	3	-	-	-
Werribee to Flinders Street via Altona Stops all stations; continue to Frankston line	-	-	-	3	3	**3**
Laverton to Flinders Street via Altona Stops all stations	3	6	**3**	-	-	-
Williamstown to Flinders Street Stops all stations; continue to Frankston line	3	5	3	3	**3**	**3**
Frankston to Flinders Street Limited stops; continue to Werribee / Williamstown	**7**	**11**	-	-	-	-
Frankston* to City Loop Stops all stations	7	**11**	6	3	6	3
Sandringham to Flinders Street Stop all stations	8	**16**	**6**	3	**6**	3
*= Some services may originate at an intermediate location Through services operate via Flinders Street and Southern Cross						

10 Stage 1 – Key projects

10.1 Summary

As discussed earlier, the key focus of the plan over the next few years is to implement a number of major infrastructure projects with the aim of creating more capacity in rapidly growing areas in Melbourne's west.

These changes will culminate in the delivery of RRL, which will enable improved segregation of the network as far as practical – in particular, between regional and metropolitan services. The 2016 Service Plans and those from 2016 onwards build on the full delivery of RRL and the consequential network reconfiguration it enables.

The upgrade of the Hurstbridge line will be completed in 2013, enabling additional peak services to operate on the line and some existing short starting services to commence from Hurstbridge or Eltham.

The key projects for this period are shown schematically below.

Figure 10-1: Summary of projects to be implemented by 2016
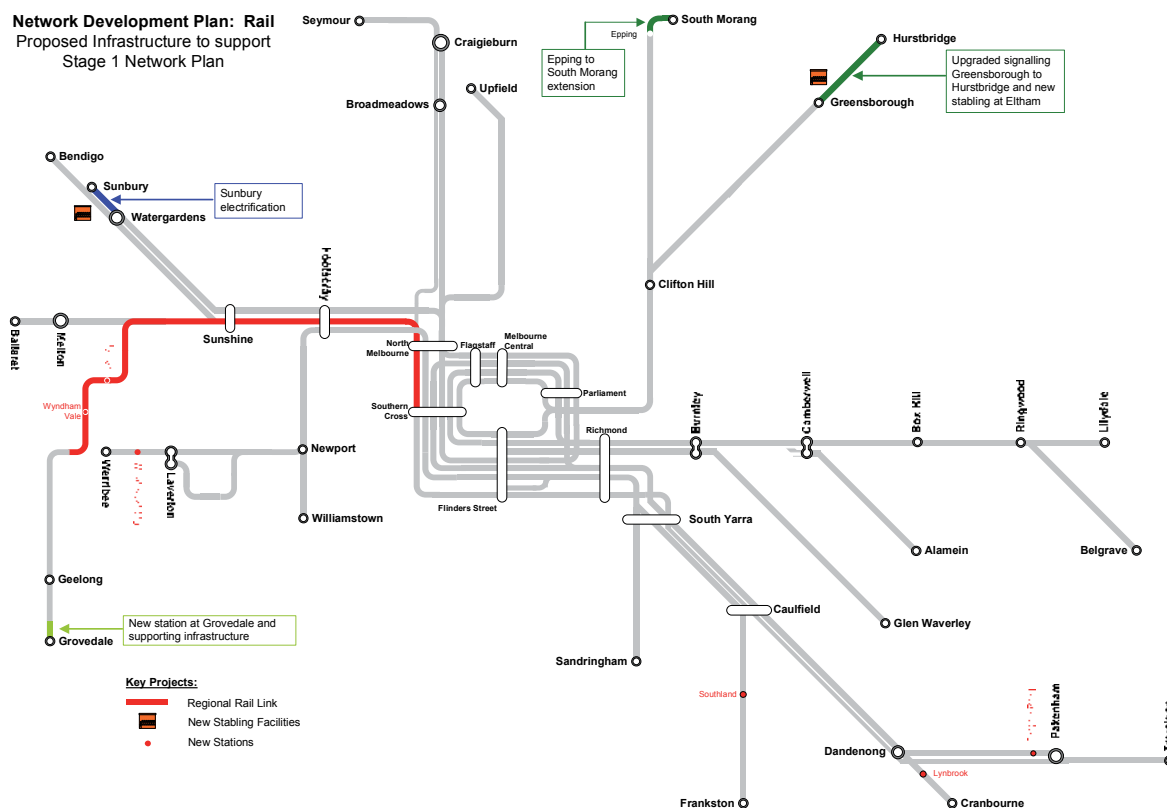
10.2　Improved network segregation

A number of operational and minor infrastructure projects will be undertaken to further improve the network segregation as far as practical within the constraints of the existing network. During this period, the key focus of the segregation changes will be to release more capacity in the inner core to generate as much capacity out of the system as possible and improve service reliability.

Operational changes

Streamlining City Loop services

As routes become segregated, there will be a need to remove some services from the City Loop. The process commenced in 2009 with the removal of Werribee services from the loop at peak times and continued with the May 2011 timetable change when all weekday Werribee / Williamstown, all Frankston weekday off-peak and all Glen Waverley morning services were removed from their respective group underground loops.

To improve network reliability and increase the capacity of the system, the following operational changes will be made to the City Loop:

- The full removal of Glen Waverley services from the City Loop at all times, enabling improved operations on all Burnley Group lines
- The removal of one in two Craigieburn services at peak times only due to capacity constraints in the Northern Underground Rail Loop.

Each of the above are described in more detail in other parts of this document and are all essential operational changes required to unlock some of the remaining capacity in the existing network. Moreover, significant reliability benefits will be achieved by enabling the sectorisation of the network in this manner.

Altered crew-changeover arrangements at Flinders Street

At present, all metropolitan train services are scheduled with a crew changeover at Flinders Street. While this practice offers an opportunity for recovery and train re-routing at times of disruption, it also reduces the overall through-put of the section. At peak times, the reduction in capacity becomes the critical bottleneck on some lines.

Crew changeover arrangements will be altered progressively to enable improved capacity and sectorisation of the network. In particular, the removal of peak hour crew changeovers will enable the following redistribution of platforms and associated track-work:

- The operation of Northern Underground Loop services via platform 5 only, releasing platform 4 to be used by Burnley direct services and eliminating interaction between the Burnley Group and the Northern Group
- The removal of Burnley direct services from platforms 6 and 7 will allow those platforms to be dedicated to Dandenong Group and Frankston loop services and V/Line terminating trains
- Platform 8 will be dedicated to inbound Werribee / Williamstown services that form outbound Frankston services
- Platform 9 will be simplified and dedicated to terminating services from the Werribee / Williamstown and Craigieburn lines
- Quicker throughput on platform 1 will also speed up travel times on the South Morang and Hurstbridge lines as well as reducing the instances of trains needing to stop at platform 14.

Removal of stabling moves in the peak 1.5 hours

At present, a number of peak hour trains form empty services to stabling upon arrival at Flinders Street. These trains are not required for the inter-peak period and must travel to a stabling facility until the next peak period. This requires trains to be inspected before departure leading to delays as well as commuter frustration. The curfew of stabling moves during this period will improve capacity and reliability across the network.

10.3 Internal train reconfiguration

The carrying capacity of trains is determined by the number of seats available, the accessible standing area and the time to board and alight at the busiest stations. At present, a load standard of an average of 800 passengers per train (averaged over any hour) is used for both the Comeng and Siemens fleets, as loads above this level affect the performance of the network due to the extended dwell times in the inner core.

The new X'Trapolis fleet currently operates successfully with an average load of 900 passengers due to an improved layout that enables quicker boarding / alighting and access to and from seating areas. A project to retrofit the first generation of X'Trapolis trains to replicate the new fleet is also close to completion.

An internal reconfiguration of the Siemens and Comeng fleets will enable more passengers to be carried while maintaining acceptable dwell times. This will involve moving some seats to create larger vestibules between the doorways and installing new handrails and straps in those areas. It is expected that an average load of 900 passengers per train will then be achievable by all train types, bringing the Siemens and Comeng trains in-line with the X'Trapolis fleet.

Key benefits
- Improves carrying capacity of Siemens and Comeng trains whilst protecting reliability
- Enables more passengers to be carried per service
- Improves boarding and alighting times
- Provides more comfortable standing room with provision of additional handrails and straps.

Project scope
- Removal and realignment of seats to improve standing areas and access to seating
- Installation of new handrails and straps to create more comfortable standing areas.

10.4 Hurstbridge line upgrade

Currently, an older-style signalling system is in operation on the Hurstbridge line beyond Greensborough. An electric staff system operates between Greensborough and Eltham and a manual 'staff and ticketing' system is in operation beyond Eltham. Along with the provision of additional stabling, the replacement of these systems with automated signalling will improve the reliability and capacity of the line.

Automated signals are being installed at strategic locations along the rail corridor between Greensborough and Hurstbridge stations to allow more than one train to travel in the same direction along the single track. The project also includes the addition of train stabling facilities at the Eltham stabling yard and the construction of a new power substation in Montmorency.

The project will improve the reliability and efficiency of the Hurstbridge line, enable extra peak period services to operate between Eltham and the city and allow new and existing services to operate more efficiently.

Key benefits

- Enables additional services to be operated from Eltham to the city at peak times
- Improves reliability leading to fewer cancellations and early terminations
- Provides more efficient operations with reduced layover times.

Project scope

- Replacement of existing signalling systems beyond Greensborough with an automatic track controlled safe working system
- New power substation at Montmorency
- Construction of two new stabling sidings and release track at Eltham.

10.5   Regional Rail Link: Stage 1 (Southern Cross to South Kensington)

RRL will be delivered in three stages. The first stage will involve the implementation of Southern Cross platforms 15 and 16 and the upgrade of the main goods lines between South Kensington and Southern Cross stations. The implementation of this early stage will provide reliability benefits for all Northern, Cross-City and regional train lines that run through North Melbourne.

Stage 1 will enable selected Geelong services to be diverted onto the main goods lines and directly into Southern Cross platforms 15 and 16. Currently, Geelong services travel on the through suburban lines via platforms five and six and need to cross from the western side of North Melbourne to the eastern side of Southern Cross station crossing all Northern Loop services.

These works will significantly reduce the number of at-grade conflicts at Franklin Street into Southern Cross platforms one to eight helping to improve reliability on the suburban network.

Key benefits

- Stage 1 of RRL will enable selected Geelong trains to be diverted at South Kensington on to the main goods lines and directly into Southern Cross Platforms 15 and 16, removing operational conflicts and providing reliability benefits to the suburban network
- This will also release inner core capacity to operate additional suburban services direct to Flinders Street. Initially this will consist of three additional Craigieburn services.

10.6   Regional Rail Link: Stage 2 (South Kensington to Sunshine)

The second stage of RRL involves the construction of a new pair of tracks between South Kensington and Sunshine alongside the existing Sunbury track pair. The additional track pair will create the opportunity to fully sectorise Sunbury line metropolitan trains from the Ballarat and Bendigo lines inbound from Sunshine. This will allow additional services to operate on all these lines and will eliminate all remaining conflicting movements over the Franklin Street junction, as regional services will travel via the Dynon fly-over at North Melbourne.

Key benefits

- Capacity released to operate more services on the Sunbury line and on the Ballarat and Bendigo corridors
- Improved reliability through the segregation of regional and metropolitan services inbound from Sunshine. This includes major benefits between North Melbourne and Southern Cross where regional trains will no longer be required to cross at-grade to access the regional platforms at Southern Cross.

10.7   Regional Rail Link: Stage 3 (Sunshine to West Werribee)

The final stage of RRL will provide a new track pair from Deer Park to West Werribee via Tarneit and Wyndham Vale stations. The creation of this link will complete the RRL project and deliver significant benefits for regional and suburban services.

All Geelong trains will run via Tarneit and merge with other regional trains from Ballarat and Bendigo at Deer Park Junction. All of these services will then proceed to Southern Cross via a dedicated track pair.

The removal of regional trains from the Sunshine and Werribee metropolitan corridors will provide critically needed capacity for additional metropolitan services to be added immediately to these high growth corridors.

RRL will also set the foundations for further metropolitan trains to be added on the Sunbury and Werribee corridors following the completion of the Melbourne Metro rail tunnel project in Stage 2.

Key benefits

- Improved peak hour capacity on Werribee, Sunbury, Craigieburn and Upfield lines
- Improved peak hour capacity on Geelong, Ballarat and Bendigo lines
- Significantly improved reliability on all lines operating through the North Melbourne precinct through the sectorisation of metropolitan and regional services
- Ability to protect travel times on regional services by removing slower metropolitan trains from their corridors.

11 Stage 2 – Network plan and service levels

Stage 2 will see the implementation of the Melbourne Metro rail tunnel project. This generational project will provide the biggest overhaul of the metropolitan rail network since the opening of the City Loop in the early 1980s. The Melbourne Metro rail tunnel project, planned for completion during Stage 2, will result in a fundamental change to the network structure and lead to significant improvements in capacity, reliability and travel times as Melbourne moves to a metro-style train system.

11.1 Background

The Melbourne Metro rail tunnel project will create the opportunity to increase service frequencies on six existing corridors; deliver the ability to operate longer trains on the Sunbury and Dandenong corridors; provide the inner-city capacity to enable future metropolitan services to operate from Melton, Melbourne Airport and Rowville; and significantly alter the routing and operating patterns of a number of lines from the northern, south eastern and western growth areas.

The delivery of the project will result in a major reconfiguration of the Northern, Cross-City and Dandenong Groups into four new independent lines operating as follows:
- Northern Loop Line: Craigieburn and Upfield services running exclusively via the Northern Loop
- Sunshine – Dandenong Line: Sunbury, Cranbourne and Pakenham services via the Melbourne Metro rail tunnel
- Cross-City Line: Reconfigured from the previous Cross-City Group to provide exclusive use for Werribee and Williamstown services to operate direct to Flinders Street via Southern Cross and through to Sandringham and vice versa
- Frankston Loop Line: Frankston corridor services operating as a stand-alone group via the released Caulfield Underground Rail Loop.

In this period, with the delivery of the Melbourne Metro rail tunnel and other supporting upgrades, service plans and timetables will be further simplified and start to operate with genuine metro-style characteristics. Moreover, the Melbourne Metro rail tunnel project will be the key enabler to allow the extension of the network to Melbourne Airport and Rowville, as well as the ability to operate electrified services from Melton via the tunnel. These supplementary works are planned for implementation as part of Stage 3 of this plan.

A number of other key projects will be implemented in Stage 2 that will influence service design and network structure over the next decade. Of particular importance will be the roll-out of the new high capacity trains and the commencement of the upgrade to high capacity signalling systems. Both of these projects will enable more passengers to be carried every hour on the existing network.

As discussed in Stage 1 (to 2016), the initial deployment of high capacity trains from 2017 will be on the Dandenong corridor. During Stage 2, a full fleet of high capacity trains will be in operation on the new Sunshine – Dandenong Line operating through the Melbourne Metro rail tunnel.

In this period, high capacity signalling will be implemented on the Sandringham line as an initial pilot and on the trunk section of the Clifton Hill Group to enable more trains to operate to South Morang and Hurstbridge. High capacity signalling will also be implemented through the Melbourne Metro rail tunnel and on the Sunbury corridor.

Figure 11-1 provides a schematic representation of the network configuration in Stage 2, with peak hour service numbers shown on each corridor based on the indicative Stage 2 timetable changes. Detailed service levels in peak, shoulder and off-peak times are described line-by-line in the following sections.

Figure 11-1: Schematic diagram of Stage 2 network (following implementation of the Melbourne Metro rail tunnel project)
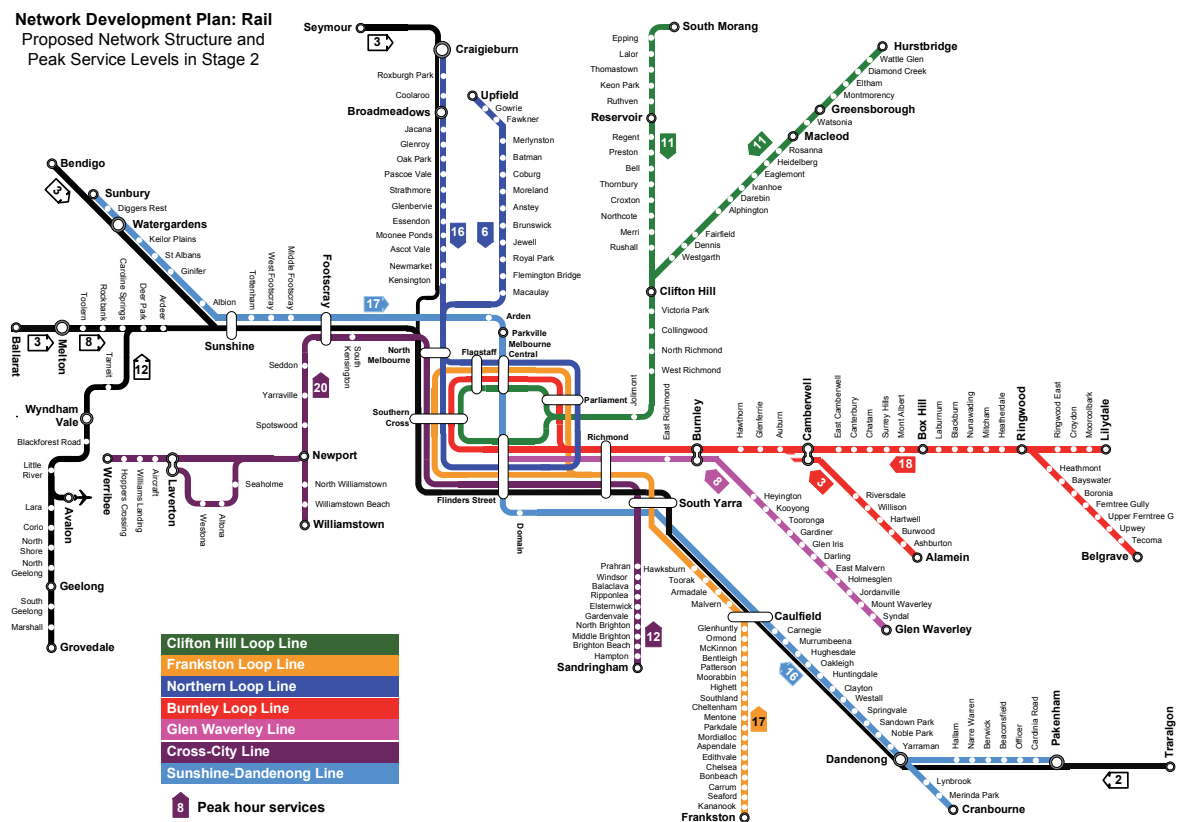
11.2   Clifton Hill Loop Line

Summary

To meet patronage requirements and protect reliability, a number of major infrastructure upgrades are planned to be implemented on this line group during Stage 2. The installation of high capacity signalling between Clifton Hill and the city will increase capacity on this busy and congested section of the corridor and enable more trains to operate. The full benefits of high capacity signalling will also require duplication of the single track between Heidelberg and Rosanna as well as a reconfiguration of Clifton Hill Junction.

Key service changes

The following key service changes are planned for the Clifton Hill Group during Stage 2:

- New greenfield timetable with additional peak hour services on both Epping and Hurstbridge lines following implementation of high capacity signalling, Clifton Hill Junction works and duplication between Heidelberg and Rosanna
- Implementation of 10 minute inter-peak services to Macleod and 10 minute weekend services to Macleod and South Morang.

Stage 2 Service Plan for Clifton Hill Loop Line

Clifton Hill Loop Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
South Morang* to City Loop via Flinders St Stops All Stations	**11**	**19**	**6**	**3**	3	**3**
Hurstbridge to City Loop via Flinders Street Stops All Stations	3	5	1.5	**1.5**	1.5	1.5
Eltham* to City Loop via Flinders Street Stops All Stations	3	7	1.5	**1.5**	1.5	**1.5**
Macleod to City Loop via Flinders Street Stops All Stations	5	8	**3**	-	-	-
*= Some services may originate at an intermediate location City Loop operation: Clockwise at all times						

11.3   Frankston Loop Line

Summary

The Frankston Loop Line will be created upon completion of the Melbourne Metro rail tunnel and will include the Frankston Line, the Caulfield through lines to Richmond and the Caulfield Underground Rail Loop (the latter having been released by the diversion of Dandenong services into the MM tunnel). The Frankston Loop Line will operate during the day as an independent stand-alone sector, delivering a high level of service reliability and an immediate increase in peak hour capacity. Service plans will be designed to make better use of rolling stock by operating one in two services from Cheltenham or Moorabbin.

To ensure an efficient utilisation of assets, the Frankston Loop Line will share a pool of rolling stock, maintenance and stabling facilities with the Cross-City Line; this will require occasional positioning moves at off-peak times to and from Newport and North Melbourne stabling yards.

The Westall maintenance facility will also be available to support the Frankston Loop Line, however, in Stage 3 it is planned to start the roll-out of high capacity trains onto the Frankston line, necessitating the construction of a new line-specific maintenance and stabling facility at Baxter.

Key service changes

The following key service changes are planned for the Frankston Loop Line during Stage 2:

- Major network reconfiguration resulting in the creation of the Frankston Loop Line offering high frequency, high reliability service from Frankston into the City Loop
- Introduction of additional services in-line with demand increases and to cater for interchange passengers wishing to access the City Loop
- Altered service pattern to enable higher frequency and offer faster travel times.

Stage 2 Service Plan for Frankston Loop Line

Frankston Loop Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Frankston to City Loop Peak: Limited Stop Off-peak: Stops All Stations	**8**	**14**	6	6	6	3
Carrum* to City Loop Most Times: Limited Stop Other Off-peak: Stops All Stations	**4**	**6**	-	-	-	-
Cheltenham* to City Loop Most Times: Limited Stop	**5**	**9**	-	-	-	-
*= Some services may originate at an intermediate location City Loop operation: Anti-Clockwise at all times						

11.4   Northern Loop Line

Summary

The Northern Loop Line will be created with the opening of the Melbourne Metro rail tunnel and will include the Craigieburn and Upfield lines, as well as the main and east suburban lines from North Melbourne to Southern Cross and the Northern Underground Rail Loop. The removal of Sunbury services from the Northern loop creates much needed inner-city capacity to enable more services to operate from both the Craigieburn and Upfield lines. This will lead to the operation of an 11 minute service from Upfield, five to six minute services from Broadmeadows and even more frequent services from Essendon. To achieve these service levels, new terminus capacity will be provided through additional platforms at Upfield and Essendon. Existing stabling and maintenance facilities on the lines will provide sufficient capacity for the rolling stock required for the Northern Loop Line.

In advance of the completion of the Melbourne Metro rail tunnel project, a signalling upgrade is planned for the northern loop to enable an additional service to operate from each of the Craigieburn and Sunbury corridors.

Key service changes

The following key service changes are planned for the Northern Loop Line during Stage 2:

- Major network reconfiguration leading to the creation of the Northern Loop Line, providing dedicated City Loop access to the Craigieburn and Upfield lines and high frequency, high reliability services for both lines
- Removal of Craigieburn direct services to be replaced by additional loop services
- Introduction of Essendon short services to accommodate high demand inbound from Essendon and avoid overcrowding on services from Craigieburn.

Stage 2 Service Plan for Northern Loop Line

Northern Loop Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Craigieburn* to City Loop Stops All Stations	**11**	**22**	**6**	**6**	**6**	**3**
Essendon to City Loop Stops All Stations	**5**	**6**	-	-	-	-
Upfield to City Loop Stops All Stations	**6**	**11**	**3**	3	3	**3**
*= Some services may originate at an intermediate location City Loop operation: Clockwise at all times						

11.5   Burnley Group

Summary

The Burnley Group will be unaffected by the network changes following the Melbourne Metro rail tunnel project and will continue to operate as it did in the previous period. Due to low forecast growth in peak patronage, it is not anticipated that additional services will be required; however, off-peak patronage growth will drive improvements in evening service frequencies on the Ringwood corridor.

Key service changes

- Implementation of improved evening services to Ringwood, Belgrave and Lilydale with trunk services operating every 10 minutes and branch services operating every 20 minutes, mirroring the inter-peak service levels.

Stage 2 Service Plan for Burnley Group

Burnley Group Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Belgrave* to City Loop Peak: Limited Stop Off-peak: Stops All Stations	6	12	3	**3**	3	**3**
Lilydale* to City Loop Peak: Limited Stop Off-peak: Stops All Stations	6	12	3	**3**	3	**3**
Ringwood to City Loop Stops All Stations except East Richmond	2	5	-	-	-	-
Box Hill to City Loop Stops All Stations except East Richmond	4	6	-	-	-	-
Alamein# to City Loop Stops All Stations except East Richmond	3	6	-	-	-	-
Alamein to Camberwell Shuttle Stops All Stations	-	-	3	3	3	**3**
Glen Waverley to Flinders Street Stops All Stations	8	15	6	3	3	**3**
*= Some services may originate at an intermediate location; City Loop operation: Anti-Clockwise at all times						

11.6   Cross-City Line

Summary

The Cross-City Line will be created upon completion of Melbourne Metro rail tunnel project and will differ from the Cross-City Group operating in the previous period in the following ways:

- The Frankston line will no longer form part of the group, having been separated into a new stand-alone group operating via the Caulfield Underground Rail Loop
- Sandringham services will no longer terminate at Flinders Street and will instead through-run to the Werribee / Williamstown line offering direct connections to Southern Cross, North Melbourne, Footscray and beyond
- Peak period services from Werribee / Williamstown will run through to Sandringham or turn-back at a new terminus created at South Yarra providing empty trains to the city from South Yarra to serve the high number of boardings at that location.

The reconfigured network will lead to additional peak hour trains being provided on the Werribee and Sandringham lines providing for continued growth west of Laverton and enabling a five minute service to operate on the Sandringham line using high capacity signalling.

Key service changes

The following key service changes are planned for the Cross-City Line during Stage 2:

- Major network reconfiguration leading to revised Cross-City Line with through running from Werribee to Sandringham and more sectorised and reliable operations
- New peak hour services added to Werribee / Williamstown and Sandringham lines upon completion of network changes.

Stage 2 Service Plan for Cross-City Line

Cross-City Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Werribee to Flinders Street via Main Line Stops all stations; continue to Sandringham	**13**	**21**	**6**	-	**6**	-
Werribee to Flinders Street via Altona Stops all stations; continue to Sandringham	-	-	-	3	-	3
Laverton to Flinders Street via Altona Stops all stations; continue to South Yarra	**4**	**7**	**3**	-	**3**	-
Williamstown to Flinders Street Stops all stations	3	**7**	3	3	3	3
Sandringham* to Flinders Street Stops all stations; continue to Werribee	**11**	**21**	6	3	**6**	3
*= Some services may originate at an intermediate location Through services operate via Flinders Street and Southern Cross						

11.7   Sunshine – Dandenong Line

Summary

The Sunshine – Dandenong Line will be created upon completion of the Melbourne Metro rail tunnel project and will represent the sixth sectorised operating group on the network. Trains will operate from Sunbury and Sydenham in the west through to Cranbourne and Pakenham in the south-east via the new Melbourne Metro rail tunnel and new underground stations at Arden, Parkville, Melbourne Central (CBD North), Flinders Street (CBD South) and Domain. The new line will also be established to accommodate new extensions in Stage 3:

- A Melbourne Airport rail link connected at Albion via a rail-rail grade separation
- A line to Rowville connected at Huntingdale via a fly-over
- Electrification of the Melton line, which will connect at Sunshine.

The new infrastructure on the Sunshine – Dandenong Line will be constructed with high capacity signalling and allow for the operation of 220 metre long trains. This will enable more passengers to be carried from the growth areas in the city's west and south-east without requiring the construction of new tracks along the existing suburban corridors. Additional carriages will be added to rolling stock sets in line with patronage growth.

Key service changes

The following key service changes are planned for the Sunshine – Dandenong Line during Stage 2:

- Network configuration changes following completion of the Melbourne Metro rail tunnel leading to the creation of the Sunshine – Dandenong Line offering very frequent and highly reliable through services from Sunbury / Sydenham to Cranbourne / Pakenham via new inner-city stations at Arden, Parkville, Melbourne Central, Flinders and Domain
- Operation of high capacity trains on the Sunshine and Dandenong corridors, providing higher carrying capacity for each train path
- Reduced station congestion in inner-city as new stations will be designed to cater for significantly higher passenger volumes
- Design and construction to enable future line extensions to Melbourne Airport, Rowville and Melton
- Enabling the operation of longer trains as patronage requires.

Stage 2 Service Plan for Sunshine – Dandenong Line

Sunshine – Dandenong Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Sunbury to Domain Stops all stations; continue to Dandenong Line	**8**	**14**	3	3	3	3
Sydenham to Domain Stops all stations; continue to Dandenong Line	**9**	**15**	3	3	3	-
Pakenham* to Parkville Express Caulfield-Domain; continue to Sunshine Line	7	15	3	3	3	3
Cranbourne to Parkville Express Caulfield-Domain; continue to Sunshine Line	5	9	3	**3**	3	3^
Dandenong* to Parkville Express Caulfield-Domain; continue to Sunshine Line	4	6	-	-	-	-
*= Some services may originate at an intermediate location ; ^= Shuttle service to/from Dandenong only Services operate via Melbourne Metro rail tunnel stopping at Domain, Flinders Street, Melbourne Central, Parkville and Arden						

12 Stage 2 – Key projects

12.1 Summary

To support the Stage 2 network and service specification plans, a series of major projects will be required.
These include:

- Melbourne Metro rail tunnel project and associated works (including new terminus capacity at Essendon, Upfield and Brighton Beach and improved line-side signalling on the Werribee line)
- Deliver an initial order of up to 33 high capacity trains and order and deliver an additional 70 high capacity trains
- Duplication of the rail line to Melton
- Initial roll-out of new high capacity signalling using in-cab signalling technology, commencing with a trial on the Sandringham line and later with the implementation on the trunk section of the Clifton Hill Group, as well as sections of the new Sunshine – Dandenong Line
- A new train maintenance facility at Pakenham East
- Additional stabling at North Melbourne Storage Yard, Lilydale, Victoria Park and Calder Park.

Figure 12-1: Summary of projects required to support Stage 2
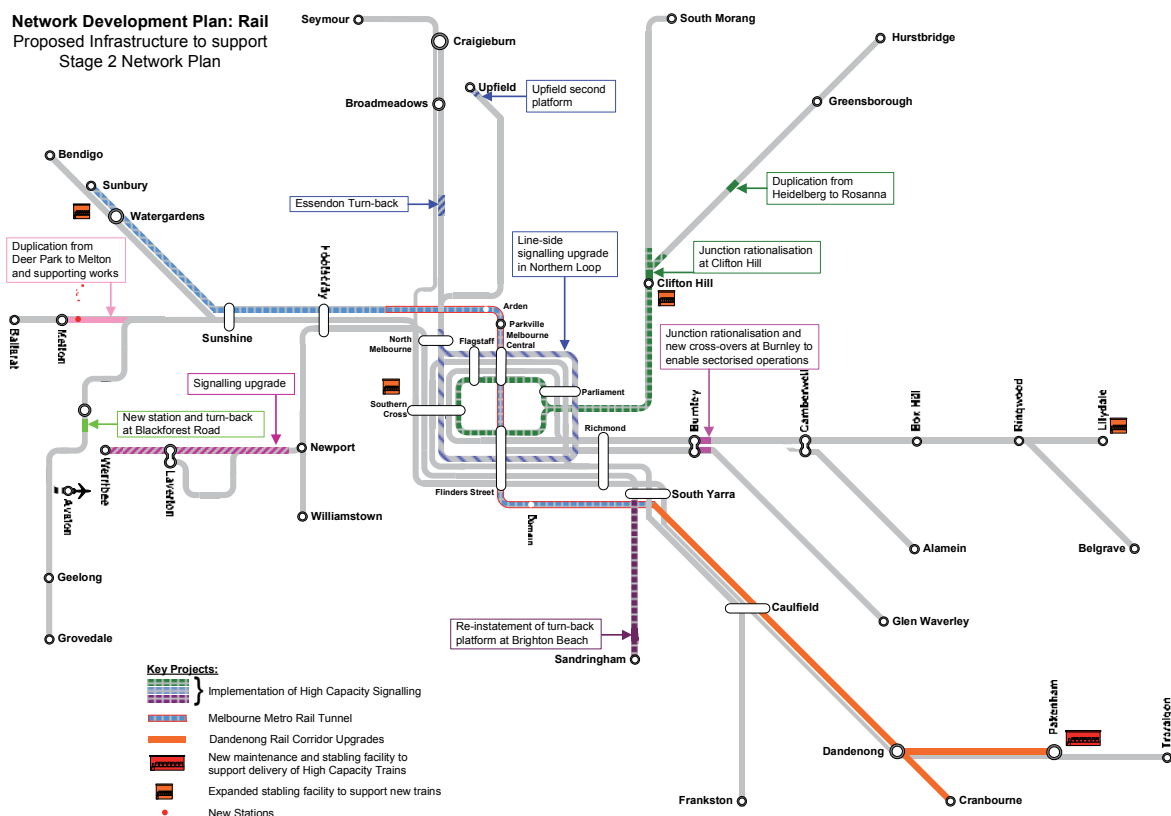
12.2 Melbourne Metro rail tunnel and associated works

The implementation of the Melbourne Metro rail tunnel project will provide a major lift in the capacity and reliability of the city's train network. The project will create the opportunity to immediately increase service capacity on seven existing corridors and provide the capacity to enable future electrified services to operate to Melbourne Airport, Rowville and Melton. It will also alter the routing and operating patterns of a number of lines from the south-east, northern and western suburbs.

The Melbourne Metro rail tunnel project will enable the existing Cross-City, Northern and Caulfield Groups to be reconfigured into four new independent lines creating capacity for the following additional peak hour services from day one:

- Four Werribee line services
- Five Craigieburn line services
- Four Sunbury line services
- Two Upfield line services
- Three Sandringham line services
- One Frankston line service.

The project also enables the operation of 220-metre-long trains on the Sunshine and Dandenong corridors – providing a capacity uplift of 50 per cent.

Key benefits

Melbourne Metro will be designed to deliver a number of key service outcomes:

- Major network reconfiguration delivering an improved sectorised network and more through-running lines
- Increased capacity to operate trains through the inner core of the network through the new tunnel, which will be designed to operate at least 24 trains per hour in each direction in the future
- Inner-city infrastructure to enable future introduction of longer (220 metre) trains on the Pakenham, Cranbourne and Sunbury lines (and provision for extension of longer trains to the Melton line)
- Increased capacity to handle city-bound passengers through the construction of five new stations within inner-Melbourne and the redistribution of key interchange locations
- Improved access to areas served by the five new stations
- Reduced pressure on Melbourne's tram network to support growing passenger numbers travelling to Parkville and St Kilda Road precincts
- 19 additional peak hour services on the Cross-City, Northern and Frankston lines on day one
- Highly punctual and reliable service where the percentage of scheduled headways delivered are comparable to other 'world class' metro operations due to the increased independence associated with greater sectorisation
- Significant land use and city-shaping benefits as well as major reductions in road congestion.

High level scope of works

- New rail tunnel from South Kensington to South Yarra, with new stations at Arden, Parkville, Melbourne Central, Flinders Street and Domain
- Implementation of high capacity signalling in the tunnel section and on the Sunbury corridor
- Upgrade of Essendon turn-back to enable additional services to operate on Craigieburn line using released capacity in the Northern Loop
- Provision of second platform at Upfield to enable additional services to operate on Upfield line using released capacity in the Northern Loop
- Upgraded signalling on Werribee and Craigieburn lines to support additional peak services
- Upgraded turn-back arrangements on the Sandringham line to enable additional peak services to operate
- Additional stabling and maintenance capacity to support increased train requirements and higher service levels.

12.3   High capacity trains and supporting infrastructure

During Stage 1, up to 33 new trains will be ordered for delivery during Stage 2. Following the implementation of the new, post-RRL timetable, all available metropolitan trains will be utilised at peak times.

A further 70 high capacity trains will be ordered and delivered during Stage 2 to cater for demand growth beyond that time and allow the commencement of retirement of Comeng trains. Moreover, to improve the efficiency and carrying capacity of the network, these trains will need to be able to carry more passengers than existing trains.

This will be particularly important on the Dandenong rail corridor where existing line capacity will have been fully utilised by this time. High capacity trains will provide the opportunity to deliver a new generation train onto the Melbourne network that will carry more passengers and provide a higher level of comfort and security, as well as contributing to improved reliability and performance in terms of speed and dwell times.

This delivery of some 100 new trains during the next decade is similar to the number of trains introduced over the last decade.

Key benefits

- More trains on the network will enable additional services to be operated on all lines
- High capacity trains will be utilised on the Dandenong corridor to enable more passengers to be carried
- High capacity trains will have a higher level of passenger comfort and security and will operate more reliably.

High level scope of works

- Delivery of the first order of 33 high capacity trains with a further order and delivery of 70 additional trains

- Construction of a new maintenance facility to support high capacity trains at Pakenham East
- Construction of new stabling facilities at Pakenham East, Calder Park, Lilydale, Eltham and North Melbourne
- Upgraded power supply systems on the Dandenong corridor to support the operation of high capacity trains
- Cascading of Comeng trains from the Dandenong line to other corridors.

12.4   High capacity signalling – pilot

Melbourne's conventional (trackside coloured light) signalling system has adequately served the rail network for more than 100 years. However, the network configuration, rapidly growing patronage and the number of services operating have outgrown its design capacity, which is now restricting growth on the network. These limitations can be overcome through the introduction of high capacity signalling systems, which will enable improved capacity at a significantly reduced cost and in a more sustainable way compared to the alternative of new lines equipped with conventional signalling.

The plan proposes a multi-stage transition to high capacity signalling, starting with a pilot to be installed and operated on the Sandringham line. The pilot project will develop, prove and optimise procedures, processes and principles for the wider introduction of high capacity signalling on the Melbourne network and facilitate the introduction on future rail links (such as Melbourne Metro), future upgrades of existing lines (such as the Clifton Hill and Dandenong rail corridors) and ultimately migration onto the entire network.

Key benefits
- Improved user-satisfaction with the system in relation to service capacity, punctuality, reliability and travel comfort
- Increased productivity of Melbourne's transport network by releasing rail track capacity and allowing performance and capacity of the existing public transport system to be optimised
- Reduced costs to passengers who experience delays or cancellations as a result of unreliable train services and from road congestion
- Improved metropolitan-wide productivity: the business productivity benefits that efficient train services bring to the Victorian economy.
-

High level scope of works
- Implement new technology on the Sandringham line and 14 Siemens trains
- Use pilot to develop and establish the operational capability of high capacity signalling on Melbourne's metropolitan rail network in delivering capacity increases
- Develop new signalling principles, procedures and processes that will enable high capacity signalling to be type-approved and accredited for use as a safe working system for the metropolitan network
- Acquire knowledge on high capacity signalling roll-out including design refinements, rolling stock modifications, productivities, installation costs, maintenance costs, schedule and risk.

12.5 Clifton Hill Group upgrades including high capacity signalling

Following the duplication works on the South Morang line, provision of new stabling at Epping and Eltham and the introduction of a new timetable, the Clifton Hill Group will be able to operate up to 18 trains per hour in the peak.

Due to high patronage growth on the South Morang Line, a total of 21 trains per hour are likely to be required to operate from the group, rising to 24 by Stage 3. This growth will exceed the practical and reliable capacity of the group and limit its capability to allow for future growth in patronage. In order to reliably deliver more services, a number of projects will need to be implemented concurrently to respond to the constraints imposed by the single line sections on the Hurstbridge line, the signalling capacity into Flinders Street and the complexity of the at-grade junction at Clifton Hill.

The Clifton Hill Group upgrades will include the following:

High capacity signalling
The Clifton Hill Group is ideally suited to be the first section of the existing network to implement high capacity signalling operation following the pilot on the Sandringham line. The group is fully separated from the rest of the network in normal operating times, the Clifton Hill loop and associated Flinders Street platforms are not used by any other services and V/Line or freight services do not use any section of the group. A dedicated fleet of X'Trapolis trains will operate on the group and the Burnley Group will no longer be as reliant on Epping as a maintenance facility.

Duplication from Heidelberg to Rosanna
The proposed implementation of high capacity signalling will deliver reliability and inner-city capacity benefits. Nevertheless, the full utilisation of the capability of high capacity signalling will not be achievable without the duplication of single track sections between Heidelberg to Rosanna and Greensborough to Eltham.

The existing single track sections limit capacity to around nine trains per hour on the Hurstbridge line, but also force a sub-optimal and inconsistent timetable pattern on both the South Morang and Hurstbridge lines affecting the reliability of the group and the operation of counter-peak services. The duplication of the line will permit a higher frequency service to operate on the corridor and allow a simpler and more consistent timetable pattern to operate on both corridors in both directions.

In the first instance, the duplication from Heidelberg to Rosanna will be required – enabling up to 11 trains per hour to operate on the line with high capacity signalling. To support the duplication, and enable more services to be operated, the track configuration at Macleod will be reconfigured to enable new short starting services to originate and terminate in a centre platform with through services operating via the outside platforms.

The duplication beyond Greensborough will be required later in the program.

Clifton Hill Junction upgrade

Clifton Hill Junction is one of the most critical junctions on the network and will need to process a higher number of alternating train movements than any other junction on the network. Moreover, following the duplication between Heidelberg and Rosanna and the implementation of high capacity signalling, the junction will become the key bottleneck on the group and be the critical factor in determining the capacity of the group.

Furthermore, even with the provision of high capacity signalling, outbound Hurstbridge line trains will need to cross onto the inbound South Morang track before crossing onto the branch line to Hurstbridge.

A reconfiguration of the junction will reduce the amount of time required to accommodate this movement and enable city-bound South Morang trains to be scheduled closer to the departure time of an outbound Hurstbridge train. This reconfiguration will require the existing cross-overs to be replaced with an upgraded junction.

Key benefits

An upgrade to high capacity signalling operation, the duplication works and implementation of new turn-backs on the Clifton Hill Group will provide the following benefits:
- Enable more services to operate on the South Morang and Hurstbridge lines
- Improved reliability on the South Morang and Hurstbridge lines as the signalling system will determine the optimum speed and positioning of trains relative to each other
- Faster travel times as current speed restrictions based on driver visibility will no longer apply
- Reduced operating and maintenance costs as the new signalling system will require less line-side equipment
- Avoid the need to replace existing line-side signalling equipment when it becomes life-expired.

High level scope of works
- Installation of communication based signalling system in the Clifton Hill loop and on all tracks between Flinders Street, Rushall and Westgarth
- Installation of in-cab signalling equipment on all X'Trapolis trains operating on the Clifton Hill Line
- Duplication of single track section between Heidelberg and Rosanna, including provision of a new bridge and tunnel
- Replacement of existing cross-overs at Clifton Hill with an upgraded junction.

12.6   Melton duplication and supporting upgrades

The construction of the RRL in 2016 will provide significant capacity improvements for regional services from the western corridors to access the city. Two additional services are likely to be added on the Ballarat line upon opening of the RRL; however, patronage growth is expected to require further capacity to be added from Ballarat and especially Melton shortly after. Further service increases will require the duplication of the section between Deer Park and Melton, as well as additional passing loops to be constructed on the Ballarat corridor.

These works will enable a higher service frequency to operate and enable the entire RRL group to operate on a 20 or 40 minute cycle. Not only will these upgrades provide much needed capacity on the Melton corridor, they will also enable additional services to operate on the Geelong line. Moreover, these works will improve service reliability and passenger convenience and support the implementation of the Melbourne Metro rail tunnel project and electrification to Melton in the next stage.

PTV is also investigating the implementation of high capacity regional trains on the Melton and Geelong lines ahead of electrification of both lines, as described in later chapters.

Key benefits
- Improved peak capacity from Melton and Ballarat
- Improved off-peak services on the Ballarat and Bendigo corridors
- Improved counter-peak services
- Improved capacity, reliability and travel times on the Geelong line.

High level scope of works
- Duplication of the line from Deer Park to Melton
- Quadruplication from Deer Park to Sunshine
- An additional two passing loops between Bacchus Marsh and Ballarat
- New stabling to accommodate six regional trains, with provision to convert to stabling of six high capacity trains of 220 metres in length following electrification.

12.7   Line-side signalling upgrade in Northern Loop

While the Melbourne Metro rail tunnel project is the solution for the Northern Group, it is likely that short term, small scale capacity relief projects will be required before its completion.
A small number of high capacity trains will operate on the Sunbury corridor from about 2020 to meet demand, but a re-signalling of the northern loop will also enable an additional train to operate in the peak hour from each of the Craigieburn and Sunbury lines.

The Northern Loop line-side signalling upgrade will effectively implement medium-speed signalling between North Melbourne and North Melbourne via the loop, using additional signals and four aspects.

An option of implementing high capacity signalling in the Northern Loop can also be considered closer to the time; however, at this stage it is anticipated that concurrent implementation across three sections on the network would be unrealistic.

Key benefits
- Improved peak capacity on the Craigieburn and Sunbury corridors
- Improved reliability for Northern Group services.

High level scope of works
- Installation of new intermediate signals in the Northern Loop
- Provision of four-aspect signalling in the Northern Loop.

12.8   Burnley junction rationalisation

Since the May 2011 timetable change, morning inbound Glen Waverley services have operated direct to Flinders Street in parallel with inbound City Loop services from Belgrave, Lilydale, Alamein and Blackburn. This operation has improved frequency and reliability in the morning peaks through a reduction in cross-moves and avoidance of delays cascading from one line to another.

However, the layout of Burnley Junction currently prevents the operation of a segregated timetable in the counter-peak. Instead, Glen Waverley services must form outbound services to Camberwell, with outbound Glen Waverley services created by trains from the loop.

The Burley Junction rationalisation alters the configuration of Burnley Junction to enable inbound stopping and express Ringwood services to merge on the outbound side of Burnley and outbound Ringwood services to utilise the centre track from Burnley. In turn, this will allow outbound Glen Waverley services to operate through the outside track.

This enables a full sectorisation of the Glen Waverley line and allows all inbound Glen Waverley trains to perform return trips to Glen Waverley.

Key benefits
- Improved reliability of all Burnley Group services through full sectorisation of the sub-groups
- Simpler and more legible service design for all users, especially passengers using East Richmond station.

12.9   Dandenong Rail Corridor upgrade

The Dandenong Rail Corridor upgrade will focus on grade separations and road alterations at multiple level crossings between Caulfield and Dandenong and the introduction of high capacity trains.

Key benefits
- Greater passenger capacity ahead of major infrastructure works
- Relieve traffic congestion
- Stimulate urban renewal.

13 Stage 3 – Network plan and service levels

13.1 Background

The network changes created during Stage 2 will provide the capacity through the inner core for the introduction of major line extensions. As a result, Stage 3 is focused on adding new lines, extensions and electrification projects.

Three of the new metropolitan lines, an electrified line to Melton and new lines to Rowville and Melbourne Airport are connected through the Melbourne Metro rail tunnel project. This will lift peak hour capacity to 24 trains per hour in each direction following the completion of grade separation works on the Dandenong corridor and extension of high capacity signalling to Cranbourne and Pakenham.

A further network change will be enabled with the construction of a second new inner-city tunnel from Clifton Hill to the city separating the Clifton Hill Group into two independent groups and providing capacity to accommodate services from a new line to Doncaster.

A Doncaster rail extension will connect to the Hurstbridge line and both Doncaster and Hurstbridge services will operate via the existing Clifton Hill Loop.

The South Morang line will be diverted to the new tunnel to Southern Cross station via Parkville.

High capacity signalling will also be further rolled out on the Werribee, Craigieburn and Upfield corridors, leading to improvements in service provision and reliability on those sections of the network.

Finally, to address demand pressures in the new Hume growth corridor and reduce pressure on the Craigieburn line, there will be a need to divert Seymour regional services to the Upfield corridor. This change will be a precursor to the electrification of the line to Wallan in the next stage.

Figure 13-1 provides a schematic representation of the network configuration in Stage 3, with peak hour service levels shown on each corridor based on the indicative Stage 3 timetable. Detailed service levels in peak, shoulder and off-peak times are shown line-by-line in the following sections.

Figure 13-1: Schematic diagram of Stage 3 network
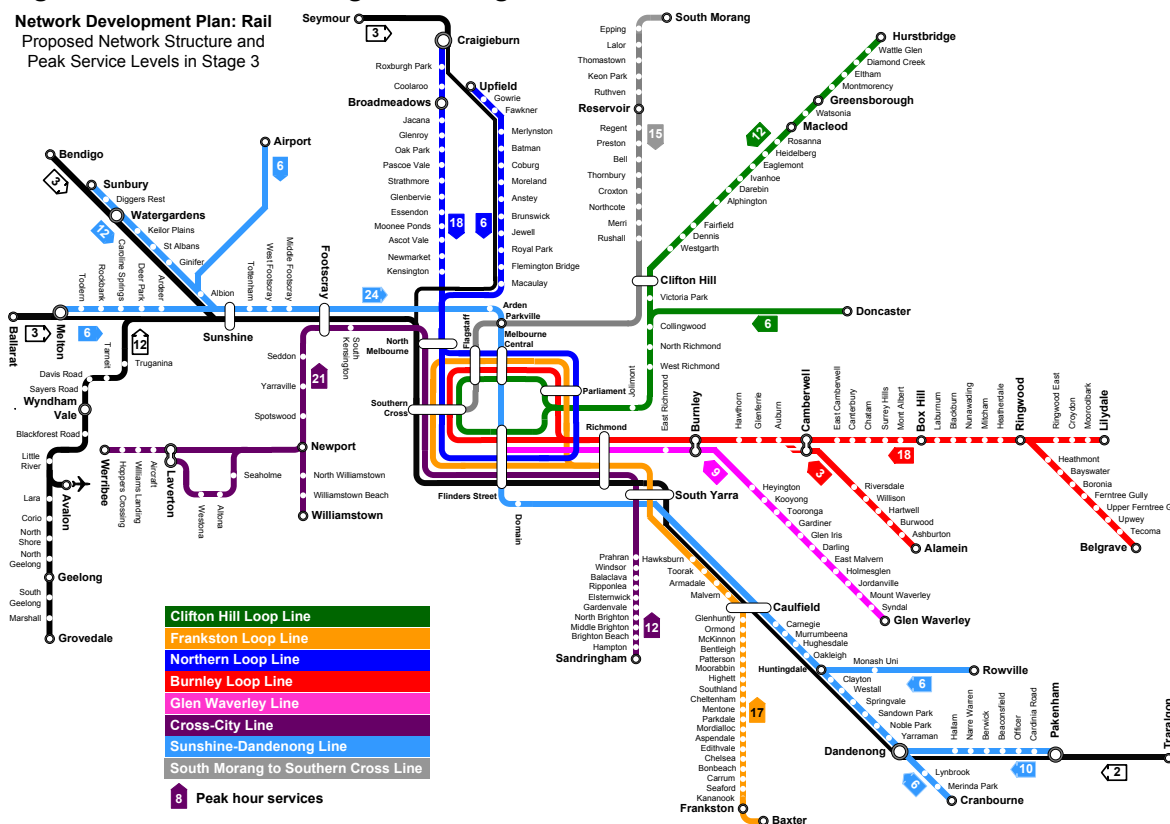
13.2 Clifton Hill Loop Line and South Morang – Southern Cross Line

Strong patronage growth on the Clifton Hill Loop Line (formerly the Clifton Hill Group) will continue to put pressure on the trunk section from Clifton Hill to the City Loop.

This issue, coupled with the intention to integrate a Doncaster rail line into the metropolitan rail network, will drive the need for a new track pair to be constructed into the city from Clifton Hill. The solution will involve the creation of the South Morang – Southern Cross Line, which will accommodate the South Morang line through a new tunnel running from Clifton Hill to Southern Cross, via interchanges at Parkville and Flagstaff. There will be the option of including additional stations in the Carlton or Fitzroy areas.

A new rail line to Doncaster will be integrated near Victoria Park with the existing Hurstbridge line to form the new Clifton Hill Loop Line.

The separation of the South Morang line from the existing Hurstbridge line and creation of two separate lines will create critically needed long-term capacity for more trains to operate to South Morang, Hurstbridge and now Doncaster.

Additionally, the South Morang – Southern Cross Line will enable a future new corridor to operate from the Epping North growth area connecting in at Lalor at a later stage.

Duplication works beyond Greensborough, the cascade of more trains onto the Clifton Hill Loop Line and more stabling at Eltham will deliver improved peak frequencies between the city and South Morang and Eltham. For the first time, there will be the ability to operate a 10 minute off-peak frequency as far as Eltham. In this period, it is planned that the Doncaster line will operate with a 10 minute service during peak and most off-peak periods.

Key service changes

The following key service changes are planned for the Clifton Hill Loop Line during Stage 3:

- Network configuration changes following completion of the Clifton Hill to Southern Cross tunnel
- Diversion of South Morang services into the new tunnel operating at higher frequency
- Addition of Doncaster line services via Clifton Hill Loop Line
- Provision of additional peak services on the Hurstbridge and South Morang lines in line with patronage growth
- Extension of 10 minute off-peak services from Macleod to Eltham.

Stage 3 Service Plan for Clifton Hill Loop Line

Clifton Hill Loop Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Doncaster to City Loop via Flinders Street Stops All Stations	**6**	**12**	**6**	**6**	**6**	**3**
Hurstbridge to City Loop via Flinders Street Stops All Stations	3	**6**	3	3	3	3
Eltham* to City Loop via Flinders Street Stops All Stations	3	6	**3**	**3**	**3**	-
Macleod to City Loop via Flinders Street Stops All Stations	**6**	**9**	-	-	-	-
*= Some services may originate at an intermediate location City Loop operation: Clockwise at all times						

Stage 3 Service Planfor South Morang – Southern Cross Line

South Morang – Southern Cross Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
South Morang* to Southern Cross Stops All Stations	**15**	**22**	6	6	6	3
*= Some services may originate at an intermediate location Services operate via new tunnel via Parkville and Flagstaff						

13.3   Frankston Loop Line

During Stage 3, the Frankston Loop Line will be electrified to Baxter to give better access to the metropolitan rail system from the Mornington Peninsula and provide a new dedicated stabling and maintenance facility for the line.

The new stabling and maintenance facility will allow high capacity trains to be deployed onto the Frankston Loop Line, improving capacity and reliability. Due to this extra carrying capacity, there will be no need to increase service levels from the previous period.

Key service changes

The following key service changes are planned for the Frankston Loop Line during Stage 3:

- Extension to Baxter to enable high capacity trains to be operated, stabled and maintained on the line, providing improved capacity
- Further improvements in reliability and travel times as high capacity trains are deployed onto the line.

Stage 3 Service Plan for Frankston Loop Line

Frankston Loop Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Baxter to City Loop Peak: Limited Stop Off-peak: Stops All Stations	8	14	6	6	6	3
Carrum* to City Loop Stops All Stations	4	6	-	-	-	-
Cheltenham* to City Loop Stops All Stations	5	9	-	-	-	-
*= Some services may originate at an intermediate location City Loop operation: Anti-Clockwise at all times						

13.4   Northern Loop Line

Summary

Capacity and reliability on the Northern Loop Line will be further enhanced during Stage 3 with the deployment of high capacity signalling on the line and the diversion of Seymour V/Line services via the Upfield corridor where greater capacity will exist to accommodate those services.

Both of these initiatives will enable a flat 10 minute service to operate at all times (except late at night and early morning) on the Upfield line, enable an extra two services to operate on the Craigieburn line at peak times and provide a more regular, more reliable and faster travel time for

V/Line passengers. Capacity will also exist to operate an additional V/Line service in the peak hour originating from Wallan to accommodate patronage growth north of Craigieburn.

Key service changes

The following key service changes are planned for the Northern Loop Line during Stage 3:

- Implementation of high capacity signalling, enabling improved capacity and reliability
- Implementation of an all-X'Trapolis fleet
- Diversion of Seymour services via Upfield to enable additional short starting V/Line services from Wallan to operate at improved speeds and improve reliability on the Craigieburn and Upfield lines.

Stage 3 Service Plan for Northern Loop Line

Northern Loop Metro Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Craigieburn* to City Loop Stops All Stations	**12**	**23**	6	6	6	3
Essendon to City Loop Stops All Stations	**6**	**8**	-	-	-	-
Upfield to City Loop Stops All Stations	6	**12**	6	3	**6**	3
*= Some services may originate at an intermediate location City Loop operation: Clockwise at all times						

13.5   Burnley Group

The Burnley Group will be unaffected by the network changes and will continue to operate with some additional services added in line with patronage growth. It is anticipated that the construction of the Doncaster line will reduce demand on the Ringwood corridor, avoiding the need for major service changes.

Key service changes

None

Stage 3 Service Plan for Burnley Group

Burnley Group Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Belgrave* to City Loop Peak: Limited Stop Off-peak: Stops All Stations	6	12	3	3	3	3
Lilydale* to City Loop Peak: Limited Stop Off-peak: Stops All Stations	6	12	3	3	3	3
Ringwood to City Loop Stops All Stations except East Richmond	2	5	-	-	-	-
Box Hill to City Loop Stops All Stations except East Richmond	4	6	-	-	-	-
Alamein# to City Loop Stops All Stations except East Richmond	3	6	-	-	-	-
Alamein to Camberwell Shuttle Stops All Stations	-	-	3	3	3	3
Glen Waverley to Flinders Street Stops All Stations	8	15	6	3	3	3
*= Some services may originate at an intermediate location; City Loop operation: Anti-Clockwise at all times						

13.6   Cross-City Line

The operation of the Cross-City Line will remain consistent with the previous period; however, capacity and reliability will be increased with the deployment of high capacity signalling from Flinders Street to Werribee and Williamstown. As a result, an additional service will operate from Werribee in the peak hour and the service pattern will be altered to offer a consistent 20 minute service from both the Altona and Williamstown lines.

Key service change

One key service change is planned for the Cross-City Line during Stage 3: implementation of high capacity signalling leading to improved reliability and peak hour capacity.

Stage 3 Service Plan for Cross-City Line

Cross-City Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Werribee to Flinders Street via Main Line Stops all stations; continue to Sandringham	15	24	6	-	6	-
Werribee to Flinders Street via Altona Stops all stations; continue to Sandringham	-	-	-	3	-	3
Laverton to Flinders Street via Altona Stops all stations; continue to South Yarra	4	7	3	-	3	-
Williamstown to Flinders Street Stops all stations	3	7	3	3	3	3
Sandringham* to Flinders Street Stops all stations; continue to Werribee	11	21	6	3	6	3
*= Some services may originate at an intermediate location Through services operate via Flinders Street and Southern Cross						

13.7   Sunshine – Dandenong Line

The construction of the Melbourne Metro rail tunnel not only enables patronage growth to be catered for on existing lines; it also creates the inner-city capacity to enable new lines to be added through the tunnel and onto the Sunshine – Dandenong Line.

During Stage 3, three new lines are planned to be added onto the trunk section:

- The line to Melton will be electrified and connected at Sunshine
- A new line will be constructed to Melbourne Airport and be connected at Albion
- A new line will be constructed to Rowville and be connected at Huntingdale.

The extra lines will require the operation of more frequent train services through the trunk section. This will require high capacity signalling to be extended to cover the entire line, as well as the completion of the required road-rail grade separations on the Dandenong corridor.

The connection of the Melbourne Airport line into the Sunshine – Dandenong Line will provide direct connectivity from the south-east of the city to Melbourne Airport, as well as enable passengers from all other lines to easily access airport services via no more than one interchange in the central area of the network.

To support the reliable operation of a high frequency trunk service at peak and off-peak times, the line to Cranbourne will be duplicated.

Key service changes

The following key service changes are planned for the Sunshine – Dandenong Line during Stage 2:

- Expansion of the Sunshine – Dandenong Line to include new branch lines to Melton, Melbourne Airport and Rowville
- Implementation of high capacity signalling between South Yarra and Cranbourne / Pakenham / Rowville, as well as on new lines to the west
- Upon completion of line extensions to Melbourne Airport and Rowville, new additional services will be added through the Sunshine – Dandenong Line trunk section serving new lines
- Upon completion of all of the above, services will reliably operate every two and a half minutes between Sunshine and Huntingdale at peak times and every three to four minutes at most off-peak times
- Duplication of the single track between Dandenong and Cranbourne will result in the delivery of a consistent 10 minute service and improved reliability.

Stage 3 Service Plan for Sunshine – Dandenong Line

| Sunshine – Dandenong Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Sunbury to Domain Stops all stations; continue to Dandenong line	8	16	3	3	3	3
Sydenham to Domain Stops all stations; continue to Dandenong line	3	6	-	-	-	-
Melton to Domain Stops all stations; continue to Dandenong line	6	12	3	3	3	3
Melbourne Airport to Domain Stops all stations; continue to Dandenong line	6	12	6	6	6	3
Pakenham* to Parkville Express Caulfield-Domain; continue to Sunshine Line	10	21	3	3	3	3
Cranbourne to Parkville Express Caulfield-Domain; continue to Sunshine Line	6	12	3	3	3	3
Rowville to Parkville Express Caulfield-Domain; continue to Sunshine Line	6	12	6	6	6	3
*= Some services may originate at an intermediate location Services operate via Melbourne Metro rail tunnel stopping at Domain, Flinders Street, Melbourne Central, Parkville and Arden						

14 Stage 3 – Key projects

14.1 Summary

Stage 2 focused on upgrading the inner core capacity of the network and implementing projects to enable a highly reliable, metro-style network to operate. Having created the capacity and infrastructure basis on which to expand, Stage 3 will seek to improve network reach through a series of line extension and electrification works while continuing to roll-out high capacity signalling on other parts of the network.

Of particular note during this period will be the addition of rail lines to Melbourne Airport, Rowville and Doncaster, as well as the electrification of the Melton line. The first three of these projects will be possible following the completion of the Melbourne Metro rail tunnel project and the delivery of high capacity signalling on the network. The Doncaster line will require the addition of a new tunnel from Clifton Hill into the city to enable the separation of the South Morang and Hurstbridge lines.

This period will also implement the first stage of higher capacity services into the Hume corridor north of Craigieburn with the operation of regional short starter services from Wallan running via the re-instated connection between Somerton and Upfield.

To facilitate the continued roll-out of high capacity trains, a new maintenance facility will be required on the Frankston line. This will necessitate the electrification of the line to Baxter.

Figure 14-1: Summary of projects to be implemented during Stage 3
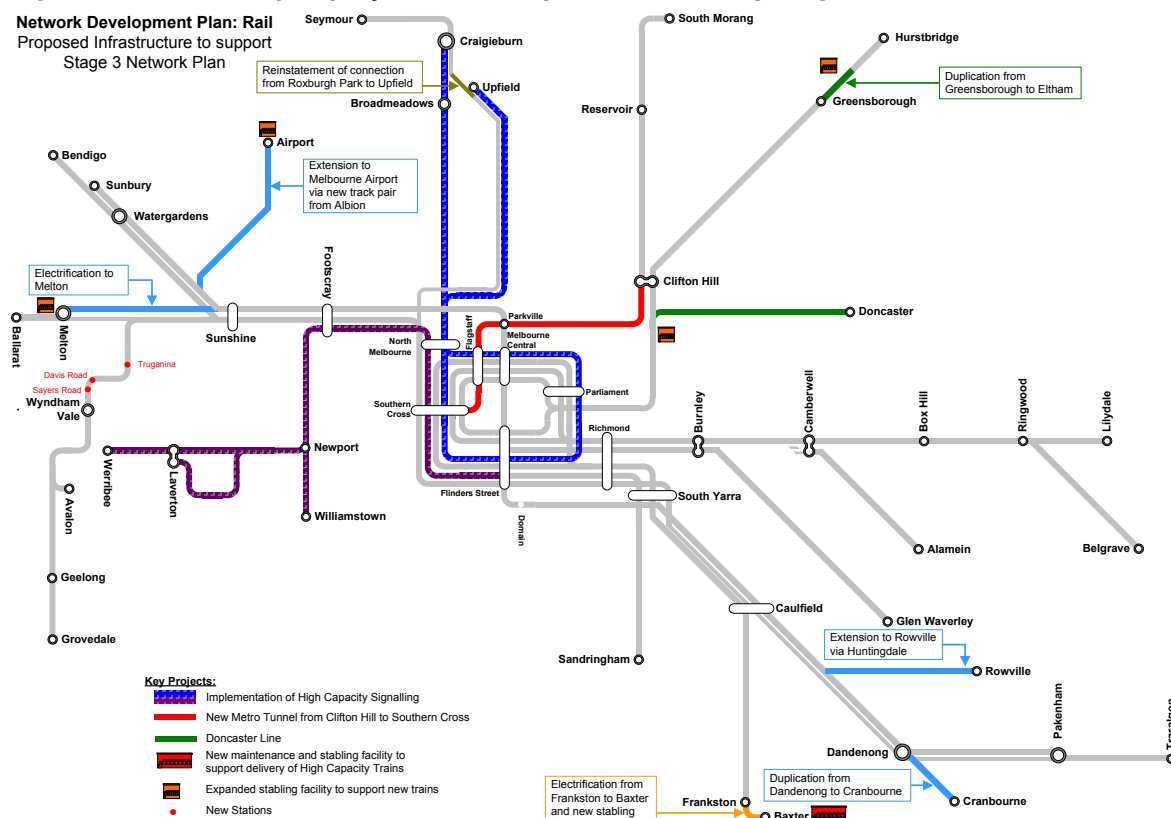
14.2 Dandenong Rail Corridor upgrades including High Capacity Signalling

The Dandenong corridor will become the busiest corridor on the network by around 2020, with further growth forecast for the following decade as Melbourne's south eastern growth areas continue to attract new residents. To support this growth, the rail corridor will need a number of significant upgrades to allow more and longer trains to operate whilst still accommodating V/Line services.

The Dandenong corridor has multiple constraints that need to be resolved progressively in a logical order. These are:

- The interaction with Frankston services in the inner core (resolved in 2016)
- Existing signalling systems that prevent trains operating closely together, particularly between Pakenham and Dandenong
- The presence of a single-line section between Cranbourne and Dandenong that constrains optimal timetabling and requires some services to commence and terminate at Dandenong or Westall
- Nine level crossings between Caulfield and Dandenong, many of them key arterial roads, which compel consideration of the impact on road traffic when developing new services.

As a result of these constraints, the first stage of improving capacity on the Dandenong corridor will be to separate the Dandenong services from the Frankston Group and operate higher capacity trains on the corridor within the limitations of the signalling system and level crossing impacts. As described earlier, these new trains will be designed to carry an average of up to 1100 passengers in comfortable conditions – providing a 20 per cent increase in capacity at peak times.

It is estimated that the new trains will provide sufficient capacity until the mid-2020s, at which point there will be a need to further increase the capacity of the corridor. The Dandenong rail corridor upgrades are works that will provide a major uplift in capacity. This uplift, coupled with the Melbourne Metro rail tunnel project, will enable the corridor to meet capacity in the long-term through operating more frequently and with the use of 220 metre long trains. Additionally, the Dandenong rail corridor upgrades will prepare the corridor to enable connection of the Rowville line extension and reduce traffic delays, helping to improve travel times for connecting bus services.

Key benefits

The Dandenong rail corridor upgrades will be designed to deliver a number of key service outcomes:

- Improved capacity (in conjunction with the Melbourne Metro rail tunnel project) to meet long-term demand on the Dandenong rail corridor
- Improved reliability for all metropolitan and regional services using the Dandenong corridor and associated Sunshine corridor via the Melbourne Metro rail tunnel project
- Key enabler for the future extension of a rail line to Rowville
- Reduced traffic delays through the grade separation of multiple level crossings
- Delivery of an efficient rail corridor through the operation of longer trains.

High level scope of works

- Further grade separations and road lay-out alterations at multiple level crossings between Caulfield and Dandenong
- Platform extensions at all stations to enable trains of up to 220 metres to operate through the corridor
- Replacement of existing signalling systems with a high capacity signalling system between Pakenham / Cranbourne and South Yarra.

14.3   Electrification to Melton

Population in the City of Brimbank and Melton Shire is forecast to grow rapidly over the next 10 to 15 years as new areas are developed along the Melton corridor. As previously discussed, a series of projects are planned to meet demand growth on both the Melton and Sunbury corridors:

- Implementation of the RRL will enable additional services to be added on both corridors
- Duplication of the Melton line will provide additional capacity from Ballarat and Melton
- Implementation of high capacity regional trains on the Melton line
- Implementation of the Melbourne Metro rail tunnel project will enable more Sunbury line services to operate and the opportunity to operate larger capacity trains on that corridor.

Despite the above projects, overcrowding is expected to occur on Melton line services around the mid-2020s. As a result, the electrification of the line will be the next step in releasing significant additional capacity.

The completion of the Melbourne Metro rail tunnel project in the previous period and the expected completion of the Dandenong Corridor upgrades in this period will enable up to 24 trains per hour to operate between Sunshine and Dandenong using up to 220 metre long trains. This provides the opportunity to link Melton line services into the Sunshine – Dandenong Line upon completion of the electrification.

Key benefits

- Enables high capacity trains to service the Melton corridor providing for longer term patronage growth
- Provides metropolitan services from the Melton corridor with direct connectivity to new Melbourne Metro stations and south eastern suburbs
- Reduces the number of passengers driving to the Sunbury line to access metropolitan services
- Provides more frequent services at stations between Sunshine and Footscray and through the Melbourne Metro rail tunnel project
- Releases capacity via RRL tracks for additional services from regional centres.

High level scope of works

- Electrification of tracks from Melton to Sunshine
- Conversion of Melton stabling to accommodate metropolitan trains
- Completion of rail fly-over at Sunshine.

14.4   Melbourne Airport Rail Link

A Melbourne Airport Rail Link Study is underway to identify the best route for a rail link between the CBD and Melbourne Airport, as part of a broader plan to ensure reliable and efficient transport access to the Airport.

The purpose of the study has been to:
- Understand the current demand for and constraints on travel to and from the Airport and how this is likely to change as air passenger volumes and Melbourne's population grows
- Identify the transport and infrastructure initiatives needed and target timeframes to ensure that all modes of access to the Airport can cater for increased demand
- Ensure that planning for a rail link and other improvements to Airport access is coordinated with other planning such as the new Melbourne Airport Master Plan and the Commonwealth Government's High-Speed Rail Study
- Establish how a rail service to Melbourne Airport could operate and identify the best route for a rail link between the Airport and the Melbourne CBD.

The study has found that forecast growth in Melbourne's population and air passenger numbers will result in demand for Airport access that exceeds the capacity of existing transport infrastructure and services.

The study has identified a range of short, medium and long-term initiatives to improve all modes of transport and ensure that access to this critical centre of activity and economic growth remains efficient and reliable.

One of these initiatives is the proposed development of the Melbourne Airport Rail Link. The Study has considered a wide range of route options for a rail link, taking into account past planning for a link, population and air passenger growth, and changes in Melbourne's transport network.

The draft finding of the study is that the best route for a Melbourne Airport Rail Link is via the existing Albion East reservation and the Melbourne Metro rail tunnel to link into the Sunshine – Dandenong Line, and that the rail link should be implemented following delivery of the Melbourne Metro rail tunnel project.

This option will allow airport services to operate through the Melbourne Metro rail tunnel, providing direct access from the Cranbourne and Pakenham lines and from Flinders Street, Melbourne Central and Parkville into the city. Passengers wishing to access airport trains from other lines (except Seymour corridor regional services) would only need to interchange once as set out in the table below:

Table 14-1: Service principles

Line Group	Lines	Interchange to Melbourne Airport Rail Link
Clifton Hill Loop Line	Hurstbridge and Doncaster	Flinders Street
South Morang – Southern Cross Line	South Morang	Parkville
Frankston Loop Line	Frankston	Caulfield or Melbourne Central
Northern Loop Line	Craigieburn and Upfield	Melbourne Central or Flinders Street
Burnley Line	Alamein, Belgrave, Glen Waverley and Lilydale	Melbourne Central or Flinders Street
Cross-City Line	Werribee, Williamstown and Sandringham	Footscray or Flinders Street
RRL Lines (Western)	Ballarat, Bendigo, Geelong. and Ararat, Echuca, Maryborough, Swan Hill, Warrnambool	Sunshine
Traralgon Regional Line	Traralgon, Bairnsdale	Flinders Street
Seymour Regional Line	Seymour, Shepparton	North Melbourne (for Northern Loop) and Melbourne Central (or SmartBus from Broadmeadows)

The operation of the Melbourne Airport Rail Link will require five trains per hour to be diverted from the Sunbury corridor compared to the Stage 2 service plan. However, this will be mitigated by the ability to operate longer trains on the Sunbury corridor following the completion of the Dandenong rail corridor upgrades. These upgrades will ensure that 24 high capacity trains per hour can operate on the trunk section of the Sunshine – Dandenong Line. There may also be opportunities to construct an additional park and ride station on the Melbourne Airport Rail Link that may attract passengers from the Sunbury line.

The Commonwealth Government is leading a study into the potential for a High Speed Railway along the East Coast of Australia. The Melbourne Airport Rail Link and High Speed Railway studies are being coordinated to identify possible synergies.

Key benefits
- Enables Melbourne Airport to be serviced by metropolitan train services for the first time
- Enables Melbourne Airport to be directly connected to the Dandenong corridor via the Melbourne Metro rail tunnel, offering easy travel opportunities for passengers in the south-east wishing to access the airport
- Enables good connections from other lines, especially regional and metropolitan lines in the west that will interchange with Melbourne Airport Rail Link services at Sunshine and Footscray.

High level scope of works

- New two-track terminus at Melbourne Airport
- New track pair between Albion and Melbourne Airport, partly alongside existing freight tracks on Albion-Jacana corridor
- New grade-separated junction at Albion to enable up regional services to de-merge from Sunbury line services while city-bound Melbourne Airport Rail Link services pick up their paths ⬚ and vice versa for outbound services
- New track pair between Sunshine and Albion for use by regional services from Bendigo to release capacity on the Sunshine – Dandenong Line tracks.

14.5   Rowville Rail Link

An independent study commissioned in 2011 investigated the feasibility of a rail line to Rowville to serve residents in the eastern suburbs, as well as the large numbers of students accessing Monash University and the surrounding innovation and employment precinct.

The study found that a 12 kilometre rail line between Huntingdale Station and the Stud Park area is feasible.

Key benefits

- A frequent, reliable, and high capacity mode of public transport service for the Knox and Monash communities
- Improved access and support to the productivity and growth of Monash University's Clayton campus and the surrounding innovation and employment precinct
- Introduce greater transport choice and options in the area, helping to reduce pressures on the local bus network and road system
- Will meet the future patronage growth for rail.

High level scope of works

- The Rowville rail line will follow the central median of North Road and Wellington Road from Huntingdale to terminate in the vicinity of Stud Park
- Four new stations will be provided at Monash University, Mulgrave, Waverley Park and Rowville with a terminus in the vicinity of Stud Park
- The route would comprise a mix of surface level, below ground and viaduct alignments
- The design would avoid any new level crossings and will preserve the existing road environment.

14.6   Cranbourne duplication

To support the upgrading of train frequencies on the Sunshine – Dandenong Line and protect its reliability, the existing single track to Cranbourne will require duplication. This project will facilitate the operation of a more frequent and reliable service and allow a simpler timetable construction on the rest of the Sunshine – Dandenong Line.

At the same time, an additional platform will be provided at Dandenong Station to facilitate the merging of Cranbourne and Pakenham trains on the city-bound side of the station. The overall

project will result in the entire Sunshine – Dandenong Line, including branch lines to Rowville, Melbourne Airport and Melton, being a two-track railway on all sections with metro-style services operating at a high level of reliability.

Key benefits
- Improved reliability on the entire Sunshine – Dandenong Line as well as associated V/Line services
- More reliable and regular services on the Cranbourne line in both directions – serving a significant population growth area
- Simpler, more reliable timetable construction enabling a10 minute service to operate from the Melbourne Airport line and five minute services from Sunshine to Dandenong.

High level scope of works
- Duplication of single track between Cranbourne and Dandenong
- New platform at Dandenong and reconfigured junction.

14.7 High Capacity Signalling – Cross-City and Northern Loop Lines

As discussed earlier, the roll-out of the high capacity signalling system will begin with a pilot on the Sandringham line followed by implementation on the Clifton Hill Loop Line and the Sunshine – Dandenong Line in two stages.

The plan proposes that high capacity signalling be implemented subsequently on the Cross-City Line between Flinders Street and Werribee / Williamstown (to tie in with the system already in place on the Sandringham line) and on the Northern Loop Line covering the City Loop and the suburban corridors to Craigieburn and Upfield.

The implementation of high capacity signalling on these lines will provide the opportunity to operate more frequent services to meet patronage growth, improve reliability and replace obsolete technology on both groups.

Key benefits
The implementation of high capacity signalling on the Cross-City and Northern Loop Lines will have the following benefits:
- Improved capacity and reliability on the Werribee / Williamstown corridor
- Improved capacity and reliability on the Craigieburn corridor and improved reliability on the Upfield corridor
- Replacement of obsolete signalling systems with a more cost-effective system.

High level scope of works
- Implementation of high capacity signalling on the Werribee / Williamstown corridor, on through suburban lines to Flinders Street and on associated lines between Flinders Street and South Yarra

- Implementation of high capacity signalling on the Craigieburn and Upfield lines and the Northern Loop Line.
- Installation of high capacity signalling equipment in Cross-City and Northern Loop Line train fleets.

14.8 Reinstatement of Somerton to Upfield link

With train frequencies increasing rapidly on the Craigieburn line, there will be a need to find an alternative route for regional services from Seymour. Related to this is the need to consider how future growth in the Hume corridor will be accommodated. Both issues can be resolved through better utilising the Upfield line to carry longer distance services.

In Stage 3, the Craigieburn and Upfield corridors will be split in the inner core with more capacity created to operate more services on the Upfield line. The Upfield line will be extended to Wallan to serve new areas north of Craigieburn and services from Seymour will be diverted to this line.

The first step will be taken in this period through the diversion of Seymour regional services via the Upfield line. This will reduce pressure on the Craigieburn line, improve travel times for Seymour services and most importantly, enable additional short starter regional services to be introduced from Wallan as a precursor for the electrification of the line.

The previous connection from Somerton to Upfield will need to be re-instated including a fly-over or underpass of the ARTC tracks. To support the new connection and enable a more sectorised and reliable service operation a new track pair would be constructed between Craigieburn and Roxburgh Park and the line between Gowrie and Upfield would need to be duplicated.

Key benefits
The reinstatement of the Somerton to Upfield link will have the following benefits:
- Enable travel times on Seymour regional trains to be reduced
- Reduce pressure on the capacity of the Craigieburn line
- Enable additional short starter services to operate from Wallan to cater for patronage growth in the Hume area.
-

High level scope of works
- New track pair from Upfield to Somerton
- New rail fly-over or underpass of ARTC tracks
- New track pair from Craigieburn to Roxburgh Park and two new platforms at Craigieburn
- Duplication from Gowrie to Upfield.

14.9 Electrification to Baxter and new stabling and maintenance facilities

There is currently a shortage of stabling on the Frankston Loop Line, meaning trains have to be transferred to and from stabling facilities in the city and at Newport. This need for more stabling will become more critical as service numbers increase and especially when the Frankston Loop Line becomes separated from the Cross-City Line.

At that point, following the implementation of the Melbourne Metro rail tunnel project, the Frankston Loop Line will be reliant on the Sunshine – Dandenong and Cross-City Lines to support maintenance and stabling of some Frankston Loop Line rolling stock.

While this situation will be manageable in the short term, it is not consistent with the philosophy of sectorising the network and will become progressively harder to support as service levels increase on the other lines.

As a result, there will be a need to establish a dedicated new train maintenance facility and stabling site for the line. This will tie in with the need to establish a second new facility to manage the second order of high capacity trains entering the network.

Little opportunity exists on the Frankston line to provide additional stabling or maintenance between the city and Frankston. However, an appropriate parcel of land has been identified in the Baxter area that could accommodate up to 30 trains and a maintenance facility.

An extension from Frankston to Baxter would provide access to this stabling facility, as well as enabling Baxter to be developed as a park and ride facility, providing opportunities to release land for the further development of Frankston as a key activity area. Stony Point services would then terminate at Baxter in a purpose-built middle platform and interchange with the Baxter / Frankston Loop Line.

Key benefits
- Provides critical increase in maintenance and stabling capacity on the network
- Enables second generation of high capacity trains to be deployed and maintained at a new dedicated maintenance facility
- Enables rationalisation of Carrum and Frankston stabling yards, releasing land for redevelopment
- Provides better network access and opportunity to develop a major park and ride facility south of Frankston, helping to reduce road congestion in Frankston and improving travel times.

High level scope of works
- Duplication and electrification of existing line from Frankston to Baxter
- Construction of new terminating station at Baxter with interchange to Stony Point services and bus services, along with park and ride facilities.
- Construction of a new stabling and maintenance yard on city-bound side of Baxter station.

14.10   Doncaster rail line and new Clifton Hill Loop Line

For many years, there have been calls for the Doncaster area to be serviced by metropolitan rail. In recent years, Doncaster has benefited from the introduction of the Doncaster Area Rapid Transit service, providing express bus services to the city, but there is recognition that in the medium-to-long-term, buses will not be able to cater sufficiently to the demand for public transport between Doncaster and the CBD.

An independent study was commissioned in 2011 to assess options for the provision of a high quality rail link between Doncaster and the city. A draft phase one report has been completed, recommending an alignment generally following the Eastern Freeway and connecting to the existing rail network at Clifton Hill.

Capacity growth on the Clifton Hill Group presents a significant challenge for the introduction of the Doncaster rail line. Even with the provision of high capacity signalling, insufficient capacity will be available to meet patronage demands on the South Morang and Hurstbridge lines and to enable a minimum 10 minute service on the Doncaster line.

Therefore, the solution is to separate the South Morang and Hurstbridge lines, creating two new corridors. The Clifton Hill Loop Line will accommodate the Hurstbridge and new Doncaster line via the existing Clifton Hill Underground Rail Loop.

The South Morang – Southern Cross Line will comprise of the South Morang line operating in a new tunnel from Clifton Hill via Parkville to Southern Cross station.

To maximise the benefits of the South Morang – Southern Cross Line, opportunities for additional stations in the Carlton North and Fitzroy North areas will also be considered and there may also be justification to provide an additional interchange at Flagstaff.

The vacated pathways via the Clifton Hill Loop Line will be used by new services from Doncaster, also providing capacity for the addition of further services to respond to growth on the Hurstbridge line.

Key benefits
- Ability to provide heavy rail connection to the Doncaster area
- Reconfigured and rationalised bus network through Doncaster to feed the rail corridor
- Increased capacity on South Morang and Hurstbridge lines to meet long-term patronage growth
- Improved reliability with the removal of the at-grade conflict at Clifton Hill
- Opportunity to extend to Epping North
- Future opportunity to extend the new tunnel to Southern Cross onwards to Newport to assist the future development of the Fishermans Bend area and provide extra capacity on the Werribee line.

High level scope of works
- Construction of a new underground tunnel from Clifton Hill to Southern Cross via Parkville and Flagstaff
- Construction of a new rail line from Victoria Park to Doncaster, generally following the Eastern Freeway centre median
- Construction of new stabling either at Doncaster or at Victoria Park to accommodate eight trains
- Construction of additional stabling at Eltham.

15 Stage 4 – Network plan and service levels

Stage 4 provides the footprint to allow some important future line extensions to be comfortably added to the system without any adverse capacity or reliability outcomes.

Patronage is forecast to continue to grow rapidly in the 2020s, especially in the northern growth area. Central to meeting this demand is a major reconfiguration of the City Loop, which will result in seven separate, independently operated suburban lines through the CBD and add a capacity improvement of 30 trains per hour to the system.

The initiatives and projects identified in this period will be the final stage in delivering the a metro-style network for Melbourne. They will result in a profound change in the way the metropolitan rail system is operated and are likely to provide the basis on which the network can be developed for the following half-century or more.

15.1 Background

While the Melbourne Metro rail tunnel project and continued roll-out of high capacity signalling will add significant capacity into the system, further capacity enhancements are likely to be required to support the network for the next 20 years. In response to this growth, a major network reconfiguration is planned to occur in Stage 4 following the completion of key capacity enhancing projects including:

- Reconfiguration of the Caulfield and Northern Underground Rail Loops to create more inner-city capacity
- Electrification projects to Geelong and Wallan
- Upgrading of the Burnley Group, including the construction of a fourth track to Camberwell.

Following these works, along with supporting stabling and maintenance facilities, the network will be reconfigured into seven fully segregated lines, with no requirement for trains to share tracks, rolling stock or stabling and maintenance facilities. These new lines will be arranged as follows:

- Clifton Hill Loop Line serving the Hurstbridge and Doncaster lines
- Ringwood Loop Line serving all stations east of Camberwell
- The Sunshine – Dandenong Line operating as in the previous period
- The South Morang – Southern Cross Line operating as in the previous period and extended to Mernda in the north and Fishermans Bend in the south
- A new through line operating from Craigieburn to Baxter via the northern side of the City Loop, with trains operating from North Melbourne to Richmond through Flagstaff, Melbourne Central and Parliament
- A new through line operating from Wallan (via Upfield) to Sandringham via Southern Cross and Flinders Street and merging with an electrified Geelong line operating to South Yarra
- A new through line operating from Werribee / Williamstown to Glen Waverley and Alamein, serving all intermediate stations to Camberwell.

All but two lines (Clifton Hill Loop Line and Ringwood Loop Line) will be designed to offer through services from the north or west to the south-east or east providing more efficient and manageable lines and quicker and easier travel opportunities in an expanded inner Melbourne.

Central to the delivery of the Stage 4 plan is the reconfiguration of the City Loop. Currently, the City Loop has three corridors that approach the city from the south-east and one corridor that approaches from the north-west, with each loop having a capacity of around 24 trains per hour.

Trains on all four loops run through all five inner core stations using the underground tunnels and the elevated viaduct between Flinders Street and Southern Cross stations.

An opportunity exists to connect the north-western approach corridor to one of the south-eastern approach corridors via the underground stations. This then frees up a pair of tracks on the viaduct that can be used for an additional through corridor that would utilise only Flinders Street and Southern Cross stations.

This results in a system that has an additional corridor approaching the city from the north-west and an extension of the existing terminating corridor from the east, providing a near doubling of capacity of that corridor.

These works will provide an opportunity to rationalise the Burnley Group into two fully independent lines providing a marked increase in capacity and reliability that will allow the group to cater for growth for many years.

The works will also enable the separation of the Craigieburn and Upfield lines, creating an opportunity to successfully serve the northern growth corridor which is expected to experience major population increases in this period and beyond.

The tunnel extension from Southern Cross to Fishermans Bend also provides improved network connectivity to an important area of urban regeneration.

Figure 15-1 provides a schematic representation of the peak period network configuration in Stage 4 with peak hour service numbers shown on each corridor based on the indicative Stage 4 timetable change. Indicative service levels in peak, shoulder and off-peak times are described in the line by line sections below.

Figure 15-1: Schematic diagram of Stage 4 network

Network Development Plan: Rail
Proposed Network Structure and
Peak Service Levels in Stage 4
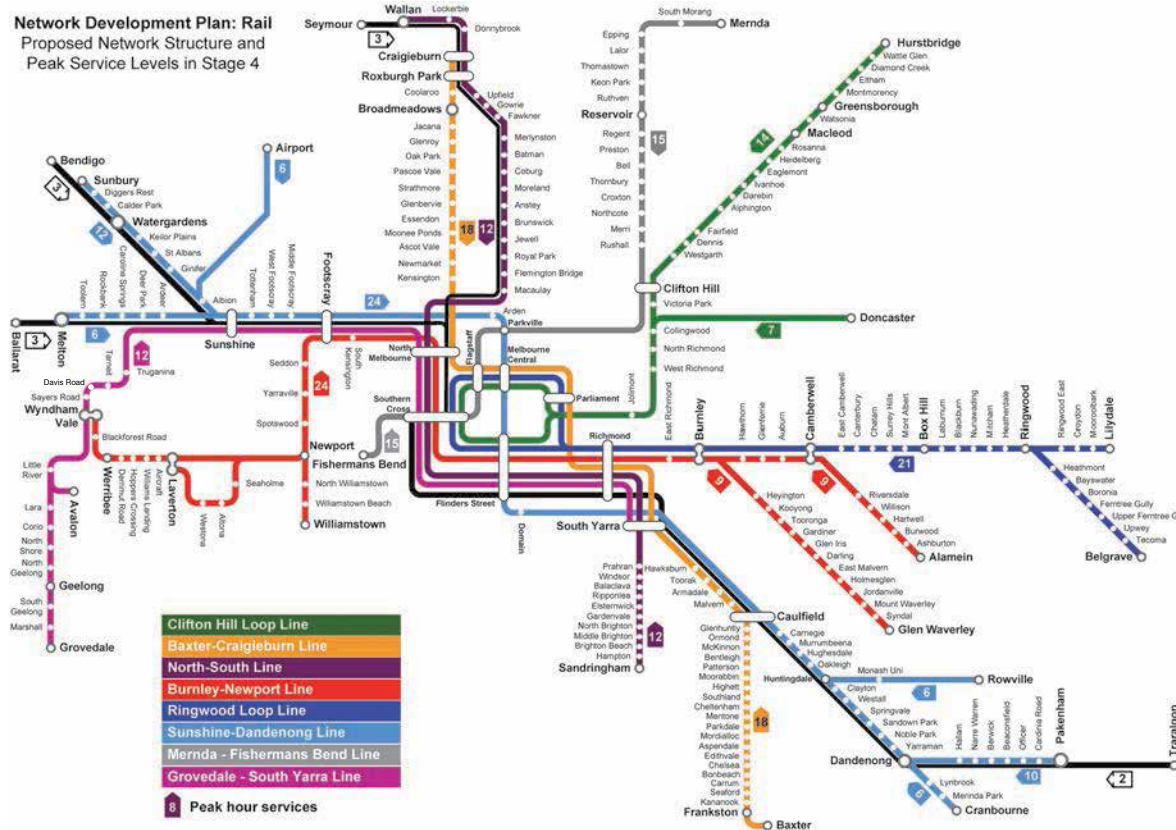
15.2   Clifton Hill Loop Line and Mernda – Fishermans Bend

Summary

The configuration of the Clifton Hill Loop Line will remain relatively unchanged in Stage 4, having been significantly upgraded in the previous period. However, service improvements will be provided utilising the spare capacity created in the previous period and line extensions to Mernda and Fishermans Bend will improve the reach of the rail network and connect to a new stabling facility at Mernda.

Key service changes

The following key service changes are planned to be implemented on the Clifton Hill Loop Line and South Morang – Southern Cross Line during Stage 4:

- Increase in peak services on all lines
- Extensions to Mernda and Fishermans Bend.

Stage 4 Service Plan for Clifton Hill Loop Line

Clifton Hill Loop Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Doncaster to City Loop via Flinders Street Stops All Stations	7	14	6	6	6	3
Hurstbridge to City Loop via Flinders Street Stops All Stations	3	7	3	3	3	3
Eltham* to City Loop via Flinders Street Stops All Stations	4	7	3	3	3	-
Macleod to City Loop via Flinders Street Stops All Stations	7	14	-	-	-	-
*= Some services may originate at an intermediate location City Loop operation: Clockwise at all times						

Stage 4 Service Plan for Mernda – Fishermans Bend Line

Mernda – Fishermans Bend Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Mernda* to Fishermans Bend Stops All Stations	15	**23**	6	6	6	3
*= Some services may originate at an intermediate location Services operate via new tunnel via Parkville and Flagstaff						

15.3   Baxter – Craigieburn Line

The Baxter – Craigieburn Line will be created upon the reconfiguration of the Caulfield and Northern Underground Loops and will effectively merge together the former Northern and Frankston Loop lines in operation during the previous phase. The key change in this phase for the Craigieburn and Frankston lines is that trains will only serve the three underground stations in the city and no longer serve Flinders Street or Southern Cross. This will release capacity for additional direct services on other lines.

As a result of these changes, at Richmond both the eastbound and westbound lines will enter the underground loop with the westbound track feeding from the existing Northern Loop and a new connection from Parliament to Richmond.

From Flagstaff station, the eastbound and westbound tracks will both run to North Melbourne – westbound trains via the existing Northern Loop tunnel and eastbound trains via a new connection to the existing Caulfield Loop.

From North Melbourne, services will feed from platforms 2 and 3 using the existing portals onto the Craigieburn line via the east suburban track pair.

High capacity trains will operate on the Baxter to Craigieburn Line, which will be maintained at Baxter, enabling the Craigieburn train maintenance facility and former rolling stock on the Craigieburn line to be transferred to the North-South Line (see 15.6).

Key service changes

The following key service changes are planned during Stage 4:

- Merger of Northern Loop Line with Frankston Loop Line to create new through Baxter – Craigieburn running in both directions between Richmond and North Melbourne stations via the underground stations only
- Separation of Craigieburn and Upfield lines to enable higher frequency of service from Craigieburn line
- Provision of higher frequency services on the Frankston line with two-tier service pattern operating from Baxter and upgraded Mordialloc terminus.

Stage 4 Service Plan for Baxter – Craigieburn Line

Baxter – Craigieburn Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Baxter to Flagstaff Peak: Limited Stop; Continue to Craigieburn Off-peak: Stops All Stations; Continue to Craigieburn	9	18	6	6	6	3
Carrum* to Flagstaff Stops All Stations; Continue to Essendon	4	9	-	-	-	-
Cheltenham* to City Loop Stops All Stations; Continue to Craigieburn	5	9	-	-	-	-
Craigieburn* to Parliament Stops All Stations; Continue to Frankston	12	24	6	6	6	3
Essendon to Parliament Stops All Stations; Continue to Carrum / Cheltenham	6	12	-	-	-	-
*= Some services may originate at an intermediate location Services operate Richmond-Parliament-Melbourne Central-Flagstaff-North Melbourne and vice versa						

15.4   Burnley – Newport Line

The Burnley – Newport Line will be created through the removal of Caulfield and Northern Loop services between North Melbourne and Richmond via Southern Cross and Flinders Street.

As a result, the Caulfield and Northern viaducts will be released to allow the operation of a new through service. The service will connect to the existing Burnley direct services, which previously terminated at Flinders Street. At the western end, the line will run through Newport and serve the Werribee and Williamstown lines.

The Burnley-Newport Line will enable all local services from the eastern suburbs to run through to Southern Cross, North Melbourne, Footscray and beyond – creating, for the first time, direct east-west connections.

More significantly, the removal of the need to turn-back Burnley direct services at Flinders Street will create capacity to operate significantly more services from the east, enabling up to five minute services from both Glen Waverley and Camberwell (stopping all stations services).

The Burnley local services (Glen Waverley and Alamein lines) will become completely segregated from the longer distance Ringwood Loop Line services operating from Belgrave and Lilydale; however, interchanges between these lines will be available.

Key service changes
The following key service changes are planned for the Burnley – Newport Line during Stage 4:
- Separation of Burnley Group into two stand-alone corridors
- Glen Waverley and Alamein lines will run direct and connect to Werribee / Williamstown line, creating improved frequencies and direct east-west connections
- Duplication from Altona Junction to Seaholme and grade separation of Altona Junction to enable 10 minute service to operate via Altona and improve reliability on the entire Cross-City Line
- Extension from Werribee to Wyndham Vale to create interchange with Geelong services and better accommodate new developments in Werribee West.

Stage 4 Service Plan for Burnley – Newport Line

Burnley – Newport Line Service Provision (trains per hour except where noted) Bold numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Wyndham Vale to Flinders St via Main Line Stops All Stations; continues to Burnley / Glen Waverley	15	24	6	6	6	3
Laverton to Flinders Street via Altona Stops All Stations; Continues to Alamein	6	12	6	3	6	3
Williamstown to Flinders Street Stops All Stations	3	6	3	3	3	3
Glen Waverley to Southern Cross Stops All Stations; Continues to Wyndham Vale	9	18	6	6	6	3
Alamein to Southern Cross Stops All Stations; Continues to Laverton / Williamstown	9	18	6	6	6	3
Services operate via Flinders Street and Southern Cross						

15.5   Ringwood Loop Line

The Ringwood Loop Line will run from Lilydale / Belgrave into the Burnley loop. Trains will run on dedicated tracks in both directions between Ringwood and Richmond. All services will run express from Camberwell to Burnley and two in three peak services will also run express from Box Hill to Camberwell.

Trains on this line will not interact with services from Glen Waverley and Alamein lines running via the local lines; however, interchanges will enable both lines to complement each other along the corridor.

The Ringwood Loop Line will be created following the completion of the four track section from Burnley to Camberwell and the connection of the Northern and Caulfield loops.

The completion of those projects, along with the implementation of high capacity signalling, will allow the potential capacity of the Belgrave / Lilydale services to rise to a total of 27 trains per hour, providing sufficient capacity to meet the long-term growth potential of the Ringwood corridor.
This line will serve as an important onward connection in the inner core for passengers transferring from other lines as it will provide the only anti-clockwise service around the City Loop.

Key service changes
The following key service changes are planned for the Ringwood Loop Line during Stage 4:
- Separation of the Burnley Group into two stand-alone corridors with Belgrave and Lilydale separated from the Glen Waverley and Alamein lines
- Express Belgrave and Lilydale services operating exclusively via the Burnley loop delivering improved reliability and capacity
- Increase in service frequencies on Ringwood Loop Line in line with demand growth.

Stage 4 Service Plan for Ringwood Loop Line

Ringwood Loop Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Belgrave* to City Loop Limited Stop	7	14	3	3	3	3
Lilydale to City Loop Limited Stop	7	14	3	3	3	3
Ringwood to City Loop Limited Stop	7	14	-	-	-	-
*= Some services may originate at an intermediate location City Loop Operation: Anti-Clockwise at all times						

15.6 North-South Line (Sandringham to Wallan)

The North-South Line will be created upon the completion of the Northern and Caulfield loop connections linking the Sandringham line with the Upfield / Wallan line via the through suburban lines between Southern Cross and Flinders Street and following the diversion of Werribee / Williamstown lines via the main suburban lines and towards the Burnley Group.

The North-South Line will have a key role in providing for patronage growth in the Hume area, especially north of Craigieburn, as it will provide the inner-city capacity for the newly electrified services to Wallan, which will operate via Upfield.

Key service changes

The following key service changes are planned for the North-South Line in the long-term:

- Separation of Upfield line from Craigieburn line enabling higher frequencies to operate and through-running from Sandringham to Upfield
- Electrification to Wallan via Upfield.

Stage 4 Service Plan for North-South Line

North-South Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Wallan to Flinders Street Stops all stations; continue to Sandringham	**6**	**12**	**3**	**3**	**3**	**3**
Upfield to Flinders Street Stops all stations; continue to Sandringham	6	6	3	3	3	-
Sandringham* to Southern Cross Stops all stations; continue to Upfield / Wallan	12	21	6	6	6	3
*= Some services may originate at an intermediate location Through Services Operate via Flinders Street and Southern Cross						

15.7 Sunshine – Dandenong Line

The Sunshine – Dandenong Line will remain unchanged in Stage 4 having been established and fully upgraded in the previous period, including the addition of line extensions and high capacity signalling.

Key service changes

None.

Stage 4 Service Plan for Sunshine – Dandenong Line

Sunshine – Dandenong Line Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Sunbury to Domain Stops all stations; continue to Dandenong line	8	16	3	3	3	3
Sydenham to Domain Stops all stations; continue to Dandenong line	3	6	-	-	-	-
Melton to Domain Stops all stations; continue to Dandenong line	6	12	3	3	3	3
Melbourne Airport to Domain Stops all stations; continue to Dandenong line	6	12	6	6	6	3
Pakenham* to Parkville Express Caulfield-Domain; continue to Sunshine Line	10	21	3	3	3	3
Cranbourne to Parkville Express Caulfield-Domain; continue to Sunshine Line	6	12	3	3	3	3
Rowville to Parkville Express Caulfield-Domain; continue to Sunshine Line	6	12	6	6	6	3
*= Some services may originate at an intermediate location Services operate via Melbourne Metro rail tunnel stopping at Domain, Flinders Street, Melbourne Central, Parkville and Arden						

15.8   Grovedale – South Yarra Line

The Grovedale – South Yarra Line will be established upon electrification of the Geelong line and the reconfiguration of the inner core. Services will operate via the RRL lines into platforms 15 and 16 at Southern Cross. These services will then merge with the North-South Line over the suburban viaduct before running through to South Yarra.

The electrification to Geelong will enable the line to be fully integrated into the metropolitan system and create through-running opportunities for Geelong passengers to reach the wider CBD area on one train.

Key service changes

The following key service changes are planned for the Grovedale – South Yarra Line during Stage 4:

- Electrification to Geelong and operation of high-capacity electrified rolling stock from Grovedale
- Duplication from Geelong to Grovedale and station enhancements to accommodate electric trains
- Reconfiguration of inner core to enable Geelong line services to be extended through to Flinders Street and South Yarra
- Increase in service levels in line with patronage growth.

Stage 3 Service Plan for Grovedale – South Yarra Line

Grovedale – South Yarra Service Provision (trains per hour except where noted) **Bold** numbers indicate improvement from previous stage	Peak Hour	Peak 2-hour Period	Inter-Peak	Evening	Weekend Peak	Other Off-Peak
Grovedale* to Flinders Street Limited Stops; some continue to South Yarra	**6**	**9**	**3**	**3**	**3**	**3**
Geelong to Flinders Street Limited Stops	3	6	-	-	-	-
Black Forest Road to Flinders Street Limited Stops; continue to South Yarra	3	6	3	-	3	-
*= Some services may originate at an intermediate location Through services operate via Flinders Street and Southern Cross						

16 Stage 4 - Key projects

16.1 Summary

Three new lines will be added to the Melbourne rail network during Stages 1, 2 and 3 – Regional Rail Link, Melbourne Metro rail tunnel and the South Morang – Southern Cross Line – which will enable the network to be transformed into a metro-style system with independent lines running simple end-to-end service patterns with little or no at-grade conflicts. It is anticipated that, as well as the significant increases in capacity, reliability on the network will be far higher than today – even with strong patronage growth.

Key works during this period involve the reconfiguration of the Northern and Caulfield loops to deliver two new through running lines through the city, one via the underground stations and one via Flinders Street and Southern Cross. These works will provide the foundation for a much higher capacity system that, at the same time, can operate much more reliably through the removal of nearly all cross-moves and junctions in the inner core.

This reconfiguration will result in seven separate, independently operated suburban lines through the CBD and will add 30 trains per hour to the system. This will establish the basis for future line extensions to be added to the system without any adverse service outcomes.
The new tunnel from Clifton Hill to Southern Cross will also be extended to provide a good transport connection into the Fishermans Bend area.

Other projects implemented in this period include quadruplication between Burnley and Camberwell. This will be the first major project implemented on the Burnley Group in this program and will double counter-peak line capacity and enable the full segregation of Burnley express and Burnley local lines during regular operations.

Further expansion of the metropolitan network will be enabled through electrification projects to Geelong and Wallan, as well as an extension to Mernda.

Many of the works identified here will set up the network to be able to accommodate significant patronage growth on all lines, as well as enabled further line extensions to be considered.

Figure 16-1: Summary of projects to be implemented during Stage 4

Network Development Plan: Rail
Proposed Infrastructure to support
Stage 4 Network Plan
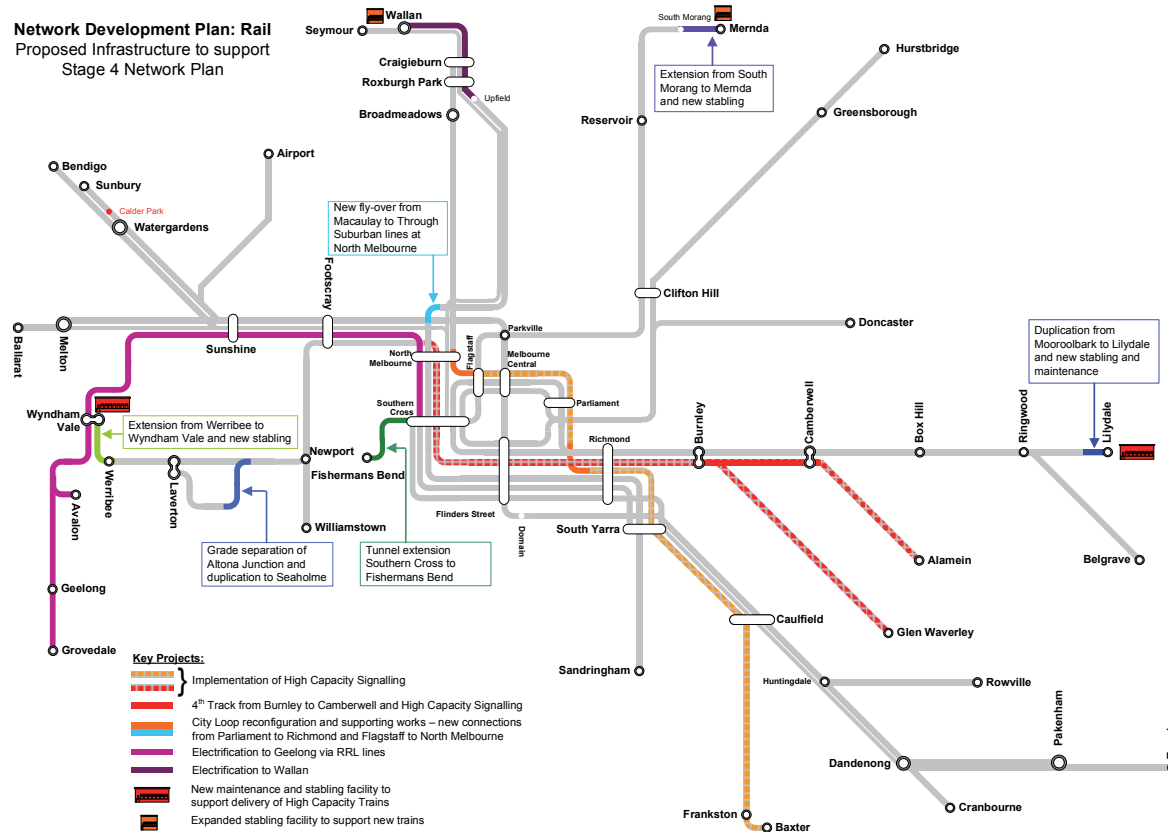
16.2   Electrification to Geelong

The Geelong line is currently the fastest growing regional rail corridor and following the completion of RRL, is expected to grow at an even faster rate due to the growth at new stations on the Wyndham Vale section of the line. The RRL project will itself enable more trains to operate per hour: by 2020, a new order of high capacity regional trains is planned to be deployed on the corridor. Thereafter, the provision of a new intermediate turn-back at Black Forest Road Station, coupled with Melton corridor upgrades, will enable an extra three trains per hour to operate as short starters to serve the metropolitan stations.

Despite the above, it is envisaged that additional capacity will be required on the line and – given the high number of trains that will need to operate – the electrification of the line will become an appropriate solution to meet long-term growth needs.

It is envisaged that the electrification of the line will be staged as follows:
- Electrification to Black Forest Road, with short starters operating with long distance high capacity trains but regional trains still operating from Grovedale and picking up at Wyndham Vale station
- Full electrification to Grovedale, with all services on the corridor operated by long distance high capacity trains.

Key benefits

- Provide a more efficient and cost-effective rail service between Geelong and Melbourne that caters for rapid growth in travel between the two centres
- Enable Geelong line services to be incorporated into the wider metropolitan system
- Enable high capacity regional trains to be cascaded onto remaining diesel-operated commuter lines through a cascade of former Geelong line regional trains
- Enable the retirement of locomotive-hauled fleet on the remaining diesel operated network through a further cascade of the V/Locity fleet.

High level scope of works

Stage 1:

- Electrification to Wyndham Vale
- Electrification of RRL lines from Southern Cross platforms 15 and16 to Black Forest Road station
- Upgrade of Melbourne Yard stabling.

Stage 2:

- Electrification from Wyndham Vale to Grovedale
- Partial duplication from Grovedale to Geelong and upgrade of stations to accommodate electric trains
- Upgrade of Waurn Ponds stabling yard.

16.3   Electrification to Wallan

The northern outskirts of Melbourne encompassing the areas of Donnybrook, Aurora and other northern suburbs are expected to experience rapid residential development. The absence of rail services in some areas will increase pressure on the existing road and bus networks, particularly during peak periods.

An extension of the Craigieburn line to the north is a logical step in catering for these new areas. However, the Craigieburn line is not expected to have sufficient capacity to accommodate additional passenger demand arising from a northern extension in the existing rail corridor. In addition, an extension would not serve Aurora or surrounding areas.

Therefore, the network has been developed to better utilise the Upfield line to carry metropolitan services from the Wallan area, as well as continuing to service regional services from Seymour.

Key benefits

- Expanded rail coverage in new residential areas
- Increased service capacity for existing Upfield line stations through greater service frequency
- Increased service frequency on Craigieburn line available after Seymour trains are diverted to the Upfield line
- Frequency improvements will encourage more people to use the Upfield line and provide a better balance of passengers on the Upfield, Craigieburn and South Morang / Mernda lines
- Makes better use of existing infrastructure on Upfield line through higher utilisation

- Provides access to a new maintenance and stabling facility for the North-South Line, removing the need to stable some trains and maintain all trains on other lines.

High level scope of works
- Electrification of new track pair from Roxburgh Park to Craigieburn
- Electrification from Craigieburn to Wallan
- New stabling facility at Wallan.

16.4 Reconfiguration of City Loop and associated works

Constraints in the Northern Group revolve around the need for Craigieburn and Upfield lines to merge in the City Loop, thereby restricting the combined frequency to 24 trains per hour.

On the Burnley Group, the terminating and turning back of Burnley local trains at Flinders Street limits capacity on all Burnley Group local lines.

The current routing and efficiency of the loop and terminating lines in the city is an inefficient use of resources (trains and infrastructure), as demonstrated in Figure 16-2 (note that some lines are not shown for clarity). The line thickness designates an indicative train loading for the AM peak period.

Figure 16-2: Existing City Loop operation and train loadings
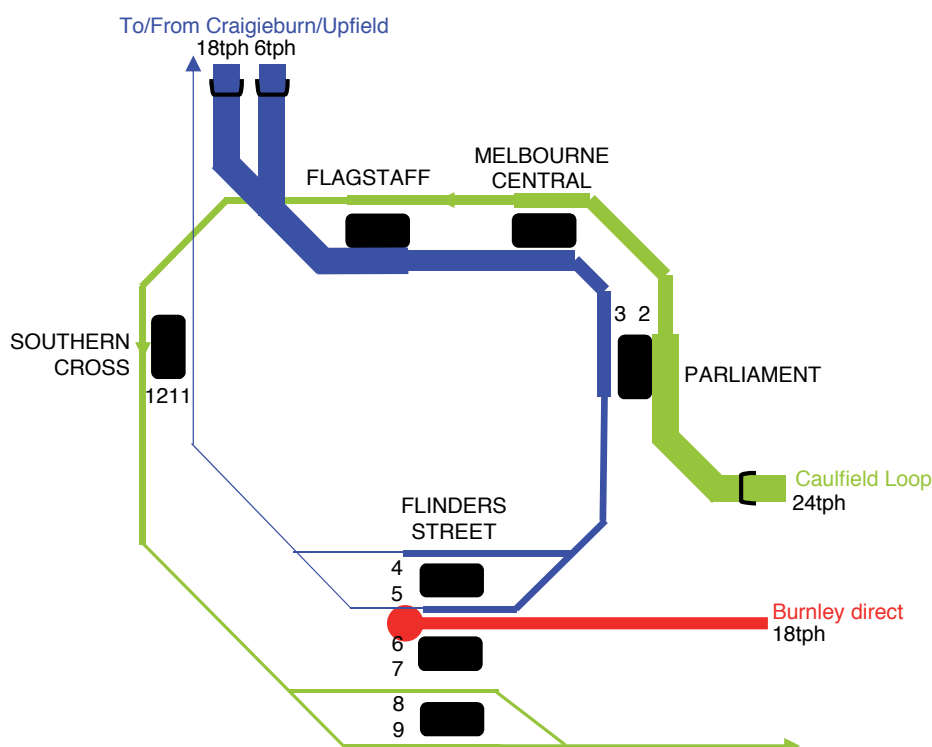
From the above figure, it can be seen that the loop operation is inefficient because all trains entering the loop will be overloaded. However, by the time they run across the viaduct between Flinders Street and Southern Cross, they will be nearly empty, which is a waste of valuable central area track capacity.

In addition, Burnley local services (the Glen Waverley and Alamein lines) that run direct to and terminate at Flinders Street will be underutilised as many passengers will transfer onto loop services at Richmond, which again is a sub-optimal use of trains and infrastructure.

By comparison, the through lines will have significant train loadings throughout the central area, resulting in a more optimal use of infrastructure.

In summary, the removal of loop operations on the Northern and Caulfield loops and the connection between specific lines on each side of the city will result in the creation of two new Cross-City lines, with capacity for an additional 30 trains per hour in the peak (Craigieburn – more than six trains per hour, Upfield and future Northern lines – more than 18 trains per hour and Burnley local lines – more than six trains per hour).

The train routing and efficiency diagram shown below in Figure 16-3 illustrates the efficiencies gained in train and infrastructure utilisation following the completion of these works.

Figure 16-3: Proposed reconfigured loop operation and train loadings
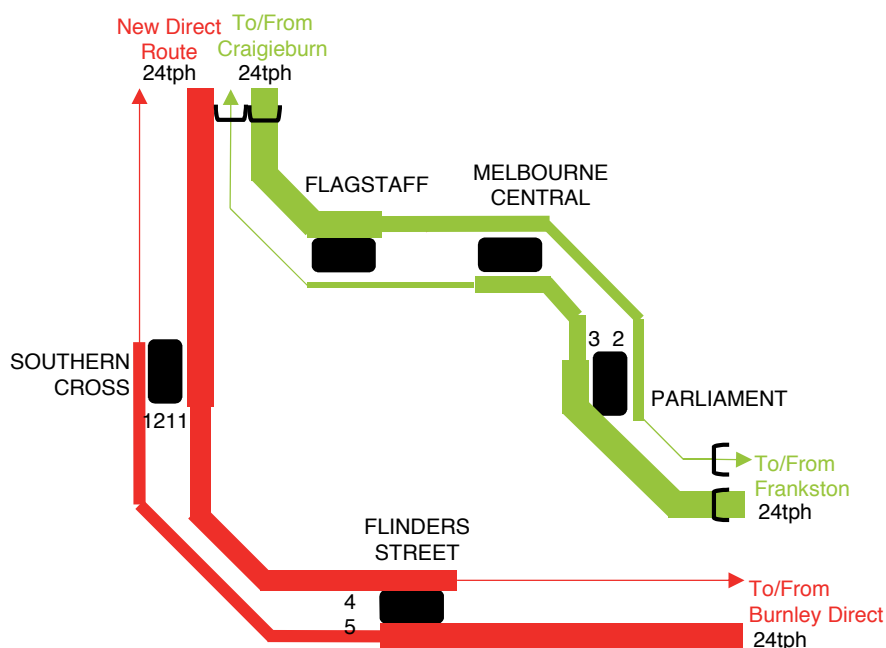
This project will result in a major re-organisation of track-work through the inner core and significant opportunities to rationalise many existing tracks, crossings and turn-outs. Figure 16-4 provides a schematic representation of the inner core configuration following the implementation of this project (not including potential freight tracks).

Figure 16-4: Revised inner core operation following loop reconfiguration
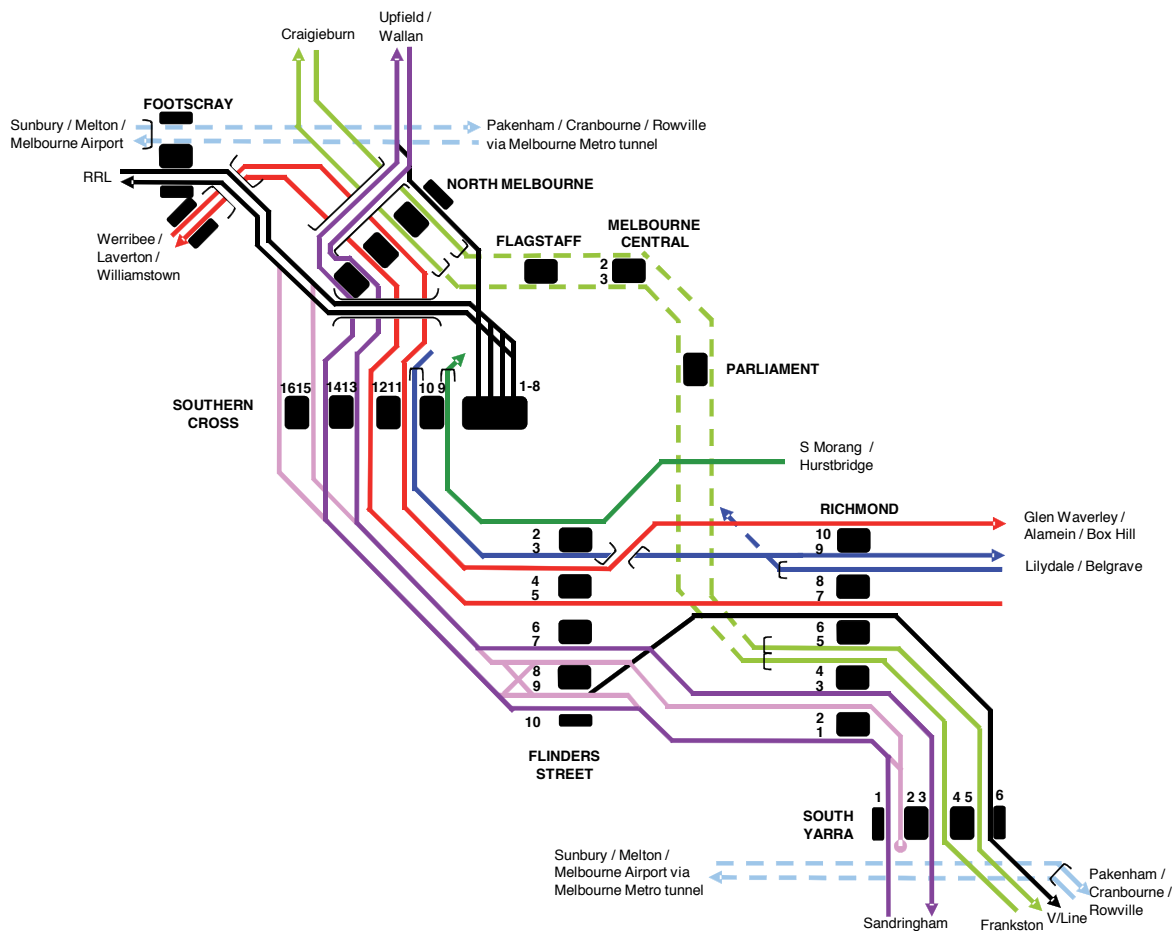
It should be noted that the project also needs to include associated works at North Melbourne and Richmond to enable the revised train routings, including the provision of a new fly-over from the Upfield line to the through suburban lines to grade separate Upfield services over Craigieburn and Werribee / Williamstown tracks.

Key benefits

The package of works identified for this period will provide the following benefits:

- Free up two viaduct tracks following removal of loop routing, effectively providing two new tracks through the city
- Provide greater capacity for growing passenger demand on Craigieburn and Upfield lines and all Burnley express and local lines
- Enhance service reliability through the full sectorisation of lines through the city and suburban sections
- Enable quicker travel times for outbound journeys on the Burnley express line through segregation from local stopping services
- Provide faster cross-town journeys by eliminating the need for passengers to backtrack or suffer layover time at Flinders Street

- Extend the network connectivity for Burnley local services by providing direct through services to Southern Cross and the west
- Facilitate easier cross-town travel through the city for all northern lines to employment, education and retail precincts clustered in the east
- Provide a better balance in passenger loadings on trains bound for either the underground city stations (Flagstaff, Melbourne Central and Parliament) or the surface stations (Southern Cross and Flinders Street), as opposed to the heavily loaded loop services and relatively lightly loaded direct services terminating at Flinders Street
- Simplify the rail network by providing direct access to and from all city stations at all times of the day, reducing current confusion and inconvenience associated with daytime loop reversals
- Increase efficiency of train movements through the city by removing loop services
- Reduce train congestion at Flinders Street by eliminating terminating and turnback manoeuvers for Burnley local services, thereby increasing train efficiency through reduced train fleet requirements
- Enable the rationalisation of track and removal of excess point work in the central area to reduce maintenance requirements
- Provide network capacity to enable new rail corridors to be built in future years to serve new developments in the northern outskirts as well as an express link to Melbourne Airport.

High level scope of works
- New tunnel link between Flagstaff (Caulfield loop) and North Melbourne platform 2. This will enable trains from Craigieburn to run into the Caulfield loop to Flagstaff, then exit via the existing portal at Richmond platform 5 and continue on to Frankston via Parliament
- New tunnel link between Parliament (Northern loop) and Richmond platform 3. This will enable trains from Frankston to run into the Northern loop to Parliament, then exit via the existing western portal at North Melbourne on to Craigieburn via Flagstaff
- Enabling works for new tunnel link from City Circle loop to down Burnley Through line to facilitate through running from Clifton Hill Loop Line to Ringwood Loop Line for the purposes of stabling and maintenance
- New fly-over from the Upfield line onto the through suburban lines at North Melbourne (over other Northern Group tracks)
- Bi-directional signalling at North Melbourne platform 1 to enable operation of city-bound and outbound Seymour services to Southern Cross.

16.5   Fourth track between Burnley and Camberwell

As detailed above, the connection of the Northern and Caulfield loops to each other will enable the creation of a new cross-town line linking the Burnley local lines (Glen Waverly and Alamein) to the Werribee line. This line will be segregated and will ultimately have a capacity of 24 trains per hour in each direction.

However the key constraint to achieving this frequency will be the three-track section between Burnley and Box Hill. During peak periods, in the peak direction, the outside line carries Burnley local services, while the centre track caters for Burnley express services.

In the counter-peak, a mixture of express and stopping services currently share the single track (although in order to maximise capacity on the counter-peak track, all trains need to stop at all stations).

This configuration means that the different train services are sectorised going in the peak direction; however, they must share one track in the counter-peak direction. As the capacity of the single counter-peak track is much less than the two peak direction tracks, the number of train movements in the peak direction is limited to avoid train congestion in the city during the morning peak. This means that some peak direction capacity cannot be used.

To overcome these issues, there is a need to quadruplicate the rail line between Burnley and Camberwell and ultimately onto Box Hill. This would involve the construction of a fourth track on the south side of the existing rail corridor, with new platforms at Camberwell. The third platform at all other intermediate stations would become redundant and could be demolished if required to make room for the fourth track.

Operational changes would be made to enable Burnley express and local services to be segregated from each other. Peak period operations would be amended as follows:
- Burnley express services (Lilydale or Belgrave) running into the City Loop
- Burnley local services (Glen Waverley and Alamein) running direct to Flinders Street then through to the Werribee line.

Key benefits
The Burnley - Camberwell quadruplication will provide the following benefits:
- Increase capacity in peak and counter-peak direction for both Burnley express and local services
- Improve reliability of both Burnley express and local services through complete sectorisation of each
- Offer quicker journeys between the city and Box Hill and Ringwood activity centres with counter-peak and off-peak express services
- Provide faster cross-town journeys by eliminating the need for passengers to backtrack or suffer layover time at Flinders Street
- Extend the network connectivity for Burnley local lines by providing direct through services to Southern Cross station and the west
- Facilitate easier cross-town travel through the city for all Northern Group lines to employment, education and retail precincts clustered in the east.

High level scope of works
- Construction of additional track between Burnley and Camberwell
- Rationalisation of intermediate stations to provide only two platforms on outside local lines, except at the key interchange stations of Camberwell and Glenferrie where four platforms will be provided
- Enabling works for additional track from Camberwell to Box Hill, activation of fourth platform at Box Hill and new rail-rail grade separation to enable local lines to terminate in platforms 1 and 2.

16.6   Extension from Werribee to Wyndham Vale and new stabling

The City of Wyndham is currently one of the fastest growing municipalities in Australia. During Stage 2, the residential development of the municipality will be mature and well-established. The RRL lines via Tarneit will serve the northern and western extents of the municipality while the Werribee line will cater for the southern areas.

Despite the presence of these two railway lines, there will be some gaps in residential catchments served by rail, specifically those areas in West Werribee located in close proximity to the Werribee racecourse. Moreover, there will be a need to create a new park and ride facility to minimise the need for parking at the activity centres at Werribee and Manor Lakes.

Another significant missing link is the absence of a direct rail-rail interchange for passengers travelling between the Geelong and Werribee lines.

Additionally, the growth in passenger demand will require additional train sets and associated stabling and maintenance facilities.

Key benefits
The package of works identified for this period will provide the following benefits:
- Increased residential catchment within close proximity of the rail network
- Improved connectivity for passengers wishing to travel between origins and destinations on the Werribee and Geelong lines, with easy direct interchange
- Direct connection between Wyndham Vale and other destinations on the Werribee line
- Reduced capacity requirement on Geelong line trains as a number of passengers in the West Werribee and Wyndham Vale areas will transfer using the suburban trains
- Addresses the shortage of storage facilities for the expanding train fleet
- Provides opportunity for a new maintenance facility in the long-term if required.

High level scope of works
To address these issues, this package of works involves the following:
- Extension of the Werribee line to Wyndham Vale (Manor Lakes) station, with new platforms at Wyndham Vale in addition to the existing V/Line platforms, plus a new station at Black Forest Road which will become the main interchange station
- New stabling facility on the north side of Ballan Road and new platforms at Manor Lakes, with the opportunity for a train maintenance facility if required in long-term.

16.7   Duplication from Altona Junction to Seaholme and grade separation of Altona Junction

The maximum frequency of two-way services on the Altona loop is currently three trains per hour. This is primarily due to the number of single line sections between Altona Junction and Laverton. These single line constraints affect the reliability of operations on the Altona loop, as well as the reliability of services on the Werribee and Williamstown lines, all of which merge on the western side of Newport.

By Stage 4, growth in passenger demand will exceed this maximum frequency of three trains per hour. In addition, extra services on the Werribee and Williamstown lines will also be required to meet patronage growth. Duplication of part of the Altona loop and the grade separation of Altona Junction is proposed to provide the required capacity increase, as well as improve reliability for this line along with neighbouring lines.

Key benefits

The Altona Junction-Seaholme duplication will provide the following benefits:
- Increased capacity in peak and counter-peak direction for Altona loop services, enabling more frequent trains
- Improved service reliability on Altona loop, as well as Werribee and Williamstown lines
- Enable a potential future extension of the Altona loop line to Point Cook.

High level scope of works
- Duplication from Altona Junction to Seaholme station
- Construction of new Seaholme station
- Construction of new rail-rail fly-over at Altona Junction to eliminate conflicts between city-bound Altona trains and outbound Werribee (main line) trains.

16.8   City Loop station upgrades

Service frequencies through the City Loop stations will increase with the provision of high capacity signalling on the Clifton Hill Group and better utilisation of existing signalling systems on the other loops. Moreover, the connection of the Northern and Caulfield loops will result in a higher proportion of train loads alighting at the City Loop stations.

Preliminary investigations completed to date, utilising simulation software and focused on Parliament station at this stage, have indicated that some additional escalator capacity will be required as well as an enlargement of the forecourt areas and an increased number of barriers at the main entrances.

At this stage of the investigation, platform capacities do not appear to be an issue even though these are causing some concern at present. This is due to the fact that in future all trains through a given platform will be running to no more than two stopping patterns and destinations.
It is currently considered that additional escalator capacity can be provided by insertion of new escalators into the existing escalator banks. The extension of the forecourt areas is an at-surface construction issue that should not be overly complex.

Key benefits
- Ensure station access and platform capacity can support passenger movements at peak times
- Reduced congestion and therefore improved travel times at key CBD stations.

High level scope of works
- Install new escalators at City Loop stations

- Widen forecourt areas and install additional ticket barriers where necessary to improve throughput.

16.9   Extension to Mernda and new stabling facilities

The extension from Epping to South Morang has improved access to the rail network from the growing residential communities in Whittlesea. Nevertheless, as growth expands further north over the next decade, a further extension of the line will enable the public transport system to continue to offer efficient and direct access to the central city.

As a secondary objective, an extension to Mernda provides an opportunity to establish a new stabling facility on the line. By around Stage 4, the South Morang line is forecast to be suffering from a significant shortfall in stabling capacity and little opportunity exists to expand the facility at Epping or to provide another stabling facility anywhere else on the corridor. The extension to Mernda opens up the opportunity to provide new stabling roads in the vicinity of the new station.

Key benefits
- Provides improved network reach by extending the South Morang line further into the Whittlesea growth area
- Provides opportunity to establish new stabling facilities for the South Morang line.

High level scope of works
- New two track extension from South Morang to Mernda
- New terminating station at Mernda with two platforms
- Installation of high capacity signalling
- New stabling facility at Mernda.

16.10   Duplication from Mooroolbark to Lilydale and new maintenance and stabling facilities

Despite requiring more than 45 trains in the fleet, at present only limited maintenance facilities are available on the Burnley Group with only the three-car workshop at Bayswater providing maintenance support to the group. Consequently, much of the maintenance of Burnley Group trains needs to be undertaken at the Epping maintenance facility on the Clifton Hill Group. The Epping train maintenance facility will become progressively stretched to the limits of its capacity as additional peak services are added on the Clifton Hill Group and as off-peak service enhancements are rolled out on both groups.

To cover the shortfall in the shorter term, the opportunity of utilising Macaulay as a secondary Burnley Group maintenance location is being considered by the rail operator. While Macaulay has played an important role in supporting the Northern Group, the recent completion of the Craigieburn train maintenance facility should enable all Northern Group trains to be maintained there, offering an option to dedicate Macaulay to the Burnley Group.

However, even with the availability of Macaulay and Bayswater, it is likely that during Stage 4 a new dedicated train maintenance facility will be required on the Burnley Group to enable:

- The release of the Macaulay train maintenance facility to support the growth in train services on the Northern Group as a result of the Melbourne Metro rail tunnel project and high capacity signalling
- The segregation of the Burnley Group into two corridors with Lilydale supporting the Ringwood Loop Line
- The need to support maintenance of trains on the Clifton Hill Loop Line following the separation of the South Morang line – leaving Hurstbridge and Doncaster lines isolated from a train maintenance facility
- Maintenance provision for further orders of high capacity trains.

As a result of the above, the plan proposes a new train maintenance facility be constructed in the Lilydale area. This facility would enable all Ringwood Loop Line trains to be fully maintained on the corridor without the need to run them to any other part of the network. Moreover, the site would also be able to accommodate trains from the Clifton Hill Loop Line, which would be transferred to and from the Ringwood line at Flinders Street.

The train maintenance facility will need to be designed to cater for high capacity trains as well as existing rolling stock to enable the transition from the older fleet to the new fleet on the group. To support the new maintenance site and a complementary increase in stabling at the same location, there will be a need to upgrade line capacity to reach the site. The existing single line section from Mooroolbark to Lilydale will be unable to reliably support the movement of trains to and from the train maintenance facility and the project includes the duplication of that line.

Key benefits
- Improved maintenance capacity on the network, enabling increases in train services
- Sectorisation of the Burnley Group, eliminating the need to transfer trains to and from the Clifton Hill and Northern Groups
- Provision of new facilities capable of supporting high capacity trains
- Opportunity to close down Bayswater train maintenance facility with the potential to release land for other purposes.

High level scope of works
- Duplication from Mooroolbark to Lilydale
- Construction of new train maintenance facility capable of maintaining the entire Burnley Group fleet and designed to accommodate existing trains and high capacity trains
- Reconfiguration of existing stabling roads at Lilydale to support a new train maintenance facility.

16.11   Extension from Southern Cross to Fishermans Bend

The Fishermans Bend area will undergo significant redevelopment in the coming decades and become an important new hub in the expanding CBD. This area will need significant additional public transport capacity and connections as it develops and it is anticipated that the initial enhanced bus network will not be sufficient to support the longer term needs for passengers wishing to access the area. This project enables a fast and frequent train service to be provided

into Fishermans Bend connecting to the new Mernda – Southern Cross Line. This will provide rapid connections to the inner city and hospital precincts as well as connections with all other rail lines through interchanges at Southern Cross, Flagstaff and Parkville. The new extension also foreshadows the longer term requirement to provide a new connection to Newport to enable more capacity to be delivered from Sunbury and Werribee.

Key benefits

- Provides improved network reach by extending the new tunnel into Fishermans Bend urban redevelopment area
- Improves travel time and access to and from growing residential and employment precinct taking pressure off the road network and deferring the need for tram network extensions
- Provides staging opportunity for ultimate extension from Fishermans Bend to Newport to facilitate connection to Werribee and Sunbury lines to relieve capacity constraints.

High level scope of works

- New two track tunnel extension from Southern Cross to Fishermans Bend
- New terminating station with two platforms and cross-over to facilitate rapid turn-around of trains
- Installation of high capacity signalling.

17 Protecting a long-term vision

After Stage 3, the plan will continue to complete the roll-out of high capacity signalling on the metropolitan network. Beyond Stage 4, the plan explores high level concepts for Melbourne's rail network with the focus at this stage on protecting options that could form part of the long-term vision for the metropolitan rail network.

By 2050, it is expected that Melbourne will be a city of 6.5 million people. To support this growth, the public transport network will need even more capacity and improved connections. Detailed development has not yet been undertaken on this long-term vision of the rail network, but a number of projects are under consideration.

At this stage, the focus of planning for this period is to protect options that could form part of the long-term vision for the rail network. Further work will be undertaken to develop the long-term network and detailed planning for shorter-term projects will be mindful of this long-term vision.

17.1   Long-term network plan

The long-term network plan builds upon the substantial changes introduced in the Stage 4 plan, which created a fully segregated network with sufficient inner-city capacity to absorb significantly more trains. The key potential changes in Stage 4 involve further new line extensions, as well as the completion of the delivery of high capacity signalling across the entire metropolitan rail network.

Figure 17-1 provides a schematic representation of the peak period network configuration in the long-term, with peak hour service numbers shown on each corridor.

Figure 17-1: Schematic diagram of the long-term network
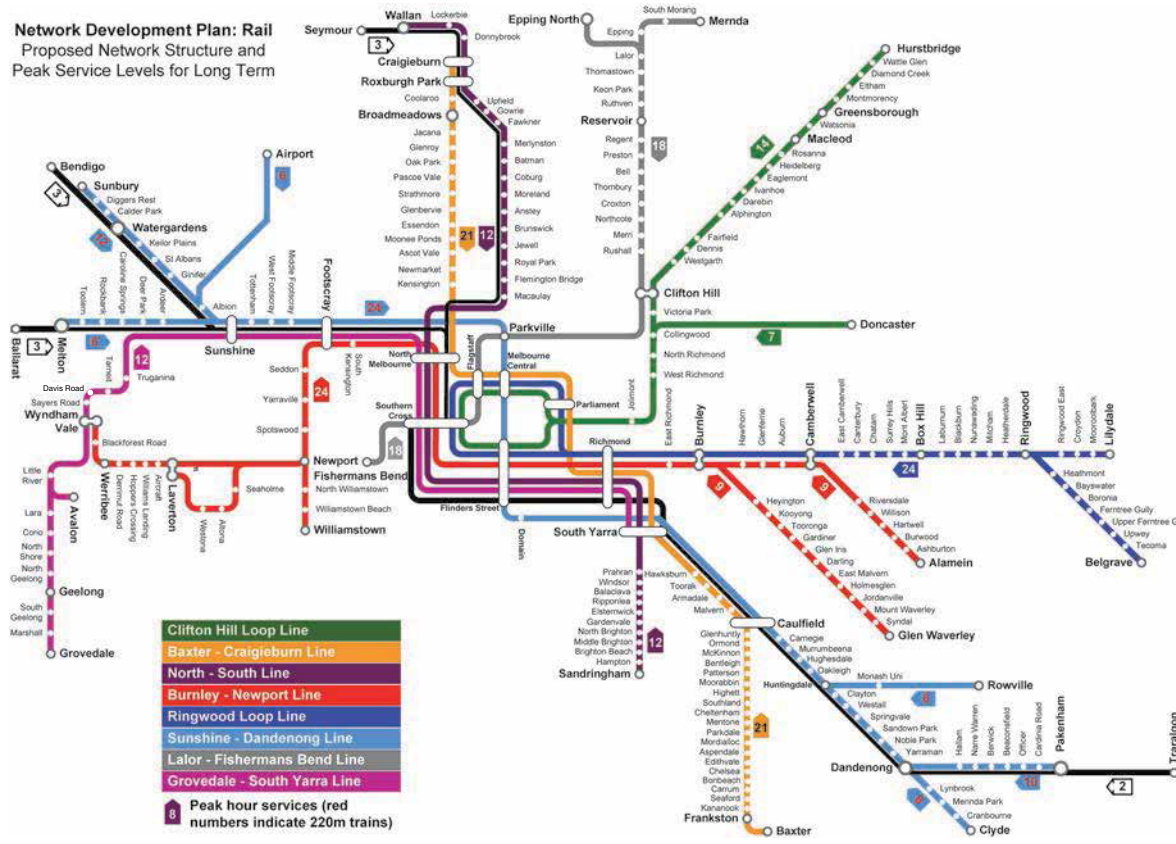
17.2　Potential service specifications

A number of service specifications could feature as part of the long-term network.

Clifton Hill Loop Line and Mernda – Fishermans Bend Line

Spare capacity would exist on the Clifton Hill Loop Line to increase service levels in the event of patronage growth being quicker than expected. The Mernda – Fishermans Bend Line could be altered to incorporate a new line extension to Epping North from Lalor. Services operating on the trunk section would split evenly between the Mernda and Epping North branches, offering peak services every six to seven minutes from each suburban terminus.

Baxter – Craigieburn Line

While the configuration of this line would remain unchanged, patronage growth in the longer-term could require additional services to be added at both ends. The provision of high capacity signalling should enable service levels to be increased up to at least 27 trains per hour on this line. In the long-term, around 21 trains per hour will be in operation.

Burnley – Newport Line

No changes are anticipated on this line from the Stage 4 plan. Nevertheless, there will be an opportunity to increase service frequencies up to 27 trains per hour on the trunk section of the line in the event of rapid patronage growth.

Ringwood Loop Line

Patronage growth is expected to necessitate increasing services levels on the trunk section of this line from 21 trains per hour to 24 trains per hour. The implementation of high capacity signalling on the corridor will facilitate this change and there will be an opportunity to further increase service frequencies up to 27 trains per hour upon further patronage growth.

North-South Line

No changes should be necessary on this line from the Stage 4 plan.

Sunshine – Dandenong Line

The Sunshine – Dandenong Line service plans are likely to remain unchanged in the longer term. However, significant extra capacity will be added in line with expected patronage growth through the lengthening of trains up to the maximum design length of 220 metres. This will help to accommodate anticipated ongoing rapid growth on the Melton corridor without the need to operate more services, while also addressing the underlying growth on the Dandenong corridor. The long-term service plans are also designed to accommodate an extension of the Cranbourne line to Clyde to better service the new growth area.
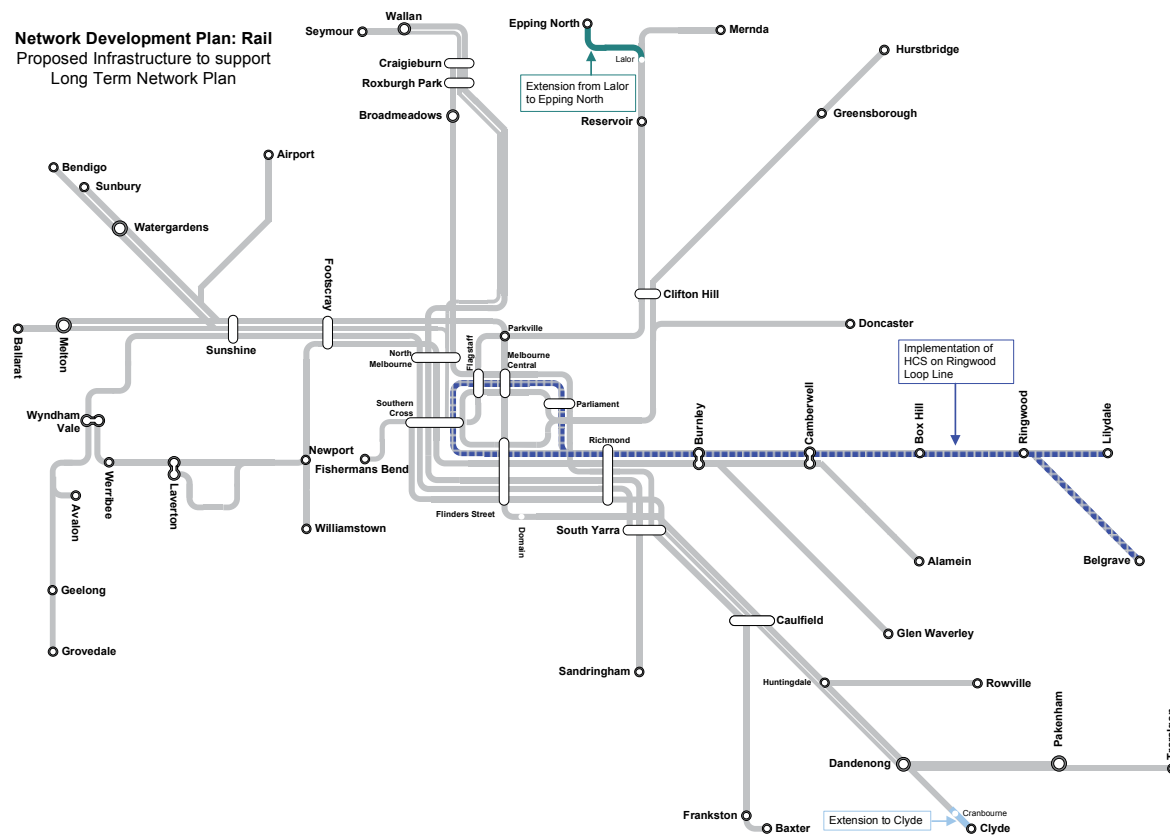
Grovedale – South Yarra Line

No changes should be necessary on this line from the Stage 4 plan.

17.3 Potential key projects to support the long-term network plan

The long-term network plan is consistent with the Stage 4 plan other than it incorporates a number of potential network extensions as well as the completion of high capacity signalling across the metropolitan network. Figure 17-2 shows a schematic representation of the possible new projects required to support the network in the longer term.

Figure 17-2: Summary of projects planned for implementation in the long-term

Network Development Plan: Rail
Proposed Infrastructure to support
Long Term Network Plan

Extension from Lalor to Epping North

Implementation of HCS on Ringwood Loop Line

Extension to Clyde

High capacity signalling – Ringwood Loop Line

The Ringwood line will be the last part of the metropolitan network to have high capacity signalling installed. Following the implementation of the fourth track between Burnley and Camberwell and the consequent separation of the Burnley Group into two stand-alone corridors, the installation of high capacity signalling can be rolled out on the Ringwood line. This will require the installation of high capacity signalling in the Burnley Underground Loop, on Burnley through tracks and the corridor from Burnley to Ringwood, as well as the branch lines to Belgrave and Lilydale. In the same timeframe, the group should have a full fleet of high capacity trains that are enabled to operate with high capacity signalling.

The key benefits from this project include improved capacity and service reliability enabled by high capacity signalling, technology in places that is consistent across the network and reduced ongoing costs compared to replacing the line-side signalling system.

Extension to Epping North

A growth area is currently in development in the Epping North and Aurora areas. While planned direct bus services to the South Morang line will offer sufficient capacity and competitive travel times in the medium term, upon full build-out of the area it is likely a higher capacity solution will need to be found. As such, a new branch line could be constructed to Epping North connecting into the South Morang line at Lalor station. This would require a new two track branch line from Lalor to Epping North, a new single track terminus at Epping North and installation of high capacity signalling.

Extension to Clyde

Major new growth areas are also being developed in Casey, extending south-east from Cranbourne. This growth will reach Clyde, probably within the next 20 years. When it does, the existing rail service to Cranbourne and connecting bus services to the edge of the Clyde growth area may not be sufficient to meet residents' travel needs.

An extension of the Cranbourne line to Clyde would provide relatively quick access to central Melbourne from the area and help to service a large community in a sustainable and efficient manner. In addition, the extension would provide the opportunity to establish a large stabling and maintenance facility for the line. It would also open up the option of further extending the network to proposed potential new airport at Tooradin.

This new two track extension from Cranbourne to Clyde would require grade separation of the South Gippsland Highway, a new double-platform terminus at Clyde and installation of high capacity signalling.

18 Rolling stock, stabling and maintenance requirements

18.1 Overview

Increases in rolling stock numbers will be needed to support patronage growth and planned service improvements over the next 20 years. There will also be a concurrent need to gradually replace Comeng trains.

Service changes and timing of infrastructure projects need to be cognisant of delivery timelines for new trains. Moreover, the deployment of new trains needs to consider the capability of main-line infrastructure to accommodate those trains – in particular, the timing of power upgrades and delivery of new maintenance facilities needs to be carefully considered and sequenced.

As discussed previously, one of the fundamental objectives of the plan is to enable more passengers to be carried on each service while maintaining acceptable dwell times.

Key to this is the delivery of new, high capacity trains that will be able to accommodate up to 1100 passengers, with the ability to be lengthened further to carry more than 1600 passengers if needed. These new trains are planned to be delivered in three orders starting in 2017, with each order delivered with a new purpose-built maintenance facility strategically located on the network to support the new trains.

Existing trains will be cascaded onto other groups to boost service numbers or retired when they reach a 35-year service life. The first batch of high capacity trains will be deployed on the Dandenong and Sunshine corridors in order to prepare the network for the creation of the Sunshine – Dandenong line upon opening of the Melbourne Metro rail tunnel. Thereafter, the cascade of rolling stock will result in high capacity trains being deployed with new supporting stabling and maintenance facilities onto lines currently without major maintenance facilities (such as Frankston and Ringwood) with existing trains being retained on those lines with major depots (such as Craigieburn and South Morang). X'Trapolis trains will therefore be migrated onto the Craigieburn and Upfield corridors in the medium term to work out of the Craigieburn maintenance facility. Siemens trains will remain based at Newport and continue to operate on the Werribee corridor and its corresponding eastern corridors.

18.2 Train Fleet Size

The identified service plan changes shown in this document will require a steady increase in trains over the next 20 years. Sufficient trains are already in the fleet or are in construction to cater for the 2016 service plan upon implementation of RRL; thereafter, all service changes will rely on the delivery of high capacity trains.

To support the stage 2 network plan there will need to be around 100 high capacity trains to expand the fleet and operate new services and enable the retirement of part of the Comeng train fleet.

This delivery of some 100 new trains during the next decade is similar to the number of trains introduced over the last decade.

Further high capacity trains will need to be purchased to support new services introduced in Stages 3 and 4 as well as to enable the retirement of the remaining Comeng fleet. Further details of future train deployment are described below.

18.3   Fleet allocation by group

The allocation of trains by group will change over time as new trains are introduced to the network and as groupings are altered. The following principles have been used to determine the most appropriate allocation in each timeframe:

- Adhering to the principles of network sectorisation and thus avoiding all trains operating on all parts of the network
- Allocating permanent fleet to each group with no more than two train types in operation
- Consideration of restrictions in terms of operating existing fleet (for example, to operate the X'Trapolis fleet in service on the Northern and Cross-City Groups will require infrastructure modifications)
- Location of existing maintenance facilities and capability of those sites to maintain each train type (for example Siemens trains can only be maintained currently at Newport)
- Planned power and signalling upgrades and relationship to rolling stock (for example, the Melbourne Metro rail tunnel will be designed to accommodate high capacity trains only)
- Utilising new trains to provide required capacity uplift on a corridor outside of other projects (for example, delivery of high capacity trains on to the Dandenong corridor is critical to meeting demand in advance of the Melbourne Metro rail tunnel)
- Avoiding the need to move trains onto different groups wherever possible.

Table 18-1 shows the planned fleet deployment in each of the key network change timeframes.

Table 18-1: Proposed fleet allocation by group

	Stage 1					Stage 2						Stage 3						Stage 4						
	Clifton Hill Group	Burnley Group	Dandenong Group	Cross-City Group	Northern Group	Clifton Hill Loop Line	Burnley Line	Sunshine to Dandenong Line	Cross City Line	Northern Loop Line	Frankston Loop Line	CHL Loop & SMG-SXS lines	Burnley Line	Sunshine to Dandenong Line	Cross City Line	Northern Loop Line	Frankston Loop Line	Mernda to Fishermans Bend Line	Clifton Hill & Ringwood Loop Lines	Sunshine to Dandenong Line	North-South Line	Baxter to Craigieburn Line	Burnley to Newport Line	Grovedale to Sth Yarra
Comeng		3	27	20	43				7		30													
Siemens				36					36						36								36	
Xtrapolis	31	43				37	5			32		51				23		23			33		18	
Hitachi																								
HCMT			5				43	59					48	77	13	12	30		58	77		59		
LDC																								22
Group Total	31	46	32	56	43	37	48	59	43	32	30	51	48	77	49	35	30	23	58	77	33	59	54	22
Yearly Total	208					249						290						326						
Maintenance Sites serving Groups	Epping	Bayswater	Westall	Newport Shops/Craigieburn	Craigieburn/Macaulay Sidings	Epping/Macaulay Sidings	Bayswater/Macaulay Sidings	Pakenham East	Newport Shops/Westall	Craigieburn	Westall	Epping/Macaulay Sidings	Bayswater/Lilydale	Pakenham East	Newport/Baxter	Craigieburn/Macaulay Sidings	Baxter	Epping	Lilydale	Pakenham East	Craigieburn	Baxter	Newport	Waurn Ponds

19 Funding

A central focus of the plan through each stage is to regularly overhaul and simplify timetables and train operations, getting every extra service possible out of the existing system at zero or low-cost, before turning to more costly infrastructure solutions.

Nearly all projects needing to be delivered by 2016 to meet expected demand are already funded and in various stages of delivery and all projects needing to be delivered in Stage 2 are at various stages of project development.

Detailed planning work will continue to allow major rail projects such as Rowville, Doncaster and Melbourne Airport to begin as soon as necessary key infrastructure and supporting works are in place and as funding becomes available.

The ability to deliver these projects will depend on funding from Commonwealth and State governments, which may include new funding models currently being examined by Infrastructure Australia and the Council of Australian Governments (COAG).

It should be noted that a program of further grade separations will be delivered through this period under a separate program to be delivered by other government agencies including VicRoads and VicTrack.

PUBLIC TRANSPORT VICTORIA PT>

For more information visit **ptv.vic.gov.au**
or call **1800 800 007** (6am – midnight daily)

Public Transport Victoria is your central stop
for information on public transport services,
fares, tickets and initiatives. Up-to-date
information is available via our website,
call centre and mobile applications.