ROAD AND TRANSPORTATION MASTERPLAN

PALESTINE

TA 2012013 PS 00 F10

IV.2 – Rail Transport

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1 Introduction

The proposal for rail transport sector envisioned by NTMP is presented in this chapter. Rail transport sector proposal is introduced with a brief overview on the existing situation, consisting in a SWOT analysis and the definition of key-level factors.

2 Overview of RailTransport Sector

At present, the transport system in West Bank and Gaza Strip does not offer any rail service. Nevertheless, in the past[1], some railways were operating across the Palestinian territories and recently the interests towards rail transport has risen again among local Authorities and stakeholders involved in the sector.
Connecting West Bank and Gaza Strip appears fundamental for improving socio-economic conditions of two Palestinian Regions; providing the considered connection with a modern,and fastrail transport system is deemed vital for creating an efficient link, capable to significantly boost the improvement process.
Rail transport is herein considered not only at national scale, with the goal of linking the two Palestinian Regions but also at wider scale, for connecting the latter ones to the neighbouring countries (i.e. Egypt and Jordan)hence contributing to the development of a more integrated socio-economic framework of Middle East.

2.1 SWOT Analysis of Existing Rail Transport Sector

The SWOT analysis of rail transport sector in West Bank and Gaza Strip is to be considered as a preliminary evaluation of competitiveness of this transport sub-sector, carried out with a focus on the cooperation between involved stakeholders atregional and local scale. While strengths and weaknesses are aimed at determining the current situation, opportunities and threats envision future perspectives for rail transport sector.
The SWOT includes:

- Identification and suggestion of issues for improving stakeholders collaboration toenhance changesin modal shift, from road to rail transport;
- Activities and initiatives to achieve synergies with neighboring countries;
- Definition of long-term strategic measures for efficient management of rail transport sector, with short and mid-term priority action plans.

Before presenting the SWOT Analysis, the following points has to be taken in to consideration:

- Geography, demography and economy of involved areas, in order to describe a general situation and prospective development;
- Current transport infrastructure, primarily for rail transport;
- Interoperability, multi-modality and accessibility;

[1] At the beginning of the last century, some sections of the *Hijaz Railway*were opened in the North of the West Bank and along Gaza Strip; these railways are currently abandoned and/or disused.

- Transport performance, to be intended as passenger and freight transport supply with respect to transport demand;
- Logistics management, sincelogistics chain is a key-level factor in contemporary rail transport sector;
- Environment and safety.

Tab 1. SWOT Analysis of Existing Rail Transport Sector

Rail Transport SWOT Analysis	
Strengths	**Weaknesses**
• Potential social economic development through internal and external connections; • Possibility to evaluate a railway integration system with different transport systems for passengers; • Possibility to evaluate a railway integration system with different transport systems for freight; • Total population of the area about (2,9 million people in the West Bank and 1,8 million in Gaza Strip)[2]; Concentration of population in coastal areas and in the most important towns; • Necessity of a modern railway transport system; Possibility of participation/intervention of public, private and/ or foreign investors; • Possibility of designing and building a new railway system that meets the satisfaction of the public; • Potential high demand for passenger transport; • Potential good demand for freight transport; • Increase of global safety in transportation; • Fast transport system reducing road traffic concentration; • Increase of transport capacity; • The need for a more environment friendly transport system; • Global transport cost reduction on medium and long term (economic feasibility).	• Difficulty in involving rural areas; • Labour policy; • Possible resistance from sectors of traditional road transport; • Large capital outlay; The different existing railway gauge and infrastructure may create difficulties; • Strong competition of bus lines; Traditional lorries transport can reach destinations not reached by rails; • Increase of management cost; • Necessity of modern infrastructure and intermodal exchange system; • Less flexibility in transportation coverage; Possibility of transport cost unbalance in non-covered areas.
Opportunities	**Threats**
• Further population growth with increase of internal /external mobility demand; • Possibility of further investments and increase in transport capacity, also with bordering countries; • Continuous modernization of infrastructure and intermodal capability.	• Difficulty to perform good provisions due to regional political instability; • Difficulty to attract investment due to the regional political instability; • Risk of uncontrolled increase in cost.

2.1.1 Focus on Strengths for Rail Transport Sector

The most relevant items reported as strengths in the SWOT analysis are described with more details below:[3]

[2] PCBS – Palestinian Central Bureau of Statistics (2016): http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/gover_e.htm
[3] Some definitions and terms about SWOT and its application in this paragraph and in the following deriveand/or are partially extracted from the following sources: http://geographymaterials.blogspot.it/2015/08/rail-transport-is-means-of-conveyance.html

- Safety. Railway accident averages and related injuries and deaths are much lower than inother modes of transport, especially road transport.
- Fast transport system. Average time needed to transport people or materials from one point to another by railway has become quite competitive with other modes of transport, and is being continuously improved by increasing train speeds, and reducing the trip lengths.
- Capacity. Trains are capable of carrying larger number of passengers and greater volumes of goods that other modes of transport cannot handle.
- Comfort.Trains offer passengers more comfort and freedom of movement inside the trains' cars.
- Environmental Protection. Trains are among the most energy-efficient modes of transport. A car needs from twice to five times the energy consumed by a train to transport one passenger one kilometer;the ratio increases from four to eight times in the case of an aircraft.
- Economic Feasibility. Based on the above benefits, railway transportation reduces the cost of transporting passengers and materials as well as road maintenance costs.

2.1.2 Focus on Weaknesses for Rail Transport Sector

Detailed descriptions of the most relevant weaknesses follows:[4]

- Railway Operational in Rural Areas. Railwaycannot be operated economically in rural areas where transport demand is low. Thus, large rural areas have no railways, causing inconveniences to rural population that can be considered one of the weakest social groups.
- Large Capital Outlay. Railway requires a large investment of capital. The costs of construction, maintenance and overhead expenses are high, when compared with other modes of transport. Investments are specific and immobile,requiring huge capital outlays that may lead to the creation of monopolies operating in conflict with public interest at large. Even if controlled and managed by the government, lack of competition may provoke inefficiency and high operational costs.
- Strong competition of bus line for passenger transport. Rail transport cannot provide door-to-door service as it is tied to a particular track and number of stations.
- Strong competition with traditional lorries transport.As it concerns freight transport, the costs of terminal operationsare high, since rail-based logistics activities take longer time thanroad-based ones.
- Low competitiveness for short-distance-trips. Rail transport is unsuitable and not convenient for short distances and low freight traffic volumes.

2.2 Key-Level Factors Definition for Rail Transport

A list of key-level factors, important for the success of rail transport sector, follows.

- Competitive Travel Times and Costs (vs other transport modes).Ensuring a suitable cost of service helps to encourage the use of train as main mode of transportation. Efficient scheduling and timetable minimize user's waiting times for train changes between lines.

Baltic Transport Outlook 2030 Main Task 5: SWOT Analysis and Multi-Criteria Analysis - Final report - December 2011
MORECO Mobility and residential costs: SWAT Analysis - June 2012
Support in the Implementation of Transport - Community Agreement EU-TCA -Multimodal Transport - Strategy (2012-2021) and Action Plan (2012-2016) - Kosovo - Version 0.4 Egis International

[4]Ibidem

- Service Flexibility. Efficient scheduling of train timetable is required to ensure good level of service, which frequency needs to be adequate to user's needs and general travel demand.
- Multi-modal Transport Integration and Multi-modal Transfer Capacity (P+R).Integration with other transport modes to create multi-modal transport system is required for enhancing the general level of service and therefore encouraging users towards shared services.
- Accessibility. Since service's benefits strictly depends onthe number of users,rail stations shall be placedat strategic and easy-to-access points of interest.
- Cleanliness and Comfort.The development and diffusion of rail transport to an increased number of users is strongly intertwined with the quality of service provided. Users are encouraged to prefer rail transport when the latter adapts to users' needs and satisfy user's expectations of comfort (i.e. comfortable seats; electrical sockets to recharge electronic devices; clean and accessible restroom; etc...);
- Service Reliability.In the last few decadesinternational standards have led to an improvement ofrail transport safety. Technological progresses, such as the use of software, sensors and smart technologies, have made rail transport more reliable and safe: reliability and punctuality are key-level factors in building customer loyalty.
- Service Capacity.Capacity shall be properly dimensioned to ensure enough space and structure, adequate to load the highest numbers of passengers, along with luggage, stroller and other personal belongings.
- Environmental Impact: Attention has been increasingly paid towards environmental issues, like emissions and recyclable materials, in recent time. International standards require also the adoption of pollution prevention and monitoring measures. Moreover, international standards ban the use of pollutants and indicate how to ensure respect for the environment.
- Safety: Train safetycan be ensured by highly reliable data processing systems. The best technologies are applied to assist the driver and give the best solution, even in the worst environmental or system circumstances. All trainsystemsare constantly monitored by complex softwareproviding the best solutions for safety in the shortest time.

3 Rail Transport Network Proposal

Rail transport network proposalenvisaged by NTMP issummarized in the following main aspects:

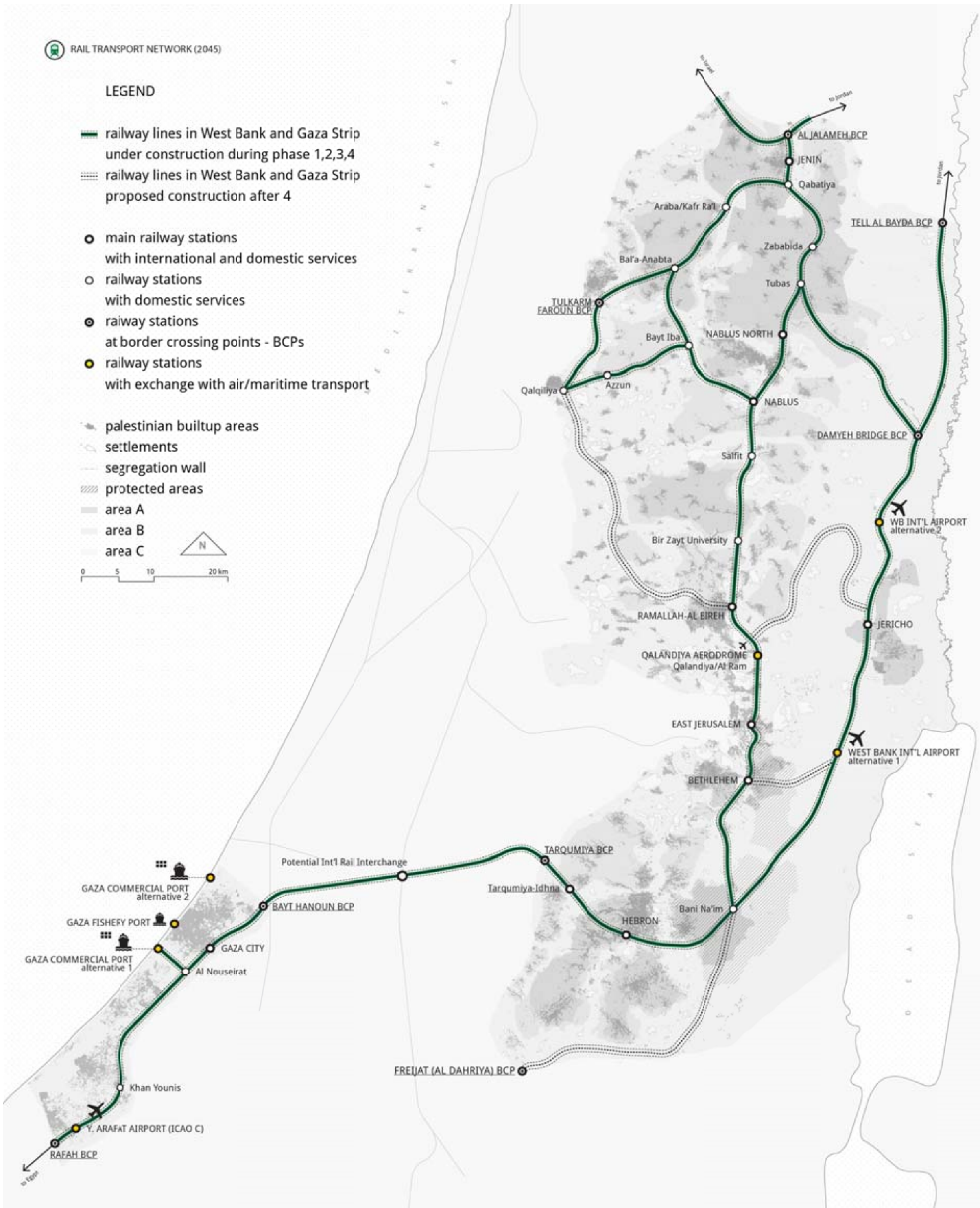
- Rail Transport Network Proposal Development by Phase;
- International Rail Key Linkages, and;
- Rail Transport Network Proposal Technical Specifications.

3.1 Rail Transport Network Development by Phase

The overall supply proposed for rail transport does not become operative at the same time but develops and extends according to the already introduced Phases.*For more detail, refer to:¶III – Road and Transportation Master Plan Overview.*Before proceeding to describe in details the development of rail transport by Phase, the entire proposed system is illustrated in the following figure.*For more details, refer to:¶AX.4 – Maps by Phase and Sector.*

Rail transport network develops starting from the domestic line linking Ramallah and Nablus, to be complete during Phase 1. This develops further to connect northwards to Jenin and southwards to BaniNa'im-Hebron and surrounding cities; this connection is to be complete before the end of Phase 2. The network is then expanded in Phase 3, through the implementation of an international link between Gaza Strip and West Bank linking Rafah BCP, in Gaza Strip, to Tell Al Bayda BCP, in West Bank, and beyond. Finally, the network is completed in Phase 4 to include orbital movements in the northern part of West Bank.

Figure 1. Rail Transport Network (2045)



3.1.1 Rail Transport Network in Phase 1A (2-YearInvestment Plan: End of 2016 – 2018)

The capacitation of the railway management and operation units, feasibility study of the national railway network and international railway network as well as the planning and design of the Ramallah – Nablus rail connection is to be done during this phase.

3.1.2 Rail Transport Network in Phase 1 (2019 – 2024)

In Phase 1, the construction of railway infrastructureis proposed to connect the conurbation of Ramallah-Al Bireh-Beitunia with Nablus. The proposed rail infrastructureextends for almost 30km and includes4 stations in total: Ramallah-Al Bireh, BirZayt University, Salfit, and Nablus. The rail infrastructure becomes operative through an Inter-city rail line, conceived as an express passenger service, with limited stops and covering medium/long-distance travels.

Tab 2. Railway Stations in Phase 1

Start Operating in Phase 1
1. Ramallah-Al Bireh 2. BirZayt University 3. Salfit 4. Nablus

3.1.3 Rail Transport Network in Phase 2 (2025 – 2031)

In Phase 2, while an inter-city rail line is already operative, to connect Ramallah-Al Bireh- with Nablus, the extension of railway infrastructure starts along the main N-S axis and towards two directions: (southwards) from Ramallah-Al Bireh-Beitunia to BaniNa'im (Hebron Governorate), and; (northwards) from Nablus to Jenin and Al Jalameh BCP.
The extension of rail infrastructure will allow for a longer and more widespread network, including the stations listed below:

Tab 3. Railway Stations in Phase 2

Already Operative from Precedent Phases	Start Operating in Phase 2
1. Ramallah-Al Bireh 2. BirZayt University 3. Salfit 4. Nablus	5. BaniNa'im 6. Bethlehem 7. East Jerusalem 8. Qalandiya/ Al Ram 9. Nablus North 10. Tubas 11. Zababida 12. Qabatiya 13. Jenin 14. Al Jalameh BCP

In Phase 2, the first international rail exchange is provided in Al Jalameh BCP, where West Bank rail transport network can exchange with the international rail line Irbid (JOR) – Haifa (ISR).
The rail infrastructure implementedbecomes operative through an Inter-city rail line, conceived as an express passenger service with limited stops and covering medium/long-distance travels.

3.1.4 Rail Transport Network in Phase 3 (2032 – 2037)

In Phase3rail network is already operative in West Bank, connecting 14 of the most populated cities. Meanwhile, the first implementation of international rail system is proposed, with the aim of allowing the following three main multi-scale connections:

- Domestic Connection
  West Bank and Gaza Strip are connected with railways;
- International Link (Gaza Strip – EGY)
  Gaza Strip is connected to Egyptian rail system at Rafah BCP Station;
- International Link(West Bank – JOR+ISR)
  West Bank is connectedto the international rail line Irbid – Haifa at Tell al BaydaBCP.

While domestic rail system is more passenger-oriented, international rail system is more freight-oriented.*(formore details, refer to: ¶VI – Logistics, BCPs and West Bank – Gaza Strip Corridor)*
The so-defined extension of railway infrastructure will allow for a longer and more widespread network, including the stations listed below:

Tab 4. Railway Stations in Phase 3

Already Operative from Precedent Phases	Start Operating in Phase 3
1. Ramallah-Al Bireh 2. BirZayt University 3. Salfit 4. Nablus 5. BaniNa'im 6. Bethlehem 7. East Jerusalem 8. Qalandiya/ Al Ram 9. Nablus North 10. Tubas 11. Zababida 12. Qabatiya 13. Jenin 14. Al Jalameh	15. Rafah BCP 16. Y. Arafat Int'l Airport 17. Khan Younis 18. Al Nouseirat 19. New Gaza Commercial Port 20. Gaza City 21. Bayt Hanoun 22. Tarqumiya-Idhna 23. Hebron 24. New West Bank Int'l Airport 25. Jericho 26. Damyeh Br. BCP 27. Tell Al Bayda BCP

The rail infrastructure completed during Phase 3 becomes operative in Phase 4, through:

- Inter-city rail line, conceived as an express passenger service with limited stops and covering medium/long-distance travels, along domestic routes, and;
- Combined freight + passenger services, along the international lines.

3.1.5 Rail Transport Network in Phase 4 (2038 – 2045)

In Phase 4, both domestic and international rail systems are operative. Railway infrastructure now links West Bank and Gaza Strip, extending from RafahBCP, to Jenin and Al JalamehBCP, running along the main urbanized areas and therefore servicing major part of the Palestinian population.
In Phase 4, domestic rail system undergoes further thelast extension, allowing for orbital movements in the northern part of West Bank, involving Qalqiliya and Tulkarm, where FarounBCP is located.

The so-defined extension of railway infrastructure will allow for a longer and more widespread network, including the stations listed in the following table:

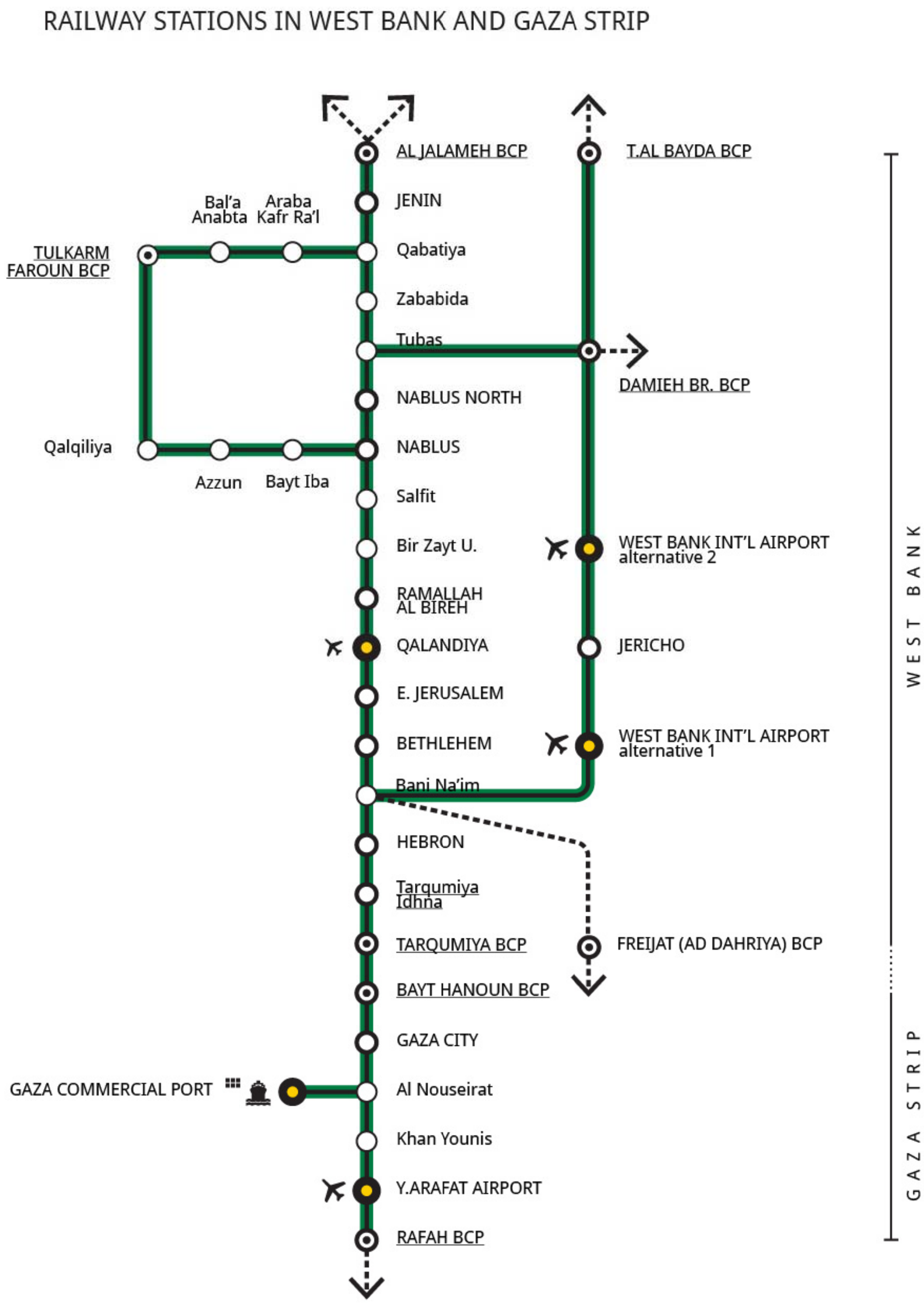
Tab 5. Railway Stations in Phase 4

Already Operational from Precedent Phases	Start Operating in Phase 4
1. Ramallah-Al Bireh 2. BirZayt University 3. Salfit 4. Nablus 5. BaniNa'im 6. Bethlehem 7. East Jerusalem 8. Qalandiya/ Al Ram 9. Nablus North 10. Tubas 11. Zababida 12. Qabatiya 13. Jenin 14. Al Jalameh 15. Rafah BCP 16. Y. Arafat Int'l Airport 17. Khan Younis 18. Al Nouseirat 19. New Gaza Commercial Port 20. Gaza City 21. Bayt Hanoun 22. Tarqumiya-Idhna 23. Hebron 24. New West Bank Int'l Airport 25. Jericho 26. Damyeh Br. BCP 27. Tell Al Bayda BCP	28. Qalqiliya 29. Tulkarm/ Faroun BCP 30. Azzun 31. Bayt Iba 32. Bal'a/ Anabta 33. Araba/ KafrRa'l

The rail infrastructure implemented becomes operative through an extension of domestic Inter-city rail line, conceived as an express passenger service with limited stops and covering medium/long-distance travels.

When completed, in 2045, the entire rail transport network for West Bank and Gaza Strip will comprise 33 stations, linking also the new Commercial Port of Gaza Strip, two international airports (Y. Arafat Airport in Gaza Strip and the new West Bank Int'l Airport), and 7 Border Crossing Points (five in West Bank and two in Gaza Strip).

Figure 2. Railway Stations and Network Scheme (2045)



3.2 International Rail Key Linkages

The linkages with neighboring countries are crucial for boosting economic development and improving multi modal transport at regional level. In particular,connecting West Bank and Gaza Strip rail network with bordering countries will eventually create important benefits for logistics sector as shown in the freight traffic forecasts and proven by the traffic modelling part.The completion of the first international rail key linkages is proposed in Phase 3.

3.2.1 International Key Linkages in Phase 3

In West Bank the following two int'l key linkages are proposed for Phase 3:

- Al Jalameh BCP;
- Tell Al Bayda BCP.

Al Jalameh BCP links West Bank rail network to the international rail line running between Haifa (West) and Irbid-Amman (East).
The connection to Haifa appears fundamental for providing West Bank with an access to Mediterranean Sea, to be considered beside the one proposed in Gaza Strip, through the implementation of a new commercial port. *For more details, refer to:¶IV.4 – Maritime Transport.*
The connection to Jordan is proposed to connect West Bank to the major cities and the Port of Aqaba in Jordan. Furthermore, this connection would allow other links with Syria, Iraq, KSA, Qatar, Bahrain, Kuwait, Oman and UAE.
Tell Al Bayda BCPis another international rail key linkage connecting West Bank rail network to the international rail line running between Haifa (West) and Irbid-Amman (East).

In Gaza Strip the following international key linkage is proposed for Phase 3:

- Rafah BCP;

Rafah BCPconnects Gaza Strip rail network with Egypt. In this case, the main benefit, for both freight and passenger transport, consists of the completion of the linkage North Africa-Middle East-Arab Gulf.
In this context, the development and usability of the rail network in West Bank and Gaza Strip, with its international links, are undoubtedly essential.

3.2.2 International Key Linkages in Phase 4

In West Bank the following international key linkage is proposed for Phase 4:

- Tulkarm/ Faroun BCP.

Tulkarm/ Faroun BCPis located in the North Eastern area of West Bank, where a district logistics centre is located. *For more details, refer to:¶VI – Logistics, BCPs and West Bank – Gaza Strip Corridor.*
The benefits resulting from the implementation of the international rail key linkages described abovecan be briefly summarizedas follows:

- Strengthening the contribution of West Bank to regional trade and economic integration;
- Acting as a catalyst for trade facilitation activities with West Bank's neighboring countries;
- Improving cost-effectiveness of regional railway network;

- Supporting competitiveness and development of Commercial Port in Gaza Strip, increasing investments returnwith port improvement projects;
- Promoting Gaza Strip role as a key gateway for Gulf countries to Mediterranean Sea.

3.2.3 Additional Rail Connections After 2045

After the completion of the rail network envisaged by NTMP, a further extension of Palestinian railway network can occur through the implementation of:

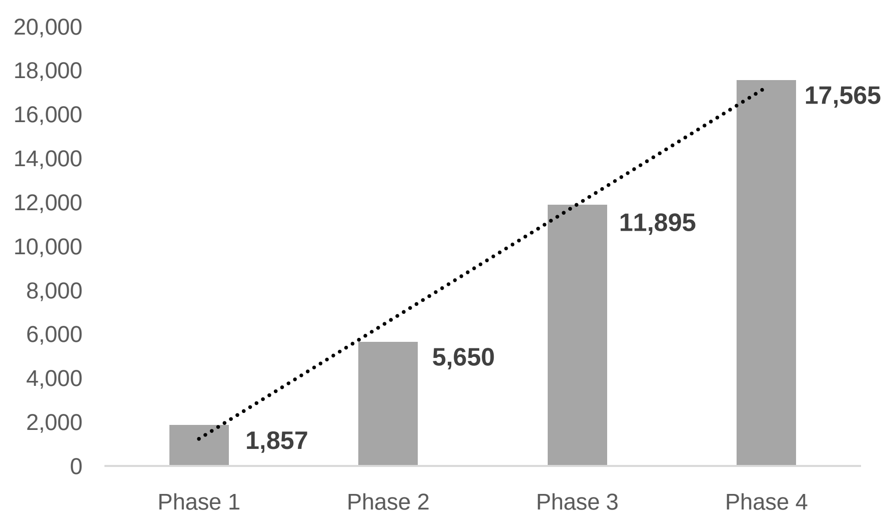
- Railway in S West Bank, from BaniNa'im to Freijat (Al Dahriya) BCP;
- Railway N-E West Bank, between Damyeh Br. BCP and National Logistics Center and the border with Jordan, and;
- Railway Station along WB-GS Corridor, connecting West Bank (Tarqumiya-Idhna BCP) with Gaza Strip (Bayt Hanoun BCP).
  For more details, refer to:¶VI – Logistics, BCPs and West Bank – Gaza Strip Corridor.

3.3 Rail Traffic Forecasts

Traffic forecasts for the proposed railway network herein described, follow. Traffic forecasts are based on PTM (Palestinian Transport Model); for a more comprehensive understanding of traffic forecasts, refer to:¶*VII – PTM Transport Model Outputs,* and¶*AX.16– Transport Model Features and Calibration*.

The table below illustrates the traffic expected along Palestinian new railway network proposed by NTMP. The values reported are organized by Phase and express the quantity of passengers travelling by train during peak 4-hour interval (15:15-19:15) of a working day.

Figure 3. Rail Transport Traffic Forecast by Phase (passengers)



The graph above shows clearly how the expansion of the rail network, as proposed by NTMP phases (for more details, refer to:¶*III – Road and Transportation Master Plan Overview* and to ¶*IV.2.3 – Rail Transport Proposal)* entails also an increase in rail-based traffic. In Phase 1 almost 2,000 passengers travel along the railway linking Ramallah to Nablus via BirZayt

University (30km), while in Phase 4 around 17,500 passengers travel on the entire rail network (450km) in the whole West Bank and Gaza Strip.
The increase of rail-based traffic, as forecasted by the PTM, will produce a decrease of road-based traffic, hence leveraging Palestinian road network.

3.4 Functional and Technical Specifications

3.4.1 Technical Specifications for Rail Network

In Phase 1, the line Ramallah-Nablus is implemented: it is a typical regional line with length of about 30 km with two intermediate stations: BirZayt and Salfit. In Phase 2, Ramallah-Nablus line is further extended to BaniNa'im (south) and Al Jalameh BCP (north).
The following characteristics are proposed for lines implemented both in Phase 1 and Phase 2:

- Standard gauge rail network: 1.435m
- Double track with minimum distance between centers: 4 m
- Vehicle loading gauge: EN 15273 GC
- Electrification, Signalization and Telecommunication systems according with UIC and Trans-European Railway Network specification
- Design speed for freight trains: 120km/h
- Design speed for passenger trains: 160km/h
- Maximum axle load: 22.5tons.
- Maximum vertical gradient: 3.5%
- Minimum curve radius: 250m
- Minimum platform length: 350m

In Phase 3, the international line Rafah BCP -Tell al BaydaBCPis implemented; rail transport network offers for the first time both domestic and international services. For this mixed line, the following characteristics are proposed:

- Standard gauge rail network: 1.435m
- Double track with minimum distance between centers: 4m
- Vehicle loading gauge: EN 15273 GC
- Electrification, Signalization and Telecommunication systems according with UIC and Trans-European Railway Network specification
- Design speed for freight trains: 120km/h
- Design speed for passenger trains: 250km/h
- Maximum axle load: 22.5tons.
- Maximum vertical gradient: 3.5%
- Minimum curve radius: 250m
- Minimum platform length: 500m

In Phase 4, the following lines in the northern part of West Bank are introduced, with the aim to complete the rail network: Qalqiliya – Tulkarm – Jenin; Nablus – Qalqiliya; Nablus – Anabta; Tubas – DamyehBr. BCP. For these four lines, the following characteristics are proposed:

- Standard gauge rail network: 1.435m
- Double track with minimum distance between centers: 4m
- Vehicle loading gauge: EN 15273 GC
- Electrification, Signalization and Telecommunication systems according with UIC and Trans-European Railway Network specification
- Design speed for passenger trains: 160km/h
- Maximum axle load: 20tons.

- Maximum vertical gradient: 3. %
- Minimum curve radius: 250m
- Minimum platform length: 300m

The creation of standardized stations is foreseen. Railway Stations shall be modular,to ease the design of each envisaged station, and equipped for commercial and service activities. Moreover, safety standards shall be taken into account for both freight and passenger transport. Therefore, installations and infrastructure parameters like fire extinguishing systems, passenger evacuation, etc., need to be standardized, to ensure common safety levels for the entire network.

3.4.2 Technical Specifications for Rolling Stock

Taking into account the types of line, services and distances between stations for Phase 1, EMU (Electrical Multiple Unit) train is proposed, in variable composition consisting of motor car with cabin and intermediate trailer car. To ensure maximum service flexibility three compositions are provided consisting of 3, 4, 5 cars. Trains may additionally travel coupled, to ensure comfortable service, also in case of overcrowding at peak times.
The main technical features for this type of train are summarized in the following table.

Tab 6. Rail Rolling Stock Technical Specs: Single-Deck EMU

General Features	
Vehicle type	Single deck EMU. First class, second class and driver coach
Main destination of use	Medium and short distances. Intercity trains.
Maximum design speed	160 km/h
Operational kilometer	About 300,000 km/year.
Main Technical Features	
Carbody	Steel car body with welded structure.
Car end connection	Automatic coupler on drive coach. Semi-permanent coupler on other coaches.
HVAC	Double air-conditioning system. Redundant control
Chair	Fixed type in second class. With slider in first class. Table on the back.
Toilette	One each car. Vacuum system.
Electronic system driving (TCN)	Yes
Passenger information system	Yes
Security system driving	Yes
Data transmission to the outside	Yes
Brake	UIC pneumatic brake. Two disks for axle. Comply with TSI norms.
Motor Car (MC)	
Power	1.5MW
Maximum speed	160km/h
Maximum length	25,400mm
Maximum height	4,050mm

Maximum width	2,850mm
Wheel distance	2,500mm
Bogie centre distance	18,300mm
Floor height at entrance level	650mm from Top of Rail
Total mass (empty)	58.0t
Total seats	70
Standing passengers (4 pass./m2)	80
Trailer Car (TC) – trailer car with cabin (SP)	
Maximum length (TC)	24,800mm
Maximum length (SP)	25,400mm
Maximum height	4,050mm
Maximum width	2,850mm
Wheel distance	2,500mm
Bogie centre distance	18,300mm
Floor height at entrance level	650mm from Top of Rail
Total mass (empty)	42.0t
Total seats	80
Standing passengers (4 pass./m2)	90
Compositions	
MC+TC+SP	230 seat + 250 standing
MC+TC+TC+MC	310 seat + 340 standing
MC+TC+TC+TC+MC	390 seat + 430 standing

Figure 4. Single-deck EMU: Alstom Coradia Meridian for Trenitalia[5]

For subsequent developments related both to the extension of the lines in Phase 2 and the predictable increase of passengers, a double deck type of train, with configurations substantially similar to the previous one but with a higher capacity, is proposed as an alternative.
In this case, the transportation of over 1000 passengers per train in five cars configuration will be feasible.This will ensure adequate mobility between West Bank cities even at peak times.
The following table summarizes the main technical features for the double-deck EMU:

Tab 7. Rail Rolling Stock Technical Specs: Double-Deck EMU

General Features	
Vehicle type	Double deck EMU. First class, second class and driver coach
Main destination of use	Medium and short distances. Intercity trains
Maximum design speed	160km/h
Operational kilometer	About 300,000km/year
Main Technical Features	
Carbody	Steel carbody with welded structure. Floor in inox steel.
Car end connection	Automatic coupler on drive coach. UIC coupler on other coaches.
HVAC	Double air-conditioning system. Redundant control
Chair	Fixed type in second class. With slider in first class. Table on the back.
Toilette	One each car. Vacuum system.
Electronic system driving (TCN)	Yes
Passenger information system	Yes
Security system driving	Yes
Data transmission to the outside	Yes
Brake	UIC pneumatic brake. Three disks for axle.

[5]Source: www.masstransitmag.com

	Comply with TSI norms.
Motor Car (MC)	
Power	1.6MW
Maximum speed	160km/h
Maximum length	27,110mm
Maximum height	4,300mm
Maximum width	2,774mm
Wheel distance	2,500mm
Bogie centre distance	20,000mm
Floor height at entrance level	650mm from Top of Rail
Total mass (empty)	65.1t
Total seats	90
Standing passengers (4 pass./m2)	100
Trailer Car (TC) – Trailer Car with Cabin (SP)	
Maximum length (TC)	26,480mm
Maximum length (SP)	27,110mm
Maximum height	4,300mm
Maximum width	2,774mm
Wheel distance	2,500mm
Bogie centre distance	20,000mm
Floor height at entrance level	650mm from Top of Rail
Total mass (empty)	49.2t
Total seats	126
Standing passengers (4 pass./m2)	100
Compositions	
MC+TC+SP	306 seat + 300 standing
MC+TC+TC+MC	432 seat + 400 standing
MC+TC+TC+TC+MC	558 seat + 500 standing

Figure 5. Double-deck EMU: Vivalto for Trenitalia[6]

In Phase 3, the construction of the mixed – domestic and international North-South line is planned taking into account the following parameters:

- longer length of the line
- ampler distances between stations
- international connections
- inter-hub domestics express services

High-speed trains with the following characteristics can be considered as part of the rolling stock:[7]

Tab 8. Rail Rolling Stock Technical Specs: Single-Deck EMU 1st/ 2nd Class

General Features	
Vehicle type	Single deck EMU. First class, second class.
Main destination of use	Intercity trains.
Maximum design speed	200km/h
Operational kilometer	About 280,000km/year each coach.
Main Technical Features	
Carbody	Steel carbody with welded structure.
Car end connection	Automatic coupler on drive coach. Fixed coupler on other coaches.
HVAC	Double air-conditioning system. Redundant control
Chair	Slider type in second class. With recline in first class. Table on the back.
Toilette	One each car. Vacuum system.

[6] Source: www.scalatt.it
[7] High-speed train (250km/h) use is strictly dependent on topography which conditions may, or may not, allow for high-speed train with restrained costs.

Electronic system driving (TCN)	Yes
Passenger information system	Yes
Security system driving	Yes
Data transmission to the outside	Yes
Brake	UIC pneumatic brake. Two disks for axle. Comply with TSI norms.
Drive Car (SMC)	
Power	0.5MW
Maximumlength	26,880mm
Maximum height	4,050mm
Maximum width	2,825mm
Wheel distance	2,500mm
Bogie centre distance	19,000mm
Floor height at entrance level	1250mm from Top of Rail
Total mass (empty)	59.0t
Total seats	68 (2 class) or 51 (1 class)
Standing passengers (4 pass./m2)	about 75
Intermediate Car (IC)	
Power	0.5MW
Maximumlength (TC)	26,400mm
Maximum height	4,050mm
Maximum width	2,825mm
Wheel distance	2,500mm
Bogie centre distance	19,000mm
Floor height at entrance level	1,250mm from Top of Rail
Total mass (empty)	56.0t
Total seats	82 (2 class) or 62 (1 class)
Standing passengers (4 pass./m2)	about 80
Compositions	
Note: it's possible add in the composition a dining car. There is no limit to the theoretical composition.	
SMC+IC+IC+IC+SMC	382 seat + 372 standing (only 2 class)
SMC+IC+IC+IC+IC+SMC	464 seat + 454 standing (only 2 class)
SMC+IC+IC+IC+IC+IC+SMC	546 seat + 536 standing (only 2 class)

Finally, in Phase 4, the railway network will be extended for an essentially domestic service, with the completion of planned railway, allowing orbital movements in the northern part of West Bank, between Nablus/Jenin, Qalqiliya/Tulkarm and between Tubas and Damyeh.
The type of train to implement at this stage will be the same as that suggested for Phase 1. Considering demographic developments in the area, the increase in demand for rail service and the possible inclusion of closely spaced small stations on the territory, and the use of a type of

vehicle called LVR (Light Rail Vehicle) with less costs, for domestic service in stage is considered. The technical characteristics of this type of vehicle can then be defined according to the actual service required.