Ministry of Transport and Road Safety

ISRAEL RAILWAYS
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ISRAEL RAILWAYS
THE 2040 STRATEGIC DEVELOPMENT PLAN

May 2017

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NS & Associates

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AB Plan

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EXECUTIVE SUMMARY

The country of Israel is heavily dependent on the private car as the principal mode of transport both for trips within the major urban areas and for trips between them. There is an extensive network of Highways within the central part of Israel but a much less developed rail network. The road network is becoming increasing congested in and between the major metropolitan areas of Jerusalem, Tel Aviv and Haifa. Within the urban areas there is a shortage of parking spaces and little scope for road improvements. Israel is also heavily dependent on trucks to carry freight within Israel, carrying about 95% of the total tonne-kilometers and this adds to the congestion on the road network.

The Government has prepared a strategic plan to improve public transport and in particular to improve the modal share taken by mass transit and the railway. Public transport in Israel has a major role in developing accessibility, the quality of life, growth and the national economy. The strategic plan sets the main objectives and challenges for developing public transport and policy which in overall terms should support national policies:

- Provide performance public transport network that will increase mobility;
- Economic growth and efficiency;
- Strengthening access to low income population and peripheral areas of the country;
- Improvements in the quality of life and the environment.

The Government of Israel has increased significantly its investment in rail lines and rail projects over the last decade. The number of passengers has grown from 23 million in 2004 to 60 million in 2016. The Government's aim is to increase this to over 250 million by 2040 and to do so further significant investment in the railway network will be required. To support the government's Strategic Plan, Israel Railways, in partnership with the Ministry of Transport and the Ministry of Finance, has developed its 2040 Strategic Development Plan to demonstrate how it can deliver the objectives of the Government.

The 2040 Strategic Development Plan includes the following features:

- Separation of the ISR passenger service into 2 levels:
  - National Service: fast, high frequency, few stops, connect the 4 Metropolitan Centers
  - Exclusive use of 250 km/h tracks by National Services operating when justified
  - Local service: regional routes, with many stops, connect to hubs, skip stop on some services.
- Freight integration:
  - Operations according to forecasts and introduction of land port hubs;
  - Dedicated facilities in main corridors and access to ports;
  - Reduced conflict with passenger services;
  - Eastern corridor and land ports.
- Advantages in system performance, reliability, regularity and clarity:
  - Trains operate at frequent regular intervals on most routes;
  - Small number of routes on many lines to provide clarity to passengers;
  - National routes have dedicated tracks from Haifa to BG Air Port and Na'an-Beer Sheva to reduce interference from local and freight services.
- Significant Capacity Increase :
  - Heavy infrastructure investment in strategic facilities;
  - Significant investment in additional rolling stock to provide increased passenger carrying capacity;
  - Prospect of high demand levels in the medium term due to delays in metropolitan Mass Transit require early investment in rail network and rolling stock;
  - Demand on routes around Tel Aviv changes as metropolitan Mass Transit is opened.
- Flexible Plan
  - Plan takes in account uncertainty (high demand forecast with many unknowns).
  - Rather than a fixed service layout, the plan proposes an operational formula.
- Integration of the passenger rail services with the mass transit systems to provide a convenient door to door service competitive with the private car.

The plan is relying on a few features that increase the level of service, the reliability of the service and the travel time.

- **Service hierarchy:** The separation of the service into national routes with higher speeds (up to 250 km/h) and very few stops and regional routes with mores stops and coverage and a skip stop service, saves time to almost all the passengers and creating supreme dedicated level of service. The long-distance trips travel much faster while the metropolitan trips have more coverage and integration with mass transit that they need for the diversity of their daily trips.

- **High frequency:** All the service routes have high frequencies. The national routes depart every 5-10 minutes in the peak periods and most of the metropolitan and the main regional lines depart every 15-20 minutes. These frequencies allow low waiting times and increase the ability to transfer easily between lines.
- **High coverage** – The number of rail stations increase to more than 120, covering almost 60% of the population within 5 km from a train station. The high coverage combined with the service hierarchy contribute to reducing travel time.
- **Mass Transit integration** - The strategic plan is coordinated and more integrated with the metropolitan mass transit systems. This results in lower transfer times and convenient door-to door times in public transport, given that proper connections will be provided.

The Strategic Plan was prepared using forecast of passenger demand from a refined version of the National Transport Model, was closely integrated with the Transport Models prepared for Jerusalem, Tel Aviv, Haifa and Be'er Sheva to ensure an integrated approach from national to local level. Various passenger networks were tested to maximize the number of passengers carried by all types of public transportation and avoid excessive new construction. 2040 Freight forecasts as prepared by Aviv/AMCG were used to identify the possible demand for freight trains in 2040 and to ensure that the network proposed would accommodate both the passenger and freight demand.

An extensive network of routes was identified and some of these routes could not be justified on the basis of forecast demand however, these routes could be beneficial to Israel. A base network of routes that carried significant numbers of passengers was identified the base network – C82. Other routes serving the Periphery to reduce the isolation in these areas were also included – C81. Other routes were geopolitical linking to surrounding countries where demand could exist in a changed geopolitical climate.

The proposed network, C81, includes flexibility in the service lines that are operated to reflect the inherent uncertainty of the forecasts and the need for the services to respond to the demand as it changes over time.

An important element of the Strategy is that of integration between the rail network and the mass transit networks in the metropolitan areas. The Mass Transit networks serve areas beyond the vicinity of the rail stations and feed passengers into and take passengers from the rail network for longer journeys. Therefore, the Strategy advocates the close integration of the networks with easy interchange provided to encourage complete journeys by public transportation.

The Strategic Plan also considers the trains that will operate the rail network and proposes a significant increase in the size of the fleet with two different types of trains. For the high speed inter urban services trains should be purchased that whilst capable of higher speeds are also capable of carrying the large number of passengers that travel between the four main metropolitan centers of Israel. It is anticipated that about 1,100 cars will be required by 2040. For the local services trains similar to the existing trains and those currently being purchased will be required to supplement the existing fleet much of which is likely to remain in service. It is anticipated that about 1,500 additional cars will be required by 2040. It is estimated that the cost of this would be about NIS 19.3 billion.

Investment in new and improved infrastructure and rolling stock is required to deliver the benefits. The cost of new infrastructure for the base network (C82) is estimated to be NIS 62.9 and NIS 104.4 billion for the extended network (C81 with extended rail lines to the periphery). In addition investment in rolling stock to support the increased services on the new high speed national network, additional local routes and to provide increased capacity on existing routes; the investment for the base network (C82) is estimated to be NIS 18.0 and NIS 19.3 billion for the extended network (C81 with extended rail services to the periphery).

The recommended strategy has been assessed against the specific objectives set by the Government. **The analysis shows that the plan meets most of the strategic goals and that the plan represents a major improvement** in all measures not only to the existing network but also to the planned 2022 network. The main results show:

- On the target year 2040, the plan has the potential to attract over **300 million passengers per year** to rail services. This figure is 5 times higher than 2016 network. The percent of rail passenger km increases more than 3 times to 19% of the total passenger km.
- In the **main corridors** between the major cities, **public transportation trip share** increases significantly to **almost 50%.** This result is much more sustainable, allowing the rail, buses and roads passengers on these corridors to travel in a

good level of service. Rail share of long distance trips increases to over 40%.

- The plan increases the level of service of the national public transport system. The plan covers more than 80% of the population with a train station less than 7 km from their home. High frequencies results in **reduced waiting time** and **higher reliability**. 60% of the population is within 60 minutes ride to Tel Aviv, and the metropolitan accessibility at 45 minutes increases from 36% to 70% (ride to the nearest metropolitan center).
- The significant increase in rail trips r**educes the private vehicles usage** relative to the base case scenario **by 10-12%** (with more advantages under the C82 scenario).
- The plan will increase the periphery accessibility. 60% of the population in the periphery is within 1.5 hours to Tel Aviv, increase from only 16% today.
- The economic analysis shows that **the plan contributes to the national economy** and is socially beneficial.
- The C82 plan results show a **better economic performance** than C81, resulting in a much **higher B/C ratio** (1.9 and 1.0 respectively) and higher operating cost recovery ratio. This is due to more efficient lines and infrastructure. The capital cost per passenger is superior and efficient. C81 2040 Strategy Extended Network lines to the periphery are expensive and have low usage and thus do not contribute much social benefits, although they do provide faster service to the periphery. The analysis shows that both versions of the plan have similar effect on the periphery accessibility, while C82 is much more efficient.

The conclusions of the strategic goals analysis show that **the 2040 strategic rail plan has the ability to change the future mobility in Israel to be much less dependent on private vehicles** and to shift towards high performance and more sustainable public transportation.

The economic performance of the strategy was analyzed using a 40 year evaluation period based on the "Nohal Prat" (Transport project appraisal guidelines in Israel) 2012. The Base Network C82 Plan yields high returns with benefit to cost ratio of 1.8-2.5 with for discount rates 4%-7% respectfully. The NPV is estimated as 30-80 Billion NIS. The C81 2040 Strategy Extended Network has high investment costs in the periphery rail lines with low usage and thus have less benefits than C82. The benefit cost ratio is below 1.0 at 7% and is 1.3 at 4%. This results show that C81 is less efficient and not socially beneficial. The results also show that the backbone of the system in the Base Network is absolutely necessary to reduce congestion between the metropolitan areas in Israel and yield high benefits to the national economy. Without this backbone network crucial investments, the government policy lines to the periphery will have negative impact on the national economy.

The rail network has also been assessed in 2030 to identify those improvements that have to be implemented before 2030 to respond to a rising population and growing traffic congestion and partial implementation of the mass transit solution. This analysis identified a number of priority projects including:

- Construction of the Ayalon Tunnel and widening of the existing railway in the Ayalon Corridor (5-6 tracks by 2030 and 6 tracks by 2040)
- Construction of a high speed line between Tel Aviv and Haifa
- Widening of the railway through Haifa to 4 tracks
- Construction of a railway along Road #431 Corridor
- Construction of Lod Bypass and Pleshet to Lod railways
- Restoration and widening of the railway along the Eastern Track
- Construction of Inland Ports
- Widening of the railway from Be'er Sheva to Tsefa.

To provide a high speed service to Be'er Sheva and enable all day freight operation it will be necessary to provide a separate two track high speed alignment between Soreq and Be'er Sheva.

The Strategic Plan for Israel Railways consists of three elements:-

- Base network – to meet demand based on professional criteria, including passenger and freight routes.
- National policy rail lines – based on government policy of connecting the periphery - These lines should be built after other items required for 2030 network unless otherwise decided by the government.
- Geopolitical tracks – based on government policy for potential connection to neighboring countries. These are dependent on geopolitical developments and to safeguard the development of these routes in the future the right of way required should be reserved.

1. INTRODUCTION

This Report sets out the 2040 Strategic Development Plan for Israel railways. It describes the passenger and freight railway networks proposed in the 2040 Strategic Development Plan. The objectives of this Plan is to provide a long term strategic plan for the national rail network for the next 25-30 years, according to the strategic goals that the government has set. The national public transport network should be hierarchical, integrated with high levels of passenger service, and be competitive to the private car. The plan will also recommend a plan for the long term freight network that will fit with overall rail demand and will help to restrain growth in road truck usage.

The 2040 Strategic Development Plan sets out the passenger services to be provided by Israel Railways. It proposes that these are organized into a hierarchy of National Routes and Local Routes. This will allow fast National services to operate between the four main metropolitan areas feed by local routes that provide a frequent service to stations close the most populated areas of Israel. It sets out the improvements to the existing network that will be required to be implemented to resolve the constraints on achieving the level of rail service envisaged for 2040. It also describes the type of trains that are envisaged to operate on the network in 2040, the potential scale of the fleet that will be required and the depots that will be required to accommodate them.

This report provides details of the costs of the 2040 Strategic Development Plan both in terms of the infrastructure required and the additions to the rolling stock. It assesses the benefits of the implementation of the 2040 Strategic Development Plan in terms of the achievements against the objectives set out in the Ministries of Transport and Finance in the strategic plan for public transport development in Israel.

The 2040 Strategic Development Plan for Israel Railways will allow Israel Railways to make a significant contribution to satisfying the growing demand for transport in Israel and reduce Israel's dependency on the private car as a means of transportation, particularly for the journey to work.

Train passing through Ayalon Corridor, Tel Aviv with congested Ayalon Highway in afternoon peak period

2. CONCEPT OF THE STRATEGIC PLAN

2.1 Context

The country of Israel is heavily dependent on the private car as the principal mode of transport both for trips within the major urban areas and for trips between them. There is an extensive network of Highways within the central part of Israel but the periphery is less well served. The road network is becoming increasing congested in and between the major metropolitan areas of Jerusalem, Tel Aviv and Haifa. Within the urban areas there is a shortage of parking spaces and little scope for road improvements.

The Government has prepared a strategic plan to improve public transport and in particular to improve the modal share taken by the railway. Rail in Israel has a very small modal share compared to other OECD countries. Public transport in Israel has a major role in developing accessibility, the quality of life, growth and the national economy. Developed public transport networks have economic, social, environmental and safety impacts, and while the social and political awareness of public transport advantages has grown, the development of the national and metropolitan public transport networks in Israel has been slow and insufficient.

The Government of Israel has increased significantly its investment in rail lines and rail projects over the last decade. The number of passengers has grown from 23 million in 2004 to 60 million in 2016. Census 2008 data shows an increase of rail share of work commute passengers from 0.3% in 1995 to 0.7% in 2008. It is estimated currently that the figure is 2% of total work commute passenger-km and increasing but it is still a low share of rail usage among commuters.

2.2 Objective of the Government

The Ministry of Transport and the Ministry of Finance have published a strategic plan for public transport development in Israel. The strategic plan sets the main objectives and challenges for developing public transport and policy which in overall terms should support national policies:

- Provide a high performance public transport network that will increase mobility;
- Enhancing social justice and strengthening access to peripheral areas of the country;
- Economic growth and efficiency;
- Improvements in the quality of life and improvement of the physical environment.

Comparison with other states has identified what can be achieved in developing public transport to be the major transport means in future. This is demonstrated in our report International Comparators - November 2015.

2.3 Goal Setting

To judge the success of the Strategic Development Plan it must be measured against the goals that correspond with the objectives of the Government. A series of Strategic Goals were identified in our Report - Transport Networks - Conceptual Networks and Demand – February 2016.

These goals was associated with a series of performance measures and a target that the plan should achieve are set out below:

- **Transportation goals**

Performance Measure	Target
Percentage of passenger km on rail network	15%
Percentage of long (over 50 km) & medium distance trips (between 20-50 km) on rail network	40%
Number of passengers on rail network (million per year)	over 250 m
Percentage of public transport usage on main corridors	40% -50%

- **Equity - Strengthening the Periphery**

Performance Measure	Target
Percentage of population within 60 minutes of Tel Aviv	60%
Percentage of population in the periphery within 90 minutes ride to the Tel Aviv	60%
Percent of jobs within 90 minutes from low income population	50%
Percentage of population within 60 minutes ride from the nearest metropolitan area	70%

- **Efficiency and Economic Growth**

Performance Measure	Target
Operating costs cover ratio of railway operations	>0.5
B/C ratio	> 1.2
Infrastructure cost per passenger (NIS)	<20 NIS
Percentage of peak hour mileage with adequate occupancy (v/c within 0.5-1)	>60%
Percentage of peak hour mileage with low occupancy (v/c <0.2)	<20%

- **Quality of Life and Physical Environment**

Performance Measure	Target
Average waiting time on rail network – peak hours (min)	< 7.5 min
Population coverage up to 7 km from rail station	80%
Reduction in private car usage (veh-km, relative to bae case)	10%
Connectivity to metropolitan systems (% of stations connected)	30%

2.4 Preparation of the Strategic Plan

Rail will provide an important element of the public transport available, and will be the main mode for long distance travel, with high speed and high frequency rail services between the Metropolitan Areas. It will also provide easy access to and from the periphery to the center of Israel. In addition the Metropolitan Areas will be served by a high quality mass transit and the rail system.

Israel is also heavily dependent on trucks to carry freight within Israel, carrying about 95% of the total tonne-kilometers. Israel Railways carried 1.18 billion tonne-kilometers in the year ending June 2015, all mainly chemicals and minerals (63%) and containers (32%). It is proposed to increase the market share held by the railway by eliminating the constraints imposed by the capacity of the existing rail network.

To produce the Strategic Development Plan there are many elements that have to be brought together as illustrated in Figure 2.1. Passenger and Freight Service Plans were developed, the rolling stock required to support those plans identified and the requirements for improvements to the Infrastructure that would be needed to support them was identified.

Passenger Service Plans have been developed as described in our reports:

- Conceptual Planning and Design – Passenger Train Services - November 2015 and
- Transport Networks – February 2016.

This has been supplemented by the additional work described in Chapters 3 & 4 and Appendix A to this report. Chapter 5 describes the routes and options that have been discounted and alternative service lines that could be considered.

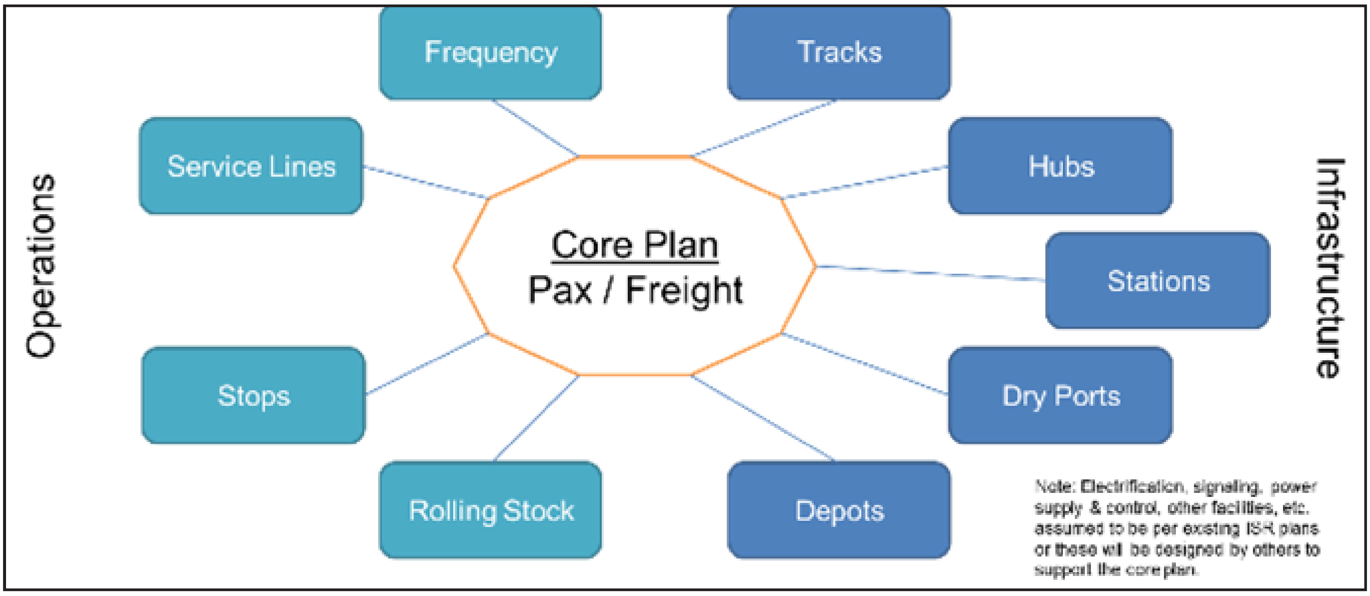


Figure 2.1 Israel Railways Strategic Development Plan

The demand that would be created has been forecast using the refined National Transport Model as described in our reports:

- Model Set-up – September 2015;
- Model Calibration – Rail Passengers 2015 – November 2015.

The service lines proposed and forecasts demand are described in Chapters 3 and 4 of this report.

A Freight Service Plan has been developed to meet the demand identified the 2040 Cargo Forecasts, as prepared by Aviv/ AMCG, and as described in our reports:

- Freight Task Working Paper – October 2015;
- Demand Analysis – Freight – February 2016.

The forecast demand is set out in Appendix E of this report. This has been supplemented by the additional work described in Section 3.7 and Appendix F to this report.

To support the service plans the infrastructure that is needed has been identified and this is described in Chapter 7 and Chapter 10, Section 10.1.

The type scale of the rolling stock needed to implement the plan are described in Chapter 8 of this report and the requirement for depot and stabling accommodation is considered in Chapter 9.

2.5 Concept of the Strategic Plan for the Railway

The following are the concepts that have been incorporated into the Strategic Plan so that it delivers the goals set out above.

- Separation of the ISR passenger service into 2 levels:
  - National Service: fast, high frequency, few stops, connect the 4 Metropolitan centers
  - Local service: regional routes, many stops, connect to hubs, skip stop on some services and
  - Wherever possible the National Service will operate on exclusive tracks with a maximum speed of 250 km/h.

- Freight integration:
  - Operations according to forecasts and introduction of land port hubs;
  - Dedicated facilities in main corridors and access to ports;
  - Reduced conflict with passenger services by the establishment of freight only routes on critical parts of the network;
  - Eastern corridor will be the main freight axis of Israel and land ports to distribute goods to centers of population.
- Advantages in system performance, reliability, regularity and clarity:
  - Trains operate at frequent regular intervals on most routes;
  - Small number of routes on many lines to provide clarity to passengers;
  - National routes have dedicated tracks from Haifa to BG Air Port and Na'an-Beer Sheva to reduce interference from local and freight services.
- Significant Capacity Increase :
  - Heavy infrastructure investment in strategic facilities;
  - Prospect of high demand levels in the medium term due to delays in metropolitan Mass Transit require early investment in rail network;
  - Demand on routes around Tel Aviv changes as metropolitan Mass Transit is opened.
- Flexible Plan
  - Plan should take account of uncertainty (high demand forecast with many unknowns).

2.6 Hierarchy of Public Passenger Transport

A hierarchical approach to public transport provision with three basic levels of passenger services is recommended with additional local and intercity bus services, cycling and walking infrastructure and policies to encourage reduced dependence on the private car. These last measures are not part of the scope of this work and should be further addressed by the policy makers.

National Routes

The first level is provided by the National Routes to be operated on the rail network. The National Routes will provide express fast service on 3 main corridors to link the four metropolitan centers of Israel:

- Haifa to Tel Aviv to Be'er Sheva;
- Haifa to Tel Aviv to Jerusalem;
- Be'er Sheva to Jerusalem.

The tracks will be designed for a 250 km/hour travel speed, where practicable, from Haifa to Tel Aviv and from south of Lod to Be'er Sheva and Eilat. From Haifa Hof HaCarmel and BG Air Port, where demand is high, the tracks will be exclusively used by high speed services. The National Routes from BG Air Port to Jerusalem will use the existing route and this route will be shared with local services. The National Routes will extend north beyond Haifa, using the regular 160 km/hour tracks, to serve stations to Nahariya and Karmiel.

To ensure a fast journey between the Metropolitan centers National Services will only stop at the principal stations in Jerusalem, Tel Aviv, Haifa and Be'er Sheva and at Ben Gurion Airport. Additionally they may stop at an interchange stations located strategically between the metropolitan areas at:

- Hadera West;

- Kiryat Gat;
- Gezer.

The routes from Haifa to Jerusalem have a very heavy demand and will require optimizing the passenger carrying capacity through the use of ETCS to maximize the number of trains that can operate with evenly spaced departures, speed regulation on approach to stations and other places with speed restrictions, high performance braking systems and high acceleration. At Hadera, where it is envisaged that not all trains will stop, passing tracks will be required together with high speed switches.

To ensure that the services can accommodate the large number of passengers expected double deck trains will be required with a capacity of 1,200 seats or more. It was envisaged that between Haifa and Ben Gurion Airport up to 14 trains per hour could be required. The short headway between high speed trains and the long dwell times, because of the large numbers of passengers alighting and boarding, will require stations to be provided with 2 platform faces for each direction at most of the stations on this route.

Local Routes

Local Routes will operate as part of the rail network, these predominantly carry passengers from the outer areas of the Metropolitan areas to its center and for passengers making longer journeys feeding into the National Routes at the interchange stations or in the Metropolitan centers. Local Trains on local routes will generally stop at every station and use regular 160 km/h tracks.

Exceptionally where it is necessary to reduce the journey time between the outer areas of the Metropolitan area and the center an additional service not calling at all stations could be added to ensure the rail journey provided an attractive alternative to the private car. The service between Netanya and Tel Aviv, which significantly increases by the addition of 4 new stations, has been identified as requiring a skip stop service.

Mass Transit Services

Mass transit services will operate in all metropolitan areas of Israel, these services will be primarily operated by BRT, LRT and Metro and provide services for short journeys. In general, for longer journeys the mass transit services feed into the Local and National rail routes.

Other Services

In addition other public transport modes will be required such as:

- Train shuttles – these services operate as an extension of the rail network and these buses are timetabled to allow passengers to connect directly into specific rail service. They provide a dedicated bus services linking settlements away from the rail network directly to rail stations, with direct access from bus stop to the rail station.
- Buses – these services provide the links between rail stations and areas of settlements that are not within walking or cycling distance of the station. The aim is wherever possible to provide a frequent reliable service; this could include providing bus priority measures.

Complimentary services as walking and cycling infrastructure should also be considered to encourage the use of those modes to reach the rail station. The types of infrastructure to provide improved access to stations that could be provided includes – wider footways, footbridges across highways, cycle paths or lanes, secure storage of cycles at stations.

3. BASE NETWORK AND SERVICES

3.1 Development Process

To produce the Network required for the 2040 Strategic Development Plan the networks identified in Phase A have been developed to progressively eliminate the problems that were identified, maximize the number of passengers carried by public transportation and avoid excessive new construction. The process of development involved a number of iterations from Alternative C5 through to C8 with numerous sub-alternatives. This process is described in detail in Appendix A.

The basic plan is presented below, represents a combination of infrastructure and service routes, including:

- Passenger network: tracks
- Passenger network: National service lines
- Passenger network: Local service lines
- Integrated network: passenger and freight shared and dedicated tracks.

The service lines presented represent the Routes Hierarchy principle conforming to the Strategic Plan Concept. It should be noted, that these lines may change in the future based on the differences in the actual growth compared to the plan assumptions. Yet any change to the plan is subject to the preservation of the plan concept and the capacity constraints of the infrastructure. The network that is included in the plan provides for some flexibility in the services that could be operated to enable the railway to offer alternative services that better reflect the actual growth in demand.

3.2 2040 Base Passenger Network

The base passenger network consists of National Routes and Local Routes. A diagram showing the Base Network routes envisaged (Alternative C82) is shown in figure 3.1. Possible additions to Base Network are described in Chapter 4 and options for other routes and services are described in Chapter 5.

Most of the passenger network will consist of a two track railway. The exceptions are:

- 6 tracks
  - Netanya Merkaz to Tel Aviv HaHagana - (2 High Speed Netanya Merkaz to Shfayim; 2 underground form Shfayim to Tel Aviv HaHagana).
- 4 tracks
  - Lev HaMifratz to Netanya Merkaz – (2 High Speed)
  - Tel Aviv HaHagana to BG Air Port - (2 underground);
  - BG Air Port to Lod Bypass;
  - Lod Bypass to Be'er Sheva (2 High Speed);
  - Eastern Track Kfar Sava to Rosh Haayin South;
  - Pleshet Junction to Ashkelon.
- 3 tracks
  - Lev HaMifratz to Kishon Depot.
- 1 track
  - Afula to Beit She'an
  - Bet Shemesh to Jerusalem Malha

In general the National routes will be designed for speeds of 250 km/h, except where there are physical limitations that prevent this, and most of the routes will be exclusively used by National service lines. Providing exclusive use maximizes the capacity of these routes. On the National Network stations will be widely spaced, except in the city centers of Jerusalem, Tel Aviv, Haifa and Be'er Sheva.

The Local Routes will be limited to a maximum speed of 160 km/h and in many cases maximum speed will be less than this. Some sections of the Local Network will be shared by National service lines and freight services.

The Freight only routes mainly link freight depots to either the National or Local Routes. However, there are some routes that duplicate other routes to provide the additional capacity needed for the intensive freight service that is envisaged or provide routes for freight services to avoid passing through urban areas.

In the base network, Alternative C82, to encourage private car users to transfer to public transport for longer journeys from the Peripheral Areas it is envisaged that a network of high quality bus services would be provided linked to railheads. Potential networks of public transport services are shown in Appendix D.

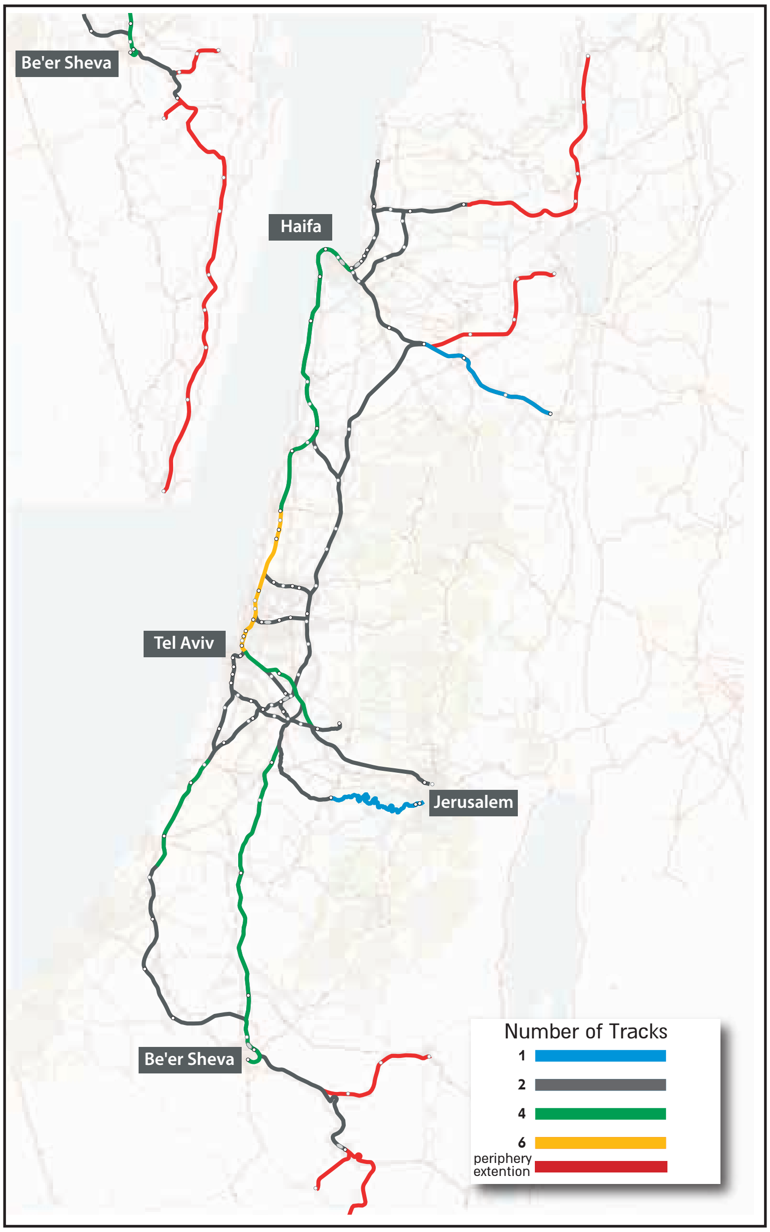
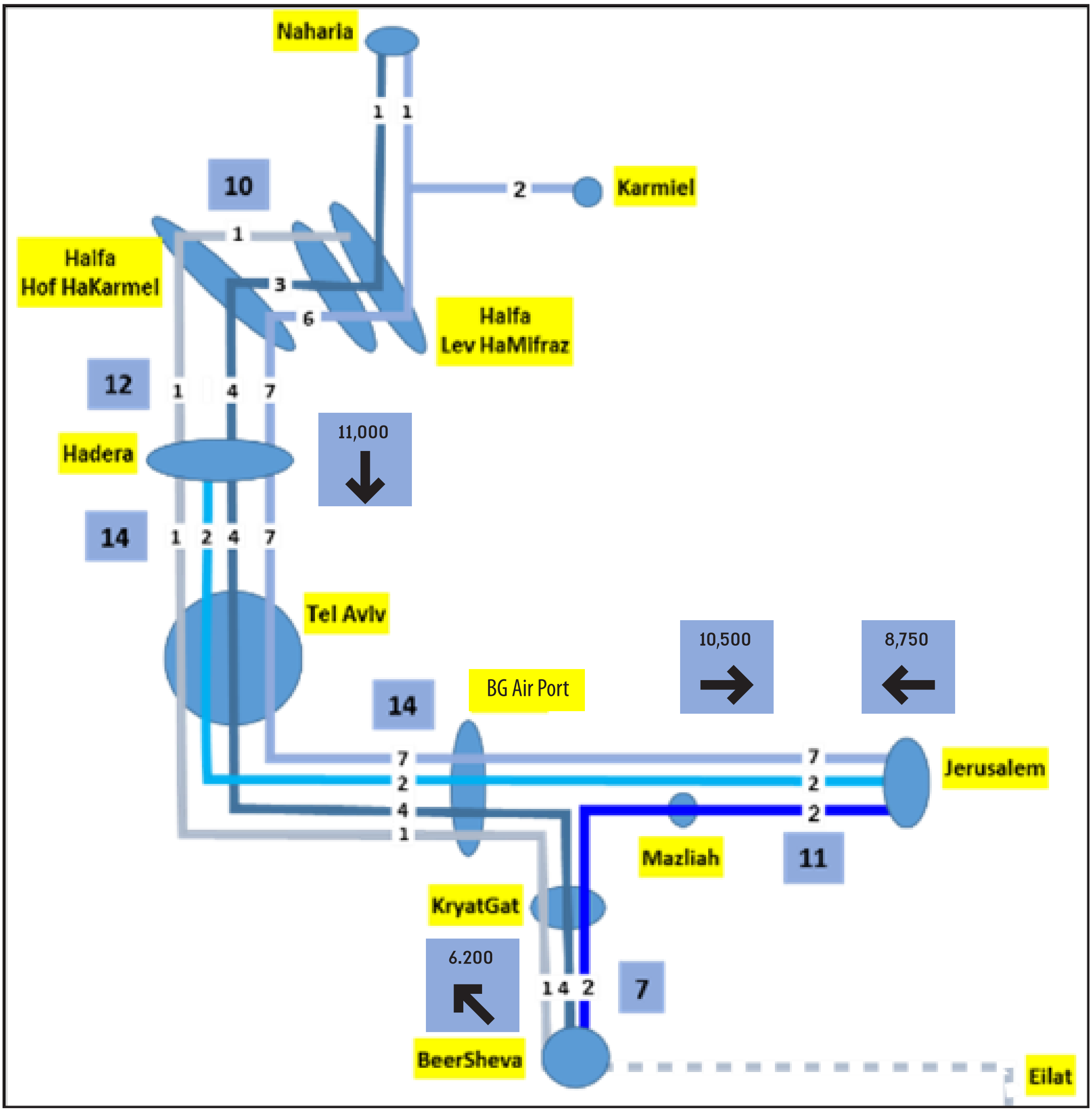


Figure 3.1 – Base Passenger Network C8

3.3 2040 Passenger National Service Lines

The National Service Lines link the four metropolitan centers of Jerusalem, Tel Aviv, Haifa and Be'er Sheva. The service lines also extend beyond these centers to serve major centers of longer distance traffic Nahariya, Karmiel and Eilat. It is envisaged that these services will stop at all or most stations between Nahariya or Karmiel and Haifa and between Be'er Sheva and Eilat.

National trains between Tel Aviv and Be'er Sheva will be routed to stop at BG Air Port station to use the Ayalon Tunnel and to provide international connections. To avoid overloading services between Haifa and Tel Aviv all trains that originate north of Haifa do not stop at Hadera.



Note: In Alt C82 Route 5 terminates at Be'er Sheva Center rather than Eilat.

Figure 3.2 – National Service Lines – Alternative C8

Route	Alt	Origin	Destination		Stop at Hadera
1	A	Nahariya	Beer Sheva Ctr.	1	no
1	B	Haifa L. HaMifratz	Beer Sheva Ctr.	2	no
1	C	Hof HaCarmel	Beer Sheva Ctr.	1	yes
2	A	Nahariya	Jerusalem	1	no
2	B	Karmiel	Jerusalem Ctr	2	no
2	C	Haifa L. HaMifratz	Jerusalem Ctr	3	no
2	D	Hof HaCarmel	Jerusalem Ctr	1	yes
3		Beer Sheva Ctr.	Jerusalem Ctr	2	n/a
4		Hadera	Jerusalem Ctr	2	yes
5		Haifa L. HaMifratz	Be'er Sheva/Eilat	1	yes

Note: In Alt C82 Route 5 terminates at Be'er Sheva Center rather than Eilat.

Table 3.1 – National Service Lines – Alternative C8

The major flows of passengers (passengers per hour) are:

- Haifa to Tel Aviv – 11,000
- Tel Aviv to Jerusalem – 10,500
- Jerusalem to Tel Aviv – 8,750
- Be'er Sheva to Tel Aviv – 6,200

3.4 2040 Passenger Local Service Lines - North

The Local Service Lines radiate from Haifa to serve, Nahariya, Karmiel, (both by the Coast Line and Road #70), Beit She'an and Hadera. The major flows of passengers (passengers per hour) are:

- Coast Line north – 7,000 (Some of these passengers are carried on National Services)
- Road #70 – 1,800
- Afula Line – 2,500

Coast Line south – 1,750 (not including passengers on National Services from Tel Aviv)

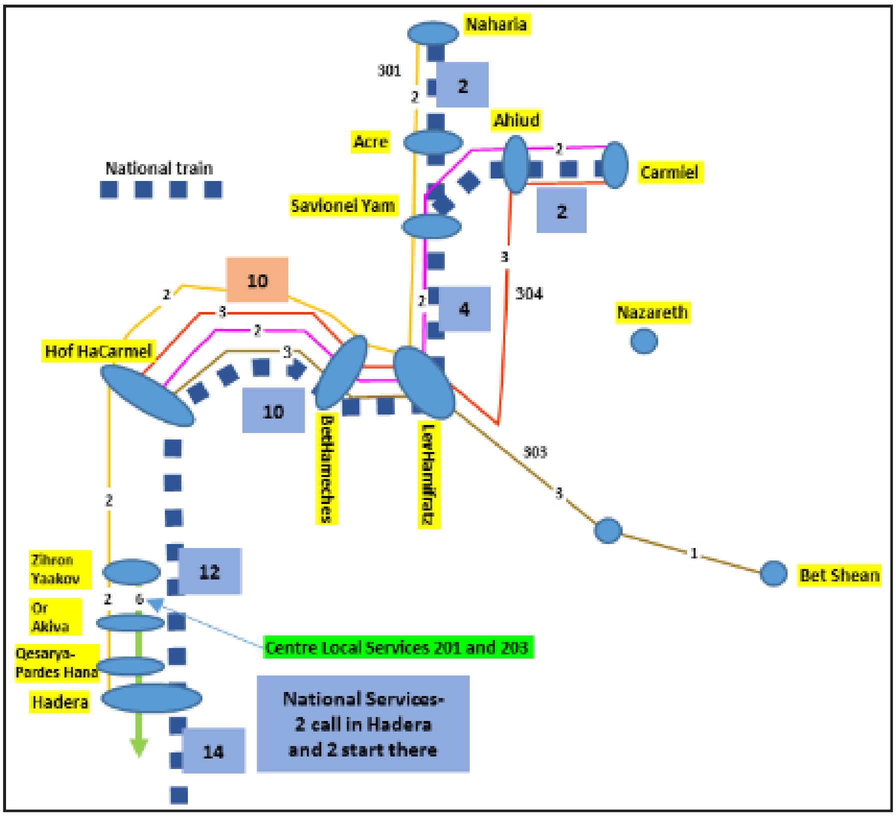


Figure 3.3 – Local Service Lines – North – Base Alternative C82

Route	Alt	Origin	Destination		Stop at Hadera
301		Nahariya	Hadera	2	no
302	B	Karmiel	Hof HaCarmel	2	no
303	B	Beit She'an	Hof HaCarmel	1	yes
303	C	Afula	Hof HaCarmel	2	no
304		Karmiel	Hof HaCarmel	3	no

Table 3.2 – Local Service Lines – North – Base Alternative C82

3.5 2040 Passenger Local Service Lines – Center

The Network in the Central Area is the most complex and with the proposed network that is proposed there is scope to operate various different service lines. As demand develops and the effects of the implementation of the Mass Transit system are realized, some of the alternative service lines may be of value. Some of the alternative service lines are described later.

The maximum passengers demand (Local Services) on the main corridors approaching Tel Aviv (passengers per hour) are:

- Coast Line North – 10,600
- Ra'anana – 1,100
- Petah Tikva and Eastern Track north -2,000
- Total from north = 13,600
- Ayalon South – 11,600
- Modi'in via BG Air Port -3,200
- Lod, Rehovot and Bet Shemesh – 5,200
- Total from south and east = 19,200.

It is not practical to terminate trains in central Tel Aviv because of the lack of available space. There is an imbalance between the numbers of passengers forecast from the north of Tel Aviv, about 13,600 local passengers per hour, against 19,200 from the south. It can be seen that the largest through flow is from the Coast Line North to Ayalon South, however, it is impractical to completely link these two routes without major reconstruction of the HaHagana station area, which would cause major disruption to services for a long period.

To overcome this problem the Coast Line North services generally continue to either to Lod or BG Air Port, the demand is slightly imbalanced. A limited number of trains cross tracks between University and Herzliya where the number of trains is reduced. The services from Ayalon South have been linked to those proceeding to the Sharon Valley, in a similar way to the present service lines, and to the Eastern Track. Some services from Ayalon South continue to the Coast Line North utilize the six track section and junction arrangement at the Road # 531 interchange which eliminate conflicts. There is some inefficiency in the use of services to the north east of Tel Aviv, but this is unavoidable because of the forecast imbalance in demand.

In addition to the services into and through central Tel Aviv two services are proposed along the Eastern Track from Hadera to Ashdod and from Ashdod to Gezer, for Jerusalem or Modi'in. Both routes, except the portion between Ashdod and Rehovot, did not attract a large number of passengers; this is because of the generally low demand along the corridors or the model predicts passengers will opt for the better level of service provided by the more frequent routes through Tel Aviv.

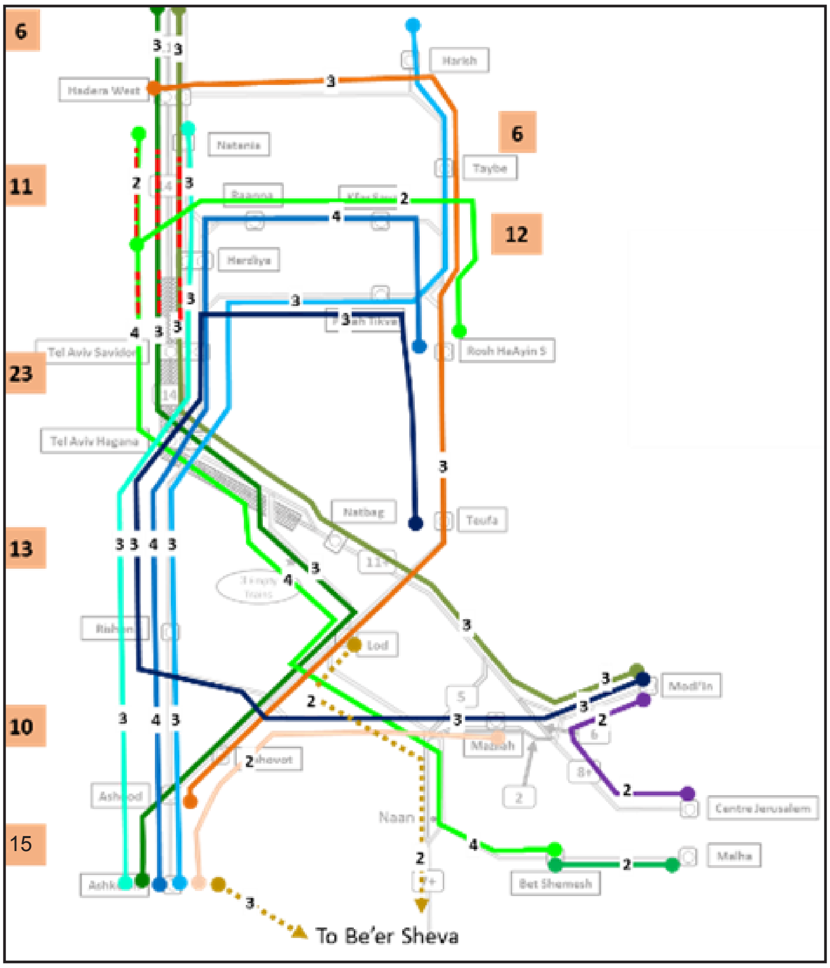


Figure 3.4 – Local Service Lines – Central Area – Base Alternative C8

3.6 2040 Passenger Local Service Lines – South and Jerusalem

In the Base Network there are few passenger lines in the South. Be'er Sheva is linked to Ashkelon and Lod and Jerusalem is linked to Modi'in. Bet Shemesh continues to be linked to Tel Aviv and Jerusalem Malha. These service lines are shown dotted on Figure 3.4 above. Flows are generally moderate between 1,000 and 2,000 passenger per hour in the primary direction, except on the line from Bet Shemesh towards Tel Aviv where the flow is forecast to be over 3,000 passengers per hour.

Route	Origin	Destination	Frequency
101	Modi'in	Jerusalem Ctr	2
202J	Malha	Bet Shemesh	1-2*
202A	Bet Shemesh	Netanya	2
202B	Bet Shemesh	Rosh Ha'Ayin S	2
103	Be'er Sheva-Ctr	Lod	2
106	Ashkelon	Be'er Sheva-Ctr	3
Regular clock face departure of 2 tph is unlikely to be possible because of single line track capacity, in some hours only 1 train will operate			

Table 3.3 – Local Service Lines – South and Jerusalem – Base Alternative C82

3.7 Forecast Passenger Demand

The demand that has been forecast for 2040 for the Base Network Service Lines together with the Periphery Service Lines, as described in Section 4.1, (Alternative C81) is shown in Appendix B together with the forecast demand at each station is shown in Appendix C.

3.8 2040 Freight Routes

Israel Railways has established a subsidiary Rail Cargo Ltd (RCL) and it has been tasked with increasing the amount of freight carried by rail and expanding the range of logistics services offered. By 2040 the freight demand is forecast to increase substantially from its present level.

To maximize the efficiency of the freight operation it is anticipated that trains operating between the main terminals will be increased in length to 750 m, this will reduce the number of trains but require additional or improved infrastructure, such as longer loops and sidings.

To provide an attractive service to its freight customers RCL will operate freight trains 24 hours a day Sunday to Thursday and for 12 hours on Friday; this will include during peak passenger service periods. This will allow regular interval services to be provided on the main routes, particularly important for time sensitive cargos such as those carried in containers. There will be a few exceptions where freight services will not be able to operate during peak passenger service periods because terminals are located on busy passenger lines with no alternative access facilities, most of these are located on the Coastal Track between Haifa and Akko.

The loads that have been forecast by Aviv/AMCG have been used as the basis of determining the routes required. The forecast demands to and from each terminal are set out in Appendix E. It is anticipated that the railway will be carrying seven principle commodities by 2040:

- Inter-modal Containers, between the ports and between the ports and inland terminals - 74 complete trains per working day;
- Sand, with a reverse flow of garbage between Tsefa and terminals in the center and north – 30 complete trains per working day;
- Minerals between the Negev and Dead Sea and the ports – 20 complete trains per working day;
- Aggregates between Tamar and terminals in the center and north – 11 complete trains per working day;
- Metal products between the ports and inland terminals – 7 complete trains per working day;
- Grain between the ports and grain terminals at Hadera East, Bene Brak, Dvira and Bet Shemesh – 6 complete trains per working day;
- Vehicles between Eilat Port and a terminal at Kedma – 6 complete trains per working day.

In addition there will be some local working of shorter freight trains between smaller terminals and the major terminals, also between terminals in Haifa and in the Negev.

The forecast demand between terminals has been converted to the number of trains to carry the demand and this is shown in Appendix F.

To accommodate this increase it will be necessary for the network capacity to be expanded considerably. As far as possible the different networks, National, Local and Freight should be segregated, however, this cannot always be justified. Keeping the networks segregated increases the reliability of all of the services because of the different performance characteristics of the trains reduce the capacity of the routes and require better timekeeping to avoid knock-on delays.

To maximize the capacity of the integrated network the speed of freight trains should be as close as possible to those of passenger services and this will ensure that damage to the track caused in super elevated curves is minimized. It is suggested that new freight rolling stock should have a maximum speed of 120 km/h.

The principal conflict is on the Coastal Track between Ashkelon, the South and Haifa, where intensive passenger services operate. In this area it is proposed to provide an alternative route for freight trains using exclusive tracks or using routes where the passenger demand is forecast to be lower. This requires the following infrastructure:

- Line to Eilat;
- Widening Mamshit to Be'er Sheva

- Be'er Sheva Bypass;
- Widening Be'er Sheva to Soreq;
- Pleshet – Lod (Rehovot Bypass, Ashdod – Soreq – Lod Bypass);
- Lod Bypass;
- Eastern Track;
- HaEmek Track;
- Nesher to Haifa Port.

This route also links the major freight terminals and is forecast to be used by between 30 and 70 trains per day and this is highlighted on Figures 3.5 and 3.6 below. The number of trains on the other parts of the freight network are much lower with a maximum of 11 trains per day from Afula to the junction with the Eastern Track.

Figures 3.5 and 3.6 also show those parts of the network are exclusively used by freight trains, those exclusively used by freight trains and those that are shared. Most of the shared track is shared by passenger trains running at speeds up to 160 km/h. The exceptions are Lod By-pass (A1 Railway to Be'er Sheva Track) and Hazeva to Eilat.

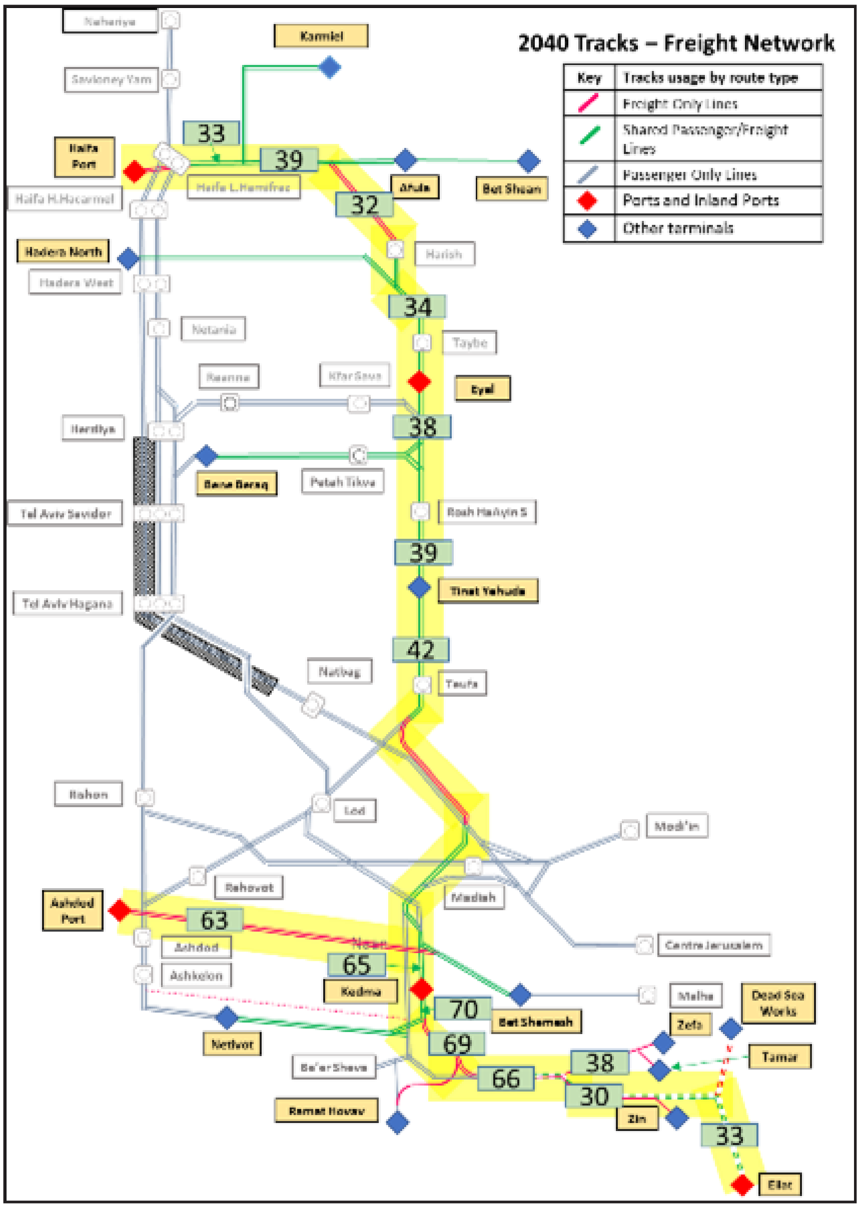


Figure 3.5 – Freight Routes – 2040 and Number per day on Principal Route with Peripheral Routes

Without the extension of the railway beyond Zin to Eilat the number of freight trains is reduced as shown on Figure 3.6.

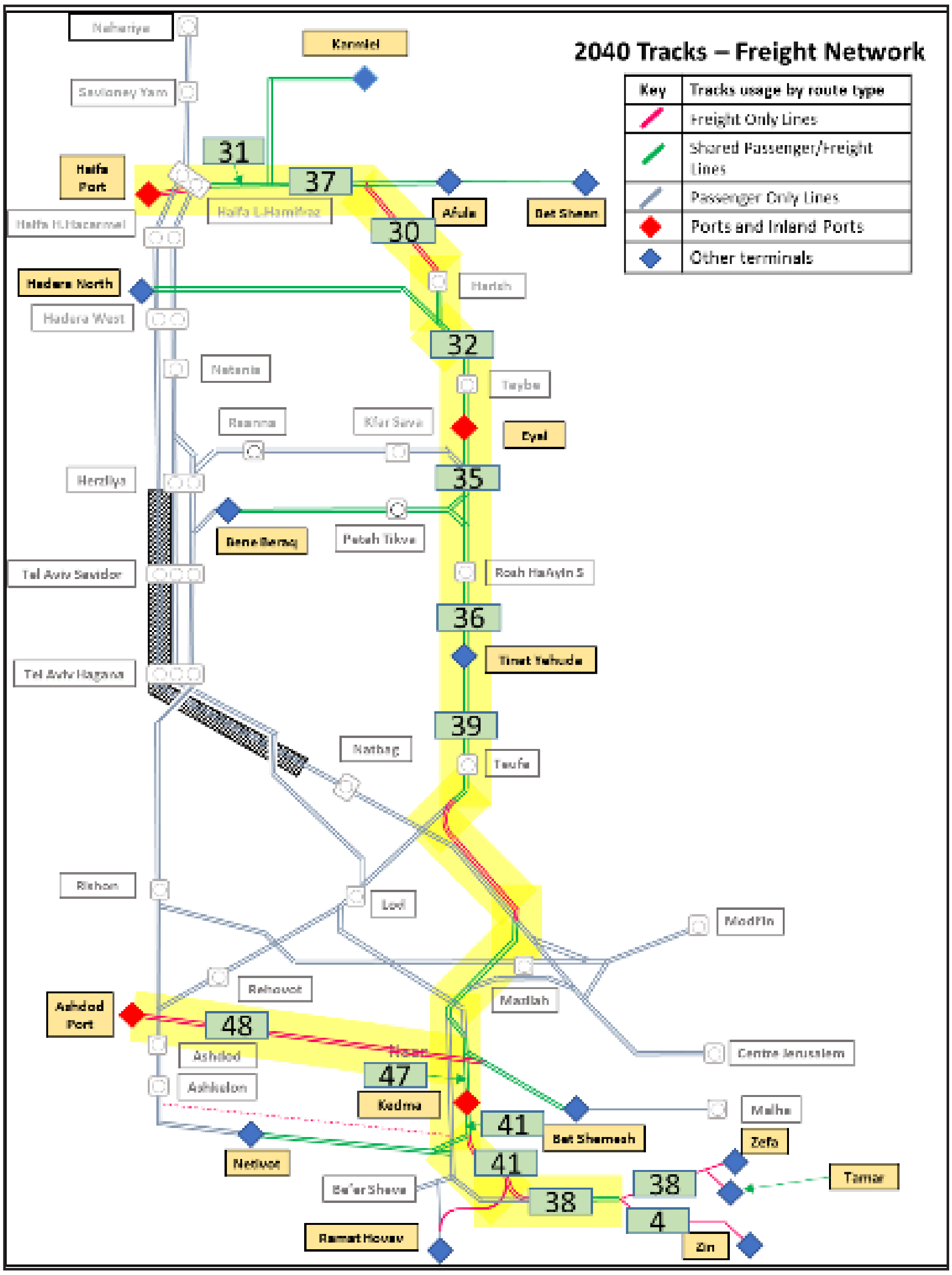
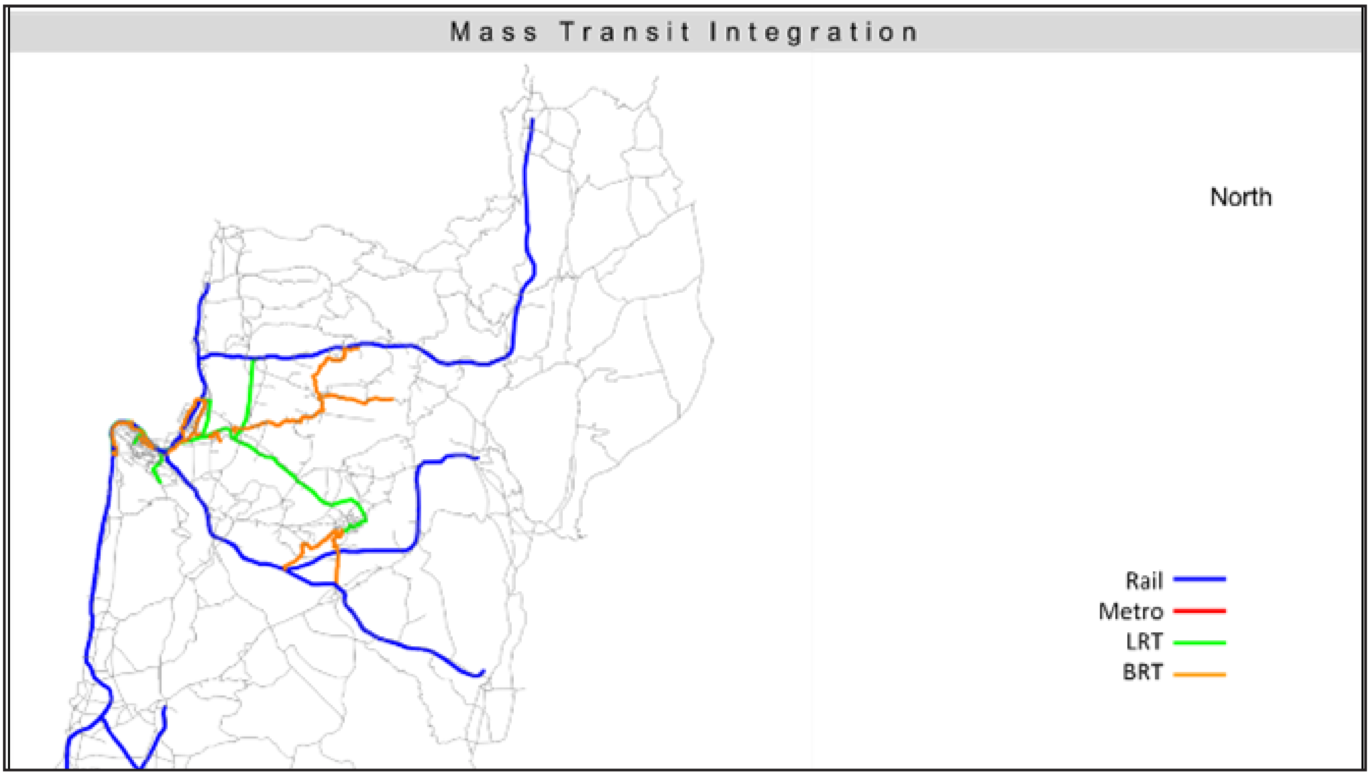


Figure 3.6 – Freight Routes – 2040 and Number per day on Principal Route without Peripheral Routes

3.9 Integrated Network

The Mass Transit and rail networks must be integrated with the mass transit services feeding passengers travelling longer distances into the rail network. Figure 3.7 shows the combined networks in the north, center and Jerusalem, this shows how the mass transit network complements the rail network.

Whilst the networks should be segregated as far as possible there must be integration of the different passenger networks, National, Local and Mass Transit to enable passenger to easily transfer between them to ensure a complete journey can be made by public transportation. Particular attention needs to be paid to the connectivity of networks at interchanges and this is fully described in Section 6.5 below.



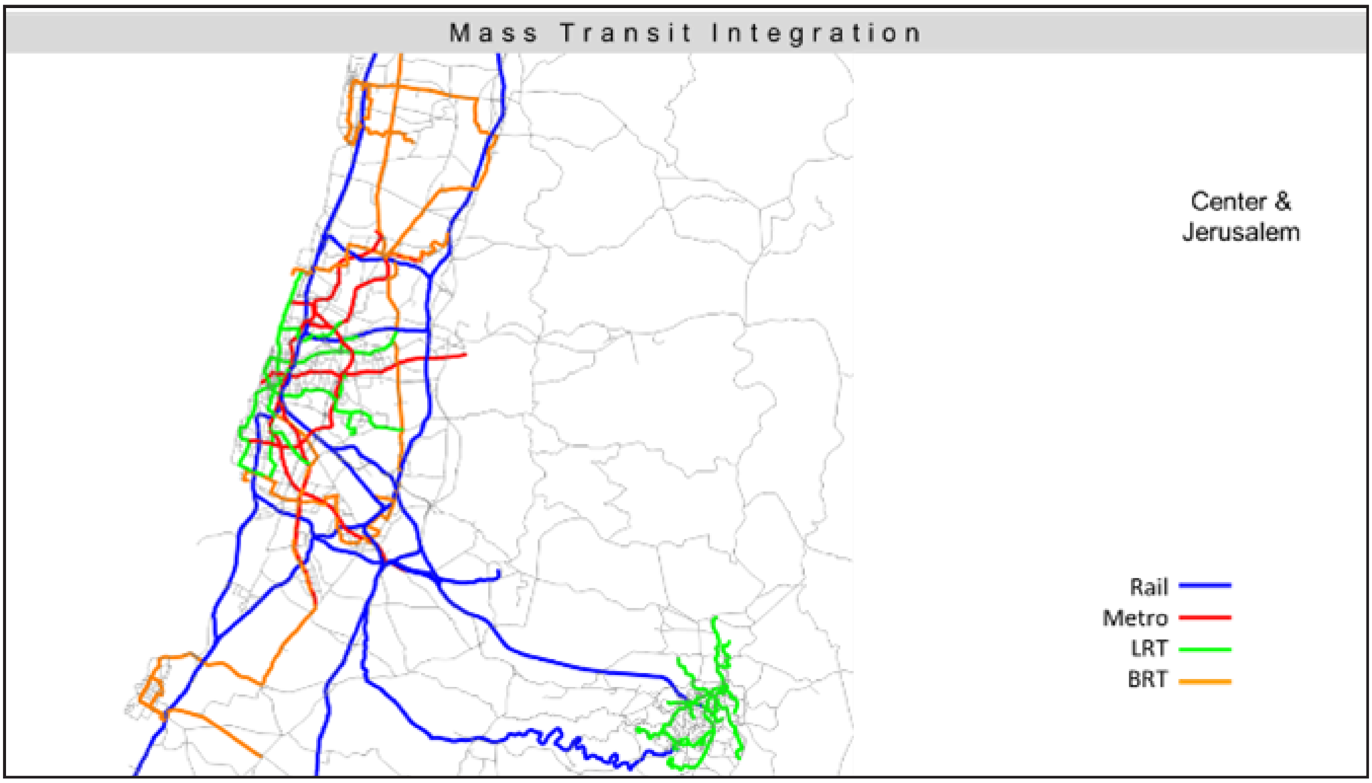


Figure 3.7 – Mass Transit Integration – North, Center and Jerusalem

4. THE PERIPHERY AND GEOPOLITICAL ROUTES

4.1 The Periphery

The government policy vision of connecting the north, center and south of the country with rail service is the basic layout for the periphery long distance service. A number of routes have been suggested to serve the periphery thereby reducing journey times to the nearest metropolitan center and thus provide access to better job opportunities for residents. Routes have been suggested to the Eilat; Kiryat Shmona; Tiveria; Arad; and Yerucham. Rail lines to the periphery will reduce the journey time to Northern Galilee and Eilat.

In the analysis of all of the alternatives the demand for rail travel in the Periphery has been low and such services will not be commercially successful, however, there could be social or strategic reasons why the government may wish as part of its 2040 Strategy for the railway to include such lines. Areas are considered to be peripheral if they have poor access to the local metropolitan center and to Tel Aviv.

Line	Maximum Forecast Demand 2040 (passenger per peak hour)
Kiryat Shmona	300
Tiveria	500
Arad (including army base)	800
Yerucham	200

Table 4.1– Maximum Forecast Demand for Lines in the Periphery

A sensitivity analysis was conducted to see whether substantially higher population growth in the Periphery would increase the demand for rail services. The growth in the larger settlements that could be served by rail and listed in Table 4.1 was doubled and the model results are presented below:

	2014		2040 Policy		2040 Sensitivity	
	Pop		Pop	inc	Pop	inc%
Kiryat Shmona	23,075		31,070	1.3	62,140	2.7
Tiveria	42,290		55,390	1.3	110,780	2.6
Arad	24,230		40,180	1.7	80,360	3.3
Yerucham	8,960		14,460	1.6	28,920	3.2

Table 4.2– Additional Population Growth in areas of the Periphery

The effect of this increase was to increase the number of passengers forecast to be carried but the number remained below that for which a rail service is considered to be commercially viable.

These results are to be expected because although the rail connection improves public transport accessibility journeys by private car generally can provide a better level of service, offering door to door service with little congestion to delay journeys. Most people in the Periphery work in the area where they live and few people from the Periphery commute to Tel Aviv because of the long distances.

The lack of major cities in the Periphery, that are likely to generate high demand, and many small communities favors providing an extensive network of high quality dedicated bus services and high quality shuttles linking locations in the Periphery to railheads and hubs.

The periphery tracks that would be added to the Base Network are shown dotted on Figure 4.1. These line are included in C81 strategic plan.

The proposed services to the periphery that are included in the C81 strategic plan and additional to those described in Chapter 3 are:

Route	Alt	Origin	Destination	Frequency
NORTH				
Local Services				
302	A	Kiryat Shmona	Hof HaCarmel	1
303	A	Tveria	Hof HaCarmel	1
SOUTH				
National Service				
5		Be'er Sheva Uni.	Eilat	1
Local Services				
104		Be'er Sheva C.	Arad	2
105		Be'er Sheva C.	Yerucham	1

Table 4.3– Additional Services in Periphery

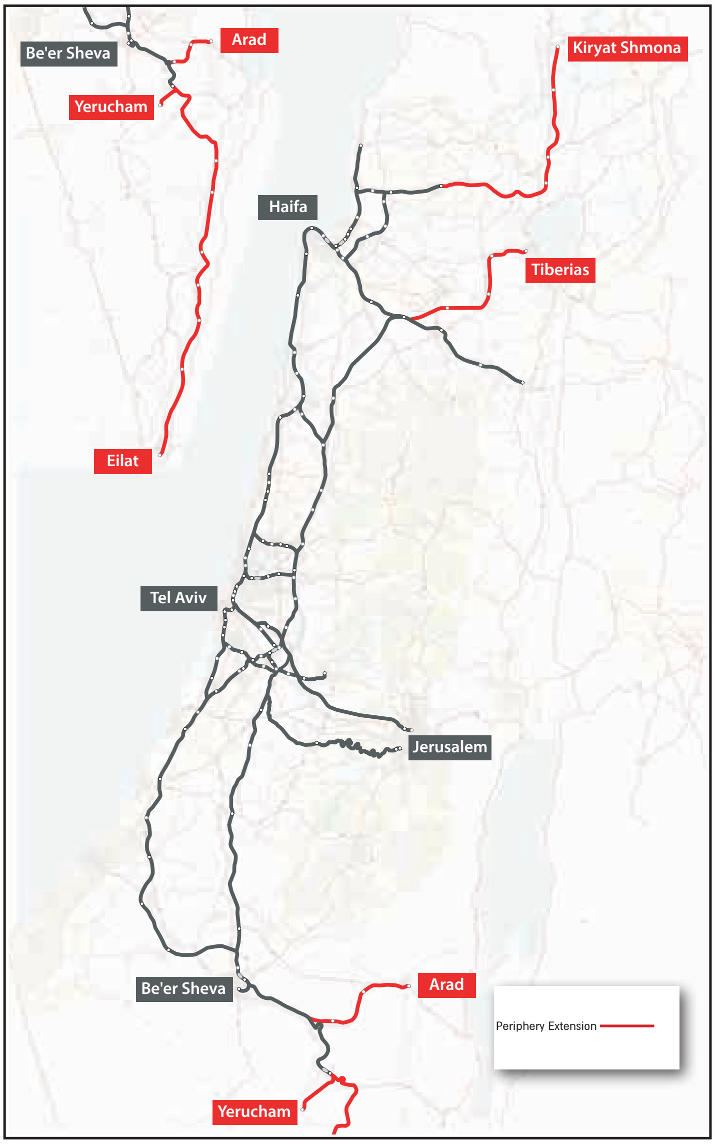


Figure 4.1 – Passenger Network with Periphery Lines

4.2 Army Bases

Three additional main military bases in the south of Israel generating trip demand need to be served. The demand is mostly demand for soldiers that travel every day to the bases and for trainees that travel only on Sunday morning and Thursday afternoon. The forecast demand is shown below:

	Training Base	Intelligence	Communication
Total Soldiers	13,000	13,500	5,350
Commuters Sun and Thu	10,800	10,600	4,200
Commuters Mon-Wed	2,500	6,600	1,800
PT/train Potential peak hour - Sun	2,500/1,500	1,500/1,000	Near BS station
PT/train Potential peak hour - Mon	1,000	1,500/1,000	Near BS station

Table 4.4 – Forecast Demand to Army Bases

The Communications Base is close to Be'er Sheva University station. The Intelligence Base is located close to Be'er Sheva and could be served by a BRT service that could also serve Arad. An economic analysis of the transportation method best suited to serve this site is being conducted by the Ministry of Transport.

The solution proposed by the Ministry of Transport is to provide direct bus services from every city in Israel to the City of Training Bases. This solution was not favored by the army. In addition a shuttle service of 20-30 buses per hour would link Be'er Sheva to the Bases. An alternative would be to provide a railway route to Zomet HaNegev to serve the City of Training Bases. This would require an extension of the freight line from Ramat Hovav.

The service to Be'er Sheva has been analyzed to identify if there is sufficient capacity to accommodate the soldiers travelling to and from Be'er Sheva. The predominant flow of other passengers is the opposite to the flow of soldiers, away from Be'er Sheva in the morning and back in the evening. It is considered that there should be sufficient capacity to accommodate the flow of soldiers to and from Be'er Sheva on Sundays and Thursdays. The larger flows of soldiers on Sundays and Thursdays may cause some overloading of services to Tel Aviv. Additional service can be provided on peak periods via the Eastern track bypassing Tel Aviv bottle neck.

4.3 Geopolitical Routes

The railway network in Israel is not connected to any other country and in the future it could be desirable to introduce routes to the surrounding countries and to link to those lines proposed in Judea and Samaria. The proposed network in Judea and Samaria and the links to neighboring counties, as proposed in TAMA 54, are shown in the plan in Appendix I. In most cases the routes required are short extensions of or branches from the proposed Strategic Network.

It is recommended that the following routes should be protected (reserve the right of way) as part of the Strategic Plan, the construction of these routes will be dependent on the geopolitical situation, but at this time it is not envisaged that these will be constructed before 2040.

The Geopolitical routes are:

- Extension of Road #70 from near Ahihud to Shlomi and the Lebanese border (23 km);
- Branch from Afula to Jenin in the PNA (15 km);
- Extension of the HaEmek Railway from Beit She'an to Jordanian border (6 km);
- Extension of the railway from Ramat Hovav or Zomet HaNegev to Egyptian border at Nitzana (49 km);
- Branch line from Heletz Railway to Yad Mordechai and to the PNA at Erez crossing;
- Branch line from near Kiryat Gat to the PNA at Tarkumia crossing;
- Branch line from line from Eilat route to Jordanian border towards Aqaba.

5. OTHER ROUTES AND SERVICES

The Strategic plan sets a base network as described in previous chapters. This chapter sets out alternative routes and service lines that were considered in developing the base network and not included. Some of the alternative service lines could be included as the base network allows flexibility in future service lines as long as the main concept and strategy of the plan is kept. This flexible aspect of the plan allows better addressing future demand and changes that might take place in the future that depart from that expected in the forecast. The effectiveness of some of these alternative will need to be carefully assessed to ensure that they satisfy the objectives for the railway described in Section 2.2 and Concept of the Strategic Plan – Section 2.5. The impact on other services also needs to be carefully considered as some services introduce potential conflicts that may reduce the capacity of the rail network.

Other alternatives were also considered and then rejected as they either did attract sufficient passenger demand to be considered viable, were impractical or were a significant departure from the Concept of the Strategic Plan.

5.1 Alternative Routes and Services

5.1.1 Services to Jerusalem

In the Base Network it has been assumed that the principal service to Jerusalem is from Tel Aviv and additional trains operate to Jerusalem to Be'er Sheva and Modi'in, this is expected to utilize the available capacity of the line to Jerusalem. However a number of alternative services could be operated particularly if these were shown to reduce the demand from Tel Aviv and therefore the number of trains required on that route. These include services to:

- Haifa or Harish and Eastern Track, via Teufa;
- Sharon Valley via Teufa;
- Rishon via Road #431;
- Ashkelon and Rehovot via Road #431.

Additional infrastructure would be required to operate services via Road #431, connecting Road #431 to the Jerusalem track.

5.1.2 North of Lev HaMifratz

Widening of the route to four tracks between Lev HaMifratz and Naaman, south of Akko, to allow National Services to stop only at Savionei Yam in the Krayot was considered. This was not included in the Base Network because the railway right of way is not wide enough and adjoining development would have resulted in a very expensive solution, potentially involving a long tunnel.

A high speed route through the Krayot for National Trains to Nahariya, Karmiel and Kiryat Shmona has been suggested. There would be no significant reduction to the journey time between Haifa and Nahariya or Karmiel because of the stops envisaged at Savionei Yam, Akko and Ahihud and speed restrictions at Naaman Junction and through the Gilon Tunnel. Beyond Karmiel to Kiryat Shmona the route is proposed to be constructed to allow 250 km/h to provide a high speed rail backbone from Kiryat Shmona to Eilat. To gain full advantage of this higher maximum speed the trains would have not to stop at the intermediate stations as the distance between stations is insufficient for the trains to reach their maximum speed.

5.1.3 Haifa

A number of alternatives were considered for widening through Haifa. The alternative included in the base network provides for widening to 4 tracks along its existing alignment, with stations at Lev HaMifratz, Beth HaMeches, Bat Galim and Hof HaCarmel; this may require the construction of a cut and cover tunnel to eliminate the barrier the existing railway provides between the city and the sea shore.

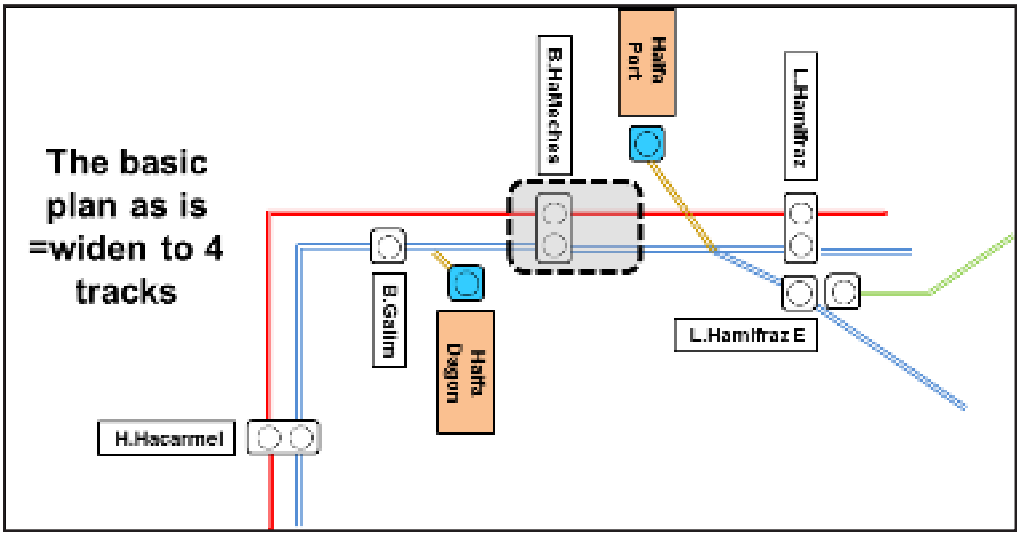


Figure 5.1 – Base Alternative Haifa

An alternative alignment for the National Tracks was also considered running direct from Beth HaMeches to Hof HaCarmel and eliminating the loop through Bat Galim. Removing the National Services between Hof HaCarmel and Beth HaMeches would allow the existing infrastructure to remain.

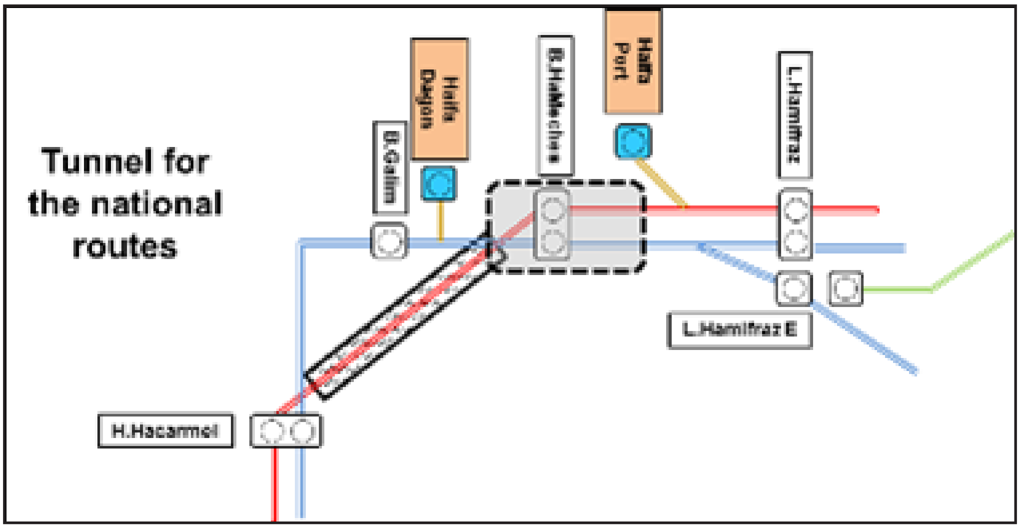


Figure 5.2 – Tunnel Alternative Haifa

Another alternative arrangement of National Services has also been proposed. This alternative involves constructing a longer tunnel under Haifa and operating some National Services direct from Lev HaMifratz to south of Haifa and some from Hof HaCarmel. These and some other alternatives need further planning and analysis.

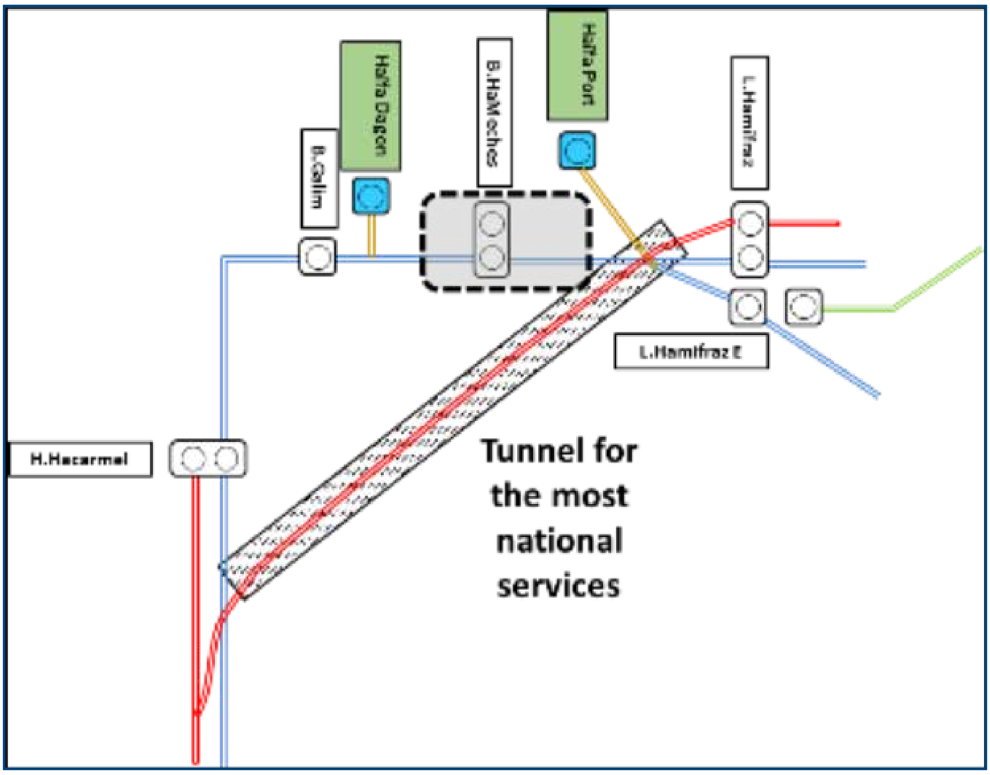


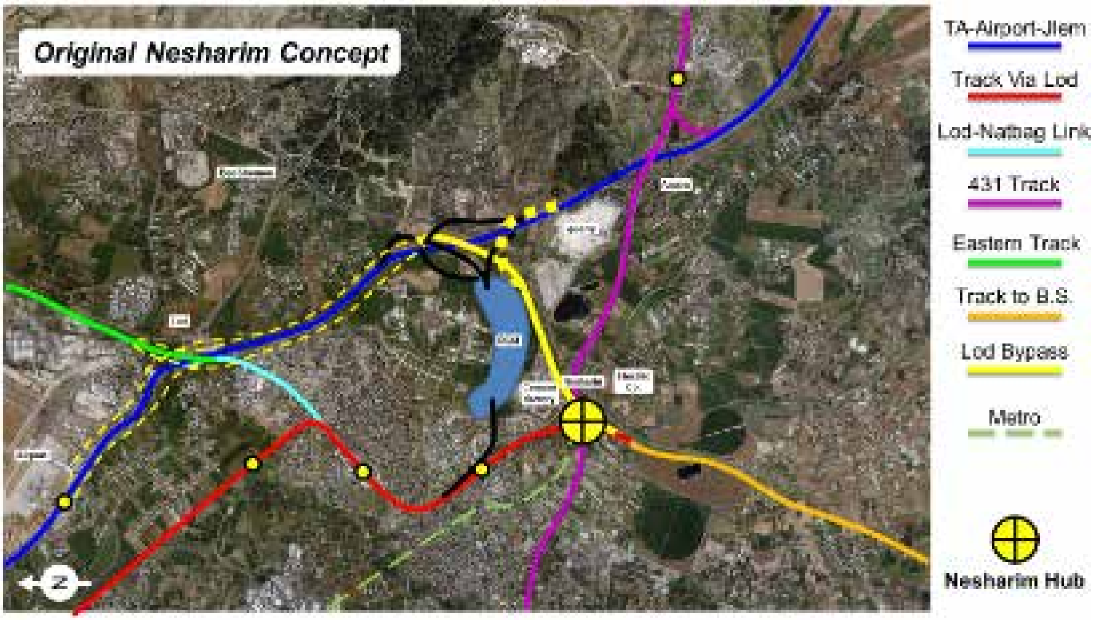
Figure 5.3– Tunnel Alternative no.2 Haifa

5.1.4 Central Area Alternatives

In the Central area a number of other service lines are possible and these could be used if actual demand does not match the forecast or to overcome the practical difficulties in implementing the infrastructure required. The effects of adopting these alternatives must be carefully considered to ensure that the benefits of the Strategy continue to be delivered. Some of the alternatives were rejected in developing the service lines included in the chosen alternative because of rail capacity issues and practical issues with providing additional infrastructure.

The alternative service lines are shown on Figure 5.4 and include:

- Use of the circular route from Tel Aviv to Tel Aviv via Petah Tikva and Ra'anana and vice versa. This route reduces the number of trains terminating at Rosh Haayin South, but care is needed not to overload the junction north of University station where there is unavoidable conflict between trains on the Coast Line and line to Petah Tikva.
- Use of circular route from Tel Aviv via Teufa. This could provide an improved link from the Eastern Track to Natbag. Again careful planning would be necessary to overload the junction east of Natbag station and north of University station and consider the potential problems of crossing movements in the Ayalon.
- Providing services from the Eastern Track to Jerusalem via the freight train link to Lod Bypass. This would improve access to Jerusalem from the Sharon Valley and Eastern Track but the number of other trains to Jerusalem would need to be reduced.
- Providing direct services from Ashdod or Rishon LeTsiyon to Jerusalem via a link between Road #431 and Gezer South. This would improve access to Jerusalem from but the number of other trains to Jerusalem would need to be reduced.
- Using an alternative north of Hadera as the northern terminus for trains from the Eastern Track. This would reduce conflicts at the new junction north of Hadera and utilize the freight link towards Haifa from the Eastern Track.



5.1.5 Be'er Sheva to Tel Aviv

It is proposed that the National Service from Be'er Sheva to Lod would operate along the proposed Lod Bypass and call at BG Air Port. The Lod Bypass is shared with freight trains operating along the main north –south corridor. It is assumed that there is sufficient capacity to accommodate two freight trains per hour and five passenger trains. If timetabling this proves impractical or additional trains are required to operate, two alternatives exist.

Both alternatives require trains to leave the high speed alignment and join the existing route through Lod, this route already carries 6 passenger trains per hour and it should be possible for more trains to be added. Trains could either proceed via the Eastern Track to Teufa South Junction and then via BG Air Port or direct from Lod to Tel Aviv. Both of these options have disadvantages operating via BG Air Port may require an increase in the number of trains in the Ayalon Tunnel, which could be problematic; operating direct to Tel Aviv results in the additional trains not serving BG Air Port. Trains operating direct to Tel Aviv would also have to share the tracks with 10 other trains per hour and this would result in a slow journey, but faster than via BG Air Port.

5.1.6 Lod Bypass and Nesharim Interchange Station

The original concept of the National Services had an interchange with Local Services to the south of Tel Aviv, near the intersection of Roads #6 and #431 (see figure 5.5). This would have provided excellent connections between the National Services and the Local Service along Road #431 serving Rishon and Modi'in and the Local Services to Lod from Bet Shemesh and Kryat Gat, as well as a possible connection to the envisaged Metro System proposed in the Tel Aviv Area Public Transport Strategic Plan. The Nesharim Concept was developed in conjunction with the Lod Bypass link, servicing the high speed National Services from BeerSheva to Tel Aviv as well as to Jerusalem, completing the vision of the four interconnected metropolitan areas. Such a Hub would provide improved accessibility to the southern Tel Aviv area, allowing improved connectivity between the different rail lines, with reasonable direct and frequent connections.

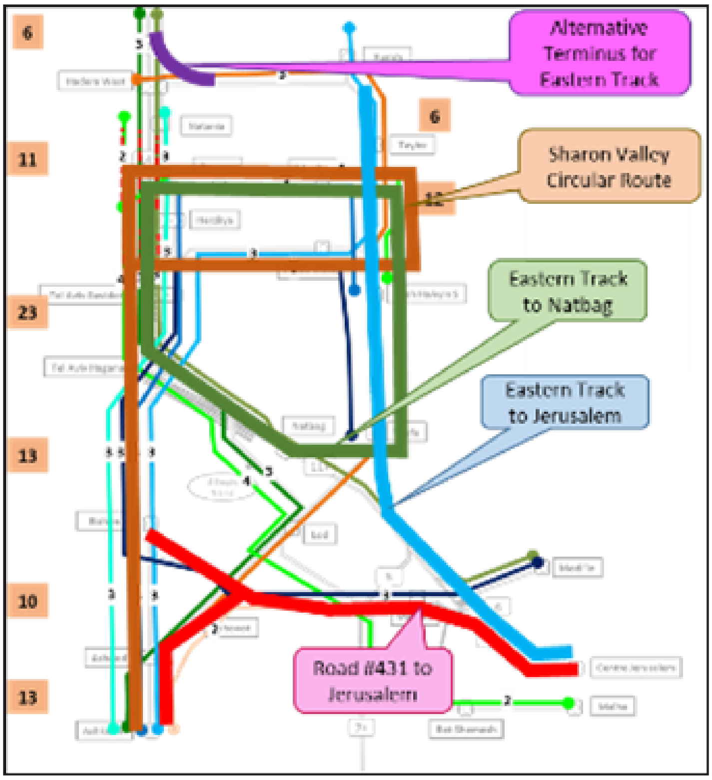


Figure 5.5– Original Nesharim Hub Concept

Advice from Israel Railways and their designers was that there are technical difficulties in providing alignments and avoiding conflict with existing highway structures and development, and in their opinion it is not possible to provide such an interchange station without completely reconstructing the highway interchange, which would be extremely costly and disruptive.

An alternative solution for the strategic Hub was not provided. Instead, an alternative location, named Gezer station, was suggested further to the east along Road #431, as shown below.

Figure 5.6– Gezer Alternative

This solution deleted the connection from the Lod-Bypass to the Jerusalem track, and provided instead a duplicate Nesharim-Anava section with a direct connection from the Beer Sheva track to the Jerusalem track. On this section, a station was proposed allowing the transfer between the 431 lines to the Beer Sheva-Jerusalem line. Additionally, a connection was proposed from the 431 to the Jerusalem track at Anava.

However, this interchange would only provide connection between the National Service from Be'er Sheva to Jerusalem which only operates at a frequency of 2 trains per hour with the 3 trains per hour along Road #431, this proved an unattractive interchange with most passengers choosing to travel through Tel Aviv because of the more frequent service available. Therefore, the Gezer station did not produce an efficient alternative to the Nesharim Hub.

Other alternatives considered included:

- BG Air Port as a Hub: by not providing either the Nesharim Hub or the Gezer station, the connection of the national routes from Be'er Sheva to Jerusalem is provided at the existing station at BG Air Port. This does not provide connectivity to Rishon, Lod or Ashkelon, as well as relying on the BG Air Port station that is not the most suitable for transferring passengers, due to traffic generated at BG Air Port itself.
- Local service from Ashkelon to Jerusalem: It was suggested to provide an additional service line from Ashkelon, Ashdod and Rehovot either to Gezer station or directly to Jerusalem, using the connection at Anava. It was suggested that there is more demand from Ashkelon, Ashdod and Rehovot to Jerusalem than from Beer Sheva. But this remains unattractive and frequencies would need to be increased or direct services provided as described above. This line would require the frequency of the Jerusalem-Tel Aviv National routes service to be reduced or additional capcity provided on the route and at the Jerusalem terminals.

Under the current situation, the plan does not include an adequate alternative for a strategic Hub in this area that matches the advantages provided by the Nesharim concept. It is therefore advised that as part of the strategic plan, further work is done to examine additional possibilities to implement the Nesharim concept.

5.2 Ayalon Corridor

A number of options for providing additional capacity in the Ayalon Corridor were considered in our report "Ayalon Corridor – Strategic Options – November 2015". As the 2040 Strategy was developed it became apparent that those options that provided only 4 tracks would be insufficient to accommodate the increased number of trains that would be required to accommodate the forecast demand.

At the end of Phase A two main options remained. A five track option with two new tracks in tunnels and with no widening of the existing railway between Savidor Merkaz and HaHagana stations and a 6 track option with two new tracks in tunnels and widening of the existing railway between Savidor Merkaz and HaHagana stations to 4 tracks (Phase A Report – Transport Networks – February 2016).

Testing of the 5 track option identified a number of issues:

- It limited the service that could be provided from Hadera and Netanya to Tel Aviv which resulted in overloading.
- No local service could be provided from Modi'in and BG Air Port to Tel Aviv.
- Reduced level of reliability because of trains to Lod using only a single track for both directions.
- Less flexibility to add new routes or vary routes.
- Much more dependent on the full implementation of the Metro system.
- Some trains terminate at HaHagana which does not provide a good service for many passengers as they have to change trains.

Therefore it is recommended that the widening of the existing railway alignment between Savidor Merkaz and HaHagana stations is developed as a project and that a project for the construction of a 2 track tunneled alignment is developed in parallel. The tunneled alignment would be used by National Services and the widened existing alignment would be utilized for Local Services.

5.3 Rejected Routes and Services

5.3.1 Tiveria and Afula to Eastern Track

In Alternatives 1 and 4 a route was provided from Tiveria to Eastern Track through Kfar Baruch to provide a direct service to Tel Aviv. Flows on this route north of Harish were low at 500 -600 passengers per hour, whereas south of Harish this increased to over 1,000 passenger per hour. The service from Tiveria to Afula is considered as a possible route for inclusion in the 2040 Strategy as link to a Peripheral Area from Haifa and thus to Tel Aviv.

This route could be included in the 2040 Strategic Plan as the railway between the HaEmek Track and Harish will be provided as part of the freight network, it would require the provision of an additional curve from the HaEmek railway to the freight line.

5.3.2 Road #4 Alternative 5.2-4 - Route Along Road #4

National road 4 is heavily congested most of the day, especially in the center area. Road 4 carries high volumes of cars with relatively low public transport passengers.

The strategic plan, and also the plan for the Tel Aviv mass transit system examined the best network structure and service needed on Road #4 corridor, see Figure 5.7. Part of the functions of a rail line a long this corridor was examined relative to:

- Providing better public transportation service to cities along Road #4
- Reducing car use and congestion along Road #4
- As an alternative to providing some of the extra capacity in the Ayalon.

These goals were tested in the model as Alternative 5.2-4. The results are described in Appendix A, Section A.1.5. The results showed that most of the high demand in this corridor is for short trips with little North South demand and thus a long rail line along Road #4 does not attract many passengers, and does not have the desired functionally. Many of the trips were "Z" or "L" shaped requiring a web shaped network with integrated transfers. The demand along the Road #4 corridor is typical of many such roads within metropolitan areas outside the CBD and is not suitable for a conventional heavy rail solution. The rail line along Road #4 do not provide high performance transit service and does not ease the congestion by much.

The conclusion of the analysis was that the proposed Metro Ring line on the Tel Aviv mass transit plan provides a good integrated solution combined with a bus lane along Road #4. The rail service through the Ayalon Corridor (Road #2) serves the demand into the CBD and the Eastern corridor (Road #6) provides a service to serve the outer parts of the main built up area. There is no need for additional rail on Road #4 corridor.

5.3.3 Hamat Gader to Beit She'an

Alternatives 1 and 4 included an extension of the existing railway from Beit She'an to Hamat Gader. The modelling showing that demand on this section of railway was negligible, less than 100 passenger per hour. A service along this route is not recommended as part of the Strategy, although part of the route could be included as geopolitical link to Jordan.

5.3.4 Shlomi to Tamra and Haifa

Alternatives 1 and 4 included an extension of the railway along Road #70 to Shlomi. The modelling showing that demand on this section of railway was small, a maximum of 130 passenger per hour north of Kafar Yasif, here demand increased but it is relatively close to Ahihud (6 km) where a better service can be provided. A service along this route is not recommended as part of the Strategy, although the route could be included as geopolitical link to Lebanon.

5.3.5 Tram Train Haifa

Lev HaMifratz is proposed as the present terminus of LRT service from Nazareth requiring passengers for other stations in Haifa to change to a rail service there. To improve the attractiveness of the LRT consideration was given to extending the service to Hof HaCarmel along the railway as a Tram-Train. This alternative was considered and rejected as it is not considered that there would be sufficient capacity for an intensive LRT service to operate with a local train service of 10 trains per hour.

5.3.6 Bet Shemesh to Ashdod via Gadera

In Alternatives 1 and 4 a route was provided from Ashdod to Jerusalem Malha, demand for this service was generally low between Ashdod and Bet Shemesh, about 300 passenger per hour. The infrastructure, except the station at Gadera, will be provided as part of the project to link Ashdod (Pleshet) to Bet Shemesh for freight traffic. However, no trains are envisaged to use the connection to the Pleshet to Bet Shemesh railway from the direction of Ashkelon and this link could be omitted.

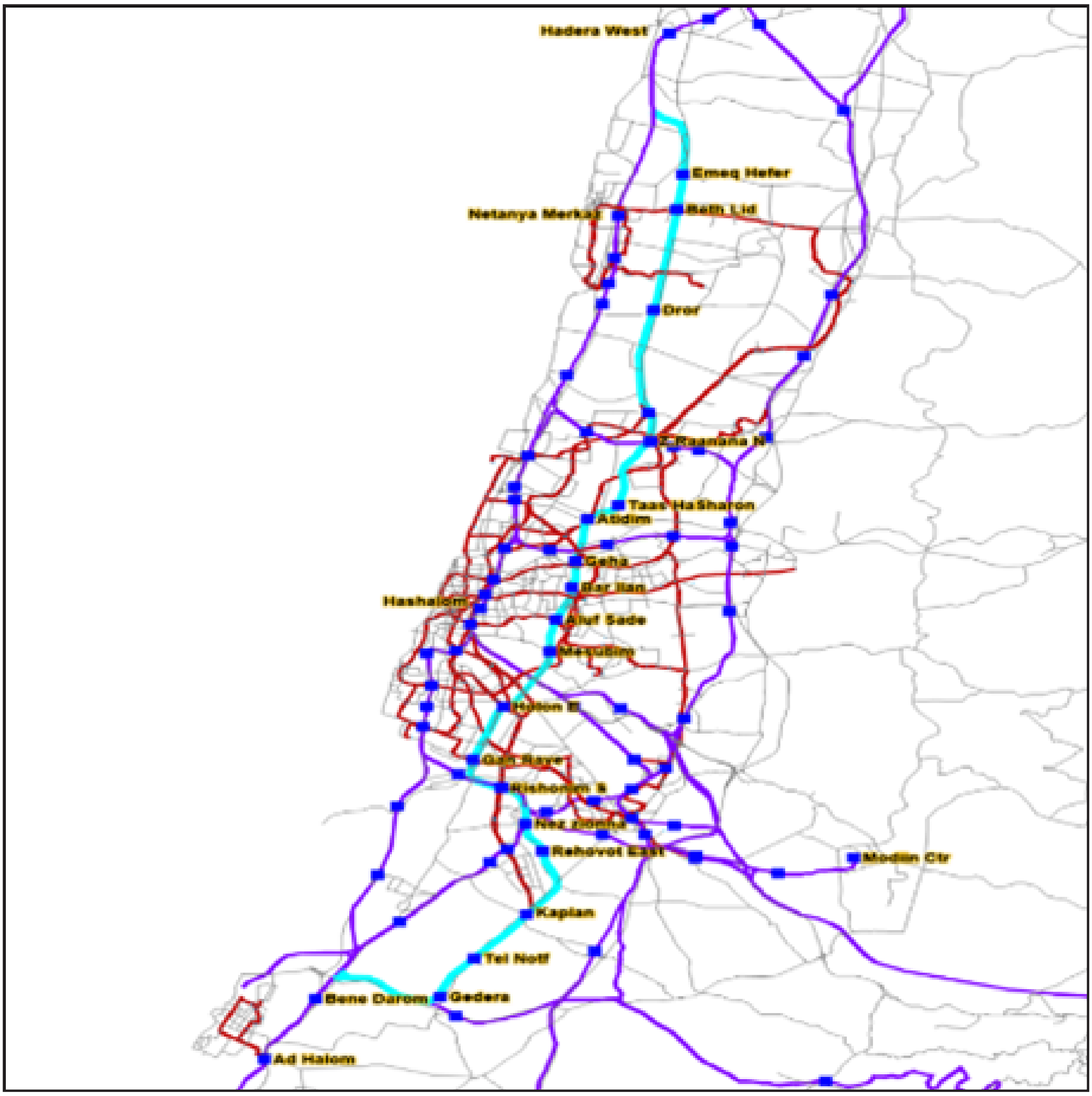


Figure 5.7– Road 4 Railway (light blue) Other Railways (purple) and Metro (red)

6. STATIONS

6.1 Station Spacing

There is an inherent conflict between providing stations more frequently to provide the best coverage and having less stations to provide a faster journey time. Often there is pressure on the railway to increase coverage by providing frequent stations. The hierarchical approach of the strategic plan tackles this conflict by providing fast services between the metropolitan centers with few stops and then allowing local trains to stop more frequently. Yet the local routes may still suffer from short spacing of stations casing journey times to increase and reducing the attractiveness of the service. However, in some locations without additional stops some stations may become overloaded and congested.

A balance needs to be struck between these conflicting needs, therefore additional stops need to be analyzed in the network context, considering the impact, both positive and negative on both the rail network and the local highway and mass transit networks. Comparison with other rail systems suggest that stations should not be spaced at intervals of less than 2 km, unless there are special circumstances. Mass Transit systems can accommodate much shorter distances between stations because the higher acceleration and deceleration performance in part compensates for the time penalty of the additional stops.

In the 2040 network there are 26 route sections with a spacing of less than 2.5 km, there are 2 in the Krayot, 4 in central Tel Aviv and 2 in central Jerusalem. The remainder, 18 sections, are in the Central Area where stations can be around 1 km. To overcome the difficulties of a slow service less well used stations could be eliminated or not provided but often these stations are linked to development agreements. Alternatively a skip stop service could be provided, but this reduces route capacity which is often not available requiring provision of additional tracks at considerable additional cost.

6.2 City Centers

There is a conflict between minimizing the delay to trains that occurs when trains make multiple stops in a city center and providing easy access to large Central Business Districts. A comparison has been made with a number of peer cities where inter-urban services operate along an axis through the city center. In all cases the distribution of stops recognizes the service hierarchy with decreasing numbers of stops: International-> Intercity-> Regional-> Suburban.

Comparison is made with the following cities to examine the number of stations serving inter-urban services:

- Berlin – 4.5 million people in the Metropolitan Area:
  - North – south axis 3 stations Gesundbrunnen, Hauptbahnhof and Südkreuz,
  - East – west axis 2 stations Ostbahnhof and Hauptbahnhof;
- Madrid – 5.5 million:
  - 2 stations Atocha and Charmartin;
- Brussels – 2.1 million
  - 3 stations, Brussels North, Central and South.

The common structure is that the longer the service the less stops in the town center and in all examples found the maximum is three stations in large centers. In some cases inter-urban trains do not stop in the CBD and passengers change to local services or metro services to reach the CBD.

6.2.1 Jerusalem

The station that is under construction in Jerusalem will not be large enough for the number of trains required to satisfy the forecast passenger demand. Increasing the size of the station at HaUma will be difficult because of the depth of the station and the planned development of large office complexes around the station.

An alternative is to extend the railway beyond HaUma to another station in a more central location, a number of locations are under consideration for the new center station. It is recommended that the railway is extended to a new Center station. The location chosen should be provide walking access to the main centers of employment and provide good connections to the planned LRT routes. A possible location is on Jaffa Street between King George Street and HaKherut Square. This has the advantage that it spreads the load between two stations and the new station provides interchange with the Blue as well as the Red LRT line.

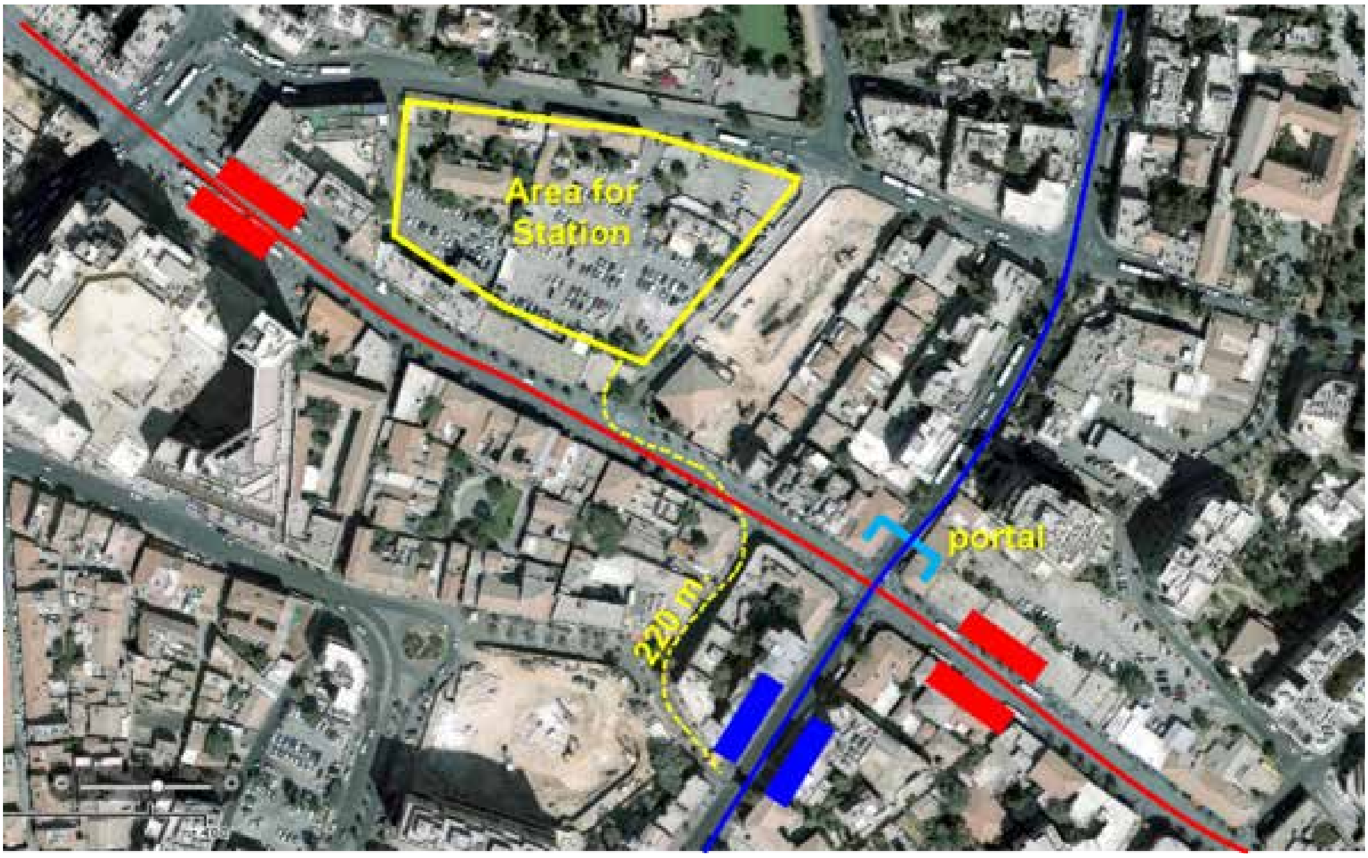


Figure 6.1–Location of Center Station at intersection of Red and Blue Line LRTs

A large station would be required to provide the required turnaround time, with at least 8 platform faces, and the restricted size of sites that are likely to be site available could make this difficult and expensive. This may require an innovative solution to managing the turnaround of trains in Jerusalem. Other solutions include:

- Extension of the railway beyond Center stations to Malha – This utilizes some of the existing railway infrastructure at Malha, which is not used, together with other facilities on railway land there. It could also allow a railway passenger service to other areas of the city, but this would duplicate the route of the Blue LRT Line. The disadvantage with this option is that it will require a long tunnel and require the removal of the linear park created along part of the old railway from Malha towards the original terminus at Khan. Another option is extension only to Khan Station allowing more operational options with shorter extension. This option combined with the new cable plan from The Khan station to the old city and Mt. Olives will allow visitors to Jerusalem easier access to the old city.
- Construction of a single track Terminal Loop Line beyond center station. – This would reduce the length of tunnel required, but would be introduce operational problems if trains arrived out of the planned sequence as train order would be difficult to change.
- Construction of a double track tunnel beyond Center to facilitate trains to layover out of the station.

Further work should be undertaken to determine the most appropriate solution for turning around trains in Jerusalem.

6.2.2 Tel Aviv

The Tel Aviv Metropolitan CBD includes the Ayalon Corridor and the historical CBD. The CBD extends from Habursa/Savidor in the north to south of HaHagana and Herzl Street. In the east, University and Holon are not in CBD as defined in TMM5. The CBD primary service area includes the walk access zones around the stations as shown on figure 6.2. Although some people may walk longer distances all other trips need to transfer to other transit modes. Providing four stations, including the additional station at Ytzhak Sade, in the Ayalon is necessary to provide good coverage for the CBD along the Ayalon.

Savidor, HaShalom and HaHagana are major intermodal hubs, allowing transfer between the rail network and the mass transit lines, however, Ytzhak Sade is not connected to the mass transit lines.

Stopping the high speed services at many stations in the CBD is not the usual practice adopted in other cities of a similar size. In cities where the route passes through the city, rather than going to a terminal station, the inter-urban services stop at no more than 2 stations. Increasing the number of stops increases the journey time for through passengers but reduces the journey time for passengers who would otherwise have to change.

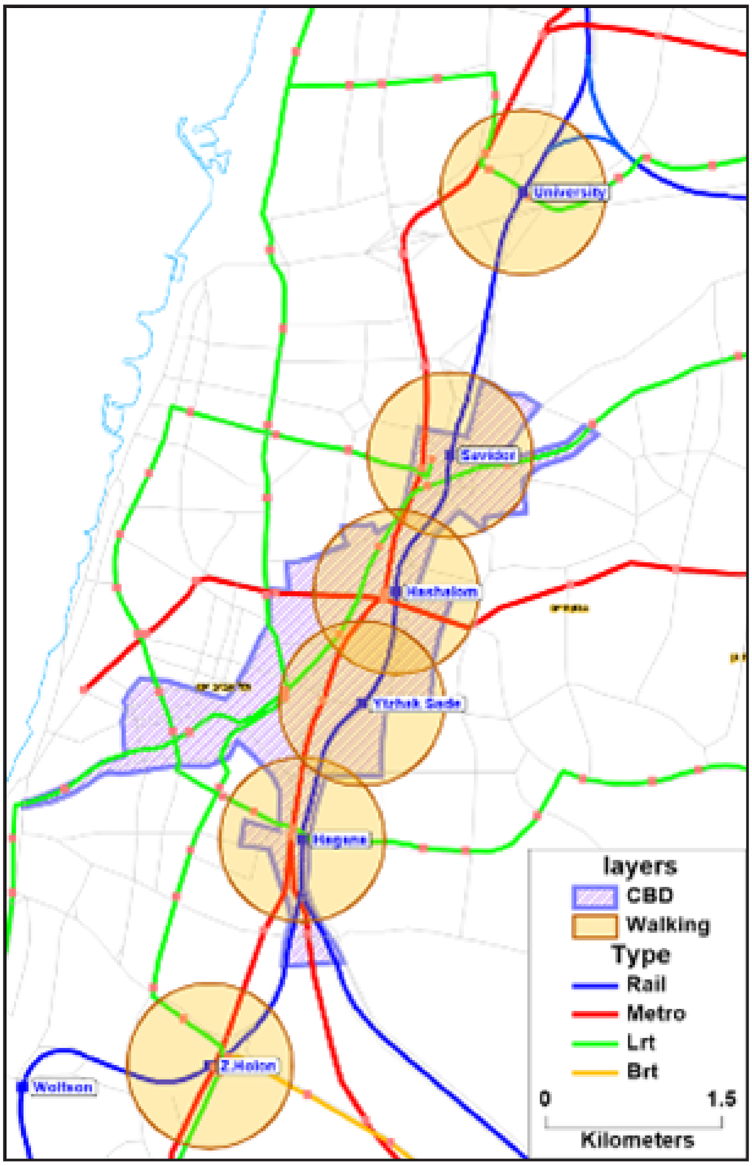


Figure 6.2–Tel Aviv CBD and Walk Zone around stations.

An assessment of demand for inter-urban passengers at the four stations in the Ayalon Corridor indicated that the demand is as shown in Table 6.1. There is limited demand for inter-urban passengers to University or Holon stations.

	Savidor	HaShalom	Y. Sade	HaHagana	Total to Tel Aviv	Through Passengers
North	610	718	248	91	1,667	
Jerusalem	257	670	367	113	1,407	
South	196	612	268	64	1,140	
Total IU	**1,063**	**2,000**	**883**	**267**	**4,214**	**7.898**

Table 6.1 Inter Urban Passengers Walking from Stations in Ayalon.

This shows that the 65% of passengers on inter urban services pass through Tel Aviv, therefore there is advantage to reducing the number of stops. In addition to passenger walking from the stations there is also demand for passengers to change trains to local services or mass transit services these take place at Savidor, HaShalom and HaHagana. It is suggested that National Services stop at Savidor and HaShalom as these have the highest demand on National Services and have interchange to the Mass Transit system. An additional station (HaHagana) could be provided, this should be decided following more detail analysis.

6.2.3 Haifa

At present there are four stations in central Haifa, Lev HaMifratz, Center HaShmona, Bat Galim and Hof HaCarmel, it is proposed to replace Center HaShmona with a station at Beth HaMeches further away from Bat Galim. It is recommended that all four stations are retained but that inter-urban services do not stop at Bat Galim to reduce journey times as it has the lowest demand.

An alternative solution for National Services that could reduce the number of National Services operating through much of Haifa is discussed in Section 5.1.3.

6.2.4 Netanya and Hadera

Netanya and Hadera also have problems of excessive Park and Ride demand. The station demand at each station is strongly influenced by the attractiveness of the service to Tel Aviv compared to other stations in the area. If National Services stop at Hadera, there is an increased demand there, when the National Services do not stop at Hadera the demand is switched to Netanya. To balance the demand more evenly requires a good service to both Hadera and Netanya, this is achieved by stopping some National Services at Hadera and providing a skip stop service from Netanya Merkaz.

6.2.5 Ashkelon

Demand from Ashkelon is very high, about 10,000 passengers per peak hour, and at present there is only one station serving the city and it is located on the north eastern outskirts of the present developed area. This will make access to station difficult, particularly as the station is located on the north-western outskirts of the city and the model identifies the main mode of access as Park and Ride, which is not practical. Therefore it is essential that two stations are provided in Ashkelon and a local feeder system of buses to both stations is provided to reduce the dependency on Park and Ride.

Figure 6.3–Driving demand to Ashkelon (Single station).

6.3 Station Hierarchy – International Comparators

Different countries have specific guidelines for the development of their stations and these guidelines often differ for mainline stations and metro/commuter line stations. We reviewed the guidelines for:

- UK;
- Germany;
- Italy;
- US (Amtrak).

These guidelines provide details on categorization and differing level of planning details. Other countries have similar guidelines that are consistent with their specific design codes, standards and practices.

- UK

Stations are placed into 6 categories depending on the number of daily passengers and annual total number of passengers. With increasing number of passengers using the station the facilities that are provided increases.

- Germany

Stations are placed in 7 categories, the categories are based on a combination of the number of platforms, length of platforms, number of passengers per day, number of stopping trains per day, whether station personnel is present or not and platform access is with barrier or barrier free.

- Italy

The classification based on combination of daily traffic; level of service to travelers, areas open to public (shopping, access to stations) and presence of other modes (bus, metro, etc.) and stations are placed in 4 categories.

- US (Amtrak)

Amtrak may not be considered to be similar to Israel because of the nature the services it operates but a similar system of categorization is applied. Stations are placed in 4 categories based on similar characteristics to the other countries; annual ridership, staffed or not, amenities and customer service components.

Some aspect of the categorization used in these countries is not appropriate for Israel, such as whether stations are staffed or unstaffed or whether there are barriers to prevent passengers entering or exiting without a ticket. It is recommended that ISR should adapt its own guidelines considering local conditions and information from other countries with perhaps 3 or 4 station categories:

- National hubs;
- Key interchange stations;
- Large stations;
- Medium stations;
- Small stations.

6.4 Illustrative Station Hierarchy

There are two main considerations in the proposed classification of stations the number of passengers that enter or leave the public transport system and the number of passengers that use the railway and transfer to or from other forms of public transportation. The stations with the most passengers entering, exiting or transferring to other rail or mass transit services are mainly located in the center of Metropolitan Areas – 10 out of the top 15 stations.

It should be noted that the forecast number of passengers at stations may vary between closely spaced stations and because of integration with the mass transit system that is currently still under planning.

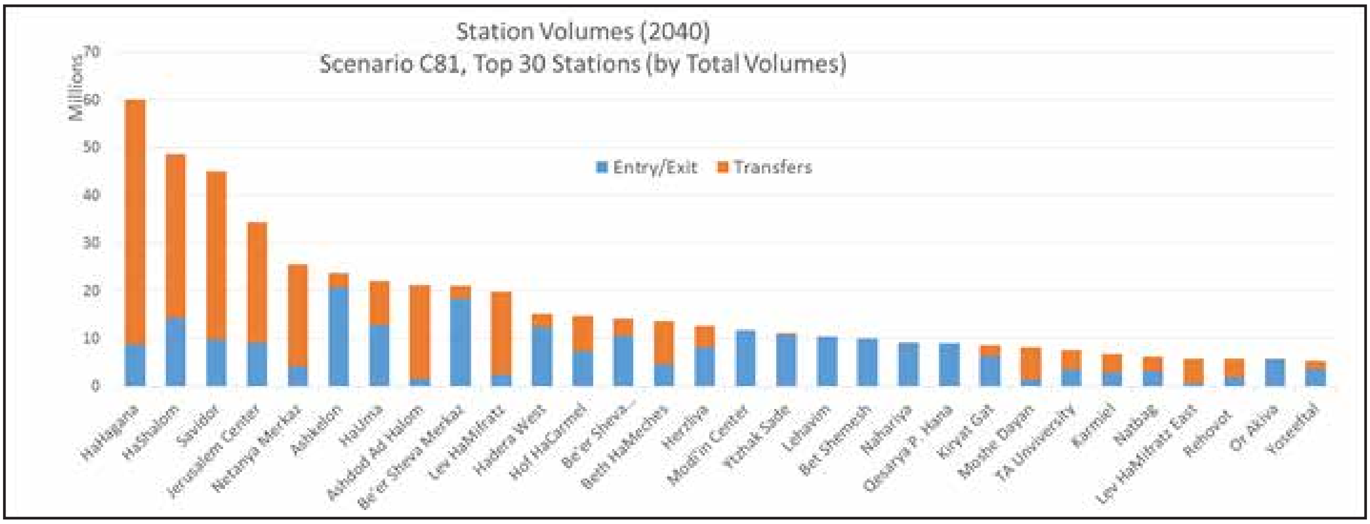


Figure 6.4 – Stations by Highest Forecast Total Volumes

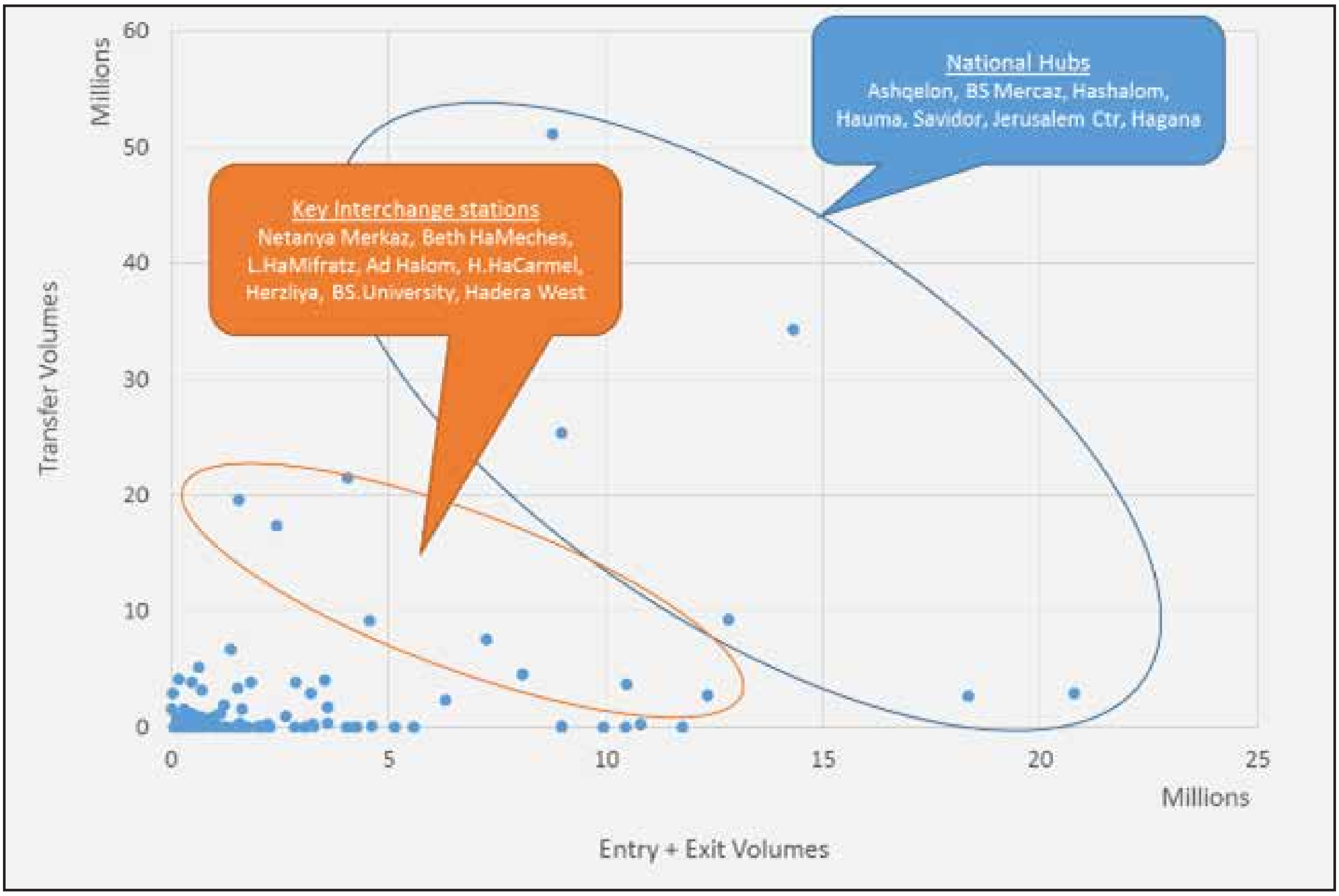


Figure 6.5– Illustrative classification of ISR stations based on entry/exit and transfer volumes

- **Hub Stations**

Stations with the largest numbers of passengers entering or exiting the rail network would be classified as National Hub Stations and or have significant transfer volumes. The following stations are suggested as National Hub Stations – Jerusalem Centre, Tel Aviv HaShalom, Tel Aviv Savidor, Tel Aviv HaHagana, Be'er Sheva Merkaz and Ashkelon.

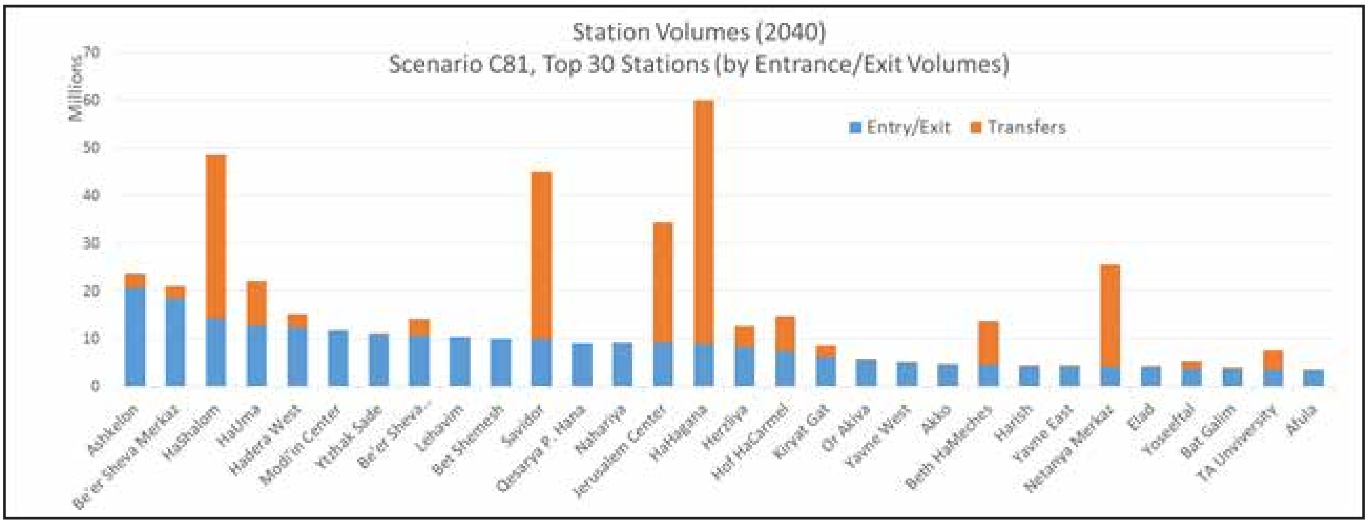


Figure 6.6 – Stations by Highest Forecast Entry/Exit Volumes (Note: Based solely on entry/exit volumes)

- **Key Interchanges**

Key Interchanges would be those stations with those stations with high transfer volumes, these would include Netanya Merkaz, Ashdod Ad Halom, Lev HaMifratz, Beth HaMeches, Hof HaCarmel, Herzliya, Hof HaCarmel, Be'er Sheva University and Hadera West.

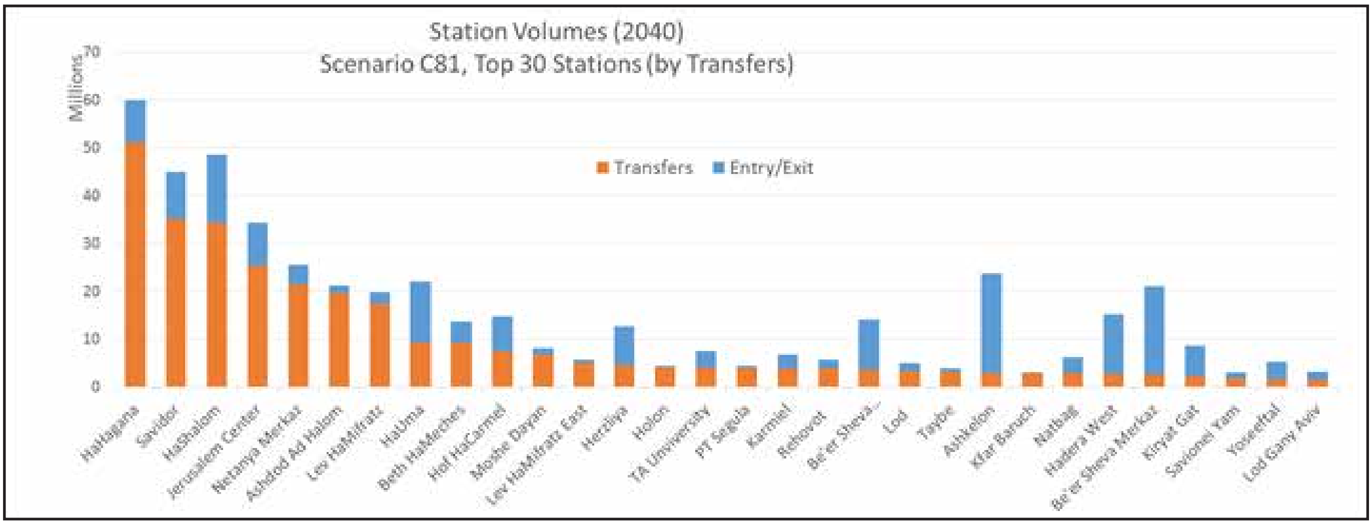


Figure 6.7 – Stations by Highest Forecast Transfer Volumes

- **Large Stations**

The next category of station would be Large Stations these would include the remaining stations in the top 60 stations for entry and exit volumes and that are not classified as National Hubs or Key Interchanges. A few of these stations have high transfer volumes and probably should be considered as key interchange stations; these include Moshe Dayan, Tel Aviv University, Karmiel, BG Air Port, Rehovot, Lod and Moshe Dayan.

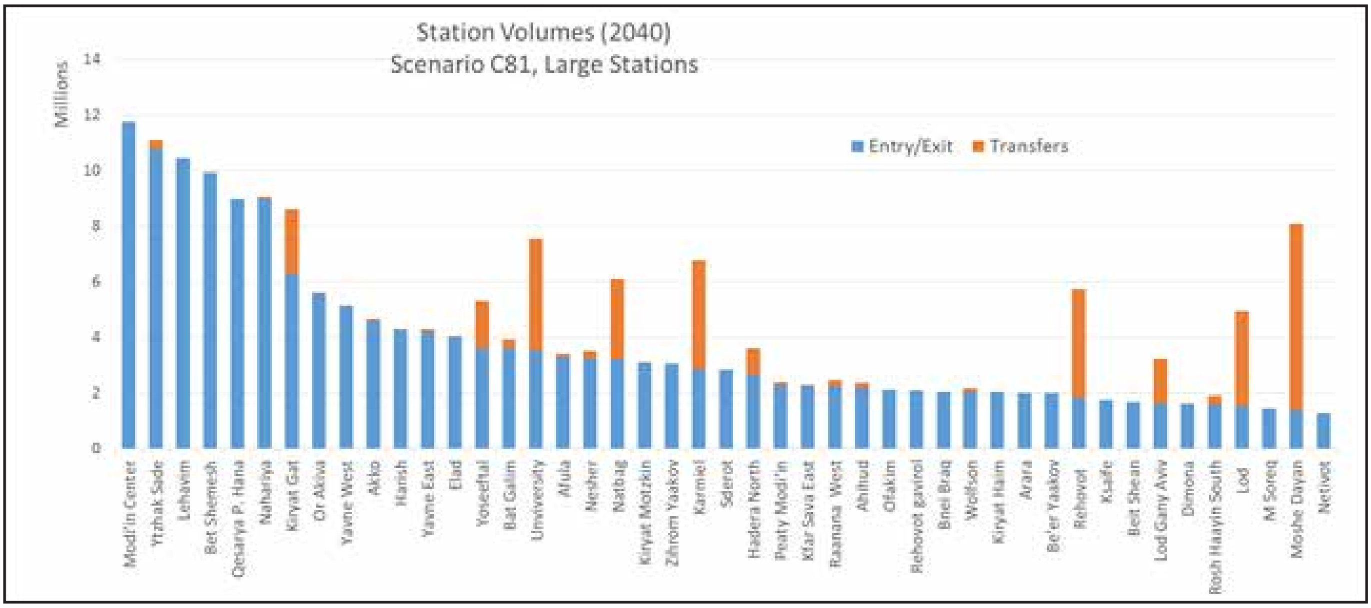


Figure 6.8 – Large Stations Forecast Volumes (Note: Based solely on entry/exit volumes)

- **Medium Stations**

The remaining stations with more than 0.5 million passenger would be classified as medium stations. Although five of these stations also have large volumes of transferring passengers; Holon, Lev HaMifratz East, Taybe, Savionei Yam, Ramla, and Lod Center and it is suggested that these would be classified as Large Stations.

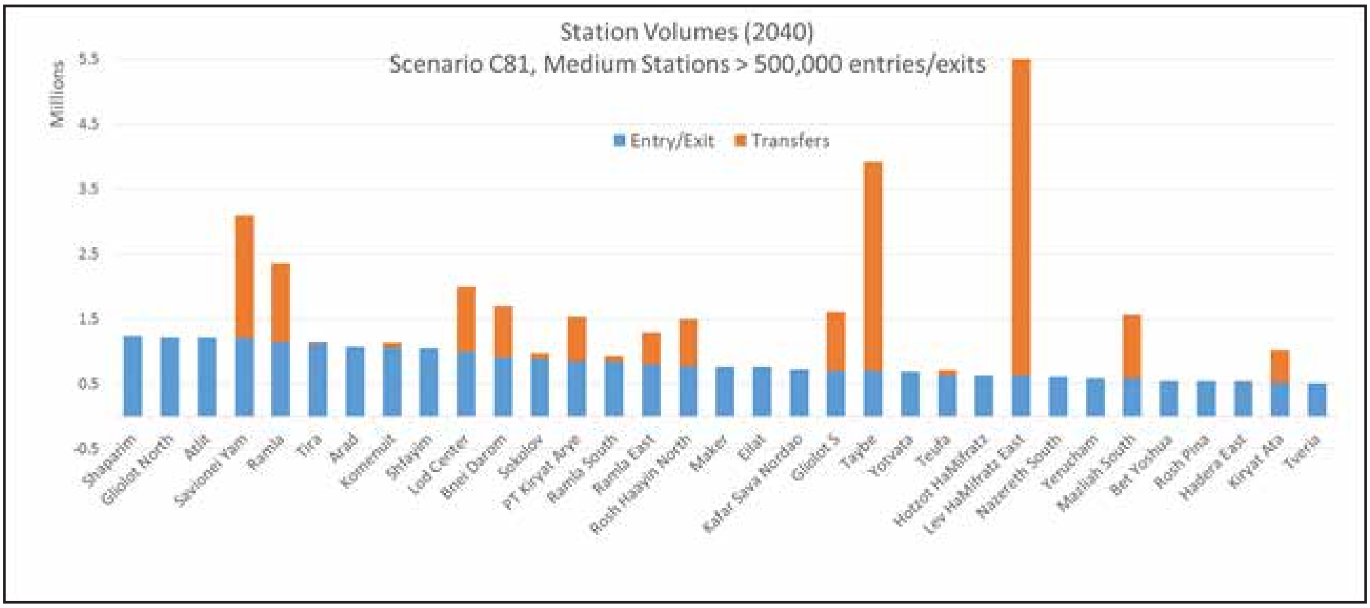


Figure 6.9 – Medium Stations Forecast Volumes (Note: Based solely on entry/exit volumes)

- **Small Stations**

Stations with less than less 0.5 million passengers would, 12 have between 0.5 and 0.25 million passenger and 18 have less than 0.25 passengers entering or exiting. Although three of these stations have large volumes of transferring passengers; Kfar Baruch, Netanya Sapir and Holon have very high volumes of transferring passenger and it is suggest that they are potentially classified as Medium Stations.

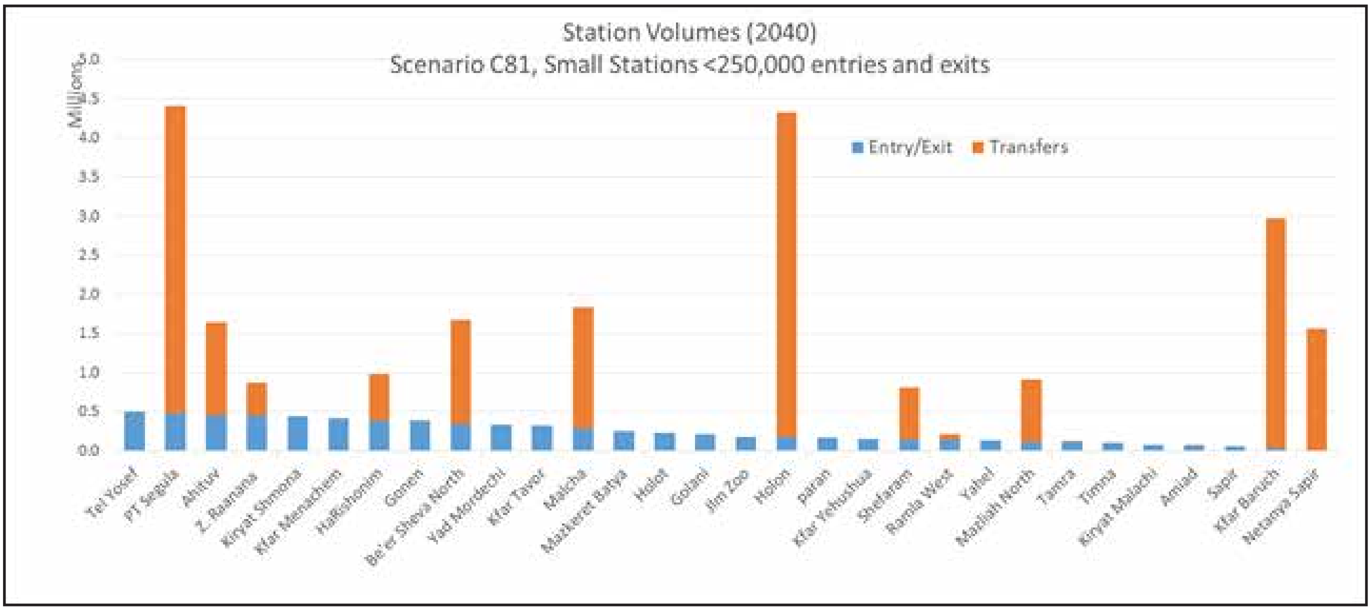


Figure 6.10 – Small Stations Forecast Volumes (Note: Based solely on entry/exit volumes)

6.5 Network Connectivity

An important element in the Strategic Plan is the interconnectivity between the public transport modes, as for many journeys passengers will need to use more than one mode, therefore connection should be as easy as possible to ensure the public transport option is attractive to passengers. Distances have to be minimized or other facilities such as moving walkways need to be provided.

The best option is that passengers can change trains by remaining on the same platform, however this is not practical in most cases as to ensure the best mutilation of network capacity the different networks need to be kept separate in most cases. The next best alternative is interchange at a common station where passengers only have to walk between platforms, where possible to reduce the distance passengers have to walk to change trains more than one connection between platforms should be provided as trains could be up to 320 m long.

Connections between different modes can also be good where a direct connections exists but distances have to be short, less than 100m, and passengers do not have to cross a highway. This will not always be practical and connections have to be made in the best way possible. Table 6.2 provides the suggested minimum connectivity requirements between different modes.

	National Rail	Regional Rail	Metro	LRT	BRT	Bus Hub
National Rail	Common platform	Common Station	Direct connection	Direct connection	Direct connection	Direct connection
Regional Rail	Common Station	Common Station	Direct connection	Direct connection	Direct connection	Direct connection
Metro			Common Station	Direct connection	Direct connection	Direct connection
LRT				Close connection	Close connection	Close connection
BRT					Close connection	Close connection

Table 6.2 Minimum connectivity guidelines.

Direct connection – walking distance < 100 m. without street crossing

- Longer distance requires conveyor

Close connection

A. Both stations at street-level: not more than 2 crossings
B. One station underground and the other at street level: not more than 1 crossing, walking distance up to 75 m. and not more than 1 escalator
C. Two underground stations: walking distance<100 m. and not more that 1 escalator

7. CONCEPT LAYOUTS

Concept layouts have been prepared for the 2040 Strategic Plan Routes and these are described below, these plans include the layouts required for 2040, including existing lines, lines under construction and most lines that are planned.

7.1 Improvements to Network Under Construction and In Planning

The following improvements that are under construction have been assumed:

- Akko – Karmiel
- Herzliya to Kfar Saba (Road #531)
- Coastal Railway University to Herzliya – widening to 4 four tracks and
- BG Air Port to Jerusalem HaUma.

The following schemes in Planning by Israel Railways have been considered:

- Haifa to Afula - widen single track railway to two tracks
- Kishon Depot to Lev HaMifratz – widen to three tracks
- Lev HaMifratz to Hof HaCarmel – widen to 4 tracks
- Hof HaCarmel to Herzliya (Road #531) additional 2 track new high speed alignment
- Eastern Track – new line Kfar Sava to Hadera North
- Eastern Track widening to 2 tracks Lod to Rosh Haayin
- Ayalon Widening to 4 tracks
- BG Air Port Station Widening and connections to Eastern Track
- Modi'in to Jerusalem connection
- Moshe Dayan - HaRishonim – Anava (Road #431)
- Lod Bypass
- Lod Bypass to Jerusalem connection via Gezer South
- Pleshet to Lod Bypass
- Be'er Sheva Bypass
- Be'er Sheva University to Be'er Sheva Center widening
- High speed railway Be'er Sheva to Eilat
- Tsefa to Tamar
- Hazeva to Dead Sea Works

7.2 National Network

7.2.1 North of Haifa

Widening of the route to four tracks between Lev HaMifratz and Naaman, south of Akko, to allow National Services to stop only at Savionei Yam in the Krayot was considered but was discounted because of the railway right of way is not wide enough and adjoining development would have resulted in a very expensive solution, potentially involving a long tunnel.

The route from Karmiel to Kiryat Shmona is proposed to be constructed to allow 250 km/h to provide a high speed rail backbone from Kiryat Shmona to Eilat.

7.2.2 Haifa

It is envisaged that by 2040 at least 20 trains will be required to operate through Haifa, from Lev HaMifratz and Hof HaCarmel, and existing two tracks through Haifa will be insufficient to accommodate this number.

Ideally all National Trains, 14 per hour, would be required to operate to Haifa to avoid the potential problems of terminating trains at intermediate stations. This would require the widening of the railway to four tracks by the provision of 2 additional tracks for the National Services. An extension of the widening to Kishon Depot to provide layover facilities. Stations would be provided at Hof HaCarmel, Beth HaMeches and Lev HaMifratz. In addition it would require the stations to have 4 platform faces and on the National Tracks to allow sufficient dwell time in the stations.

Widening through Haifa is difficult as the width of the railway Right of Way (ROW) is constrained by adjoining development for much of its length, which either precludes widening or makes it extremely expensive. In addition there are pressures to reduce the impact of the railway on other sections where the railway cuts the city off from the sea shore. Particular problems that have been identified in the work conducted on behalf of Israel Railways are:

- ROW north of Lev HaMifratz only able to accommodate 3 tracks, allowing only a single track connection from Lev HaMifratz to Kishon Depot;
- ROW at Lev HaMifratz station only able to accommodate 4 tracks with 4 platform faces;
- ROW at Beth HaMeches station only able to accommodate 4 tracks with 4 platform faces and tracks to Haifa East.

These restrictions will require the number of National Services passing through Haifa to be minimized to maximize the headways between trains to allow maximum dwell time in stations and for trains to terminate at Hof HaCarmel as well as Lev HaMifratz. It is proposed that the 2 National Trains would terminate at Hadera and 2 at Hof HaCarmel, therefore only 10 National Trains per hour in each direction would pass through Beth HaMeches. Of these the 4 National Trains that originate north of Lev HaMifratz would use the local tracks at Lev HaMifratz and 6tph would terminate there and proceed along the single track to Kishon to layover.

7.2.3 Haifa to Tel Aviv

From Haifa to Tel Aviv it is proposed to construct a new high speed route to support a frequency of 14 trains per hour, the existing railway will be used under normal operations by local and freight trains. The intent is to provide a low journey time between stations in central Haifa and Tel Aviv to make the railway attractive to longer distance passenger in preference to the use of the private car.

The new railway will be designed for speeds up to 250 km/h, if it is not practical, for economic or environmental reasons, for some parts it may necessary to have lower design speeds. To maximize the capacity of the railway graduated speed reduction will be imposed as they approach Haifa, Tel Aviv and any significant intermediate speed reductions to prevent bunching of services. An intermediate station will be required at Hadera West to enable passengers from the area south of Haifa and area around Hadera to have a fast journey to Tel Aviv and other more distant destinations. It is not proposed to stop all trains at Hadera, therefore it is proposed that through tracks with unrestricted speed, other than by alignment constraints, are provided with the platforms set on loop tracks. The loop tracks should be as long as possible with high speed switches to allow stopping trains to leave and rejoin the main tracks at as high speed as possible to reduce disruption to through trains.

Connections would be made to the proposed Engineering Depot at Zihron Yaakov and the local tracks at Hadera West. In the event of disruption to the high speed tracks it is recommended that connections are made to and from the local tracks at Zihron Yaakov and Hadera West.

7.2.4 Tel Aviv (Ayalon Corridor)

A tunneled two track alignment is proposed through the Ayalon Corridor to allow the National Services to operate independently from the Local Services.

The tunnel is expected to commence in the vicinity of the junction of the Coast Track and the Road #531 Railway, near Shfayim. Before the railway enters the tunnel it is recommended that connections are made with the Local Tracks to allow National Trains to use the Local Tracks in the event of disruption or maintenance on the tunneled alignment.

The tunnels will continue along the Ayalon Corridor with new underground stations provided at Savidor Merkaz, HaShalom and a further station (this should be decided following more detail analysis). Each of these stations will be designed to have four platform faces. This will allow trains to have a reasonable layover considering the number of passengers that will be alighting.

7.2.5 Tel Aviv to BG Air Port

The National Tracks will continue in a tunneled alignment along the line of Highway #1 towards Ganot and then towards BG Air Port. The tunnel is expected to end to the east of Shapirim Interchange. The tunnels are expected to be carrying 14 trains per hour in each direction. To avoid conflicting movements at BG Air Port station the tunnel is proposed to emerge between the two local tracks, switches will be provided between the local tracks and national tracks to allow trains to be routed either via the tunnel or existing tracks. These could be used in the event of disruption or maintenance on either route.

7.2.6 BG Air Port to Jerusalem

Approaching BG Air Port the National Tracks will be joined by the existing tracks from Tel Aviv, these will be carrying the local service to Modi'in. The railway will need to be widened to 4 tracks from BG Air Port to the junction with the Lod Bypass and the station increased in size to have 4 platform faces. It is expected that there would 9 tph to Jerusalem, 5 tph for Be'er Sheva and 3 tph for Modi'in, giving a total of 17 tph. To maximize the dwell time available at the station it is proposed that one platform face in each direction is used by Jerusalem trains (9 tph) and the other by Be'er Sheva and Modi'in trains (8 tph).

To the east of BG Air Port station four tracks would be required until the National Trains for Be'er Sheva join the Lod Bypass. Also to the east of BG Air Port station junctions would be provided with the Eastern Track allowing trains from BG Air Port to proceed towards Teufa and Lod. The connection towards Lod provides an alternative route for trains to Be'er Sheva. The connections from Teufa allow any alternative route from the Eastern Track to Tel Aviv. Before the junction with the Lod Bypass trains for Modi'in would join the trains for Jerusalem through switches, there would also be switches provided to connect the Lod Bypass, from the Eastern Track, to the Jerusalem track.

Trains for Modi'in would diverge at the existing Daniel Interchange. At Anava interchanges would be provided with the Jerusalem track (9 tph) to allow free flow interchange with the tracks to Modi'in (2 tph) and Road #431 (2 tph).

No changes to the Jerusalem track are planned until Jerusalem HaUma. Turning around 13 trains per hour in Jerusalem will not be possible using the existing station at HaUma, the maximum capacity of this station is, at most, 6 tph. The railway is proposed to be extended to a new station Jerusalem Center through a new tunnel. This could be built to accommodate turning around 13 tph, this would requiring mining an extensive underground station as the available site is of limited size and this could be very expensive. Alternative arrangement to a conventional inter-urban terminus will need to be explored, this could include adopting suburban or metro type solutions.

7.2.7 BG Air Port to Be'er Sheva

From BG Air Port National Trains would join the Lod Bypass. Lod Bypass will be shared with freight services, it is anticipated that up to 2 freight trains would use this route together with 5 National trains per hour; this is about the maximum that could be accommodated. At the south end of Lod Bypass National trains from Jerusalem will join the route, this will be using an interchange as a junction with switches will not have sufficient capacity

At the end of Lod Bypass the route from Lod will join adding a further 6 tph. This gives a total of 15 tph of a very varied nature requiring an increase to 4 tracks to provide the necessary capacity. It is proposed to provide a new high speed two track alignment from the Lod Bypass to Be'er Sheva. This alignment will be designed for speeds up to 250 km/h, if this is not practical, for economic or environmental reasons, for some parts it may necessary to have lower design speeds. An interchange will need to be provided to separate the high speed trains and freight trains at the start of the high speed track.

No interchange will be provided with the track to Bet Shemesh, the track from Pleshet to Soreq or the Be'er Sheva Bypass. If the new high speed line was to the east of the existing railway at Na'an, the track from Bet Shemesh would need to pass under or over the new high speed route to remove the conflict between high speed trains and the local trains. A station is required to be provided at Kiryat Gat, it is planned that all trains would stop at this station and a simple twin side platform arrangement is suggested. A connection between the high speed track and the existing track is suggested near Kiryat Gat to allow diversion of trains from one route to the other in the event of disruption or maintenance.

The size of Be'er Sheva University station will be increased to accommodate the number of trains and empty train movements to the depot. Between Be'er Sheva University and Center stations 11 tph will operate and the railway will be widened to 3 tracks to provide flexibility in the routing of trains into and out of the terminus.

7.2.8 Be'er Sheva to Mamshit

The existing railway between Be'er Sheva and Tsefa is single track and has an alignment that does not allow high speeds services to operate. To provide a high speed, a new alignment, or modified alignment will be required for the high speed service to Eilat. It is forecast that there would only be one train per hour using this in the Base Case and up to 3 freight trains. With this low level of utilization this new alignment, with suitable loops to hold slower freight services could replace the existing alignment, provided the gradients of the new track were low enough for freight trains.

If local services were provided to Arad and Yerucham then the number of trains would rise and it would be necessary to widen the existing railway between Be'er Sheva and the junction to Arad.

7.2.9 Mamshit to Eilat

Beyond Mamshit the high speed line would follow a different alignment from the freight tracks to be able to descend into the Arava valley. It is believed that much of the route will be in tunnels. Near Hazeva the high speed alignment will rejoin the freight track, including a branch track from the Dead Sea Works which will have junctions by switches to allow freight trains to proceed to Eilat or towards Be'er Sheva.

The forecasts suggest that between Hazeva and Eilat one high speed trains and 1 or 2 freight trains would pass each hour. Stations are planned to be provided at Hazeva, Sapir, Paran, Yahel, Yovata and Timna, each stations would consist of two side platforms located on loops, able to accommodate a full length freight train, off the through tracks. This arrangement would allow passenger trains to pass slower freight trains and if required for passenger trains to not stop at a station. The demand at some of these stations is forecast to be negligible and further work is required to determine whether some could be omitted.

7.3 North Area

7.3.1 Nahariya to Lev HaMifratz

The existing arrangement of tracks requires no changes to accommodate the forecast number of trains, up to 4 tph.

A new station will be provided in the north of the Krayot at Savionei Yam, this will be provided with 4 platform faces to allow national services to pass local services.

7.3.2 Karmiel to Naaman and Nesher

The existing arrangement of tracks requires no changes to accommodate the forecast number of trains, up to 7 tph. However, two additional platform faces will be required at Karmiel to accommodate the number of trains. A new junction will be formed at Ahihud with a new railway along the line of Road #70. This railway will have two tracks and able to accommodate a service of 3 tph and the small number of freight trains. Simple stations, with either an island or two side platforms, will be provided at Tamra, Shefarim and Kiryat Ata. The junction with the HaEmek railway will have two tracks towards Haifa and a single track towards Afula for freight services from Karmiel to the Eastern Track.

The railway along Road #70 would be extended to form the geopolitical link to Lebanon through Shlomi, see Section 4.3.

7.3.3 Karmiel to Kiryat Shmona

The route from Karmiel to Kiryat Shmona is included in the C81 2040 Strategy Extended Network to provide a link to the Periphery, see Section 4.1. If included as a strategic link to the Periphery it is suggested that this be constructed as a double track railway to accommodate a 250 km/h service. Simple stations, with either an island or two side platforms, will be provided at each station because of the frequency of 1 train per hour expected.

7.3.4 Beit She'an to Jordon River

A geopolitical link to Jordan through the Jordan River Crossing. The form of this link should be determined when demand has been assessed, if there a significant number of trains required, this could require improvements to the railway between Afula and Beit She'an.

7.3.5 Afula to Lev HaMifratz

This length of railway will require to be widened from single to two tracks to handle a passenger service of up to 6 tph and 1 to 2 freight trains per hour.

A classification yard is required to control the entry of trains to Haifa Port and to sort trains for the various destinations in the port area. To avoid conflict between freight trains requiring access to the port and the large number of passenger services south of Lev HaMifratz a tunnel will be required from the classification yard to the new port area at Kishon with a link on the port side of the Coastal Track to Haifa East Yard.

7.3.6 Afula to Tiveria

The route from Afula to Tiveria is included in the C81 2040 Strategy Extended Network to provide a link to the Periphery, see Section 4.1.If included as a strategic link to the Periphery it is suggested that this be constructed as a single track railway with passing places provided at Golani and Kfar Tavor because of the low frequency of trains expected. A simple station, with either an island or two side platforms, would be provided at Tiveria.

7.3.7 Afula to Jenin

This railway is included as a geopolitical route to the PNA, see Section 4.3. The form of this link should be determined when demand has been assessed.

7.3.8 Haifa to Hadera West

As described in paragraph 7.2.1 the railway will widened by two tracks between Lev HaMifratz and Hof HaCarmel and the local tracks will need to accommodate up to 10 tph plus an occasional freight train from Haifa East to Dagon. The existing station at Center will be replaced by a new station at Beth HaMeches. The station at Hof HaCarmel will need to be expanded to accommodate the terminating National Services and up to 6 Local Services, although some of these could layover at the operational station at Hotrim.

Between Hof HaCarmel and Zihron Yaakov the existing railway would have to accommodate only 4 tph and no changes would be required. It is proposed to reroute the existing railway to avoid Binyamina providing two new stations at Zihron and Or Akiva. At Zihron there is space available to provide the terminal for services from Tel Aviv and suitable facilities will be required to terminate up to 6 tph. Up to 10 tph could need to use the length between Zihron and Hadera North, this could be accommodated on the existing tracks.

At Hadera North a new freight terminal is to be provided, access to this would be from the Eastern Track with an interchange to carry freight trains across the Coast Line. A new junction with switches is may be required to allow trains from the Eastern Track to go to Hadera West because it may not be possible to provide an interchange because of conflict with Road #65. This junction by switches may cause problems because of the conflict with the 10 tph on the Coast Line. It may be necessary to reduce this number of trains by terminating some trains from Haifa at Or Akiva and a facility should be provided here.

7.4 Central Area

7.4.1 Hadera West to Tel Aviv

The number of trains operating on the Coast Line north of Tel Aviv requires the railway to be widened to 4 tracks, in addition to the 2 tracks for the national services, from the Tel Aviv to Netanya Center. The two additional tracks from Netanya would be required to be able to operate the skip stop service.

The all stations service would terminate at Netanya Center and facilities to terminate trains here will be required. The facilities to terminate trains provided as part of the Coast Line Railway widening at Herzliya may also be required. Within the constraints of the space available facilities to terminate trains from Haifa and the Eastern Track should be provided, if this is not possible to provide sufficient facilities then trains would have to continue to Or Akiva, see paragraph 7.3.8.

New stations are envisaged on the local tracks at Netanya College, Netanya Sapir, Shfayim, Glilot North and Glilot South. It is envisaged that platform faces should be provided at all stations, if space permits, but are needed at Netanya Merkaz.

7.4.2 Eastern Track

The Eastern Track will be restored as a two track railway from Kfar Sava to Hadera North, carrying up to 6 tph and 1 to 2 freights trains per hour. Stations will be provided at Kfar Sava East, Tira, Taybe, Ahituv and Hadera East, the stations will have side platforms and at all except Tira and Hadera East loops will be provided to accommodate freight trains. A new freight terminal will be provided at Hadera North, Hadera East (grain) and Eyal, or alternative location.

The Eastern Track will be extended to link to the HaEmek Track with a new station at Harish with two island platforms with 4 faces. Two operational stations will be provided to allow freight trains to put aside into loops for other freight trains to pass.

From Kfar Sava to Rosh Haayin the number of passenger trains using the Eastern Track increases considerably to up 10 tph and it will require to be widened to 4 tracks with additional platforms provided at Rosh Haayin North and South stations.

From Rosh Haayin South to Lod the railway is widened to 2 tracks and new stations constructed at Elad, Teufa and Lod Center. Each station, except Teufa, will have side platforms at Teufa two island platforms will be provided to accommodate terminating trains. A freight terminal is provided at Tirat Yehuda.

South of Teufa station interchanges will be provided between the Eastern Track and Lod Bypass and the Jerusalem Railway towards BG Air Port.

7.4.3 Tel Aviv (Ayalon Corridor)

At the end of Phase A it was determined that a new two track tunnel would be required to carry the National Services as described in paragraph 7.2.4 above. Two options were identified for the local services, retaining the existing 3 track layout or widening the layout to 4 tracks. The further work carried out in Phase B has determined that by 2040 it would be necessary for there to be four local tracks to carry up to 23 tph in addition to the two tunnel tracks for national services.

The recommended layout is that two tracks on the eastern side will carry trains from the Sharon Valley to the Ayalon South using the existing flyover interchange at HaHagana to cross to the west side of the Ayalon, two tracks from would be required from Ganot carrying local trains from Lod and BG Air Port.

An additional station would be constructed at Ytzhak Sade between HaHagana and HaShalom stations, subject to sufficient space being available. In normal operation during peak periods it is envisaged that trains would not cross between the eastern and western pairs of tracks to avoid conflicting movements reducing the capacity of the railway. To the north of University stations as the number of trains reduces trains could cross between the track pairs.

Within the Ayalon Corridor between University and HaHagana stations there would remain some capcity in 2040 on the four at-grade tracks however, the utilization of this capacity would be constrained by the capacity of other parts of the network. In particular. The junction to the north of University station restricts any additional capcity on the eastern pair of tracks, unless a grade separated interchange was to be provided here. Some spare capcity exists in the western pair of at-grade tracks from Lod towards Herzliya but the need for some trains to cross to the eastern tracks and then to Ra'anana limits that capacity.

The size of the passenger facilities at each of the existing stations will need to be expanded to deal with increased number of passengers using these stations. In addition it is proposed to increase the number of platform faces at Savidor Merkaz to 8, providing a pair of faces for each of the 4 tracks. This will allow services to be regulated without a reduction in capacity.

7.4.4 Ayalon South

The route will have to carry up to 13 tph. No changes are proposed to the layout of the Ayalon South between HaHagana and Pleshet Junction.

7.4.5 Lod

The number of trains passing through Lod will increase by 2040 with up to 12 tph using the station. There will be more conflicting movements but these should be able to be accommodated with switches. Two trains from Be'er Sheva will terminate and this will increase the number of platform faces required and it is suggested that a new island platform is constructed to accommodate these.

7.4.6 Ashdod to Ashkelon

The growth of demand from Ashkelon and Ashdod results in a considerable increase in the number of trains operating between Pleshet and Ashkelon to up to 16 tph; this requires this section to be widened to 4 tracks. A new station is proposed for Bnei Darom and a new depot to the south of the existing Ashkelon station. The existing station at Ashkelon would not be large enough to accommodate all of the trains that would layover at this location. It is proposed that two stations are provided at Ashkelon this could reduce the number of trains terminate at each station. However a large station would still be required at the southern station and to reduce the size of this station trains could layover in the depot at Ashkelon.

7.4.7 Route 431

The two track railway along Road #431 from Moshe Dayan to Modi'in will not require to be widened, however, new connections will be required to allow trains from Rehovot to join it and travel in the direction of Modi'in. A new station at Gezer will be constructed this will have two platform faces on the Road #431 and two on the railway from Lod Bypass to the Jerusalem Railway. An alternative of linking the Road #431 to the railway from Lod Bypass to the Jerusalem Railway should be considered.

7.4.8 Pleshet to Lod

To provide a link from Ashdod Port to the main freight axis from the South to Haifa a two track railway from Pleshet to Soreq should be constructed, this will remove the need for 3 freight trains per hour to use the busy railway through Rehovot and Lod or through Ashkelon where there would be insufficient capacity to accommodate freight traffic.

The railway will be linked to Lod Bypass to Be'er Sheva railway near Soreq with north and south facing connections and also to the railway to Bet Shemesh. No passenger service is envisaged over this route. It is proposed by Israel Railways to add connections to the Ayalon South and towards Ashkelon, neither of these routes is required for the 2040 Strategy, however, the link to Ayalon South would provide a very useful facility in the event of disruption to services on routes between Tel Aviv and Soreq.

7.4.9 Na'an – Bet Shemesh - Malha

There is forecast to be a strong demand from Bet Shemesh towards Tel Aviv and to accommodate this a service of 4 trains per hour would be required, this requires the existing single track to be doubled. There is also forecast to be strong demand from Bet Shemesh to Malha and this would require some improvements to the railway to be made to provide a regular clock face interval service of 2 trains per hour, an interval service of 40 minutes should be possible utilizing both loops. However, other transportation solutions are being considered for linking Bet Shemesh to Jerusalem that could affect the demand on the railway.

7.5 South Area

Most of the required major improvements in the south for the Base Network are described in paragraph 7.2.8.

7.5.1 Heletz Railway

Israel railways propose to double the existing single track Heletz Railway between Ashkelon and Kiryat Gat, this widening is not required to support the 2040 Strategy, but could be required to support the geopolitical railway from Erez to Tarkumia, see Section 7.5.2 below. The railway could be used by freight trains from Ashdod to Be'er Sheva, in the Strategy these trains are assumed to use the Pleshet to Lod railway, this avoids the trains having to pass along the heavily used railway between Pleshet and Ashkelon. This railway does provide an alternative route in the event of disruption to services between Pleshet and Kiryat Gat which has less steep gradients than the route through Netivot. The requirement for widening the Heletz railway should be determined when demand has been assessed for the geopolitical line from Erez to Tarkumia.

7.5.2 Line from Erez to Tarkumia

This route is not included in the Base 2040 Strategy, but could be included as a geopolitical line from Gaza to Tarkumia in the PNA, see Section 4.3. The form of this link should be determined when demand has been assessed. The route would be constructed as a branch for Erez to Yad Mordechai and the Heletz Railway and from Kiryat Gat to Tarkumia. It may also include widening of the Heletz Railway, see Section 7.5.1 above.

7.5.3 Be'er Sheva Bypass

To remove freight traffic from Be'er Sheva it is proposed to construct a twin track railway to allow trains from Kiryat Gat to Dimona and Ramat Hovav to avoid passing through Beer Sheva, this would be of considerable benefit in reducing conflicts between different types of service at Be'er Sheva University.

It is expected that by 2040 this route would be used by 3 trains per hour as far the connection to Dimona but with only 3 trains a day continuing towards Ramat Hovav. It is considered that consideration should be given to reducing the continuation to Ramat Hovav as a single track with provision to widen to two tracks. The widening could be required if the geopolitical link to the Egypt was constructed and freight demand increased.

7.5.4 Be'er Sheva to Zomet HaNegev

This route is not included in the 2040 Strategy for passengers, see Section 4.2, Freight traffic for Ramat Hovav would utilize the Be'er Sheva Bypass but the existing route would be retained for use in the event of disruption and for possible access to Be'er Sheva depot. The route would also form part of geopolitical route to Egypt at the Nitzana border crossing and this may require access to Be'er Sheva. The form of this link should be determined when demand from Nitzana has been assessed.

7.5.5 Line to Arad

This route is included in the C81 2040 Strategy Extended Network to provide a link to the Periphery, see Section 4.1. Up to 2 trains per hour could be expected and it is suggested that this Branch is constructed as a single track railway with passing loops at each of the intermediate stations Arara and Ksaife. Each station would have an island platform or two side platforms.

7.5.6 Line to Yerucham

This route is included in the C81 2040 Strategy Extended Network to provide a link to the Periphery, see Section 4.1. One passenger train per hour and an occasional freight train could be expected and it is suggested that this Branch is constructed as a single track railway. The station at Yerucham would have an island platform or two side platforms and a small freight terminal to handle containers.

7.5.7 Line to Tsefa and Tamar

The present route from Mamshit to Tsefa is single track, by 2040 this will be joined by the line from the new quarry at Tamar and it is expected that 2 trains per hour could be expected from these sites. It is recommended that the railway is widened to two tracks from Tsefa to Mamshit and two tracks provided to Tamar. The single track connection to Zin would be adequate.

7.5.8 Line to Zin and Hazeva

The present route from Mamshit to Zin is single track, this branch will be extended to Hazeva to provide the freight route to Eilat and it is expected that 1 to 2 trains per hour could be using this route. It is recommended that the railway is widened to two tracks from Mamshit to Zin and two tracks provided to Hazeva.

7.5.9 Line to Hazeva to Dead Sea Works

It is expected that up to 7 trains per day would be operated from the Dead Sea Works. It is suggested that a single track railway should be sufficient for the volume of traffic expected. To provide flexibility in timetabling it is suggested that an operational station with a long passing loop is provided.

7.6 Signaling Enhancement

The number of trains operating on many lines will have substantially increased by 2040 and short headways between trains will be needed and in many areas of Israel are not supported by the present signaling arrangements. Therefore, in addition to the improvements outlined above it will be necessary to enhance the signaling systems to provide the required short headways.

7.7 Platform Lengthening

Some platform faces on the network are shorter than the length of train that is now envisaged in the 2040 Strategy to meet the forecast demand. The 2040 Strategy envisages that platforms will be at least 350 m long.

7.8 Electrification

It is assumed that all lines, except that between Bet Shemesh and Malha, will be electrified and the cost of the additional electrification required has been included in the cost estimates in Chapter 10.

At present Israel Railways has a fleet of modern diesel locomotives many of which would be expected to remain in service after 2040. Therefore it is likely that as passenger trains change over to electrical haulage the surplus diesel locos will be used on freight services unless this is prevented by other considerations, such as long tunnels on the route. When all available diesel locos have been used or when the locos reach the end of their economic life they would be replaced by electric locos, although there may remain a need for some diesel locos to be retained. The timing of the change form diesel to electric traction for freight services will depend on the actual growth of freight traffic, the performance of the diesel locos when hauling longer and heavier trains and the economic case for buying new electric or diesel locos.

Many of the routes used by freight services will be electrified to handle passenger services but some lengths of the network will only have freight services and it could be considered that these sections should not be electrified initially and these routes worked by diesel locos. The trains could change to electric haulage at a convenient location if necessary. This decision would be dependent on the relative economics of diesel and electric haulage together with costs of changing motive power.

7.9 Service Line Terminals

The increase in the number of trains operating will require the capacity of some terminals to be increased to handle the number of trains that terminate. It is assumed. To determine the Operational Layouts the capacity at each terminal has been estimated using a set of assumptions for the C81 2040 Strategy Extended Network:

- Layover - 1/6th of the sum of inbound and outbound Journey times or minimum of 20 minutes
- Evenly distributed arrivals and departures
- Platform re-occupation after train departs – minimum 5 minutes local services, 10 minutes national services.

Detailed assessment of the required layout at each terminal will be necessary as the 2040 Strategy is developed in more detail and the chosen service line and their frequencies determined. In some cases it may not prove to be practical to provide the required capacity and amendments will be required to the choice of terminal for the service line.

In some case it may be possible for two service lines to be combined to reduce the number of trains terminating, for example at Ashqelon where service lines 106 and 206 could be combined. The time required for layovers at terminals should also be reviewed in the light of experience and best practice, accepting that reducing layover time may reduce the overall performance of the service, but with high frequency services on some parts of the network the effect on passengers will be reduced.

Station	National Service Lines	TPH	Average Layover	Local Service Lines	TPH	Average Layover	Terminating Services	Through Services (TPH)	Platforms /sidings required
Kiryat Shmona				302A	1	35	1		2 platforms
Karmiel	2B	2	40	302B, 304	4	20	6	1	4 platforms + 2 sidings
Nahariya	1A, 2A	2	45	301	2	30	4		3 + 1 siding
Beit Shean				303A	1	20	1		2 platforms
Tveria				303B	1	25	1		2 platforms
Afula				303C	1	20	1	2	3 platforms
Lev HaMifratz	1B, 2C, 5	6	55					8	4 platforms + 6 sidings. Note *
Hof HaCarmel (National)	1C, 2D	2	38					10	3 platforms + 2 sidings. Note *
Hof HaCarmel (Local) / Hahotrim				302, 303, 303	8	25	8	2	3 platforms + 3 sidings. Notes *▵
Zihron Yaakov / Or Akiva				201, 203	6	40	6	2	4 sidings + 4 platforms. Note ▵
Notes:	*	See also Sections 5.1.3 and 7.2.2							
	▵	See also Section 7.3.8							
	¶	See also Section 7.4.1							

Table 7.1 Terminal Requirements – North - C81.

Station	National Service Lines	TPH	Average Layover	Local Service Lines	TPH	Average Layover	Terminating Services	Through Services (TPH)	Platforms /sidings required
Harish				205	3	40	1	1.5 (freight)	4 platforms
Hadera West (National)	4	2	25				2	12	2 platforms
Hadera West / Kfar Vitkin				207, 301	5	40	5	6	4 platforms + 2 sidings. Note *
Netanya Merkaz				202A, 208	5	41	6		4 platforms + 3 sidings
Tveria				303B	1	25	1		2 platforms
Herzliya				202B	2	35	15		6 platforms + 2 sidings
Rosh HaAyin				204	4	35	1	6 + 2 (freight)	5 platforms
Teufa				206	3	40	1	3 + 2 (freight)	4 platforms
Modi'in				101, 201, 206	8	20	8		4 platforms
Lod				103	2	25	2	10	6 platforms
Bet Shemesh				202A, 202B, 2002J	5-6	30	5-6		3 platforms + 2 sidings
Ashdod				207	3	35	3	15	4 platforms + 2 sidings
Notes:	*	**See also Section 7.4.1**							

Table 7.2 Terminal Requirements – Center - C81.

Station	National Service Lines	TPH	Average Layover	Local Service Lines	TPH	Average Layover	Terminating Services	Through Services (TPH)	Platforms /sidings required
Jerusalem	2, 3, 4	11	30	101	2	20	13		8 platforms. Note ▵
Ashkelon (North)				106	3	20	3	15	4 platforms + 2 sidings
Ashkelon (South) and Depot				203, 204, 205, 208, 209	15	40	15	3	4 platforms + 8 sidings
Be'er Sheva	1,3	6	40	103, 104, 105, 106	8	20	14		8 platforms
Arad				104	2	20	2		2 platforms
Yerucham				105	1	20	1		2 platforms
Eilat	5	1	80				1		2 platforms
Notes:	▵	**See also Section 6.2.1 and 7.2.6**							

Table 7.3 Terminal Requirements – South and Jerusalem - C81.

7.10 Operational Layouts

Operational Layouts for the routes have been prepared for the 2040 Strategic Plan and these are contained in Appendix G.

8. ROLLING STOCK REQUIRED

8.1 Types of Passenger Rolling Stock

8.1.1 National Services

Typical trains that operate most high speed services have a single deck layout, have premium seating areas with lower density, catering and other areas that do not provide passenger seating, this reduces the passenger density, expressed as passengers per meter of train. The type of train required for most National Services is unusual because many journeys will be relatively short because the metropolitan areas are close together, unlike most high speed services that operate in other countries where distances are much greater.

The typical characteristics of a high speed inter urban train are shown below:

Characteristic	Realization in typical Inter-urban Train
Capacity Arrangement	The Inter-urban train is expected to carry all passengers in seats, since long travel times are usual. Some railway operators offer various classes of seating and services which reduces the capacity of the train. There is limited space for standing passengers in the entry area or in the gangways, some operators provide fold down seats in the vestibule areas.
Interiors	The interior is designed for long travel distances. A high number of seats is placed to provide maximum seating capacity. Optimizations regarding the design of the interiors so as achieve short times for boarding and alighting are not considered. The Inter-urban train generally provides more comfort and is equipped with several toilets.
Doors and Vestibule	The interior layout is optimized for maximum passenger comfort (i.e. for a maximum number of seats). Therefore doors are not as wide as in other trains and vestibules are less generous. The doors and the entry are not optimized to arrange a fast boarding and alighting of passengers. The doors are less wide than the doors of other rolling stock. The entry area is relatively narrow and does not provide much space or seating capacity.
Dwell Times	The dwell times of an inter-urban train are longer than the dwell times of other trains. The journey time being mainly influenced by top speed.
Inter-Car-Gangways	Cars of an inter-urban trains are connected by narrow gangways and divided by one or more doors. A flow of passengers from one car to another is possible but it is limited by the narrow gangway and the inter-car-gangway doors. These characteristics affect the time for boarding and alighting and the passenger distribution over the train.
Top Speed	The Inter-urban train is characterized a higher top speed than the other rolling stock.
Acceleration / Deceleration	Acceleration and deceleration levels are lower than acceleration / deceleration levels of other passenger trains, since longer distances exist between stops and the overall journey time is mainly influenced by top speed less than by the acceleration and deceleration levels.
Frequency of Trains	The number of trains per hour between stations is generally low.

Table 8.1 – Typical Characteristics of High Speed Trains

Figure 8.1 – Typical High Speed Inter Urban Train - Siemens Valero

The National Routes in Israel are unusual for a typical inter urban train because they are characterized by an intensive service between Haifa and Tel Aviv and between Tel Aviv and Jerusalem and Be'er Sheva. Journeys are generally short, most are less than 45 minutes, but can be as short as 20 and as long as 220 minutes, this requires that seats are provided for every passenger.

To reduce the number of trains that are required to operate on the sections of the network with the highest forecast demand the trains need to carry a large number of passengers within the constraint of the maximum platform length that will be available. To satisfy this demand each train will be required to carry at least 1,200 during an average peak hour and this requires a frequency of between 6 and 14 trains per hour during peak periods.

Another unusual feature will be the need for short dwell times, this is because of the intensive service that is envisaged and limited number of platforms that can be provided in the center of the metropolitan areas without incurring considerable additional capital expenditure.

The trains will be required to combine the characteristics of a high maximum speed, assumed to be 250 km/h with many of the characteristics of a suburban train, yet recognizing that not all passengers will be making short journeys. This results in the following basic requirements for these trains:

- Higher maximum speed, 250 km/h;
- High acceleration and braking rates, to ensure close headways;
- Electrically hauled;
- Designed for maximum seating capacity with high seating density – at least 3.7 passengers per m of train length (pax/m);
- Trains will be single class and without additional facilities, such as catering;
- Wide doors to reduce dwell times.

Few high speed trains are in service that would provide the required high seating density; this can only be provided by using double deck trains. Most double deck high speed trains in service are limited to 200 km/h with only two types have maximum speed greater than this, these are TGV Duplex (320 km/h) France and E4 Shinkansen Japan (240 km/h). The TGV Duplex was introduced to cope with increased demand on routes running at minimum headways. The E4 Shinkansen was designed to accommodate additional commuter traffic around Tokyo.

Figure 8.2 – TGV Alstom EuroDuplex

There are many examples of double deck high speed trains with a 200 km/h maximum speed, with a passenger density of over 4 pax/m in a single class layout, include:

- Bombardier, Twindexx Express;
- Bombardier Omneo;
- Alstom Coradia Duplex.

Considering the number of trains that Israel Railways will require would probably encourage manufacturers to develop enhancements to these trains to meet the higher maximum speed requirement.

Figure 8.3 – Double Deck High Speed Inter Urban Trains - Bombardier, Twindexx Express - Bombardier Omneo - Alstom Coradia Duplex

Figure 8.4 – Interior of Bombardier Twindexx Express

8.1.2 Local Services

As with most of the National Services many of the local services are intensive with a forecast of high passenger demand. To reduce the number of trains that are required to operate on the sections of the network with the highest forecast demand the trains need to carry a large number of passengers within the constraint of the maximum platform length that will be available. To satisfy this demand each train will be required to carry at least 1,200 during an average peak hour with a frequency of up to 13 trains per hour.

As with most local trains there is a need for short dwell times, this is because of the intensive service that is envisaged and limited numbers of platform that can be provided in the center of the metropolitan areas without incurring considerable additional capital expenditure. Many of the journeys made on local trains by 2040 will be of a duration that requires seats to be available for most passengers, but provision for standing passengers for shorter journeys is also required. These trains require both wide doorways and vestibule areas to ensure free flows of passengers and areas for passengers to stand.

Stations served by local train services are both closely spaced in some parts of the network in intensively developed areas whereas in other parts there is considerable distance between stations, the spacing being as little as 1 km and to over 30 km. This requires local trains to have both high acceleration and deceleration levels and a maximum speed of 160 km/h.

The typical characteristics of a local train are shown below:

Characteristic	Realization in Local Train
Acceleration / Deceleration	Acceleration and deceleration level are high, but not as high metro trains since station distances and therefore travel distances are longer. A short travel time is more affected by the maximum speed.
Top Speed	Local trains need to have a higher speed than metro trains due to the fact that a higher maximum speed to shorten journey times.
Dwell Times	The dwell times should be minimized by the design of the doors, vestibules, interior layout.
Doors and Vestibules	Wide Doors are important to realize short passenger boarding and alighting times as well. Therefore the overall dwell time will be reduced significantly. Suburban rolling stock is typically designed with 4 doors per car. Apart from wide doors, the entry is focused on a good passenger flow. This requires large vestibules and (in the case of double deck coaches) large stairs.
Floor height	Ideally the floor height of the entrance shall allow level boarding and alighting to speed boarding and alighting.
Interiors	The interior of a Local train is designed to ensure good passenger flow and at the same time on certain comfort level. These trains also provide space for standing passengers. Local trains will need to be equipped with toilets.
Inter-Car-Gangways	Adjoining cars of a unit must be connected with each other and provide a passenger flow between the cars to enable passengers to pass from one car to another. Wide inter-car gangways without doors ensure a good passenger flow between the cars to encourage an even distribution of passengers along the train.
Capacity Arrangement	The quantity of seats remains high because of the longer journey time but with more space for standing passengers.

Table 8.2 – Characteristics Required for Local Trains

Examples of suitable rolling stock that is currently being produced include:

- Bombardier, Twindexx
- Alstom Coradia Duplex
- Stadlter Kiss
- Bombardier Omneo

Figure 8.5– Double Deck Local Trains - Bombardier, Twindexx - Stadtler Kiss - Alstom Coradia Duplex --- Bombardier Omneo

It is envisaged that much of the existing Bombardier and Siemens rolling stock will remain in service in 2040 and this can be utilized on many of the local services, particularly on parts of the network where forecast demand is lower and frequencies are lower.

It is assumed that most local trains will be electrically powered, either an electric loco and coaches or an electric multiple unit. It is assumed that the railway between Bet Shemesh and Jerusalem Malha will remain diesel powered because of its environmentally sensitive location.

8.2 Scale of Passenger Rolling Stock Required - Recommended Network

An estimate of the number of trains that will be required to operate the service in 2040 has been prepared. This is based on Alternative 8.1 the services that are assumed are illustrated in each sub-section below. The following assumptions have been made in the estimates:

- Turnaround time is the sum of the inbound journey and outbound journey times divided by 6, subject to a minimum of 20 minutes;
- An average value is used to calculate the number of trains required for a route, actual turnaround at some stations will be standardized to minimize the facilities required, and any lost recovery time would be applied at the next turnaround.
- Local routes operating in one metropolitan area are not joined to routes operating in another;
- Availability of electrically hauled rolling stock is 90%;
- Availability of diesel rolling stock is 85%;
- An operational reserve of 5% of the number of trains required for services is maintained to cover heavy maintenance, refurbishment, collision repairs and special events;
- Any new rolling stock will be composed of multiple units;
- Passenger services will be operated by electric trains.

8.3 National Services – C81

The network and frequency of national routes is illustrated in figure 8.6.

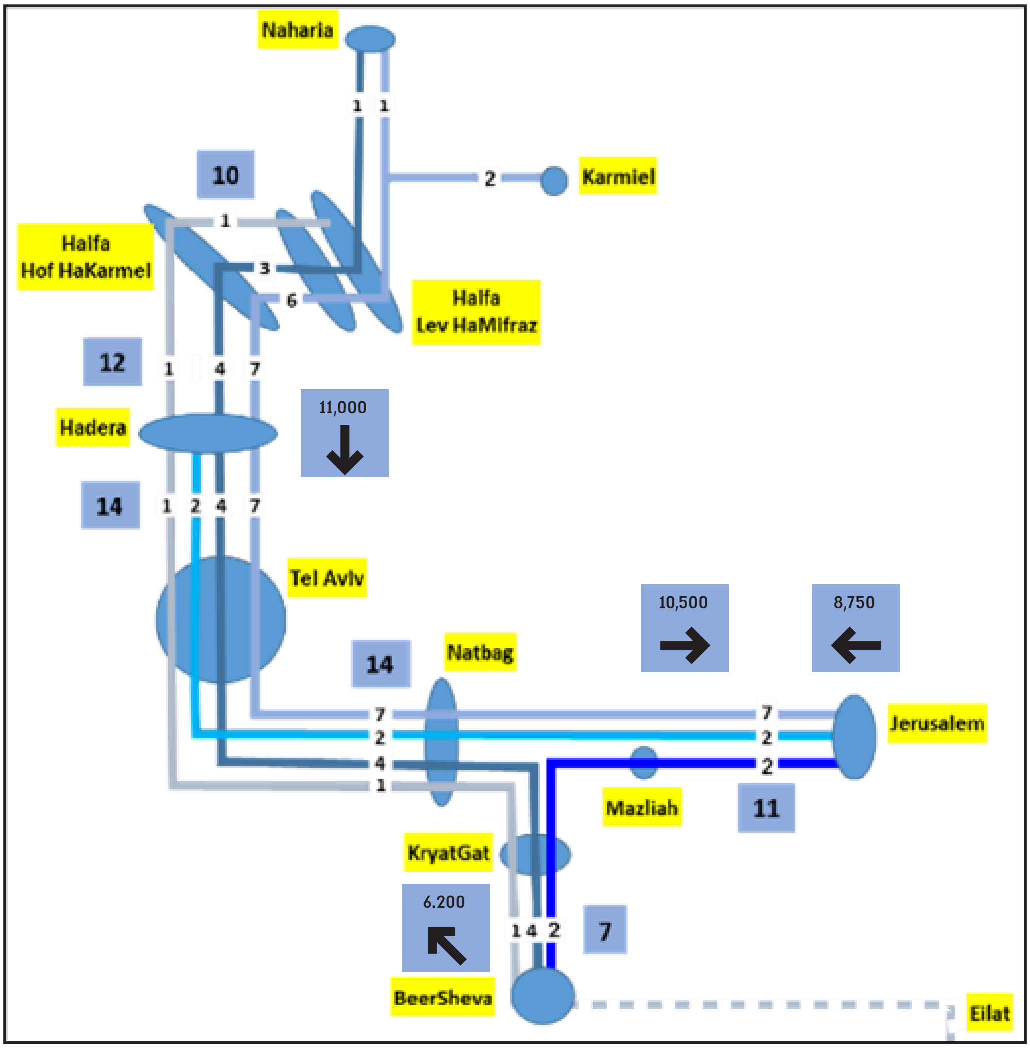


Figure 8.6 – National Service Lines – Alternative C81

It is estimated that a total of 79 trains will be required each weekday to operate all of the National Routes, Alt C81, the number required for each route is set out in Table 8.3.

The minimum passenger capacity of many of the trains during the peak hours is about 1,200 seats on those lines between Tel Aviv and Jerusalem, which is about the maximum practical capacity of a trains within the network constraints.

On routes that do not operate between Tel Aviv and Jerusalem it may be possible to operate with smaller trains. To ensure operational flexibility smaller trains should be capable of being combined to make a full size trains but the more units comprising a train reduces the capacity of the train and increase capital and running costs, however operating with smaller units allows trains to be increased in size as demand grows.

Assuming that a full length train is composed of 12 cars these trains could be either divided into two units of 6 cars or three units of 4 cars. By 2040 all National Services during peak hours, except between Jerusalem and Be'er Sheva (Line # 3) would be required to be operated with 12 cars. Line # 3 only requires 4 car trains, using a 4 car trains for this service would reduce the total number of cars by 4%; therefore a 6 car consist will be assumed.

Line Number	From	To	Trains Per Hour	Journey Time	Average Layover Allowance	Trains Required	Units/train	Units Required
1A	Nahariya	Be'er Sheva Center	1	130	45	6	2	12
1B	Lev HaMifratz	Be'er Sheva Center	2	110	40	10	2	20
1C	Hof HaCarmel	Be'er Sheva Center	1	110	40	5	2	10
2A	Nahariya	Jerusalem Center	1	115	40	6	2	12
2B	Karmiel	Jerusalem Center	2	120	40	11	2	22
2C	Lev HaMifratz	Jerusalem Center	3	95	35	13	2	26
2D	Hof HaCarmel	Jerusalem Center	1	95	35	5	2	10
3	Be'er Sheva Center	Jerusalem Center	2	65	25	6	1	6
4	Hadera	Jerusalem Center	2	65	25	6	2	12
5	Lev HaMifratz	Eilat	1	235	80	11	2	22
Daily Requirement						79		152
Maintenance reserve								15
Total Required								167

Table 8.3 – Number of National Trains required by route

If the network was not extended to Eilat, Alternative C82, it is estimated that 5 fewer trains would be required, reducing the total number of units required to 155.

There are a number of possible scenarios for the off peak periods, this will depend on the level of demand and practical considerations regarding splitting trains and storing trains during the day. However, it is expected that the frequency of trains would be reduced on those sections of the network that have a very high frequency during the peak period, but the number of cars would probably remain unchanged.

It could be expected that the frequency of the services operating on the following sections of the network would be reduced:

- Jerusalem to Tel Aviv
- Tel Aviv to Haifa
- Tel to Be'er Sheva.

The frequency would probably remain the same between

- Nahariya or Karmiel and Haifa
- Jerusalem and Be'er Sheva and
- Eilat and Be'er Sheva.

Trains would be taken out of service at the end of the peak periods and introduced again at the start of the evening peak at Haifa and Be'er Sheva where there are stabling facilities, this would also occur at Jerusalem and Tel Aviv where excess trains would be taken to the stabling facilities at Ragam.

8.4 Local Services

There are three basic networks of local services, these are in the Center based on Tel Aviv, the North based on Haifa and in the South based on Be'er Sheva. For this exercise it has been assumed that there is no inter-working of services between the three areas. Inter-working of services through the boundaries of the areas has benefits in reducing the requirement for turnaround facilities at the boundary and providing through services for passengers. However, it can increase the number of trains required where there is an imbalance in the demand either side of the boundary.

The requirement for each of three networks is considered in the following sub-sections to determine the number of trains required to operate the service during peak periods. These three requirements are then brought together Section 8.6 where the total requirement for Local Trains is considered. This includes the use of the existing Bombardier Double Deck trains and the Siemens Single Deck trains.

8.4.1 North

The Local Trains services that are assumed to be operated in the peak hours 2040 are shown on figure 8.7.

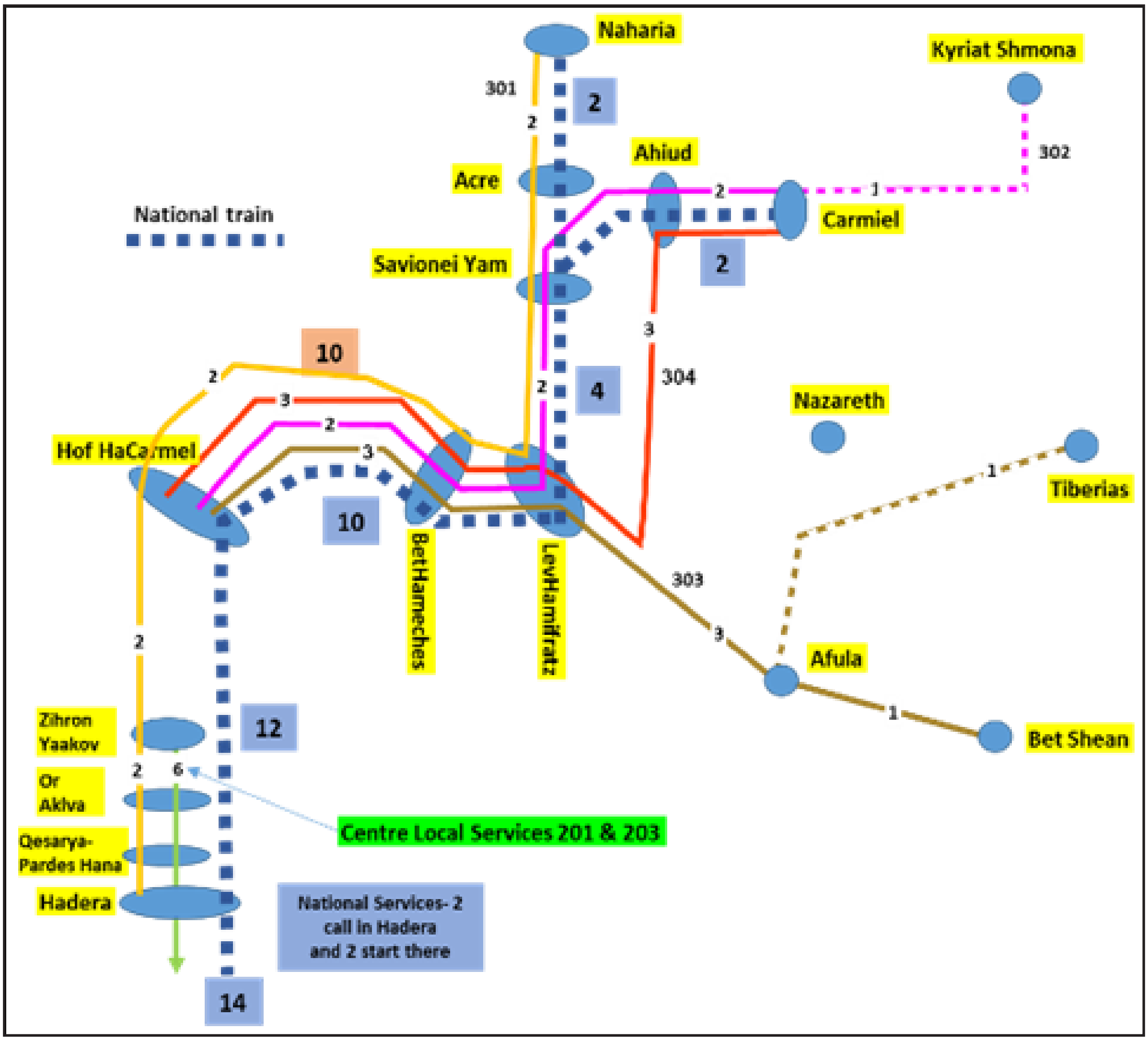


Figure 8.7 – Local Service Lines – North –
Alternative C81 is shown as solid and dotted line, Alternative C82 is shown as solid line only

To operate the Local Services in the North requires a total of 33 trains, the number required for each route is set out in Table 8.4.

Line Number	From	Via	To	Trains Per Hour	Journey Time	Average Layover Allowance	Trains Required
301	Nahariya		Hadera	2	80	30	8
302	Karmiel	Savionei Yam	H.HaCarmel	2	55	20	5
303B	Beit Shean		H.HaCarmel	1	60	20	3
303C	Afula		H.HaCarmel	2	45	20	5
304	Karmiel	Kyrat Ata	H.HaCarmel	3	55	20	8
Daily Requirement Base C82							**29**
301	Nahariya		Hadera	2	80	30	8
302A	K Shmona	Savionei Yam	H.HaCarmel	1	95	35	5
302B	Karmiel	Savionei Yam	H.HaCarmel	1	55	20	3
303A	Tiveria		H.HaCarmel	1	65	25	3
303B	Beit She'an		H.HaCarmel	1	60	20	3
303C	Afula		H.HaCarmel	1	45	20	3
304	Karmiel	Kyrat Ata	H.HaCarmel	3	55	20	8
Daily Requirement Inc. Peripheral Lines C81							**33**

Table 8.4 – Number of Local Trains required by route – North Area

8.4.2 Central Area

The Local Trains services that are assumed to be operated in the peak hours 2040 are shown on figure 8.8.

To operate the Local Services in the Central Area requires a total of 142 trains, the number required for each route is set out in Table 8.5.

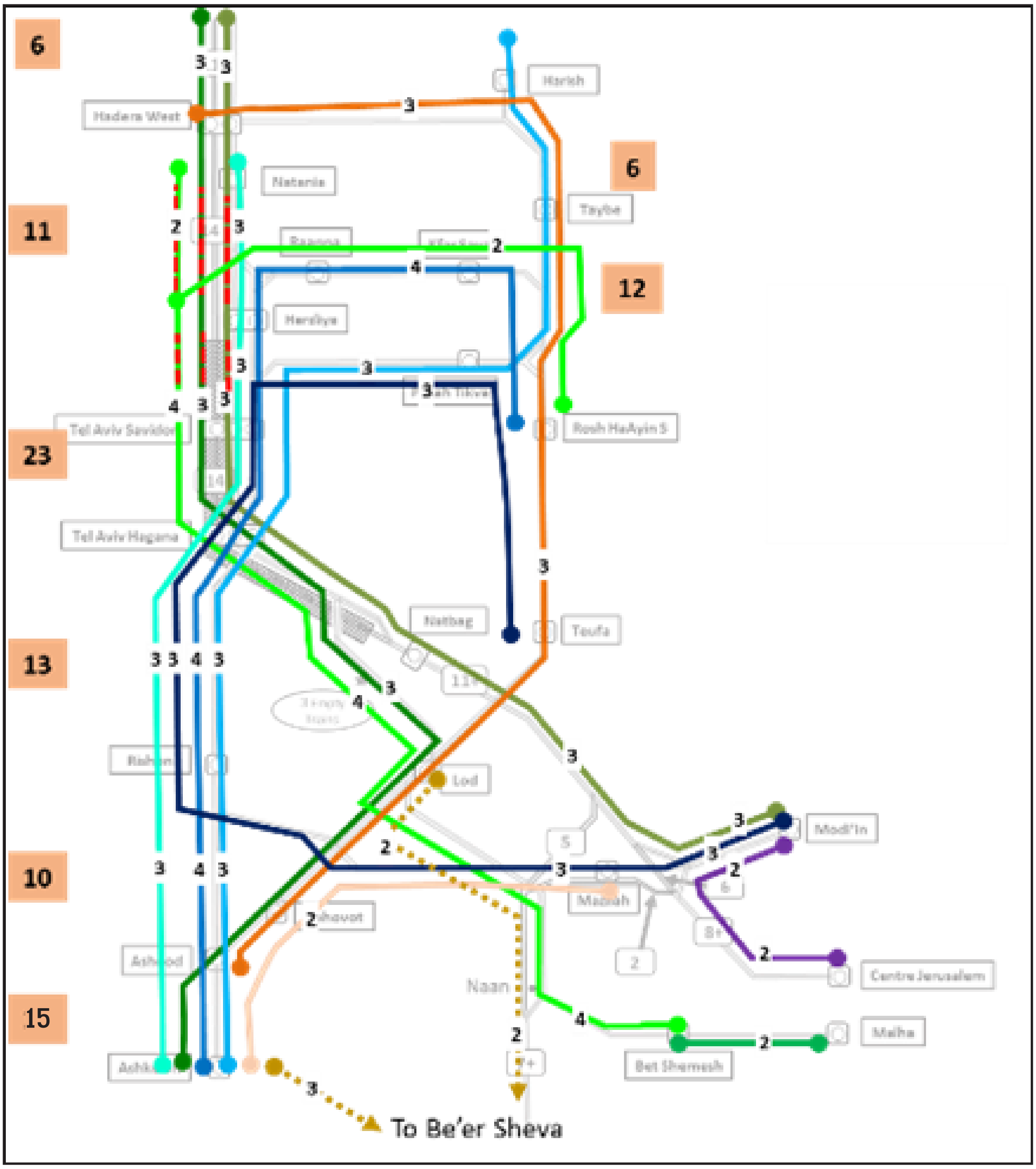


Figure 8.8 – Local Service Lines – Central Area – Alternative C81

Line Number	From	Via	To	Trains Per Hour	Journey Time	Average Layover Allowance	Trains Required
101	Jerusalem		Modi'in	2	30	20	4
201	Zihron Yaakov		Modi'in	3	105	35	14
202A	Netanya		Bet Shemesh	2	75	40	7
202B	Rosh Ha'Ayin South	Ra'anana	Bet Shemesh	2	95	35	9
202J	Bet Shemesh		Jerusalem Malha	1-2	45	20	5
203	Zihron Yaakov		Ashkelon	3	125	45	17
204	Rosh Ha'Ayin South	Ra'anana	Ashkelon	4	105	35	19
205	Harish	Bnei Brak	Ashkelon	3	120	40	16
206	Teufa	Bnei Brak	Modi'in	3	115	40	16
207	Hadera	Teufa	Ashdod	3	100	35	14
208	Netanya		Ashkelon	3	125	45	17
209	Gezer		Ashkelon	2	45	20	5
Daily Requirement							143

Table 8.5 – Number of Local Trains required by route - Central Area

8.4.3 South

The Local Trains services that are assumed to be operated in the peak hours 2040 are shown on figure 8.9.

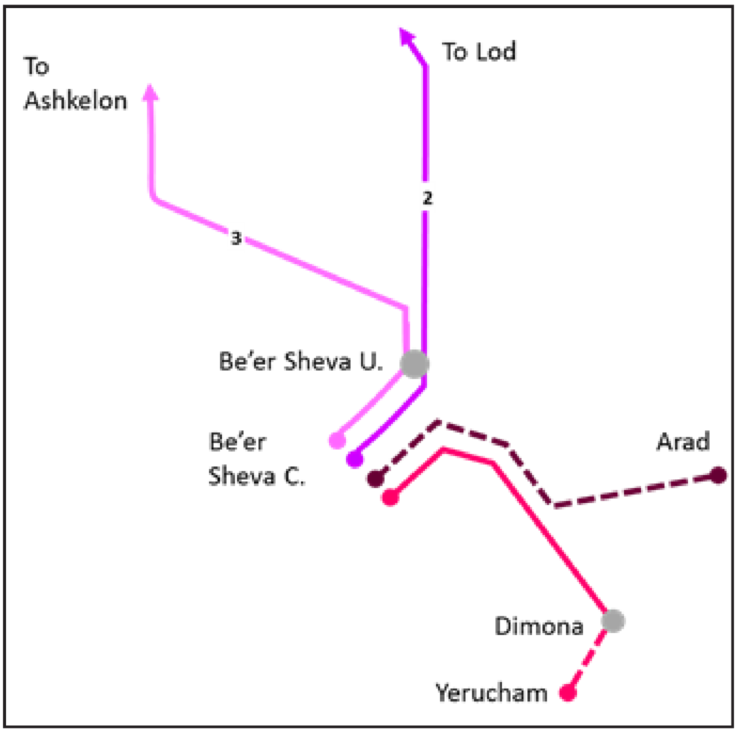


Figure 8.9 –Local Services – South Area –

Alternative C81 is shown as solid and dotted line, Alternative C82 is shown as solid line only

To operate the Local Services in the South requires a total of 21 trains, the number required for each route is set out in Table 8.6.

Line Number	From	Via	To	Trains Per Hour	Journey Time	Average Layover Allowance	Trains Required
103	Be'er Sheva Center		Lod	2	70	25	7
106	Be'er Sheva Center		Ashkelon	3	60	20	8
Daily Requirement Base C82							**15**
104	Be'er Sheva Center		Arad	2	35	20	4
105	Be'er Sheva Center		Yerucham	1	35	20	2
Daily Requirement Inc. Peripheral Lines C81							**21**

Table 8.6 – Number of Local Trains required by route - South Area

8.5 Existing Rolling Stock

Unlike the National Services that will require to be operated by entirely new rolling stock some of services could be operated by the rolling stock that is service at present. It is planned to convert the existing Bombardier double deck trains and the Siemens single deck trains to haulage by electric locomotives. This rolling stock will be between 25 and 38 years old by 2040 and although some will be approaching the end of its economic life by this time, it is assumed that will continue to be used. The existing fleet consists of:

Manufacturer	Driving Car	Trailer Car	Trailer Car (Handicapped)	Trailer Car Total
Siemens	14	79	24	103
Bombardier	65	239	63	302

Table 8.7 – Existing Rolling Stock likely to be available for deployment in 2040

The total number of trains required to operate the weekday peak hour services envisaged is 183 in the Base Case and 197 with the Peripheral routes included. Many of the services in the Central Area require trains with a minimum capacity of 1,200 seats, but other services require trains with a lower capacity. To ensure operational flexibility smaller trains should be capable of being combined to make a full size trains but the more units comprising a train reduces the capacity of the train and increase capital and running costs, however operating with smaller units allows trains to be increased in size as demand grows. A unit of 6 cars and capacity of 600 passengers has been assumed.

The existing Bombardier rolling stock has a seating density and capacity similar to that envisaged for the new rolling stock and ideally should be similarly divided, but if the offers the flexibility of being divided into smaller of larger trains. A 5 car double deck unit with Bombardier TRAXX loco would have a passenger capacity and length similar to that assumed for a 6 car multiple unit. However, this would not utilize all of the available trailer cars. It also would not utilize the full capabilities of the TRAXX locos that are capable of hauling up to 8 cars – a train of 7 trailers would be approximately equivalent to an 8 car EMU and could provide around 900 seats. It is suggested a combination of units are deployed.

The existing Siemens can be formed into 14 units of 8 or 9 cars. Trains of 9 car could be formed to utilize more of the existing rolling stock, these would have a capacity similar to a 6 car double deck EMU.

It is assumed that by 2040 the existing Alstom cars will have reached the end of life and will be replaced by the new double deck EMU rolling stock and that the IC3 Diesel Multiple Units (DMU) will have also reached the end of their economic lives. It is assumed that the IC3 units will have been replaced by a smaller number of units for those services that require such trains.

8.6 Local Trains Requirement – Base Case

A deployment is illustrated in Table 8.8, other deployments would be possible to suit particular allocations of types to depots. This shows the allocations of existing rolling stock to services and the requirements for the number of additional EMU units with the alternative of using 4 or 6 car unit length. Utilizing 4 car units would produce a potential saving of 2.6 % in the number of cars needed. Using 4 car units offers more flexibility and allows a closer match of supply to demand but may come at a higher cost because of the need for more driving cars and with some loss of train capacity. A compromise of using a mix of 4 and 6 car would be probably be the most practical solution.

Line Number	From	To	Trains Required	DD EMU or other Train Type	
				No of 6 car DDEMU	No of 4 car DDEMU
101	Modi'in	Jerusalem (M)	4	5 DDE	5 DDE
103	Be'er Sheva (M)	Lod	7	7 DDE	7 DDE
106	Be'er Sheva (M)	Ashkelon	8	5 DDE	5 DDE
201	Zihron Yaakov	Modi'in	14	28	42
202A	Netanya	Bet Shemesh	7	7 DDE	7 DDE
202B	Rosh Ha'Ayin South	Bet Shemesh	9	7 DDE	7 DDE
202J	Bet Shemesh	Jerusalem Malha	5	20 (3 car DMU)	20 (3 car DMU)
203	Zihron Yaakov	Ashkelon	17	34	51
204	Rosh Ha'Ayin South	Ashkelon	19	38	57
205	Harish	Ashkelon	16	32	48
206	Teufa	Modi'in	16	3 + 5 DDE	3 + 5 DDE
207	Hadera	Ashdod	14	14	14
208	Netanya	Ashkelon	17	34	51
209	Gezer	Ashkelon	5	5 DDE	5 DDE
301	Nahariya	Hadera	8	16	24
302A	Karmiel	H.HaCarmel	5	5	10
303B	Beit She'an	H.HaCarmel	3	6	6
303C	Afula	H.HaCarmel	5	9 SDE + 2	9 SDE + 4
304	Karmiel	H.HaCarmel	8	9 SDE	9 SDE
			187	212	310
Maintenance reserve				22	32
Total DDEMU				234	342
Total Cars				1,404	1,368

Table 8.8 – Assumed Deployment of Trains to local lines in 2040 Base Case

The number of units in each train would not be fixed during the off peak hours. There are two options, reduce the number of cars in a train or reduce the number of trains per hour that operate. With the local services there is scope to reduce the number of cars in a train. It would be expected that each station would have two trains per hour during the off-peak period and this would probably not require trains to be full size on many local lines.

8.7 Summary of Train Requirements – Base Case Alternative C82

The following is a summary of the trains that would be required to deliver the Israel Railways Strategic Development Plan 2040.

- New National Trains
  - 155 – 6 car units
- Additional Local Trains
  - 234 – 6 car EMU
- Existing Fleet –
  - 32 – 5 car DD trains,
  - 27 – 7 car DD trains,
  - 13 – 9 car SD trains,
  - 72 electric locos and
  - 25 DMU.

8.8 Local Trains Requirement – Periphery Option

A deployment is illustrated in Tables 8.9, other deployments would be possible to suit particular allocations of types to depots. This shows the allocations of existing rolling stock to services and the requirements for the number of additional EMU units with the alternative of using 4 or 6 car unit length. Utilizing 4 car units would produce a potential saving of 2.3 % in the number of cars needed. Using 4 car units offers more flexibility and allows a closer match of supply to demand but may come at a higher cost because of the need for more driving cars and with some loss of train capacity. A compromise of using a mix of 4 and 6 car would be probably be the most practical solution.

Line Number	From	To	Trains Required	DD EMU or other Train Type	
				No of 6 car DDEMU	No of 4 car DDEMU
101	Modi'in	Jerusalem (M)	4	5 DDE	5 DDE
103	Be'er Sheva (M)	Lod	7	7 DDE	7 DDE
104	Be'er Sheva Center	Arad	4	4	4
105	Be'er Sheva Center	Yerucham	2	2	2
106	Be'er Sheva (M)	Ashkelon	8	5 DDE	5 DDE
201	Zihron Yaakov	Modi'in	14	28	42
202A	Netanya	Bet Shemesh	7	7 DDE	7 DDE
202B	Rosh Ha'Ayin South	Bet Shemesh	9	7 DDE	7 DDE
202J	Bet Shemesh	Jerusalem Malha	5	20 (3 car DMU)	20 (3 car DMU)
203	Zihron Yaakov	Ashkelon	17	34	51
204	Rosh Ha'Ayin South	Ashkelon	19	38	57
205	Harish	Ashkelon	16	32	48
206	Teufa	Modi'in	16	3 + 5 DDE	3 + 5 DDE
207	Hadera	Ashdod	14	14	14
208	Netanya	Ashkelon	17	34	51
209	Gezer	Ashkelon	5	5 DDE	
301	Nahariya	Hadera	8	16	24
302A	Kiryat Shmona	H.HaCarmel	5	5	10
302B	Karmiel	H.HaCarmel	3	3	3
303A	Tiveria	H.HaCarmel	3	3	6

Line Number	From	To	Trains Required	DD EMU or other Train Type	
				No of 6 car DDEMU	No of 4 car DDEMU
303B	Beit She'an	H.HaCarmel	3	6	9
303C	Afula	H.HaCarmel	5	9 SDE + 2	9 SDE + 4
304	Karmiel	H.HaCarmel	8	9 SDE	9 SDE
			187	224	328
Maintenance reserve				23	34
Total DDEMU				247	362
Total Cars				1,482	1,448

Table 8.9 – Assumed Deployment of Trains to local lines in 2040 Periphery Option

8.9 National Trains Requirement with Service to Kiryat Shmona

In addition to the trains identified in Section 8.3 and 8.7, 3 additional trains would be required to operate a National Service beyond Karmiel. The trains operating beyond Karmiel could be composed of only 6 cars because of the lower demand, therefore reducing the number of trains needed, similarly the same situation could apply to services beyond Be'er Sheva to Eilat.

8.10 Summary of Train Requirements – Base with Periphery Alternative C81

The following is a summary of the trains that would be required to deliver the Israel Railways Strategic Development Plan 2040.

- New National Trains
  - 167 – 6 car units
- Additional Local Trains
  - 247 – 6 car EMU
- Existing Fleet –
  - 32 – 5 car DD trains,
  - 27 – 7 car DD trains,
  - 13 – 9 car SD trains,
  - 72 electric locos and
  - 25 DMU.

9. DEPOTS

Further work beyond the scope of this project is required to validate the assumptions that have been made about stabling and maintenance facilities at depots, together with an assessment of the size and shape of space available at each of the depot locations selected. This could identify the need for changes to the fleet distribution or the introduction of further depot or stabling locations.

9.1 Proposed Passenger Stabling Depot Locations

It is assumed that all trains will be stabled in depot or stabling facilities overnight. Depots providing stabling facilities for passenger trains are planned to be provided in the following locations:

- Haifa and Kishon (considered as one location);
- Ragam and Lod (considered as one location);
- Ashkelon;
- Be'er Sheva;
- Eliat.

These locations provide a reasonable coverage of the areas where the main passenger services of Israel Railways are envisaged to operate in 2040.

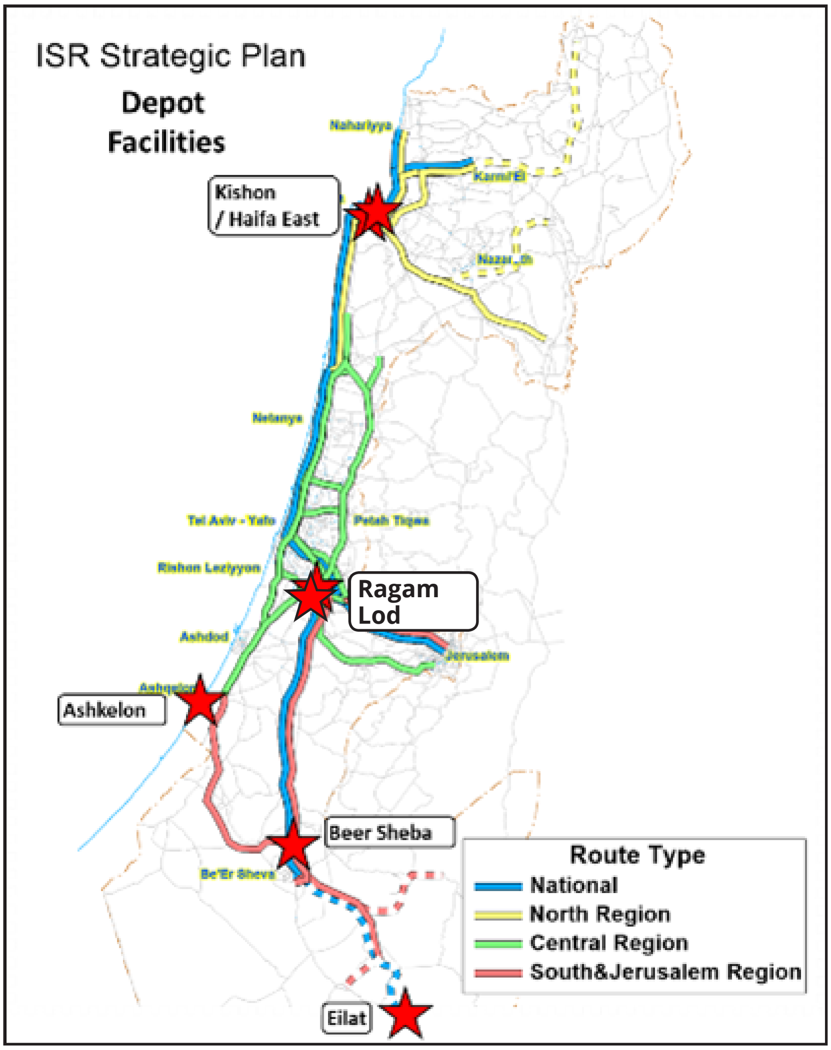


Figure 9.1– The Network and Depot Locations

The approximate distances from the depot locations to the route termini and the approximate number of trains that are required to be at that terminus to start the peak hours service are shown in the figures below.

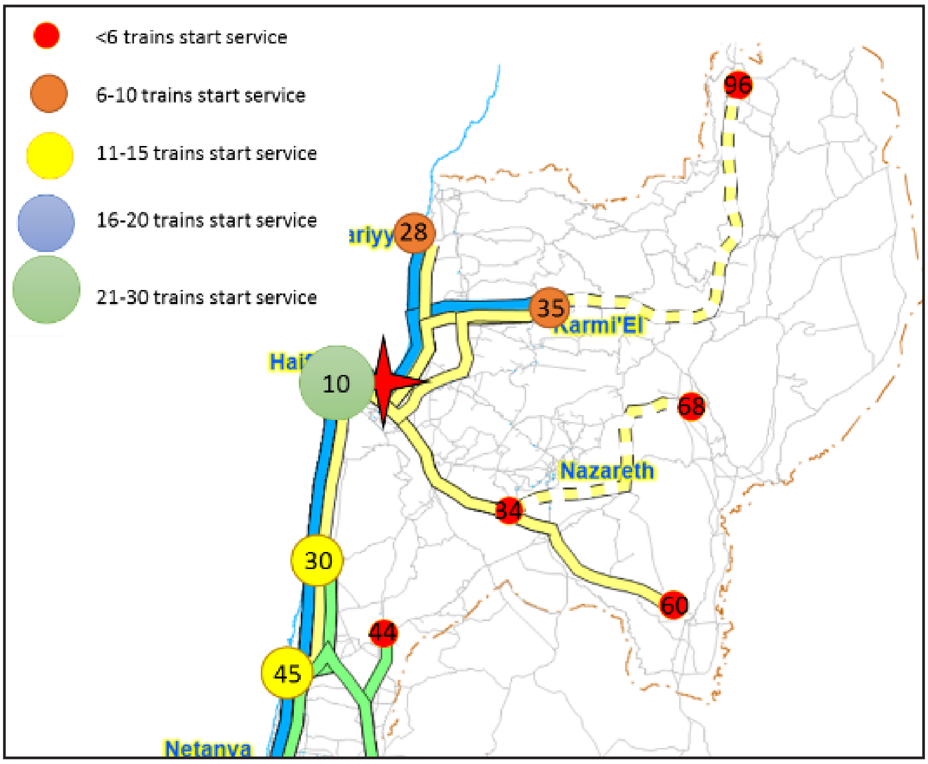


Figure 9.2 – Trains required at Termini and their Distances from Haifa East/Kishon

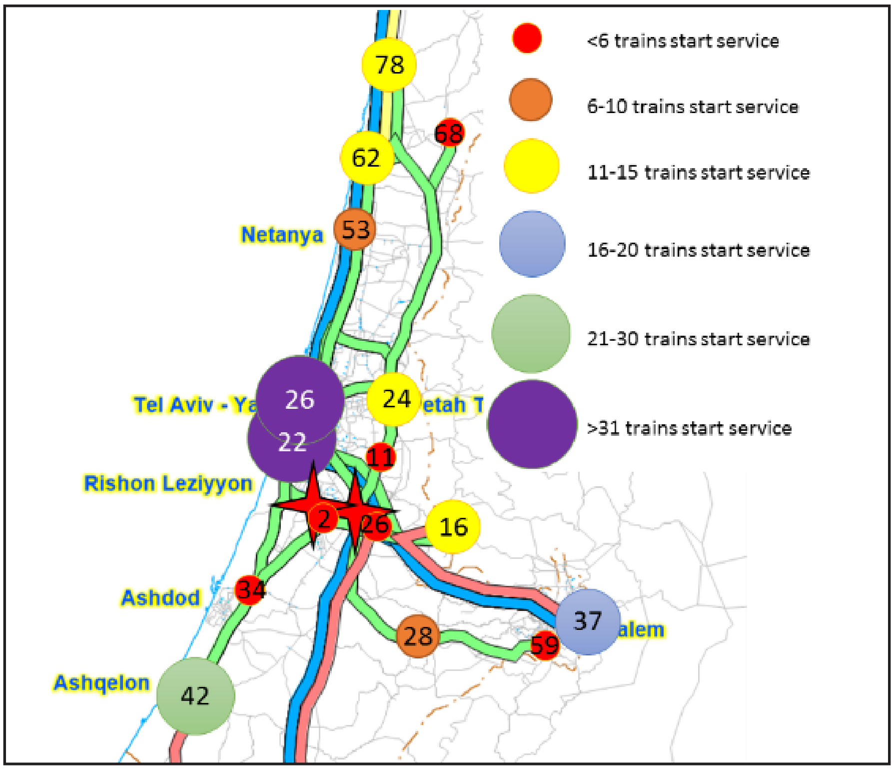


Figure 9.3– Trains required at Termini and their Distances from Ragam and Lod

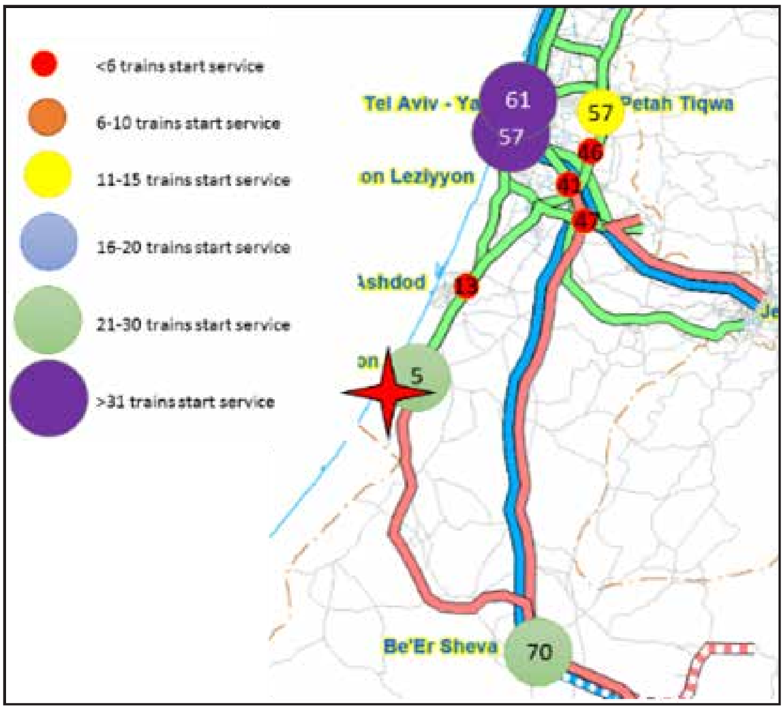


Figure 9.4 – Trains required at Termini and their Distances from Ashkelon

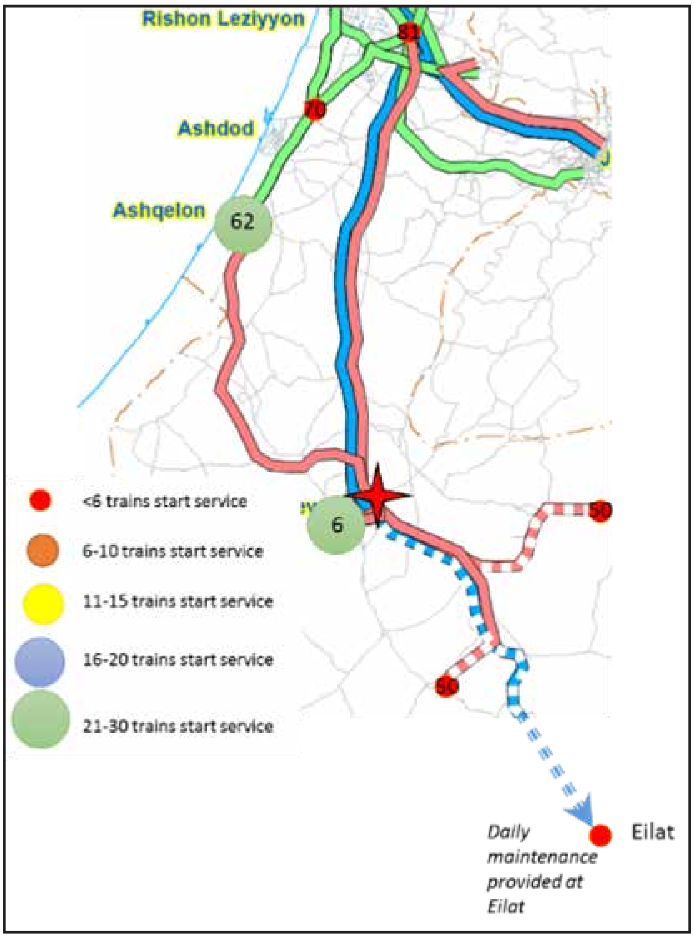


Figure 9.5 – Trains required at Termini and their Distances from Be'er Sheva

All terminal stations lie within 100 km of one of the depots, providing a reasonable travel time to take up and leave service. However, ideally depots or stabling facilities should be located close to the principal terminals to reduce the amount of deadhead train kilometers.

To reduce of deadhead train kilometers consideration could be given to providing additional depots; this would also reduce the size of the accommodation that is needed at the planned depots. Consideration should be given to providing secure at or near more remote terminal stations this would also reduce the size of the stabling required in depots, minimize dead-head train kilometers and to utilize platforms and turnaround facilities not used at night. In addition trains not required outside the peak periods could also be stabled in these facilities avoiding the need for some of these trains to return to a depot during the middle of the day.

In the north the terminal stations furthest from the depots at Haifa and Kishon are between 50 and 100 km and have relatively few trains starting from them. The possibility of stabling trains at these locations should be explored, however, this would not eliminate empty trains as there would be a need to carry crews for the trains at these outstations, although at the end of the peak hours' service, the normal service trains could be used. Locations that would be beneficial are:

- Kiryat Shmona
- Beit She'an and
- Tveria.

In the center of Israel most terminal stations are less than 50 km from Ragam/Lod, the exceptions are to the north of Tel Aviv at Netanya, Hadera, Harish and Zichron Yaakov, although, all except Netanya, are less than 50 km from Haifa. There is a need for a significant number of trains to commence service at Hadera and Zichron and if additional depot capcity is necessary because of the planned depots were not large enough then this should be located in this area.

The depot at Ashkelon is in a good location with many train services starting at Ashkelon, it is also close to Ashdod where other services start. The depot could also provide relief to Ragam and Lod if required.

Be'er Sheva, like Ashkelon, is in a good location with many train services starting from Be'er Sheva; it has two outlying terminals at Arad and Yeruham but the number of trains required at each of them is small. The train that starts at Yeruham could be stabled at Dimona depot to reduce deadhead kilometers.

Terminals where there a large number of trains starting and ending service should also be examined to identify those where suitable stabling accommodation is available or could be provided. These include:

- Karmiel
- Zihron Yaakov
- Netanya
- Modi'in and
- Jerusalem Centre/HaUma

9.2 Maintenance Facilities

In addition to the stabling facilities identified above maintenance facilities will be required at all or some of the stabling depots. The requirements and the scale of the maintenance facilities will depend on the specific requirements of the trains that Israel Railways selects for its new fleets.

It is assumed that all daily servicing will take place within the stabling facilities. It is assumed that all of trains within the maintenance reserve will require depot accommodation although some of these trains will be undergoing overhaul at Kishon Works.

Another critical assumption is the capability of the depots to maintain the different types of rolling stock or only stable rolling stock. For the calculation of depot size it is assumed that Ashkelon will not only have facilities for daily maintenance and that trains will be allocated for maintenance purposes to either Ragam or Be'er Sheva. The allocation of train types to depots that has been assumed is:-

- All Siemens Single Deck rolling stock - Kishon, as at present;

- Bombardier Double Deck rolling stock - Ragam/Lod and Be'er Sheva;
- Local Double Deck EMU – Ragam, Ashkelon and Haifa;
- High Speed EMU – Haifa, Ragam and Be'er Sheva;
- Electric locos - Haifa, Ragam and Be'er Sheva.

9.3 Freight Train Depot Locations

Freight locomotives are mainly maintained at the Haifa East and Dimona depots. By 2040 the capacity of these depots will have to increase to reflect the increasing number of freight trains operating. In addition a facility near Ashdod should be considered. Freight train stabling are to be provided at the Ports, Inland Ports, Freight Terminals and storage/classification yards at Nesher, Kfar Manachen and Mamshit.

Freight wagons are primarily maintained at Kishon Works, the expansion of the passenger and freight fleets may overload the capacity of the site to accommodate all of the heavy maintenance work required. Consideration should be given to providing maintenance to wagons at another location in the south of Israel.

9.4 Passenger Fleet Distribution to Depots

In the following assessment of depot stabling space requirements it is assumed that each route terminal will have rolling stock provided from the nearest depot. Space limitations may require some adjustments to this as some terminals can be served from more than one depot with only limited disadvantage. It is also assumed that each siding will be approximately 375 m in length and capable of accommodating the one of the following:

- 1 x full length national train;
- 2 x half-length national trains;
- 1 x 12 car local EMU;
- 2 x 6 car local EMUs;
- 4 x 3 car local DMUs
- 2 x 5 car trains composed of existing double deck cars with electric loco (5-DDE);
- 1 x 7 car trains composed of existing double deck cars with electric loco (7-DDE); or
- 1 x 9 car trains composed of existing single deck cars with electric loco (7-SDE or 9-SDE)

In addition to providing stabling for the number of trains required to operate the weekday service, provision is required to accommodate some of the maintenance reserve – trains awaiting repairs or trains ready for service but not required. For this assessment this reserve, approximately 5% of the fleet required for service, has been distributed in line with the fleets that are required to operate from each depot.

The depots also have to have the facilities to perform maintenance and an allowance of at least 5% of the fleet allocated to that depot has been made.

9.5 Haifa

It is envisaged that the depot and stabling at Haifa East and Kishon would provide the trains required to operate all of the National Services that start from Hadera, Haifa, Nahariya and Karmiel. It would also provide the rolling stock for all of the local trains that operate in the north of Israel as well as the trains that start at Zihron Yaakov heading towards Tel Aviv.It is estimated that the depots and stabling at Haifa East and Kishon need to provide facilities to make available for service the following trains each weekday, including trains for the Operational Reserve:

Train Type	Number required for Service	Maintenance / Operational Reserve	Total Number Units	Number of Stabling Sidings Required
National Trains				
2 x 6 car EMU	23		46	
1 x 6 car EMU		3	3	
Total National Units			49	25
Local Trains				
2 x 6 car EMU	22		44	
1 x 6 car EMU	18	3	21	
Total Local EMU	62		65	33
8-SDE	11	1	12	12
Total				70

9.6 Ragam and Lod

It is envisaged that the depot and stabling at Ragam would provide the trains required to operate all of the National Services that start from Tel Aviv and Jerusalem. It would also provide the rolling stock for all of the local trains that operate from the stations of Harish, Netanya, Rosh Haayin, Teufa, Modi'in, Bet Shemesh and Jerusalem Malha. It is estimated that the depots and stabling at Ragam need to provide facilities to make available for service the following trains each weekday:

Train Type	Number required for Service	Maintenance / Operational Reserve	Total Number Units	Number of Stabling Sidings Required
National Trains				
2 x 6 car EMU	37		74	
1 x 6 car EMU	3	4	7	
Total National Units		4	81	41
Local Trains				
2 x 6 car EMU	48		96	
1 x 6 car EMU	7	5	12	
Total Local EMU			108	54
3-DMU	20	3	23	6
5-DDE	19	2	20	11
7-DDE	19	1	20	20
Total				**132**

Total length of sidings required for stabling trains = 45.4 km.

In addition the site would have the capacity to maintain the following trains:-

- National Trains
  - 4 x 6 car EMU
- Local Trains
  - 6 x 6 car EMU
  - 2 x 5 car Double Deck trains
  - 2 x 7 car Double Deck trains
  - 4 x 3 car Diesel Multiple Units

9.7 Ashkelon

The facility at Ashkelon would provide stabling for those trains that start at Ashkelon. It is estimated that stabling facility at Ashkelon needs to provide facilities to make available for service the following trains each weekday:

Train Type	Number required for Service	Maintenance / Operational Reserve	Total Number Units	Number of Stabling Sidings Required
Local Trains				
2 x 6 car EMU	24		48	
1 x 6 car EMU	5	3	8	
Total Local EMU			56	28
5-DDE	7	1	8	4
Total				32

Total length of sidings required for stabling trains = 12.0 km.

9.8 Be'er Sheva

This depot will provide the trains that start in the south of Israel. It is estimated that the depot and stabling at Be'er Sheva needs to provide facilities to make available for service the following trains each weekday:

Train Type	Number required for Service	Maintenance / Operational Reserve	Total Number Units	Number of Stabling Sidings Required
National Trains				
2 x 6 car EMU	10*		20	
1 x 6 car EMU	3	2	5	
Total National Units			25	13
Local Trains				
1 x 6 car EMU	6	1	7	4
5-DDE	4	1	5	3
7-DDE	4		4	4
Total				24

* Three 12 car trains are assumed to be stabled and receive daily maintenance at Eilat overnight, these are not included in the figures given above.

Total length of sidings required for stabling trains = 7.9 km.

In addition the site would have the capacity to maintain the following trains:-

- National Trains
  - 2 x 6 car EMU
- Local Trains
  - 2 x 7 car Double Deck trains

9.9 Eilat

It is expected that a small "satellite" depot will be provided at Eilat to provide secure storage and any daily maintenance operations for passenger trains and freight locomotives that finish/start service at Eilat. This site would have the capacity to stable three 12 car National trains. It would be expected that the National Trains would receive other maintenance at Haifa, the other terminus of the service line serving Eilat.

9.10 Depot North of Tel Aviv

If an additional depot was provided north of Tel Aviv it would considerably reduce the size of the accommodation that would be required at Ragam and also allow a smaller number of trains could also be moved from Haifa. No specific location has been identified for this additional depot.

The total length of sidings required for stabling trains would remain broadly the same, if a depot with 48 sidings were provided this would reduce the number at Ragam/Lod by up to 33% and in Haifa by about 10%.

10. ESTIMATED COST OF DELIVERING STRATEGY

10.1 Infrastructure Improvements

The infrastructure improvements that will be required to implement the 2040 plan have been identified and organized by region. The improvements are broken down into key elements for which unit construction costs are estimated. The unit costs have been developed based on consideration of recent experience in Israel for similar works, as well as international experience for more unusual elements. The total cost of infrastructure improvements in millions of NIS is summarized in the table below for alternatives C81 and C82.

		Total Cost (MM NIS)	
Item	Description	C81	C82
Infrastructure			
C1	Ayalon Corridor - to 5 tracks	10,370	10,370
C2	Ayalon Corridor - to 6 Tracks	3,921	3,921
C3	Central Region North - Eastern Line	5,063	5,063
C4	Jerusalem	1,587	1,587
C5	Central Region South	9,606	9,606
N1	Coastal Line to Haifa	12,198	12,198
N2	North Region to Carmiel (Rd 70), HaEmek Railway and Eastern Line	5,448	5,448
N3	North Region to Kiryat Shmona	12,068	
N4	Afula to Tiveria	1,706	
S1	South Region	5,060	5,060
S2	Eilat	22,549	
S3	Arad and Yerucham	1,363	
G1	Maintenance Depots	9,615	9,615
G2	Geopolitical Lines	3,845	
	Subtotal Infrastructure	104,397	62,866

The total cost to develop the full 2040 plan is estimated at NIS 104.4 billion under plan C81. Alternatively, under plan C82, many of the peripheral lines are excluded with demand served by other means, resulting a reduced infrastructure cost of NIS 62.9 billion.

The infrastructure works have been grouped broadly by region: Center (C), North (N) and South (S), with some items grouped generally (G). The estimate for each subgroup is presented in the following tables.

10.1.1 Central Area

The table below details the cost estimate to expand the Ayalon corridor to 5 tracks (C1). It includes 26 km of tunnels to accommodate the new high speed line, new track, switches, signalization, electrification, ETCS and GSMR infrastructure. It works to upgrade existing stations in the corridor, including platform extensions, construction of a new station at Yitzhak Sade, expansion of BG Air Port station, and connection of deep platforms along the high speed line to the at-grade stations serving the local lines.

C1 – Ayalon Corridor to 5 Tracks				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
2 single line rail tunnel (26 km)	km	52.0	75,000	3,900
Single track – slab	km	52.0	7,000	364
New double track connections	km	16.5	14,000	231
Railroad switches	LS	170.0	1,700	289
Track signalization	km	85.0	1,250	106
Track electrification	km	85.0	2,500	213
ETCS and GSMR infrastructure	km	85.0	1,300	111
Platform extension Savidor Merkaz	m2	954	6.0	6
Platform extension HaShalom	m2	873	6.0	5
Platform extension HaHagana	m2	2,040	6.0	12
New station - Yitzhak Sadeh	LS	1	37,000	37
New platforms - Yitzhak Sadeh	m2	6,300	6.0	38
Station signaling operating system	LS	1	30,000	30
Improved Station Buildings University	LS	1	10,000	10
Improved Station Buildings Savidor Merkaz	LS	1	20,000	20
Improved Station Buildings HaShalom	LS	1	20,000	20
Improved Station Buildings HaHagana	LS	1	20,000	20
Expanded BG Air Port Station	LS	1	50,000	50
New underground platforms Savidor Merkaz	m2	5,400	6.0	32
New underground platforms HaShalom	m2	5,400	6.0	32
New underground platforms HaHagana	m2	5,400	6.0	32
Access to tunnel platforms Savidor	LS	1	100,000	100
Access to tunnel platforms HaShalom	LS	1	100,000	100
Access to tunnel platforms HaHagana	LS	1	100,000	100
New flyover south of Herzliya	m	9,600	7	67
Subtotal Hard Costs				5,926
Planning, Design and Management		25%		1,481
Contingency		50%		2,963
Subtotal Hard and Soft Costs				10,370

The following table presents the incremental investment to expand the Ayalon corridor to 6 tracks (C2). The presumes the completion of C1 works, and includes the diversion of the Ayalon River, the completion of the fourth at-grade track and temporary construction works.

C2 – Ayalon Corridor to 6 Tracks				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
Diversion of River	LS	1	1,150,000	1,150
Widening of railway km 93.400 to 96.650	km	3.25	7,000	23
Railroad switches	LS	7	7,900	51
Track signaling	km	3.25	1,250	4
Track electrification	km	3.25	2,500	8
ETCS and GSMR infrastructure	km	3.25	1,300	4
Temporary Construction works	LS	1	1,000,000	1,000
Subtotal Hard Costs				**2,241**
Planning, Design and Management		25%		560
Contingency		50%		1,120
Subtotal Hard and Soft Costs				**3,921**

The table below details the investment required in the northern central region (C3), principally along the eastern line. It includes new track and stations as the eastern line is extended until the coastal line at Hadera, as well as new freight terminals.

C3 – Central Region North – Eastern Line				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New double track (Remez Jct to Kfar Sava)	km	40.0	7,000	280
New double track (Kfar Sava to R. Haayin)	km	5.5	7,000	39
New double track (E Railway to Hadera W)	km	2.0	7,000	14
New single track (Sgula to R. Haayin to Lod)	km	19.5	3,500	68
New double track (Harish ext)	km	13.0	7,000	91
Railroad switches	LS	70	1,700	119
Track signalization	km	141	1,250	176
Track electrification	km	141	2,500	351
ETCS and GSMR infrastructure	km	141	1,300	183
Structures	m2	28,100	7	197
New station - Kfar Sava East	LS	1	18,000	18
New station - Tira	LS	1	18,000	18
New station - Taybe	LS	1	18,000	18
New station - Ahituv	LS	1	18,000	18
New station - Hadera E	LS	1	18,000	18
Reconstruct stations at R Haayin N & S	LS	2	18,000	36
New stations - Eald and Tuefa and Lod Center	LS	3	18,000	54
Side platform	LS	20	11,800	236

Parking spaces	LS	10	12,800	128
Access roads	LS	10	4,000	40
Station signaling operating system	LS	10	30,000	300
Freight Loops at Harish, Ahituv, Taybe and Eyal	LS	4	7,000	28
New freight terminal – Eyal or alternative location	LS	1	250,000	250
New freight terminal - Hadera N	LS	1	80,000	80
New freight terminal - Tirat Yehuda	LS	1	80,000	80
Flyover Hadera N	m2	4,800	7	34
Junction at K. Sava	LS	1	10,000	10
Junction at R. Haayin	LS	1	10,000	10
Subtotal Hard Costs				2,893
Planning, Design and Management		25%		723
Contingency		50%		1,447
Subtotal Hard and Soft Costs				5,063

The next two tables summarize the infrastructure improvements made in Jerusalem (C4) to extend the line to new station in the city center, and the southern central region (C5).

C4 Jerusalem				
Item	**Unit**	**Quantity**	**Unit Cost ('000 NIS)**	**Total Cost (MM NIS)**
Extend 2 track tunnel in Jerusalem	Km	6	75,000	450
Single track – slab	Km	6	7,000	42
Railroad switches	LS	12	4,800	58
Track signalization	Km	6	1,250	8
Track electrification	Km	6	2,500	15
ETCS and GSMR infrastructure	Km	6	1,300	8
New station - Jerusalem	LS	1	37,000	37
Deep access to platforms	LS	1	200,000	200
New underground platforms Jerusalem	m2	10,000	6	60
Station signaling operating system	LS	1	30,000	30
Subtotal Hard Costs				907
Planning, Design and Management		25%		227
Contingency		50%		453
Subtotal Hard and Soft Costs				1,587

C5 - Central Region South				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New double track - Lod bypass	Km	21	7,000	147
New double track (Lod to Be'er Sheva)	Km	68	14,000	952
Widen to double track (Na'an to Bet Shemesh)	Km	20	3,500	70
New double track (Ashdod to Soreq)	Km	18	7,000	126
New double track (Ashqelon to Pleshet)	Km	22	7,000	151
New double track (Road #431)	Km	26	7,000	182
Railroad switches	LS	165	3,375	555
Track signalization	Km	349	1,250	436
Track electrification	Km	349	2,500	873
ETCS and GSMR infrastructure	Km	349	1,300	454
Structures	m2	69,800	7	489
New stations	LS	7	37,000	259
Side platform	LS	14	11,800	165
Parking spaces	LS	7	12,800	90
Access roads	LS	7	4,000	28
Station signaling operating system	LS	7	30,000	210
New freight terminal - Kedma	LS	1	25,000	25
New freight terminal Bet Shemesh	LS	1	8,333	8
Classification Yard Kfar Menachem	LS	1	40,000	40
Ashdod enlarge marshalling yards	LS	1	230,000	230
Subtotal Hard Costs				5,489
Planning, Design and Management		25%		1,372
Contingency		50%		2,744
Subtotal Hard and Soft Costs				9,606

10.1.2 North Area

The table below (N1) details the investment required to extend the coastal line to Haifa, including improvements within Haifa. It includes widening to four tracks along the coastal line and station improvements.

N1 - Coastal Line to Haifa				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
Tunnel (Lev HaMifratz to B. HaMeches) cut/cover	Km	3.5	120,000	420
Tunnel (Hof HaCarmel to B. HaMeches) 2 single	Km	3.3	150,000	495
Widen to 4 tracks (L. HaMifratz to B. HaMeches)	Km	3.4	14,000	48
Widen to 4 tracks (B. HaMeches to H. HaCarmel)	Km	9.4	14,000	132
Widen to 4 tracks (H. HaCarmel to Netanya)	Km	57.0	14,000	798
Widen to 6 tracks (Netanya to Shfyaim)	Km	13.0	21,000	273
Double track (Binyamina Bypass)	Km	9.4	7,000	66

L. HaMifratz interchange (Port Access tunnel)	Km	3.0	120,000	360
Haifa East and Nesher freight marshalling yards	LS	1	140,000	140
Railroad switches	LS	210	4,800	1,006
Track signalization	Km	210	1,250	262
Track electrification	Km	210	2,500	524
ETCS and GSMR infrastructure	Km	210	1,300	272
Structures	m2	41,920	7	293
New stations	LS	13	37,000	481
Side platform	LS	26	11,800	307
Parking spaces	LS	39	12,800	499
Access roads	LS	39	4,000	156
Station signaling operating system	LS	13	30,000	390
Platform extension existing stations	m2	8,000	6	48
Subtotal Hard Costs				6,970
Planning, Design and Management		25%		1,743
Contingency		50%		3,485
Subtotal Hard and Soft Costs				12,198

The table below (N2) summarizes improvements elsewhere in the north region, including to Karmiel, the HaEmek railway and the completion of the Eastern line to Haifa.

N2 - North Region to Karmiel (Rd 70), HaEmek Railway and Eastern Line				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New tracks to Karmiel	km	25	7,000	172
New tracks to Eastern Line	km	34	14,000	476
Widen Lev Hamifrats to Afula	km	34	3,500	119
Railroad switches	LS	76	1,950	147
Track signalization	km	151	1,250	189
Track electrification	km	151	2,500	378
ETCS and GSMR infrastructure	km	151	1,300	196
Structures	m2	30,200	7	211
New stations - Karmiel line	LS	3	18,000	54
Side platform	LS	6	11,800	71
Parking spaces	LS	3	12,800	38
Access roads	LS	3	4,000	12
Station signaling operating system	LS	3	30,000	90
Tunnels	km	8	75,000	600
New freight terminals (3)	LS	1	360,000	360
Subtotal Hard Costs				3,113
Planning, Design and Management		25%		778
Contingency		50%		1,556
Subtotal Hard and Soft Costs				5,448

The two tables below, N3 and N4 summarize improvements to peripheral areas in the north, Kiryat Shmona and Afula to Tiveria.

N3 - North Region to Kiryat Shmona				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New double tracks Karmiel to Kiryat Shmona	km	50	14,000	700
Tunnels - single track	km	40	75,000	3,000
Railroad switches	LS	50	1,950	98
Track signalization	km	100	1,250	125
Track electrification	km	100	2,500	250
ETCS and GSMR infrastructure	km	100	1,300	130
Structures	m2	320,000	7	2,240
New stations	LS	4	18,000	72
Side platform	LS	8	11,800	94
Parking spaces	LS	4	12,800	51
Access roads	LS	4	4,000	16
Station signaling operating system	LS	4	30,000	120
Subtotal Hard Costs				6,896
Planning, Design and Management		25%		1,724
Contingency		50%		3,448
Subtotal Hard and Soft Costs				12,068

N4 - Afula to Tiveria				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
Single track railway	km	25	3,500	88
Railroad switches	LS	13	1,950	24
Track signalization	km	25	1,250	31
Track electrification	km	25	2,500	63
ETCS and GSMR infrastructure	km	25	1,300	33
Structures	m2	80,000	7	560
New stations	LS	2	18,000	36
Side platform	LS	4	11,800	47
Parking spaces	LS	2	12,800	26
Access roads	LS	2	4,000	8
Station signaling operating system	LS	2	30,000	60
Subtotal Hard Costs				975
Planning, Design and Management		25%		244
Contingency		50%		487
Subtotal Hard and Soft Costs				1,706
Subtotal Hard and Soft Costs				12,068

10.1.3 South Area

The following table summarizes investments required in the south region. Including new tracks from Be'er Sheva to Tsefa and the Be'er Sheva bypass.

S1 - South Region				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New double tracks (Beersheva to Zefa)	km	85.0	10,500	893
Beersheva bypass	km	16.0	14,000	224
Railroad switches	LS	101	1,950	197
Track signalization	km	202	1,250	253
Track electrification	km	202	2,500	505
ETCS and GSMR infrastructure	km	202	1,300	263
Structures	m2	40,400	7	283
Junctions	LS	1	10,000	10
New stations	LS	3	18,000	54
Side platform	LS	6	11,800	71
Parking spaces	LS	3	12,800	38
Access roads	LS	3	4,000	12
Station signaling operating system	LS	3	30,000	90
Subtotal Hard Costs				2,892
Planning, Design and Management		25%		723
Contingency		50%		1,446
Subtotal Hard and Soft Costs				5,060

The tables below present costs for peripheral extensions in the south region, to Eilat (S2) and Arad and Yerucham (S3).

S2 – Eilat				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New double track to Eilat	km	220.0	14,000	3,080
Tunnels - single track	km	50	75,000	3,750
New double track Zin to Hazeva	km	27	14,000	378
Widen existing railway (Zin to Mamshit)	km	11	3,500	39
New single track to Dead Sea Works	km	38.0	7,000	266
Passing sidings	km	10.0	3,500	35
Railroad switches	LS	138	4,800	664
Track signalization	km	553	1,250	691
Track electrification	km	553	2,500	1,383
ETCS and GSMR infrastructure	km	553	1,300	719
Structures	m2	110,600	7	774
New stations	LS	8	18,000	144
Side platform	LS	16	11,800	189
Parking spaces	LS	8	12,800	102
Access roads	LS	8	4,000	32
Station signaling operating system	LS	8	30,000	240
Freight terminal	LS	2	200,000	400
Subtotal Hard Costs				12,885
Planning, Design and Management		25%		3,221
Contingency		50%		6,443
Subtotal Hard and Soft Costs				22,549

S3 - Arad and Yerucham				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New single track	km	40	3,500	140
Railroad switches	LS	20	1,950	39
Track signalization	km	40	1,250	50
Track electrification	km	40	2,500	100
ETCS and GSMR infrastructure	km	40	1,300	52
Structures	m2	8,000	7	56
New stations	LS	4	18,000	72
Side platform	LS	7	11,800	83
Parking spaces	LS	4	12,800	51
Access roads	LS	4	4,000	16
Station signaling operating system	LS	4	30,000	120
Subtotal Hard Costs				779
Planning, Design and Management		25%		195
Contingency		50%		389

Subtotal Hard and Soft Costs				1,363
Station signaling operating system	LS	8	30,000	240
Freight terminal	LS	2	200,000	400
Subtotal Hard Costs				12,885
Planning, Design and Management		25%		3,221
Contingency		50%		6,443
Subtotal Hard and Soft Costs				22,549

10.1.4 General

The following table (G1) summarizes investment requirements in depots through the national system.

G1 - Maintenance Depots				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
New track at depots	km	98	7,000	686
Railroad switches	LS	196	4,800	941
Track signaling	km	98	1,250	123
Track electrification	km	98	2,500	245
Additional depot improvements	LS	1	3,500,000	3,500
Subtotal Hard Costs				5,494
Planning, Design and Management		25%		1,374
Contingency		50%		2,747
Subtotal Hard and Soft Costs				9,615

The following table (G2) summarizes the investments to extend the railway network to neighboring countries and territories.

G2 - Geopolitical Lines				
Item	Unit	Quantity	Unit Cost ('000 NIS)	Total Cost (MM NIS)
Double track Ahihud to Kfar Yasif	km	5	7,000	35
Single track Kfar Yasid to Shlomi	km	14	3,500	49
Single track Shlomi to Lebanon Border	km	4	3,500	14
Single track Beit She'an to Jordan River	km	6	3,500	21
Double track Heletz Railway to Yad Mordechai to Erez	km	9	7,000	63
Heletz Railway widen to double track	km	18	3,500	63
Kiryat Gat to Tarkumia crossing	km	22	7,000	154
Single track Z HaNegev to Nitzana	km	49	3,500	172
Single track Afula to Jenin	km	15	3,500	53
Railroad switches	LS	84	1,950	164
Track signalization	km	168	1,250	210
Track electrification	km	168	2,500	420
ETCS and GSMR infrastructure	km	168	1,300	218
Structures	m2	67,200	7	470
Stations (K Yasif, Cabri, Shlomi, Jenin, Erez, Tarkumia)	LS	6	18,000	108
Side platform	LS	12	11,800	142
Parking spaces	LS	4	12,800	51
Access roads	LS	4	4,000	16
Station signaling operating system	LS	6	30,000	180
Freight terminals	LS	6	100,000	600
Subtotal Hard Costs				3,202
Planning, Design and Management		25%		800
Contingency		50%		1,601
Subtotal Hard and Soft Costs				5,603

10.2 Rolling Stock

The table below summarizes the rolling stock acquisition costs for passenger trains for alternative C81.

Alternative C81 Train Type	Unit Cost (NIS MM)	Quantity Required	Cost (NIS MM)
DD EMU - National (6 car)	63	167	10,474
DD EMU - Local (6 car)	36	247	8,785
Total		414	19,259

Adjusting for the reduced rolling stock needs under alternative C82,

Alternative C82 Train Type	Unit Cost (NIS MM)	Quantity Required	Cost (NIS MM)
DD EMU - National (6 car)	63	155	9,722
DD EMU - Local (6 car)	36	234	8,322
Total		389	18,044

The estimated cost for new freight rolling stock is estimated at NIS 650 MM.

10.3 Operation and maintenance

The tables below summarizes the annual operation and maintenance costs for alternative C81, C82 and the base alternative, respectively:

Operations and Maintenance Costs - Alternative C81				
Item	Unit Cost (NIS)	Unit	Qty	Annual Cost (MM NIS)
RS Maintenance	25	train-km	32,477,296	812
Operations Labor	60	train-km	32,477,296	1,949
Power consumption	25	train-km	32,477,296	812
Track O&M	500,000	track-km	2,572	1,286
Station	11,000,000	Station	120	1,320
Depots	500,000,000	LS	1	500
Total Alternative C81				6,678

Operations and Maintenance Costs - Alternative C82				
Item	Unit Cost (NIS)	Unit	Qty	Annual Cost (MM NIS)
RS Maintenance	25	train-km	30,381,987	760
Operations Labor	60	train-km	30,381,987	1,823
Power consumption	25	train-km	30,381,987	760
Track O&M	500,000	track-km	1,957	978
Station	11,000,000	Station	102	1,122
Depots	450,000,000	LS	1	450
Total Alternative C82				5,892

Operations and Maintenance Costs - Base Alternative				
Item	Unit Cost (NIS)	Unit	Qty	Annual Cost (MM NIS)
RS Maintenance	25	train-km	10,839,781	271
Operations Labor	60	train-km	10,839,781	650
Power consumption	25	train-km	10,839,781	271
Track O&M	500,000	track-km	1,230	615
Station	11,000,000	Station	67	737
Depots	250,000,000	LS	1	250
Total Base Alternative				2,795

11. THE STRATEGIC PLAN – GENERAL AND ECONOMIC ASSESSMENT

11.1 Introduction

This chapter includes a general overview of the plan based on the general evaluation framework that was set at the beginning of the project. The analysis and evaluation of the final plan included:

- System performance analysis and strategic goals – This analysis is aimed to determine how the plan meets the strategic goals set by the government and the overall system performance.
- Economic analysis – This analysis included the evaluation of the impacts and benefits of the plan to the national economy and a cost benefit analysis.

11.2 System performance and strategic goals

11.2.1 Strategic Goal Performance - Passenger

The final plan was analyzed and compared to the strategic goals as described in Section 2.3. The strategic goals indicate how well the plan meets the future demand and enable mobility in the national level. The strategic goals are divided into four categories:

- Transportation
- Equity and periphery accessibility
- Efficiency and economic growth
- Quality of life and the environment

As shown in Table 11.1, for each category, a series of indices were developed to describe more defined objectives. For each index a target goal was set, based on international experience and the previous strategic assessment.

Table 11.1 presents the strategic goals score of the plan, under the two alternative scenarios C81 and C82 for the year 2040 forecasts. The plan scores are compared to the existing 2015 network and the planned 2022 network.

The analysis shows that the plan meets most of the strategic goals and that the plan represents a major improvement in all measures not only to the existing network but also to the planned 2022 network. The main results show:

- On the target year 2040, the plan has the potential to attract over **300 million passengers per year** to rail services. This figure is 5 times higher than 2016 network. The percent of rail passenger km increases more than 3 times to 19%.
- In the **main corridors** between the major cities, **public transportation trip share** increases significantly to **almost 50%.** This result is much more sustainable, allowing the rail, buses and roads passengers on these corridors to travel in a good level of service. Rail share of long distance trips increases to over 40%.
- The plan increases the level of service of the national public transport system. The plan covers more than 80% of the population with a train station less than 7 km from their home. High frequencies results in **reduced waiting time** and **higher reliability.** 60% of the population is within 60 minutes ride to Tel Aviv, and the metropolitan accessibility at 45 minutes increases from 36% to 70% (ride to the nearest metropolitan center).
- The significant increase in rail trips **reduces the private vehicles usage** relative to the base case scenario **by 10-12%** (with more advantages under the C82 scenario).
- The plan improves the periphery accessibility. 60% of the population in the periphery is within 1.5 hours to Tel Aviv, increase from only 16% today. The plan will increase low income population access to jobs from 12% today to 50% - bringing closer job opportunities to more people.
- The economic analysis shows that **the plan contributes to the national economy** and is socially beneficial.

- The C82 plan results show a **better economic performance** than C81, resulting in a much **higher B/C ratio** (1.9 and 1.0 respectively) and higher operating cost recovery ratio. This is due to more efficient lines and infrastructure. The capital cost per passenger is superior and efficient. C81 2040 Strategy Extended Network lines to the periphery are expensive and have low usage and thus do not contribute much social benefits, although they do provide faster service to the periphery. The analysis shows that both versions of the plan have similar effect on the periphery accessibility, while C82 is much more efficient.

The conclusions of the strategic goals analysis show that **the 2040 strategic rail plan has the ability to change the future mobility in Israel to be much less dependent on private vehicles** and to shift towards high performance and more sustainable public transportation.

	Index	Target	2015	2022	2040 C81	2040 C82
Transportation goals	Percentage of passenger trips on rail network	8%	3%	3%	8%	8%
	Percent of passenger km on rail network	15%	6%	9%	19%	19%
	Percentage of long distance trips on rail network (over 50 km.)	40%	10%	16%	40%	42%
	Percentage of medium distance trips on rail network (over 20-50 km.)	15%	5%	6%	14%	13%
	Number of rail passengers (million per year)	over 250	53	83	305	306
	Percentage of public transport passengers on main corridors	40% – 50%	31%	33%	47%	48%
Equity and Periphery	Percent of population within 60 minutes of Tel Aviv	60%	32%	38%	61%	59%
	Percent of population in the periphery within 90 minutes to Tel Aviv	60%	16%	30%	64%	62%
	Percent of jobs within 90 minutes ride from low income population	50%	12%	18%	49%	49%
	Percent of population within 45 minutes ride from nearest metropolitan area	70%	36%	46%	69%	72%
Efficiency and Economic Growth	Operating cost recovery ratio	>0.5	0.45	-	0.65	0.73
	Benefit/Cost (B/C) ratio at 7%	>1.2	-	-	1.0	1.9
	Infrastructure (capital) cost per passenger (NIS)	<20 NIS	-	-	20	14
	Percentage of peak hour mileage with adequate occupancy (v/c>0.5)	>60%	41%	35%	53%	59%
	Percentage of peak hour mileage with low occupancy (v/c <0.2)	<20%	28%	37%	23%	20%
Quality of Life and Environment	Average waiting time on rail and mass trasnit network - in peak hours (minutes)	7.5	12	10	3	3
	Population coverage up to 7 km from rail station	80%	68%	75%	86%	80%
	Reduction in private car usage - (% relative to do nothing scenario)	-10%	0	-	-10%	-12%
	Connectivity to metropolitan systems - (% of rail stations connected)	30%	4%	9%	27%	34%

Table 11.1– Strategic goals performance

11.2.2 Strategic Goal Performance - Freight

Israel is heavily dependent on trucks to carry freight within Israel, carrying about 95% of the total tonne-kilometers. Israel Railways carried 7.54 million tonne, 1.18 billion tonne-kilometers in the year ending June 2015, all mainly chemicals and minerals (63%) and containers (32%).

The Strategic Plan envisaged that by 2040 Israel Railways are forecast with the proposed network of freight terminals will have increased to between 38 and 41 million tonne. Without the extension to Eilat this would reduce to 33 million tonne. Both scenarios involve a significant diversion of freight traffic from truck to rail.

The diversion of freight traffic will be encouraged by the provision of rail based facilities and congestion in the ports and on the highway network, but it is dependent in part on commercial forces. There are two main elements in the increase in freight that is envisaged the transport of sand and aggregates from Tsefa and Tamar and the movement of containers from the ports to inland ports and between the ports. Sand and aggregates are ideally suited to transport by rail with much moved over long distances into the urban areas of the center and north. The forecast increase in containers is probably less robust as it depends on the establishment of the container port at Eilat which has a distance advantages over road compared to movements from Ashdod and Haifa.

11.2.3 Performance – Supply and Demand Balance

Table 11.2 presents key figures of rail infrastructure in the plan. The plan more than doubles the track length and almost triples the service (in terms of train-km). As shown on the strategic goals analysis, this increase resulted in almost five times more passengers than 2015 and four times more than the expected ridership on 2022. This result suggests that the plan achieves a "network effect" and high efficiency.

The number of stations is also doubled. The high number of stations contributes to the coverage and travel time goals above, but also means a high investment and a need for a rationalized station design process.

Figure 11.1 shows load factors of the lines in the plan, based on the model results. Most of the lines are well balanced with adequate passenger volumes over train capacity in the range of 0.5-1.0. A few lines of the national services have higher load factors, between 1.0-1.2, which we believe can be balanced on a corridor level by the operating scheme suggested on this plan. Some lines have low utilization (load factors are in the range of 0.2-0.5).

	2022	2040 (C81)	Increase
Right of way length (km)	618	1,068	73%
Tracks length (km)	1,230	2,572	109%
Peak departures	50	124	148%
Train-Km	4,461	12,642	183%
No. of stations	67	120	79%

Notes: based on C81 plan compared to current plan for 2022 network

Table 11.2– The Strategic Plan infrastructure

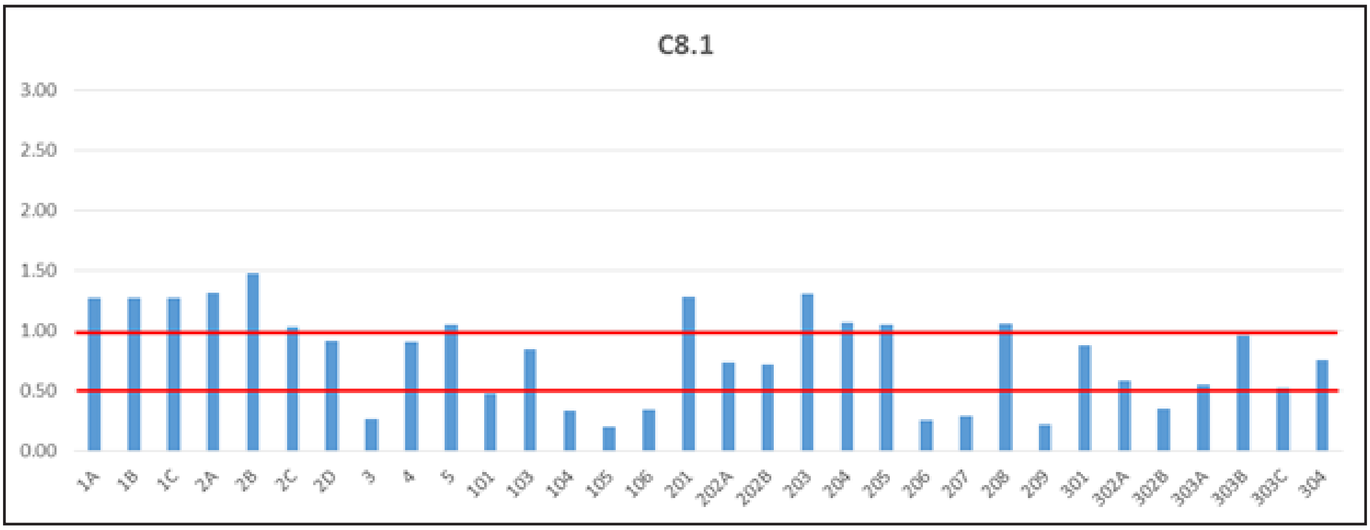


Figure 11.1– Route Balance Load Factors – Alternative C81

11.2.4 Performance – Passengers and Modal Share

The plan has the potential and ability to attract 300 million passengers annually by 2040, representing almost 20% of the total vehicle-km traveled in Israel. These figures suggest that the plan provides a high level of service and capacity to meet this demand and to shift travel habits to be more public transport oriented. Most of the rail trips are trips between the four metropolitan cities (Tel Aviv, Jerusalem, Haifa and Be'er Sheva) and within these metropolitan areas (inner metropolitan trips). This result is very consistent with the population and activity forecasts, as well as with the plan strategy of dividing the network into metropolitan service and long distance national routes between the metropolitan areas.

Train catchment between the metropolitan areas is almost 50% as can be seen on Figure 11.2 and with more details on Figure 11.3. It is worth to notice that the Jerusalem-Tel Aviv corridor and the Haifa-Tel Aviv corridor public transport accounts for more than 50% of the trips.

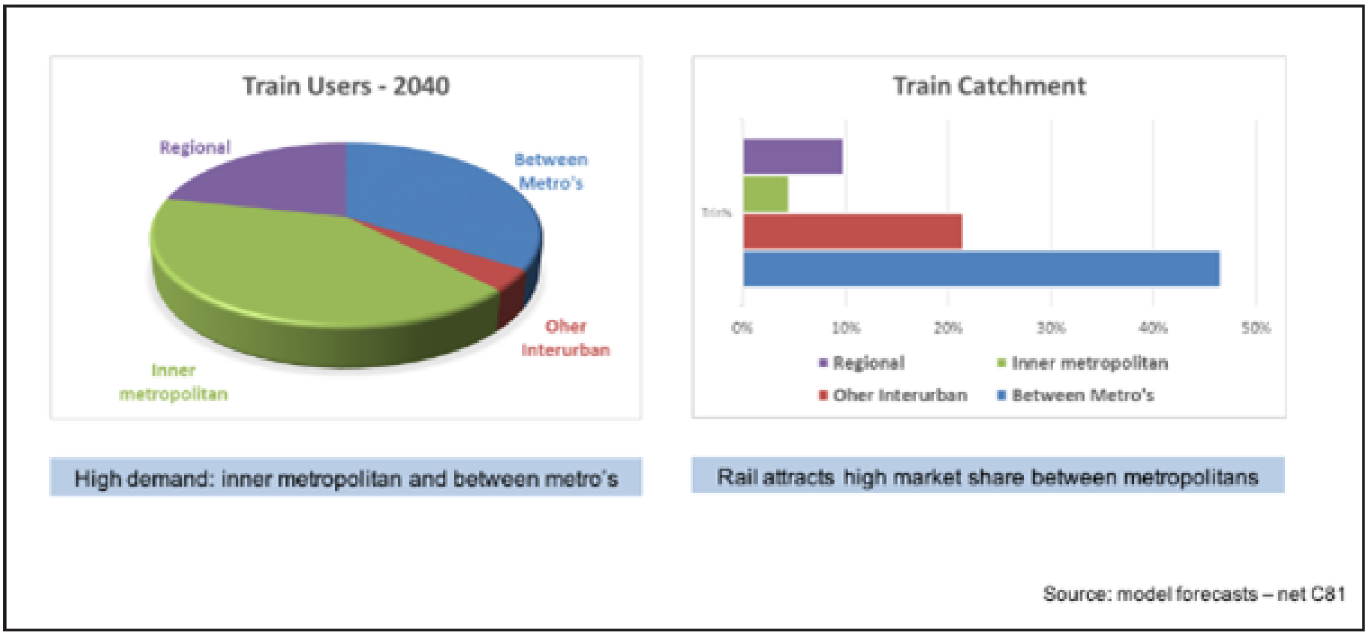
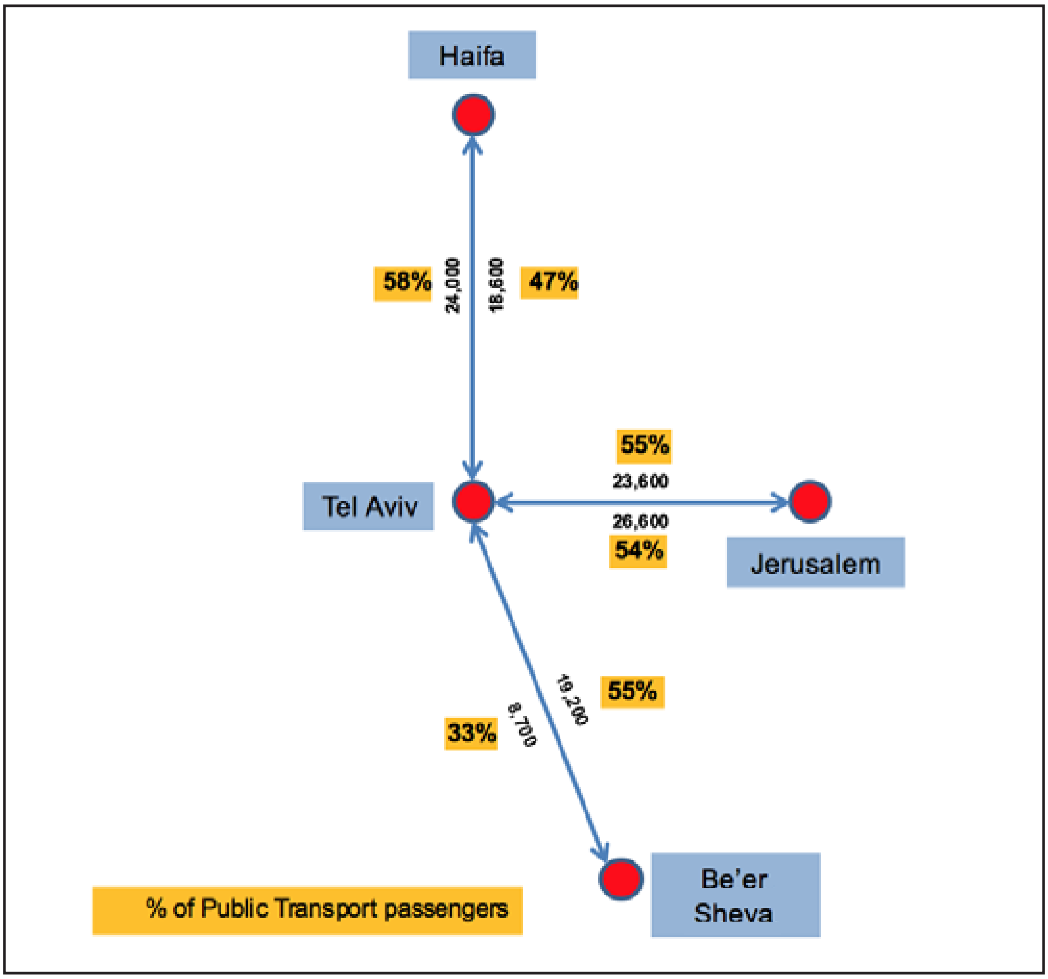


Figure 11.2– Rail Passenger Market



Note: The numbers on chart present total motorized passenger (all modes) forecast on corridors for one peak AM hour on 2040, National model forecasts

Figure 11.3– Public transport market share on main corridors (rail, bus and mass transit)

11.2.5 Performance – Travel Times

The plan is relying on a few features that increase the level of service, the reliability of the service and the travel time.

- **Service hierarchy:** The separation of the service into national routes with higher speeds (up to 250 km/h) and very few stops and regional routes with mores stops and coverage and a skip stop service, saves time to almost all the passengers and creating supreme dedicated level of service. The long-distance trips travel much faster while the metropolitan trips have more coverage and integration with mass transit that they need for the diversity of their daily trips.
- **High frequency:** All the service routes have high frequencies. The national routes depart every 5-10 minutes in the peak periods and most of the metropolitan and the main regional lines depart every 15-20 minutes. These frequencies allow low waiting times and increase the ability to transfer easily between lines. This means that almost every
- **High coverage:** The number of rail stations increase to more than 120, covering almost 60% of the population within 5 km from a train station. The high coverage combined with the service hierarchy contribute to reducing travel time.
- **Mass Transit integration:** The strategic plan is coordinated and more integrated with the metropolitan mass transit systems. This results in lower transfer times and convenient door-to door times in public transport, given that proper connections will be provided.

Figure 11.4 and 11.5 show travel time maps to Tel Aviv. Additional travel time were analyzed but are not presented here. The maps show that the plan covers more areas and provide good door-to door travel times between the metropolitans, attracting high passengers' volumes. The north and south periphery have good coverage within convenient travel times to the nearest metropolitan center and to Tel Aviv.

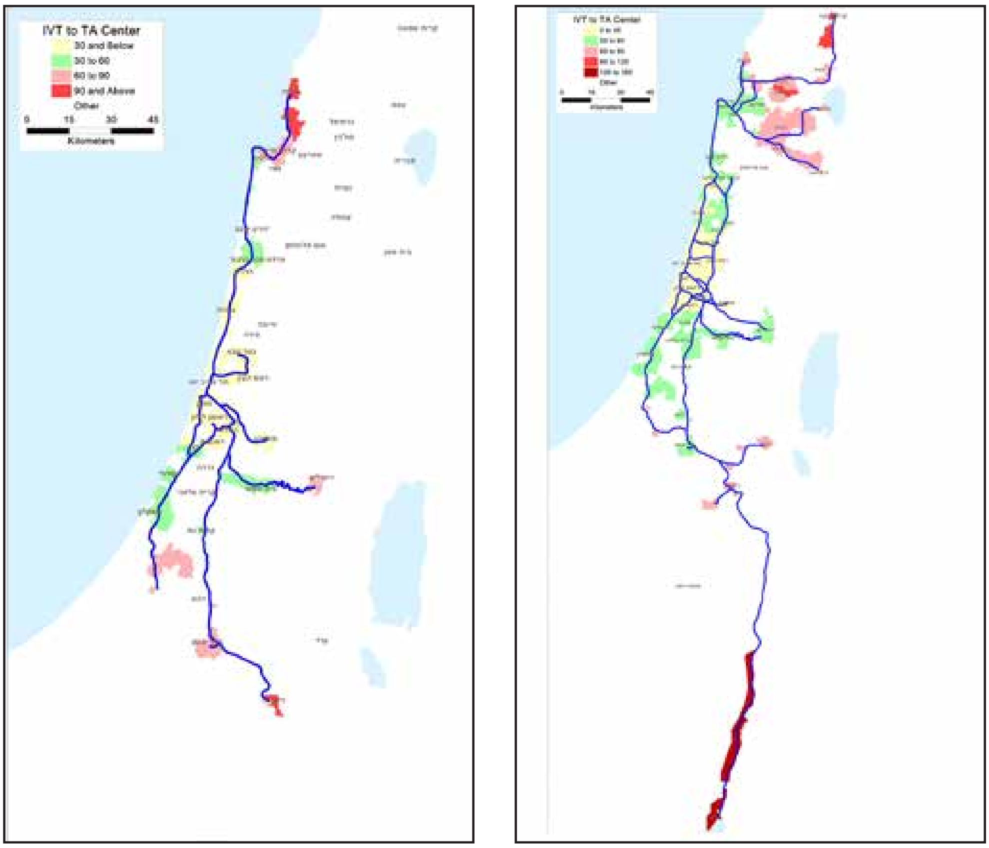


Figure 11.4– Travel time to Tel Aviv 2015-2040 Comparison (All Israel)

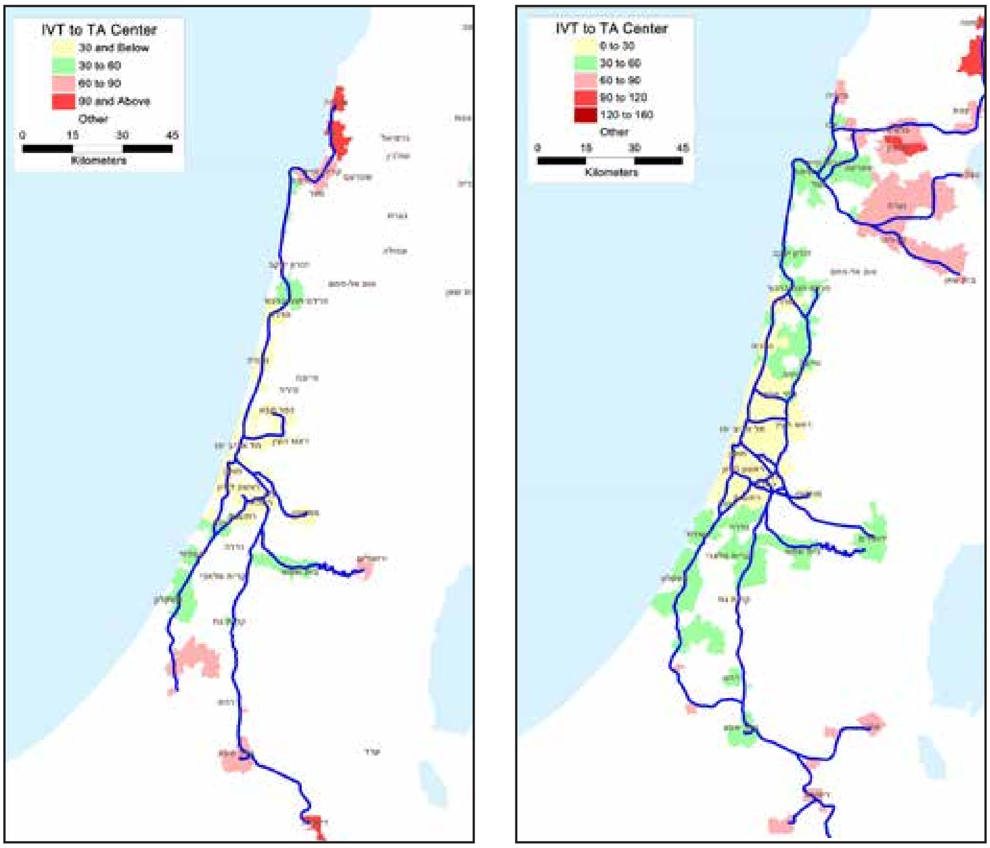


Figure 11.5– Travel time to Tel Aviv 2015 - 2040 Comparison (Existing network Nahariya – Dimona)

11.3 Economic Analysis

The main purpose of the economic analysis was to help design an efficient and balanced strategic plan and to assess the economic impact and benefits of the plan.

The economic analysis of the plan is based on forecast of the National Transport Model calibrated and improved for this strategic plan (see phase A Report: transport model calibration). The analysis was carried over 40 years based on the "Prat" (Transport project appraisal guidelines in Israel) 2012.

A cost-benefit analysis (CBA) was conducted for all the alternatives. The national economic benefits included passengers' time savings, car operating cost saving, parking and capital cost savings, reliability, environmental impacts, safety, public transport option value, and impacts on urban developments. The benefits were calculated for a target year upon completion of the strategic plan (2040) and full scale operation.

The model does not include the effects and benefits of the rail freight services

11.3.1 Capital Costs

Capital cost was calculated based on unit cost data and project level cost data received from ISR and some additional data based on international experience.

Rail operating and maintenance costs were based on ISR data and international experience. The operating costs for the mass transit lines (Metro, LRT and BRT) were based on the data collected on the strategy plans of the metropolitan systems (Tel Aviv data provided by EGIS using models and tools based on the company's experience in France and other places and adjusted to Israel prices). Operating cost includes employee wages, material costs, energy costs, and technology. Maintenance cost included train and network maintenance based on European experience (see phase A report international comparatives).

Table 11.3 and Table 11.4 provides an overview of the capital and O&M costs of the plan. C82 rail infrastructure and rolling stock costs are estimated as 81 Billion NIS with additional 5 Billion NIS for train shuttles' infrastructure in the periphery. C81 include heavy investment in government policy rail lines in the periphery, including the line to Kiryat Shmona and Eilat, and hence the capital costs are much higher: 124 Billion NIS.

Capex Summary			
Column1	Column2	Total Cost (MM NIS)	Column3
Item	Description	C81	C82
Infrastructure			
C1	Ayalon Corridor - to 5 tracks	10,370	10,370
C2	Ayalon Corridor - to 6 Tracks	3,921	3,921
C3	Central Region North - Eastern Line	5,063	5,063
C4	Jerusalem	1,587	1,587
C5	Central Region South	9,606	9,606
N1	Coastal Line to Haifa	12,198	12,198
N2	North Region to Carmiel (Rd 70), HaEmek Railway and Eastern Line	5,448	5,448
N3	North Region to Kiryat Shmona	12,068	
N4	Afula to Tiveria	1,706	
S1	South Region	5,060	5,060
S2	Eilat	22,549	
S3	Arad and Yerucham	1,363	
G1	Maintenance Depots	9,615	9,615
G2	Geopolitical Lines	3,845	
	Subtotal Infrastructure	104,397	62,866
Rolling Stock		19,259	18,044
Total Infrastructure + Rolling Stock		123,656	80,910

Note: MM NIS, excluding VAT.

Table 11.3– Capital Costs – Rail Infrastructure

O&M Cost Billion NIS	Scenario	
	C81	C82
Annual O&M cost - Rail	6.7	5.9

Note: Billion NIS, excluding VAT. The costs include operating and maintenance costs of train and network

Table 11.4– Operating and maintenance costs- Rail

11.3.2 Transportation Costs

The data for the economic model was evaluated based on peak hour model transportation model forecasts (see Phase A report: transport model calibration). Daily and annual factors were used to estimate the annual benefits and costs of each of the scenarios.

The model scenario examined on the economic analysis were:

- Base Scenario – This scenario was used as the "do nothing" scenario. The rail network defined as the planned 2022 network and the mass transit networks included only exiting lines and lines that were under construction on 2016. This scenario assumes no additional improvement of the rail network rather than projects already under construction. The base scenario do not have enough capacity to carry the trip demand forecast on 2030 and 2040 on both rail and road networks and thus few sub scenarios were developed to the base case scenarios spreading the congestion on roads and rail networks.
- Strategic plan C81 Scenario – The base plan version with more rail service in the periphery.
- Strategic plan C82 Scenario – The base plan version with more train shuttles (BRT's) in the periphery.

11.3.3 The Economic Model

The economic benefits to the national economy included:

- Time savings and congestion mitigation – The transportation model estimated the passengers'' time savings relative to the "do nothing" scenario. The model estimates time saving of public transportation system, passengers shifting to public transportation and reduction in congestion in road network.
- Vehicle operating cost saving – Reduction in vehicle operating cost on the road network together with changes of the public transportation operating costs.
- Parking and capital saving – These benefits included only reduction in car parking places needed in Tel Aviv CBD due to extensive usage in rail and mass transit.
- Improve travel time reliability - Rail system in congested areas and corridors can improve significantly the reliability of the travel time and allow passengers to better plan their departure and arrival times. This is set in the model in terms of reduction in trip time variation.
- Environmental impacts: reduction in air pollution – Calculation in changes in air pollution due to reduction in vehicle km on the road network. The emissions were calculated based on the Ministry of Environment emission data. We used European Union average rail emission cost data.
- Safety impacts – Safety impacts were roughly estimated as a possible direction of the impact based on the reduction of vehicle usage and average cost factors. No explicit calculation of risk and probability was carried.
- Option value of public transport – Option value of public transport is more commonly used these days. The strategic plan will impact on many cities and people and thus option value of the new system is needed to show wider impacts of the transit system. The option value of the plan was estimated based on the willingness to pay values found in the "Prat" 2012 option value survey.
- Economic development – Although large scale system might have many economic development characteristics, we only included agglomeration benefits of the CBD in Tel Aviv, effected by the increase of the capacity provided with the rail and mass transit system. This only accounts for relatively small share of the overall long term economic impact of the system.

We did not include other benefits and impacts like noise, comfort of ride, improve quality of life, international competitiveness, reduction in fuel usage and energy dependency, population spread or density benefits etc.

11.3.4 The Results

The economic benefits of the plan are presented in Table 11.5. The annual benefits of C82 on 2040 are estimated as 13.8 Billion NIS per year. These benefits include almost 8.5 Billion NIS of time savings and reliability benefits. The plan will also contribute to reduction to air pollution and increase in road safety. C81 benefits are lower, about 10 Billion NIS on 2040. C81 2040 Strategy Extended Network lines to the periphery are expensive and have low usage and thus do not contribute much social benefits and have higher operating and maintenance costs.

CBA - Summary Table Billion NIS	units	C81	C82
Economic Benefits			
Direct			
Operating Costs savings	layer 1	1.2	2.9
Time Savings	layer 1	5.6	6.9
Parking + Capital Savings	layer 1	0.1	0.1
Reliability	layer 1	1.2	1.5
	layer 1		
Total direct benefits		8.2	11.4
Externalities			
Environment	layer 2	0.6	0.7
Safety	layer 2	1.1	1.3
Urban Development (Agglomeration)	layer 2	0.3	0.3
Option Value	layer 2	0.1	0.1
Total externalities		2.0	2.4
Total Annual Benefits, Billion NIS		10.2	13.8

Table 11.5– The plan impacts and economic benefits

The economic analysis summary is presented in Table 11.6. We used 4% discount rate, representing a suitable rate for long term social projects, and 7% rate as the current practice in "Prat" 2012 guidelines.

C82 Plan yields high returns with benefit to cost ratio of 1.9-2.6 with for discount rates 4%-7% respectfully. The NPV is estimated as 30-80 Billion NIS. **This result show that the core of the plan (Plan C82) has very high contribution to the national economy and it is socially beneficial.**

C81 has high investment costs in the periphery rail lines with low usage and thus have less benefits than C82. The benefit cost ratio is below 1.0 at 7% and is 1.4 at 4%. **This results show that C81 is less efficient and not socially beneficial.**

The results show that the backbone of the system in **C82 is absolutely necessary to reduce congestion between the metropolitan areas in Israel** and yield high benefits to the national economy. **Without this backbone network crucial investments, the government policy lines to the periphery will have negative impact on the national economy.**

Billion NIS, 2016 economic prices			
		C81	C82
Capital Costs		123.7	85.9
Annual Benefit target year		10.2	13.8
investment period - years		20	20
4%			
NPV (4%,40 years)		26.3	84.6
B/C ratio		1.4	2.6
7%			
NPV (7%,40 years)		-1.9	32.6
B/C ratio		1.0	1.9

Table 11.6– Economic analysis summary results

12. STRATEGIC PLAN IMPLEMENTATION

12.1 Forecast Demand for 2030

A 2030 forecast was prepared for both the Policy Scenario and the Base Scenario. Since a 2030 policy scenario forecast was not available, an interpolation forecast was prepared and used to produce the 2030 travel forecast. The roads network was based on the approved MoT road scenario for 2030.

For each scenario two different mass transit scenarios was used:-

- C30 – Sensitivity
  - Haifa: Metronit, University cable car, Nazareth LRT
  - Jerusalem: Stage C
  - Tel Aviv: LRT only (red/green/purple)
- C31 - Base
  - Haifa: Metronit, University cable car, Nazareth LRT
  - Jerusalem: Stage C
  - Tel Aviv: LRT only (red/green/purple) and Metro (1+2)

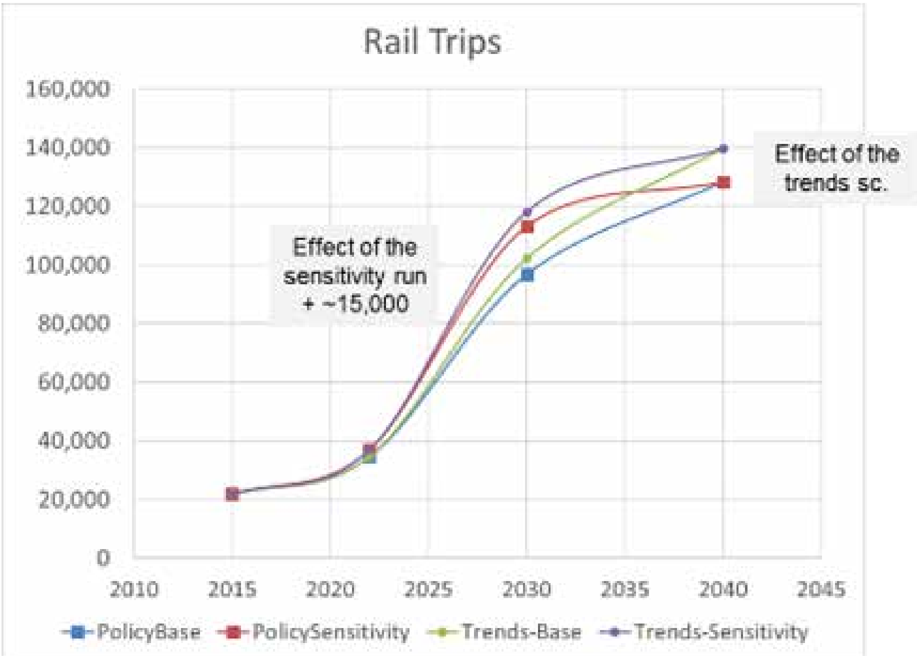


Figure 12.1 – Total Rail Trips Forecast

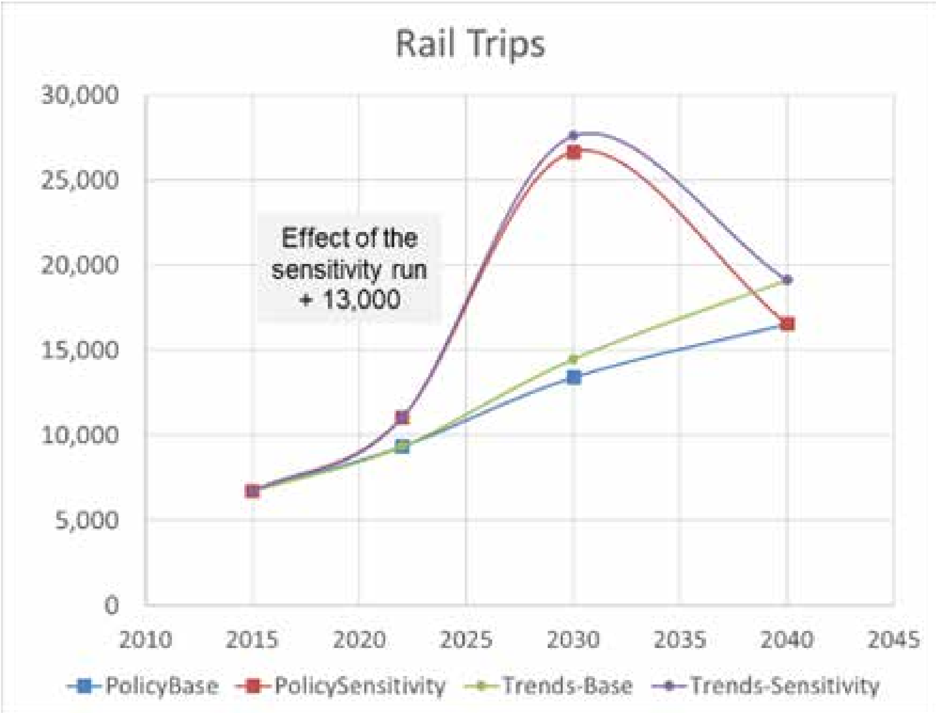


Figure 12.2 – Rail Trips Forecast Central district to Tel Aviv district

These forecasts showed that the rail demand will have increased by 2030 such that there will be a need for an increase in the frequency of services on many lines, particularly along the Coast Track and Ayalon South and a major investment in new rail infrastructure is required particularly in the central area. Without the completion of Mass Transit network in Tel Aviv the railway has to play a more significant role in providing public transportation within the area that will be covered by Metro Lines 1 and 2, increasing demand from the Sharon Valley, Ayalon South and along Road #431 and from Rehovot.

The following new routes and improvements that could be delivered by 2030 was assumed, it was assumed that the Metro Lines in Tel Aviv would not be delivered by this time:

- Passengers
  - 6 tracks in the Ayalon (Tunnel)
  - Lod bypass
  - Haifa 4 tracks (Tel Aviv to Lev HaMifratz)
  - Eastern Track (to Harish)
  - New/Expanded stations
    - » Widening BG Air Port
    - » Center station in Jerusalem
    - » Expand station in Be'er Sheva
    - » Expanded Ayalon stations
- Freight
  - Lod Bypass
  - Eastern track through Hadera
  - Terminal: Eyal or alternative location
  - 2 tracks from Beer Sheva to Tsefa
  - Port access improvements
- It is assumed that the following mass transit systems will be in place (C30 – Sensitivity) :
- Haifa: Metronit, University cable car, Nazareth LRT

- Jerusalem: Stage C
- Tel Aviv: LRT only (red/green/purple)

The following services were assumed to operate:

- National Services

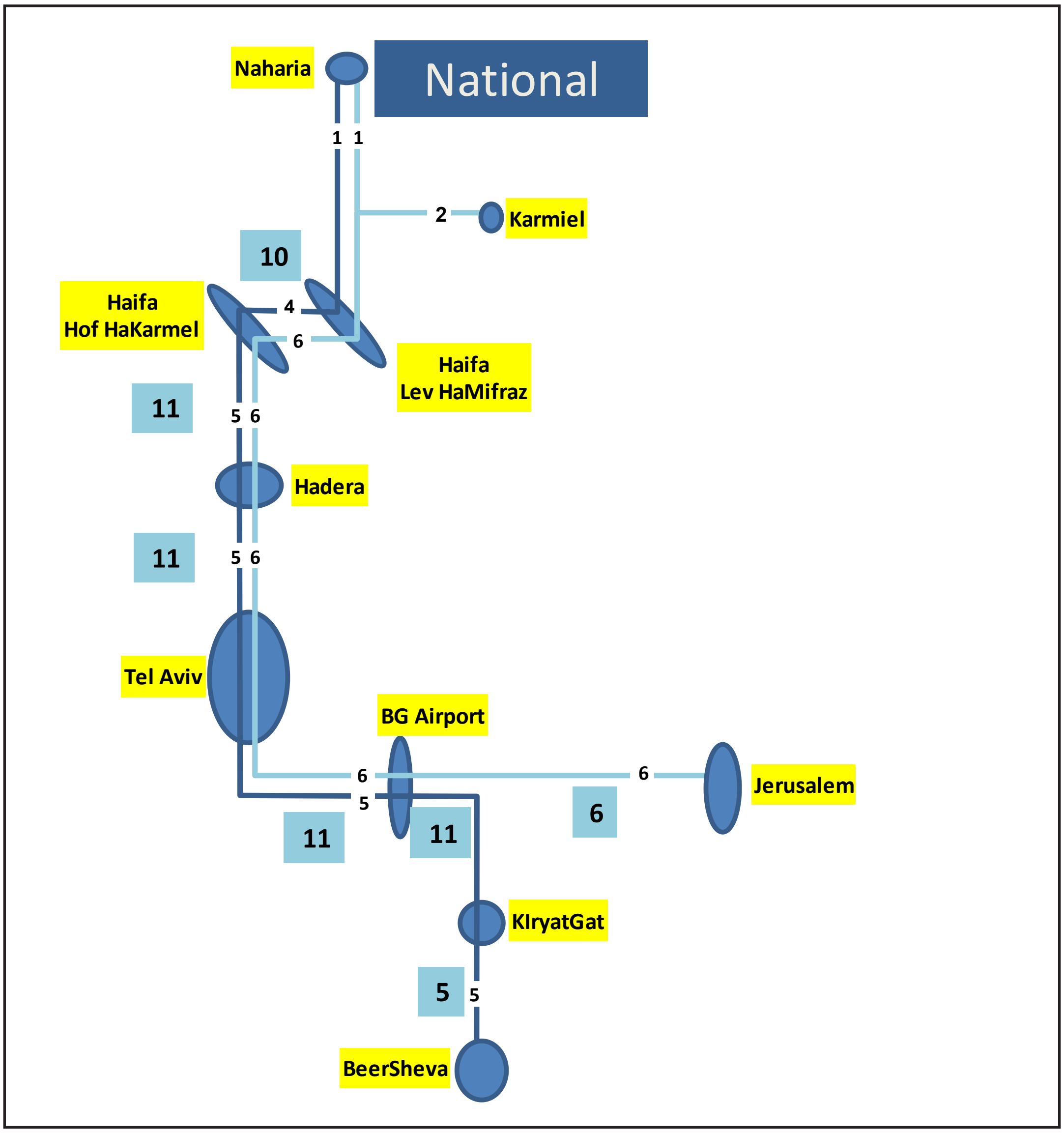


Figure 12.3–National Services 2030

- Local Services
  - North – as C81, Figure 12.4
  - South - as C81, Figure 12.5
  - Center and Jerusalem as Figure 12.6.

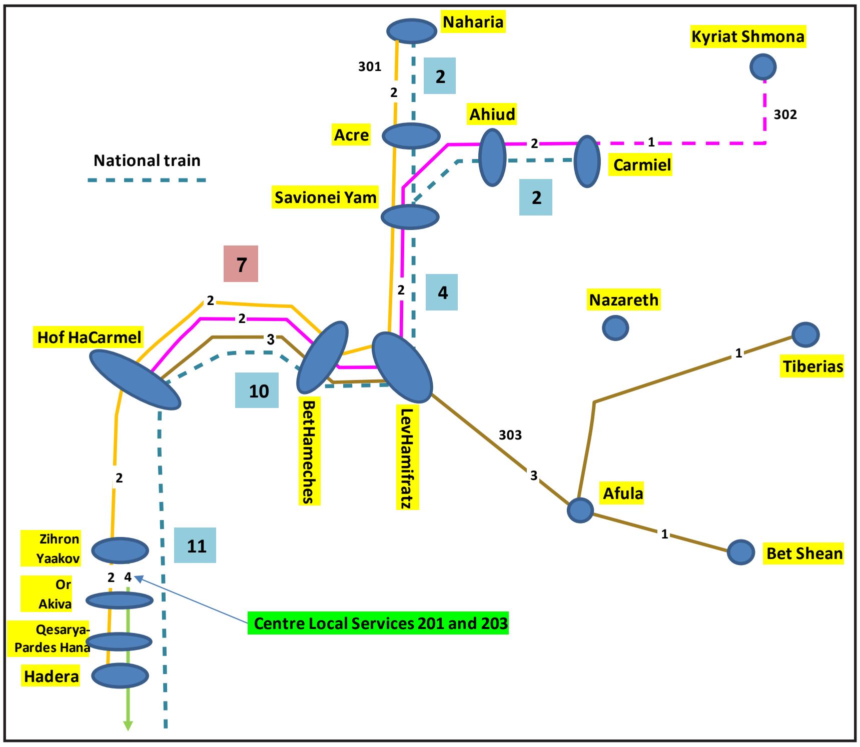


Figure 12.4 –Local Services – North 2030

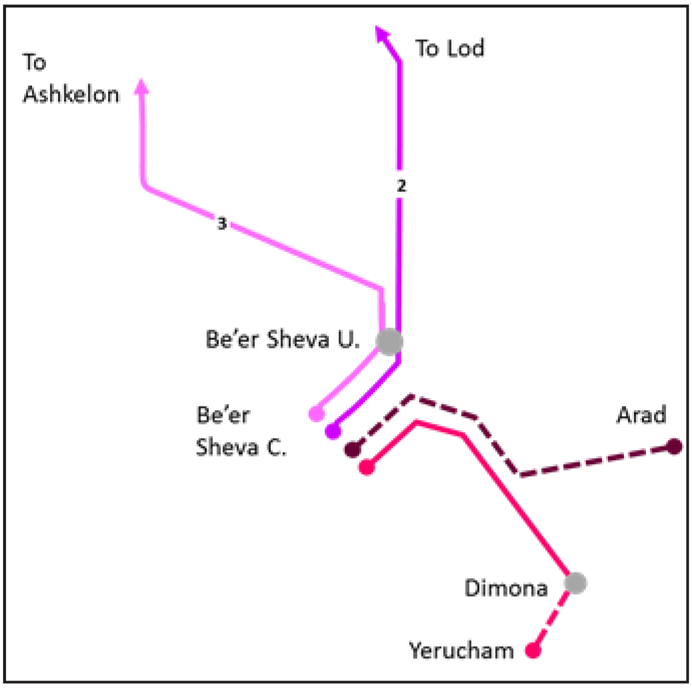
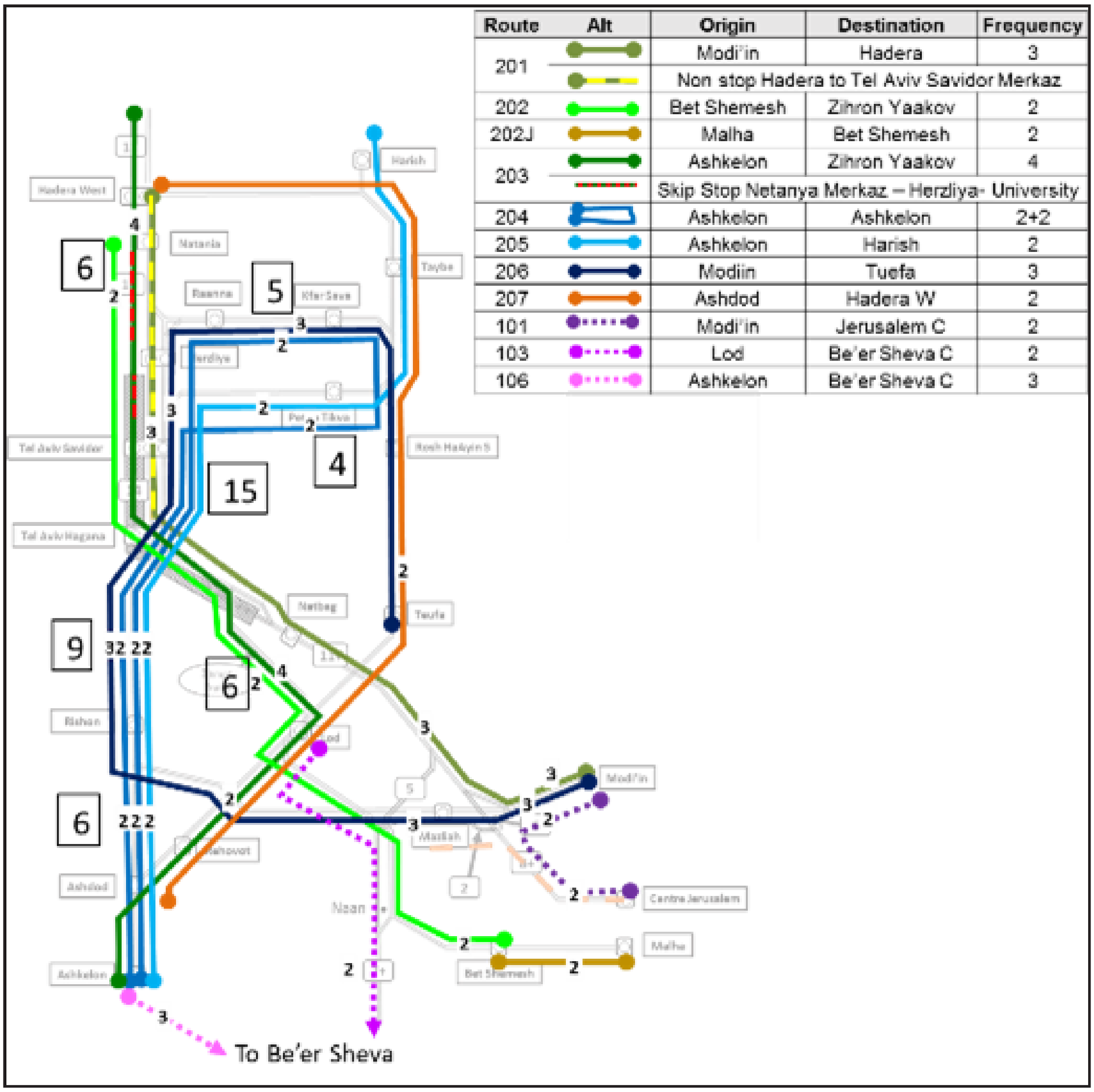


Figure 12.5 –Local Services – South Area 2030



Route	Alt	Origin	Destination	Frequency
201		Modi’in	Hadera	3
		Non stop Hadera to Tel Aviv Savidor Merkaz		
202		Bet Shemesh	Zihron Yaakov	2
202J		Malha	Bet Shemesh	2
203		Ashkelon	Zihron Yaakov	4
		Skip Stop Netanya Merkaz – Herzliya- University		
204		Ashkelon	Ashkelon	2+2
205		Ashkelon	Harish	2
206		Modiin	Tuefa	3
207		Ashdod	Hadera W	2
101		Modi’in	Jerusalem C	2
103		Lod	Be’er Sheva C	2
106		Ashkelon	Be’er Sheva C	3

Figure 12.6 –Local Services – South Area 2030

12.2 Assessment of 2030 Network

Although in general the forecast demand for rail transport increase between 2030 and 2040 the most significant change in demand occurs in the Central Area. Figure 12.7 shows load factors of the lines in the 2030 plan, based on the model results. Most of the lines are well balanced with adequate passenger volumes over train capacity in the range of 0.5-1.0. As in 2040 some lines have low utilization (load factors are in the range of 0.2-0.5).

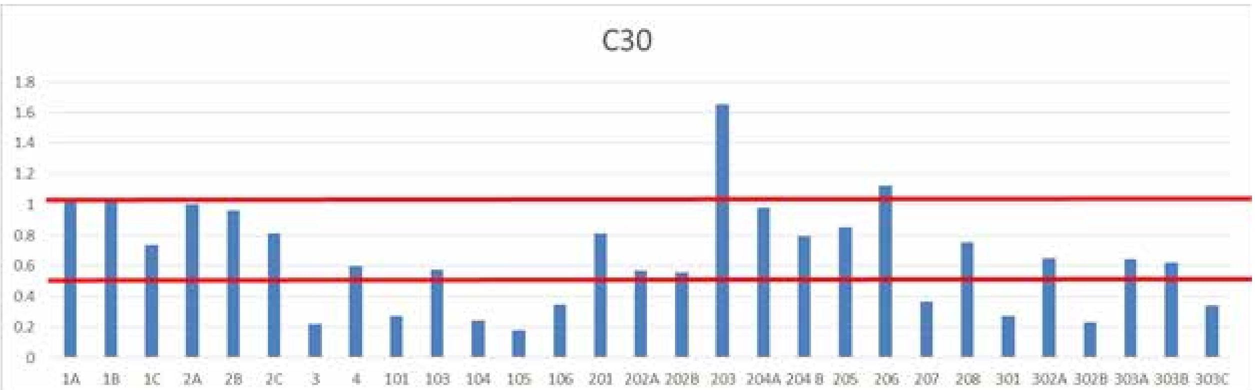


Figure 12.7– Route Balance Load Factors – Alternative C30

The demand that has been forecast for 2030 is shown in Appendix B; the forecast demand at each station is shown in Appendix C.

The highest load factors occur on some local services in the central area and this reflects passengers from the inner metropolitan areas using the railway because of the lack of the Metro Lines 1 and 2. A higher proportion of journeys are short but by 2040 many of these trips transfer to the Mass Transit system and demand increase more from the outer metropolitan areas. The consequence of this is that by 2040 most journeys on local services into Tel Aviv assuming standing passengers would be unacceptable because of the longer journey time, but in 2030 standing would be acceptable.

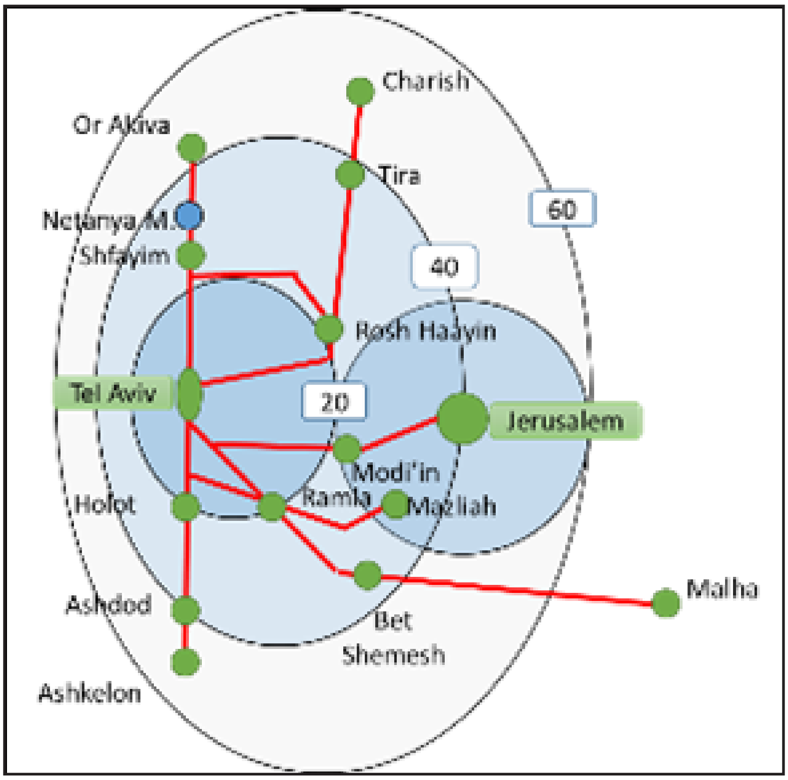


Figure 12.8– Approximate Journey Time to Tel Aviv and Jerusalem

12.3 Priority Projects

The following have been identified as the most important projects that need to be delivered to ensure that the railway can meet the demand forecast for 2030.

12.3.1. Ayalon

The services assumed for 2030 envisage 29 trains per hour passing through the Ayalon Corridor during a peak hour, this requires the expansion of the capacity. This requires the construction of the tunnel under the corridor for the National Services, it is assumed that 14 tph operate on these tracks. The remaining 15 tph will have to use the at grade tracks, whilst this is within the capacity of the 3 existing tracks the routes that are operated do not permit this to happen. 9 tph will link the Ayalon South to the Sharon Valley and 6 tph will link Lod with Netanya this would require trains to cross tracks at HaHagana and this would remove capacity.

Therefore it is recommended that the six track layout, Ayalon Tunnel and widening to 4 tracks at grade, is constructed by 2030.

12.3.2 Coastal Track (Tel Aviv to Lev HaMifratz)

Demand from Haifa and the north of Israel towards Tel Aviv and beyond is forecast to be very strong by 2030 about 11,000 passenger per hour, with further demand form intermediate stations about 9,000 passenger per hour, requiring a service of at least 17 trains per hour. This is beyond the capability of the existing two tracks. In addition it is proposed to provide a mix of service types with fast trains, semi-fast and all stations services, to provide an attractive alternative for car users, this would further reduce the capacity of the two track railway.

The number of passenger trains decreases north of Hadera to 15 tph but from here the tracks will be shared with freight services and the additional capacity of 4 tracks will be required. Through Haifa itself it is proposed to operate up to 18 passenger trains per hour together with the freight services and the additional capacity of 4 tracks will be required.

It is recommended that the two additional tracks for high speed services are added to the railway between Tel Aviv and Lev HaMifratz to provide the capacity required to satisfy the demand that is forecast for 2030. The section between the end of the Ayalon Tunnel and Haifa Hof HaCarmel should be designed for 250 km/h operation.

12.3.3 Road #431

In 2030 flows along this route are high carrying 4,500 passengers per hour, the construction of the Metro routes reduces demand, but are moderate in 2040. This route forms an important link within Rishon LeTsiyon and to Tel Aviv. Without this railway it is likely that more demand would fall on the line through Rehovot and Lod which is forecast to be very busy.

12.3.4 Lod Bypass

Lod Bypass provides additional capacity in the Lod area. Without the bypass there would be up to 17 trains per hour passing Lod station and there would be considerable conflicts caused by trains crossing paths, in addition to the passenger services freight services would also operate.

Lod Bypass allows National Services from Be'er Sheva to Tel Aviv to avoid Lod and go directly to BG Air Port rather than accessing to BG Air Port from the Eastern Track. It also allows freight services to avoid the built up areas of Ramla and Lod and gain access to the Eastern Track at Teufa.

12.3.5 Eastern Track

The Eastern Track from Teufa to Hadera provides a route for freight trains to avoid the busiest section of the Coastal Track from Lod to Hadera allowing freight trains to operate all day. Widening the railway from Lod to Teufa allows a passenger service to operate along this route providing an alternative for some passengers to the Coastal Track or using the private car.

Extending the Eastern Track to Harish and providing a direct service to Tel Aviv provides an attractive service to settlements along the route.

12.3.6 Freight Terminals

To facilitate the growth in freight traffic on the railway a Freight Terminal at Eyal, or an alternative location, on the Eastern Track should be constructed to serve the central area. Improvements should also be made to improve the flows into and out of the Ports of Ashdod and Haifa.

Flows from Ashdod would also be improved by the construction of the Pleshet – Lod Project, this would remove freight traffic from Lod and Rehovot and allow more flexible timetabling.

12.3.7 Soreq to Be'er Sheva

If the forecast increase in freight traffic, particularly building materials from the Negev, and to operate a high speed service between Tel Aviv and Be'er Sheva it will be necessary to provide a separate two track alignment for National Services.

12.3.8 Be'er Sheva to Tsefa/Tamar

Aggregates and minerals from the Tsefa/Tamar area is a major source of freight for the railway and it is expected that this traffic will grow and a major constraint on growth will be the single track line from Be'er Sheva. It is therefore suggested that this track should be doubled and, if practicable, the alignment improved to allow increased train speeds.

12.4 Freight in 2030

In 2030 it is assumed that the principal route for freight traffic from south to north will be by a widened route from Tsefa, Tamar and Zin to Be'er Sheva, the Lod Bypass and Eastern Track from Teufa to Hadera. From Hadera North freight trains will share the widened Coast Track to Haifa.

12.4.1 Demand

Freight demand in 2030 has been estimated from the forecasts prepared by Aviv/AMCG with adjustment to take account of parts of the network that will not be developed by 2030. As in 2040 it has been assumed that to maximize the efficiency of the freight operation it is anticipated that trains operating between the main terminals will be increased in length to 750 m, this will reduce the number of trains but require additional or improved infrastructure, such as longer loops and sidings.

The service will generally operate 24 hours a day Sunday to Thursday and for 12 hours on Friday. There will be some restriction through and around Haifa and between Soreq and Be'er Sheva. The commodities moved will be the same as in 2040, except there will no trains carrying new imported vehicles for distribution in Israel. The forecast demand between terminals has been converted to the number of trains to carry the demand and this is shown in Appendix F:

- Inter-modal Containers, between the ports and between the ports and inland terminals - 40 trains per working day;
- Sand, with a reverse flow of garbage between Tsefa and terminals in the center and north – 29 trains per working day;
- Minerals between the Negev and Ashdod – 10 trains per working day;
- Aggregates between Tamar and terminals in the center and north – 10 trains per working day;
- Metal products between the ports and inland terminals – 5 trains per working day;
- Grain between the ports and grain terminals at Hadera East, Bene Brak, Dvira and Bet Shemesh – 7 trains per working day.

In addition there will be some local working of shorter freight trains between smaller terminals and the major terminals, also between terminals around Haifa.

12.4.2 2030 Freight Routes

To accommodate this increase it will be necessary for the network capacity to be expanded considerably. As far as possible the different networks, National, Local and Freight should be segregated, however, this cannot always be justified. Keeping the networks segregated increases the reliability of all of the services because of the different performance characteristics of the trains reduce the capacity of the routes and require better timekeeping to avoid knock-on delays.

It is assumed that the principal conflict that restricts freight traffic now; the Coastal Track between Ashkelon, the South and Hadera, where intensive passenger services operate will be resolved by the construction of the Eastern Track, Lod Bypass and Pleshet – Lod (Rehovot Bypass, Ashdod – Soreq – Lod Bypass). In addition to operate increased services to the Negev it will be necessary to widen from Mamshit to Be'er Sheva and to allow freight services to operate throughout the day and a high speed National Service between Tel Aviv and Be'er Sheva it will be necessary provide a new two track high speed alignment between Lod Bypass and Be'er Sheva.

The number of freight trains forecast is shown on Figure 12.9.

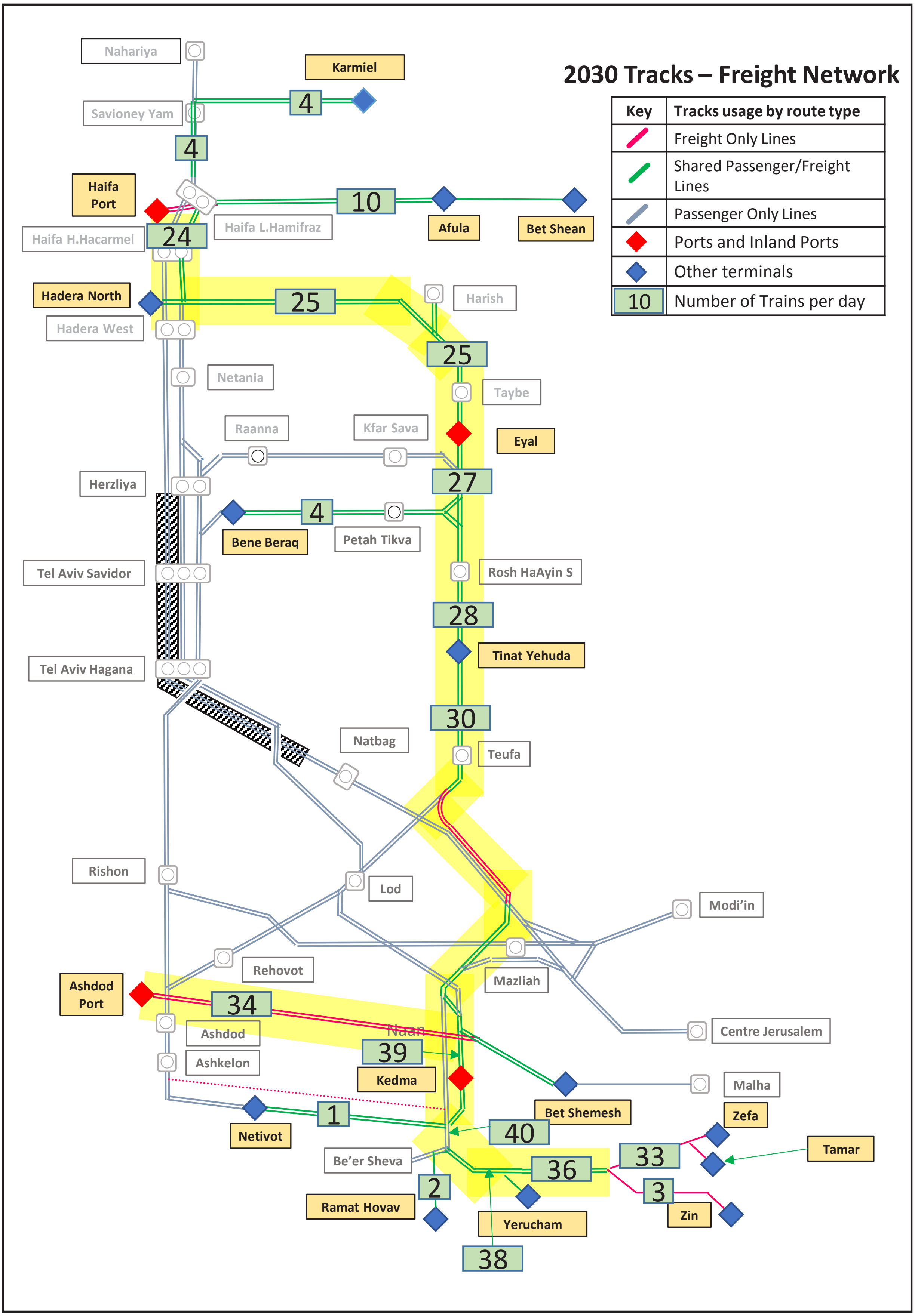


Figure 12.9 – Freight Routes – 2030 and Number per day on Principal Routes

13. FINAL PLAN

13.1 The Strategy

The 2040 Strategic Development Plan includes the following features:

- Separation of the ISR passenger service into 2 levels:
  - National Service: fast, high frequency, few stops, connect the 4 Metropolitan centers
  - Exclusive use of 250 km/h tracks by National Services operating when justified
  - Local service: regional routes, with many stops, connect to hubs, skip stop on some services.
- Freight integration:
  - Operations according to forecasts and introduction of land port hubs;
  - Dedicated facilities in main corridors and access to ports;
  - Reduced conflict with passenger services;
  - Eastern corridor and land ports.
- Advantages in system performance, reliability, regularity and clarity:
  - Trains operate at frequent regular intervals on most routes;
  - Small number of routes on many lines to provide clarity to passengers;
  - National routes have dedicated tracks from Haifa to BG Air Port and Na'an-Beer Sheva to reduce interference from local and freight services.
- Significant Capacity Increase :
  - Heavy infrastructure investment in strategic facilities;
  - Prospect of high demand levels in the medium term due to delays in metropolitan Mass Transit require early investment in rail network;
  - Demand on routes around Tel Aviv changes as metropolitan Mass Transit is opened.
- Flexible Plan
  - Plan takes in account uncertainty (high demand forecast with many unknowns).
  - Rather than a fixed service layout, the plan proposes an operational formula.

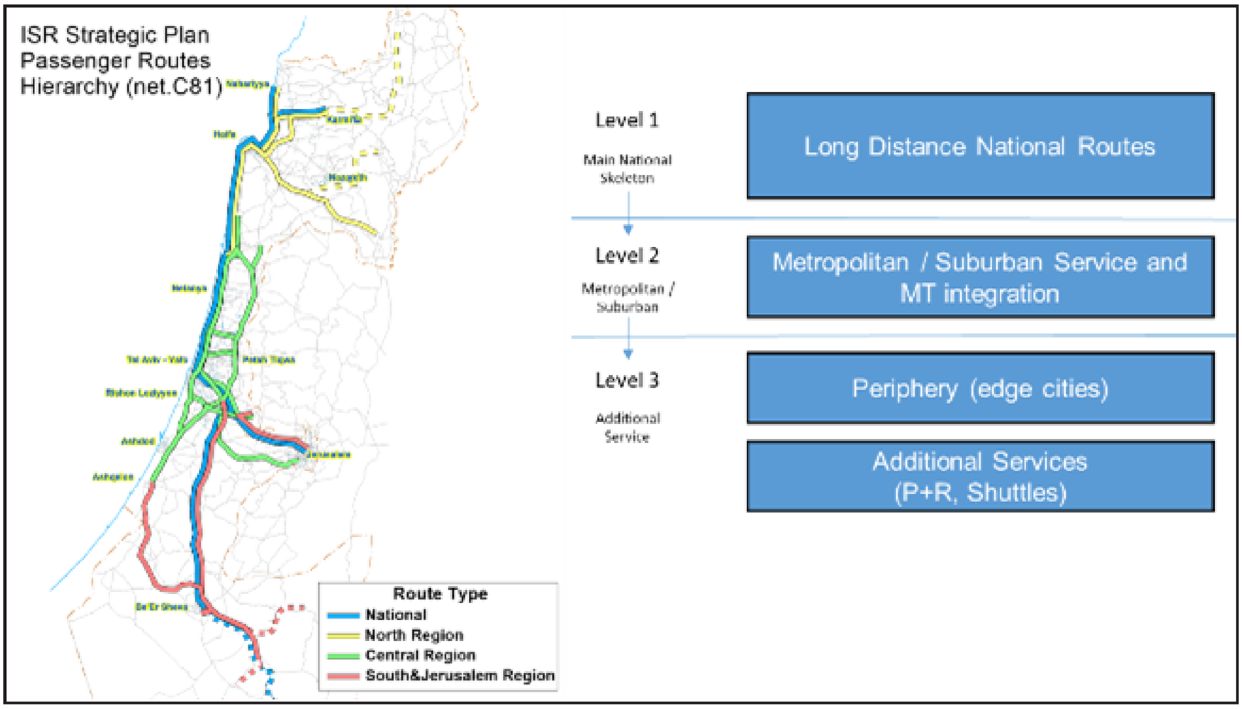


Figure 13.1 Hierarchy of Israel Rail Passenger Services

13.2 Recommended Alternative

It is recommended that Alternative C81 is adopted as the 2040 Strategic Plan for Israel Railways. It consists of three elements:

- Base network – to meet demand based on professional criteria (Alternative C82), including freight routes.
- National policy rail lines – based on government policy of connecting the periphery - These lines should be built after other items required for 2030 network unless otherwise decided by the government.
- Geopolitical tracks – based on government policy of potential connection to neighboring countries. These are dependent on geopolitical developments and to safeguard these routes the right of way required should be reserved.

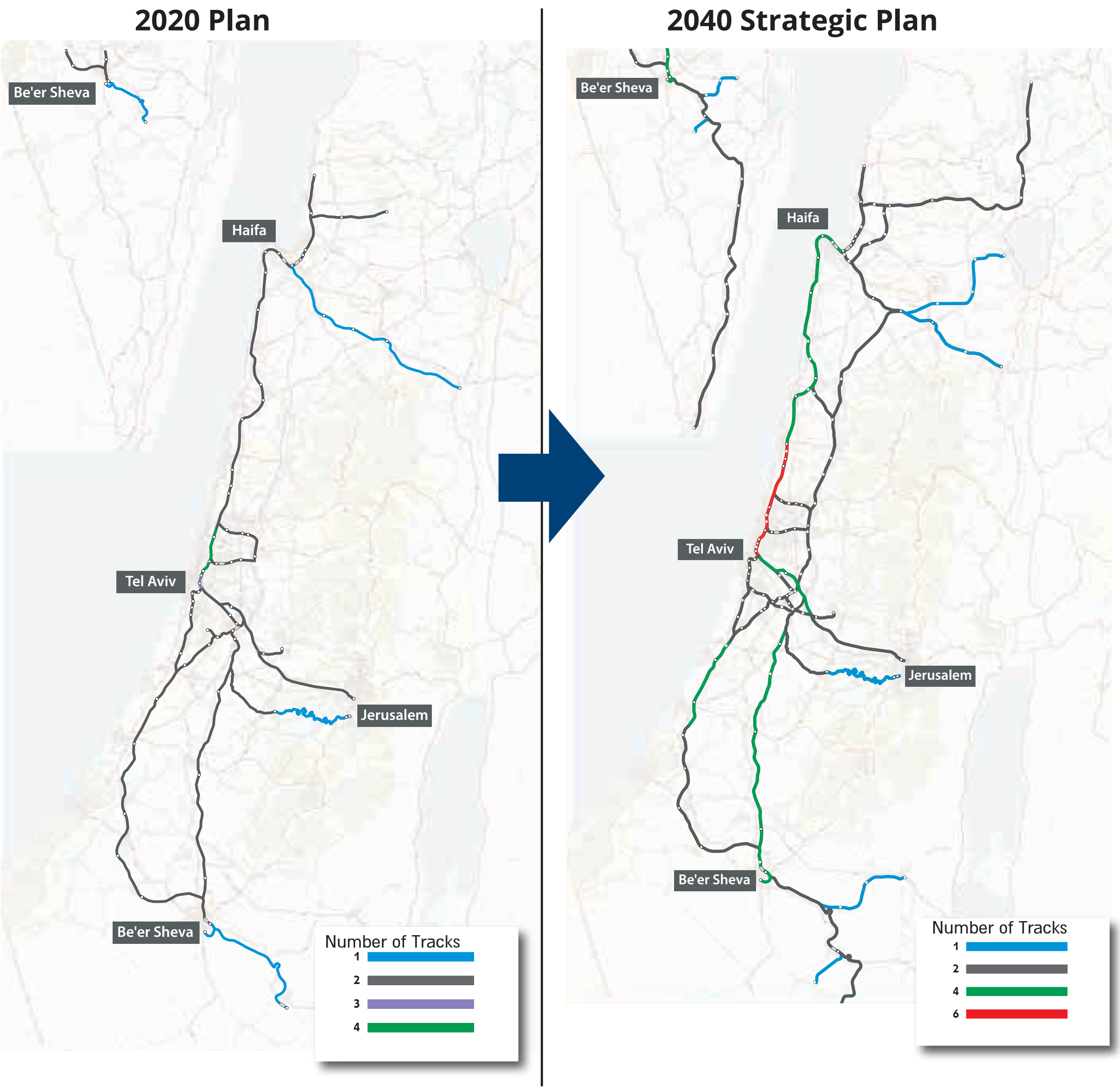


Figure 13.2 Passenger Network – C81 Compare to 2020 Plan

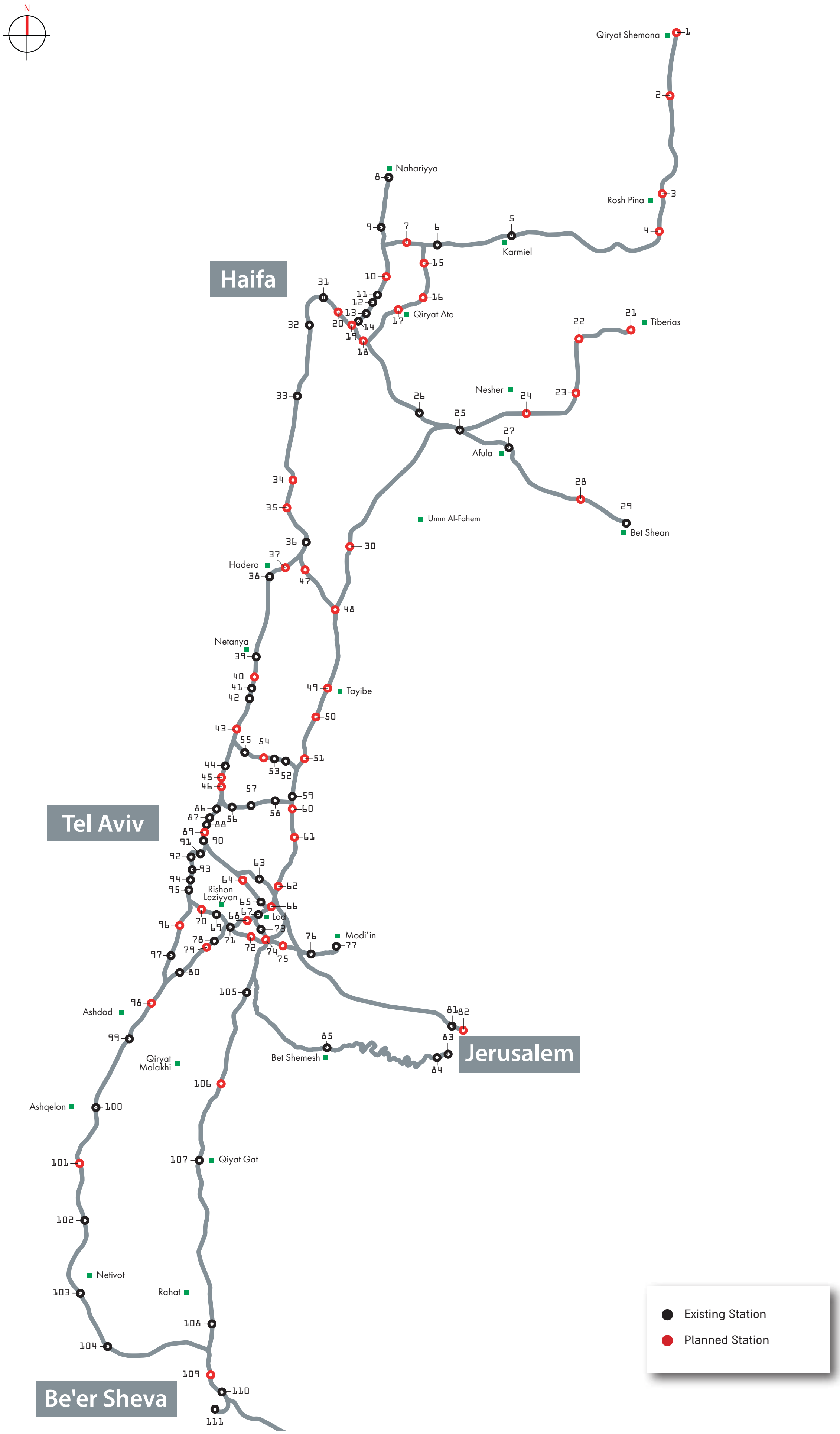
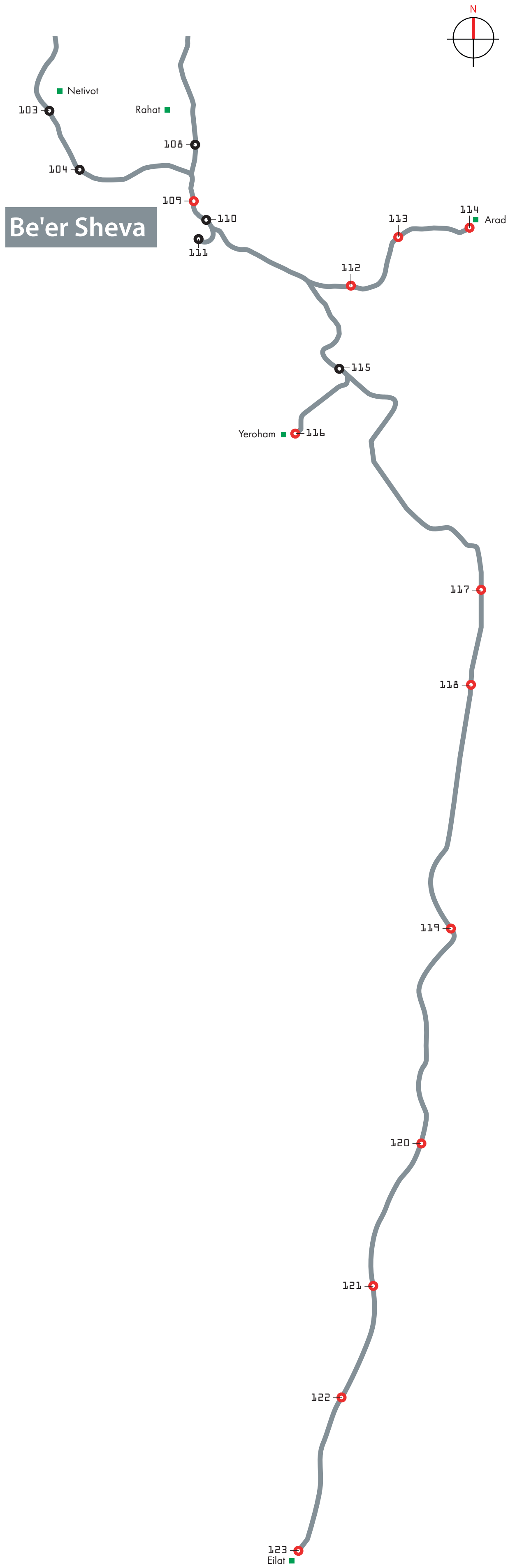


Figure 13.3 Alternative C81 Passenger Network - North and Center



1	Qiryat Shemona
2	Gonen
3	Rosh Pina
4	Ammiad
5	Karmiel
6	Ahihud
7	Maker
8	Nahariyya
9	Acre
10	Qiryat Yam Savionei Yam
11	Qiryat Motzkin
12	Qiryat Haim
13	Huzot Hamifratz
14	Lev Hamifratz
15	Tamra
16	Shefaram
17	Qiryat Ata
18	Nesher
19	Lev Hamifraz East
20	Haifa Beth Hameches
21	Tiberias
22	Zomet Golani
23	Kefar Tavor
24	Nazareth South
25	Kefar Barukh
26	Kefar Yehoshua Yoqneam
27	Afula
28	Tel Yosef
29	Bet Shean
30	Harish
31	Haifa Bat Galim
32	Haifa Hof Hacarmel
33	Atlit
34	Zikhron Ya'aqov
35	Or Aqiva
36	Qesaryya Pardes Hanna
37	Hadera North
38	Hadera West
39	Netanya
40	Netanya College
41	Netanya Sapir
42	Bet Yehoshua
43	Shefayim
44	Herzliyya
45	Ramat Hasharon Glilot North
46	Ramat Hasharon Glilot South
47	Hadera East
48	Ahituv
49	Tayibe
50	Tira
51	Kefar Sava North
52	Kefar Sava Nordao
53	Hod Hasharon Sokolov
54	Ra'annana South
55	Ra'annana West
56	Bene Beraq
57	Petah Tiqwa Kiryat Arie
58	Petah Tiqwa Segulla
59	Rosh Ha'ayin North
60	Rosh Ha'ayin South
61	Elad-Rinntya
62	Teufa
63	Ben Gurion Airport
64	Shapirim
65	Lod Ganey Aviv
66	Lod North
67	Lod
68	Ramla West
69	Rishon Leziyyon Harishonim
70	Rishon Leziyyon Me'uyan Soreq
71	Be'er Ya'aqov
72	Ramla South
73	Ramla
74	Ramla East
75	Mazliah
76	Peatey Modi'in
77	Modi'in Center
78	Rehovot
79	Rehovot Gavirol
80	Yavne
81	Jerusalem Yizhak Navon
82	Jerusalem Center
83	Jerusalem Malcha
84	Jerusalem Zoo
85	Bet Shemesh
86	Tel Aviv University
87	Tel Aviv Center Savidor
88	Tel Aviv Hashalom
89	Tel Aviv Yizhak Sade
90	Tel Aviv Hagana
91	Zomet Holon
92	Holon Wolfson
93	Bat Yam Yoseftal
94	Bat Yam Komemiut
95	Rishon Leziyyon Moshe Dayan
96	Holot Gan Rave
97	Yavne West
98	Bene Darom
99	Ashdod Ad Halom
100	Ashqelon
101	Yad Mordekhay
102	Sederot
103	Netivot
104	Ofaqim
105	Mazkeret Batya
106	Qiryat Malakhi Yoav
107	Qiyat Gat
108	Lehavim Rahat
109	Be'er Sheva Ramot
110	Be'er Sheva North
111	B'eer Sheva Center
112	Arara
113	Kuseife
114	Arad
115	Dimona
116	Yeroham
117	Hazeva
118	Sapir Arava
119	Paran
120	Yahel
121	Yotvata
122	Timna
123	Eilat

Existing Station
Planned Station

Figure 13.4 Alternative C81 Passenger Network - South

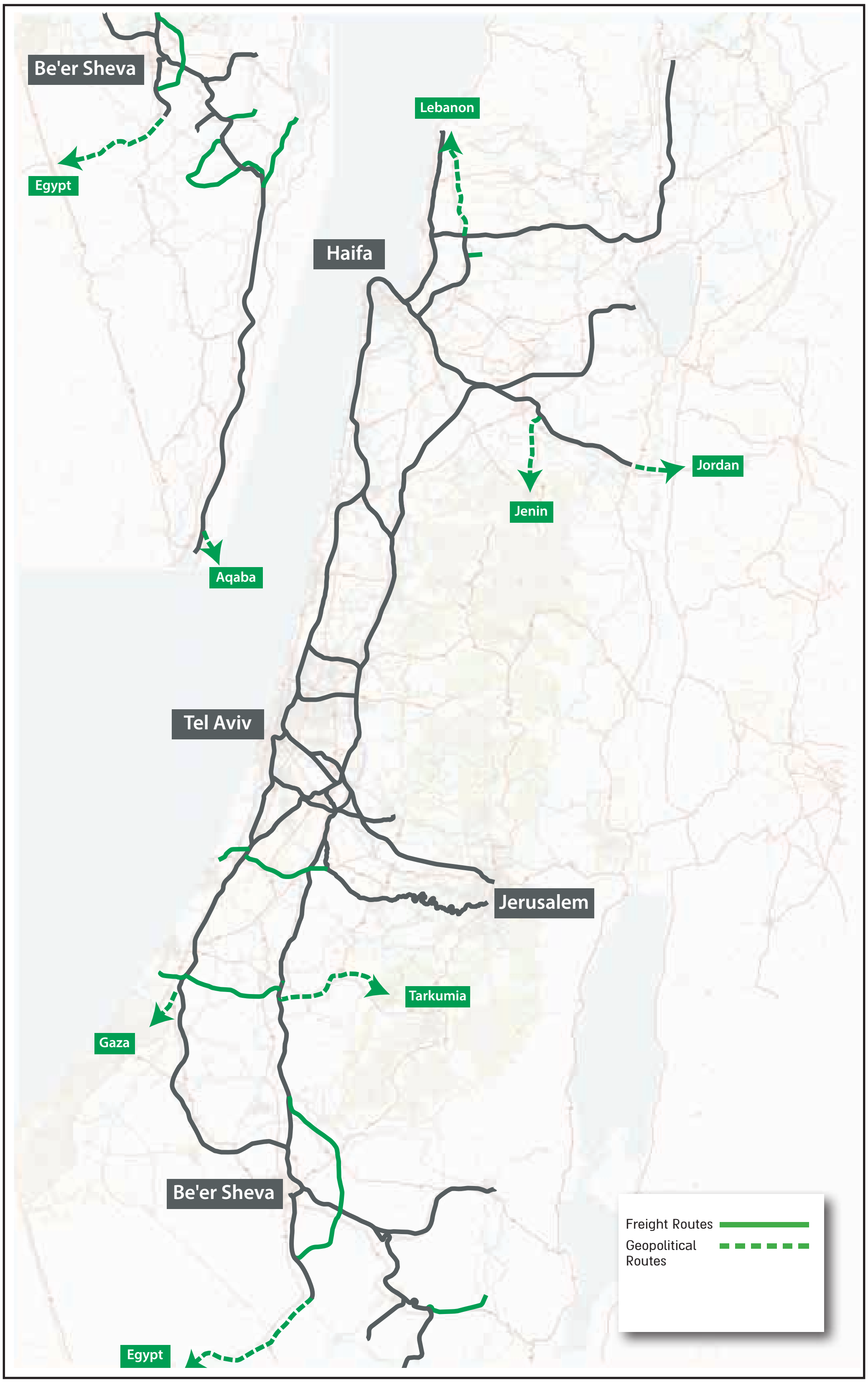


Figure 13.5 Geopolitical and Freight Only Routes

APPENDICES

A. APPENDIX A – DEVELOPMENT OF PHASE A NETWORKS

A.1 Alternative C5

Further runs of the Transport Model were made to complete identification of the improvements that would be required to support the 2040 Strategy and to combine the best features of the previous alternatives and address some areas of concern as noted in our report "Phase A Report - Transport Networks" issued in February 2016.

The principal areas of concern addressed were:

- Overloading of National Routes, particularly Haifa to Tel Aviv –
  - ncrease the number of trains operating or eliminating the stop at Hadera.
- North Local Services – underutilized services
  - Reduce frequency of services to more closely match demand.
- Central Local Services – matching supply to demand
  - Reduce overloading by increasing the number of trains operating on line from Hadera and Ashkelon.
  - Do not include underutilized lines
  - Reduce frequency to a minimum of 3 trains per hour on routes with insufficient demand to require more trains.
- South Local Services – underutilized services
  - Reduce frequency of services to more closely match demand

Three further Alternative Service Line patterns were developed, C5.1, C5.2 and C5.2A. All Alternatives include a two track tunnel for National Services under the Ayalon. Alternatives C5.1 and C5.2 required the widening of the Ayalon Corridor to 6 tracks two for National Services and 2 for Local Services. Alternative C5.2A was similar to C5.2 but it was designed to utilize the existing three track Ayalon Corridor for local services rather than widen the existing tracks to provide 4 local tracks. This required some services to terminate from the south to terminate at HaHagana station.

A common network was adopted for the North and South for all of these alternatives.

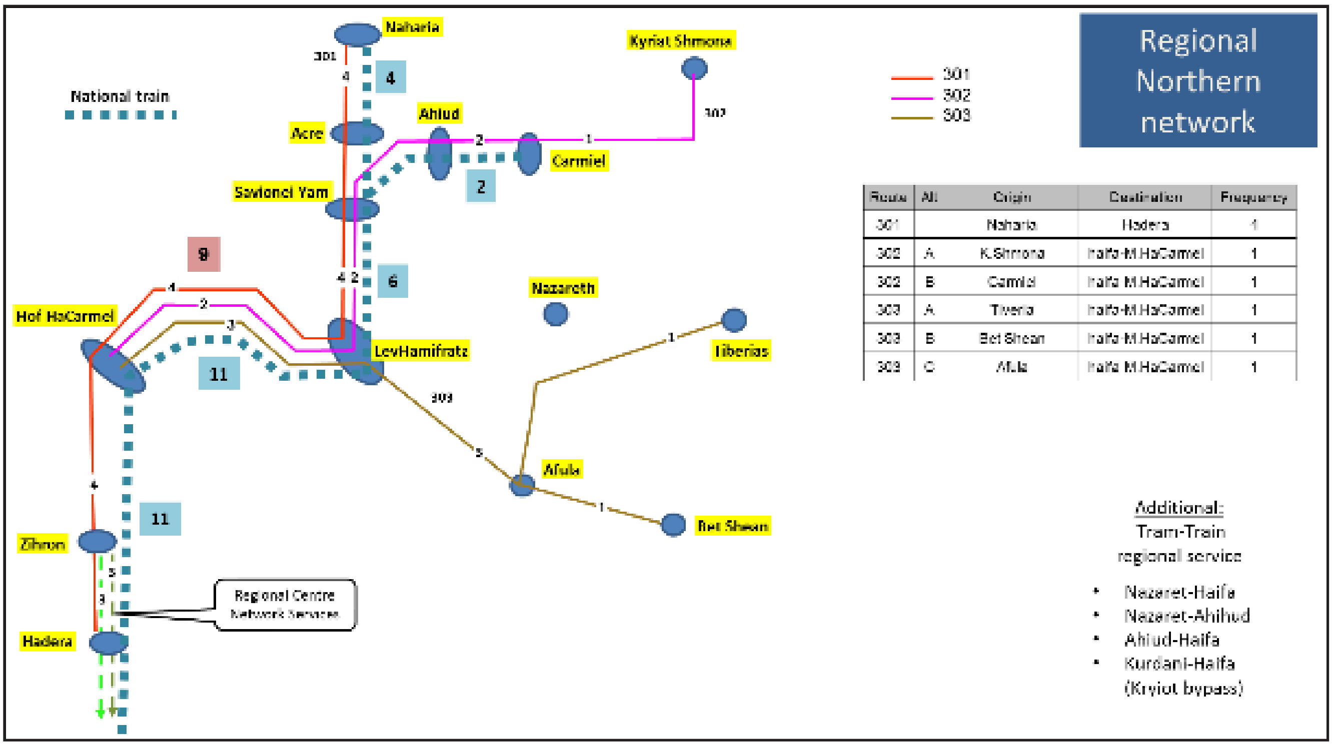
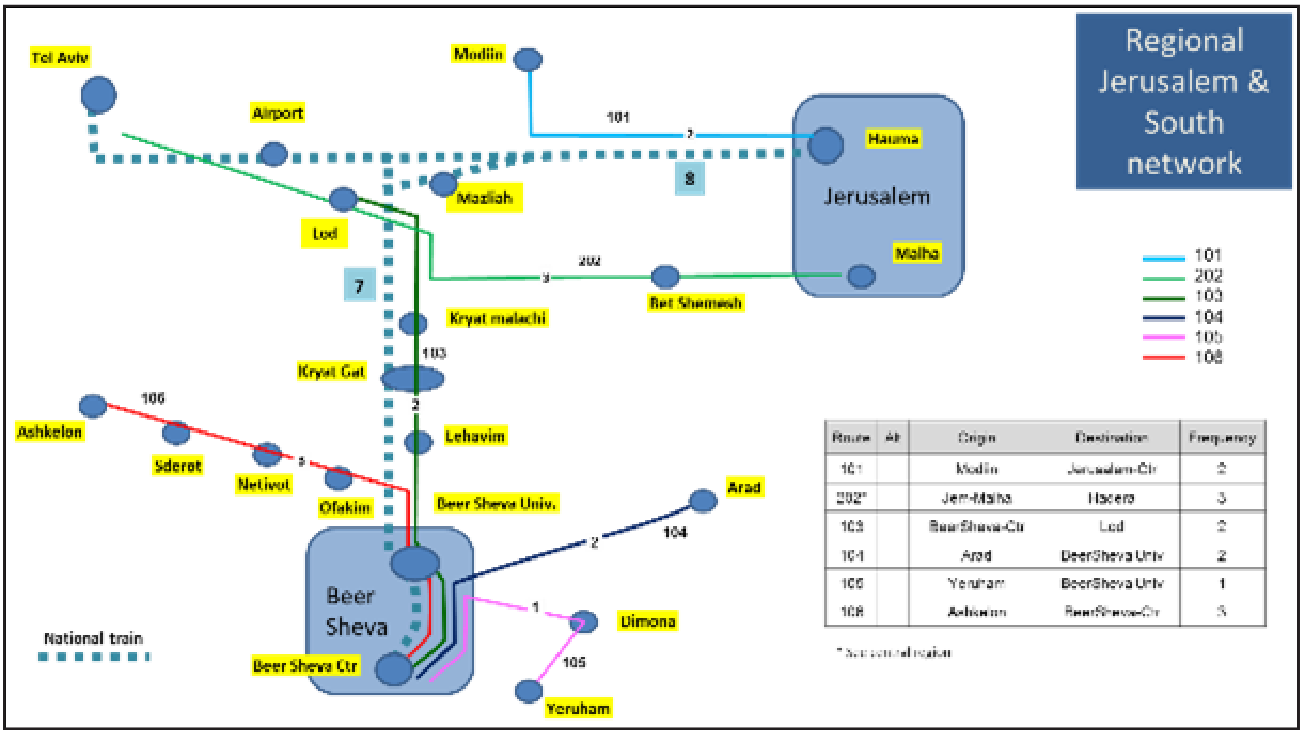


Figure A1.1 –Local Routes (North) – Alternative C5



Route	Alt	Origin	Destination	Frequency
101		Modiin	Jerusalem-Ctr	2
202*		Jer-Malha	Hadera	3
103		BeerSheva-Ctr	Lod	2
104		Arad	BeerSheva Univ	2
105		Yeruham	BeerSheva Univ	1
106		Ashkelon	BeerSheva-Ctr	3

* See central region

Figure A1.2 –Local Routes (South) – Alternative C5

A.1.1 Travel time / Station spacing

A particular concern identified was the increase in journey times in 2040 on some routes compared to those likely to prevail after electrification of the services. This increase was caused by the number of stations that are planned to be constructed. There is an inherent conflict between providing coverage and route performance. Often there is pressure on the railway to increase coverage by providing more stations to serve new development areas, however, adding an additional station introduces a time penalty for those passengers already on the train. It takes additional time in slowing down and speeding up and the duration of the stop.

The hierarchical approach of the strategic plan helps to address this conflict in by introducing National Routes where the number of stations are limited to those that strategically important. Additional stations may be required to close long gaps between stations and to avoid some stations may become overloaded and congested Yet the local/suburban routes will still suffer from short distances between them without careful analysis in the network context.

Unless special circumstances apply, such as in metropolitan centers then heavy rail stations should not be closer than 2 km apart, similar to the average spacing of the stations on the Ayalon South between HaHagana and Moshe Dayan. There are 18 route sections with spacing 2 km, 2 in the north, 2 in Jerusalem and the remaining 14 in the central area. The risk with the development of the network is that the introduction of more stations will increase journey time from those that exist now, potentially making the railway less attractive.

The major difficulty is between Hadera and Tel Aviv where there will be 4 stations within 6.5 km at Netanya and between Herzliya and University where there will also be 4 stations in 6.5 km. This causes particular problems for the service level provided for passengers from Netanya to Tel Aviv, where the journey times would be significantly extended with the introduction of the additional station stops. To overcome this a number of Operational Strategies were considered.

	Operational Strategy	Alt.	Ayalon Layout	National routes	Regional routes
A	Eliminate Stations				
B	Provide skip stop service	C5.1	2+4	Haifa - Tel Aviv non stop	Stop at all stations + Skip stop service from Netanya to Tel Aviv
C	Provide National Service to Hadera	C5.2	2+4	Haifa - Tel Aviv one stop (Hadera)	Stop at all stations
C	Provide National Service to Hadera	C5.2A	2+3	Haifa - Tel Aviv one stop (Hadera)	Stop at all stations.

Table A1.1 – Operational Strategies - Hadera to Tel Aviv

Operational Strategy A was not considered to be possible as permission has already been given for the new stations, in future the Railway Company and the various Ministries and Municipalities must work closely to match development to existing stations. In alternative C5.1 operational strategy B of providing a skip stop service on the same tracks as the all stations service was used and the stop at Hadera on the National Services was eliminated. Alternative C5.2 adopted operational strategy C to utilize spare line capacity on the National Routes by increasing the number of trains operated.

A.1.2 Alternative C5.1

This alternative restricts the National Services to 11 trains per hour and omits the stop at Hadera. The service to Hadera is provided by the introduction of a Skip Stop service and this is extended to commence from Zihron to Tel Aviv.

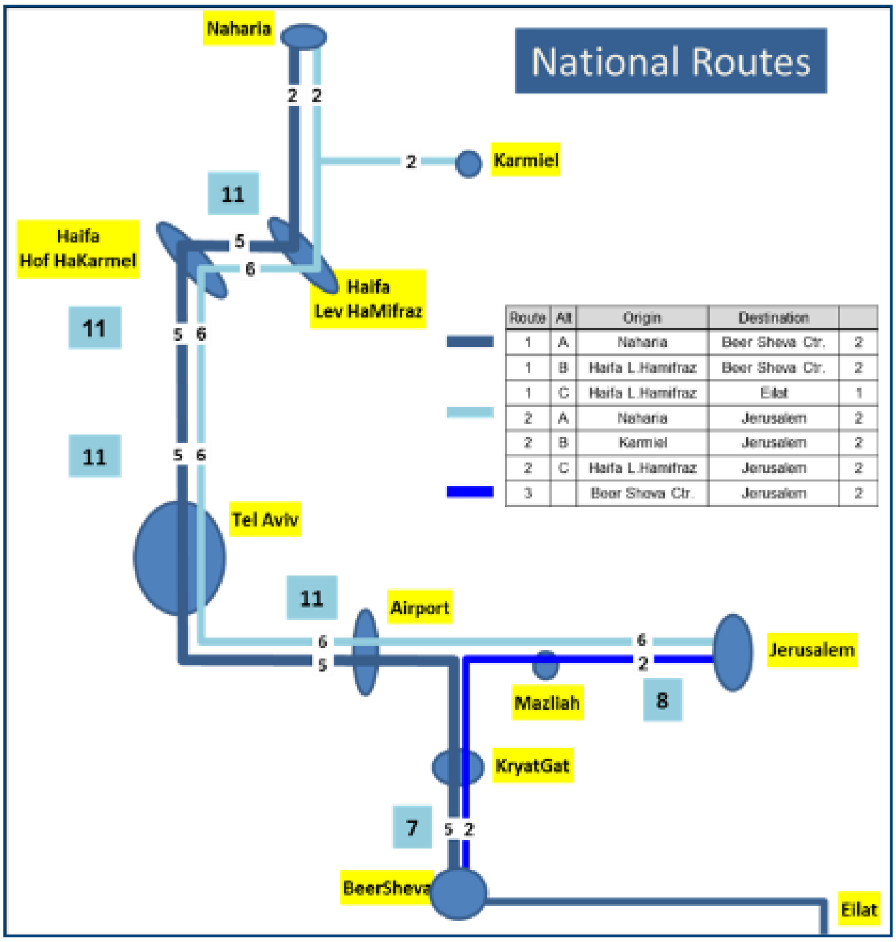


Figure A1.3 – National Routes – Alternative C5.1

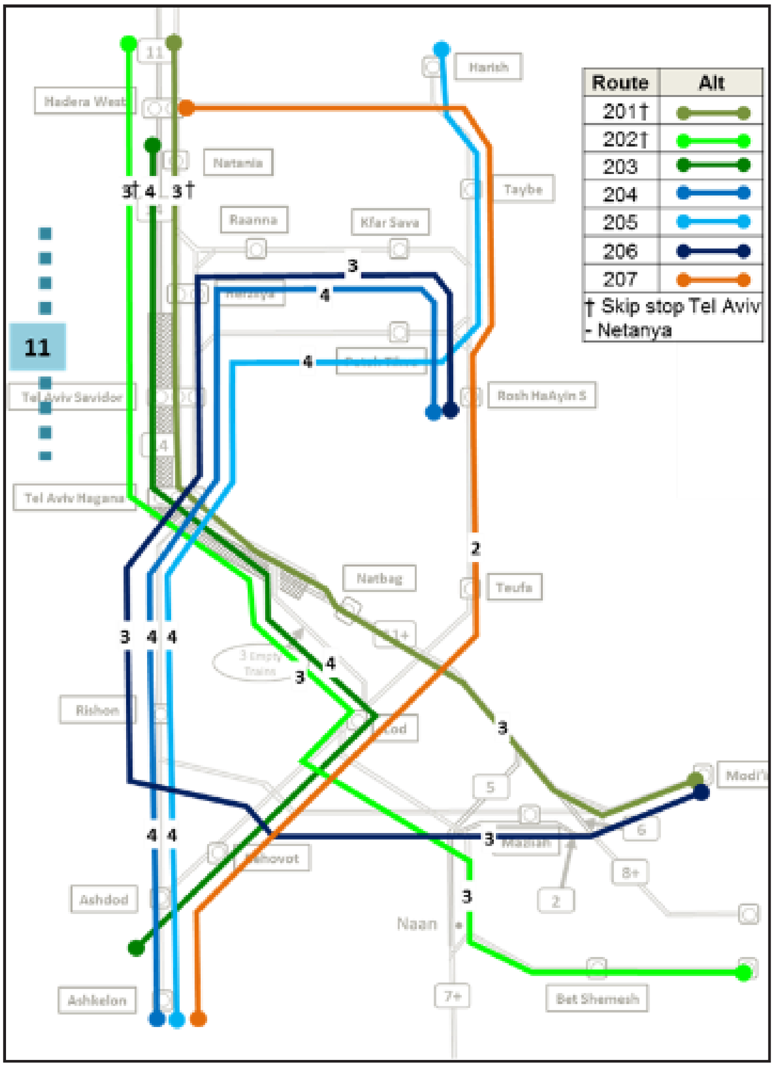


Figure A1.4 – Local Routes (Central Area) – Alternative C5.1

There were a number of issues with C5.1 with routes becoming overloaded as shown on Figure A1.3 below. The largest problems affected the skip stop services from Hadera to Tel Aviv – Lines 201 and 202 and the services from Ashkelon to Tel Aviv – Lines 204 and 205.

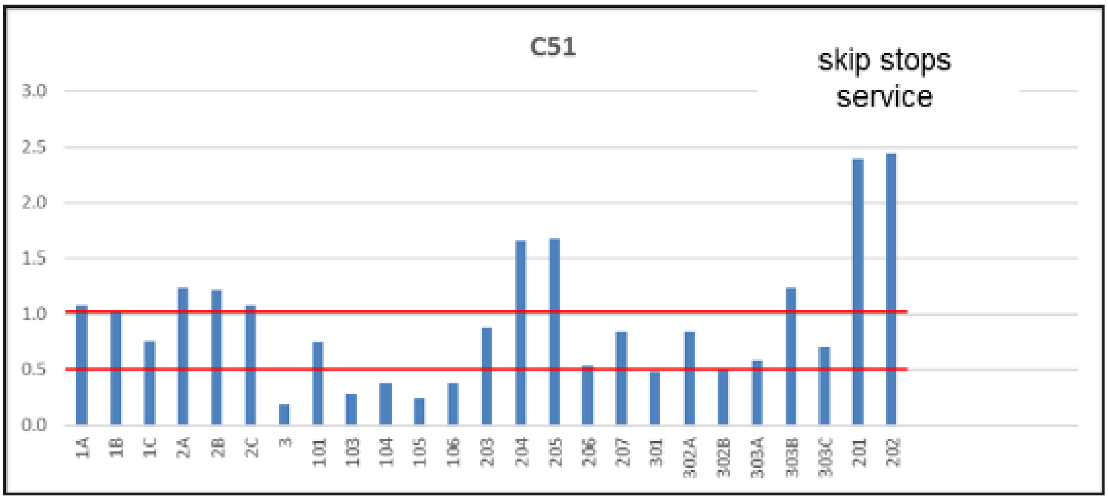


Figure A1.5– Load Factors – Alternative C5.1

A.1.3 Alternative C5.2

This alternative returns the stop at Hadera to the National Services increasing the number of National Trains to 14, with 3 trains starting at Hadera. There is no skip stop service and all local services start at Hadera. Passenger from Zihron to Hadera North change trains at Hadera West.

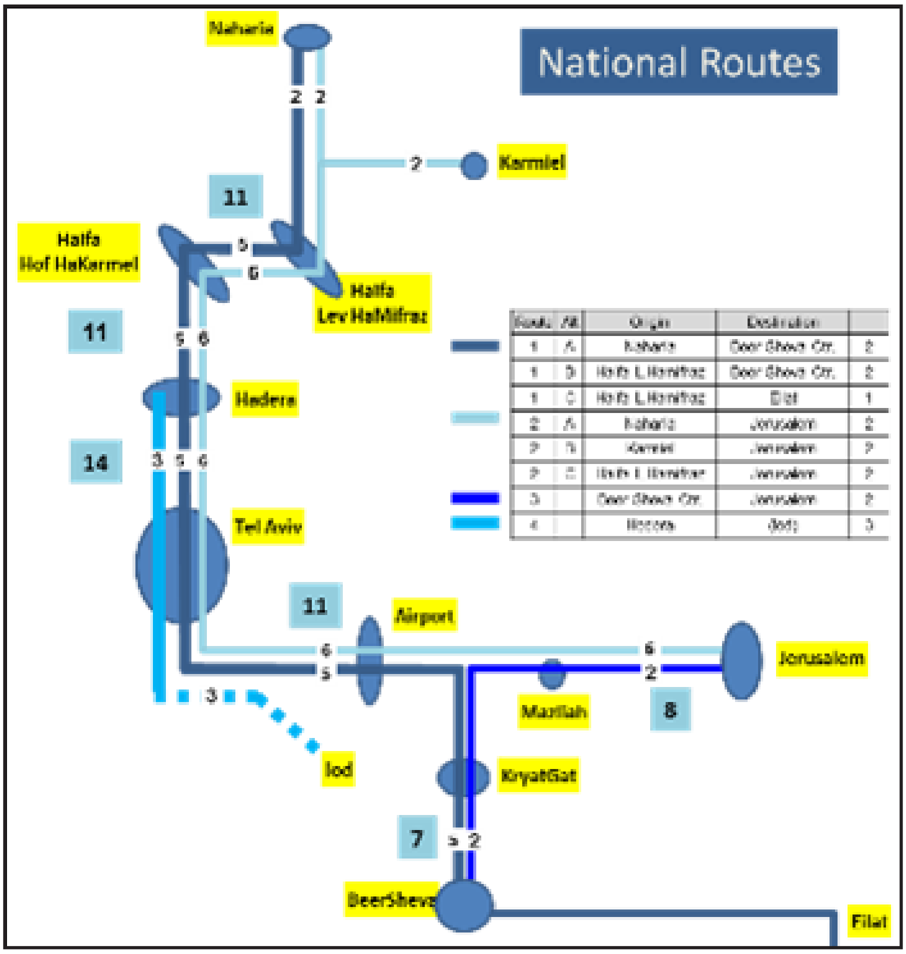


Figure A1.6 – National Routes – Alternative C5.2

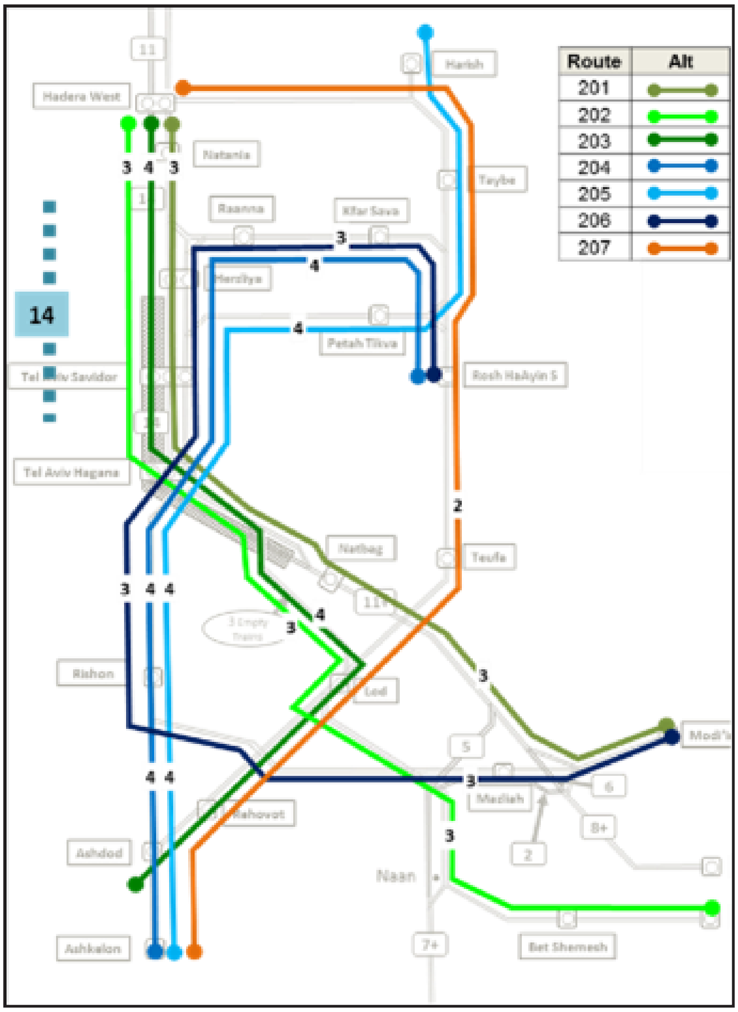


Figure A1.7– Local Routes (Central Area) – Alternative C5.2

With alternative C5.2 there were also issues with overloading. The problems of overloading of the services from Ashkelon to Tel Aviv – Lines 204 and 205 remained. In addition some of the National Services became overloaded at Hadera and Line 4, the service that starts from Hadera was underutilized.

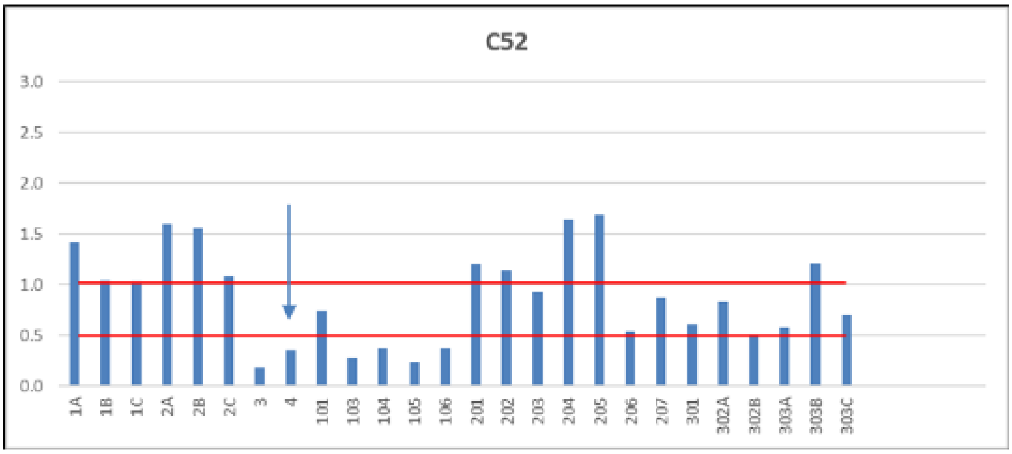
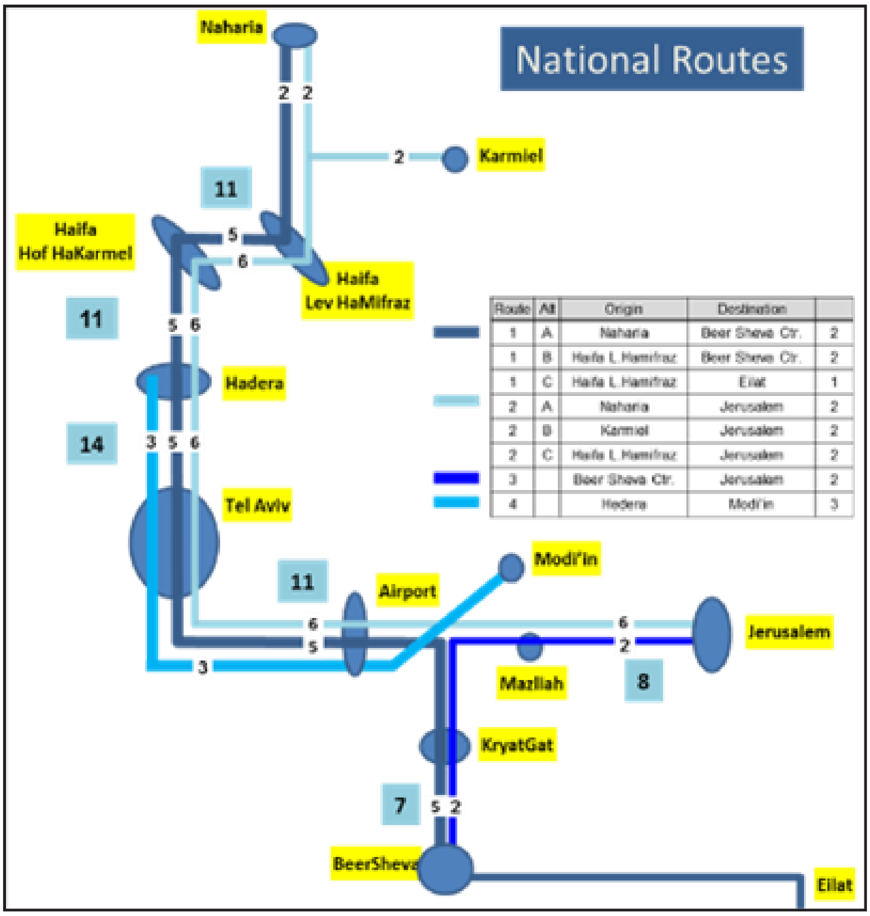


Figure A1.8– Load Factors – Alternative C5.2

A.1.4 Alternative C5.2A

To allow a reduced number of local trains to operate through the Ayalon the National Trains that start at Hadera were taken to Modi'in and the trains from Bet Shemesh and Malha were terminated at HaHagana station.



Route	Alt	Origin	Destination	
1	A	Naharia	Beer Sheva Ctr.	2
1	B	Haifa L.Hamifraz	Beer Sheva Ctr.	2
1	C	Haifa L.Hamifraz	Eilat	1
2	A	Naharia	Jerusalem	2
2	B	Karmiel	Jerusalem	2
2	C	Haifa L.Hamifraz	Jerusalem	2
3		Beer Sheva Ctr.	Jerusalem	2
4		Hedera	Modi'in	3

Figure A1.9 – National Routes – Alternative C5.2A

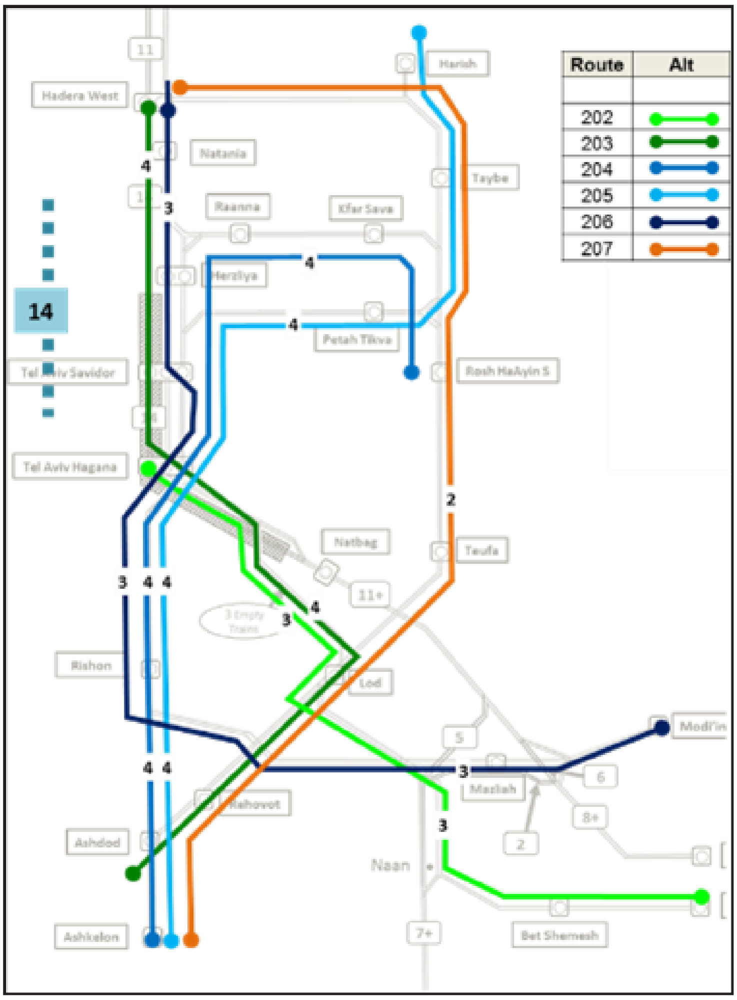


Figure A1.10– Local Routes (Central Area) – Alternative C5.2A

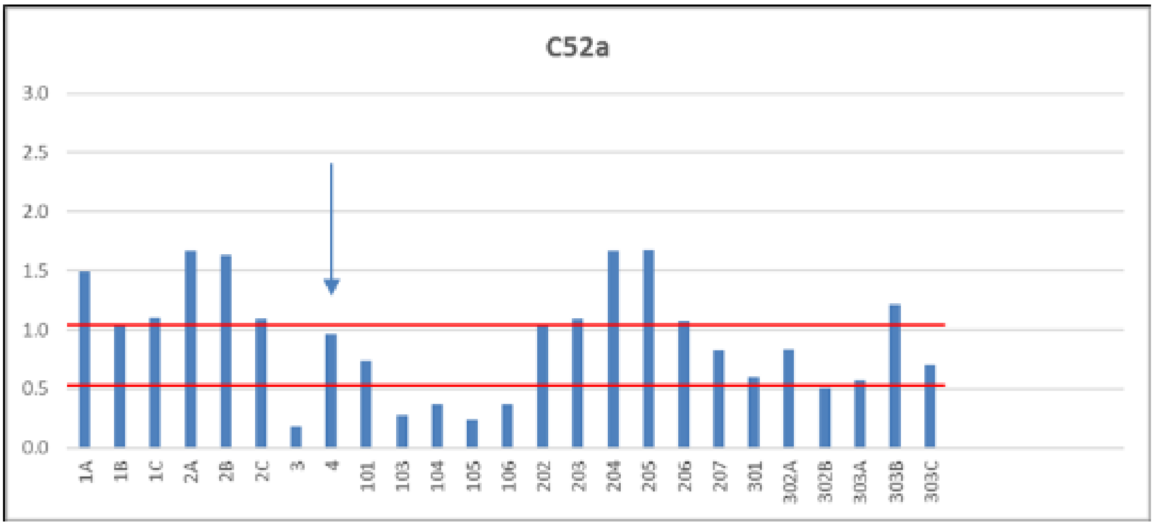


Figure A1.11– Local Routes (Central Area) – Alternative C5.2A

In alternative C5.2A the issues with overloading were the same as for C5.2. The problems of overloading of the services from Ashkelon to Tel Aviv – Lines 204 and 205 remained. In addition some of the National Services became overloaded at Hadera and Line 4, the service that starts from Hadera was underutilized. However the demand from Modi'in increased the load factor on Line 4 in the north bound direction.

A.1.5 Alternative C5.2-4 - Route Along Road #4

An alternative to providing some of the extra capacity in the Ayalon was to provide a new rail route along the Road #4 corridor through Ramat Gan. This could also provide better public transportation service to cities along the corridor and reduce car use and congestion along Road #4.

This was tested in the model as Alternative 5.2-4. This showed that there was demand in this corridor but it was for short trips with little North South demand and it did not provide significant relief to the Ayalon. The maximum demand in the center of the corridor was less than 1,000 passengers an hour. Many of the trips were "Z" or "L" shaped requiring a web shaped network with integrated transfers, as shown in Figure A1.12. The demand along the Road 4 corridor is typical of many such roads within metropolitan areas outside the CBD and is not suitable for a conventional heavy rail solution.

The proposed Metro Ring line gives a good integrated solution combined with a bus lane. The rail service through the Ayalon Corridor (Road #2) serves the demand into the CBD and the Eastern corridor (Road #6) provides a service to serve the outer parts of the main built up area. There is no need for additional rail on Road #4 corridor.

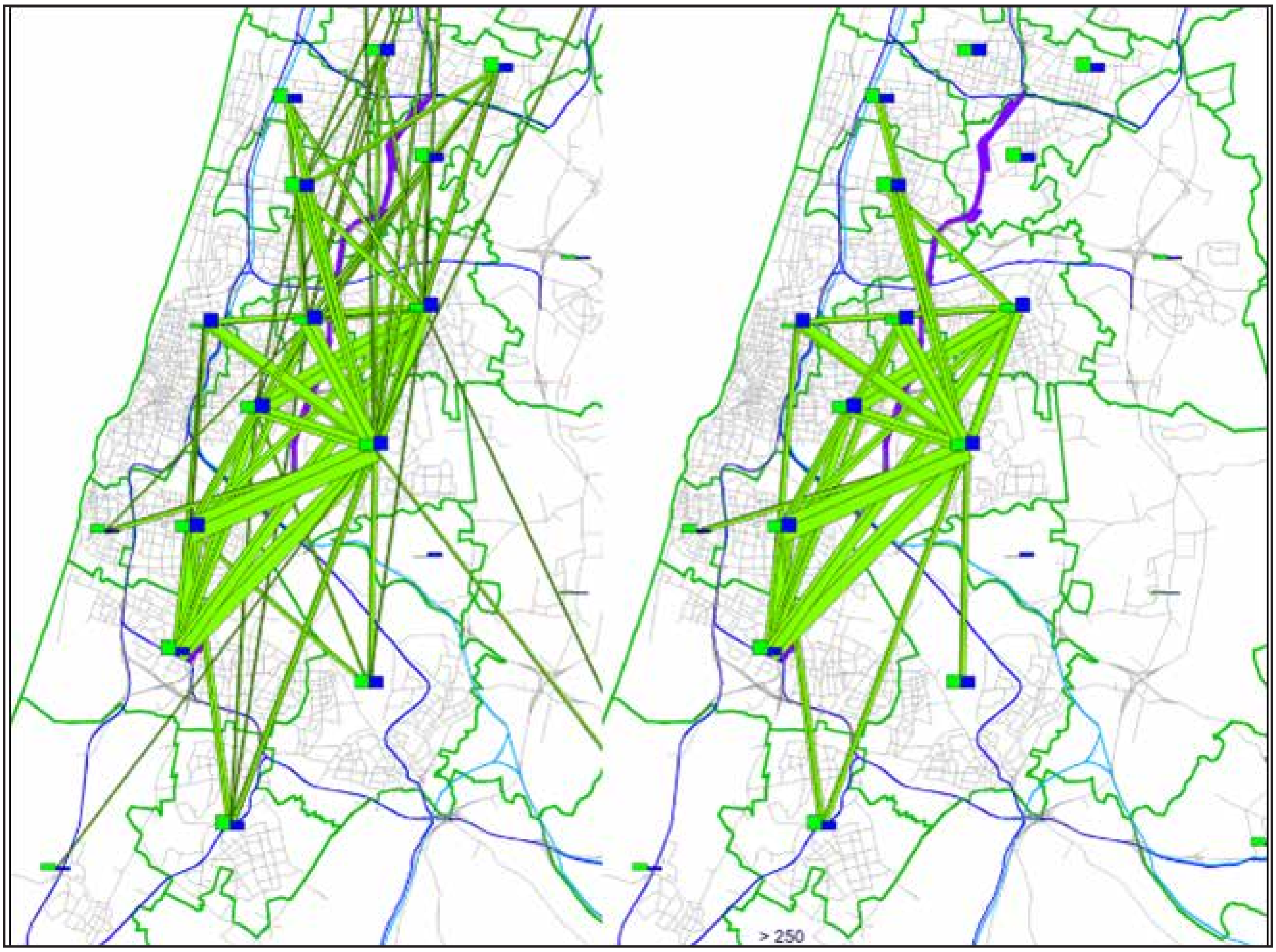


Figure A1.12–Road #4 Corridor Demand, left all demand, right demand >250 per hour

A.1.6 Conclusions from Alternative C5

- **Modal Share**

Overall there was little overall change to the modal share of the railway and there was little difference between these alternatives:

	C51		C52		C52a	
Car	943,540	62%	943,180	62%	943,760	62%
Bus	91,310	6%	91,190	6%	91,280	6%
Train+MT	478,510	32%	478,990	32%	478,320	32%
Total	1,513,360	100%	1,513,360	100%	1,513,360	100%
Train	121,250	8%	123,160	8%	120,530	8%
MT	357,260	24%	355,830	24%	357,790	24%

Table A1.2 – Passenger Trips by Mode

- **Alternative C5.2A**

This was discounted for the following reasons:-
- It imposed limits on the service from Netanya and Hadera to Tel Aviv
- There was no local service from Modi'in/BG Air Port to Tel Aviv
- Less reliability - 1 track from Lod
- It restricted the flexibility to add new routes
- It is more dependent on Metro system
- Some train service stop at HaHagana, which is known to be unpopular with passengers.

- **Park and Ride Capacity**

Another factor that needed to be considered was the attractiveness of Hadera West and Netanya Merkaz for transfer station for Park and Ride. The higher level of service in alternative C5.1 provided by the skip stop service made Netanya Merkaz very attractive and similarly the National Service at Hadera West in alternative C5.2 made it very attractive. The levels of demand for Park and Ride in both these stations was considered unrealistic and a better balance between the stations is required.

	Hadera			Netanya Merkaz		
Alt.	Transfer Rail to Rail	Transfer Car to Rail	Total Boarding	Transfer Rail to Rail	Transfer Car to Rail	Total Boarding
C51	1,000	1,500	5,000	150	3,700	8,000
C52	6,000	3,900	12,000	0	1,900	4,500

Table A1.3 – Passengers Transferring at Hadera and Netanya

- **Route Along Road #4**

The construction of a railway along Road #4 did not produce high loading and consequently significantly reduce demand in the Ayalon. The corridor is best served by the Metro Ring Line.

- **Further Development of Alternatives**

Alternative C5.1 and C5.2 performed better than the previous alternatives but required some further work to address the issues that remained.

A.2 Alternative C6

A.2.1 Rail Network C6

Alternative C6 was prepared to address the problems identified in C. This was done by adjustment to the service pattern or number of trains operating, however, there are some more significant issues and these are described below.

A.2.2 Hadera to Tel Aviv Service

Neither Alternative C5.1 nor C5.2 successfully addressed the problem of providing the service between Hadera and Tel Aviv.

In alternative C5.1 operational strategy B of providing a skip stop service on the same tracks as the all stations service was used. This was unsuccessful as insufficient capacity was provided to accommodate demand and increased the demand for parking at Netanya beyond that which could be provided. Alternative C5.2 adopted operational strategy C to utilize spare capacity on the National Routes, again this had issues in that it only partly resolved the level of service issue and caused a concentration of Park and Ride passengers at Hadera which was not practical.

To overcome these problems two further strategies, D and E, were developed. Strategy D adopted in Alternative 6.1 increased the number of skip stop local services to satisfy the demand identified in C5.1. This required widening of the Coast Line to 6 tracks from Netanya to Route 531, where the Ayalon Tunnel commences. Strategy E increased the number of National Services operating from Haifa towards Tel Aviv and stopped them at Hadera, no skip service local service was provided. A further strategy, F, combining the limited skip stop local service of B with the enhanced National Service of E was developed.

	Operational strategies	Alt	Advantages	Disadvantages
A	Eliminate Stations		Improve performance	Reduction in coverage
B	Provide skip stop service	C5.1	Improve performance	Introduces operational constraints and may require passing loops. Diversion of passengers to Netanya.
C	Provide National Service to Hadera	C5.2	Improve performance for Hadera	No improvement of service from Netanya. Diversion of passengers to Hadera.
D	Provide skip stop service with additional tracks	C6.1	Improve performance without capacity reduction	Cost, additional Right of Way
E	Provide increased number of National Services to Hadera	C6.2	Improve performance for Hadera, removes over load from National Services	No improvement of service from Netanya. Diversion of passengers to Hadera.
F	Provide National Service to Hadera and skip stop service	C6.5	Improve performance, spread demand more evenly between Hadera and Netanya	Could introduce operational constraints and may require passing loops.

Table A2.1 – Operational Strategies - Hadera to Tel Aviv

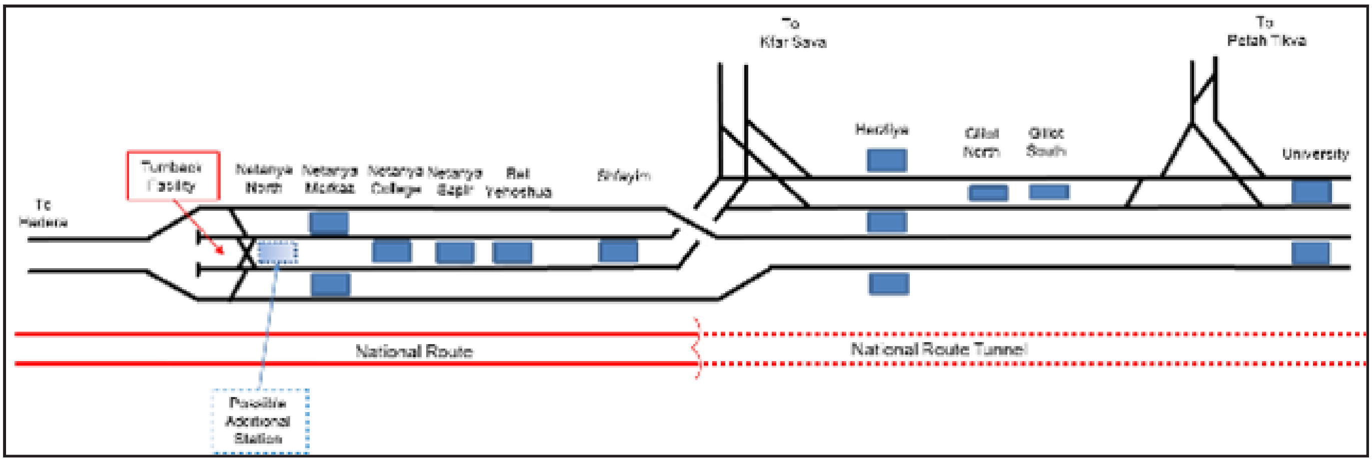


Figure A2.1– Outline Operational Layout - Hadera to Tel Aviv – Alternative C6.1

A.2.3 Haifa to Tel Aviv Passenger Interchange

The service patterns tested are shown on Figure A2.2 below together with the interchanges between the routes:

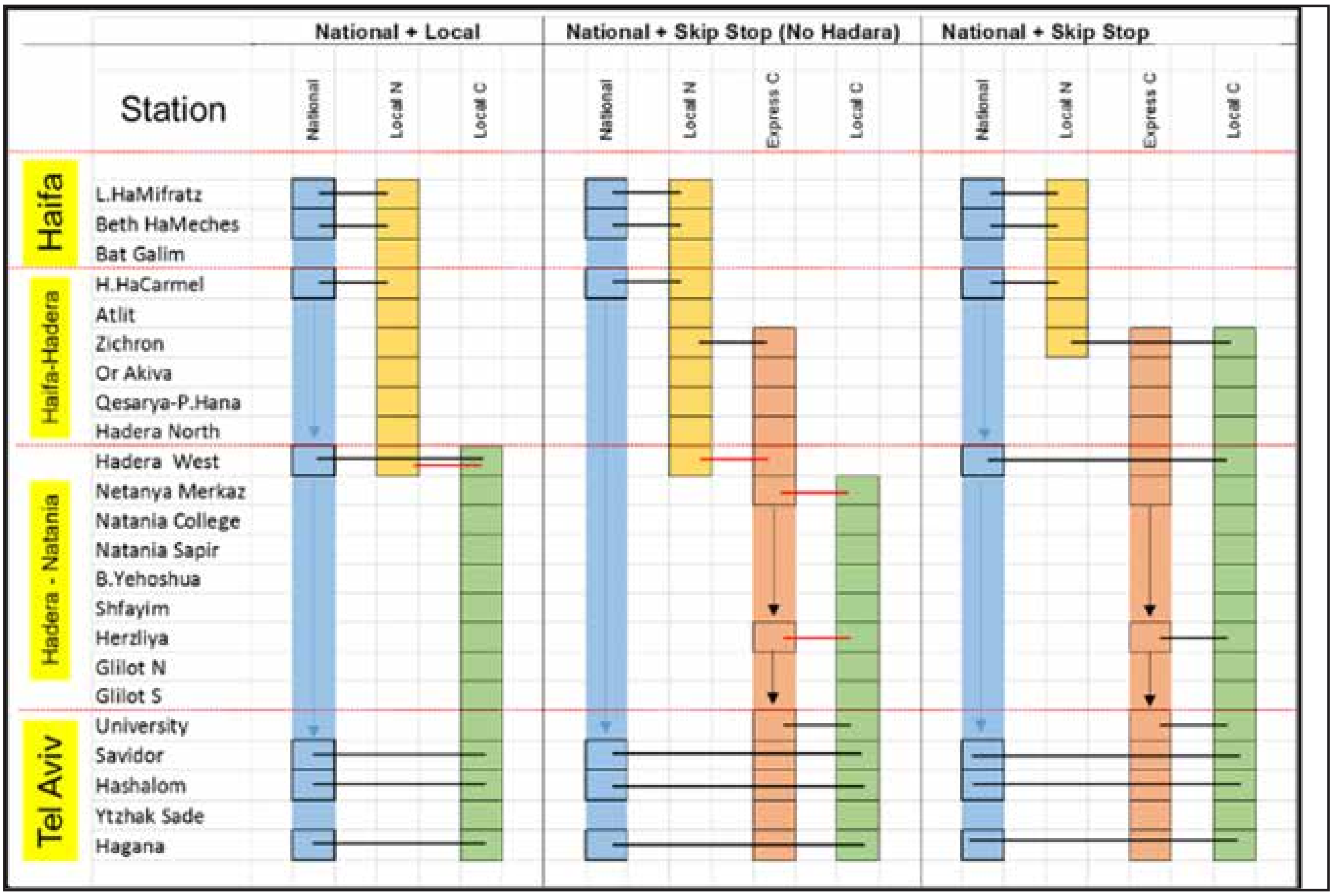


Figure A2.2– Alternative Stopping and Interchange Patterns – Haifa to Tel Aviv

Alternative C6.1 provides passenger interchange between lines at three principal locations:

- Zihron – North local to Center express local (Skip stop)
- Netanya Merkaz – Center express local to Center all stations local
- Herzliya - Center express local to Center all stations local.

In this alternative some passengers may have to change at both Zihron or Hadera and Netanya to complete a journey between Haifa and University.

Alternative C6.2 provides passenger interchange between lines at:

- Hadera West – North local to Center all stations local and to National to Tel Aviv
- Hadera West – National from Haifa to Center all stations local

The interchange arrangements are simpler as all interchange is provided at Hadera. However, journey times will be longer as trains to Tel Aviv stop at all stations.

Alternative C6.5 provides passenger interchange between lines at:

- Zihron – North local to Center express local (Skip stop)
- Hadera West – National from Haifa to Center all stations local
- Hadera West – National from Haifa to Center express local
- Netanya Merkaz - North local to Center all stations local
- Herzliya - Center express local to Center all stations local

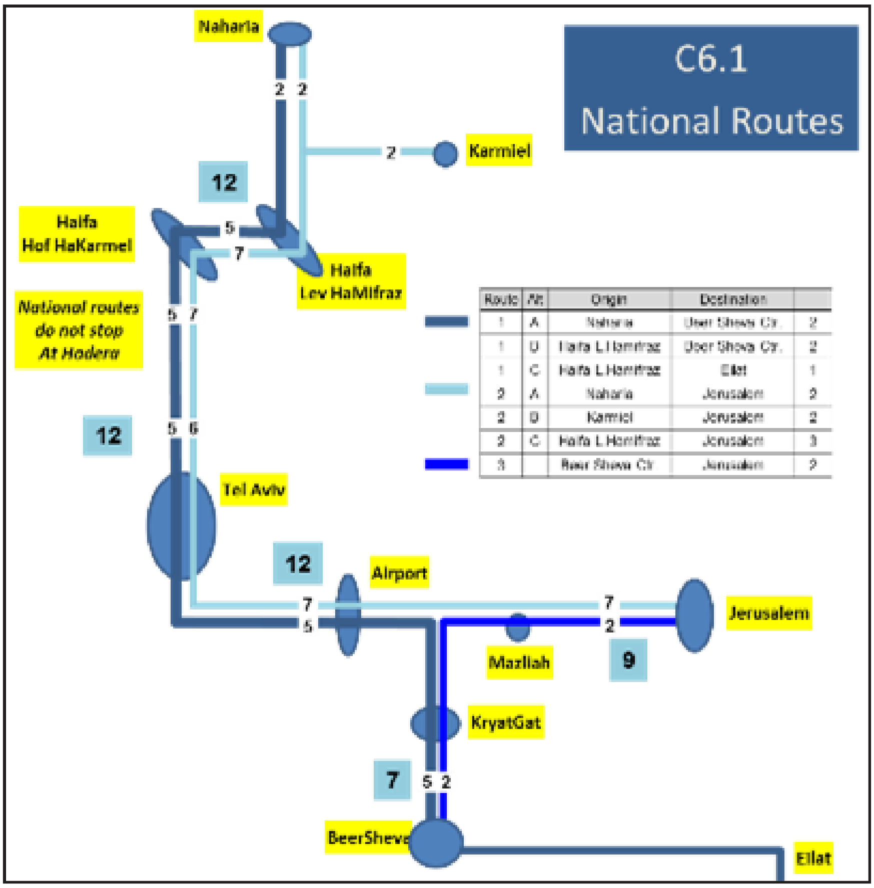
Although the interchange arrangements are more complex passengers need only change at one location to complete a journey between Haifa and University.

A.2.4 Alternative C6.1

Alternative C6.1 is similar to C5.1 with National Services not stopping at Hadera, but the frequency was increased from Haifa to Jerusalem to address overloading of these services, to give a total of 12 trains per hour between Haifa and Tel Aviv.

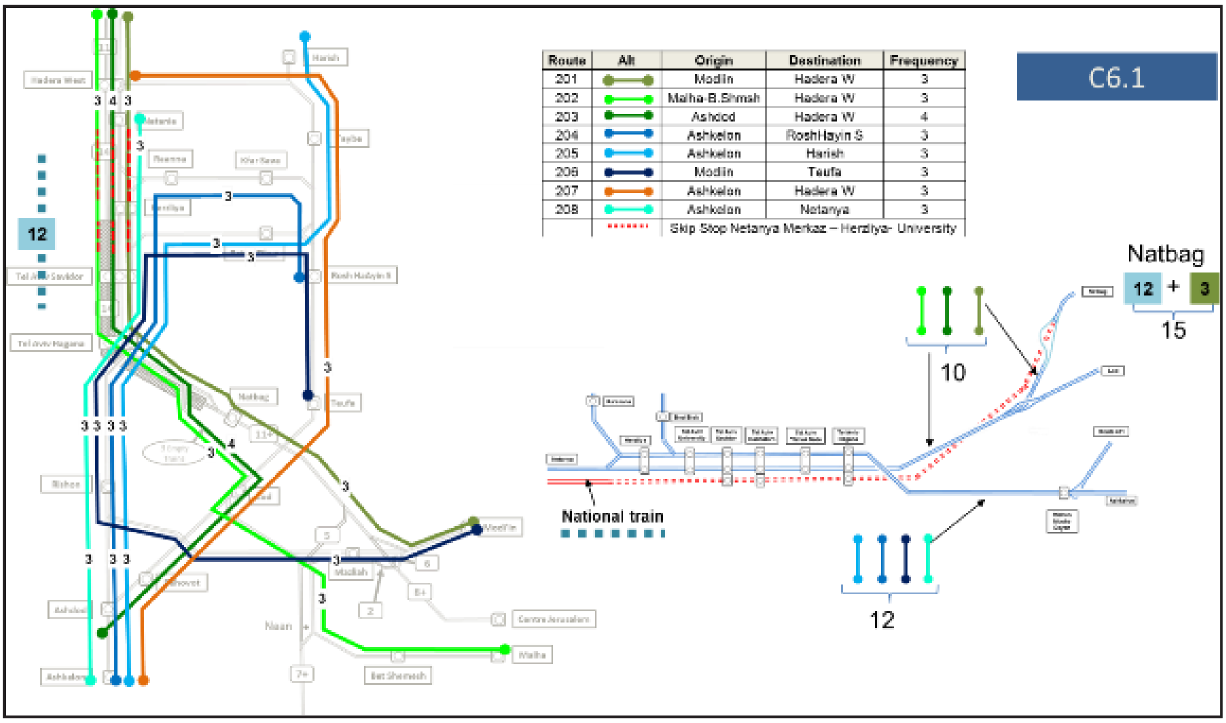
The local services in the Central area have been modified from C5.1 to:-

- Extend the Central area local services to Zihron to provide a through service for passengers at most intermediate stations to Haifa,
- Increase the skip stop service from Hadera to remove the overloading of trains,
- Increase the number of trains from Ashkelon to remove the overloading of trains,
- Reduce the frequency on some less busy lines, and
- Produce a frequency of at least 3 trains per hour at all stations.



Route	Alt	Origin	Destination	
1	A	Naharia	Beer Sheva Ctr.	2
1	B	Haifa L Hamifraz	Beer Sheva Ctr.	2
1	C	Haifa L Hamifraz	Eilat	1
2	A	Naharia	Jerusalem	2
2	B	Karmiel	Jerusalem	2
2	C	Haifa L Hamifraz	Jerusalem	3
3		Beer Sheva Ctr	Jerusalem	2

Figure A2.3 – National Routes – Alternative C6.1



Route	Alt	Origin	Destination	Frequency
201		Modiin	Hadera W	3
202		Malha-B.Shmsh	Hadera W	3
203		Ashdod	Hadera W	4
204		Ashkelon	RoshHayin S	3
205		Ashkelon	Harish	3
206		Modiin	Teufa	3
207		Ashkelon	Hadera W	3
208		Ashkelon	Netanya	3
		Skip Stop Netanya Merkaz – Herzliya- University		

Figure A2.4– Local Routes (Central Area) – Alternative C6.1

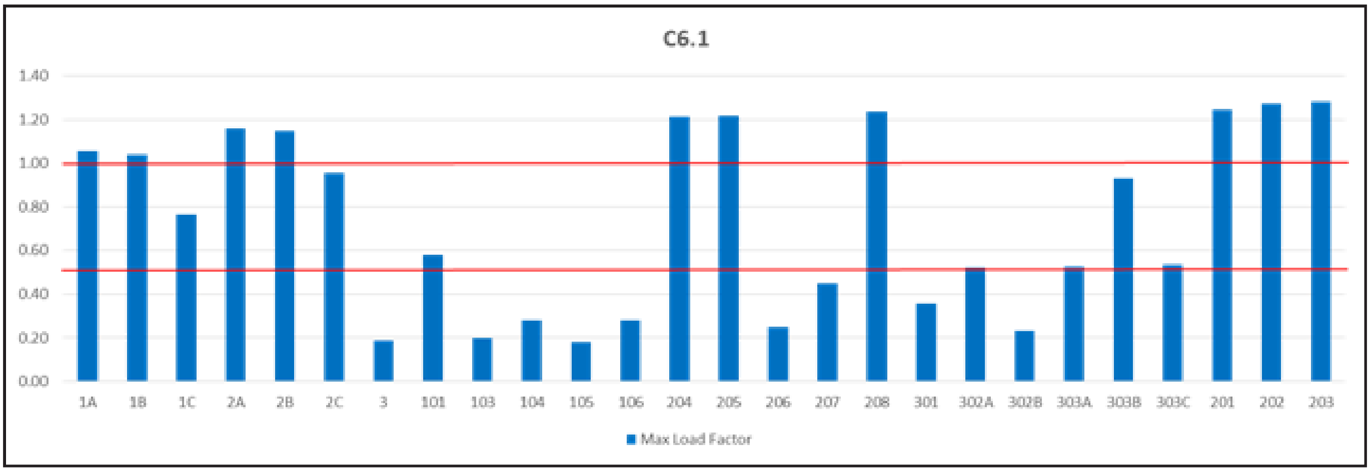


Figure A2.5– Load Factors – Alternative C6.1

The load factors in Alternative 6.1 were generally satisfactory. There were some small overloading of the National Services, but the average loading across all services between the same stations was less than 1. Services from Ashkelon to Tel Aviv via the Ayalon South were overloaded and an additional train would be required to remove this. The skip stop service was overloaded between Netanya and Tel Aviv, but as the journey time is less than 20 minutes standing could be permitted.

A.2.5 Alternative C6.2

Alternative C6.2 is similar to C6.1 except that National Services stop at Hadera and the frequency is increased to 14 trains per hour between Haifa and Tel Aviv and the center local services all terminated at Hadera.

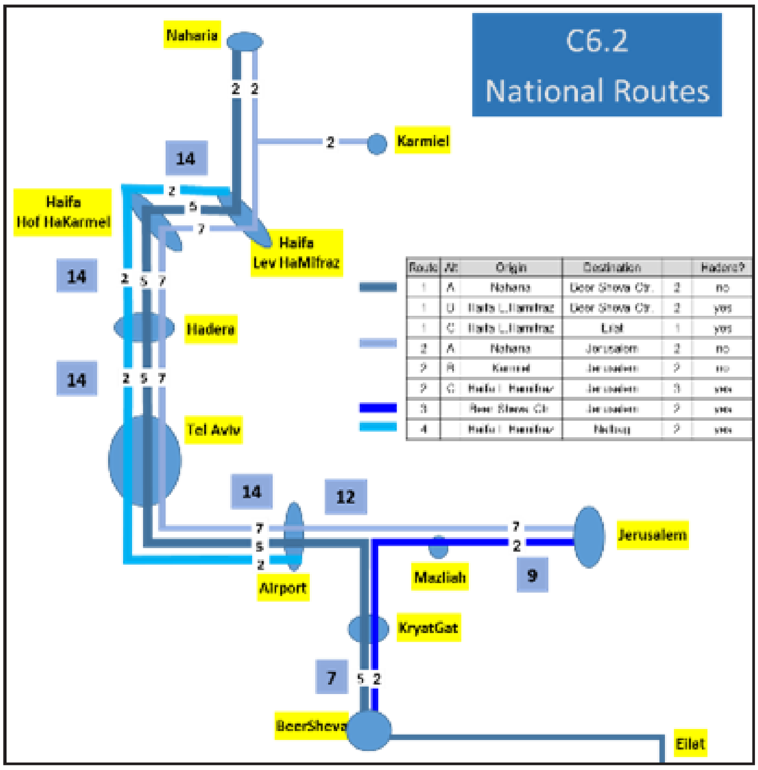


Figure A2.6 – National Routes – Alternative C6.2

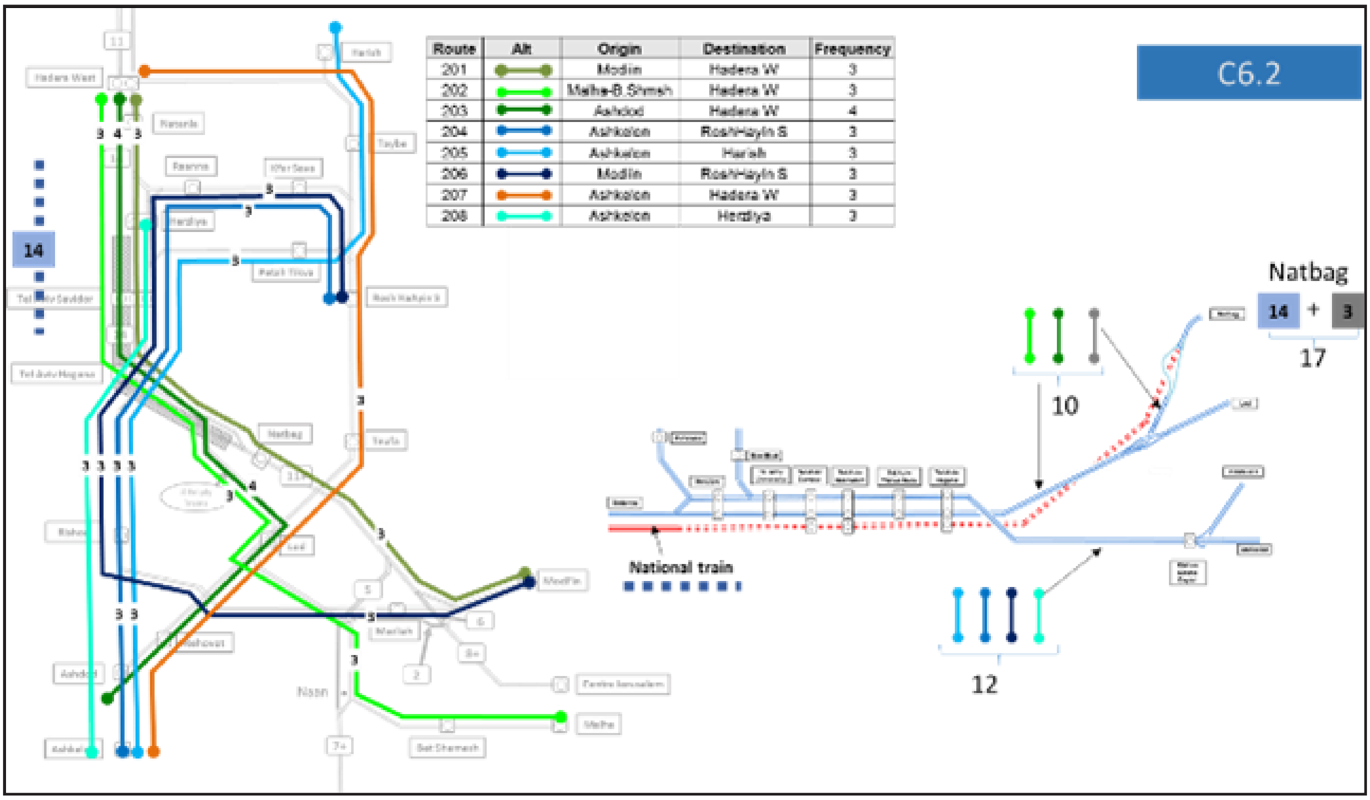


Figure A2.7– Local Routes (Central Area) – Alternative C6.2

The load factors in Alternative 6.2 were generally satisfactory. There were some small overloading of the National Services, particularly from Hadera to Tel Aviv. Services from Ashkelon to Tel Aviv via the Ayalon South were overloaded and an additional train would be required to remove this. A significant problem with this alternative is providing a station with sufficient capacity at Hadera.

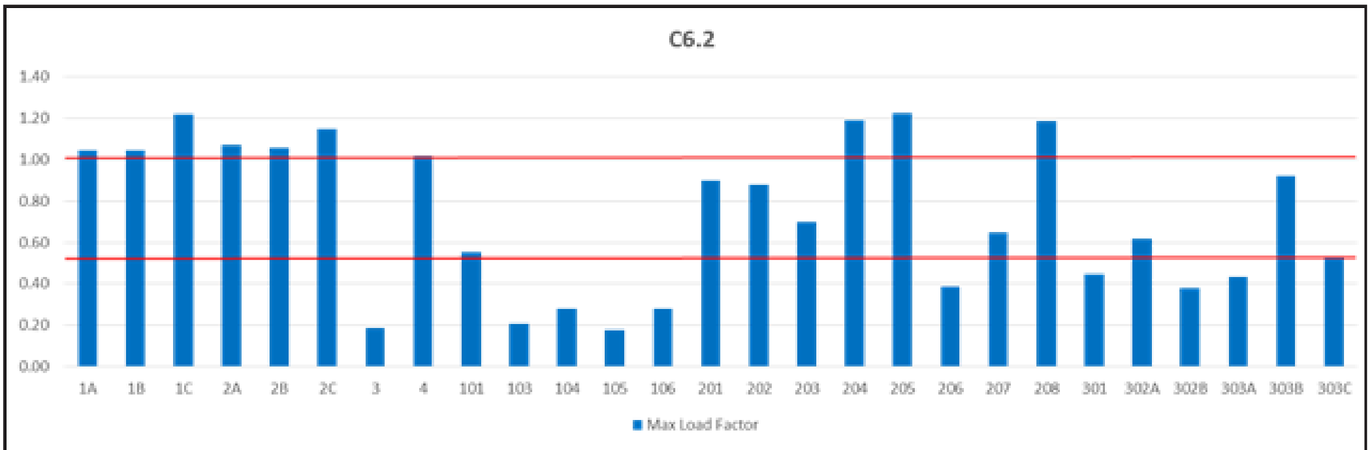


Figure A2.8– Load Factors – Alternative C6.2

A.2.6 Alternative C6.5

Alternative 6.5 combined the National Routes from C6.2 with a new Center Region Local service pattern, including a skips top service from Netanya to Tel Aviv. A mixed service of all stations and skip stop services was provided between Or Akiva and Tel Aviv with a reduced number of trains operating north of Herzliya. Because of higher demand from the north side of the Sharon Valley a loop service was provided between University, Petah Tikva, Kfar Sava, Ra'anana and University to increase the number of trains through Ra'anana compared to Alt C6.2. The service to Ashkelon was also increased.

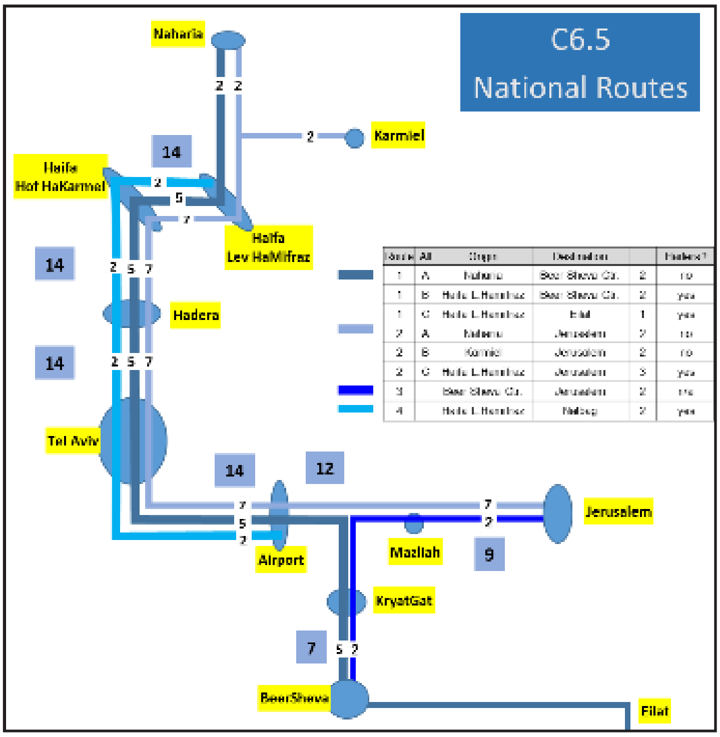


Figure A2.9 – National Routes – Alternative C6.5

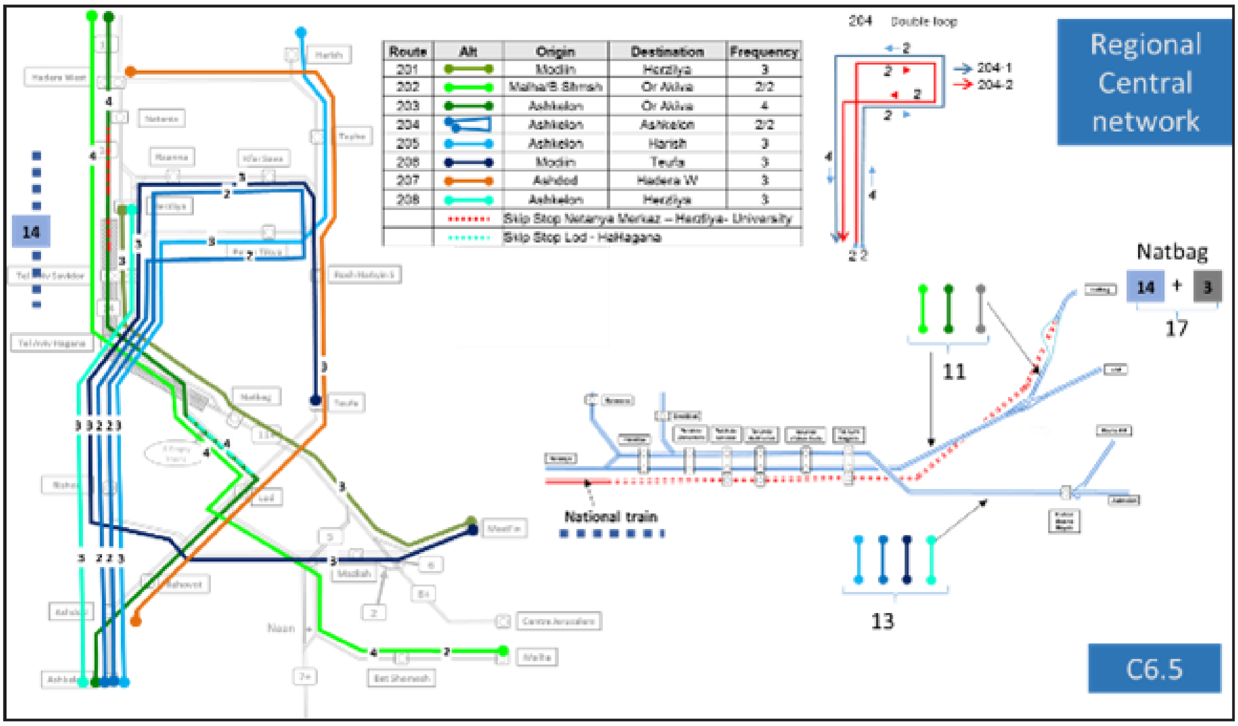


Figure A2.10– Local Routes (Central Area) – Alternative C6.5

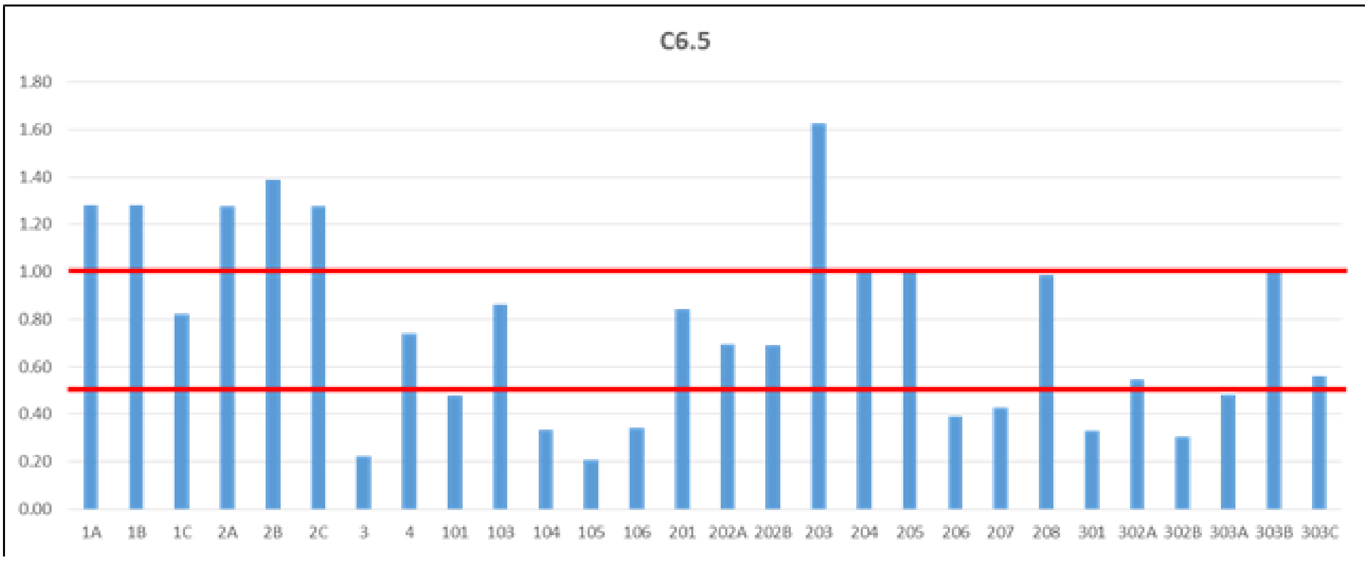


Figure A2.11– Load Factors – Alternative C6.5

The load factors in Alternative 6.5 were generally satisfactory, except for services on the Coast Line between Hadera and Netanya and Tel Aviv.

Some National services from Hadera to Tel Aviv and from Tel Aviv to Jerusalem are overloaded in this alternative, this can be addressed by changing the trains that stop in Hadera and extending Line 4 to Jerusalem. There is also some overloading from Kiryat Gat to Ben Gurion Airport, this could be addressed by running one additional train per hour north bound only from Be'er Sheva in the morning peak and reducing the number of Tel Aviv bound trains from Jerusalem. This train may have to be routed via Lod to ensure there is sufficient capacity for freight services on Lod Bypass.

The overloading on Line 203 from Netanya to Tel Aviv could be addressed by increasing the number of trains operating on this service.

A.2.7 Issues in the North

A number of issues were identified in the Haifa Area relating to Alternative C6, these were:

A.2.7.1 Krayot Corridor

The service pattern of a mix of National Services, stopping only at Savionei Yam, and Local Services stopping at all stations required the widening of the route between Lev HaMifratz and Naaman Junction south of Akko. The existing Right of Way could not accommodate this widening and alternative solutions to provide the widening were considered to be too expensive for the value that would be gained. The railway would need to be widened to three tracks from Lev HaMifratz to Kishon Depot, the maximum available within the confines of the existing Right of Way, to provide access for National Services to layover in the depot and generally improved access to the Depot. However, it was agreed that the Right of Way should be secured for future expansion of the route.

The alternative is to reorganize the services such that all services stopped at all stations, some services may skip some less used stations.

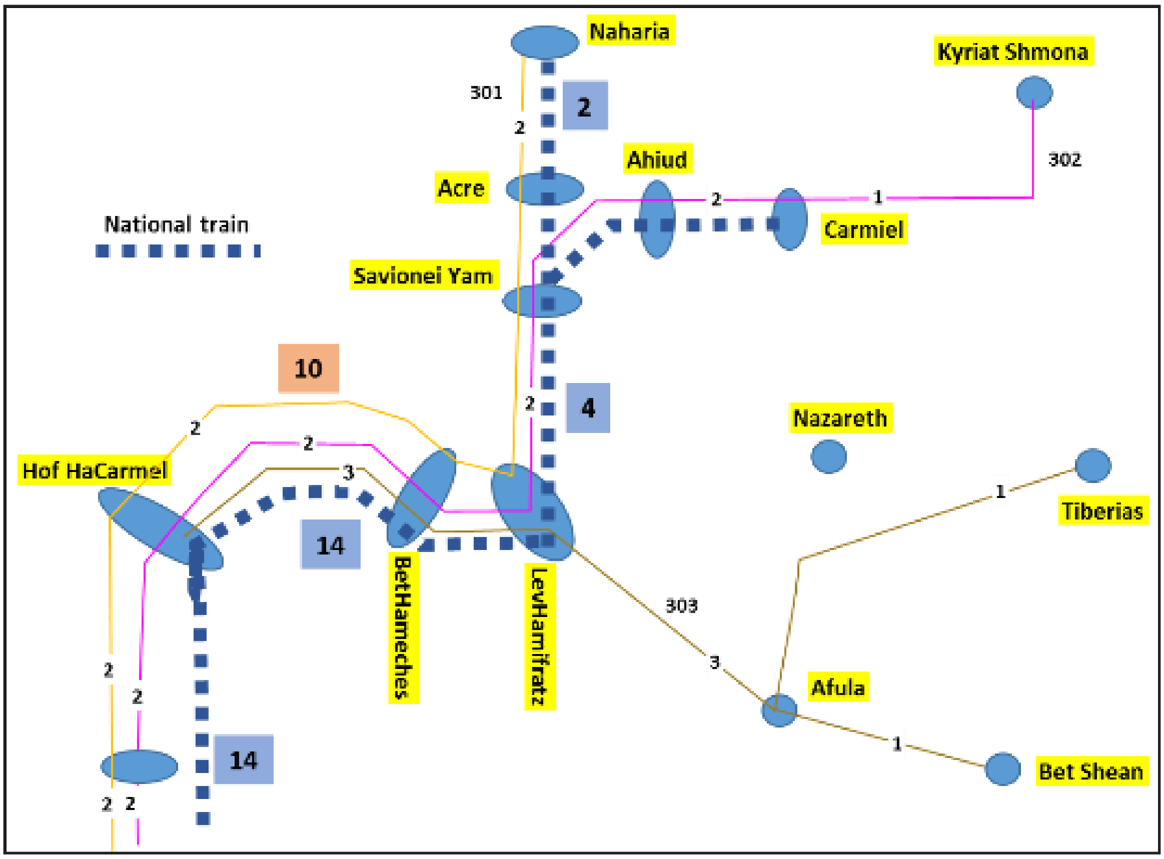


Figure A2.12–Changes to Krayot Area Services

A.2.7.2 Road #70 Corridor

A railway along the Road #70 had been considered previously as part of long term plan for the rail and as a link to Lebanon. Alternative C1 and C4 included a railway from Shlomi to Haifa along the line of Road #70, passenger demand was very low.

Analysis of origin and destination demand showed that the model may have underestimated demand along Road #70, diverting it the Coastal Railway. The model was refined and run again (C6.6), this showed that there could be sufficient demand along Road #70 south of Ahihud, particularly from Kiryat Ata. It also reduced the number of passengers passing through the Krayot by diverting them to this route.

It was considered that this route between Ahihud and Haifa should be included in the Strategic Plan for 2040 because it would:

- be useful as it could provide an operational back-up to the route through the Krayot;
- provide a good alternative route for passengers from Karmiel; and
- serve freight services from Karmiel and potentially in the locality.

The route north from Ahihud to Shlomi would be protected for future interconnection with Lebanon.

A.2.7.3 Access to Haifa Port

Access has to be provided for freight services to Haifa Port from the direction of the HaEmek Railway, in particular the holding/classification yard at Nesher. This requires freight trains destined for the Port to cross the four tracks between Haifa Beth HaMeches and Lev HaMifratz, during peak hours the intensity of the service envisaged is such that it would not be possible to operate freight trains to the Port during peak hours.

To overcome this a tunnel, or overpass, is recommended to be constructed to allow freight traffic from Nesher to the Port to cross the coastal railway without conflict. It is envisaged this link would pass in the direction of the expanded port at

Kishon, with a connection to the existing port, Haifa East yard and depot.

A.2.7.4 Haifa Corridor

The railway between Lev HaMifratz, the proposed Beth HaMeches and Hof HaCarmel stations has to be widened to 4 tracks to provide sufficient capacity for the National and Local services that need to be operated to meet the forecast demand. Four options were considered:

A. Construct two additional tracks for National Services alongside the existing railway, used by Local Services;
B. Construct a tunnel direct from Beth HaMeches to Hof HaCarmel for National Services with the existing railway used by Local Services;
C. Construct a tunnel direct from Beth HaMeches to Hof HaCarmel for National Services with the existing railway used by Local Services and Tram Train services from Nazareth; and
D. Construct a tunnel direct from Beth HaMeches to Hof HaCarmel for National Services and Local Services with the existing railway used by Tram Train services from Nazareth.

Option C was discounted as there is insufficient capacity in the exiting railway to accommodate Tram Train services. Option A was preferred as this uses the existing Right of Way but will require significant environmental mitigation measures to be taken and space is restricted that may cause operational problems at Beth HaMeches station. Option B is likely to be more expensive than Option A but would reduce the environmental impact of the widening and an underground station at Beth HaMeches would resolve the potential operational issues.

It is recommended that a detailed study of the Haifa Corridor is carried out. To determine the best option.

A.3 Alternative C7

Alternative C7.1 was developed to incorporate those parts of the previous alternatives that proved most effective.

A.3.1 National Services

The number of National Services operating north of Haifa was reduced to allow operation of a two track railway between Lev HaMifratz and Naaman Junction. The number of trains stopping at Hadera was set at 4 trains per hour, a compromise between C5.2 and C6.2, but with the addition of a skip-stop Local Service serving Hadera. The number of National Services to Jerusalem was increased to the level provided in C6.2.

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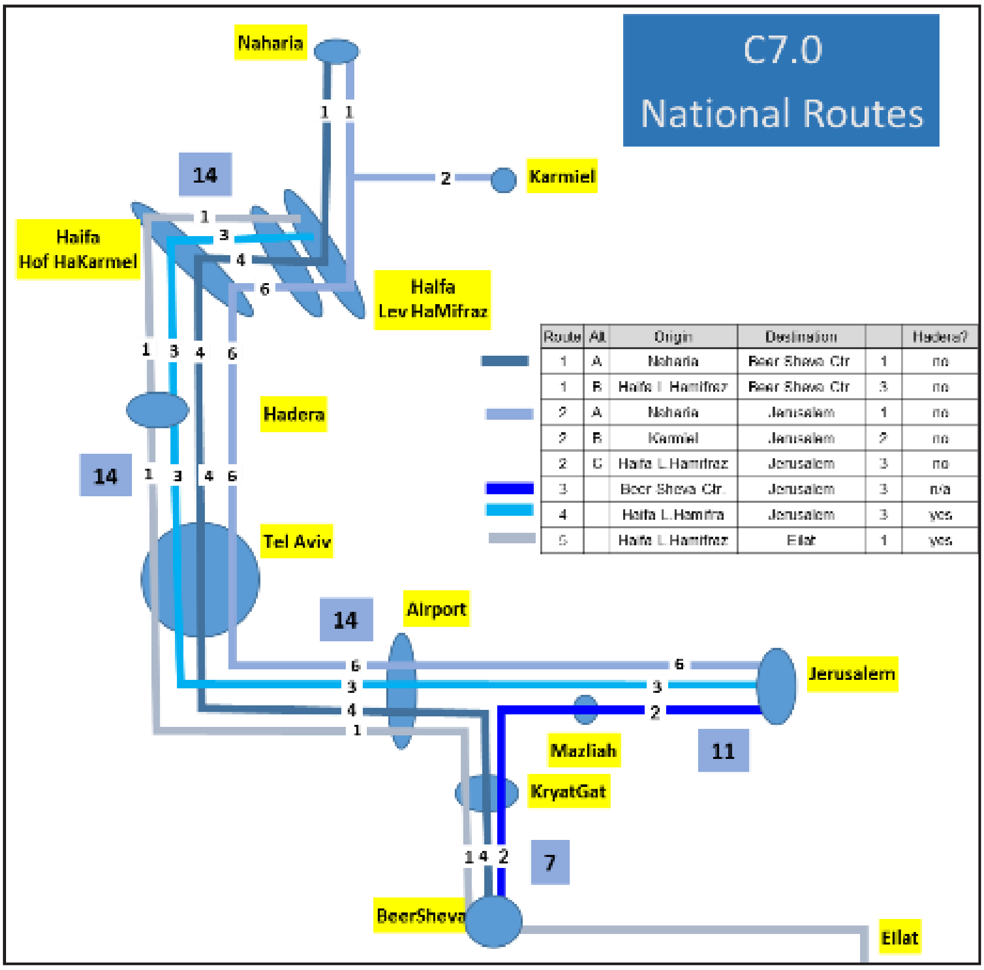


Figure A3.1 – National Routes – Alternative C7

A.3.2 Local Services - North Area

The basic services tested in Alternative C6 were retained and a service from Karmiel along Road #70 was added.

A.3.3 Local Services - Central Area

To satisfy demand from Coastal Railway north of Tel Aviv, provide reasonable travel times and not overload National Services and balance demand from Hadera and Netanya it was considered that it was necessary to provide a skip-stop service from Hadera to Tel Aviv stopping only at Netanya Merkaz and Herzliya. The demand from Ashkelon and Ashdod along the Ayalon South was very high and overloaded the service, to overcome this the number of trains was increased to provide 10 tph from Ashkelon.

Two options were considered for the services to Ra'anana and Petah Tikva with Alternative 7.1 providing a balance of 5 tph with a loop service each whereas Alternative 7.2 favored the route via Petah Tikva with 6 tph and 4 tph via Ra'anana whilst providing a faster service to Elad and Teufa.

It was noted that there was a reasonably strong demand from the Ashdod and Rehovot area towards Jerusalem in previous alternatives this required passengers to travel via Tel Aviv. To offer a potentially better service and reduce demand through Tel Aviv an additional service was included from Ashdod to Matzliah to connect with the Be'er Sheva to Jerusalem service.

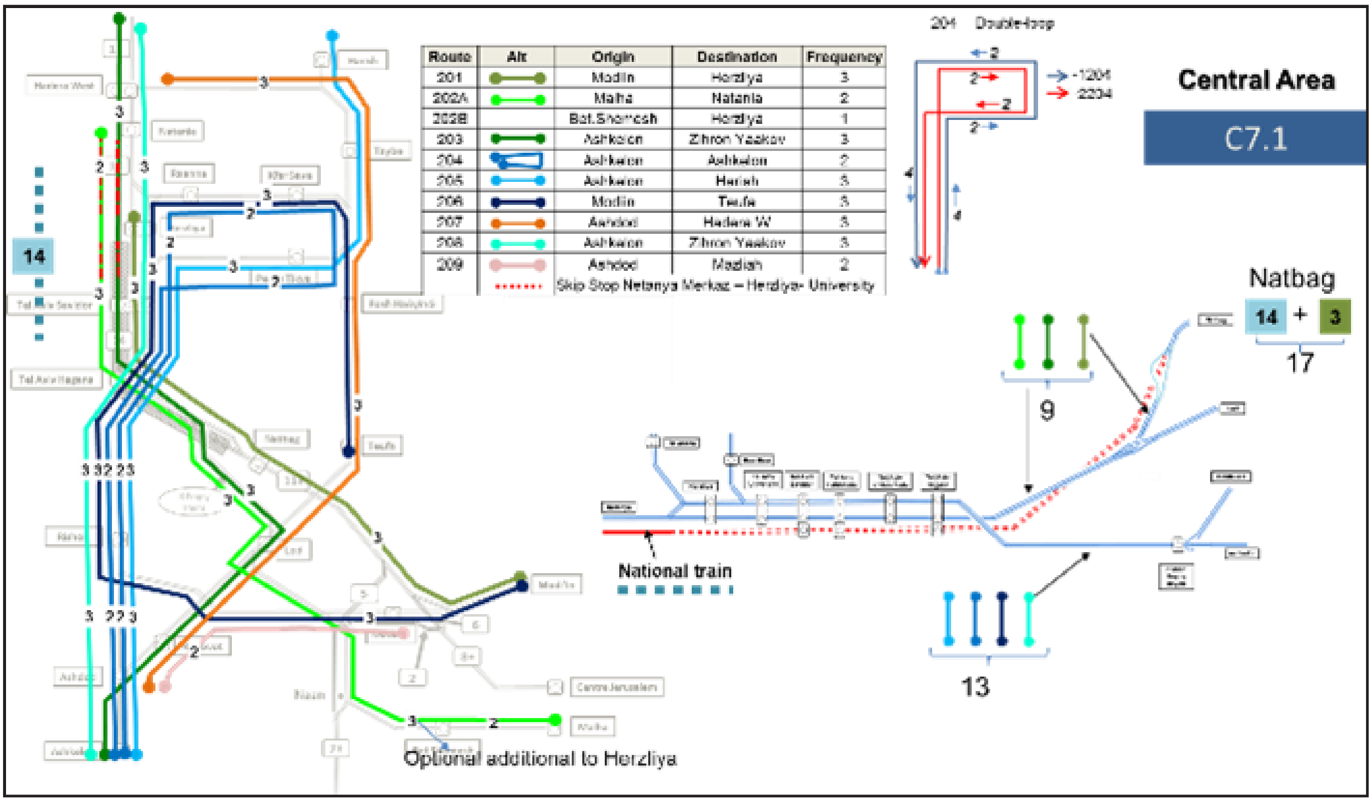
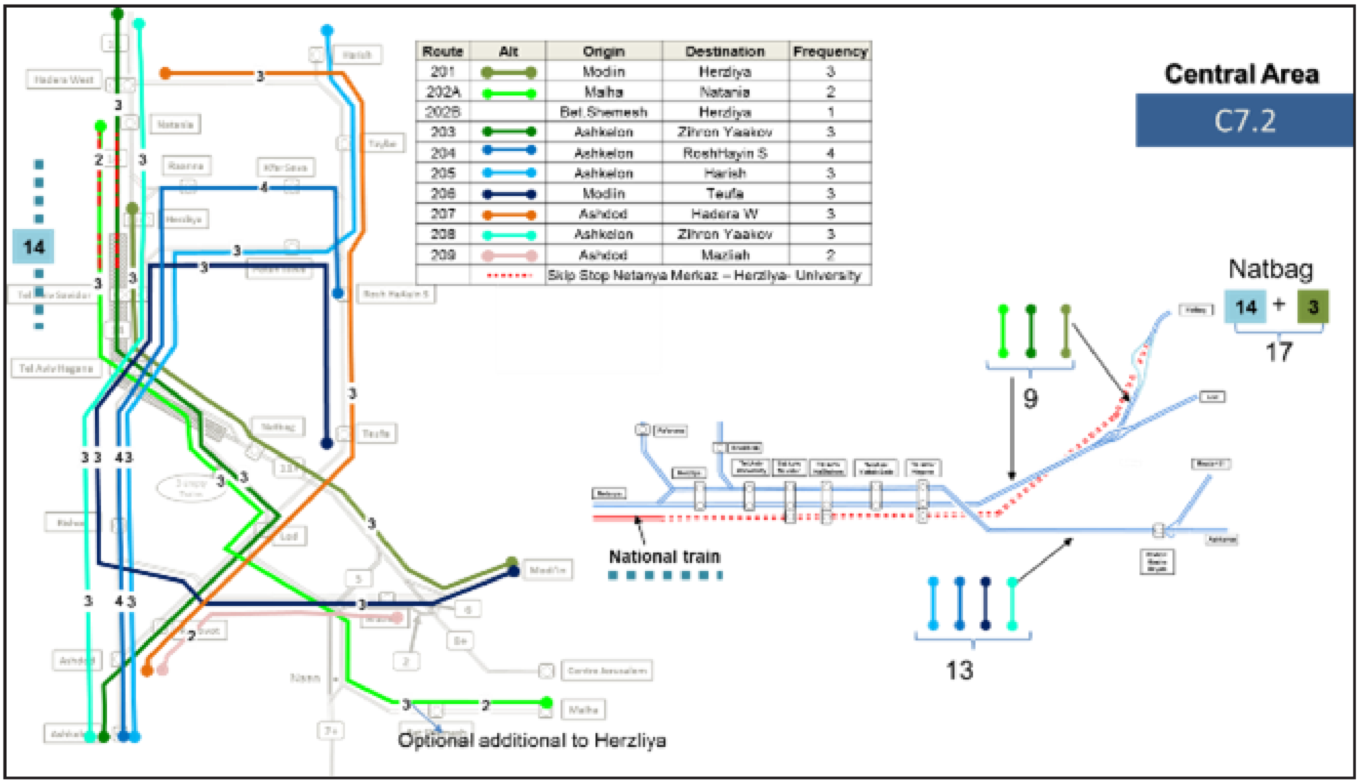


Figure A3.2 Local Routes Central Area – Alternative C7.1



Route	Alt	Origin	Destination	Frequency
201		Modin	Herzliya	3
202A		Malha	Natania	2
202B		Bet.Shemesh	Herzliya	1
203		Ashkelon	Zihron Yaakov	3
204		Ashkelon	RoshHayin S	4
205		Ashkelon	Harish	3
206		Modin	Teufa	3
207		Ashdod	Hadera W	3
208		Ashkelon	Zihron Yaakov	3
209		Ashdod	Mazliah	2
		Skip Stop Netanya Merkaz – Herzliya- University		

Figure A3.3 Local Routes Central Area – Alternative C7.2

A.3.4 Local Services – South Area

The services tested in Alternative C6 were retained.

A.3.5 Results

The load factors in Alternative C7 were generally satisfactory. Two problems were found firstly the skip stop service from startling from Zihron Yaakov become seriously overloaded at Netanya (Route 203) and secondly the new route from Ashdod to Matzliah (Route 209) was not well utilized.

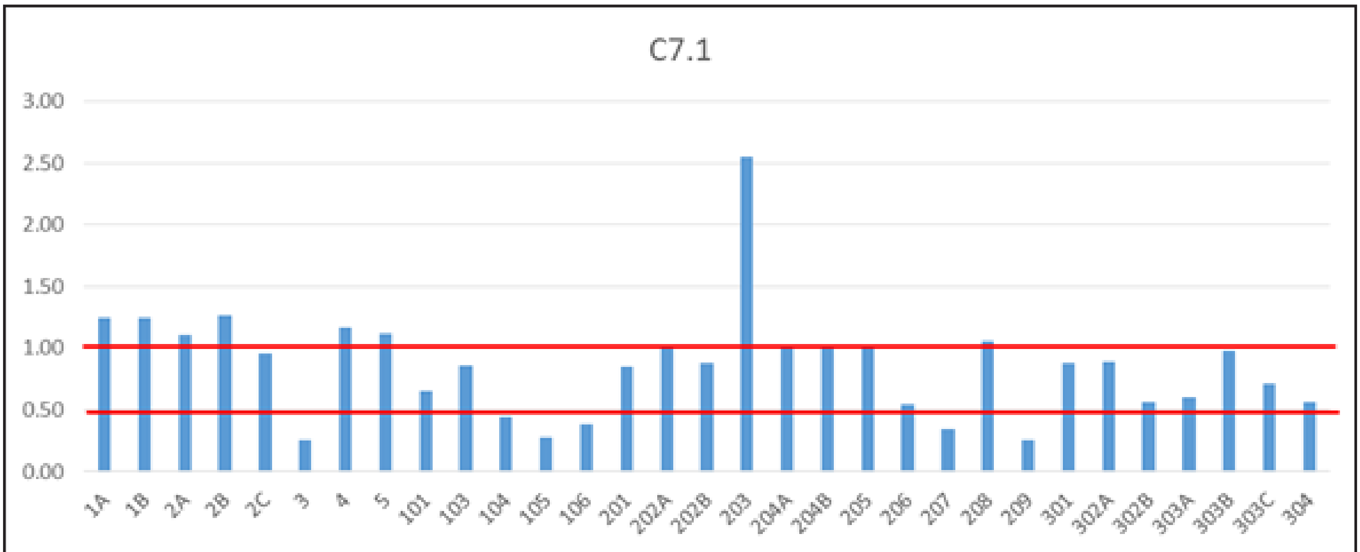


Figure A3.4– Load Factors – Alternative C7.1

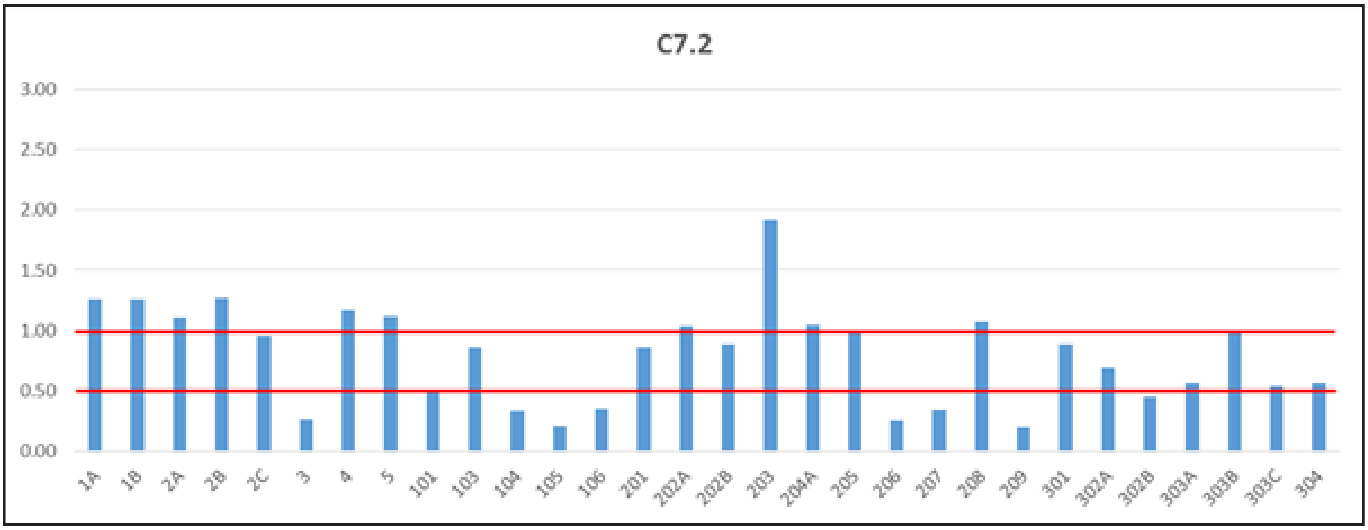


Figure A3.5– Load Factors – Alternative C7.2

A balance has to be struck between the National Services serving Hadera and the number of Skip-stop Services that serve both Hadera and Netanya. An increase in the number of services stopping at Netanya was required.

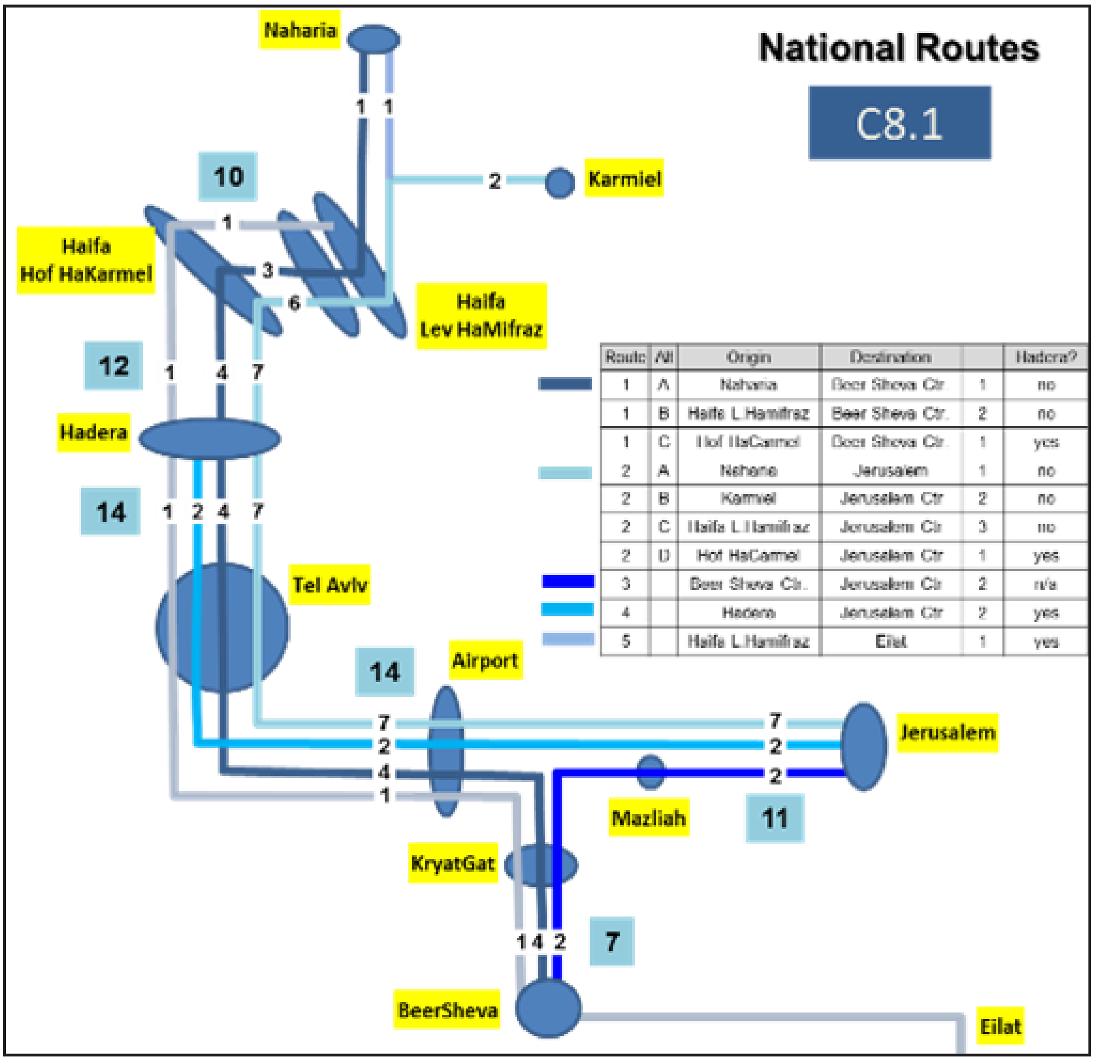
The potential demand for passengers using the Matzliah interchange to reach Jerusalem has been identified from analysis of the model as 1,500 passengers per hour, this is greater than the demand from Be'er Sheva and the South (550). However, interchanging at Matzliah is not attractive because of the limited service (2 tph) compared to interchanging in Tel Aviv (up to 9 tph). Although the model probably exaggerates the advantage of travelling via Tel Aviv if good connections to limit waiting time could be provided at Matzliah. Therefore the flows on Route 209 would probably be higher in practice.

Alternative C7.1 performed better in respect of passenger attraction in the Sharon Valley by significantly increasing the number of passengers from stations from Kfar Sava Nordau through to Ra'anana West.

A.4 Alternative C8

A.4.1 National Services

Further analysis of the improvements required to implement Alternative C7 identified that there was likely to be insufficient room for the stations in Haifa to be able to accommodate 14 tph on the National Routes and that the capacity of Lev HaMifratz as a terminus would be severely restricted by adjacent development and the limited capacity of the link to Kishon. It was necessary to reduce the number of National trains originating in Haifa to the minimum to provide for passenger demand. To overcome this problem it was proposed to revise the services to start 2 tph from Hof HaCarmel, where there was sufficient room for a turn back facility, and 2 tph from Hadera. 2 tph would start from Nahariya and Karmiel and the remaining 6 tph would start from Lev HaMifratz.



Route	Alt	Origin	Destination		Hadera?
1	A	Naharia	Beer Sheva Ctr.	1	no
1	B	Haifa L.Hamifraz	Beer Sheva Ctr.	2	no
1	C	Hof HaCarmel	Beer Sheva Ctr.	1	yes
2	A	Naharia	Jerusalem	1	no
2	B	Karmiel	Jerusalem Ctr	2	no
2	C	Haifa L.Hamifraz	Jerusalem Ctr	3	no
2	D	Hof HaCarmel	Jerusalem Ctr	1	yes
3		Beer Sheva Ctr.	Jerusalem Ctr	2	n/a
4		Hadera	Jerusalem Ctr	2	yes
5		Haifa L.Hamifraz	Eilat	1	yes

Figure A4.1 – National Routes – Alternative C81

A.4.2 Local Services

Adjustments were made to the Central Area Local Services to address the overcrowding on the skip stop service by increasing the frequency of service and increasing the number of National trains stopping at Hadera from 4 to 5. The frequencies through Ra'anana were increased by extending Route 202B, although there could be operational issues at Rosh HaAyin caused by lack of available space for turn back facilities that may prevent this extension or require trains to terminate further along the Eastern Track.

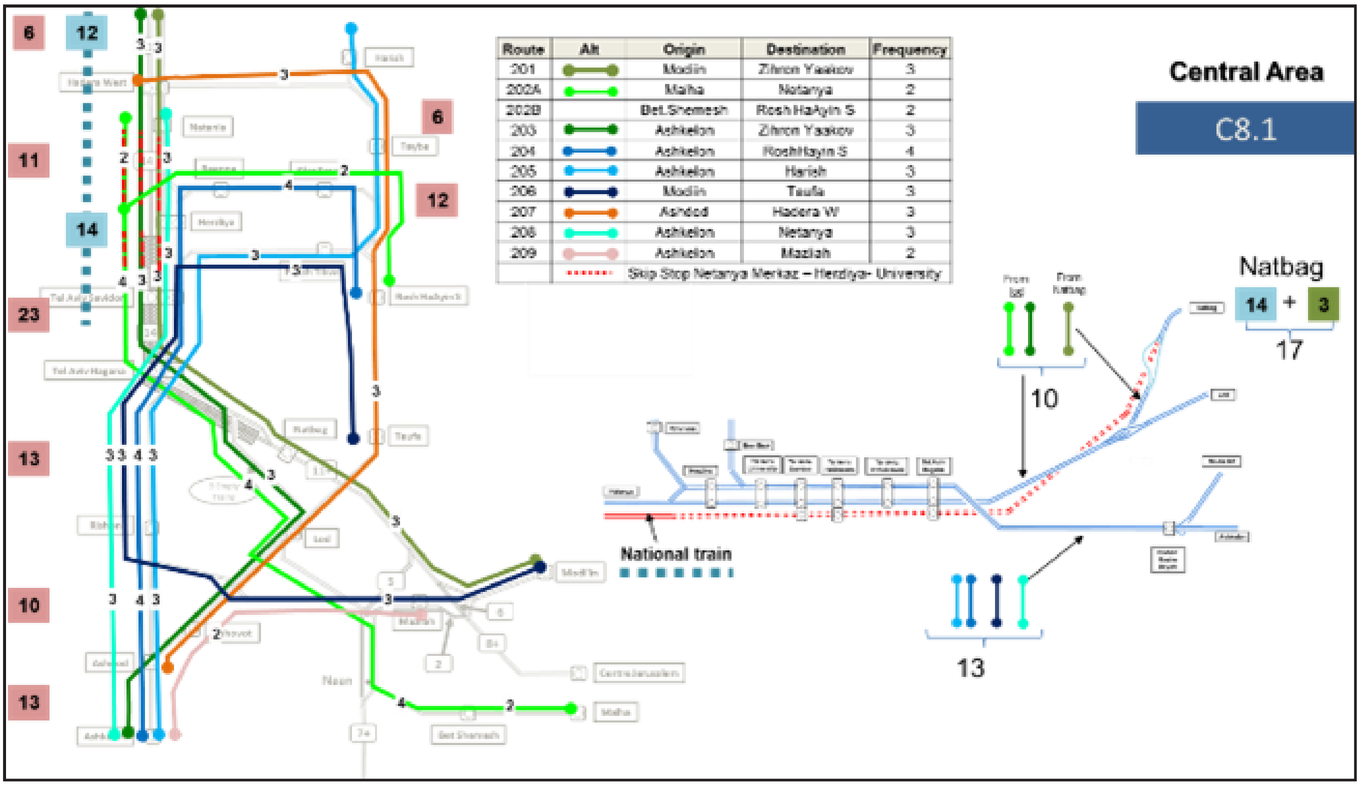


Figure A4.2 Local Routes Central Area – Alternative C81

The Local Service in the North and South were unchanged from Alternative C7.

A.4.3 Results

The load factors in Alternative C8 were generally satisfactory. Those Local Services that were overloaded were generally for segments of journeys that were less than 20 minutes duration. There was some overloading of the National Services the overloading occurs between

- Haifa and Tel Aviv - this is caused partly by the way the model allocates passengers to trains, overall the capacity utilized is about 90%.

Be'er Sheva, Kiryat Gat to BG Air Port – this could be overcome by providing an additional service, although tis would have to operate via Lod to ensure sufficient capacity for freight traffic on Lod Bypass.

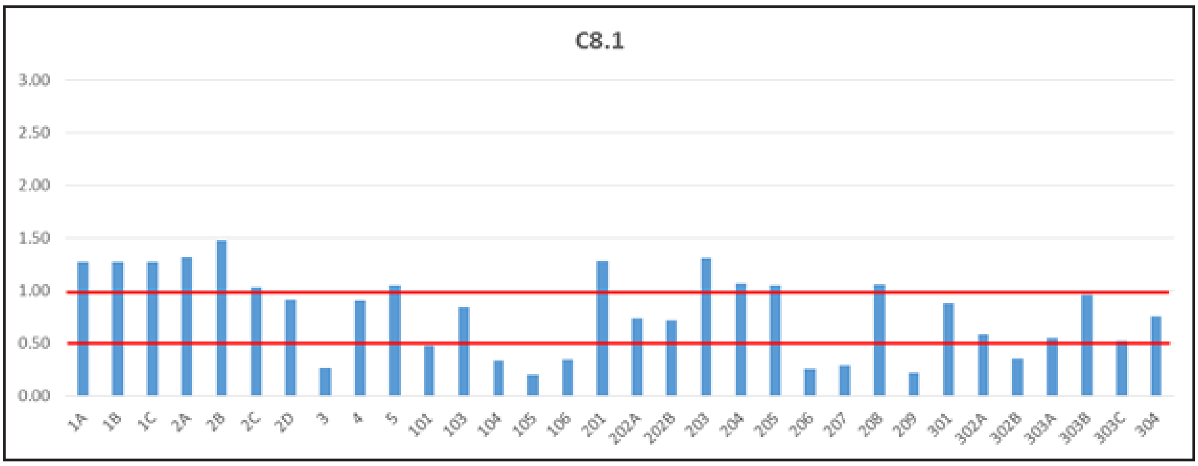


Figure A4.3– Load Factors – Alternative C81

B. APPENDIX B – PASSENGER FLOWS

B.1 Alternative C81 -2040

Figure B1.1 – Passenger Flows Alternative C81 North

Figure B1.2 – Passenger Flows Alternative C81 Haifa

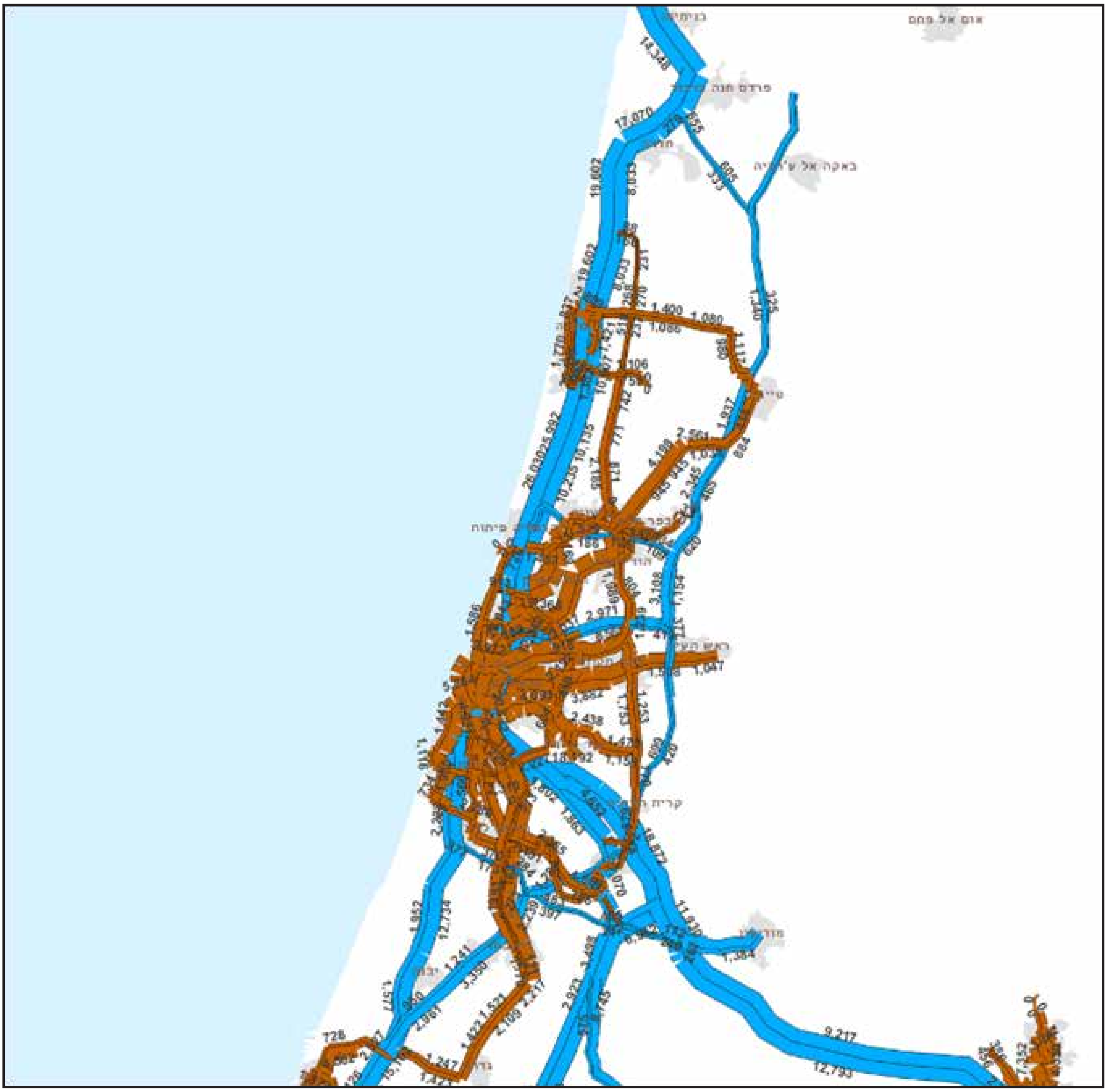


Figure B1.3 – Passenger Flows Alternative C81 Center north

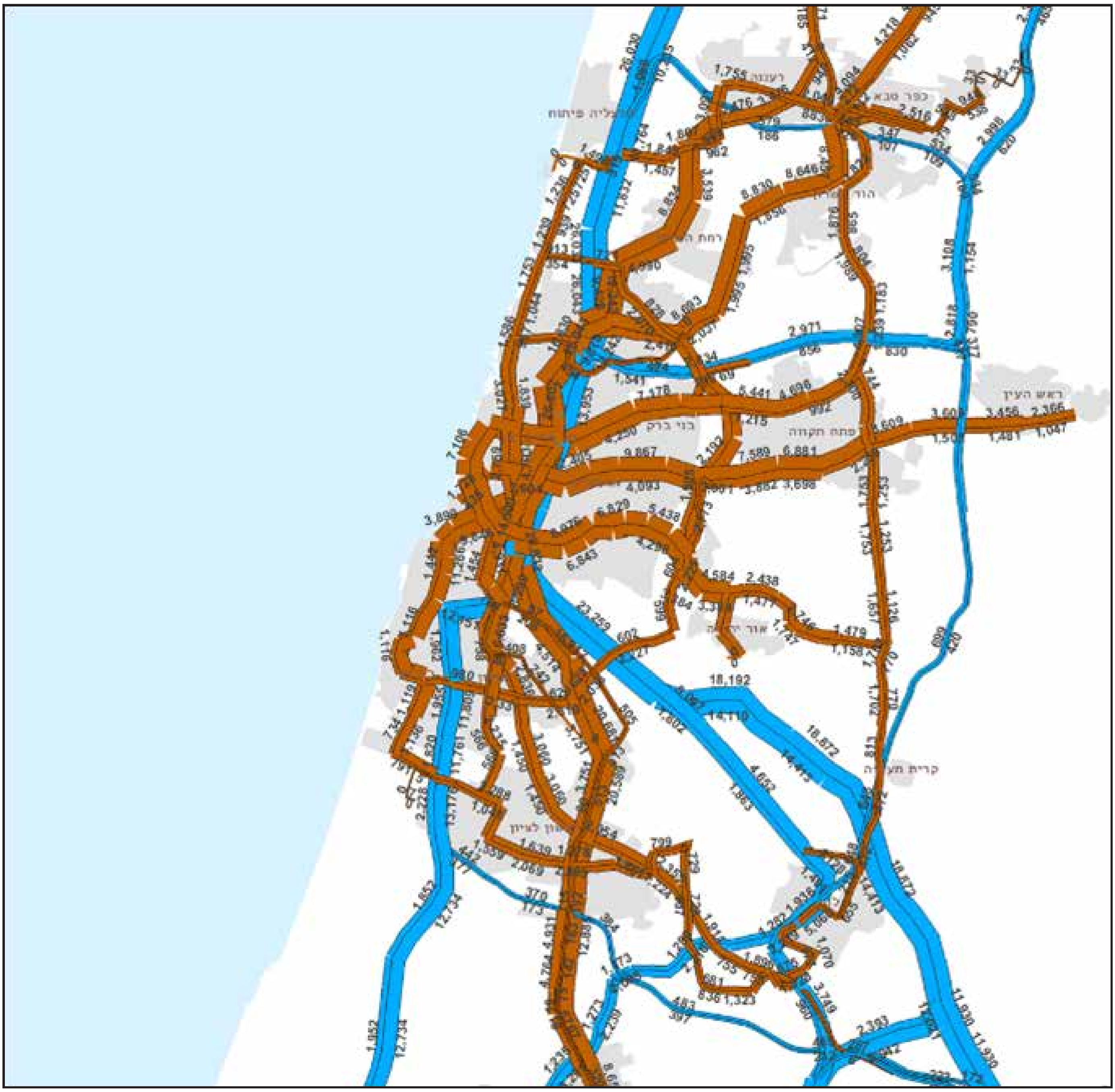


Figure B1.4 – Passenger Flows Alternative C81 Tel Aviv

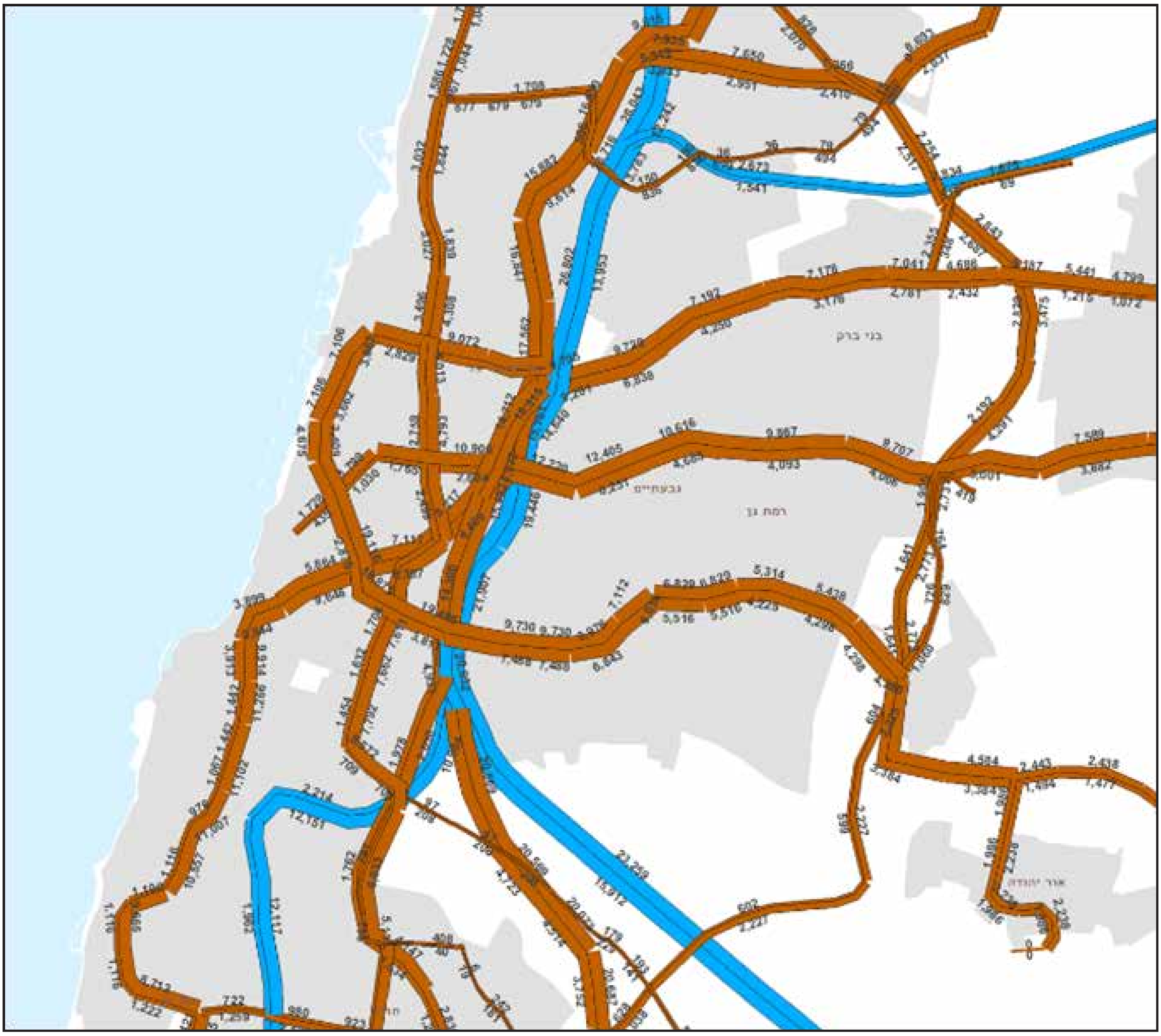


Figure B1.5 – Passenger Flows Alternative C81 Central Tel Aviv

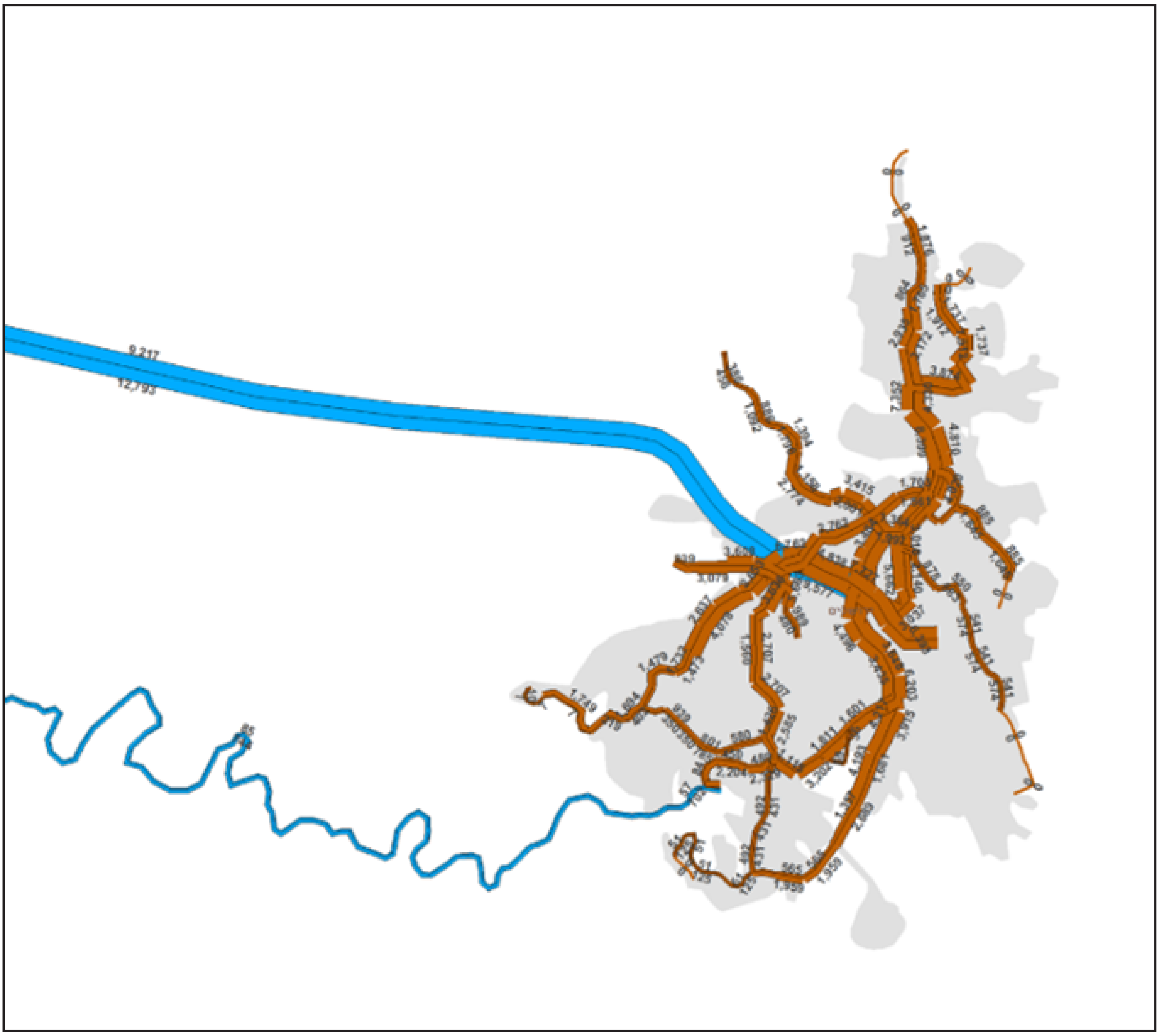


Figure B1.6 – Passenger Flows Alternative C81 Jerusalem

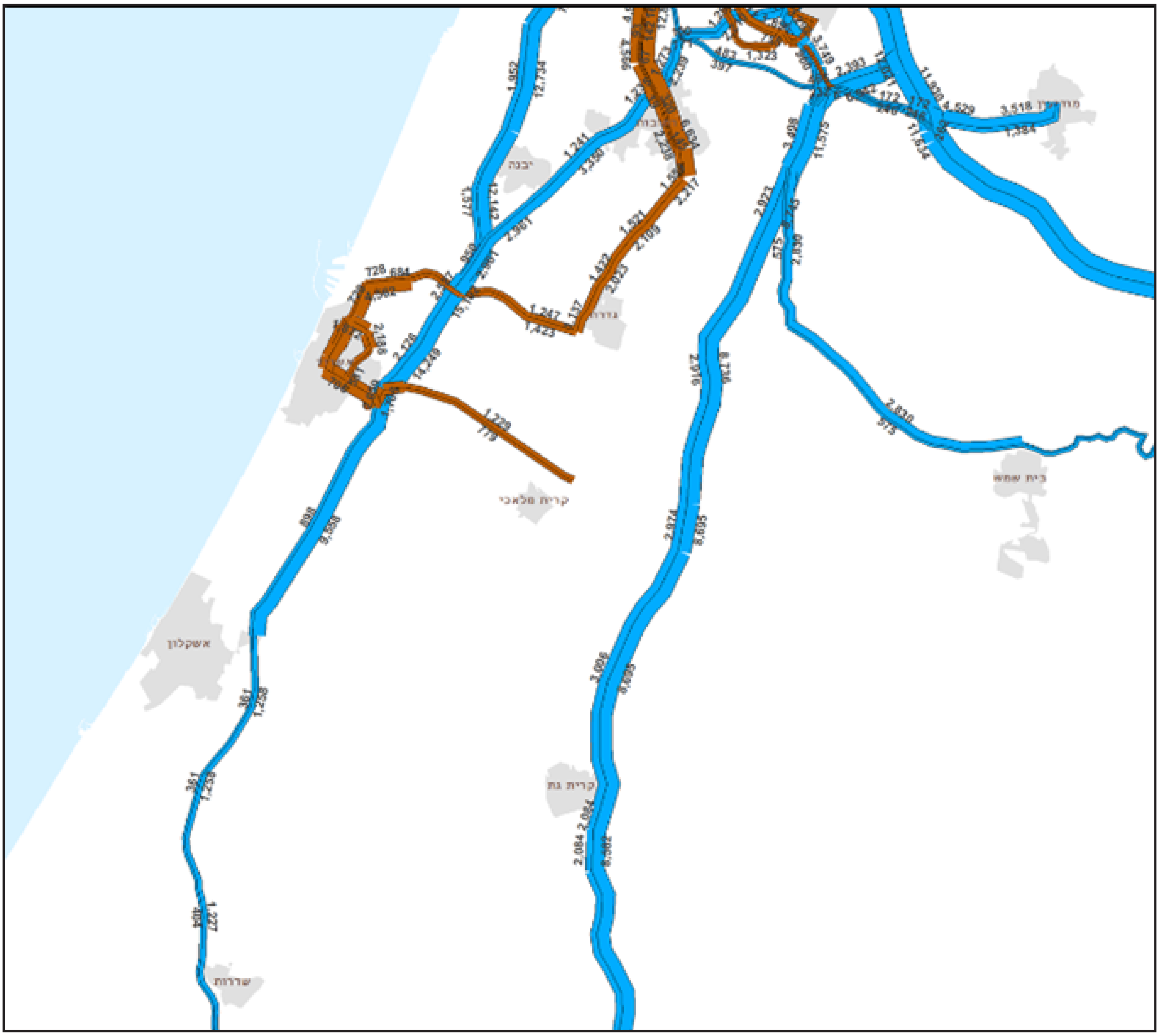


Figure B1.7– Passenger Flows Alternative C81 Center South

Figure B1.8 – Passenger Flows Alternative C81 South

B.2 Alternative C30 -2030

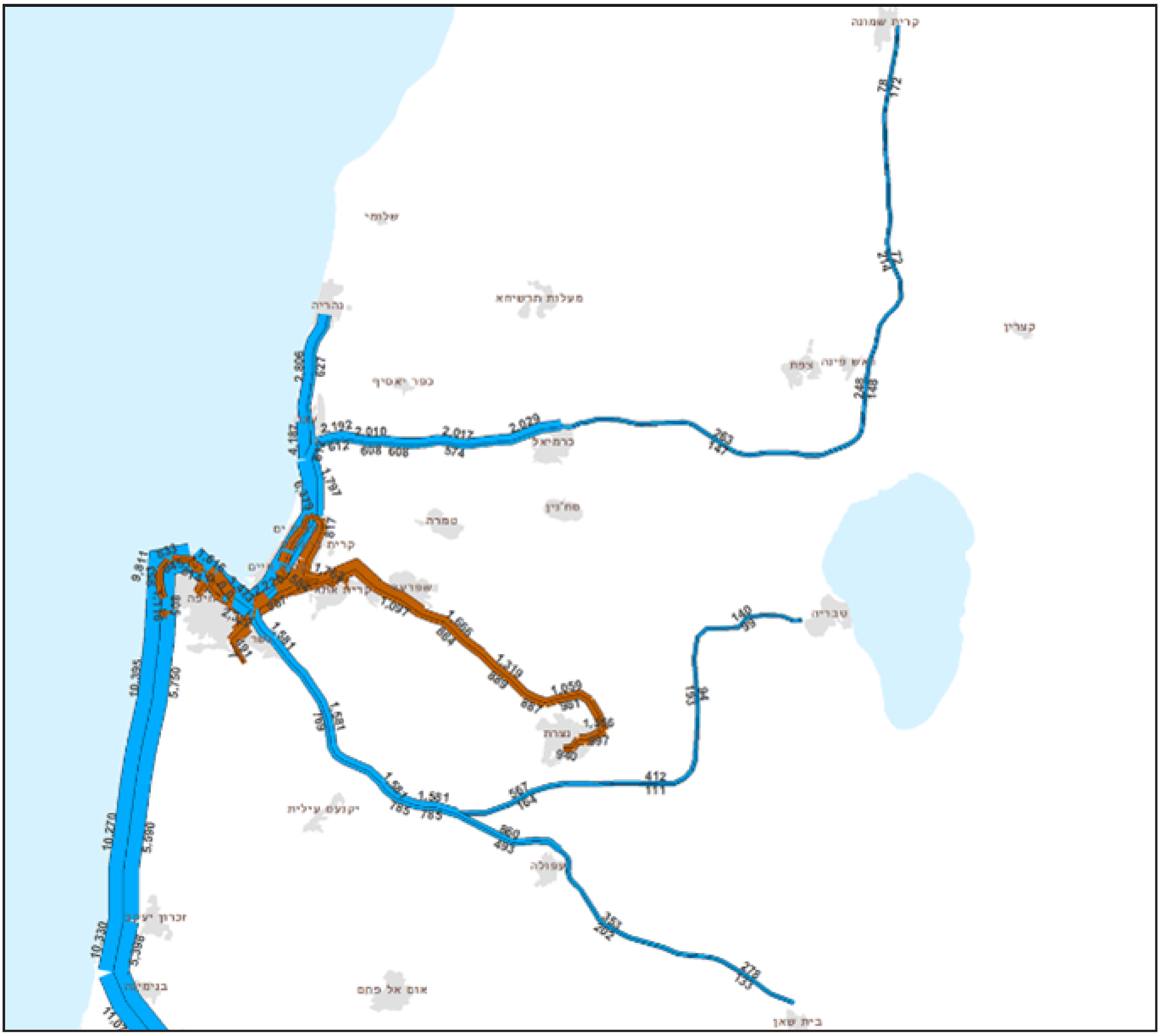


Figure B2.1 – Passenger Flows Alternative C30 North

Note: Lines from Karmiel to Kiryat Shmona and from Afula to Tveria not implemented in 2030

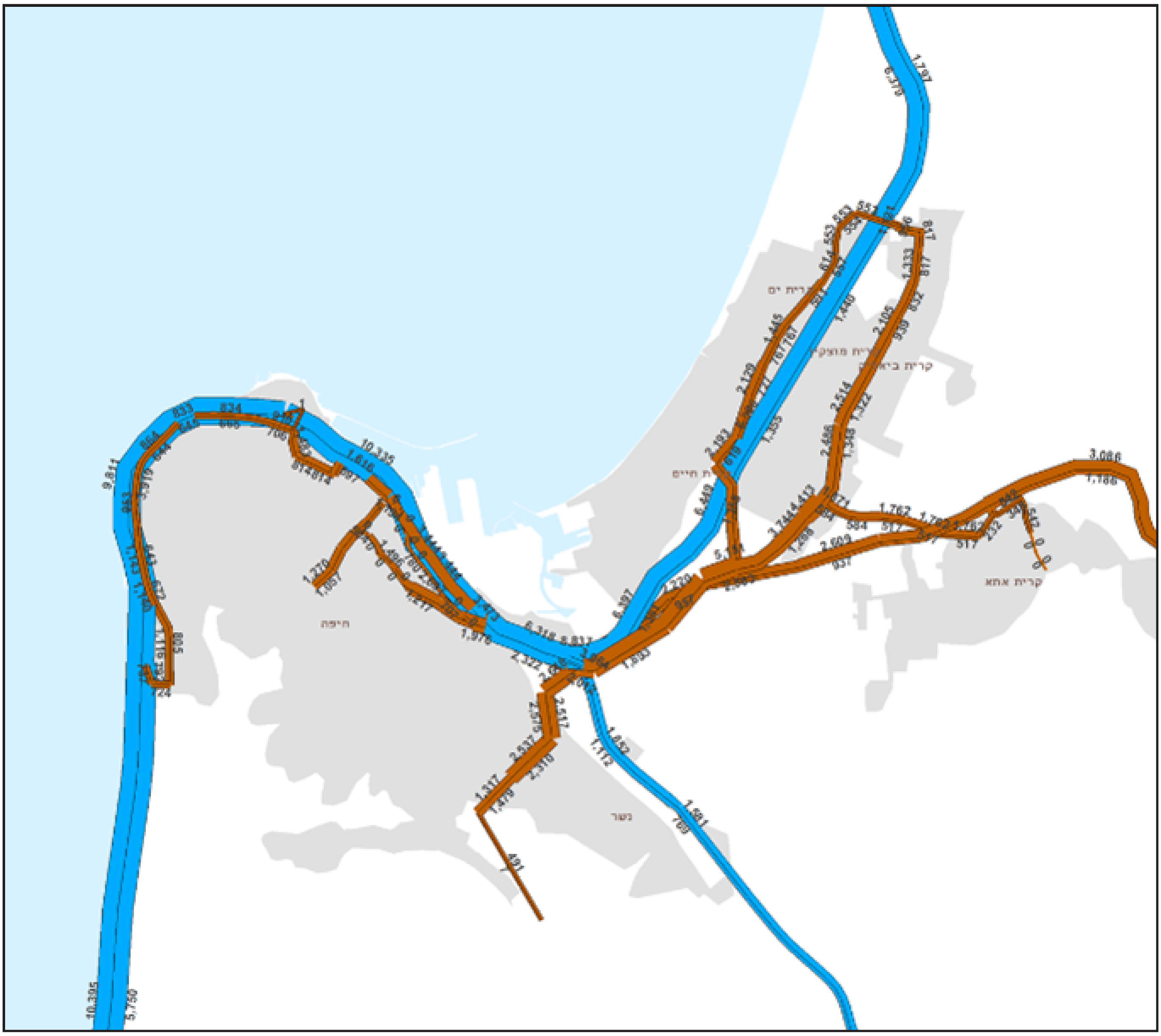


Figure B2.2 – Passenger Flows Alternative C30 Haifa

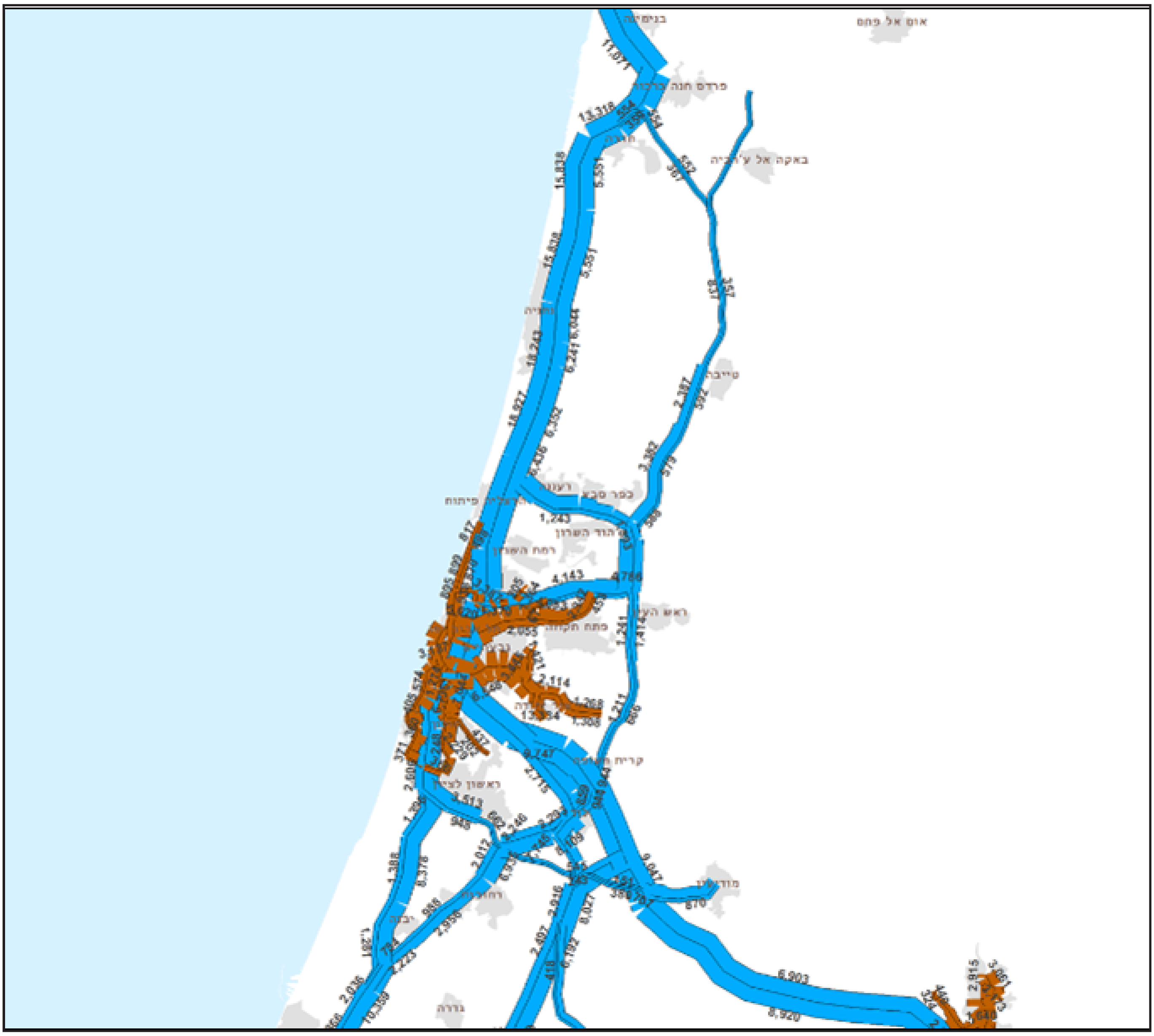


Figure B2.3 – Passenger Flows Alternative C30 Center north

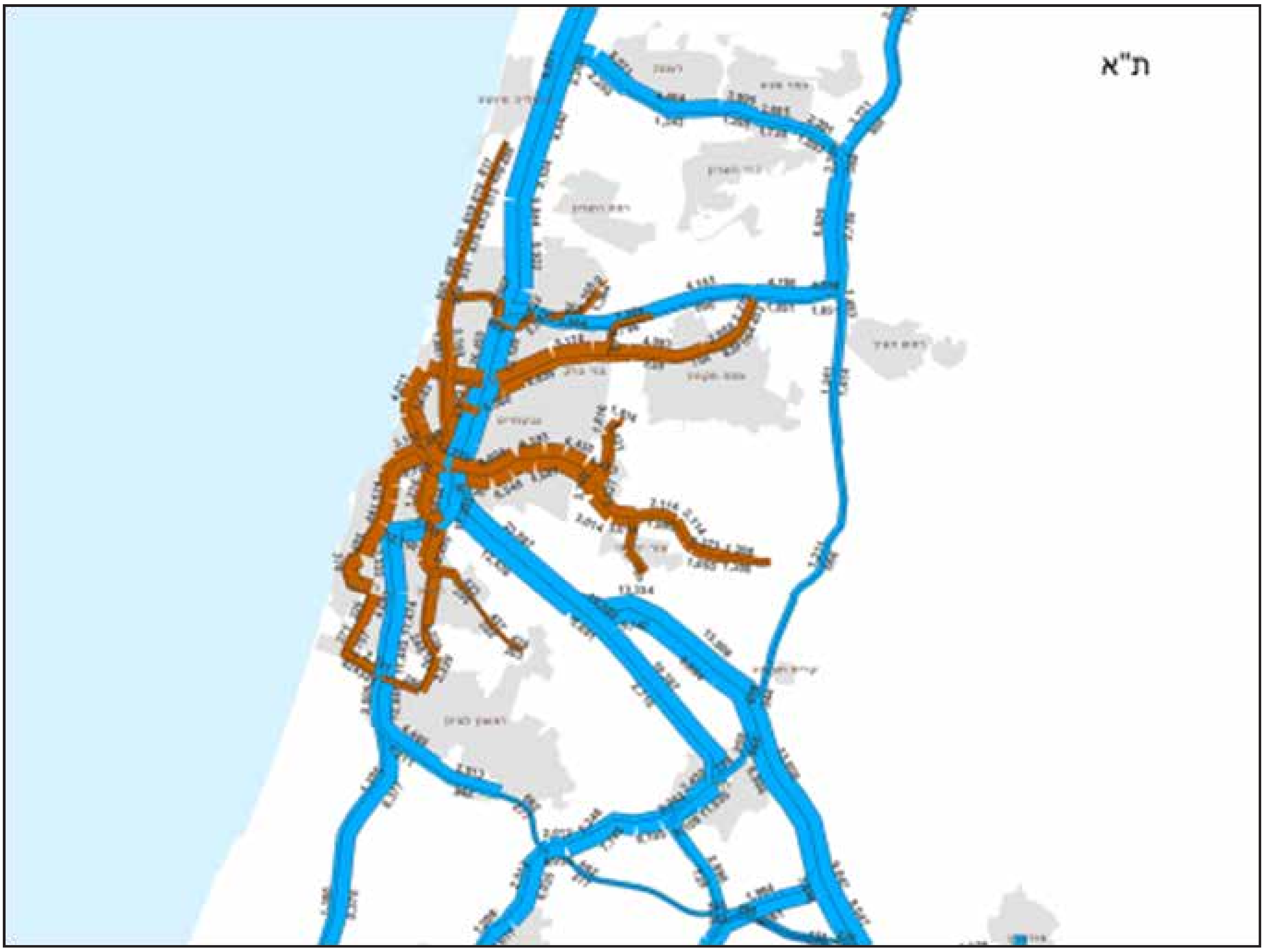


Figure B2.4 – Passenger Flows Alternative C30 Tel Aviv

Figure B2.5 – Passenger Flows Alternative C30 Central Tel Aviv

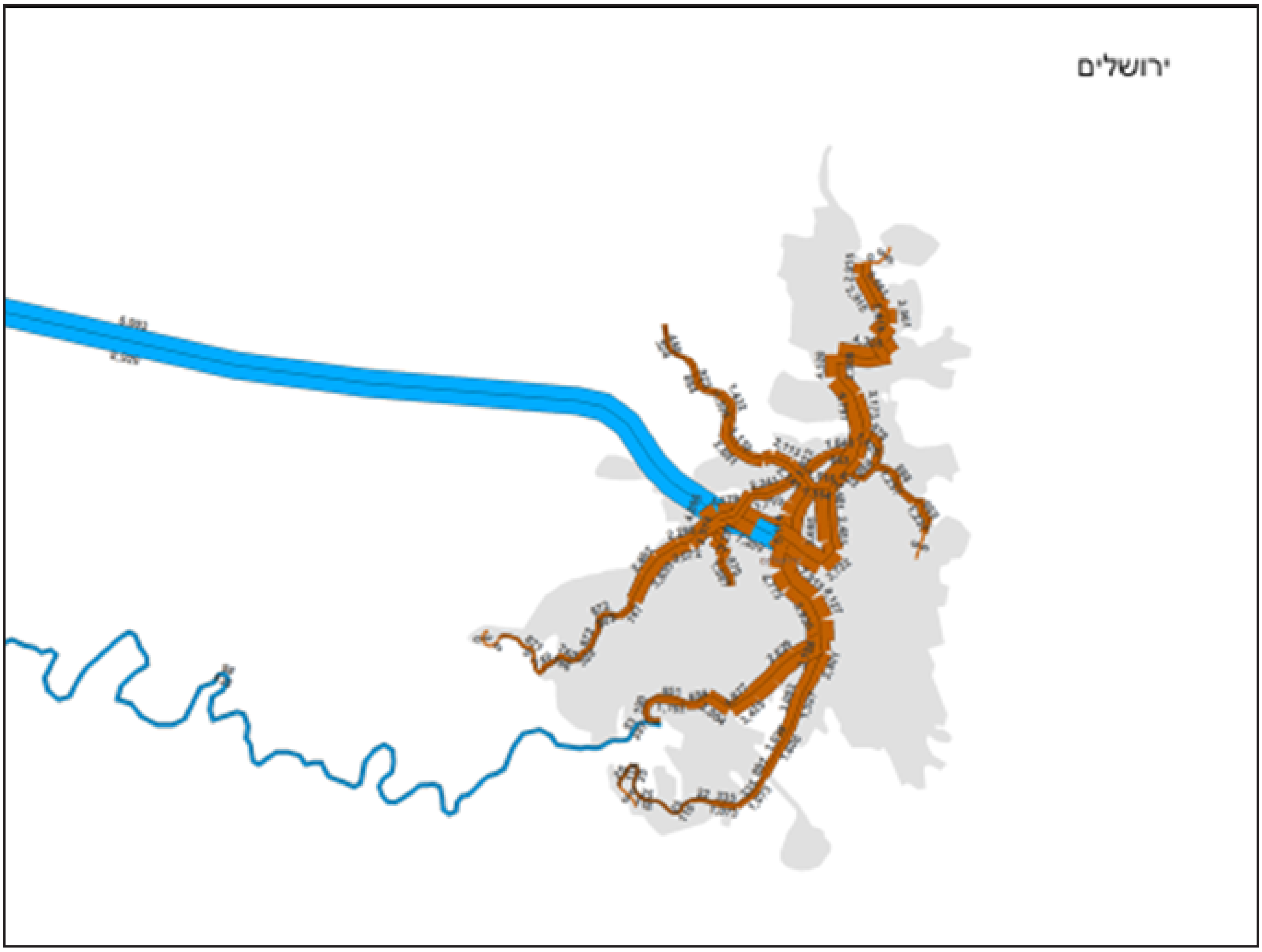


Figure B2.6 – Passenger Flows Alternative C30 Jerusalem

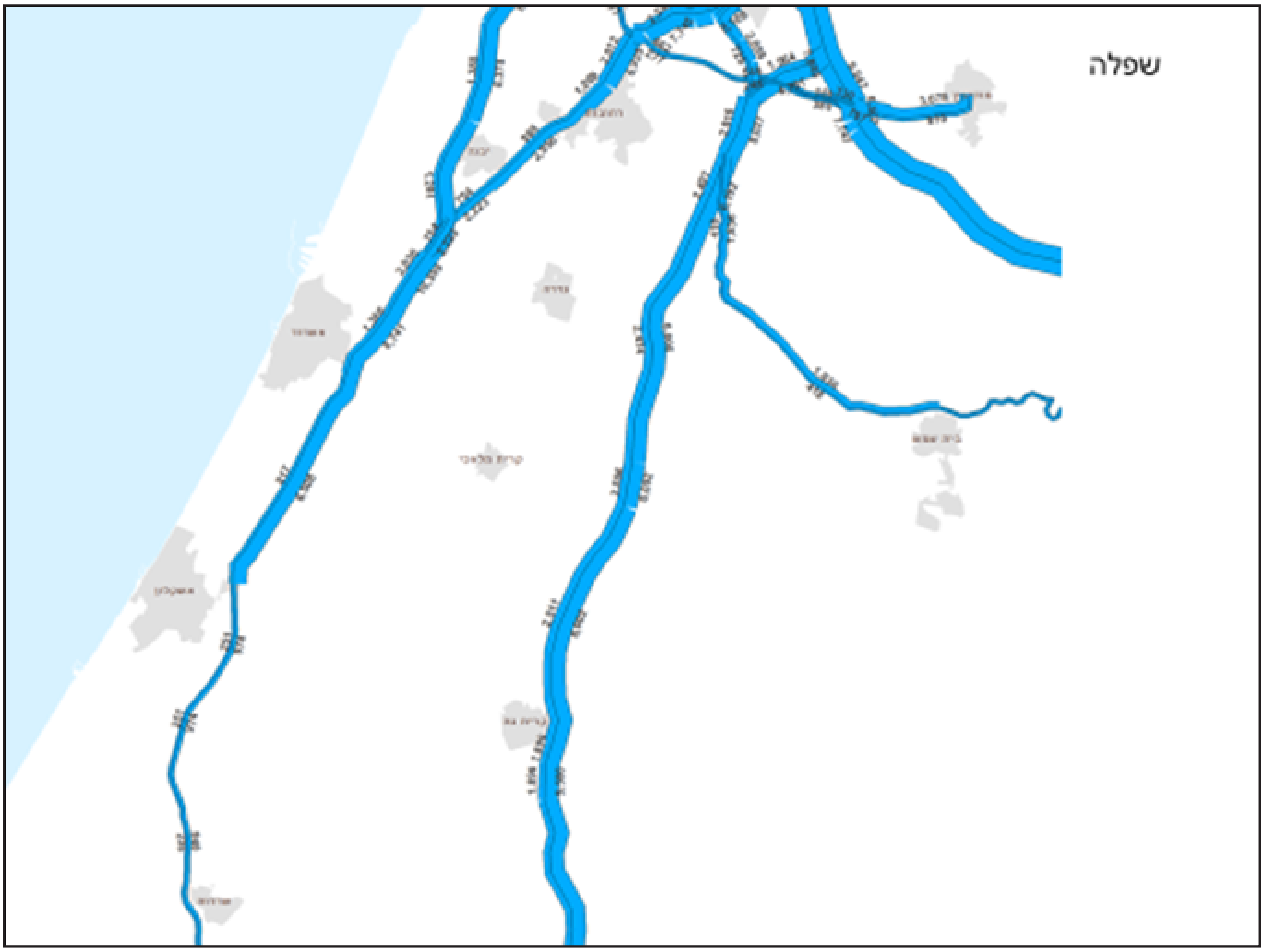


Figure B2.7 – Passenger Flows Alternative C30 Center South

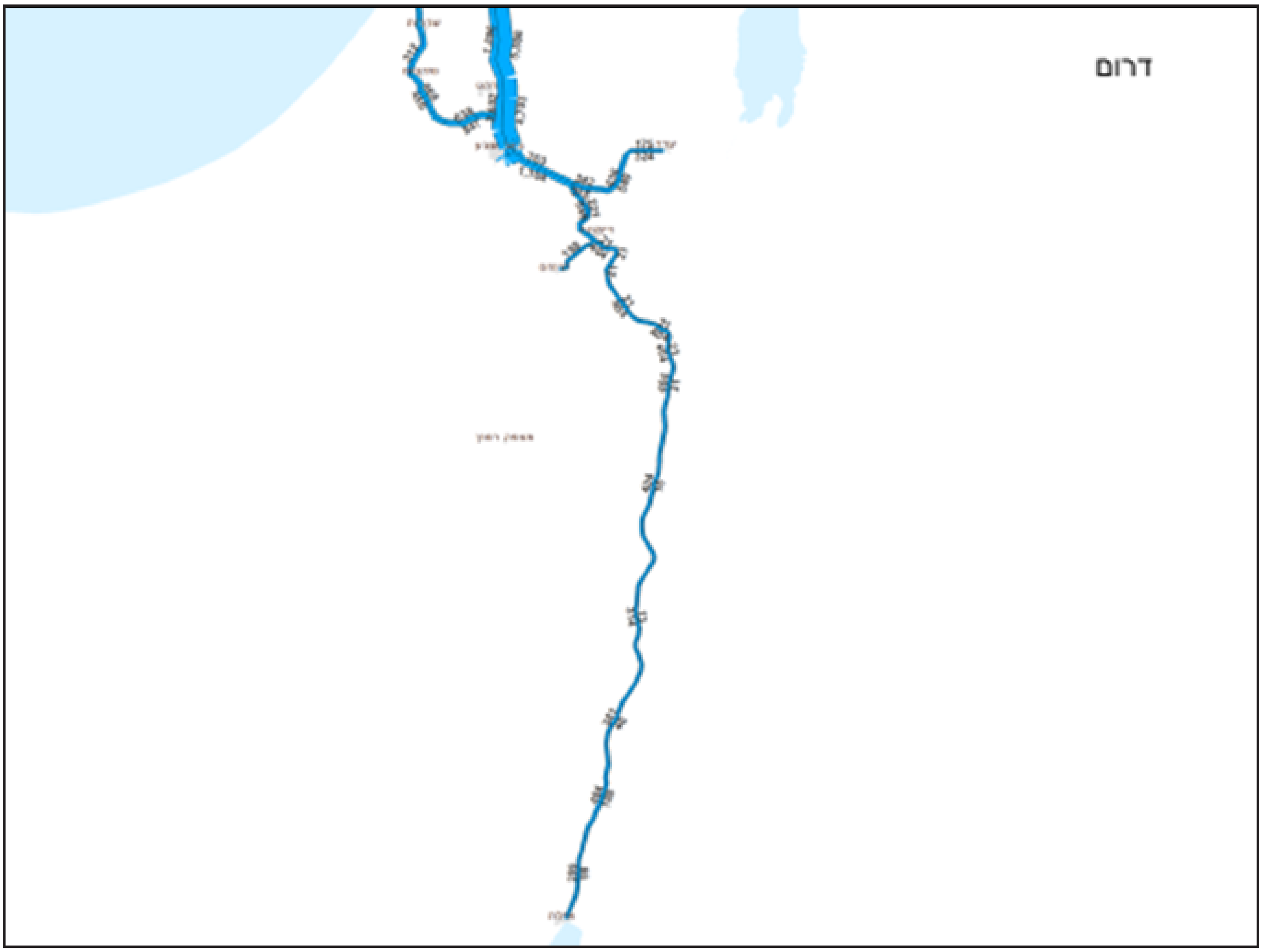


Figure B2.8 – Passenger Flows Alternative C30 South

Note: Lines from Dimona to Eilat and Yerucham and from Be'er Sheva to Arad not implemented in 2030

C. APPENDIX C – FORECAST NUMBER OF PASSENGERS BOARDING AND ALIGHTING MORNING PEAK HOUR

The forecast number of passengers at stations, set out in the following tables, may vary between closely spaced stations and because of integration with the mass transit system that is currently still under planning. A more detailed forecast will be needed for detailed station planning.

C.1 Alternative C81 – 2040

Station	Boarding					Alighting				Total Activity
	Walk		Transfer			Walk	Transfer			
	In	P+R	In	Out	Total	Out	In	Out	Total	
Acre	1,023	96	34	0	1,153	859	34	0	893	2,046
Afula	547	332	0	22	901	496	0	26	522	1,422
Ahihud	15	830	67	0	912	232	67	0	299	1,211
Ahituv	66	35	498	0	600	88	498	0	586	1,186
Ammiad	2	22	1	0	25	2	1	0	3	28
Arad	156	27	0	0	183	263	0	0	263	446
Arara	325	273	0	0	598	232	0	0	232	831
Ashdod Ad Halom	0	649	117	5,496	6,261	0	117	2,682	2,799	9,060
Ashqelon	5,393	3,276	1,250	0	9,919	906	1,250	0	2,156	12,076
Atlit	267	32	0	0	299	214	0	0	214	512
Bat Yam Komemiut	43	101	32	0	175	230	32	0	262	438
Bat Yam Yoseftal	644	251	0	322	1,217	420	0	495	915	2,132
Be'er Sheva Center	3,008	1,373	1,062	0	5,443	3,405	1,062	0	4,467	9,910
Be'er Sheva North	2,200	862	1,584	0	4,646	1,222	1,584	0	2,806	7,453
Be'er Sheva Ramot	0	143	542	0	686	0	542	0	542	1,228
Be'er Ya'aqov	376	31	0	0	408	383	0	0	383	790
Ben Gurion Airport	98	390	1,189	0	1,677	864	1,189	0	2,054	3,731
Bene Beraq	23	2	0	0	26	810	0	0	810	835
Bene Darom	0	453	507	0	959	0	507	0	507	1,466
Bet Shean	391	135	0	0	525	168	0	0	168	694
Bet Shemesh	2,860	673	0	0	3,533	620	0	0	620	4,153
Bet Yehoshua	76	90	0	0	166	66	0	0	66	232
Dimona	314	47	0	0	362	307	0	0	307	669
Eilat	61	1	0	0	62	261	0	0	261	323
Elad-Rinntya	1,107	50	0	0	1,157	527	0	0	527	1,684
Gonen	18	119	1	0	138	19	1	0	20	158
Hadera East	34	139	0	0	173	68	0	0	69	241
Hadera North	479	86	366	0	932	552	366	0	918	1,850
Hadera West	2,245	1,798	1,122	0	5,165	1,165	1,122	0	2,287	7,452
Haifa Bat Galim	184	108	54	39	385	1,237	54	98	1,389	1,774
Haifa Beth Hameches	40	449	2,651	704	3,843	1,178	2,651	401	4,230	8,073

Station	Boarding					Alighting				Total Activity
	Walk		Transfer			Walk	Transfer			
	In	P+R	In	Out	Total	Out	In	Out	Total	
Haifa Hof Hacarmel	358	631	1,308	962	3,259	2,059	1,308	1,001	4,368	7,627
Harish	1,413	113	0	0	1,526	253	0	0	253	1,780
Hazeva	0	0	0	0	0	0	0	0	0	0
Herzliyya	247	816	632	438	2,134	2,392	632	1,050	4,074	6,208
Hod Hasharon Sokolov	70	197	0	21	288	71	0	18	89	377
Holon Wolfson	283	26	0	0	309	526	0	0	526	835
Holot Gan Rave	0	101	0	0	101	0	0	0	0	101
Huzot Hamifratz	4	2	0	0	6	250	0	0	250	256
Jerusalem Center	591	0	0	4,248	4,838	3,177	0	6,399	9,577	14,415
Jerusalem Malcha	3	9	0	45	57	95	0	607	702	759
Jerusalem Yizhak Navon	757	2,510	0	1,936	5,202	1,865	0	2,175	4,040	9,242
Jerusalem Zoo	24	4	0	0	28	42	0	0	42	70
Karmiel	101	1,256	19	1,391	2,766	53	19	588	659	3,426
Kefar Barukh	0	11	35	642	688	0	35	571	606	1,295
Kefar Sava Nordao	10	56	0	0	66	251	0	0	251	317
Kefar Sava North	653	85	0	0	738	240	0	0	240	978
Kefar Tavor	36	48	0	0	84	52	0	0	52	137
Kefar Yehoshua Yoqneam	60	133	0	0	194	51	0	0	51	245
Kuseife	227	103	0	0	330	402	0	0	402	733
Lehavim Rahat	2,397	1,289	0	0	3,687	677	0	0	677	4,364
Lev Hamifratz	3	354	435	3,752	4,543	662	435	2,968	4,065	8,608
Lev Hamifratz East	0	150	0	1,047	1,198	125	0	1,479	1,604	2,802
Lod	0	196	985	0	1,181	186	985	0	1,171	2,352
Lod Ganey Aviv	519	0	0	349	868	162	0	594	756	1,624
Lod North	72	1	0	65	138	341	0	419	761	898
Maker	227	34	0	0	261	69	0	0	69	330
Mazkeret Batya	39	16	0	0	55	52	0	0	52	107
Mazliah North	0	53	19	288	360	0	19	34	53	414
Mazliah South	0	246	0	31	277	0	0	383	383	660
Modi’in Center	2,631	887	0	0	3,518	1,384	0	0	1,384	4,902
Nahariyya	1,887	1,207	36	0	3,130	681	36	0	717	3,848
Natanya College	0	0	0	13	13	0	0	2	2	15
Natanya Sapir	0	0	0	433	433	0	0	226	226	659
Nazareth South	155	27	0	0	183	71	0	0	71	254
Nesher	449	39	114	0	602	882	114	0	996	1,598
Netanya	0	1,724	148	5,614	7,486	0	148	3,370	3,517	11,003
Netivot	282	93	0	0	376	154	0	0	154	530
Ofaqim	444	279	0	0	723	163	0	0	163	886
Or Aqiva	1,261	453	4	0	1,718	618	4	0	622	2,340
Paran	0	70	0	0	70	0	0	0	0	70
Peatey Modi’in	0	1,008	43	0	1,051	0	43	0	43	1,094
Petah Tiqwa Kiryat Arie	141	70	0	10	220	144	0	275	419	639
Petah Tiqwa Segulla	0	198	1	577	776	13	1	1,077	1,091	1,867
Qesaryya Pardes Hanna	1,384	1,386	0	0	2,771	974	0	0	974	3,745
Qiryat Haim	348	53	0	0	401	369	0	0	369	770

Station	Boarding					Alighting				Total Activity
	Walk		Transfer			Walk	Transfer			
	In	P+R	In	Out	Total	Out	In	Out	Total	
Qiryat MalaKhi Yoav	0	32	0	0	32	0	0	0	0	32
Qiryat Motzkin	490	336	0	5	831	352	0	0	352	1,182
Qiryat Shemona	114	0	0	0	114	70	0	0	70	184
Qiryat Yam Savionei Yam	0	382	293	137	811	119	293	436	847	1,658
Qiyat Ata	0	59	3	125	186	139	3	224	366	552
Qiyat Gat	626	297	973	0	1,896	1,731	973	0	2,704	4,600
Ra'annana South	0	27	0	74	101	27	0	120	147	248
Ra'anana West	156	429	0	32	618	385	0	86	471	1,089
Ramat Hasharon Glilot North	1	0	0	0	1	506	0	0	506	507
Ramat Hasharon Glilot South	92	157	0	58	307	41	0	354	395	701
Ramla	104	6	2	100	212	403	2	421	825	1,037
Ramla East	0	82	210	0	293	446	210	0	656	949
Ramla South	101	5	6	6	118	244	6	15	265	383
Ramla West	0	36	0	4	40	14	0	9	23	63
Rehovot	11	170	15	636	832	564	15	1,344	1,923	2,755
Rehovot Gavirol	309	91	0	0	400	453	0	0	453	854
Rishon Leziyyon Harishonim	0	15	1	208	225	66	1	118	184	409
Rishon Leziyyon Me'uyan Shoreq	238	5	0	0	244	375	0	0	375	618
Rishon Leziyyon Moshe Dayan	0	322	241	794	1,358	253	241	1,872	2,366	3,723
Rosh Ha'ayin North	157	221	145	0	523	328	145	0	473	995
Rosh Ha'ayin South	105	102	343	0	549	132	343	0	475	1,024
Rosh Pina	14	42	0	0	56	171	0	0	171	226
Sapir Arava	0	25	0	0	25	0	0	0	0	25
Sederot	506	211	0	0	717	464	0	0	464	1,181
Shapirim	18	480	4	0	502	22	4	0	26	528
Shefayim	0	433	0	287	720	0	0	105	105	825
Shefayim	188	0	0	0	188	250	0	0	250	438
Tamra	0	46	3	0	49	0	3	0	3	51
Tayibe	0	289	1	788	1,078	0	1	569	570	1,648
Tel Aviv Center Savidor	496	339	3,554	2,241	6,630	3,224	3,554	8,827	15,605	22,235
Tel Aviv Hagana	185	138	6,470	4,860	11,652	3,107	6,470	10,769	20,346	31,998
Tel Aviv Hashalom	143	225	107	5,910	6,384	5,582	107	8,534	14,223	20,606
Tel Aviv University	0	68	795	141	1,003	1,320	795	972	3,087	4,090
Tel Aviv Yizhak Sade	290	29	160	0	478	3,961	160	0	4,121	4,600
Tel Yosef	85	15	0	0	100	108	0	0	108	208
Teufa	18	72	3	6	99	177	3	21	202	301
Tiberias	92	58	0	0	150	110	0	0	110	261
Timna	0	44	0	0	44	0	0	0	0	44
Tira	177	237	7	0	421	57	7	0	64	485
Yad Mordekhay	56	50	0	0	106	32	0	0	32	137
Yahel	28	1	0	0	29	26	0	0	26	54
Yavne	913	137	0	0	1,051	952	0	0	953	2,003
Yavne West	398	789	0	0	1,188	970	0	0	970	2,158
Yeroham	163	9	0	0	171	79	0	0	79	250
Yotvata	138	13	0	0	151	137	0	0	137	288
Zikhron Ya'aqov	753	189	0	0	942	338	0	0	338	1,280
Zomet Golani	44	110	0	0	154	19	0	0	19	173
Zomet Holon	0	73	67	334	474	0	67	1,391	1,458	1,932

C.2 Alternative C30 -2030

Station	Board-ing	Alight-ing	Station	Board-ing	Alight-ing	Station	Board-ing	Alight-ing
Acre	1,613	-791	Karmiel	1,830	-672	Ramla East	382	-388
Afula	550	-334	Kefar Barukh	430	-404	Ramla South	260	-178
Ahihud	86	-127	Kefar Sava Nordao	1,725	-877	Ramla West	500	-183
Ahituv	499	-355	Kefar Sava North	533	-193	Rehovot	3,419	-1,896
Ammiad	19	-3	Kefar Tavor	242	-40	Rehovot Gavirol	2,312	-880
Arad	175	-324	Kefar Yehoshua Yo-qneam	28	-13	Rishon Leziyyon Haris-honim	3,113	-932
Arara	344	-203	Kuseife	261	-225	Rishon Leziyyon Me'uy-an Shoreq	1,046	-352
Ashdod Ad Halom	3,352	-1,668	Lehavim Rahat	1,782	-273	Rishon Leziyyon Moshe Dayan	1,720	-2,570
Ashqelon	6,743	-1,775	Lev Hamifratz	4,425	-3,186	Rosh Ha'ayin North	3,429	-2,798
Atlit	203	-168	Lev Hamifratz East	799	-705	Rosh Ha'ayin South	755	-660
Bat Yam Komemiut	78	-141	Lod	2,720	-2,322	Rosh Pina	46	-87
Bat Yam Yoseftal	983	-431	Lod Ganey Aviv	325	-50	Sapir Arava	5	0
Be'er Sheva Center	3,386	-2,184	Lod North	265	-961	Sederot	503	-327
Be'er Sheva North	2,374	-1,528	Maged El-Krum	411	-242	Shapirim	267	-78
Be'er Sheva Ramot	617	-373	Maker	216	-38	Shefayim	191	-245
Be'er Ya'aqov	1,184	-608	Mazkeret Batya	239	-77	Tayibe	1,827	-511
Ben Gurion Airport	1,738	-2,155	Mazliah North	256	-51	Tel Aviv Center Savidor	8,192	-18,964
Bene Beraq	33	-655	Mazliah South	261	-171	Tel Aviv Hagana	10,777	-22,012
Bene Darom	1,990	-1,041	Modi'in Center	3,078	-870	Tel Aviv Hashalom	829	-6,830
Bet Shean	278	-133	Nahariyya	2,806	-626	Tel Aviv University	1,520	-5,634
Bet Shemesh	2,182	-428	Natanya College	884	-1,096	Tel Aviv Yizhak Sade	246	-5,014
Bet Yehoshua	565	-55	Natanya Sapir	261	-199	Tel Yosef	100	-93
Dimona	230	-285	Nazareth South	199	-97	Teufa	204	-835
Eilat	98	-289	Nesher	305	-377	Tiberias	140	-99
Elad-Rinntya	1,019	-300	Netanya	3,511	-1,584	Timna	110	-125
Gonen	252	-16	Netivot	325	-200	Tira	1,614	-605
Grand Total	30,590	-16,371	Ofaqim	785	-165	Yad Mordekhay	62	-51
Hadera East	69	-49	Or Aqiva	1,191	-538	Yahel	32	-38
Hadera North	719	-743	Paran	39	-127	Yavne	1,029	-529
Hadera West	5,540	-2,612	Peatey Modi'in	1,034	-151	Yavne West	557	-423
Haifa Bat Galim	142	-965	Petah Tiqwa Kiryat Arie	253	-580	Yeroham	168	-158
Haifa Beth Hameches	2,163	-2,537	Petah Tiqwa Segulla	511	-992	Yotvata	249	-338
Haifa Hof Hacarmel	1,831	-3,078	Qesaryya Pardes Hanna	2,239	-645	Zikhron Ya'aqov	419	-167
Harish	631	-111	Qiryat Haim	285	-224	Zomet Golani	71	-13
Hazeva	0	0	Qiryat MalaKhi Yoav	82	-41	Zomet Holon	807	-2,510
Herzliyya	1,482	-3,074	Qiryat Motzkin	594	-205	Zomet Holon	807	-2,510
Hod Hasharon Sokolov	2,340	-788	Qiryat Shemona	78	-172	Teufa	204	-835
Holon Wolfson	137	-261	Qiryat Yam Savionei Yam	1,368	-1,308	Grand Total	144,111	-144,111
Holot Gan Rave	115	-123	Qiyat Gat	1,395	-1,514			
Huzot Hamifratz	4	-80	Ra'annana South	1,131	-617			
Jerusalem Center	3,349	-7,209	Ra'anana West	3,168	-2,020			
Jerusalem Malcha	53	-397	Ramat Hasharon Glilot North	535	-948			
Jerusalem Yizhak Navon	4,433	-2,591	Ramat Hasharon Glilot South	407	-206			
Jerusalem Zoo	45	-38	Ramla	358	-563			

D. APPENDIX D – FEEDER-RAIL SERVICES TO BASE NETWORK – ALTERNATIVE C82

To provide high quality public transport services to the Periphery and encourage transfer of longer distance passenger from the private car a network of feeder services linked to rail heads would be provided in the north and south of Israel.

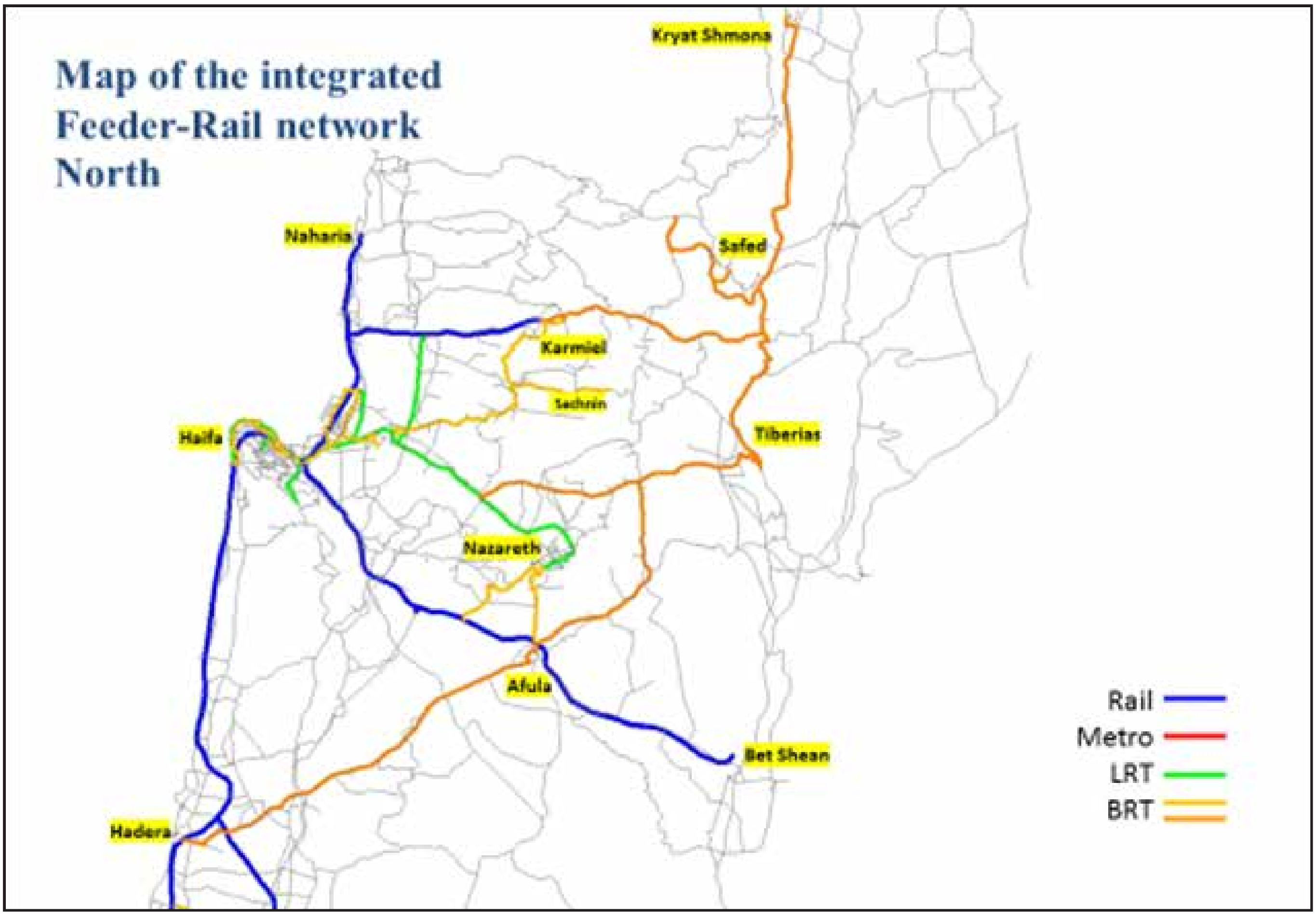


Figure D1– Feeder-Rail Network North – Alternative C82

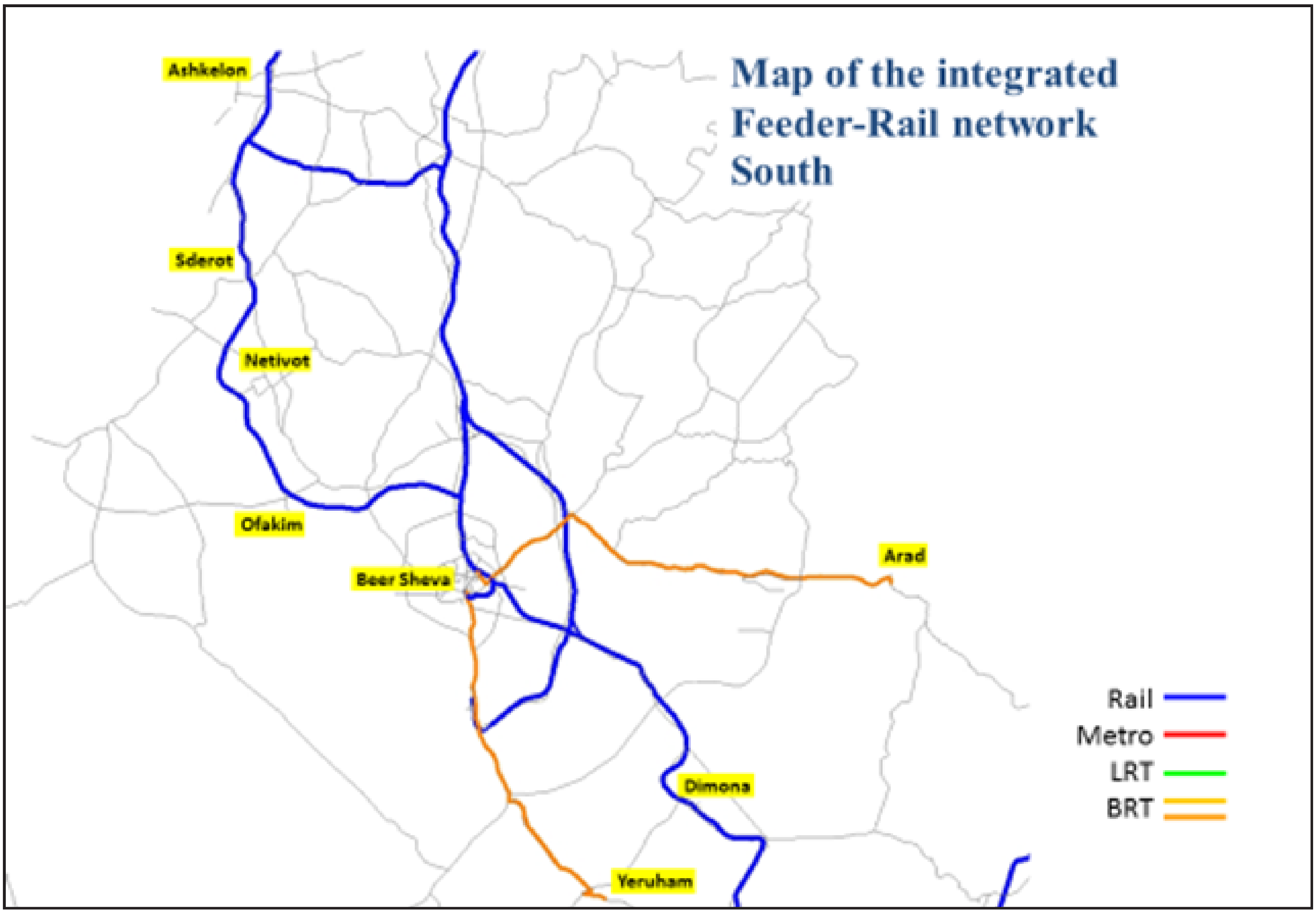


Figure D2– Feeder-Rail Network South – Alternative C82

E. APPENDIX E – FREIGHT DEMAND

E.1 Principal Flows 2040

The principal freight demands forecast to be carried by the railway by 2040 are set out in the tables below. If the railways to the periphery were not to be constructed then some of the flows would be reduced.

Multi Modal Containers

The transport of containers is more complex than the other commodities; a total of approximately 1.85 million loaded TEU 1are forecast to be moved per year by 2040. Practically all containers are forecast to either originate from or are dispatched to the ports of Haifa, Ashdod or Eilat. The terminal dispatching or receiving the shipment are given in table below. The small number not moving to or from the ports are containers carrying chemicals between Kishon, Hadera North, Ramat Hovav and Tsefa.

Port	Haifa		Ashdod		Eilat		Land Bridge - Eilat
Terminal	To	From	To	From	To	From	From
	Annual TEU (thousands) loaded containers						
Karmiel	38	25	32	7			
Afula	40	30	18	15			
Beit Shean	45	22	18	8			
Haifa Port			93	20		41	
Kishon Fertilizers	1	1	29	40			
Hadera North	19	20	11	14			
Eyal Terminal	40	49	30	30	20	21	
Bene Beraq	4	0	4	1			
Tirat Yehuda	55	25	45	30	5	5	
Beit Shemesh	6	33	6	33	3	8	
Ashdod Port	20	93					325
Kedma			0	128		48	
Netivot	5	1	16	8			
Yeruham	3	2	3	2			
Tsefa	22	4	48	64			
Ramat Hovav	14	6	29	37			
Eilat	41						
Land bridge - Eilat			325	0			
Jordan	18	17	0	0			
Total in/out	328	327	706	442	28	123	325

Aggregates

All aggregate traffic is assumed to originate from the quarries at Tamar:

Destination	Annual demand (tonnes)
Hadera North	720,000
Eyal	500,000
Tirat Yehuda	860,000
Bet Shemesh	360,000
Kedma	1,910,000
Total	4,350,000

1 TEU = twenty-foot equivalent unit – 20 foot container (6.058 m long) = 1TEU; 40 foot container (12.192 m long) = 2TEU.

Sand

All sand traffic is assumed to originate at Tsefa and Tamar with half originating in each location and be transported to the following terminals:

Origin	Annual demand (tonnes)
Karmiel	260,000
Afula	300,000
Beit She'an	160,000
Haifa	320,000
Hadera North	260,000
Eyal	120,000
Bnei Brak	260,000
Tirat Yehuda	500,000
Bet Shemesh	1,000,000
Malha ▵	200,000
Ashdod	340,000
Kedma	520,000
Total	4,240,000

▵ - traffic from Malha assumed to be unloaded at Bet Shemesh

It is assumed that the sand is shipped in intermodal containers and these containers are used to return garbage for disposal in the quarries at Tsefa.

Garbage

All garbage is assumed to be transported to Tsefa in intermodal containers from the following terminals, this forms a reverse flow to the movement of sand. Where the number of containers containing sand delivered to these terminals is insufficient for the amount of garbage additional containers are provided.

Origin	Annual demand (tonnes)
Karmiel	150,000
Afula	200,000
Beit She'an	120,000
Haifa	220,000
Hadera North	180,000
Eyal	80,000
Bnei Brak	180,000
Tirat Yehuda	280,000
Bet Shemesh	220,000
Malha ▵	20,000
Ashdod	180,000
Kedma	410,000
Total	2,240,000

▵ - traffic from Malha assumed to be loaded at Bet Shemesh

Minerals

Minerals are forecast to be transported between the ports of Ashdod and Eilat and the terminals at Tsefa, Zin and the Dead Sea Works and between the terminals at Zin and Tsefa:

		Annual demand (tonnes)	
Destination \ Origin	Ashdod	Tsefa	Eilat
Ashdod		1,100,000	
Tsefa	3,000,000		
Zin	900,000	500,000	
Dead Sea Works			3,000,000
Total	3,900,000	1,600,000	3,000,000

Metals

Metal is forecast to be transported from the ports of Haifa and Ashdod to the following terminals:

	Annual demand (tonnes)	
Destination \ Origin	Haifa	Ashdod
Afula	160,000	160,000
Tirat Yehuda	160,000	160,000
Bet Shemesh	160,000	160,000
Kiryat Gat	145,000	145,000
Total	625,000	625,000

Grain

Grain is moved from the ports of Haifa and Ashdod to the following terminals:

	Annual demand (tonnes)	
Destination \ Origin	Haifa	Ashdod
Na'aman	200,000	
Hadera East	500,000	
Bnei Brak	200,000	110,000
Dvira	270,000	
Bet Shemesh		220,000
Total	1,170,000	330,000

Vehicles

All vehicle traffic is forecast to originate from the port of Eilat and be transported to terminals at:

Destination	Annual demand (vehicles)
Afula	32,000
Kedma	235,000
Total	267,000

E.2 Forecast Demand at Terminals -2040

The forecast demands for 2040 for each terminal by commodity are set out in the tables below.

Karmiel

To/From	Loaded Containers		Sand	Garbage
	(TEU)		(tonne)	
	Leaving	Arriving	Unloaded	Loaded
Haifa	38,000	25,000		
Ashdod	32,000	7,000		
Tsefa			130,000	150,000
Tamar			130,000	
Total	70,000	32,000	260,000	150,000

Na'aman

To/From	Grain
	(tonne)
	Unloaded
Haifa Dagon	200,000
Total	200,000

Afula

To/From	Loaded Containers		Sand	Garbage	Metals	Vehicles
	(TEU)		(tonne)		(tonne)	vehicles
	Leaving	Arriving	Unloaded	Loaded	Unloaded	Unloaded
Haifa	40,000	30,000			160,000	
Ashdod	18,000	15,000			160,000	
Tsefa			150,000	200,000		
Tamar			150,000			
Eilat						32,000
Total	58,000	45,000	300,000	200,000	320,000	32,000

Beit She'an (including traffic to /from Jordan)

To/From	Loaded Containers		Sand	Garbage
	(TEU)		(tonne)	
	Leaving	Arriving	Unloaded	Loaded
Haifa	63,000	39,000		
Ashdod	18,000	8,000		
Tsefa			80,000	120,000
Tamar			80,000	
Total	81,000	47,000	300,000	200,000

Haifa Port

To/From	Loaded Containers (TEU)		Sand (tonne)	Garbage (tonne)	Metals (tonne)	Vehicles vehicles
	Leaving	Arriving	Unloaded	Loaded	Unloaded	Unloaded
Karmiel	25,000	38,000				
Afula	30,000	40,000			160,000	
Beit She'an	22,000	45,000				
Jordan	17,000	18,000				
Kishon Fertilizers	1,000	1,000				32,000
Hadera North	20,000	19,000				32,000
Eyal Terminal	49,000	40,000				
Bene Beraq	0	4,000				
Tirat Yehuda	25,000	55,000			160,000	
Beit Shemesh	33,000	6,000			160,000	
Ashdod Port	93,000	20,000				
Netivot	1,000	5,000				
Kiryat Gat					145,000	
Yeruham	2,000	3,000				
Tsefa	4,000	22,000	160,000	220,000		
Tamar			160,000			
Ramat Hovav	6,000	14,000				
Eilat		41,000				
Total	327,000	328,000	320,000	220,000	625,000	

Kishon Chemical Works

To/From	Loaded Containers (TEU)	
	Leaving	Arriving
Haifa	1,000	1,000
Ashdod	29,000	40,000
Hadera North	1,000	0
Total	31,000	41,000

Small quantities of containers are also sent to Ramat Hovav.

Haifa - Dagon

To/From	Grain (tonne)
	Unloaded
Na'aman	200,000
Hadera East	500,000
Bene Beraq	200,000
Dvira	270,000
Total	1,170,000

Hadera North

To/From	Loaded Containers (TEU)		Aggregate s	Sand	Garbage
			(tonne)		
	Leaving	Arriving	Unloaded	Unloaded	Loaded
Haifa	19,000	20,000			
Kishon Chemical Works		1,000			
Ashdod	11,000	14,000			
Tsefa				130,000	180,000
Tamar			720,000	130,000	
Total	30,000	35,000		260,000	180,000

Hadera East

To/From	Grain
	(tonne)
	Unloaded
Haifa Dagon	500,000
Total	500,000

Eyal

To/From	Loaded Containers (TEU)		Grain	Sand	Garbage
			(tonne)		
	Leaving	Arriving	Unloaded	Unloaded	Loaded
Haifa	40,000	49,000			
Ashdod	30,000	30,000			
Eilat	20,000	21,000			
Tsefa				60,000	80,000
Tamar			500,000	60,000	
Total	90,000	100,000		120,000	80,000

Bene Brak

To/From	Loaded Containers (TEU)		Grain	Sand	Garbage
			(tonne)		
	Leaving	Arriving	Unloaded	Unloaded	Loaded
Haifa	4,000	0			
Haifa Dagon			200,000		
Ashdod	4,000	1,000	220,000		
Tsefa				130,000	180,000
Tamar				130,000	
Total	8,000	1,000	420,000	260,000	180,000

Tirat Yehuda

To/From	Loaded Containers (TEU)		Grain	Sand	Garbage	Metals
	(TEU)		(tonne)			
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded
Haifa	45,000	25,000				160,000
Ashdod	55,000	30,000				160,000
Eilat	5,000	5,000				
Tsefa				250,000	280,000	
Tamar			860,000	250,000		
Total	105,000	60,000	860,000	500,000	280,000	320,000

Beit Shemesh

To/From	Loaded Containers		Grain	Sand	Garbage	Metals
	(TEU)		(tonne)			
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded
Haifa	6,000	33,000				160,000
Ashdod	6,000	33,000				160,000
Eilat	3,000	8,000				
Tsefa				600,000	240,000	
Tamar			360,000	600,000		
Total	15,000	74,000	360,000	1,200,000	240,000	320,000

Kedma

To/From	Loaded Containers		Grain	Sand	Garbage	Vehicles
	(TEU)		(tonne)			
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded
Haifa						
Ashdod		128,000				
Eilat		48,000				235,000
Tsefa				260,000	410,000	
Tamar			1,910,000	260,000		
Total	0	176,000	1,910,000	520,000	410,000	235,000

Kiryat Gat

To/From	Grain
	(tonne)
	Unloaded
Haifa	145,000
Ashdod	145,000
Total	290,000

Dvira

To/From	Grain
	(tonne)
	Unloaded
Haifa	270,000
Total	270,000

Ashdod

To/From	Loaded Containers	Grain	Sand	Garbage	Minerals	Metals		
	(TEU)	(tonne)						
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded	Unloaded	Loaded
Karmiel	7,000	32,000						
Afula	15,000	18,000						160,000
Beit She'an	8,000	18,000						
Haifa	25,000	93,000						
Kishon Chemicals	40,000	29,000						
Hadera North	14,000	11,000						
Eyal	30,000	30,000						
Bnei Brak	1,000	4,000	110,000					
Tirat Yehuda	30,000	45,000						160,000
Beit Shemesh	33,000	6,000	220,000					160,000
Kiryat Gat								145,000
Kedma	128,000							
Netivot	8,000	16,000						
Yerucham	2,000	3,000						
Ramat Hovav	37,000	29,000						
Tsefa	64,000	48,000		170,000	180,000	1,100,000	3,000,000	
Tamar				170,000				
Zin							900,000	
Eilat Land Bridge		325,000						
Total	442,000	709,000	330,000	340,000	280,000	1,100,000	3,900,000	625,000

Netivot

To/From	Loaded Containers	
	(TEU)	
	Leaving	Arriving
Haifa	5,000	1,000
Ashdod	16,000	8,000
Total	21,000	9,000

Yeruham

To/From	Loaded Containers	
	(TEU)	
	Leaving	Arriving
Haifa	3,000	2,000
Ashdod	3,000	2,000
Total	6,000	4,000

Ramat Hovav

To/From	Loaded Containers (TEU)	
	Leaving	Arriving
Haifa	14,000	6,000
Ashdod	29,000	37,000
Total	43,000	43,000

Tsefa

To/From	Loaded Containers		Sand	Garbage	Minerals	
	(TEU)		(tonne)			
	Leaving	Arriving	Loaded	Unloaded	Loaded	Unloaded
Karmiel			130,000	150,000		
Afula			150,000	200,000		
Beit She'an			80,000	120,000		
Haifa	22,000	4,000	160,000	220,000		
Hadera North			130,000	180,000		
Eyal			60,000	80,000		
Bnei Brak			130,000	180,000		
Tirat Yehuda			250,000	280,000		
Beit Shemesh			600,000	240,000		
Ashdod	48,000	64,000	170,000	180,000	3,000,000	
Kedma			260,000	410,000		
Zin						500,000
Total	70,000	68,000	2,120,000	2,240,000	3,000,000	500,000

Tamar

To/From	Sand	Aggregates
	(tonne)	
	Leaving	Arriving
Karmiel	130,000	
Afula	150,000	
Beit She'an	80,000	
Haifa	160,000	
Hadera North	130,000	720,000
Eyal	60,000	500,000
Bnei Brak	130,000	
Tirat Yehuda	250,000	860,000
Beit Shemesh	600,000	360,000
Ashdod	170,000	
Kedma	260,000	1,910,000
Total	2,120,000	4,350,000

Dead Sea Works

To/From	Minerals (tonne) loaded
Eilat	3,000,000
Total	3,000,000

Zin

To/From	Minerals
	(tonne)
	loaded
Ashdod	900,000
Tsefa	500,000
Total	1,400,000

Port of Eilat

To/From	Loaded Containers		Vehicles	Minerals
	(TEU)		(vehicles)	(tonne)
	Leaving	Arriving	Loaded	Unloaded
Afula			32,000	
Haifa	41,000			
Eyal	21,000	20,000		
Tirat Yehuda	5,000	5,000		
Beit Shemesh	8,000	3,000		
Kedma	48,000		235,000	
Dead Sea Works				3,000,000
Total	123,000	28,000	267,000	3,000,000

Eilat – Land Bridge

To/From	Loaded Containers	
	(TEU)	
	Leaving	Arriving
Ashdod	325,000	
Total	325,000	0

E.3 Principal Flows 2030

The principal freight demands forecast to be carried by the railway by 2030 are set out in the tables below.

Multi Modal Containers

The transport of containers is more complex than the other commodities; a total of approximately 1 million loaded TEU[2] are forecast to be moved per year by 2030. Practically all containers are forecast to either originate from or are dispatched to the ports of Haifa or Ashdod. The terminal dispatching or receiving the shipment are given in table below. The small number not moving to or from the ports are containers carrying chemicals between Kishon, Hadera North, Ramat Hovav and Tsefa.

Port	Haifa		Ashdod	
Terminal	To	From	To	From
	Annual TEU (thousands) loaded containers			
Karmiel	33	18	24	6
Afula	31	23	15	13
Beit Shean	40	18	17	6
Haifa Port			72	16
Kishon Fertilizers	1	1	18	31
Hadera North	12	17	10	15
Eyal Terminal	27	33	20	20
Bene Beraq	3	0	3	1
Tirat Yehuda	47	22	42	25
Beit Shemesh	4	27	4	27
Ashdod Port	16	72		
Kedma			0	81
Netivot	3	1	13	6
Yeruham	2	1	2	1
Tsefa	14	2	30	41
Ramat Hovav	9	4	18	23
Jordan	6	6	0	0
Total in/out	246	245	289	313

Aggregates

All aggregate traffic is assumed to originate from the quarries at Tamar:

Destination	Annual demand (tonnes)
Hadera North	570,000
Eyal	400,000
Tirat Yehuda	690,000
Bet Shemesh	290,000
Kedma	1,520,000
Total	3,470,000

2 TEU = twenty-foot equivalent unit – 20 foot container (6.058 m long) = 1TEU; 40 foot container (12.192 m long) = 2TEU.

Sand

All sand traffic is assumed to originate at Tsefa and Tamar with half originating in each location and be transported to the following terminals:

Origin	Annual demand (tonnes)
Karmiel	220,000
Afula	260,000
Beit She'an	150,000
Haifa	310,000
Hadera North	230,000
Eyal	80,000
Bnei Brak	220,000
Tirat Yehuda	430,000
Bet Shemesh	760,000
Malha ▵	60,000
Ashdod	310,000
Kedma	480,000
Total	3,450,000

▵ - traffic from Malha assumed to be unloaded at Bet Shemesh

It is assumed that the sand is shipped in intermodal containers and these containers are used to return garbage for disposal in the quarries at Tsefa.

Garbage

All garbage is assumed to be transported to Tsefa in intermodal containers from the following terminals, this forms a reverse flow to the movement of sand. Where the number of containers containing sand delivered to these terminals is insufficient for the amount of garbage additional containers are provided.

Origin	Annual demand (tonnes)
Karmiel	150,000
Afula	200,000
Beit She'an	120,000
Haifa	220,000
Hadera North	180,000
Eyal	80,000
Bnei Brak	180,000
Tirat Yehuda	280,000
Bet Shemesh	220,000
Malha ▵	20,000
Ashdod	180,000
Kedma	410,000
Total	2,240,000

▵ - traffic from Malha assumed to be loaded at Bet Shemesh

Minerals

Minerals are forecast to be transported between the port of Ashdod and the terminals at Tsefa, Zin and between the terminals at Zin and Tsefa:

	Annual demand (tonnes)	
Destination / Origin	Ashdod	Tsefa
Ashdod		900,000
Tsefa	2,930,000	
Zin	830,000	430,000
Total	3,770,000	1,330,000

Metals

Metal is forecast to be transported from the ports of Haifa and Ashdod to the following terminals:

	Annual demand (tonnes)	
Destination / Origin	Haifa	Ashdod
Afula	110,000	110,000
Tirat Yehuda	110,000	110,000
Bet Shemesh	110,000	110,000
Kiryat Gat	100,000	100,000
Total	420,000	420,000

Grain

Grain is moved from the ports of Haifa and Ashdod to the following terminals:

	Annual demand (tonnes)	
Destination / Origin	Haifa Dagon	Ashdod
Na'aman	170,000	
Hadera East	470,000	
Bnei Brak	170,000	90,000
Dvira	220,000	
Bet Shemesh		190,000
Total	1,020,000	280,000

E.4 Forecast Demand at Terminals -2040

The forecast demands for 2040 for each terminal by commodity are set out in the tables below.

Karmiel

To/From	Loaded Containers (TEU)		Sand (tonne)	Garbage (tonne)
	Leaving	Arriving	Unloaded	Loaded
Haifa	33,000	18,000		
Ashdod	24,000	6,000		
Tsefa			110,000	150,000
Tamar			110,000	
Total	57,000	24,000	220,000	150,000

Na'aman

To/From	Grain (tonne)
	Unloaded
Haifa Dagon	170,000
Total	170,000

Afula

To/From	Loaded Containers (TEU)		Sand (tonne)	Garbage (tonne)	Metals (tonne)
	Leaving	Arriving	Unloaded	Loaded	Unloaded
Haifa	31,000	23,000			110,000
Ashdod	15,000	13,000			110,000
Tsefa			130,000	200,000	
Tamar			130,000		
Eilat					
Total	46,000	36,000	260,000	200,000	220,000

Beit She'an (including traffic to /from Jordan)

To/From	Loaded Containers (TEU)		Sand (tonne)	Garbage (tonne)
	Leaving	Arriving	Unloaded	Loaded
Haifa	46,000	24,000		
Ashdod	17,000	6,000		
Tsefa			70,000	120,000
Tamar			70,000	
Total	63,000	30,000	140,000	200,000

Haifa Port

To/From	Loaded Containers (TEU)		Sand (tonne)	Garbage (tonne)	Metals (tonne)
	Leaving	Arriving	Unloaded	Loaded	Unloaded
Karmiel	18,000	33,000			
Afula	23,000	31,000			110,000
Beit She'an	18,000	40,000			
Jordan	6,000	6,000			
Kishon Chemicals	1,000	1,000			
Hadera North	17,000	12,000			
Eyal Terminal	33,000	27,000			
Bene Beraq	0	3,000			
Tirat Yehuda	22,000	47,000			110,000
Beit Shemesh	27,000	4,000			110,000
Ashdod Port	72,000	16,000			
Netivot	1,000	3,000			
Kiryat Gat					100,000
Yeruham	1,000	2,000			
Tsefa	2,000	14,000	150,000	220,000	
Tamar			150,000		
Ramat Hovav	4,000	9,000			
Total	245,000	246,000	300,000	220,000	420,000

Kishon Chemical Works

To/From	Loaded Containers (TEU)	
	Leaving	Arriving
Haifa	1,000	1,000
Ashdod	18,000	31,000
Hadera North	1,000	0
Total	20,000	32,000

Small quantities of containers are also sent to Ramat Hovav.

Haifa - Dagon

To/From	Grain (tonne)
	Unloaded
Na'aman	170,000
Hadera East	470,000
Bene Beraq	170,000
Dvira	220,000
Total	1,020,000

Hadera North

To/From	Loaded Containers		Aggregate s	Sand	Garbage
	(TEU)		(tonne)		
	Leaving	Arriving	Unloaded	Unloaded	Loaded
Haifa	17,000	12,000			
Kishon Chemical Works		1,000			
Ashdod	10,000	15,000			
Tsefa				130,000	180,000
Tamar			720,000	130,000	
Total	27,000	28,000		260,000	180,000

Hadera East

To/From	Grain
	(tonne)
	Unloaded
Haifa Dagon	470,000
Total	470,000

Eyal

To/From	Loaded Containers		Grain	Sand	Garbage
	(TEU)		(tonne)		
	Leaving	Arriving	Unloaded	Unloaded	Loaded
Haifa	27,000	33,000			
Ashdod	20,000	20,000			
Eilat				40,000	80,000
Tsefa			400,000	40,000	
Tamar	47,000	53,000	400,000	80,000	80,000
Total	90,000	100,000		120,000	80,000

Bene Brak

To/From	Loaded Containers		Grain	Sand	Garbage
	(TEU)		(tonne)		
	Leaving	Arriving	Unloaded	Unloaded	Loaded
Haifa	3,000	0			
Haifa Dagon			170,000		
Ashdod	3,000	1,000	90,000		
Tsefa				110,000	180,000
Tamar				110,000	
Total	6,000	1,000	260,000	220,000	180,000

Tirat Yehuda

To/From	Loaded Containers (TEU)		Grain (tonne)	Sand	Garbage	Metals
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded
Haifa	47,000	22,000				110,000
Ashdod	42,000	25,000				110,000
Tsefa				220,000	280,000	
Tamar			690,000	220,000		
Total	89,000	47,000	690,000	500,000	280,000	220,000

Beit Shemesh

To/From	Loaded Containers (TEU)		Grain (tonne)	Sand	Garbage	Metals
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded
Haifa	4,000	27,000				110,000
Ashdod	4,000	27,000				110,000
Tsefa				380,000	240,000	
Tamar			290,000	380,000		
Total	15,000	74,000	290,000	760,000	240,000	220,000

Kedma

To/From	Loaded Containers (TEU)		Grain (tonne)	Sand	Garbage	Vehicles
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded
Haifa						
Ashdod		81,000				
Tsefa				240,000	410,000	235,000
Tamar			1,520,000	240,000		
Total	0	81,000	1,520,000	480,000	410,000	

Kiryat Gat

To/From	Grain (tonne)
	Unloaded
Haifa	145,000
Ashdod	145,000
Total	290,000

Dvira

To/From	Grain (tonne)
	Unloaded
Haifa	220,000
Total	220,000

Ashdod

To/From	Loaded Containers		Grain	Sand	Garbage	Minerals		Metals
	(TEU)		(tonne)					
	Leaving	Arriving	Unloaded	Unloaded	Loaded	Loaded	Unloaded	Loaded
Karmiel	6,000	24,000						
Afula	13,000	15,000						110,000
Beit She'an	6,000	17,000						
Haifa	16,000	72,000						
Kishon Chemicals	31,000	18,000						
Hadera North	15,000	10,000						
Eyal	20,000	20,000						
Bnei Brak	1,000	3,000	90,000					
Tirat Yehuda	25,000	42,000						110,000
Beit Shemesh	27,000	4,000	190,000					110,000
Kiryat Gat								100,000
Kedma	81,000							
Netivot	6,000	13,000						
Yerucham	1,000	2,000						
Ramat Hovav	23,000	18,000						
Tsefa	41,000	30,000		160,000	180,000	900,000	2,930,000	
Tamar				160,000				
Zin							830,000	
Total	313,000	289,000	280,000	320,000	280,000	900,000	3,770,000	420,000

Netivot

To/From	Loaded Containers	
	(TEU)	
	Leaving	Arriving
Haifa	3,000	1,000
Ashdod	13,000	6,000
Total	17,000	6,000

Yeruham

To/From	Loaded Containers	
	(TEU)	
	Leaving	Arriving
Haifa	2,000	1,000
Ashdod	2,000	1,000
Total	5,000	3,000

Ramat Hovav

To/From	Loaded Containers	
	(TEU)	
	Leaving	Arriving
Haifa	9,000	4,000
Ashdod	18,000	23,000
Total	28,000	27,000

Tsefa

To/From	Loaded Containers		Sand	Garbage	Minerals	
	(TEU)		(tonne)			
	Leaving	Arriving	Loaded	Unloaded	Loaded	Unloaded
Karmiel			110,000	150,000		
Afula			130,000	200,000		
Beit She'an			70,000	120,000		
Haifa	14,000	2,000	150,000	220,000		
Hadera North			120,000	180,000		
Eyal			40,000	80,000		
Bnei Brak			110,000	180,000		
Tirat Yehuda			220,000	280,000		
Beit Shemesh			380,000	240,000		
Ashdod	30,000	41,000	160,000	180,000	2,930,000	900,000
Kedma			240,000	410,000		
Zin						430,000
Total	44,000	43,000	1,730,000	2,240,000	2,930,000	1,330,000

Tamar

To/From	Sand	Aggregates
	(tonne)	
	Leaving	Arriving
Karmiel	130,000	
Afula	150,000	
Beit She'an	80,000	
Haifa	160,000	
Hadera North	130,000	720,000
Eyal	60,000	500,000
Bnei Brak	130,000	
Tirat Yehuda	250,000	860,000
Beit Shemesh	600,000	360,000
Ashdod	170,000	
Kedma	260,000	1,910,000
Total	2,120,000	4,350,000

Zin

To/From	Minerals
	(tonne)
	loaded
Ashdod	830,000
Tsefa	430,000
Total	1,260,000

F. APPENDIX F – FREIGHT TRAIN FLOWS

The assumed demand for freight traffic in 2040 has been converted in a number of trains that will operate on each working day. It is assumed that by 2040 freight trains will operate at with a maximum length of 750 m and that improvements to infrastructure (track, terminals and ports) have been made. It is assumed that the freight railway will operate 24 hours a day Sunday to Thursday and for 12 hours on Friday.

The freight trains flows are likely to overestimate the number of trains that will operate because it has also been assumed that every service operates on each working day, this results in some trains operating without a full load as there is insufficient demand. However, in the case of some commodities it may be acceptable to customer to operate the service less frequently.

To calculate the number of trains required to accommodate the forecast flows the following assumptions are made:

- Container Trains can carry 90 TEU
- Aggregate Trains can carry up to 1,800 tonne (30 cars with capacity of 60 tonne)
- Sand Trains can carry up to 1,800 tonne (30 cars with capacity of 60 tonne)
- Garbage Trains can carry up to 1,350 tonne (30 cars with capacity of 45 tonne)
- Minerals Trains can carry up to 1,800 tonne (30 cars with capacity of 60 tonne)
- Metal products Trains can carry up to 1,800 tonne (30 cars with capacity of 60 tonne)
- Grain Trains can carry up to 1,800 tonne (30 cars with capacity of 60 tonne)
- Vehicle carrying trains can carry up to 162 vehicles (37 cars with capacity for 6 vehicles)

The gross weight of the different categories of loaded freight train are assumed to be:

- Container Trains – 1,800 tonne loaded;
- Aggregate Trains – 2,550 tonne loaded, 750 tonne empty;
- Sand Trains – 2,700 tonne loaded;
- Garbage Trains – 2,250 tonne loaded;
- Minerals Trains – 2,550 tonne loaded, 750 tonne empty
- Metal products Trains – 2,550 tonne loaded, 900 tonne empty;
- Grain Trains – 2,100 tonne loaded, 750 tonne empty;
- Vehicle carrying trains – 1,000 tonne, loaded 700 tonne empty.

It is estimated that in 2040 the average gross weight of a freight train will be about 1,700 tonne.

F.1 Freight train flows -2040

In addition to Passenger Services required to satisfy the forecast passenger demand the railway network is also to be planned to accommodate a significant increase in freight traffic as described in the report on Task 5 - Demand Analysis – Freight dated 29th February 2016.

Rather than the situation at present where freight trains do not operate on the busiest parts of the network during peak hours it is assumed that practically all freight terminals will be accessible at all time if required. Some sections of the rail network are so intensely used by 2040 that freight trains will not be able to operate during peak passenger hours, but only a few small terminals exist on these parts of the network.

Trains have been allocated onto the Network using the Eastern Track, Lod Bypass and the existing rail line to Be'er Sheva and Be'er Sheva Bypass as the main north to south corridor. This corridor is linked to Haifa Port through Nesher and to Ashdod Port through the route from Soreq.

The number of trains has been calculated for each of the six principal freight commodities, it is assumed that mixed commodity trains are not operated. Operating mixed commodity trains will not significantly reduce the number of trains on the main network as full single commodity trains are assumed but may reduce the number of trains to some of the smaller terminals. To calculate the hourly flow of trains the daily total has been divided by 24.

The number of trains for the main sections of the network is shown in the tables below for both with and without the Peripheral Routes.

location		Sand/ Garbage	Aggregates	Grain	Metals	Minerals	Containers	Vehicles	Total	Average per Peak Hour
Karmiel	Kiryat Ata	1					4		5	<0.25
Jordan	Beit She'an						1		1	<0.25
Beit She'an	Afula	1					5		6	<0.25
Afula	Eastern Track Ext	2			1		8		11	0.5
Road #70	Eastern Track Ext	4		3	3		29		39	1.75
Road #70	Haifa	1		3	3		26		33	1.5
Haifa	Remez			2			1		3	<0.25
Eastern Track	Hadera N		2				1		3	<0.25
Eastern Track	Hadera W						1		1	<0.25
HaEmek Railway	Eastern Track	4		3	2		23		32	1.5
Eastern Track	Eyal	5	2	2	2		23		34	1.5
Eyal	Rosh HaAyin N	6	4	2	2		24		38	1.75
Rosh HaAyin N	Rosh HaAyin S	6	4	2	2		24		38	1.75
Bene Beraq	Rosh HaAyin S	1		2			1		4	<0.25
Rosh HaAyin S	Tirat Yehuda	7	4	2	2		24		39	1.75
Tirat Yehuda	Naan Junction	8	6	2	2		24		42	1.75
Naan Junction	Ashdod			1	2		16		19	1
Naan Junction	Bet Shemesh						2		2	<0.25
Naan Junction	Kedma	8	6	1			6		21	1
Soreq Junction	Ashdod			2	4	11	46		63	2.75
Bet Shemesh	Ashdod			1	1		3		5	<0.25
Ashdod	Kedma	4	1		1	11	27		44	2
Ashdod	Netivot						1		1	<0.25
Netivot	Be'er Sheva Bypass						1		1	<0.25
Naan Junction	Bet Shemesh	3	1	1	1		2		8	0.5
Naan Junction	Kedma	12	7	1	1	11	33		65	2.75
North to	Kedma	4					8		12	0.5
Passing	Kedma	8	7	1	1	11	25		53	2.25
South to	Kedma	4	4				6		14	0.75
Kedma	Kiryat Gat	12	11	1	1	11	28	6	70	3
Kiryat Gat	Dvira	12	11	1		11	28	6	69	3
Dvira	Be'er Sheva Bypass	12	11			11	28	6	68	3
Be'er Sheva Bypass	Dimona Line Jnc	12	11			11	29	6	69	3
Dimona Line Jnc	Ramat Hovav						3		3	<0.25
Dimona Line Jnc	Dimona	12	11			11	26	6	66	2.75
Dimona	Mamshit	12	11			11	24	6	64	2.75
Mamshit	Tsefa	12	11			11	4		38	1.75
Tsefa	Tamar	5	11						16	0.75
Mamshit	Zin					4	20	6	30	1.25
Zin	Hazeva						20	6	26	1.25
Dead Sea Works	Hazeva					7			7	0.5
Hazeva	Eilat					7	20	6	33	1.5

Table B.1 – Number of Trains on Main Sections of Network C81

location		Sand/ Garbage	Aggregates	Grain	Metals	Minerals	Containers	Total	Average per Peak Hour
Karmiel	Kiryat Ata	1					4	5	<0.25
Jordan	Beit She'an						1	1	<0.25
Beit She'an	Afula	1					5	6	0.25
Afula	Eastern Track Ext	2			1		8	11	0.5
Road #70	Eastern Track Ext	4		3	3		27	37	1.75
Road #70	Haifa	1		3	3		24	31	1.5
Haifa	Remez			2			1	3	<0.25
Eastern Track	Hadera N		2				1	3	<0.25
Hadera N	Hadera W						1	1	<0.25
HaEmek Railway	Eastern Track	4		3	2		21	30	1.25
Eastern Track	Eyal	5	2	2	2		21	32	1.5
Eyal	Rosh HaAyin N	6	4	2	2		21	35	1.5
Rosh HaAyin N	Rosh HaAyin S	6	4	2	2		21	35	1.5
Bene Beraq	Rosh HaAyin S	1		2			1	4	<0.25
Rosh HaAyin S	Tirat Yehuda	7	4	2	2		21	36	1.5
Tirat Yehuda	Naan Junction	8	6	2	2		21	39	1.75
Naan Junction	Ashdod			1	2		16	19	1
Naan Junction	Bet Shemesh						2	2	<0.25
Naan Junction	Kedma	8	6	1			3	18	0.75
Soreq Junction	Ashdod			2	4	11	31	48	2
Bet Shemesh	Ashdod			1	1		3	5	<0.25
Ashdod	Kedma	4	1		1	11	12	29	1.25
Ashdod	Netivot						1	1	<0.25
Netivot	Be'er Sheva Bypass								
Naan Junction	Bet Shemesh	3	1	1	1		2	8	0.5
Naan Junction	Kedma	12	7	1	1	11	15	47	2
North to	Kedma	4					8	12	0.5
Passing	Kedma	8	7	1	1	11	7	35	1.5
South to	Kedma	4	4					8	0.5
Kedma	Kiryat Gat	12	11	1	1	11	7	43	2
Kiryat Gat	Dvira	12	11	1		11	7	42	1.75
Dvira	BSB	12	11			11	7	41	1.75
BSB	Dimona Line Jnc	12	11			11	7	41	1.75
Dimona Line Jnc	Ramat Hovav						3	3	<0.25
Dimona Line Jnc	Dimona	12	11			11	4	38	1.75
Dimona	Mamshit	12	11			11	4	38	1.75
Mamshit	Tsefa	12	11			11	4	38	1.75
Tsefa	Tamar	5	11					16	0.75
Mamshit	Zin					4		4	<0.25

Table B.2 – Number of Trains on Main Sections of Network C82

F.2 Freight train flows -2030

By 2030 the railway network will not be as extensive as it will be by 2040, with only the priority projects identified in Section 12.3 constructed. This will impose some limitations on the freight services that can operate during peak passenger hours. The most significant restrictions will occur on the route from Be'er Sheva to Soreq and around Haifa

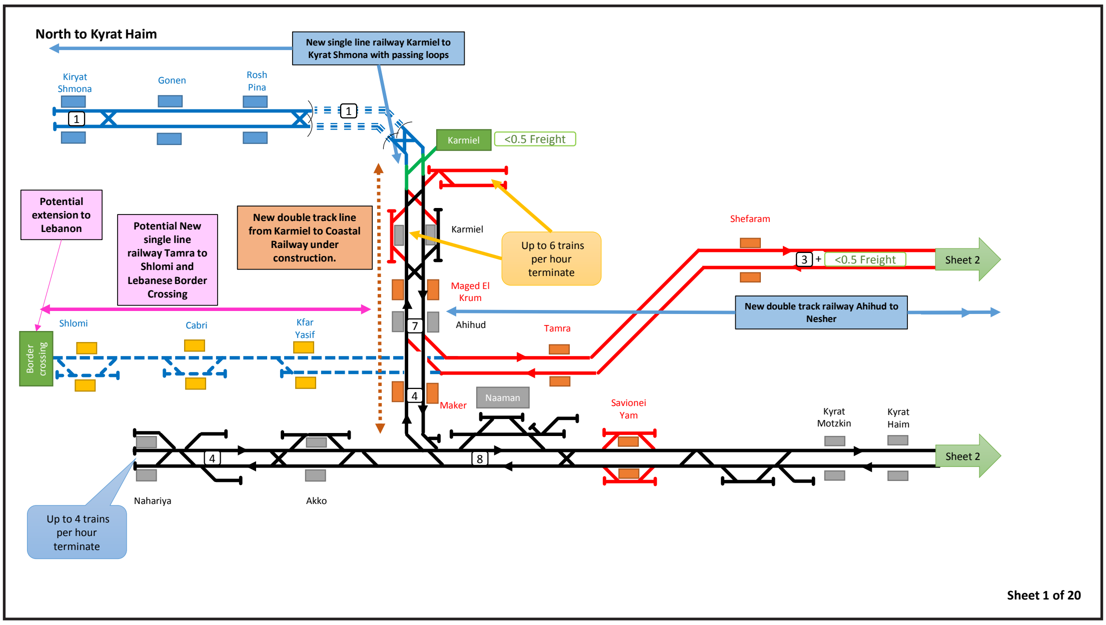
Section		Sand/ Garbage	Aggregates	Grain	Metals	Minerals	Containers	Total	Average per Peak Hour
Na'aman	Haifa	0	0	1	0	0	0	1	<0.25
Karmiel	Kiryat Ata	1	0	0	0	0	3	4	<0.25
Jordan	Bet Shean	0	0	0	0	0	1	1	<0.25
Bet Shean	Afula	1	0	0	0	0	4	5	<0.25
Afula	Kiryat Ata	2	0	0	1	0	7	10	0.5
Kiryat Ata	Haifa	3	0	0	1	0	10	14	0.75
Haifa	Remez	4	0	3	1	0	16	24	1
Eastern Track	Hadera N	5	2	4	1	0	15	27	1.25
Hadera N	Hadera W	0	0	0	0	0	0	0	<0.25
Hadera W	Bene Beraq	0	0	0	0	0	0	0	<0.25
ER	Eyal	5	2	2	1	0	15	25	1.25
Eyal	Rosh HaAyin N	6	3	2	1	0	15	27	1.25
Rosh HaAyin N	Rosh HaAyin S	6	3	2	1	0	15	27	1.25
Bene Beraq	Rosh HaAyin S	1	0	2	0	0	1	4	<0.25
Rosh HaAyin S	Tirat Yehuda	7	3	2	1	0	15	28	1.25
Tirat Yehuda	Naan Junction	8	5	2	1	0	14	30	1.25
Tirat Yehuda	Ashdod	0	0	1	1	0	10	12	0.5
Tirat Yehuda	Bet Shemesh	0	0	0	0	0	2	2	<0.25
Tirat Yehuda	Kedma	8	5	1	0	0	2	16	0.75
Naan Junction	Ashdod	0	0	1	3	10	20	34	1.5
bet Shemesh	Ashdod	0	0	0	1	0	2	3	<0.25
Ashdod	Kedma	3	1	0	1	10	8	23	1
Ashdod	Netiviot	0	0	0	0	0	1	1	<0.25
Netiviot	BSB	0	0	0	0	0	1	1	<0.25
Naan Junction	Bet Shemesh	2	1	0	1	0	2	6	0.25
Naan Junction	Kedma	11	6	1	1	10	10	39	1.75
North to	Kedma	3	0	0	0	0	4	7	0.5
Passing	Kedma	8	6	1	1	10	6	32	1.5
South to	Kedma	5	4	0	0	0	0	9	0.5
Kedma	Kiryat Gat	13	10	1	1	10	6	41	1.75
Kiryat Gat	Dvira	13	10	1	0	10	6	40	1.75
Dvira	Goral Junction	13	10	0	0	10	6	39	1.75
Goral Junction	Be'er Sheva University	13	10	0	0	10	7	40	1.75
Be'er Sheva University	Ramat Hovav	0	0	0	0	0	2	2	<0.25
Be'er Sheva University	Dimona	13	10	0	0	10	5	38	1.75
Dimona	Mamshit	13	10	0	0	10	3	36	1.5
Mamshit	Tsefa	11	10	0	0	9	3	33	1.5
Tsefa	Tamar	4	10	0	0	0	0	14	0.75
Mamshit	Zin	0	0	0	0	3	0	3	<0.25

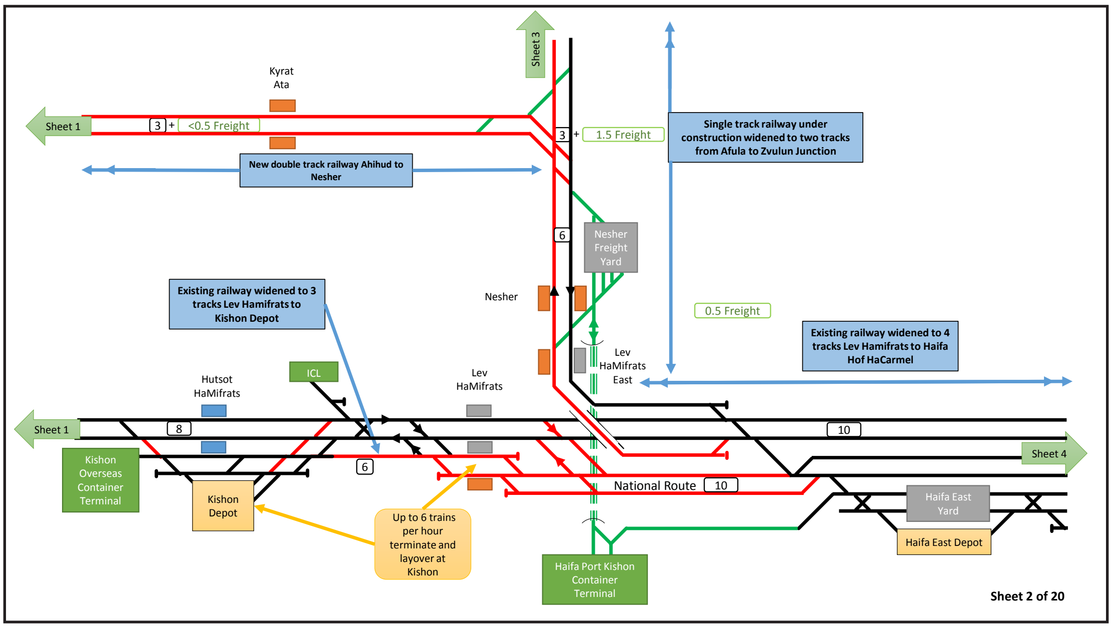
G. APPENDIX G – OUTLINE OPERATIONAL LAYOUTS

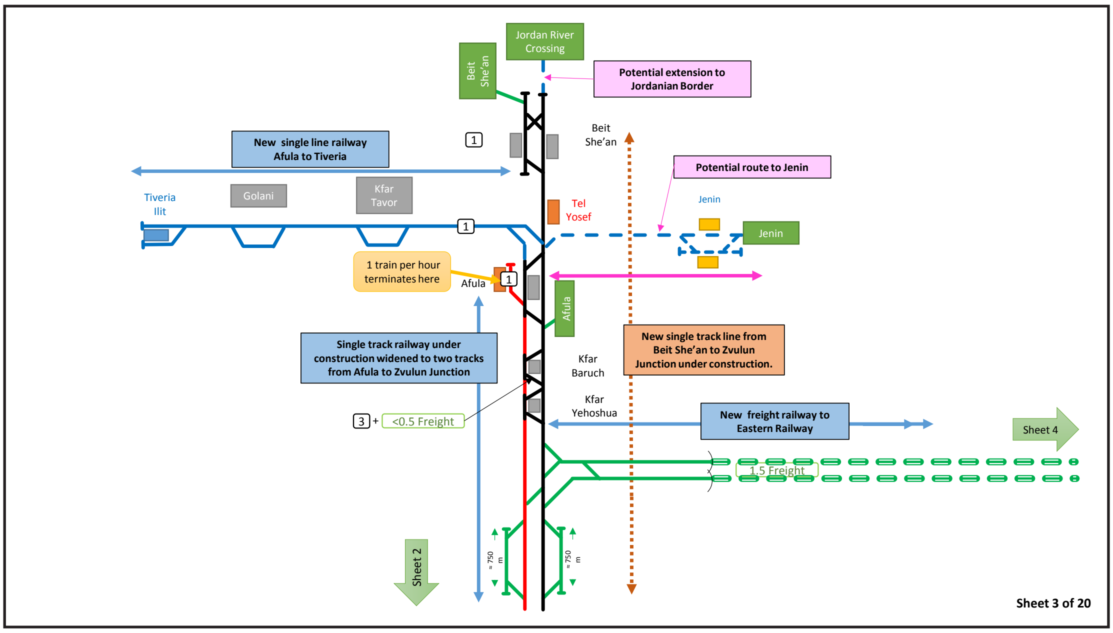
Israel Railways Strategic Development Plan 2040

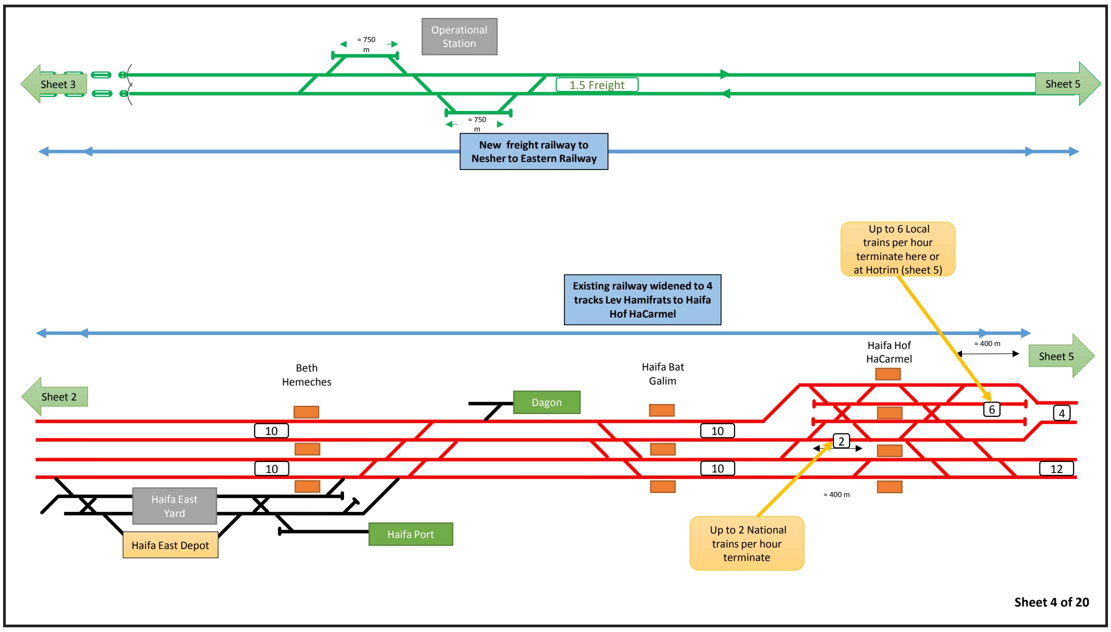
Key

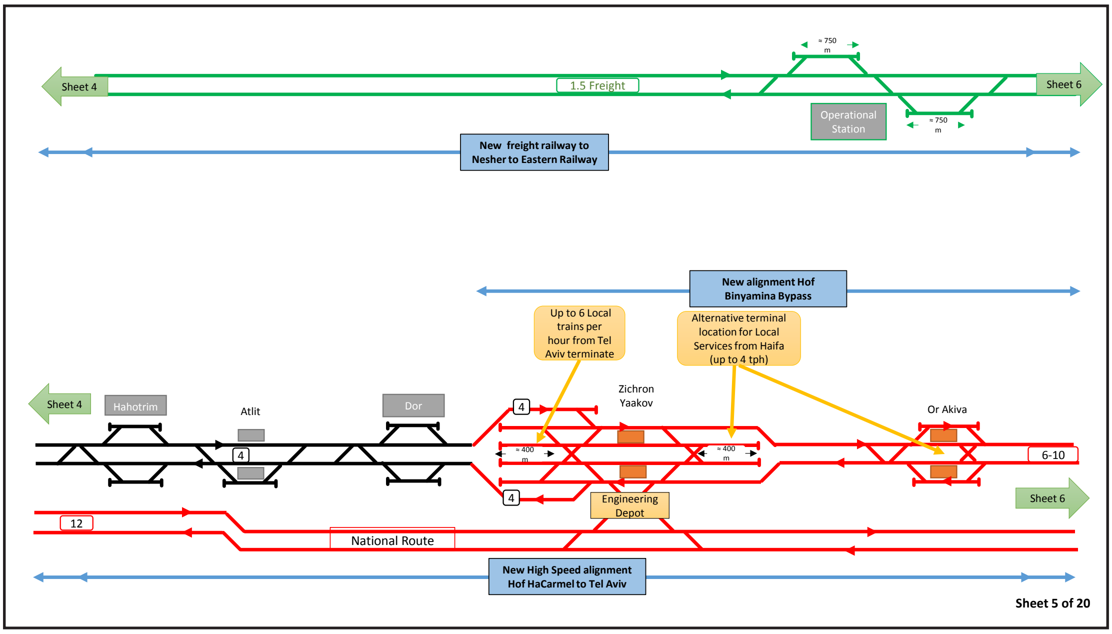
Existing Tracks (2022)		Existing stations (2022)	Nahariya
Tracks for C8.2		New Stations C8.2	Savionei Yam
Additional tracks for C8.1		New Stations C8.1	Rosh Pina
Geopolitical tracks		Stations geopolitical/ other tracks	Shlomi
Freight only tracks C8.2 Freight only tracks C8.1		New platforms at existing stations	Lev HaMifrats East
Tracks recommended for operational flexibility		Freight stations	Karmiel
Tunnel Sections		Operational stations	Naaman

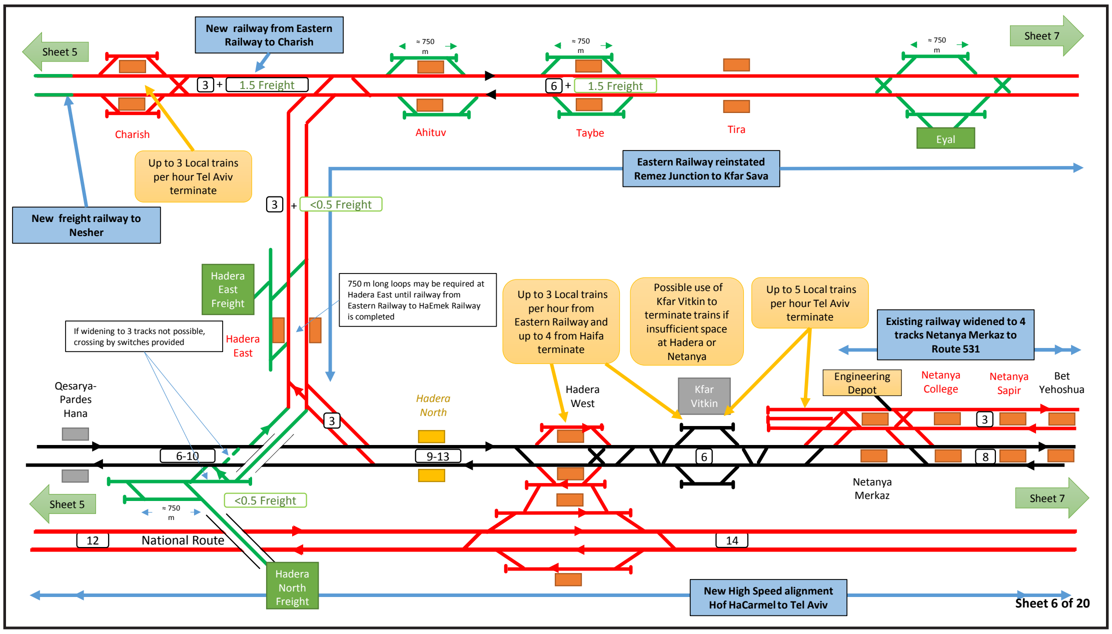


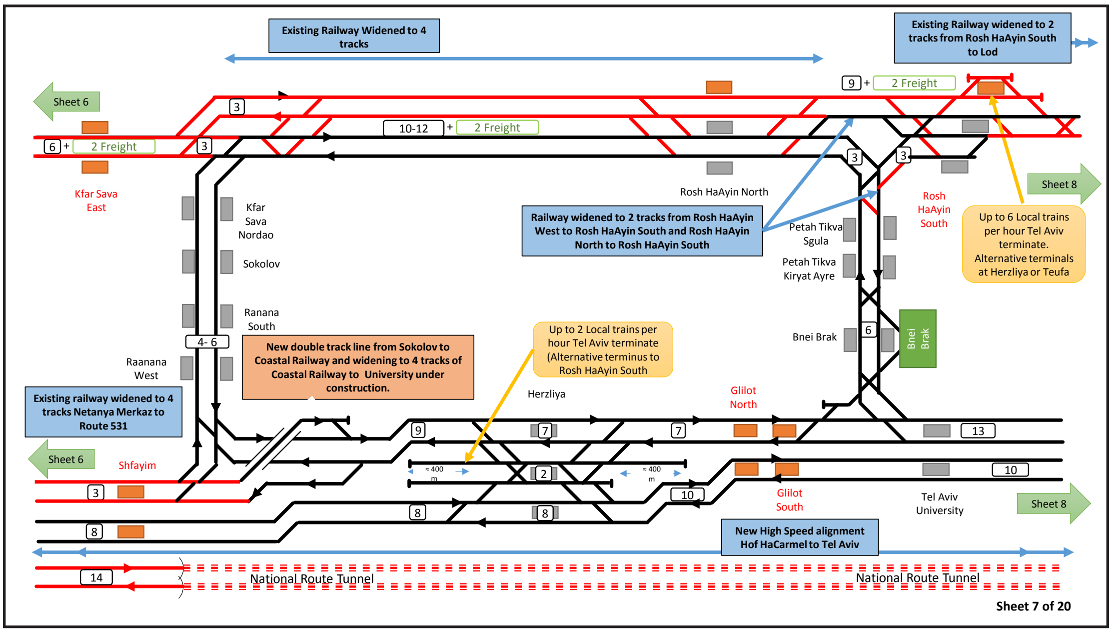


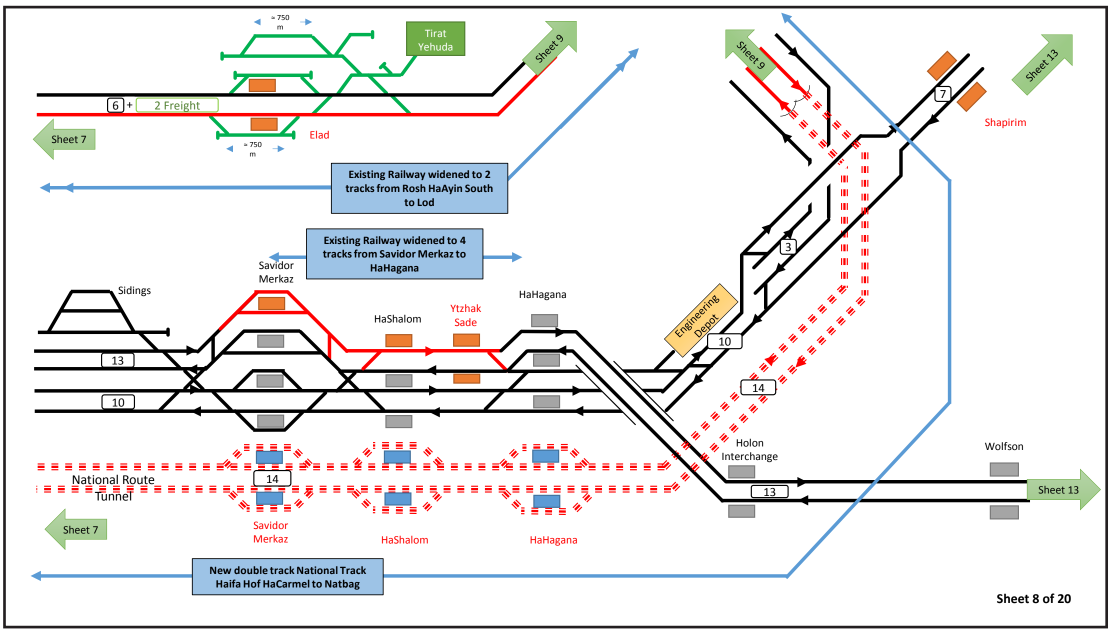

Jordan River Crossing
Beit She'an
Potential extension to Jordanian Border
Beit She'an
New single line railway Afula to Tiveria
1
Potential route to Jenin
Tiveria Ilit
Golani
Kfar Tavor
Tel Yosef
Jenin
1
Jenin
1 train per hour terminates here
Afula
1
Afula
Single track railway under construction widened to two tracks from Afula to Zvulun Junction
New single track line from Beit She'an to Zvulun Junction under construction.
Kfar Baruch
Kfar Yehoshua
3 + <0.5 Freight
New freight railway to Eastern Railway
Sheet 4
1.5 Freight
Sheet 2
≈ 750 m
≈ 750 m
Sheet 3 of 20

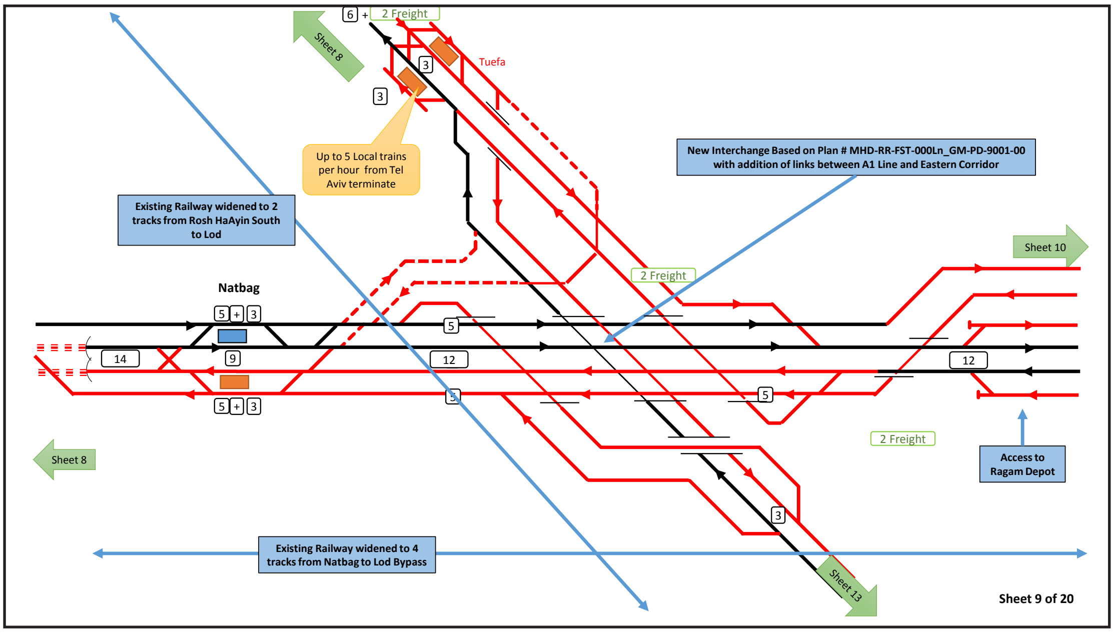

Operational Station
≈ 750 m
Sheet 3
1.5 Freight
Sheet 5
≈ 750 m
New freight railway to Nesher to Eastern Railway
Up to 6 Local trains per hour terminate here or at Hotrim (sheet 5)
Existing railway widened to 4 tracks Lev Hamifrats to Haifa Hof HaCarmel
≈ 400 m
Haifa Hof HaCarmel
Sheet 5
Beth Hemeches
Haifa Bat Galim
Sheet 2
Dagon
6
4
10
10
2
10
10
12
≈ 400 m
Haifa East Yard
Haifa Port
Haifa East Depot
Up to 2 National trains per hour terminate
Sheet 4 of 20

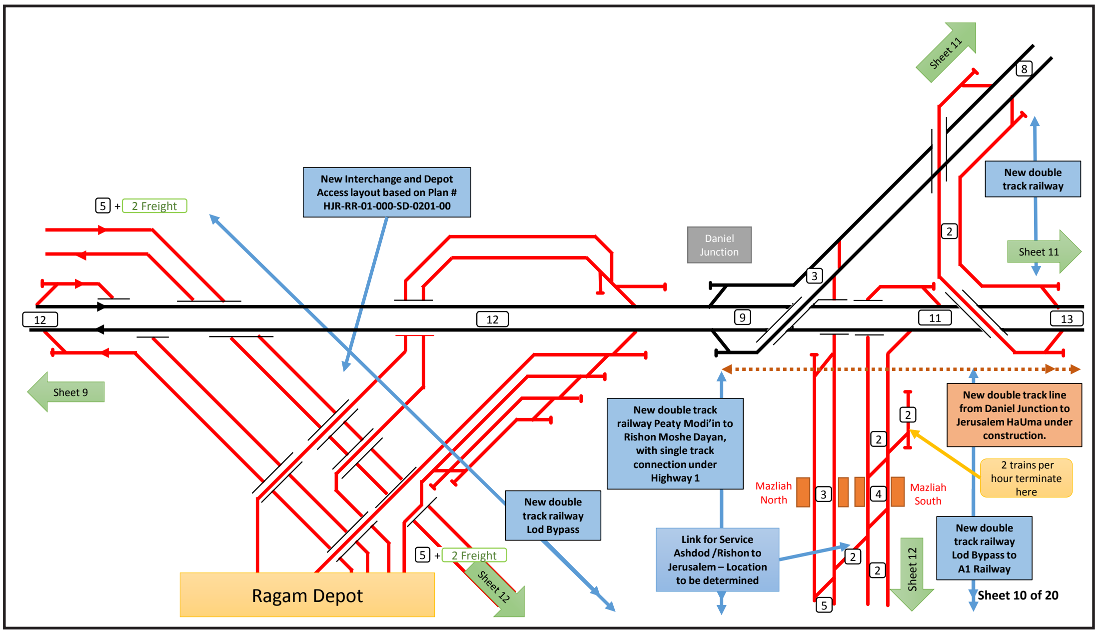

≈ 750 m
Sheet 4
1.5 Freight
Sheet 6
Operational Station
≈ 750 m
New freight railway to Nesher to Eastern Railway
New alignment Hof Binyamina Bypass
Up to 6 Local trains per hour from Tel Aviv terminate
Alternative terminal location for Local Services from Haifa (up to 4 tph)
Zichron Yaakov
Sheet 4
Hahotrim
Atlit
Dor
4
Or Akiva
4
≈ 400 m
≈ 400 m
6-10
4
Engineering Depot
Sheet 6
12
National Route
New High Speed alignment Hof HaCarmel to Tel Aviv
Sheet 5 of 20

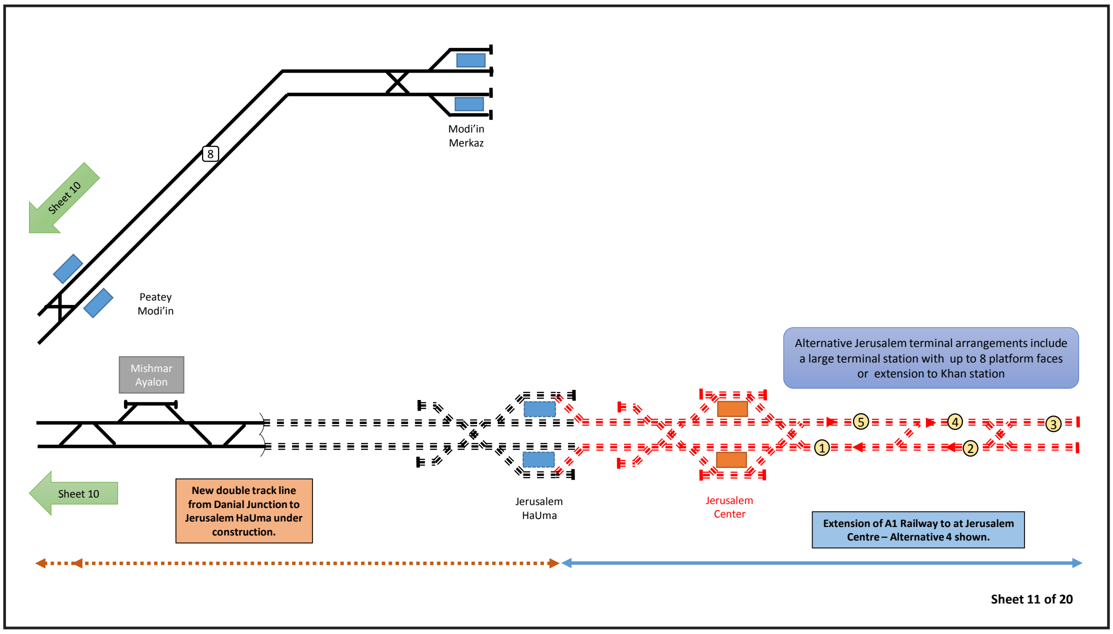

Sheet 5
New railway from Eastern Railway to Charish
3 + 1.5 Freight
≈ 750 m
6 + 1.5 Freight
Sheet 7
Charish
Ahituv
Taybe
Tira
Eyal
Up to 3 Local trains per hour Tel Aviv terminate
Eastern Railway reinstated Remez Junction to Kfar Sava
New freight railway to Nesher
3 + <0.5 Freight
Hadera East Freight
750 m long loops may be required at Hadera East until railway from Eastern Railway to HaEmek Railway is completed
Up to 3 Local trains per hour from Eastern Railway and up to 4 from Haifa terminate
Possible use of Kfar Vitkin to terminate trains if insufficient space at Hadera or Netanya
Up to 5 Local trains per hour Tel Aviv terminate
Existing railway widened to 4 tracks Netanya Merkaz to Route 531
If widening to 3 tracks not possible, crossing by switches provided
Hadera East
Qesarya-Pardes Hana
Hadera North
Hadera West
Kfar Vitkin
Engineering Depot
Netanya College
Netanya Sapir
Bet Yehoshua
6-10
9-13
6
3
8
Sheet 5
<0.5 Freight
Netanya Merkaz
Sheet 7
12
National Route
14
Hadera North Freight
New High Speed alignment Hof HaCarmel to Tel Aviv
Sheet 6 of 20

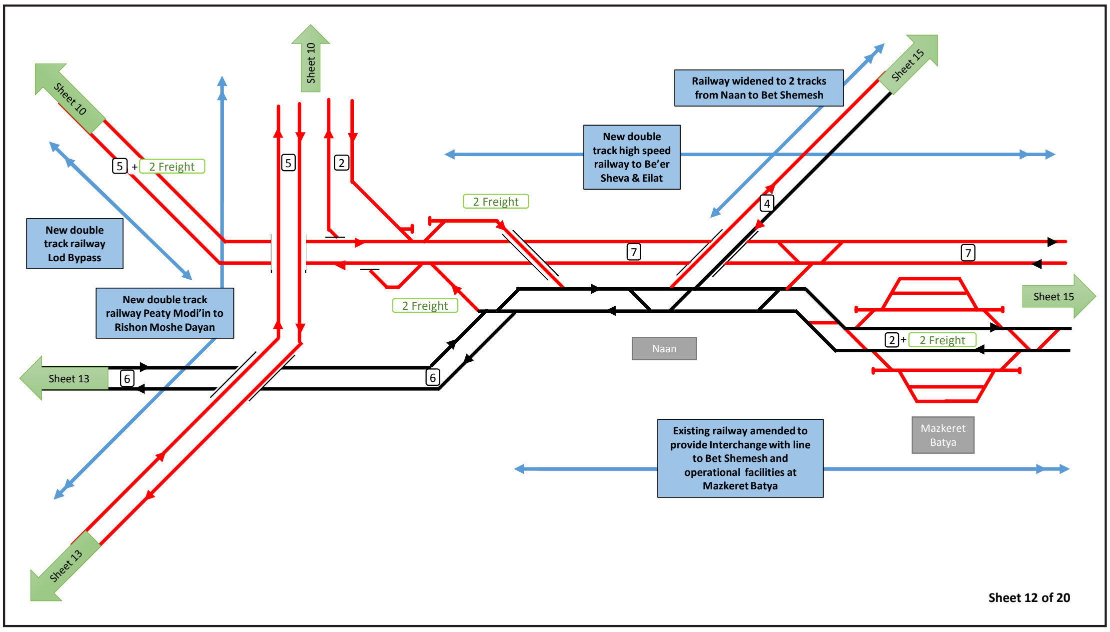

Existing Railway Widened to 4 tracks
Existing Railway widened to 2 tracks from Rosh HaAyin South to Lod
9 + 2 Freight
Sheet 6
3
10-12 + 2 Freight
6 + 2 Freight
Kfar Sava East
Kfar Sava Nordao
Sokolov
Ranana South
Raanana West
Rosh HaAyin North
Railway widened to 2 tracks from Rosh HaAyin West to Rosh HaAyin South and Rosh HaAyin North to Rosh HaAyin South
Petah Tikva Sgula
Petah Tikva Kiryat Ayre
Rosh HaAyin South
Sheet 8
Up to 6 Local trains per hour Tel Aviv terminate. Alternative terminals at Herzliya or Teufa
4- 6
New double track line from Sokolov to Coastal Railway and widening to 4 tracks of Coastal Railway to University under construction.
Up to 2 Local trains per hour Tel Aviv terminate (Alternative terminus to Rosh HaAyin South
Bnei Brak
Existing railway widened to 4 tracks Netanya Merkaz to Route 531
Herzliya
Glilot North
Sheet 6
Shfayim
9
7
13
≈ 400 m
2
10
Glilot South
Tel Aviv University
8
Sheet 8
New High Speed alignment Hof HaCarmel to Tel Aviv
14
National Route Tunnel
National Route Tunnel
Sheet 7 of 20

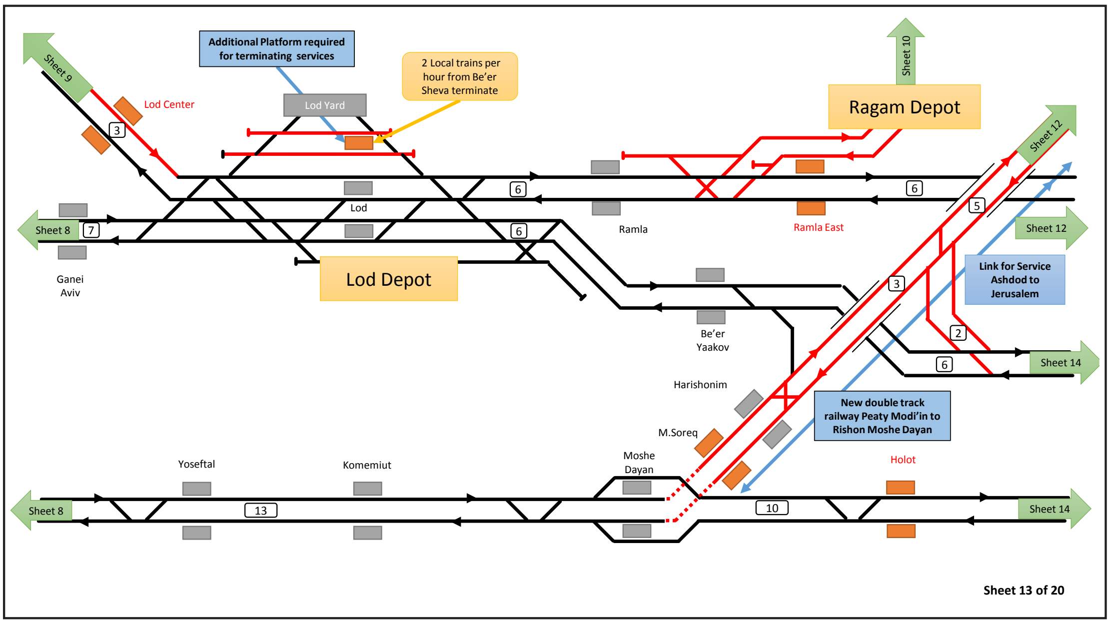

≈ 750 m
Tirat Yehuda
Sheet 9
Sheet 9
Sheet 13
6 + 2 Freight
7
Shapirim
Sheet 7
Elad
Existing Railway widened to 2 tracks from Rosh HaAyin South to Lod
Existing Railway widened to 4 tracks from Savidor Merkaz to HaHagana
3
Sidings
Savidor Merkaz
HaShalom
Ytzhak Sade
HaHagana
Engineering Depot
10
13
10
14
Holon Interchange
Wolfson
National Route Tunnel
14
13
Sheet 13
Sheet 7
Savidor Merkaz
HaShalom
HaHagana
New double track National Track Haifa Hof HaCarmel to Natbag
Sheet 8 of 20

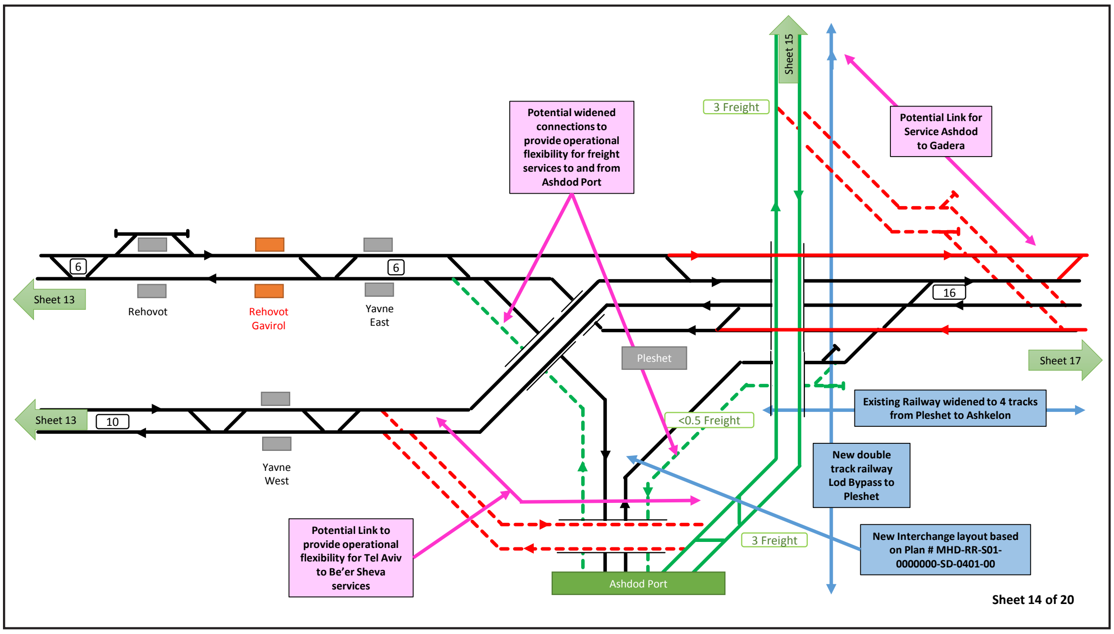

6 + 2 Freight
Sheet 8
Tuefa
3
3
Up to 5 Local trains per hour from Tel Aviv terminate
New Interchange Based on Plan # MHD-RR-FST-000Ln_GM-PD-9001-00 with addition of links between A1 Line and Eastern Corridor
Existing Railway widened to 2 tracks from Rosh HaAyin South to Lod
Sheet 10
2 Freight
Natbag
5 + 3
14
9
5
12
12
5
5
5 + 3
2 Freight
Sheet 8
Access to Ragam Depot
3
Existing Railway widened to 4 tracks from Natbag to Lod Bypass
Sheet 13
Sheet 9 of 20

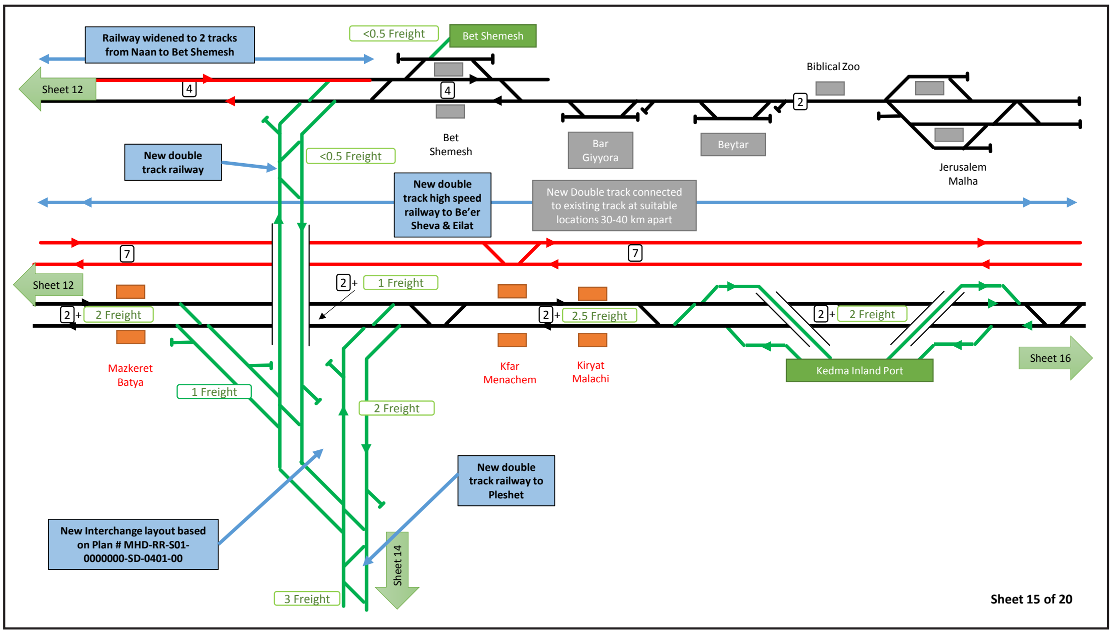

Sheet 11
8
New Interchange and Depot Access layout based on Plan # HJR-RR-01-000-SD-0201-00
5 + 2 Freight
New double track railway
Daniel Junction
2
Sheet 11
3
12
12
9
11
13
Sheet 9
New double track railway Peaty Modi'in to Rishon Moshe Dayan, with single track connection under Highway 1
New double track line from Daniel Junction to Jerusalem HaUma under construction.
2
2
2 trains per hour terminate here
Mazliah North
3
4
Mazliah South
New double track railway Lod Bypass
5 + 2 Freight
Link for Service Ashdod /Rishon to Jerusalem – Location to be determined
2
2
New double track railway Lod Bypass to A1 Railway
Sheet 12
Sheet 12
5
Ragam Depot
Sheet 10 of 20

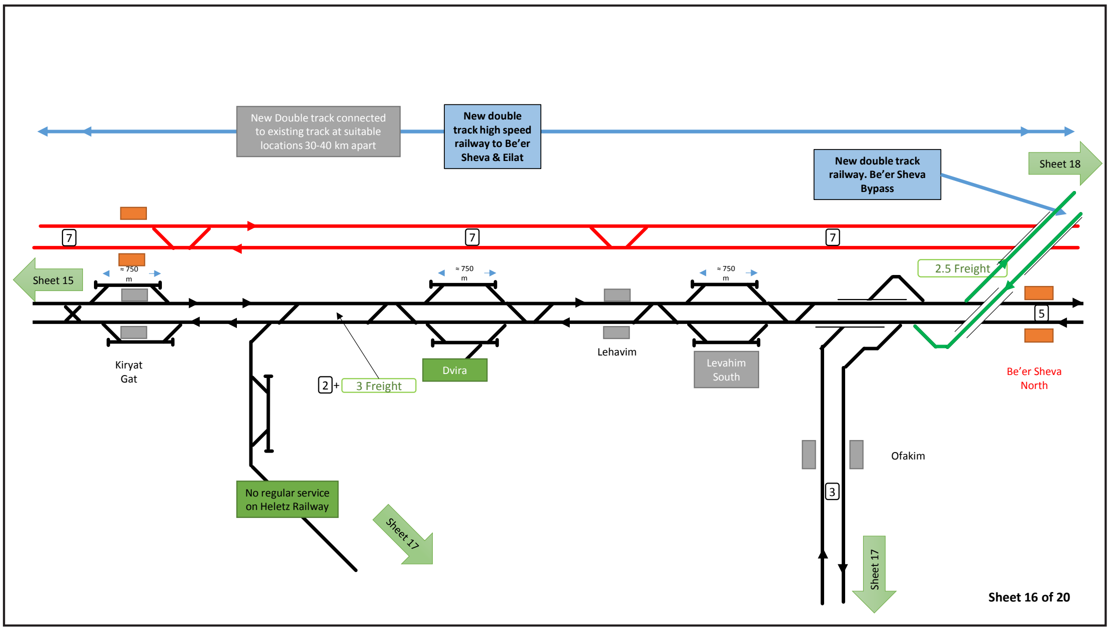

8
Modi'in Merkaz
Sheet 10
Peatey Modi'in
Alternative Jerusalem terminal arrangements include a large terminal station with up to 8 platform faces or extension to Khan station
Mishmar Ayalon
5
4
3
1
2
Sheet 10
New double track line from Danial Junction to Jerusalem HaUma under construction.
Jerusalem HaUma
Jerusalem Center
Extension of A1 Railway to at Jerusalem Centre – Alternative 4 shown.
Sheet 11 of 20

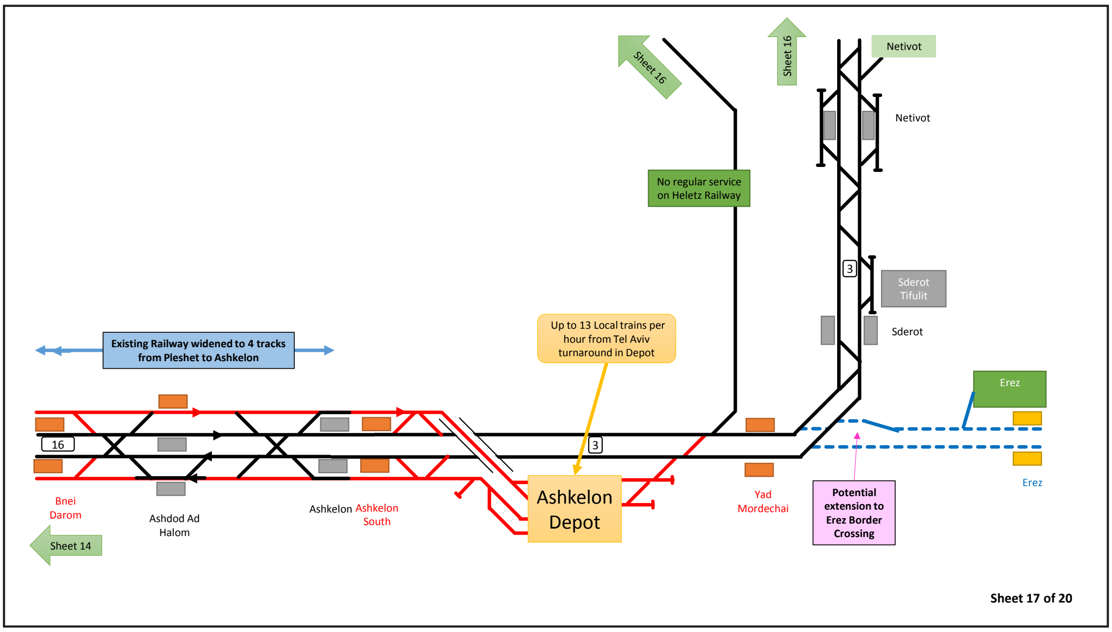

Sheet 10
Sheet 10
5 + 2 Freight
5
2
New double track railway Lod Bypass
New double track railway Peaty Modi'in to Rishon Moshe Dayan
2 Freight
New double track high speed railway to Be'er Sheva & Eilat
Railway widened to 2 tracks from Naan to Bet Shemesh
Sheet 15
4
7
7
2 Freight
Sheet 15
Naan
2 + 2 Freight
Sheet 13
6
6
Mazkeret Batya
Existing railway amended to provide Interchange with line to Bet Shemesh and operational facilities at Mazkeret Batya
Sheet 13
Sheet 12 of 20

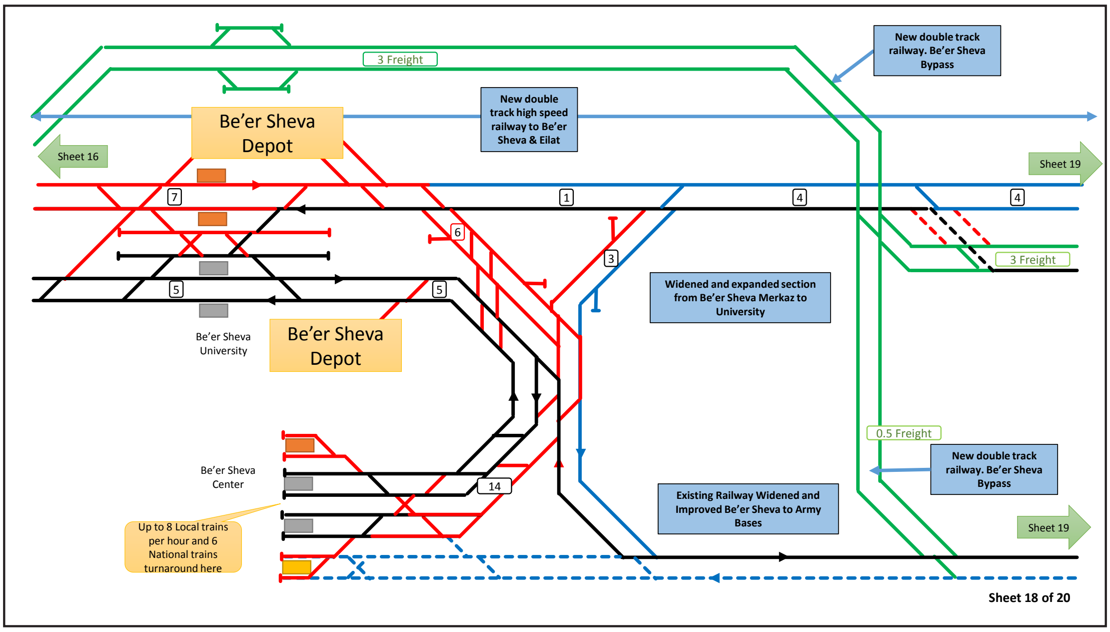

Sheet 9
Additional Platform required for terminating services
2 Local trains per hour from Be'er Sheva terminate
Sheet 10
Ragam Depot
Lod Center
3
Lod Yard
Sheet 12
6
6
5
Lod
Ramla
Ramla East
Sheet 8
7
6
Sheet 12
Ganei Aviv
Lod Depot
3
Link for Service Ashdod to Jerusalem
Be'er Yaakov
2
6
Sheet 14
Harishonim
New double track railway Peaty Modi'in to Rishon Moshe Dayan
M.Soreq
Yoseftal
Komemiut
Moshe Dayan
Holot
Sheet 8
13
10
Sheet 14
Sheet 13 of 20

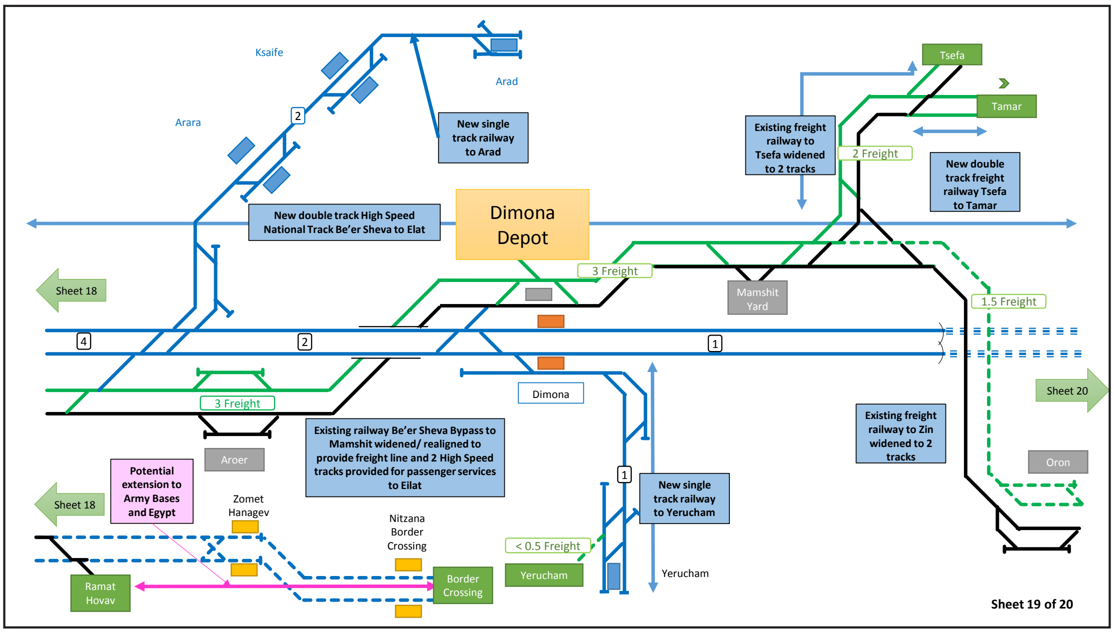

Sheet 15
3 Freight
Potential widened connections to provide operational flexibility for freight services to and from Ashdod Port
Potential Link for Service Ashdod to Gadera
6
6
16
Sheet 13
Rehovot
Rehovot Gavirol
Yavne East
Pleshet
Sheet 17
Sheet 13
10
<0.5 Freight
Existing Railway widened to 4 tracks from Pleshet to Ashkelon
Yavne West
New double track railway Lod Bypass to Pleshet
3 Freight
New Interchange layout based on Plan # MHD-RR-S01-0000000-SD-0401-00
Potential Link to provide operational flexibility for Tel Aviv to Be'er Sheva services
Ashdod Port
Sheet 14 of 20

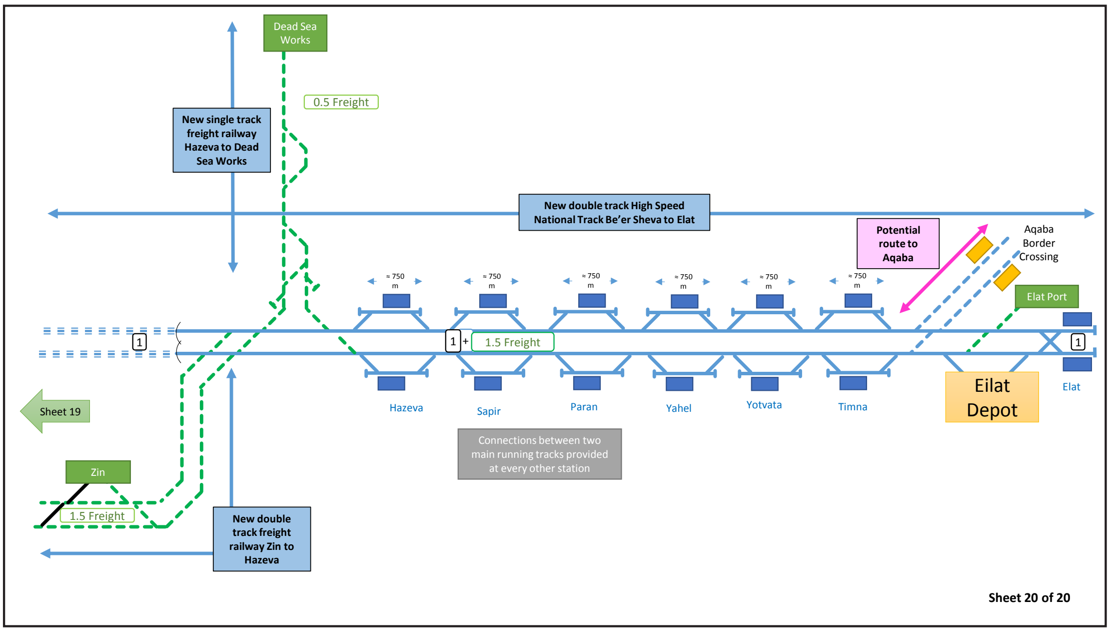

Railway widened to 2 tracks from Naan to Bet Shemesh
<0.5 Freight
Bet Shemesh
Sheet 12
4
Bet Shemesh
Biblical Zoo
2
Bar Giyyora
Beytar
Jerusalem Malha
New double track railway
<0.5 Freight
New double track high speed railway to Be'er Sheva & Eilat
New Double track connected to existing track at suitable locations 30-40 km apart
7
Sheet 12
2+ 1 Freight
2+ 2 Freight
2+ 2.5 Freight
2+ 2 Freight
Mazkeret Batya
1 Freight
Kfar Menachem
Kiryat Malachi
Kedma Inland Port
Sheet 16
2 Freight
New double track railway to Pleshet
New Interchange layout based on Plan # MHD-RR-S01-0000000-SD-0401-00
Sheet 14
3 Freight
Sheet 15 of 20


New Double track connected to existing track at suitable locations 30-40 km apart
New double track high speed railway to Be'er Sheva & Eilat
New double track railway. Be'er Sheva Bypass
Sheet 18
7
Sheet 15
≈ 750 m
2.5 Freight
5
Kiryat Gat
2+ 3 Freight
Dvira
Lehavim
Levahim South
Be'er Sheva North
Ofakim
3
No regular service on Heletz Railway
Sheet 17
Sheet 17
Sheet 16 of 20


Sheet 16
Sheet 16
Netivot
Netivot
No regular service on Heletz Railway
3
Sderot Tifulit
Sderot
Up to 13 Local trains per hour from Tel Aviv turnaround in Depot
Existing Railway widened to 4 tracks from Pleshet to Ashkelon
Erez
16
3
Ashkelon Depot
Bnei Darom
Ashdod Ad Halom
Ashkelon
Ashkelon South
Yad Mordechai
Potential extension to Erez Border Crossing
Erez
Sheet 14
Sheet 17 of 20


3 Freight
New double track railway. Be'er Sheva Bypass
Be'er Sheva Depot
New double track high speed railway to Be'er Sheva & Eilat
Sheet 16
Sheet 19
7
1
4
4
6
3
3 Freight
5
5
Widened and expanded section from Be'er Sheva Merkaz to University
Be'er Sheva University
Be'er Sheva Depot
0.5 Freight
New double track railway. Be'er Sheva Bypass
Be'er Sheva Center
14
Existing Railway Widened and Improved Be'er Sheva to Army Bases
Sheet 19
Up to 8 Local trains per hour and 6 National trains turnaround here
Sheet 18 of 20


Ksaife
Arad
Tsefa
Tamar
Arara
2
New single track railway to Arad
Existing freight railway to Tsefa widened to 2 tracks
2 Freight
New double track freight railway Tsefa to Tamar
New double track High Speed National Track Be'er Sheva to Elat
Dimona Depot
3 Freight
Sheet 18
Mamshit Yard
1.5 Freight
4
2
1
Dimona
Sheet 20
3 Freight
Existing railway Be'er Sheva Bypass to Mamshit widened/ realigned to provide freight line and 2 High Speed tracks provided for passenger services to Elat
Existing freight railway to Zin widened to 2 tracks
Aroer
Oron
Potential extension to Army Bases and Egypt
Sheet 18
Zomet Hanagev
Nitzana Border Crossing
1
New single track railway to Yerucham
< 0.5 Freight
Ramat Hovav
Border Crossing
Yerucham
Yerucham
Sheet 19 of 20


Dead Sea Works
0.5 Freight
New single track freight railway Hazeva to Dead Sea Works
New double track High Speed National Track Be'er Sheva to Elat
Potential route to Aqaba
Aqaba Border Crossing
Elat Port
1
1
1.5 Freight
1
Hazeva
Sapir
Paran
Yahel
Yotvata
Timna
Eilat Depot
Elat
Sheet 19
Connections between two main running tracks provided at every other station
Zin
1.5 Freight
New double track freight railway Zin to Hazeva
Sheet 20 of 20

H. APPENDIX H – ADDITIONAL FILES

Modelling

Model Run	File Name
C30	Dropbox\ISR Project 2015\Reports\Final report\Files\C30_Routes and station boardings.xlsx
C5	Dropbox\ISR Project 2015\Model\Runs\160327\RunSummary_2040_C5_Ver.xls
C51	Dropbox\ISR Project 2015\Model\Runs\160327\C5-1\C51-Rail-Pass.pptx
C51	Dropbox\ISR Project 2015\Model\Runs\160327\C5-1\Line Profiles - C51.xlsx
C52	Dropbox\ISR Project 2015\Model\Runs\160327\C5-2\C52-Rail-Pass.pptx
C52	Dropbox\ISR Project 2015\Model\Runs\160327\C5-2\Line Profiles - C52.xlsx
C52A	Dropbox\ISR Project 2015\Model\Runs\160327\C5-2a\C52a-Rail-Pass.pptx
C52A	Dropbox\ISR Project 2015\Model\Runs\160327\C5-2a\Line Profiles - C52a.xlsx
C52-4	Dropbox\ISR Project 2015\Model\Runs\160327\C5-2_Rd4\C52-4-Rail-Pass.pptx
C52-4	Dropbox\ISR Project 2015\Model\Runs\160327\C5-2_Rd4\Line Profiles - C52-4.xlsx
C61	Dropbox\ISR Project 2015\Model\Runs\160425\Alt C61.pptx
C61	Dropbox\ISR Project 2015\Model\Runs\160425\C61-Rail-Pass.pptx
C61	Dropbox\ISR Project 2015\Model\Runs\160425\Line Profiles - C61.xlsx
C62	Dropbox\ISR Project 2015\Model\Runs\160425\Alt C62.pptx
C62	Dropbox\ISR Project 2015\Model\Runs\160425\C62-Rail-Pass.pptx
C62	Dropbox\ISR Project 2015\Model\Runs\160425\Line Profiles - C62.xls
C65	Dropbox\ISR Project 2015\Model\Runs\160608\RunSummary_2040_C65_Ver.xls
C65	Dropbox\ISR Project 2015\Model\Runs\160608\Alt C65.pptx
C65	Dropbox\ISR Project 2015\Model\Runs\160608\C65-Base-Rail-Pass.pptx
C65	Dropbox\ISR Project 2015\Model\Runs\160608\Line Profiles - C65 Policy.xlsx
C65	Dropbox\ISR Project 2015\Model\Runs\160608\Line Profiles - C65 Base.xlsx
C65	Dropbox\ISR Project 2015\Model\Runs\160608\C65-Rail-Pass Scenario Diff.pptx
C65	Dropbox\ISR Project 2015\Model\Runs\160608\C65-Policy-Rail-Pass.pptx
C65	Dropbox\ISR Project 2015\Model\Runs\160608\Service Plan - version C65.pdf
C7	Dropbox\ISR Project 2015\Model\Runs\160718\Alt C70_160719.pdf
C71	Dropbox\ISR Project 2015\Model\Runs\160718\Line Profiles - C71-Policy.xlsx
C71	Dropbox\ISR Project 2015\Model\Runs\160718\C71_Policy-Rail-Pass Master.pptx
C72	Dropbox\ISR Project 2015\Model\Runs\160718\Line Profiles - C72-Policy.xlsx
C72	Dropbox\ISR Project 2015\Model\Runs\160718\C72_Policy-Rail-Pass Master.pptx
C81	Dropbox\ISR Project 2015\Model\Runs\160825\C81 Routes.pdf
C81	Dropbox\ISR Project 2015\Model\Runs\160825\Line Profiles - C81.xlsx
C81	Dropbox\ISR Project 2015\Model\Runs\160825\C81_Policy-Rail-Pass.pptx
C81	Dropbox\ISR Project 2015\Model\Runs\160825\C81 layout_160811.pdf

Other Supporting Files

File Name	Description
Dropbox\ISR Project 2015\Reports\Final report\Files\C30_Routes and station boardings.xlsx	2030 Routes and Passengers per station
Dropbox\ISR Project 2015\Reports\Final report\Files\C81 Station and Routes.xlsx	C81 Routes and Passengers per station
Dropbox\ISR Project 2015\Reports\Final report\Rail Answers.xlsx	Response to queries on earlier versions
Dropbox\ISR Project 2015\Reports\Final report\Files\C30-Policy-Rail-Pass.pptx	Passenger flow plots for C30
Dropbox\ISR Project 2015\Reports\Final report\Files\2030 Freight Total Final.xlsx	2030 Freight Train Calculator
Dropbox\ISR Project 2015\Reports\Final report\Files\2040 Freight Demand all flows.xlsx	2040 Freight Train Calculator
Dropbox\ISR Project 2015\Reports\Final report\Files\S2S Travel Times.xlsx	Inter station travel times
Dropbox\ISR Project 2015\Reports\ Jerusalem layout B pres	Alternative layouts for Jerusalem Center Terminus

I. APPENDIX I – NATIONAL PLANNING PROGRAM 54 – PROJECT OUTLINE – RAILWAY LINES SYSTEM IN JUDEA AND SAMARIA