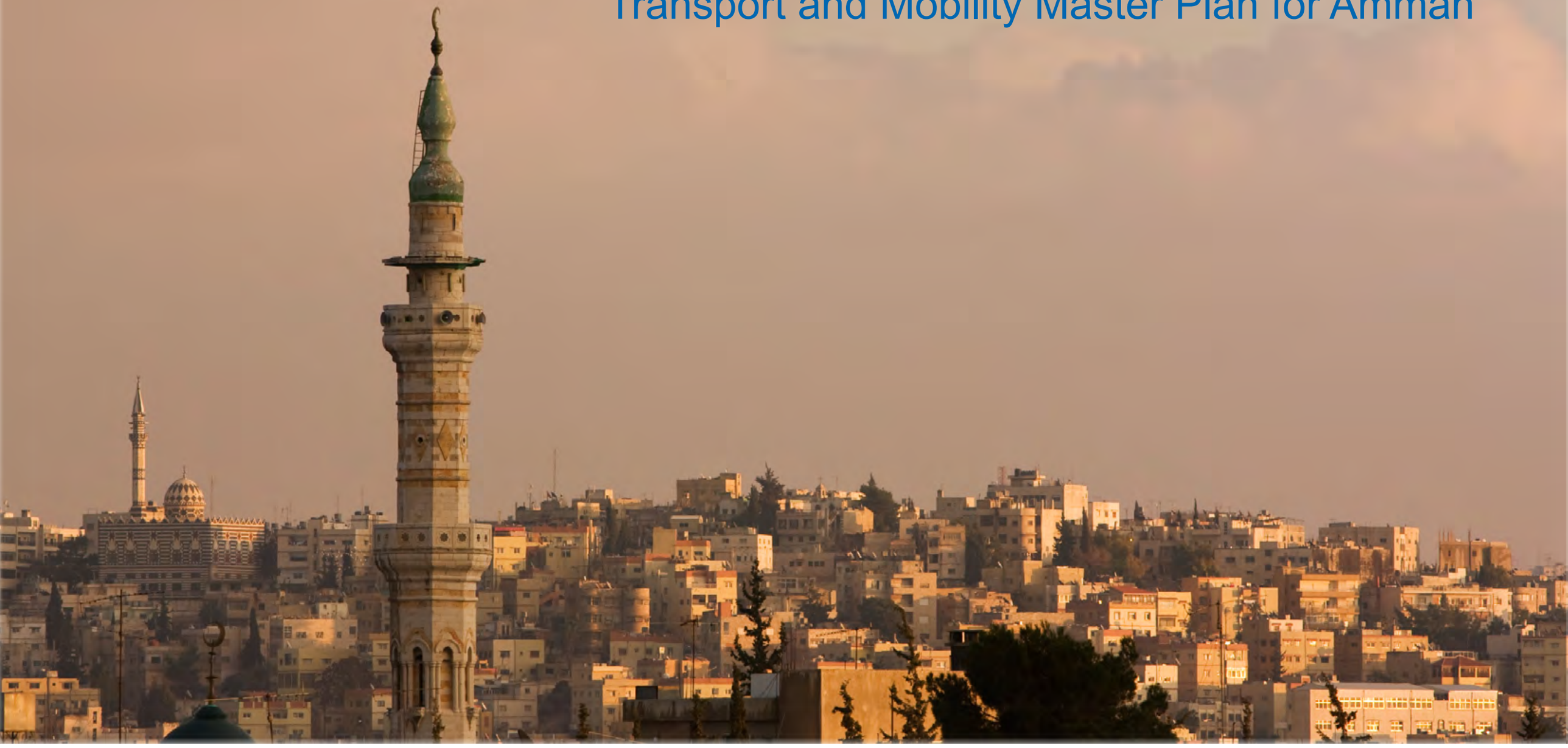
Transport and Mobility Master Plan for Amman



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Consolidated Consultants
Engineering & Environment

Final Report
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Greater Amman Municipality

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Introduction 1

Introduction

Greater Amman is quickly developing into one of the leading cities in the Middle East. It is renowned for quality services in a number of sectors including tourism, medicine, e-commerce, finance, commercial banking and trucking. Greater Amman Municipality (GAM) has continually planned road infrastructure improvements ahead of time to allow for growth in traffic, however this has also led to increased congestion.

The 1999 national registered vehicle fleet composition was estimated at around 321,500. In 2002, the vehicle fleet had increased to nearly 543,000 vehicles representing an increase of 69% or a growth of 19% per annum since 1999. In 2005, there were nearly 680,000 vehicles registered, representing an increase of 115% since 1999.

In Jordan, the number of private cars per thousand population for 1996 was around 40. As a result of the significant growth in vehicle registrations since 1999, the vehicle motorisation rate for Jordan increased from 49 cars per thousand population in 1999, to 63 in 2001, 67 in 2002, and 80 in 2005. Between 2005 and 2008, vehicle registrations in Amman have grown by 25%.

Using the vehicle licensing department statistics for 2005, the number of private saloons per 1000 population in the GAM is estimated at 157 which is nearly double the national average.

Currently, there are 178 cars per 1000 people, which is moderate when compared to developed nations in Europe or the USA. This relatively low rate is attributable to the relatively lower income levels in Amman, but also the large family size and dependency on a single income within the household.

The forecast growth in car ownership using real income growth rate of 2% per annum in a forecast car ownership of 248 cars per person - a growth of 40%. The GAM masterplan forecasts that Amman will continue to be a young society which dampens the growth rate in car ownership. However, the population of GAM is expected to double by 2025, and this will increase the number of cars from 380,000 to 1,170,000 cars, which is a 3-fold increase. With Amman already suffering congestion and with limited space to increase central urban highway capacity, alternative modes now need to be considered.

With the city moving into the 21st century, as part of the Amman Plan, GAM has prepared a sustainable transport strategy for the short, medium and long term time horizons which requires a strong vision, determination and a move towards public transport and supportive transport policies.

The plan also proposes that public transport should be designed to provide a hierarchy of services, with strategic high level routes being provided by Light Rapid Transit (LRT) or Bus Rapid Transit (BRT), then the next tier of less strategic but important urban services being provided by large buses, and more local feeder services being provided by minibuses or white taxis.

It is necessary to have a balanced and integrated system that makes the best possible use of existing transport and traffic facilities in order to form the basis of a long term sustainable transport strategy. However, in the medium to longer term, to remain sustainable, this will need to be supplemented by a much more efficient and expanded public transport network with supportive demand management measures.

The study was developed through five integrated components:

- Phase 0: Inception
- Phase 1: Data Collection and Analysis
- Phase 2: Strategy Development
- Phase 3: Implementation and Operational Assistance
- Phase 4: Finalisation of Study and Reports

The overall process was designed to deliver a tailored urban transport master plan for Greater Amman that will include a set of high priority multi-modal transport projects supported by strengthened institutions and improved organisational and management for the public authorities.

The approach adopted by this Summary commences with a section on the background to Amman's transport system, and then explains the data collection exercise and the overall methodology used to arrive at the final recommendations. It sets out the transport vision for Amman, the objectives and core principles and the target definitions selected to demonstrate whether the objectives have been met. It then outlines the integrated range of strategies selected to deliver the Plan, and covers the multi modal model designed to test their effectiveness through demand forecasting. On the basis of a full analysis of the results over a range of scenarios, strategy and economic appraisals are produced and an actions and implementation programme proposed. Finally, the organisational structure required to deliver the Plan is considered.

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Background 2

Background

The Amman Plan provides a blueprint to guide growth and change in the Greater Amman area up to 2025. It supports the future development of Amman as a leading 21st century city and sets out the spatial policies and development proposals that will lead to the achievement of the City's Vision.

The Transport and Mobility Master Plan builds upon the Amman Plan, and provides a set of transport objectives, principles and policies designed to ensure that Greater Amman's transport system is developed in a way that facilitates the safe and efficient movement of people and goods within and through the City.

Transportation and the City

All cities need to be defined in terms of their purpose, form, structure and dynamic. The conurbation that comprises the defined city will reflect these qualities and be organised in such a way that it functions sensibly, economically and provides ease of use for the inhabitants, workers, visitors and tourists.

The transport system must reflect, support and enhance the city that it serves and provide important connections to other areas, through links by road, rail and by ground transport to the airport. Mobility within the city is also vital for it to function well with good accessibility from and to home, work place and other leisure and community activities. Transport can also help to shape the development of new areas and act as a catalyst for concentrated economic development. Comparison with other cities provides an instructive set of benchmarks, which can inform the review and planning process in determining how Amman should proceed. The overwhelming impression that results from these broad comparisons is that Amman has come to rely on cars and a burgeoning road network that has come to dominate and define Amman. While the reasons for this position may be explained in the immediacy of past needs and pace of economic development, it is now a handicap that must be overcome in creating the city of tomorrow. The following points summarise the principle features of the current transportation system in Amman:

- The last integrated transport study was conducted in the mid 1980s and the recommended strategy was never implemented.
- Amman has too much reliance on the road network and car usage, investing primarily in road based infrastructure since the 1980s.
- There is very little investment in public transport which is currently provided by buses and taxis. In 2008, public transport made up only 2.8% of all vehicles on the system and accounted for only 14% of all trips made in Amman.
- There is a general perception that bus use is only relevant to low income groups, which currently limits the general appeal of public transport to potential users.
- The vehicle availability is 178 per 1,000 people (2008) and growing.
- Across Amman the growth in vehicular traffic has risen by over 10% per annum since 2005.
- Jordan has relatively low fuel, registration and vehicle operating costs.
- Parking measures are rarely enforced and cost of parking is low.
- Demand and Mobility Management measures are very limited.
- Road traffic accident levels are relatively high in Jordan (including Amman), at around 34 deaths per 100,000 population.

Greater Amman's Transport Provision

An extensive road network has been developed over the last 20 years, intended to meet the growing demand for additional car trips, through major infrastructure projects such as grade separation of junctions and new links. The combination of the relatively inexpensive cost of using private cars in Amman and the current lack of higher quality, well perceived, public transport services results in the predominance of private transport, which has been further encouraged by the expansion of the highway network. In many parts of the city this network acts as a barrier to pedestrian movement and community social cohesion. Nearly all major developments have assumed the use of the vehicle for access. However, through the initiatives of GAM, improved local public transport services using buses are now being introduced. The implementation of the first Bus Rapid Transit system is a major step forward in the goal of transforming the public transport mode share in Greater Amman from its very low current level towards that of other major world cities.

In 2007, GAM acquired the powers of planning and regulating public transport within its boundaries. This provides the Municipality with an excellent opportunity to integrate the planning and provision of transport services in general with land use planning in order to facilitate the pattern of growth envisaged in the Amman Plan.

Future Development

Against this background of a city where major investment in highway infrastructure has failed to eliminate congestion, where pedestrian facilities and safety is lacking (despite the high number of trips still undertaken by walking) and where public transport services are limited, unreliable and poorly used, it is necessary to consider the impacts of planned future developments, as set out in the Amman Plan.

The Amman Plan envisages the following growth pattern up to 2025:

- The population of Greater Amman to increase from 2.2 million in 2008 up to a maximum of 6.4 million by 2025
- Large amount of planned new development.
- The City's urban envelope to expand with the creation of new mixed use developments in areas such as East Amman (Amman Development Corridor), the intensification corridors as developed within the Amman Plan and High Density Mixed Use areas such as Central Parkway and the Northern and Southern gateways.
- Planning policy will concentrate on increased density of housing, thus creating a large demand for internal trips within the City, where key facilities such as retail, health and education are already widely dispersed.

The challenges resulting from this very high level of forecast growth and development must not be underestimated. A radical and comprehensive strategy approach will be essential in order to change current perceptions on the provision of transport services and accommodate the very high level of new trip generation resulting from this growth.

Whilst an integrated planning policy of creating employment opportunities and housing in close proximity will assist in reducing the proportion of long trips, the pressures on the transport system to accommodate large increases in trips will still apply. One of the current features of Amman is the propensity for work and education trips to be both time consuming and lengthy. Whereas the average journey time by car is just under 30 minutes, the average journey time by bus is over 50 minutes, and the average number of legs to a public transport journey is 2.25 (i.e. most bus journeys consist of 2-3 changes to different routes).

SWOT Analysis

As part of the analysis and assessment of the future year transport in Greater Amman a SWOT analysis of the city transport system has helped identify and understand the Strengths, Weaknesses, Opportunities and Threats that exist.

The SWOT analysis for Greater Amman is detailed below and includes:

- Land Use
- Public Transport
- Environment
- Finance
- Urban Traffic Control (UTC) / Intelligent Transport Systems (ITS)
- Pedestrians
- Parking
- Freight

Strengths

- Extensive road network, which is relatively well maintained
- Initial ITS projects (UTC, CCTV) implemented
- Modern telecommunications infrastructure
- AMP well received by public and politicians
- Political will to change and improve transport
- Excellent education system

Weaknesses

- Poor accident record
- Under-developed public transport system which is not integrated
- No rail based public transport
- Cultural preference for private transport
- Poor enforcement of traffic regulations
- Poor use of road space
- Previously uncoordinated policy development
- Climate/topography does not favour cycling/walking
- Limited ITS project skills/ experience
- No demand management policies

Opportunities

- Transfer of regulatory powers provides basis for effective planning
- Exploitation of ITS could quickly aid traffic/transport strategies.
- Delivery of integrated transport system
- Release suppressed public transport demand
- Increase levels of investment
- Deliver easy quick wins

Threats

- Volatility of fuel prices
- World economic climate
- Long term economic growth encourages car ownership
- Need for instant results
- ITS schemes may be introduced piecemeal and in an uncoordinated way
- Lack of stability and profitability of public transport operators

The implications of these strengths, weaknesses, opportunities and threats have been fully taken into account in the development of the overall strategy for the TMMP.

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Data Collection 3

Data Collection

A major transport survey was conducted to establish key transport and socio economic characteristics and relationships. A key element of the Amman Transport and Mobility Master Plan (TMMP) has been the development of a multi-modal transportation model, and the outputs from the transport survey have been used to build transport demand matrices for this model.

Surveys included:

- Transport Counts
- Journey Time Surveys
- Household Survey
- Origin – Destination Surveys

Transport Counts

In order to assist in the development, calibration and validation of the multi modal transport model, several transport counts were conducted as follows:

- Automatic Traffic Counts (ATC)
- Manual Classified Counts (MCC)
- Public Transport Occupancy Counts (PTOC)

Screen lines and cordons were developed across the GAM area as shown on Figure 1 and Figure 2.

Figure 1 - Internal Traffic Cordons and Screen Lines

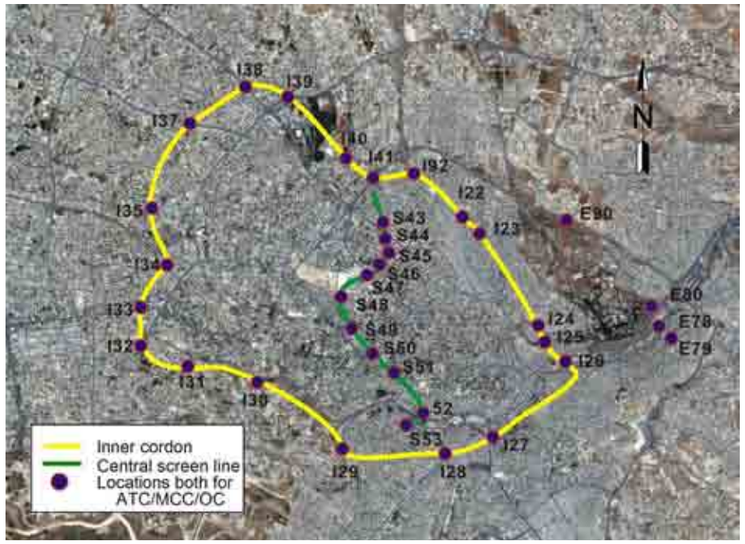
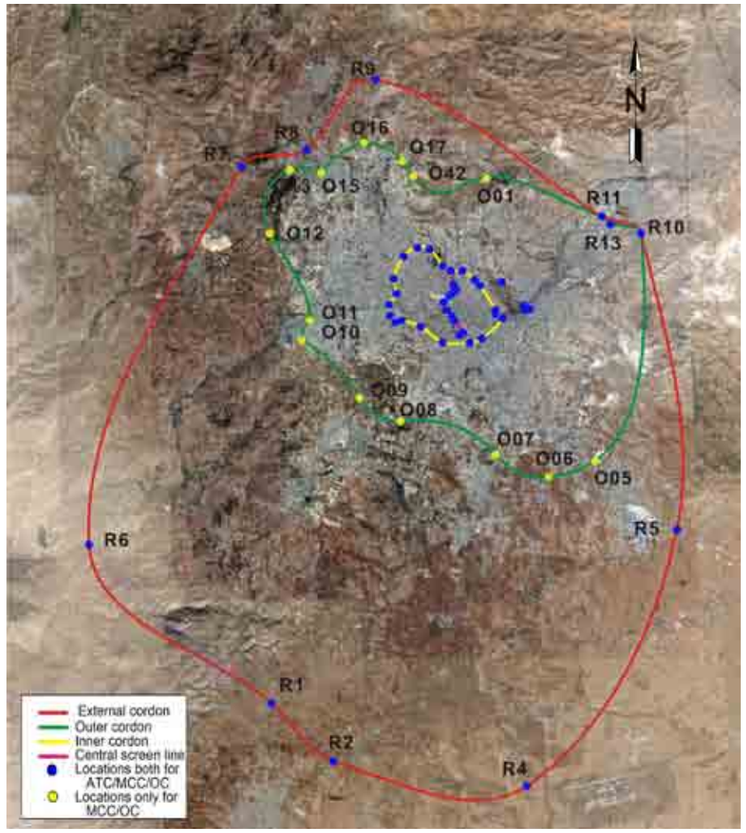


Figure 2 - External Traffic Cordon



A summary of the key survey results is presented below.

Automatic Traffic Counts

According to the ATC surveys the overall peak hour is between 07:30 and 08:30 and it accounts for 6.6% of the total 24 hour flow, and the lunch peak hour factor (PHF) is the same as the late afternoon peak with about 6.2%.

Table 1 - ATC Peak Hour Factors

Direction	24 hour Volume	12 hour Volume (7:00-19:00 hrs)	07:30-08:30	13:30-14:30	15:00-16:00
1	1,173,565	854,784	89,605	70,313	67,727
2	1,105,347	795,467	59,915	71,363	74,393
Total	2,278,912	1,650,250	149,519	141,676	142,120
Factor 24hr to Peak Hour =			6.6%	6.2%	6.2%

Compared with available historical morning peak data for Amman, the present network maintains the same morning peak period as previous studies and the PHF has reduced:

- In the major intersections study in 1983, the network peak hour was between 0730 and 0830 with an overall weighted average peak hour factor of 7.1%.
- In 1989 the “Improvement of Traffic Flow at Selected Road Intersections Study”, the AM peak hour was also between 0730 and 0830 with a peak hour factor of 7.7%.
- In 1999, The “Greater Amman Urban Transport Study” found a similar timing for the AM peak with a corresponding peak hour factor of 7.2%.
- In 2005 Amman Urban Transport Study (AUTS), the PHF was 7.08%

Thus the studies conducted from 1989 to date have shown a consistent decreasing trend in the morning Peak Hour Flow from 7.7% to 6.6%. Generally, this implies that morning peak demand is growing and that the morning peak period is spreading to create a longer peak period.

The current afternoon peak period for the road network is essentially the same as in the 2005 AUTS, with the PHF of 6.24% being lower than the previous figure of 6.87% in 2005. The afternoon peak period also shows a flatter profile, and the lunch PHF in the period from 13.30 to 14.30 is the same as for the period between 15.00 and 16.00, which implies that the peak volumes are relatively stable during the 2.5 hour period between 13.30 and 16.00.

Manual Classified Counts

It is necessary to carry out manual classification count (MCC) surveys to supplement the ATC surveys and to provide vehicle classification as well as information about public transport demand at screen line and cordons. 12-hour MCCs were undertaken at 60 survey stations for one typical day. A summary of MCC results for the screen line and each cordon, and the overall trend analysis are presented overleaf.

Combined Screen and Cordon Line Analysis

- Over the 12-hour survey period (0700-1900), around 1.51 million vehicles were counted throughout Greater Amman area.
- The majority of the vehicles (76.7%) comprise private vehicles and taxis. In 2005, this was 68.4%.
- Public Transport (minibuses and buses) comprise 3.2% of the total compared with 5.6% in 2005, while white car (service taxis) represent 2.6% of the total and just 3.9% in 2005, while pick-ups and vans reduce to 13.0% from 15.8% in 2005

Public Transport Occupancy Counts

During the Manual Classified Counts (MCCs), additional information was observed regarding the occupancy of public transport vehicles. The occupancy ratio was used to estimate the public transport patrons at key locations during the peak hours. This provides valuable information and is used to validate the public transport model.

Combining occupancy rate with traffic volume of different public transport vehicles, the passenger volume and internal composition of all public transport modes can be estimated.

Occupancy rates for public transport vehicles also reflect the vehicle efficiency and the occupancy level inside vehicles during different operation periods, and such information will benefit the improvements for public transport operation and management.

The analysis of a total of 46 places where public transport occupancy counts (PTOC) took place, as well as passenger volume and motorised modal shares are summarised in Table 2 and Table 3.

Table 2 - Minibus Occupancy Distribution for MCC Stations

Minibus Occupancy	Public		Private		Total	
	vehicles	distribution	vehicles	distribution	vehicles	distribution
0-50%	4212	19%	11420	64%	15632	39%
50-75%	5258	24%	3233	18%	8491	21%
75-100%	10850	49%	3082	17%	13932	35%
overloaded	1940	9%	124	1%	2064	5%
Total	22260	100%	17859	100%	40119	100%

Table 3 - Large Bus Occupancy Distribution for all MCC Stations

Large Occupancy	Public		Private		Total	
	vehicles	distribution	vehicles	distribution	vehicles	distribution
0-50%	2863	22%	1265	41%	4128	26%
50-75%	3031	23%	571	18%	3602	22%
75-100%	5078	39%	1218	39%	6296	39%
overloaded	1957	15%	62	2%	2019	13%
Total	12929	100%	3116	100%	16045	100%

Vehicle Classification Trends

A comparison of vehicle classifications with the 1985 Amman Comprehensive Study, the 1989 Intersections Study, Greater Amman Urban Transport Study in 1999 and Amman Urban Transport Study in 2005 has been made. The results are presented in Table 4 .

Table 4 - Vehicle Classification Comparison

Study	Private Vehicles (%)	Taxis/ Servis (%)	Buses and Minibuses (%)	Pickups/ Vans (%)	Trucks (%)	Total (%)
1985	53	25	5	10	7	100.0
1988	53	28	5	10	3	100.0
1999	47	22	5	18	8	100.0
2005	52.6	19.2	5.5	15.8	6.9	100.0
2008	63.9	14.8	3.2	13.0	5.1	100.0

As can be seen the percentage of private vehicles has dropped between 1988 and 1999 by 6% and a subsequent increase in pick-ups and vans has occurred. This trend was reflected in the national vehicle registrations between 1989 and 1997. Whilst private passenger vehicles have increased by an average of 2.4% per annum, which is below the average all-vehicle growth rate of 3%, pickups have increased by over 13% per annum.

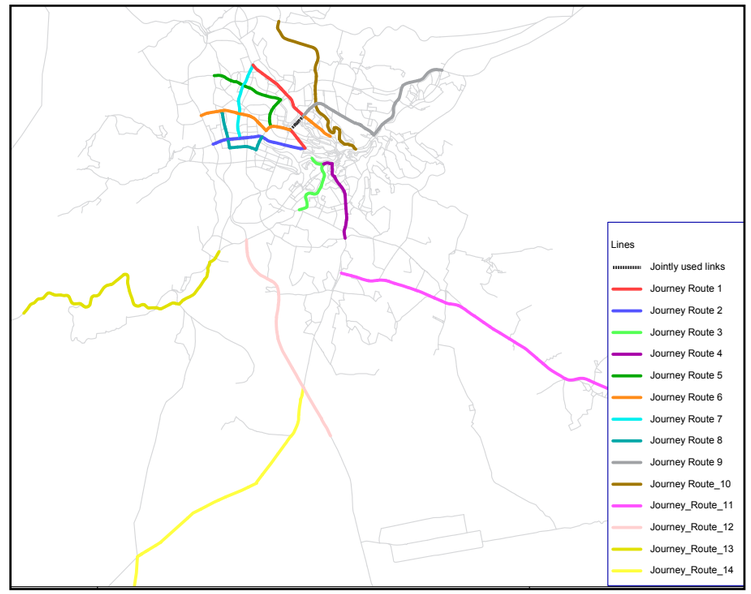
In 2005, the percentage of private vehicles has increased to the same percentage recorded for 1985 and 1988 studies.

In 2008, the most outstanding feature is that the private vehicle share has increased to 63.9%, and all other vehicle shares excluding taxi/service car show a decreasing trend, especially the bus/minibus vehicles share which reduces by 2.3% during a short period. This implies that the rapid motorization has been occurring in Amman over the last 10 years with annual growth rates exceeding 10%pa.

Journey Time Surveys

Journey time surveys were updated along 5 routes that were surveyed between 2006 and 2008 to understand if there is any discernible change to journey times over time and to provide a full complement of journey time surveys for all 14 routes for 2007/2008. The journey times for 4 routes outside Amman urban area are not expected to change significantly, because these routes are inter-urban and currently relatively free-flowing. Average AM peak hour speeds were around 30 kph whilst PM peak hour speeds were 32 kph.

Figure 3 - Journey Time Survey Routes



Household Surveys

A household survey (HHS) was conducted across Greater Amman. This was the first HHS conducted since the mid 1980s. The sample of the person trip survey was conducted on the basis of the household data obtained from the Census survey in 2004. An overall sample of 9,256 households was achieved or 2.1% of households. Of the households surveyed, a total of 21,212 person trip surveys were completed. The sector and zoning system used is presented in the following two figures.

Figure 4 - Sector Zoning System

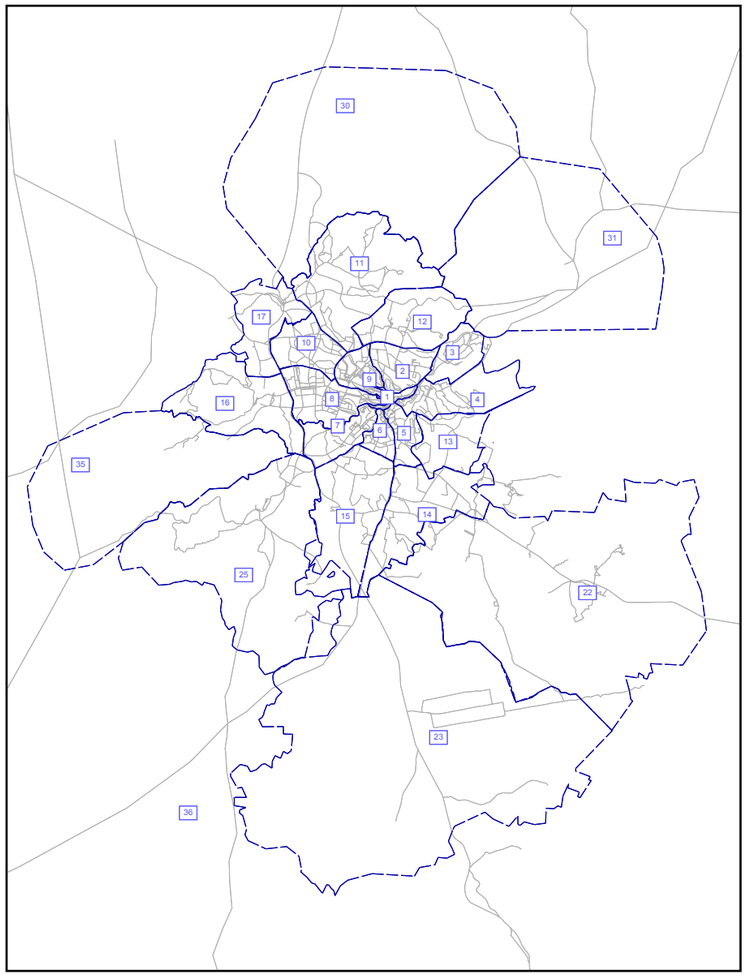
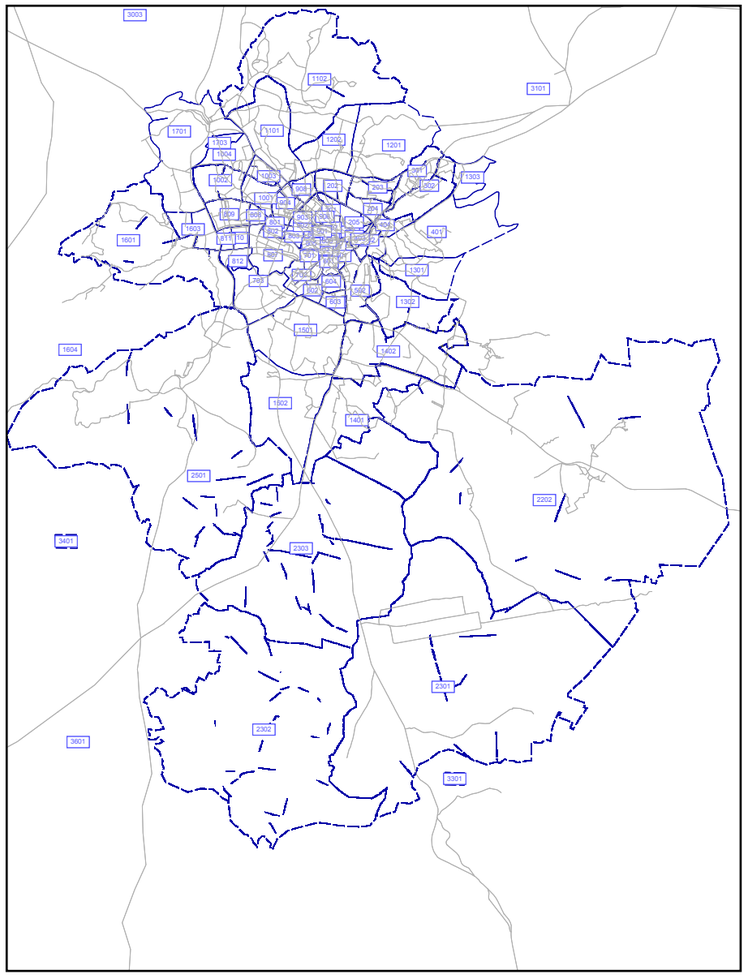


Figure 5 - Zone System

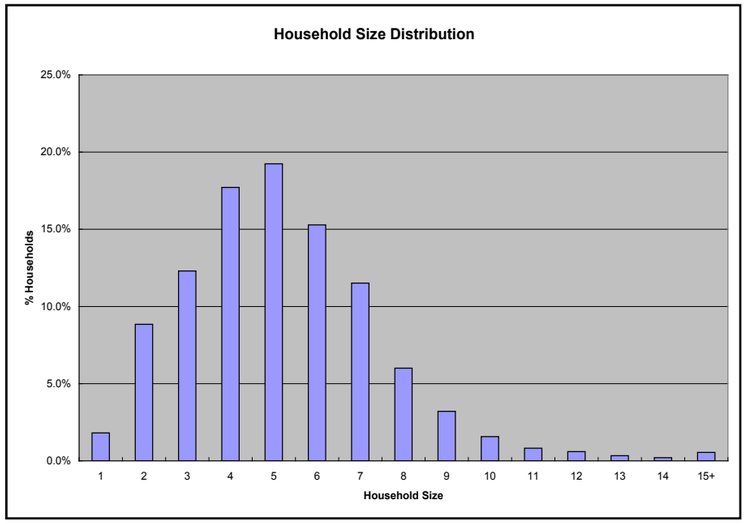


A summary of the key findings is presented.

Household Size

Figure 6 presents the distribution of household size. The average household size was 5.2, with 52% of households containing between 4-6 people.

Figure 6 - Household Size Distribution

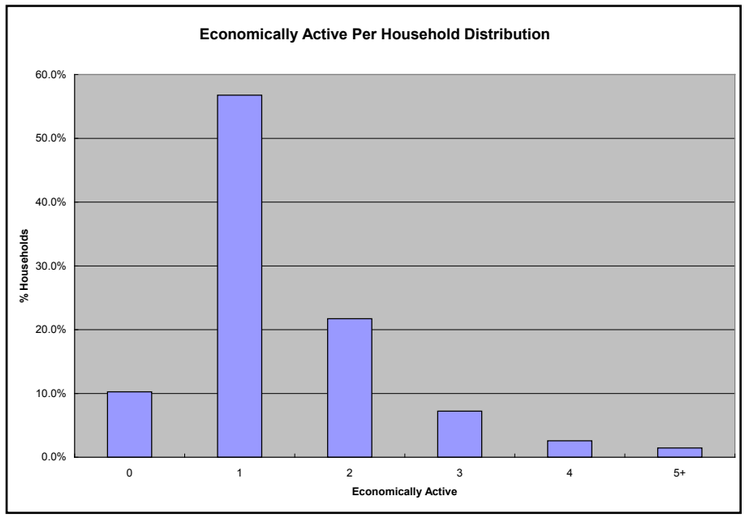


Economically Active

Figure 7 presents the distribution of economically active people per household. The expanded survey data shows that:

- The average household has 1.4 economically active people
- Nearly 10% of households have no economically active persons
- Nearly 33% of households have multiple economically active persons

Figure 7 - Economically Active Per Household Distribution

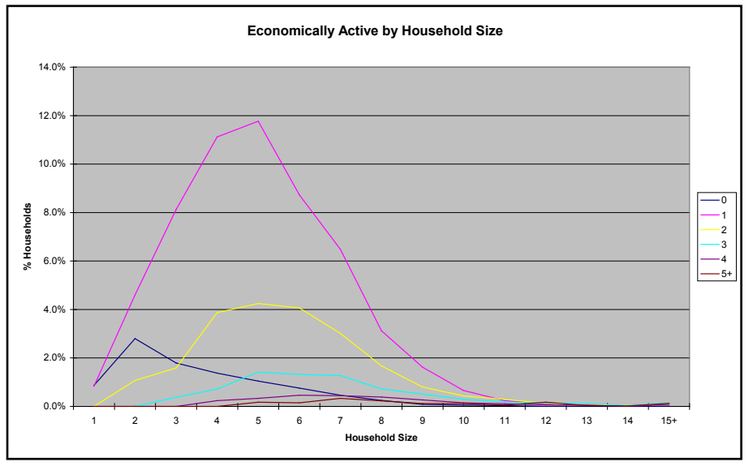


Family Structure

Figure 8 presents the distribution of household size for each level of economically active people per household. Based on this, six family structures are defined, which is consistent with the 1988 Amman Transport Study.

- Family structure 1: no economically active persons
- Family structure 2: 1 economically active person and household size is below 5
- Family structure 3: 1 economically active person and household size is 5 to 8
- Family structure 4: 1 economically active person and household size is over 8
- Family structure 5: 2 economically active persons
- Family structure 6: more than 2 economically active persons

Figure 8 - Economically Active by Household Size

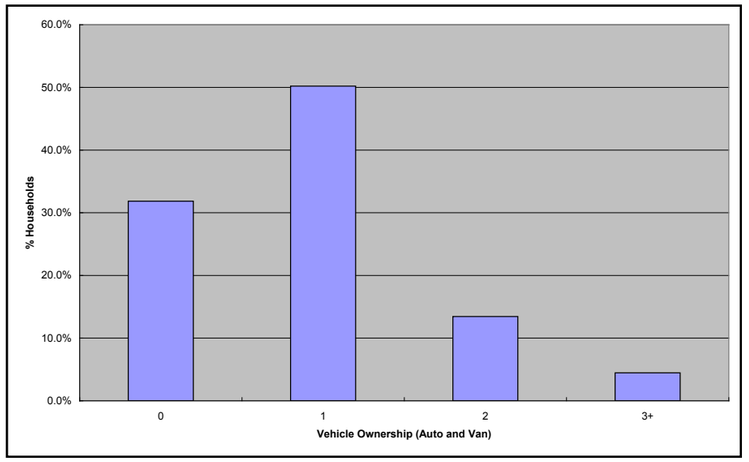


Vehicle Availability

Figure 9 presents the distribution of vehicle availability per household. The expanded survey data shows that:

- Vehicle availability is moderate
- 32% of households are without access to a private vehicle
- 50% of households have access to one private vehicle
- 18% of households have multiple ownership of private vehicles
- The average vehicle availability per household is 0.93, or 178 per 1000 people.

Figure 9 - Vehicle Availability per Household

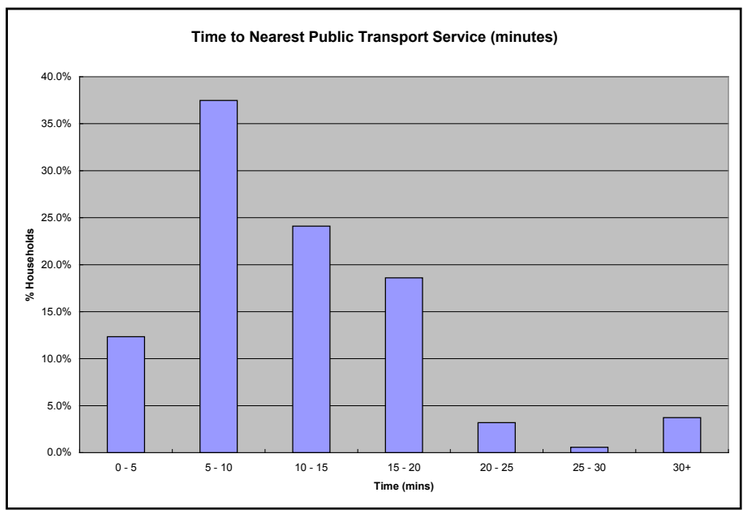


Public Transport Access

Figure 10 presents the distribution of walk time access to the nearest public transport. The expanded survey data shows that:

- Access to public transport is good, with an average walk time of 9 minutes
- The 85% percentile is 15 minutes

Figure 10 - Time to Nearest Public Transport Service (minutes)

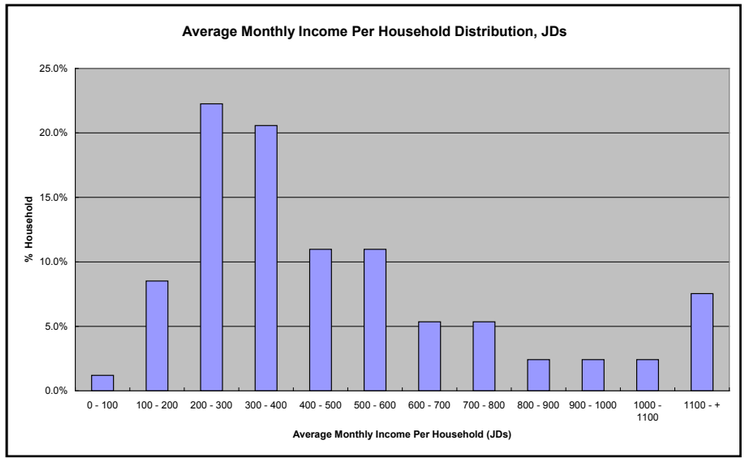


Household Income

Figure 11 presents the distribution of average monthly income per household. The expanded survey data shows that:

- The majority of households have a monthly income of 200-400 JDs
- The average monthly household income is 528 JDs
- The 85th percentile is 700 JDs

Figure 11 - Average Monthly Income per Household Distribution, JDs

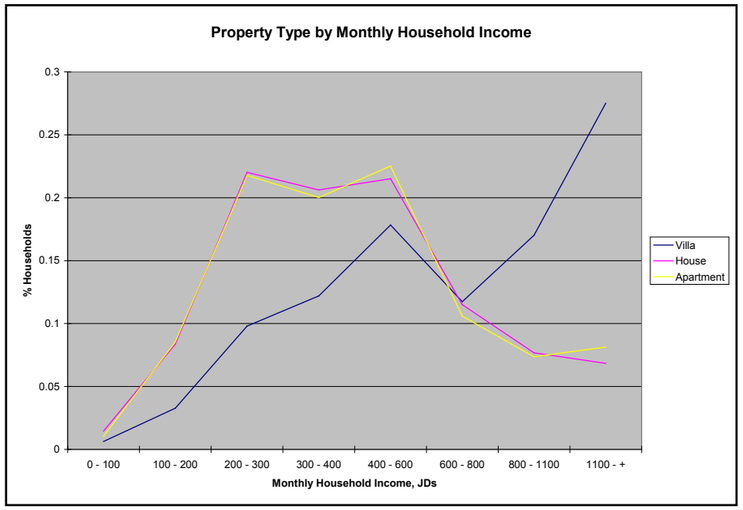


Household Income by Property Type

Figure 12 presents the distribution of average monthly income per household by different property type. The expanded survey data shows that:

- The income distribution is similar for houses and apartments.
- Villas are generally more affluent.

Figure 12 - Household Income by Property Type

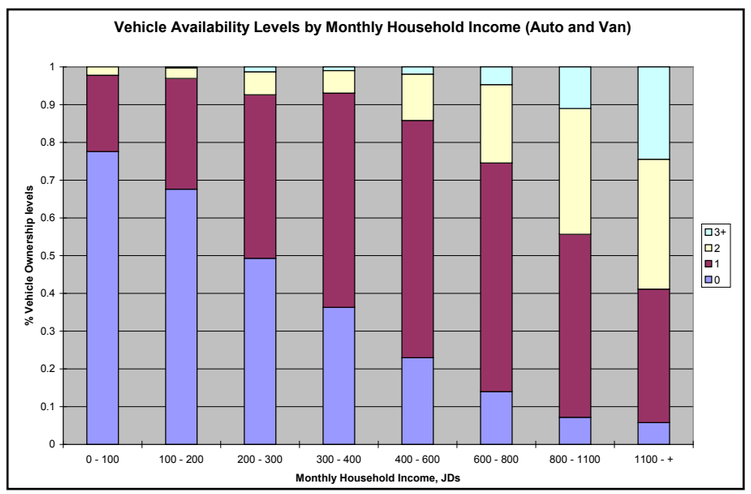


Household Income and Vehicle Availability

The main driver of vehicle ownership or availability is household income. Throughout the world there is a definite trend between income and vehicle ownership. As society becomes wealthier, citizens aspire to greater personal freedom or perceived status. Figure 13 presents the relationship between household income and different levels of vehicle availability.

The survey data is used to calibrate a vehicle availability model, which is used to forecast the occurrence of vehicle available households as real GDP increases.

Figure 13 - Vehicle Availability Levels by Monthly Household Income (Auto and Van)

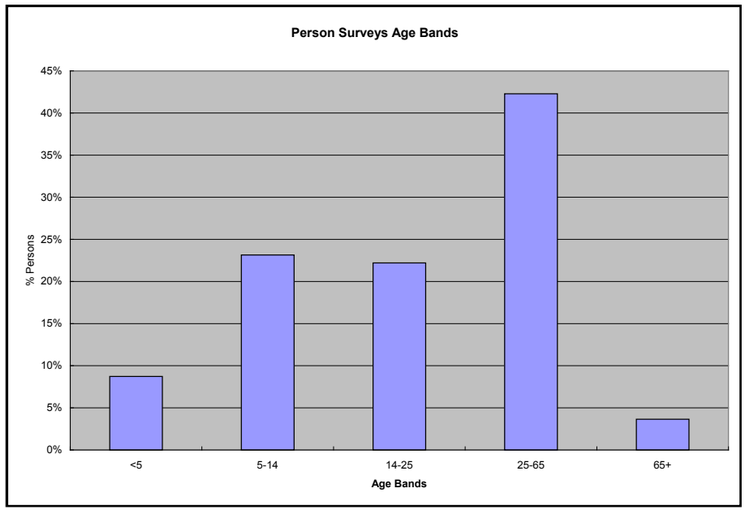


Age and Gender

Figure 14 shows the Person Surveys Age Bands.

- Nearly 64% of people are of an economically active age.
- 23% of people are of school age.
- 4% of people are of retirement age.

Figure 14 - Person Surveys Age Bands

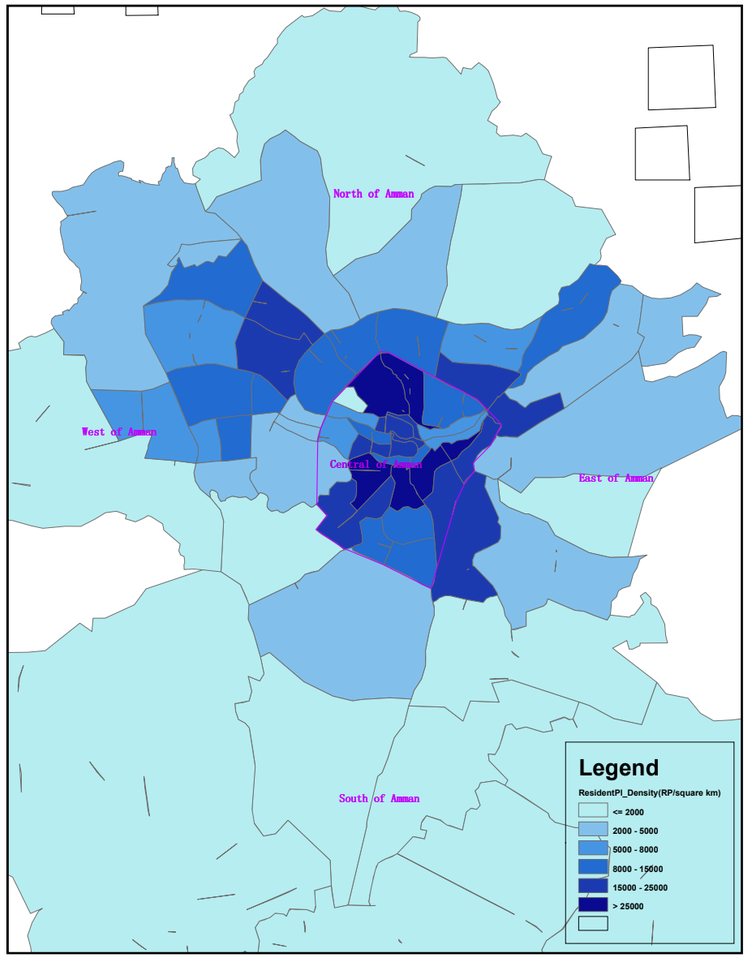


Residential Density

It can be seen that there is very high residential density towards the south east of Amman, whereas the workplace locations are to the west of Amman resulting in relatively long cross city trips.

Figure 15 presents the density of residents at the sub-sector level.

Figure 15 - Residential Density



Workplace Density

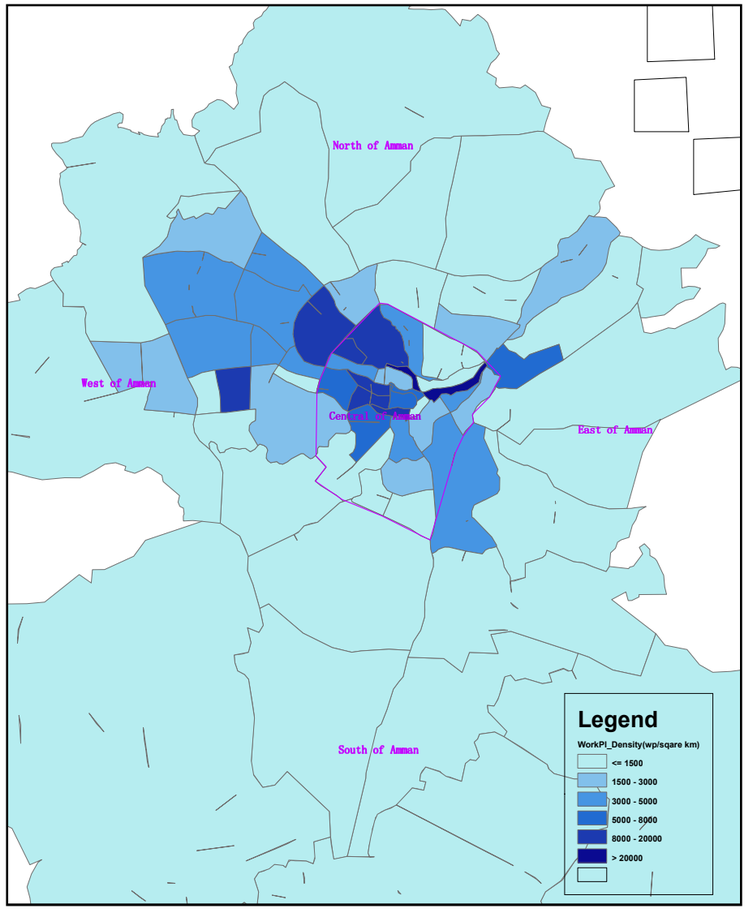
Figure 16 presents the work place density.

- Nearly 39% of work places are located in sectors to the west of Amman
- 94% of work places are located internally with Amman, only 6% of work places are located externally

The data shows that:

- 27% of people are employed (employee, employer or self employed)
- 3% of people are unemployed
- 40% are in education (33% are pupils, 7% are students)
- 4% are retired

Figure 16 - Workplace Density

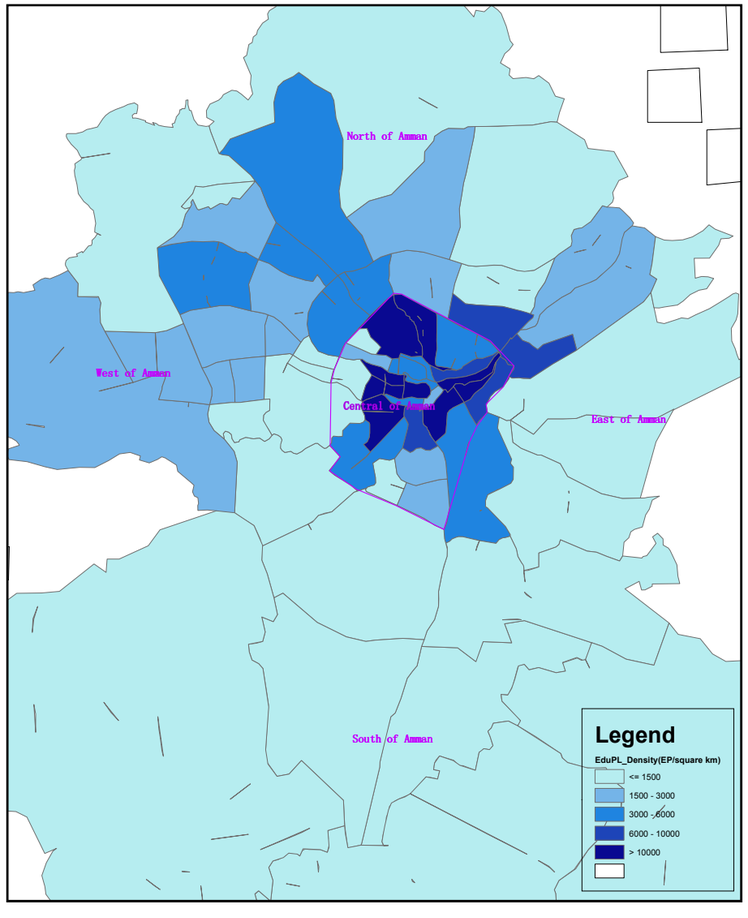


Location of Educational Density

Figure 17 presents the location and educational density.

- 95% of education places are located internally with Amman, only 5% of education places are located externally
- A large number of higher educational places are towards the north west of Amman.

Figure 17 - Location and Educational Density



Number of Person Trips

The household surveys show an average of 1.73 trips per weekday per person. Figure 18 presents the distribution of daily trip making. 73% of residents make 2 trips per day. The surveys highlighted that a significant proportion (21%) do not make any trips. Based on work status, 8 types of journey have been defined.

Figure 18 - Trip Purpose Distribution, Daily

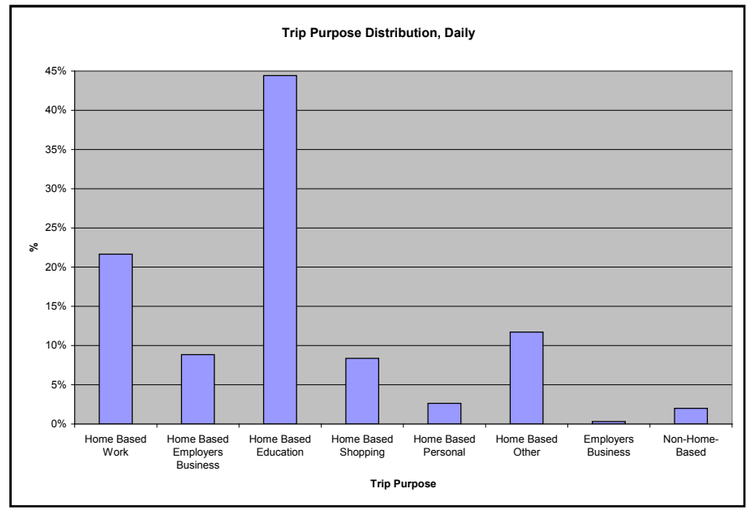


Figure 19 shows the timing of trips throughout the day. There is a distinct peak in the morning between 0700 and 0800, with 22% of trips. The graph shows the start time of trips, however, a significant number of these trips will be completed in the next hour, which will dampen the peak observed. The early afternoon peak is not as significant as the morning peak. The operational focus of this study will be the AM peak due to the heavy demand during this period.

Figure 19 - Distribution by Trips by Departure Time of Day

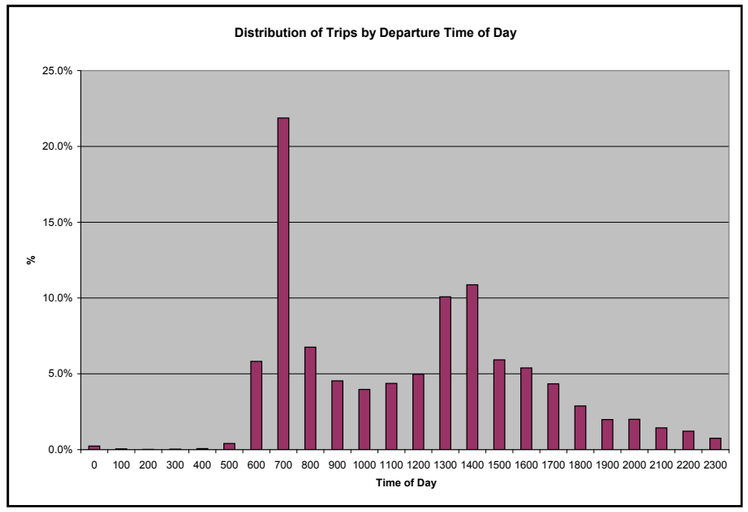
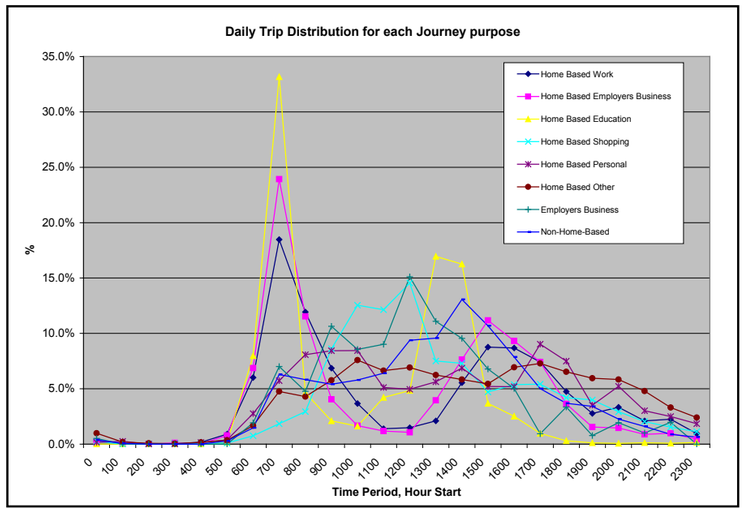


Figure 20 compares the relative contribution of each journey purpose to trip making throughout the day.

Figure 20 - Daily Trip Distribution for each Journey Purpose



The desire line diagrams on Figure 21 and Figure 22 indicate the magnitude of sector to sector demand with the heavy demands shown by the thicker lines.

Figure 21 - Main Daily Trip Movements (Sector to Sector)

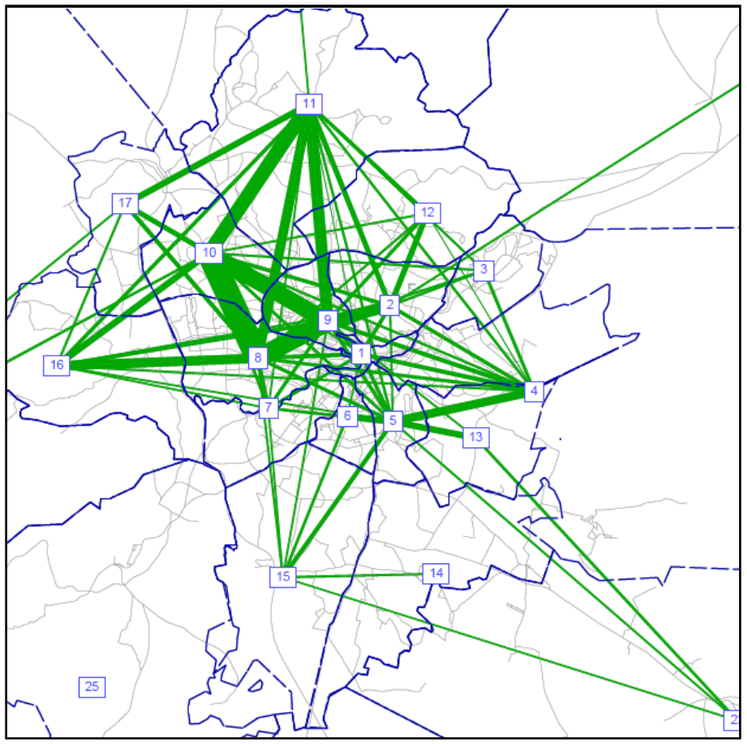
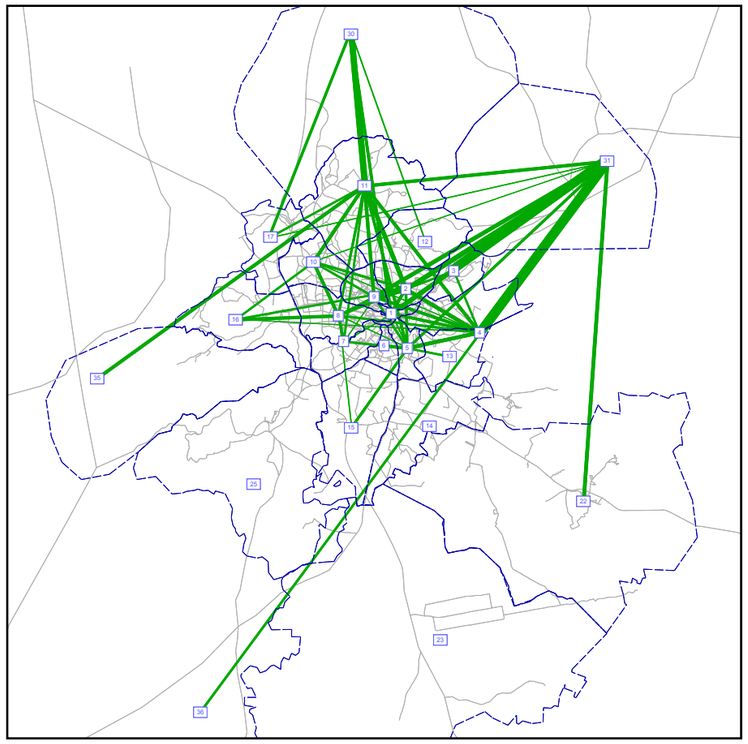


Figure 22 - Main Daily Public Transport Trip Movements (Sector to Sector)



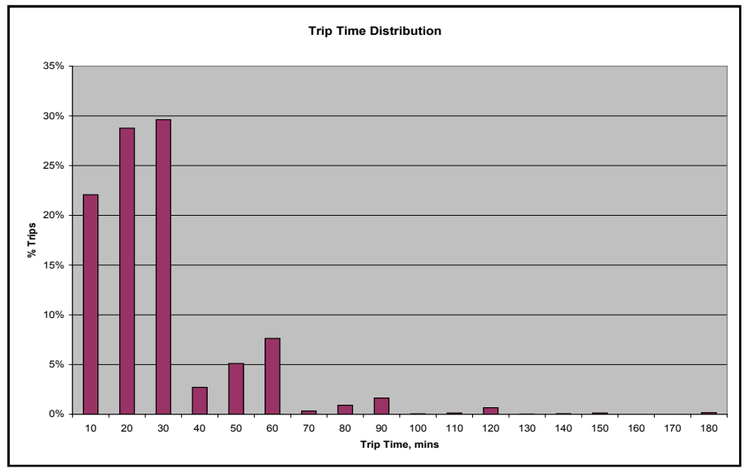
Trip Length Distribution (TLD)

The distribution of the duration of trips is an important factor to understand, and is crucial to the development of synthetic transport models. This can vary by trip purpose and by mode, and can be measured in terms of the length of a trip, usually distance, or the time taken to complete a trip.

Figure 23 shows the overall TLD for all trips, in terms of the duration of the trip.

- 80% of trips are under 30 minutes in duration
- 96% of trips are under 60 minutes in duration
- 22% of trips are less than 10 minutes in duration, which indicates that slow modes, especially walking, are competitive.
- 1% of trips take longer than 90 minutes

Figure 23 - Trip Time Distribution



Mode Split

The main modes are private car (33%), walking (26%), public transport (13 - 14%) and yellow taxi (9%), which is collectively over 80% of all trips.

Public transport comprises public buses, minibuses and white taxis.

External Trips

The Road Side Interview (RSI) sample rate was inbound only. Therefore, the 24 hour inbound only Origin-Destination (OD) matrices are transposed to obtain the outbound trips. The total 24 hour OD matrices are formed by combining inbound and outbound movements.

Figure 24, Figure 25 and Figure 26 present the 24 hour desire lines for external trip movements for private, goods and public transport vehicles.

External Demand

The estimation of intra-urban person trips provides part of the demand on the city streets for private cars, taxis and public transport. In addition, an estimation of the external trips which enter the city is required to complete the transport demand. This demand is derived from a cordon road-side interview survey at the edge of the urban area. The survey showed that around 112,000 vehicles enter Amman over a the 12 hour period with 79% being private vehicles, 6% public transport and 15% goods vehicles.

Figure 24 - External Private Vehicle Desire Lines, 24 hour

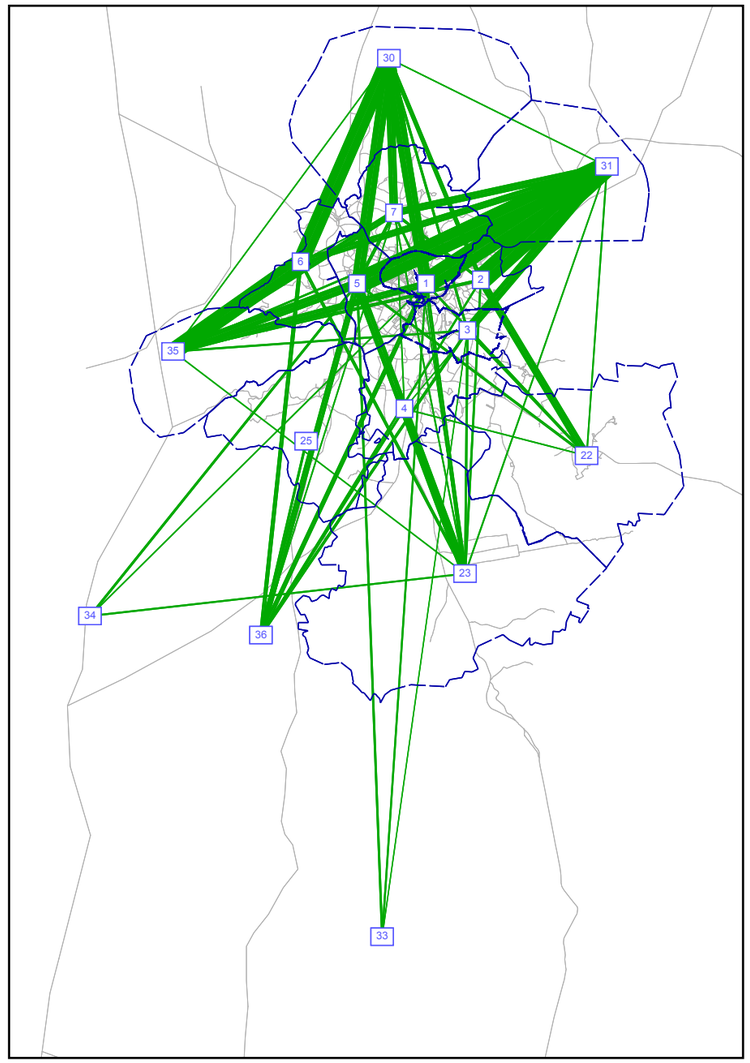


Figure 25 - Goods Vehicle Desire Lines, 24 hour

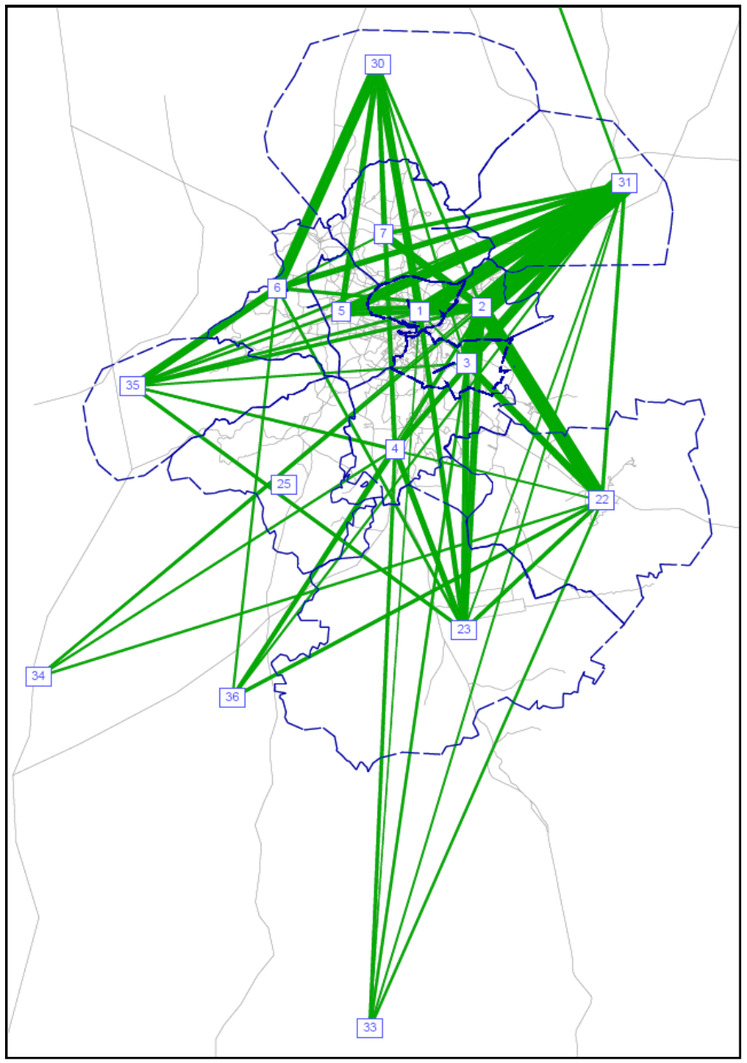
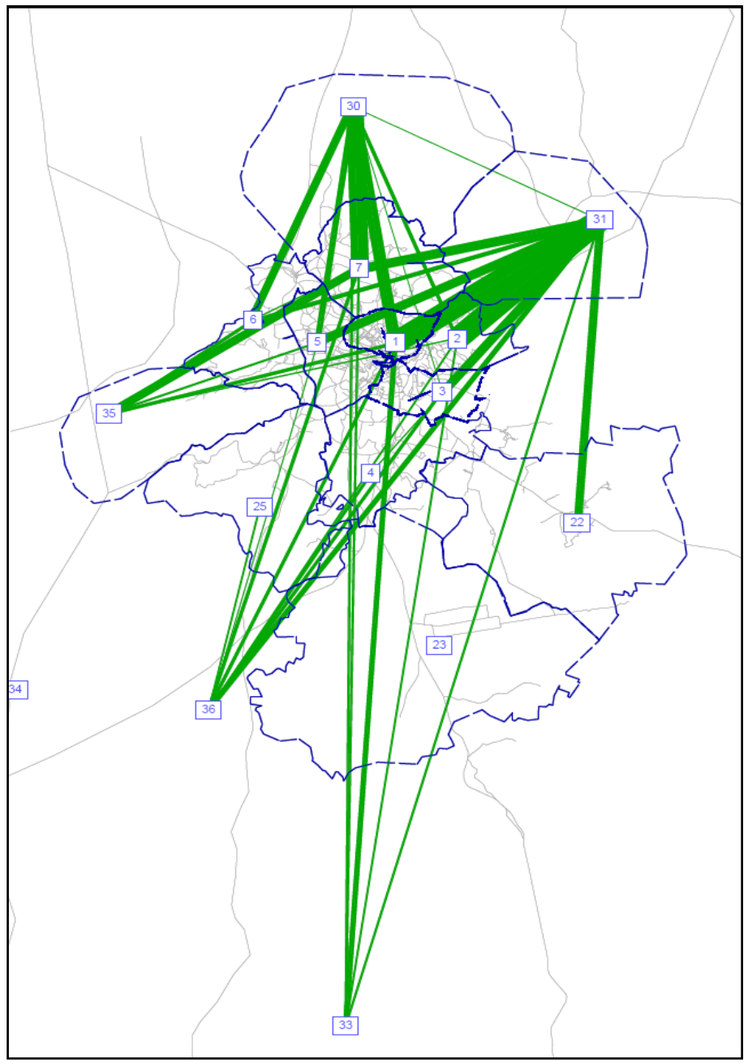
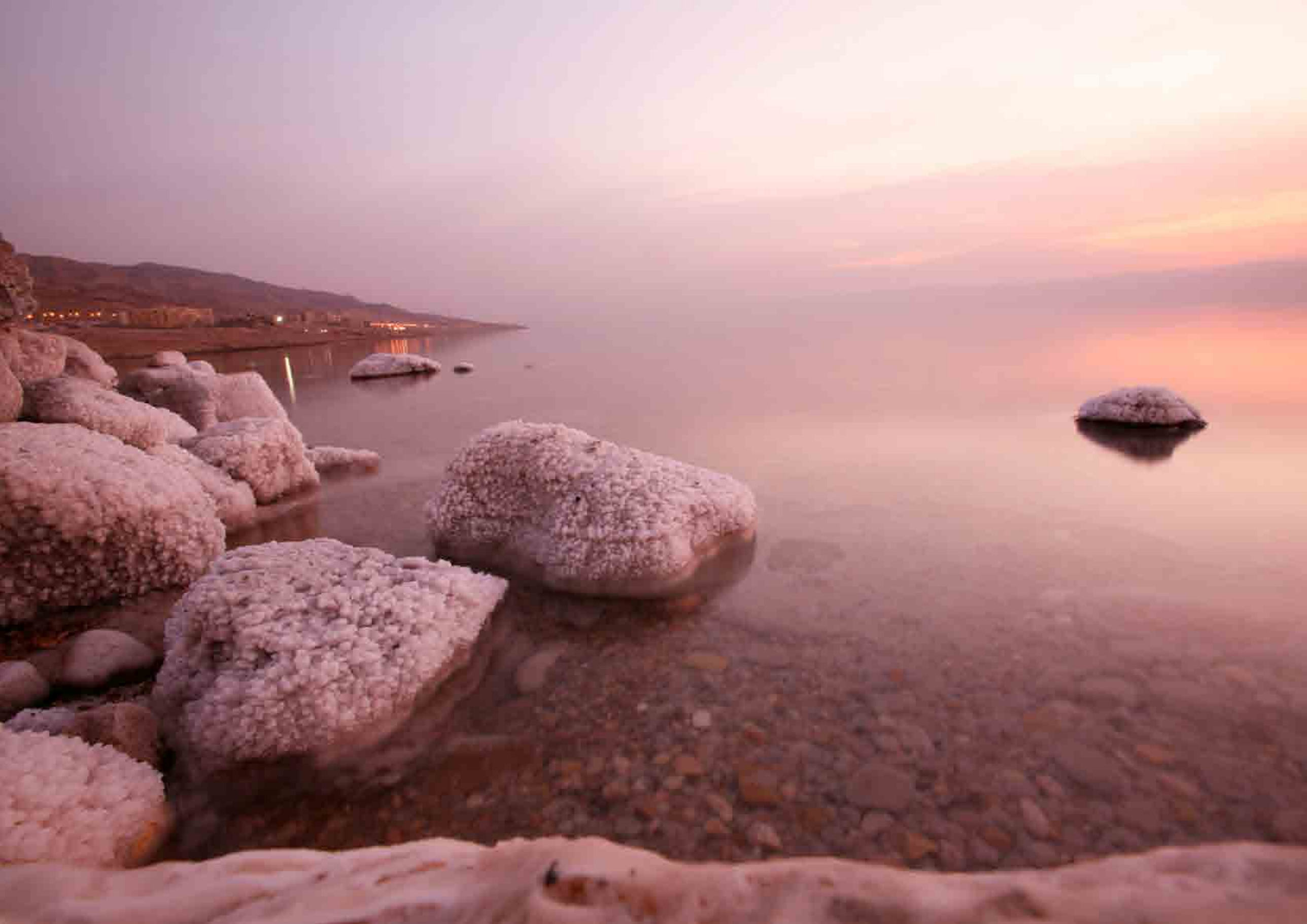


Figure 26 - External Public Transport Desire Lines, 24 hour



Methodology 4



Methodology

In the Transport and Mobility Master Plan for Amman, these term definitions are used:

- **Vision:** A short statement expressing the essence of what a successful transportation system in Amman will look like.
- **Objectives:** A summary of where Amman wants to be, what it will look like and by when it is intended to achieve it.
- **Policies or Core Principles:** What needs to be done in order to achieve the vision and objectives.
- **Strategies:** How it is intended to apply the policies/core principles in terms of plans and timescales.
- **Programmes:** The detail of how it is intended to deliver the strategies.
- **Target Definitions/Performance Indicators:** How progress should be measured, demonstrating the effectiveness of the chosen strategies/ programmes by end results (target definitions) or ongoing progress measurement (performance indicators).

The methodology process commenced by deriving a transport vision statement for Amman, together with a number of key transport objectives. These objectives were assembled by combining the original study objectives, the 'strengths, weaknesses, opportunities and threats' analysis and benchmarking of other cities, and were then agreed with GAM. The resultant transport strategy was also specifically designed to incorporate the Amman transport objectives as set out in the Metropolitan Growth Strategy of the Amman Plan.

Core Principles and Policies were also established in order to achieve the vision and objectives. At the initial stage, a total of eight target definitions were agreed, which are intended to enable the outputs and outcomes from whatever programmes are implemented to be measured and used as a guide for the levels of success achieved in meeting the chosen objectives.

The next stage in the process was to develop a series of integrated strategies, comprising specific measures intended to meet the target definitions set, and thus successfully deliver the objectives.

In order to determine the optimal combination of measures across the multiple strategies, a number of scenarios were constructed, varying from minimal improvements to the transport system to major investment programmes and the application of demand management measures. The scenarios were populated from a long list of potential transport interventions. These were then tested, using the modelling process described in detail later in this Summary. As well as assessing the results against the target definitions, all elements of the scenarios were subjected to a Multi Criteria Appraisal Framework, which enabled all measures, whether capable of being modelled or not, to be assessed for efficiency and effectiveness against a multitude of factors. The scenarios were adjusted and retested until the most effective one was identified as the recommended scenario.

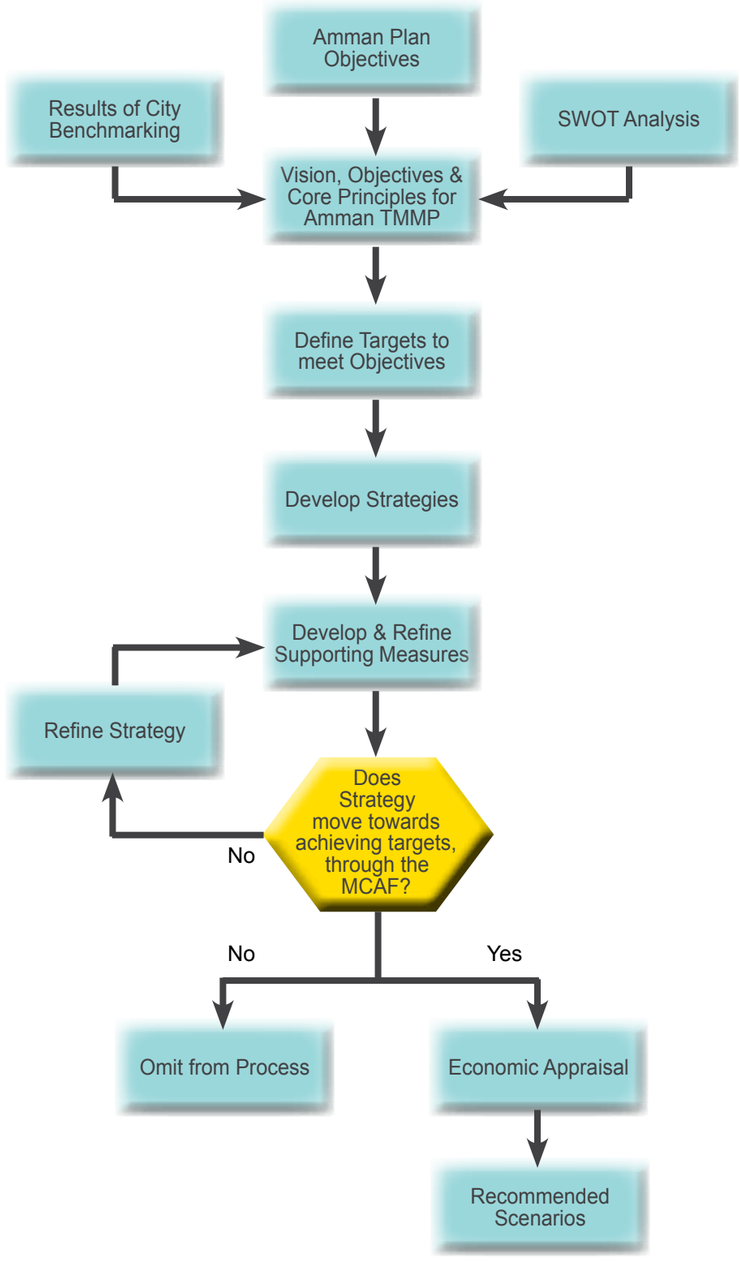
If there is a shortfall between the desired target level and the mode share target that the strategy is achieving, then more of the measures listed can be introduced. This process can be utilised to further refine the strategies, or as a means of adjusting either programmes or the target definitions themselves if their implementation is not achieving the desired results.

The MCAF brings together the weights and scores of each objective and each measure, as well as the performance of each scenario against target definitions. Those scenarios having high weighted average scores and those meeting most of the target definitions are then taken forward to the economic appraisal.

The combined MCAF score and the economic viability of the scenario determines the most appropriate scenario to be recommended.

The chosen process is illustrated on Figure 27.

Figure 27 - Process Methodology



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Vision 5

Vision

The transport vision for Amman is to achieve by 2025 an integrated, accessible, affordable, safe, sustainable and environmentally-friendly transportation system which facilitates the planned development of the City and contributes positively to the health and economic welfare of its citizens and businesses.

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Key Transport Objectives 6

Key Transport Objectives

The current pattern of the development of the transportation system in Amman has been the result of very rapid growth in the population and people's dependence on private cars for travel within the City. In responding to this, the Greater Amman Municipality (GAM) has previously allocated a disproportionate investment of capital into building roads designed almost exclusively to maximise the carrying capacity for automobile traffic. The relative decline in the attractiveness of public transport as a travel option, and increasing road congestion, coupled with a variety of social, economic, environmental, land use, and financial concerns, has generated the need to evaluate carefully rebalancing the transportation infrastructure investment priorities.

Consequently, greater public sector investment must be made in higher quality, higher-capacity, and more effective public transport systems and other more environmentally-friendly forms of transportation, notably walking.

Amman's transportation system will need to be an integrated and multi modal one that moves people and goods from origin to destination by the most efficient, equitable, economic, safe, and environmentally responsible mode. It will improve the quality of life, respect the natural environment, enhance the economy, and be managed in a responsible and responsive manner.

The following are the specific key objectives of the TMMP, to be achieved by 2025:

- To improve the general mobility of persons and freight;
- To improve safety for all transport users and to enhance the pedestrian realm;
- To reduce reliance on the car and encourage alternative modes of transport;
- To enhance accessibility for citizens to goods and services, in particular through the provision of a comprehensive and affordable public transport system;
- To minimise the impact of congestion on the road network for citizens, visitors and businesses;
- To control energy consumption and reduce the pollutant emissions and greenhouse gases directly related to transport in order to reduce the impact of energy supply on the country's economy and the impacts on the environment;
- To ensure that transport plays a positive role in achieving continuous and sustainable economic growth in Greater Amman; and
- To improve the quality of life within Greater Amman.

The TMMP is also intended to support the Amman Plan in meeting the following objectives:

- To integrate land-use and transportation to ensure the timely implementation of public transport and transportation infrastructure, which supports the objectives of the MPG land-use plan;
- To create a comprehensive multi modal transportation planning system;
- To identify and implement a metropolitan transportation hierarchy;
- To identify and develop inter-modal transportation interchanges;
- To improve the quality of public transport services;
- To produce a significant change in the individual decisions of citizens concerning choice of travel mode in favour of more walking and more public transport use;
- To assess and employ new methods for addressing road junction capacity;
- To create and implement a consistent priority structure for guiding investment decisions in the transportation system;
- To build institutional capacity to plan a sustainable transportation system.

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Core Principles & Policies 7

Core Principles & Policies

The following core transport principles/policies underpin the integrated transport strategy development for the Amman TMMP. These core principles will allow a complete transport system to be developed, which has the capacity to meet both current needs and also accommodate and safeguard the planned needs of future demand and growth as envisaged in the Amman Plan. Although presented under a series of sub-headings, these core principles should be read in unison and form part of the overall transport strategy solution proposed for Greater Amman.

Overarching Core Transport Principles and Policies

The overarching core transport principles and policies are as follows:

- That the transport system for Amman should be planned and implemented in full cohesion with the approved land-use strategies set out in the Amman Plan;
- That the transport system for Amman should be designed as an integrated system, with all transport modes operating in harmony;
- That a set of integrated transport policies should be developed and a multi-functional transport organisation with the powers and responsibilities to implement them be established;
- That a public transport system which is accessible and affordable to all citizens of Amman be developed;
- That the image and perception of public transport to all Amman citizens and visitors, regardless of their socio-economic conditions, be improved;
- That a major reduction in the growth of road traffic within the Greater Amman boundaries and a significant modal shift towards public transport and the soft modes be achieved;
- That the mobility of persons and freight and citizens' accessibility to services and goods be improved;
- That the resultant integrated transport system for Amman should provide a range of mode choices for all trips, whilst promoting public transport and walking as the preferred mode choices;
- That the integrated transport system for Amman should also provide for safety of travel by all users in an environmentally sustainable manner and to meet the needs of the full range of transport users, including residents, commuters and tourists;
- That road network capacity provision and growth should only be provided for identified transport bottlenecks, where alternative public transport capacity cannot be readily provided as a feasible alternative, and should be constrained to a level that is commensurate with the proposed land-use and urban form objectives of the Amman Plan;
- That demand management measures will be extended and enhanced to help in restraining traffic growth;
- That opportunities will be sought to maximise private and public sector investment to ensure that public transport services and facilities are as commercially sustainable as possible over the long term period; and
- That major new developments will be strategically located in accordance with the principles of the Amman Plan and at locations which allow full integration with the core public transport services, in particular the planned LRT and BRT networks.

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Target Definitions 8

Target Definitions

Context

In order to assist in measuring success in delivering the overall transport strategy, target definitions have been set across the different transport objective areas. Full achievement of these targets also needs to be set within the context of the overall population growth predicted within Amman. This is critical, as for example, in considering an increase in the percentage of trips undertaken using public transport, the numbers needed to attain a target are substantially higher in a growing population situation than would otherwise be the case.

The Amman Plan suggests that infrastructure should be designed to support an increase in population from 2.2 million to 6.4 million in 2025. However a more conservative projection was used in order to allow for proper evaluation of various strategies/project and following discussions with GAM, an agreed 2025 population forecast of 4.7 million was adopted.

Measuring Progress

Targets need to be measurable, so a smaller number of targets with a specific focus and a clear methodology for monitoring is far better than a plethora of targets for which the data is difficult to collect and/or a likelihood of poor consistency between different sets of data.

Indicators against which progress can be monitored include:

- PT % mode share
- Journey time
- Vehicle speed
- Accident rates
- Vehicle km reduction
- Volume of emissions

Table 5 - Target 1: Vehicle Kilometres by road vehicles

Target Definition 1	Number of private vehicle kilometres travelled by road to be confined to achieved levels: Amman is to ensure that traffic volumes on the roads are decreased, or at least stabilized.
Rationale	New target relating to the implementation of the strategy to ensure that the increased take up of public transport does correspond to a reduction in car trips.
Applies	Amman wide.
Measure	The number of vehicle kilometres travelled by cars and HGVs for all journeys made during peak hour.
Data Source	Results of traffic modelling.
Benchmark	London has 1,700,000 annual private passenger vehicle kms per km of road, Hong Kong 2,940,000, Singapore 3,980,000 and Dubai 1,640,000.
Current Position	The traffic model indicates that the current daily vehicle kms across the GAM area is 15,150,000 by cars and 2,060,000 by HGVs.
DM1 2020	41,970,000

Table 6 - Target 2: Public Transport Mode Share

Target Definition 2	Public Transport Mode Share: Amman is looking to increase the proportion of personal travel made by public transport from 14% to 40%.
Rationale	Target level of use of public transport anticipated as being required for Amman to achieve its policy objectives.
Applies	Amman wide.
Measure	The proportion of personal travel made on public transport modes, defined as white taxi, large bus, minibus.
Data Source	Household survey and data (2008).
Benchmark	London has 42% public transport mode share, compared to 54% for New York, and 63% each for Singapore and Hong Kong, Middle East cities 17%.
Current Position	Available data indicates that total public transport modal share is currently 14%.
DM1 2025	19%

Table 7 - Target 3: Journey Time by Public Transport

Target Definition 3	Average Journey Time by Public Transport: Amman is to reduce the average journey time by public transport in peak hour from 45 minutes to 30 minutes.
Rationale	New target relating to the implementation of many parts of the Transport Strategy.
Applies	Amman wide.
Measure	The average journey time for all journeys made by white taxi, large bus, minibus for all journey purposes made during peak hour.
Data Source	Journey time surveys and Global Positioning satellite systems installed on public transport vehicles.
Benchmark	Average AM peak hour journey times in global cities range from 30 to 45 minutes. The transport strategy for Amman aims to reduce this to 30 minutes.
Current Position	The traffic model indicates that the current average journey time by all public transport modes is 45 minutes.
DM1 2025	60 min

Table 8 - Target 4: Reduction in Emissions

Target Definition 4	Reduce levels of pollutant and greenhouse gas emissions: Amman is to reduce the average greenhouse gas emissions from road based traffic by 12 %.
Rationale	Through achieving the target relating to containing traffic growth, the Amman transport strategy measures will also achieve a reduction in CO2 levels.
Applies	Amman wide.
Measure	The ppm of CO2.
Data Source	Results of traffic modelling.
Benchmark	Middle East cities range from 300 to 1,000 kg per captia of CO2.
Current Position	Across the GAM area, emission levels of CO2 is currently around 500 kg per capita.
DM1 2025	700 kg per capita

Table 9 - Target 5: Accessibility to Public Transport Network

Target Definition 5	Increasing the number of households within 400 metres of a public transport service with a peak frequency of at least one service every 10 minutes from 55% to 60%: Amman is to increase the proportion of households within 400m of the public transport network.
Rationale	The objectives within the Amman Plan for improving the environmental quality within the city. The target share of public transport will be reached by increasing the proportion of households within range of the network.
Applies	Amman wide.
Measure	The percentages of all residential homes within the range of bus or rail stops, stations, interchanges as measures using GIS tools.
Data Source	Results of GIS mapping and modelling.
Benchmark	-
Current Position	The traffic model indicates that the current theoretical proportion of residents within 400m of the public transport network as measured by the traffic model is 55%.
DM1 2025	58%

Table 10 - Target 6: Accessibility to Jobs

Target Definition 6	Achieving 40% of jobs within 2km of the city's major transport nodes. Amman is to increase the proportion of jobs within 2km of the city's major public transport nodes.
Rationale	Through increasing the number of employers who are within easy reach of the public transport system, this will both improve accessibility to jobs, and increase the modal share of public transport, both targets within the Amman Plan.
Applies	Amman wide.
Measure	The number of employer's offices within 2km range of key rail stations and key bus interchanges (to be defined) as measured by GIS.
Data Source	Results of GIS modelling.
Benchmark	-
Current Position	The traffic model indicates that the current proportion of jobs within 2km of the city's major theoretical transport nodes is 43%.
DM1 2025	35%

Table 11 - Target 7: Reduction in Pedestrian Accidents

Target Definition 7	Reduction in the number of pedestrian personal injury accidents.
Rationale	The Jordanian economy is growing rapidly. Unconstrained growth in private car travel will lead to congestion, greater road safety problems and a deteriorating environment. Promoting the role of pedestrians will help improve their safety and comfort of movement and reduce the number of accidents.
Applies	City-wide.
Measure	The number of pedestrian personal injury accidents.
Data Source	Locally available government data (police records).
Benchmark	2007 figure of 471 severe and fatal pedestrian injuries in Amman Police Directorate.
Current Position	In 2007 a total of 2166 of pedestrian injury accidents (all severities) occurred in the Amman Police Directorate.
-	-

Table 12 - Target 8: Mode Share for Walking

Target Definition 8	To maintain the mode share of walking for short-distance trips.
Rationale	Promoting the role of pedestrians will help improve their safety and comfort of movement and reduce the number of accidents.
Applies	City-wide.
Measure	Mode share of walking from household surveys.
Data Source	Household Survey
Benchmark	-
Current Position	It is estimated that 26% of trips are undertaken by walking. These figures suggest that there is scope for journeys made by walking, particularly for journeys under 2km.
DM1 2025	18%

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Strategies 9

Strategies

Using the overarching core transport principles and policies as a guide, an overall transport strategy has been developed, which is underpinned by a series of integrated and detailed thematic strategies covering the areas of demand management, network improvements, public transport, road safety, pedestrians, parking, freight movement, Intelligent Transport Systems (ITS) and city centre traffic circulation.

The City Centre strategy is presented in section 10.

Overall Transport Strategy

The key elements of the overall transport strategy are:

- To design and build a multi-modal transportation demand model using a full range of data that reflects current transport and mobility patterns, and to run this model to test a number of future scenarios;
- To develop a number of integrated and comprehensive urban transport strategies designed to discourage dependence on private cars and promote the development and use of public transport, together with securing safe and convenient pedestrian movements;
- To ensure that all transport plans and proposals put forward in the TMMP are integrated with land-use developments based on the preferred strategies of the Amman Plan;
- To ensure that traffic safety improvement proposals are supported by appropriate travel speed and driving behaviour, as well as overall safety awareness; and
- To provide a reference framework guidance that should be used by GAM to evaluate and review future development projects that have an impact on transport and mobility.

Strategy Development Approach

The overall integrated strategy and associated thematic strategies have been designed specifically to meet the key transport objectives, with appropriate targets and performance indicators to measure progress.

The strategies have been selected from an options framework, which provides choices of a variety of improvements to non-car modes and a series of demand management measures.

The strategies are based upon a number of key transport options related to:

- Principles of Demand Management and their application
- Road Network Improvements
- Public transport (bus, BRT and LRT)
- Road safety
- Pedestrian environment
- Parking
- Freight transport Systems
- Intelligent Transport Systems (ITS)

The approach discussed and agreed with GAM was to adopt a systematic process where phased, significant improvements to the public transport system through the options would be implemented, with the support of increasingly strong demand management policies. A series of aspirational targets and indicators was agreed, and the iterative process described above was undertaken to determine which strategy and programme combination achieved the best balance of results, taking into account meeting the targets set and the feasibility and practicality of successful implementation. Underpinning this approach, is the need for a number of strategies related to safety, pedestrian environment, freight etc that not only integrate and support the public transport strategies but also address serious issues related to those transport sectors. Finally, regulatory and organisational structure to ensure that programmes can be effectively and efficiently introduced has been considered.

Packages of options were therefore tested against the agreed objectives, targets and performance indicators. The approach to each strategy development was evidence-based, but at the same time ensuring that each strategy was comprehensive in itself. The strategies are summarised on the following pages.

Demand Management Strategy and its Application

Why is this strategy needed?

The main objectives of the TMMP revolve around the concepts of reducing the problems caused by congestion and improving mobility and access to services. Whilst improvements to, for example, public transport, walking facilities and the improved provision of information through ITS help to achieve these objectives, their impacts are significantly enhanced by the implementation of measures designed to stabilise, reduce or suppress the generation of car trips. Such measures are intended either to increase the comparative costs between the use of the car and alternative modes, or to reduce the supply of available space for cars through measures such as parking restrictions or public transport priority lanes. Experience elsewhere in the world has consistently demonstrated that demand management measures are essential if the growth of car trip generation is to be successfully addressed.

However, demand management policy alone can not solve the problem. A strong public transport system must be in place before any demand management policy can be applied in support of the public transport system.

What are the principles behind this strategy?

The introduction of demand management policy measures represent a step change in the way in which the transport system is currently managed in Amman. The emphasis on the demand management policy is to allocate increasing costs to motoring and making the use of public transport far more attractive to the general public. The development of demand management requires a staged approach brought in once the provision of public transport is a viable and more attractive option. Taking into account public perception and acceptability to cost based demand management measures, we developed three policy options, soft, moderate and strong representing increasing costs to private based transport. These measures were tested within the strategies, allowing the impact of policy to be measured.

The purpose will be to arrive at a balance of transport improvements and demand management measures which best achieve the objectives and associated targets and performance indicators.

What are the strategy objectives?

The demand management objectives are designed to assist and support main stream public transport measures and to bring some degree of control over the use of the transport network.

Three levels of demand management measures have been designed and revolve around the introduction of, or increase in:

- Fuel costs
- Taxi fares
- Public transport fares
- Parking charges
- Work place charges, and,
- Cordon pricing

Recognising the fact that some degree of sensitivity needs to be applied with the introduction of demand management measures, three degrees of intervention were introduced:

- Soft measures
- Moderate measures
- Strong measures

The introduction of the above measures represents a step change in the way in which the transport system is currently managed. The emphasis on the demand management scenarios is to allocate increasing costs to motoring and making the use of public transport far more attractive to the general public. The development of demand management measures would require a staged approach brought in once the provision of public transport is a viable and more attractive option.

How will the strategy be delivered?

Given the current absence of demand management policy in Amman, it is recommended that GAM begins with the partial implementation of the soft policy.

Whilst it is not easy to formulate transport policies which are universally acceptable it is also very hard to implement them in a way that pleases people, including the supposed beneficiaries. The extent of GAM's discretion which takes place in the implementation of the policy, will be influenced by available resources and political support.

A set of activities directed towards putting a program into effect which would be significant in any implementation of policy consists of:

- Organization - the arranging of resources
- Interpretation - the translation of policy language into feasible plans and directives, and
- Application - the routine provision of the necessary services and instruments

In terms of "winning the public vote", a media and advertising campaign must be launched to ensure that the public clearly understand the plans and objectives of GAM.

The soft demand management measures include fuel and taxi price increases, the introduction of a new fare system designed to encourage usage and ensure overall PT fares do not rise in excess of general inflation and the enforcement of existing parking regulations and charges. The increase in fuel prices is clearly a Government led decision; however, regulating taxi and public transport fares is within GAM's authority.

Soft measures can only be undertaken once sufficient public transport infrastructure is available to the public that offers genuine alternatives of travel. We therefore recommend the following implementation approach:

- **Fuel:** Raise by 1% per annum in real terms; Government Decision: Immediate Action
- **Taxi Fares:** Raise by 1% per annum in real terms; GAM decision: Action once BRT is operational
- **Public Transport Fares:** Action once first BRT line is operational
- **Parking Costs:** Action immediately along strategic routes and controlled parking zones.

Table 13 shows the assumptions made in modelling the various demand management options for information, but does not necessarily reflect the actual way in which such measures would be implemented.

Table 13 - Demand Management Options

Demand Management Options					
Intervention	**Variable**	**Level of Intervention**			
		Current Situation	**Soft**	**Medium**	**Strong**
Fuel Costs	Cost per litre in JD	0.584 JD/litre 0.072 JD/km (assumed increase back to same levels as 2008 in real terms)	Raise by 1% per annum	Raise by 1.5% per annum	Raise by 2% per annum
Taxi Fares	Fare per km in JD	0.25 JD fixed 0.18 JD/km	Raise by 1% per annum	Raise by 1.5% per annum	Raise by 2% per annum
Public Transport Fare	Fare per km in JD	0.16 JD/day +0.005 JD/km travelled maximum 0.41 JD per leg	As Base case	10% reduction (subsidy)	25% reduction through the use of travel card
Parking Costs Costs are in JD and apply to "home to work, home to collet etc" trips only. To be applied to both AM Peak and All Day runs.	Average Cost for Car Parking the **city centre** (GAM defined)	* JD3 / day but not enforced	Leisure JD 1.5 Work JD 2.0 College JD 2.0	Leisure JD 3.0 Work JD 3.0 College JD 3.0	Leisure JD 3.0 Work JD 3.0 College JD 3.0
	Average Cost for Car Parking with workplace levy	* JD3 / day but not enforced	Leisure JD 1.5 Work JD 2.0 College JD 2.0	Leisure JD 3.0 Work JD 3.0 College JD 3.0	Leisure JD 3.0 Work JD 3.0 College JD 3.0
Cordon Charging	Toll per trip to cross the inner cordon (city centre) Peak period	None	As Base Case	JD 1 for Scenario 5a only	JD 2 for Scenario 5b only

Road Network Improvements

Why is this strategy needed?

In order to assess the operational characteristics of the Greater Amman transport network, an analysis of the existing network has been assessed in terms of traffic, major new developments, key urban highways and major strategic highway improvements.

The assessment has looked at the need for highways that are to be built to provide access to new developments, improvements to junctions and improvements that are committed by Government. The strategy has not been designed to accommodate a further increase in traffic per se, but has considered roads as the primary means of facilitating public transport.

What are the principles behind this strategy?

The primary principle behind the strategy is that the increased motorisation within Greater Amman which has increased the demand for road based infrastructure is not sustainable. Further to this, public transport has been inadequate and has lagged behind the development of the road network resulting in low public transport patronage.

The principle therefore is only to consider road infrastructure to provide access to major developments, key corridors, the expansion of the city or to relieve key congestion areas. The strategy road network improvement programme should therefore run in parallel with the implementation of new zones such as Area A, B and C and the Government's plans to expand the city to the east (Amman Development Corridor) or road hierarchy improvements such as turning the Amman Ring Road into an expressway. The strategy runs in parallel with the increased public transport provision and the demand management and parking policies that are being considered and the key is to obtain a balance between increasing public transport patronage and road capacity.

What are the strategy objectives?

The strategy objective for the highways programme is only to provide additional road capacity to support the expansion of the city and to improve the road hierarchy. The strategy involves:

- Adding roads to accommodate and support new urban developments
- Add and extend the road network to assist and support the expansion of the city (to the east)
- Improve key road based corridors to reinforce the road hierarchy
- Improve junctions along key corridors to reinforce the road hierarchy

How will the strategy be delivered?

The schemes have been assessed and introduced as per the development process or Government programme. These projects are required to ensure that traffic is kept flowing along major strategic transport corridors and access to developments are introduced to allow connectivity to the primary transport network.

Figure 28 represents the major schemes planned for introduction and is included within the assessment of all scenarios. The delivery attempts to stay in line with GAM's / Public Works Department programme.

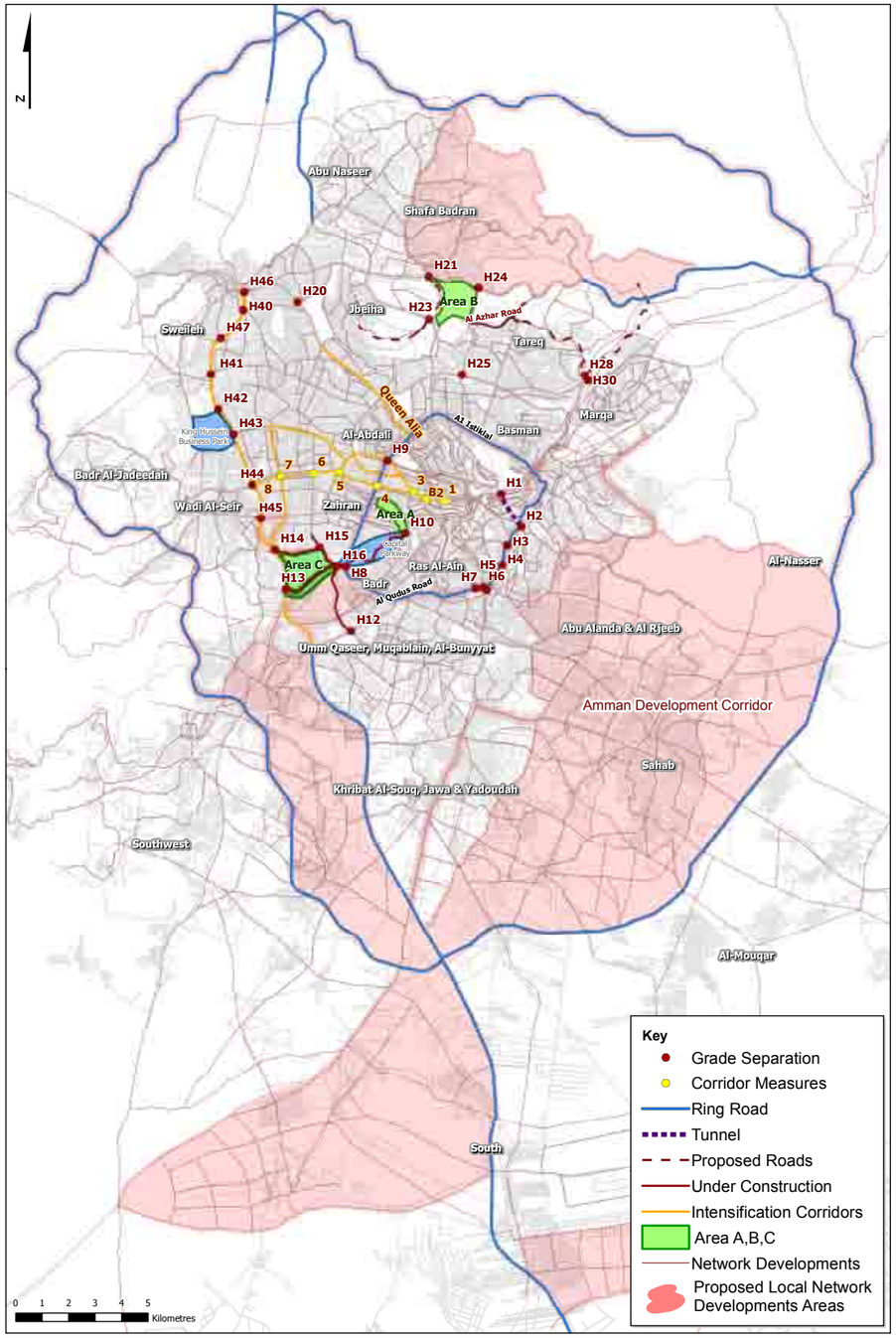
For this strategy, the Amman Ring Road to the west and north is omitted from the programme as we view the construction of this schemes to be beyond the 2025 time horizon.

The major strategic projects as shown on Figure 28 include:

- H1: Tunnel Link between Al Yarmouk Rd and Al Jaysh Rd
- H2: Grade Separation between Al Yarmouk Rd and Al Yarmouk Rd (Al Jusoryr Al-Asharah Rd)
- H3: Grade Separation between Al Yarmouk Rd and Usama Bin Zayed Rd
- H4: Grade Separation between Al Yarmouk Rd and Khaled Bijan Rd
- H5: Grade Separation between Al Yarmouk Rd and Al Aaydeen Rd
- H6: Grade Separation between Al Yarmouk Rd and Prince Al Hassan Rd and Mosaab Ben Omayr Rd
- H7: Grade Separation between Mosaab Bin Omayr Rd and Khawia Bent Al Azwar Rd
- H8: Grade Separation between Prince Hashim Bin Al Hussein Rd and Wadi Abdoun Rd (under construction / the proposed Capital Parkway Masterplan)
- H9: Grade Separation between Queen Nour Rd and Prince Shaker Bin Zayd Rd (at Abdali)
- H10: Grade Separation between Wadi Abdoun Rd and Prince Ali Bin Al Hussein Rd and Prince Abdallah Al Salem Al Sabah Rd
- H11: New Link between Prince Hashim Bin Al Hussein Rd (grade separation H8) and the junction Wadi Abdoun Rd and Prince Abdallah Al Salem Al Sabah Rd (grade separation H10)
- H12: Grade Separation between Al Kodos Rd and Al Horreyya Rd and Al Horreyya Rd (under construction)
- H13: Grade Separation between Queen Alia Airport Rd and King Abdallah Bin Al Hussein II Rd bordering Area C (South)
- H14: Grade Separation between Queen Alia Airport Rd and King Abdallah Bin Al Hussein II Rd and Wadi Abdoun Rd (under construction) bordering Area C (North)
- H15: Grade Separation between Wadi Abdoun Rd (under construction) and Al Horreyya Rd (under construction)
- H16: Grade Separation at Area C between Al Horreyya Rd (under construction) and the new road (under construction) linking Queen Alia Airport Rd and Prince Hashim Bin Al Hussein Rd
- H17: New Link (Al Horreyya Rd under construction) between Al Horreyya Rd and Princess Alia Bent Al Hussein Rd passing the Eastern border of Area C
- H18: New Link between Queen Alia Airport Rd and Prince Hashim Bin Al Hussein Rd and the proposed Capital Parkway (Wadi Abdoun Rd under construction)
- H19: New Link (Wadi Abdoun Rd under construction) between the junction at Queen Alia Airport Rd/King Abdallah Bin Al Hussein II Rd and Al Horreyya Rd (under construction) passing the Northern border of Area C
- H20: Grade Separation between Queen Rania Al Abdallah Rd and Ahmad Al Tarawina Rd
- H21: Grade Separation between Yajouz Rd and Shafa Bardan Rd
- H22: New proposed link between junction Yajouz Rd/Shafa Bardan Rd and Jordan Street passing the West of Area B and linking into the area South of Jordan Street crossing the junction with Al Hakeem Al Nazsabouri Rd
- H23: Grade Separation between Jordan Street and the new proposed link (H22) passing the West of Area B
- H24: Grade Separation between Yajouz Rd and Prince Al Hussein Bin Abdallah Rd
- H25: Grade Separation between Al Shaheed Rd and Prince Al Hussein Bin Abdallah Rd and Al Aksa Rd
- H26: New proposed link between Prince Al Hussein Bin Abdullah Rd and Yajouz Rd on the existing Al Azhar Rd and the Northern part of Tabarbour Rd
- H27: New proposed link between junction Al Azhar Rd/Tabarbour Rd (H26) linking into Prince Faysal Bin Al Hussein Rd (H28)
- H28: Grade Separation between Prince Faysal Bin Al Hussein Rd on the new proposed link (H27) and the road linking into Al Shaheed Rd
- H29: New proposed link between junction Prince Faysal Ben Al Hussein Rd/ the road linking into Al Shaheed Rd (H28) linking into the Northern part of Al Nahda Rd and crossing over Yajouz Rd
- H37: Road Upgrade between Al Shaheed Rd (H31) and King Abdullah I Rd (H32)
- H38: Road Upgrade between King Abdullah I Rd (H33) and Al Hezam Al Daeri Rd (H34), crossing Al Hezam Al Daeri Rd and linking into the area South

- H39: Road Upgrade between junction Al Hezam Al Daeri Rd /Al-Fida Rd/Al Faw Rd (H35) linking Al Faw Rd with King Abdullah I Rd
- H40: Grade Separation between King Abdallah Ben Al Hussein II and Rifaa Al Ansari and Jarash
- H41: Grade Separation between King Abdallah Ben Al Hussein II and Wasfi Al Tall
- H42: Grade Separation between King Abdallah Ben Al Hussein II and Saeed Khayr
- H43: Grade Separation between King Abdallah Ben Al Hussein II and Makka Al Mokarrama
- H44: Grade Separation between King Abdallah Ben Al Hussein II and Zahran and Al Bayader
- H45: Grade Separation between King Abdallah Ben Al Hussein II and Queen Zein Al Sharaf and Al Sinaa
- H46: Grade Separation between King Abdallah Ben Al Hussein II and Queen Rania Al Abdallah and Jarash
- H47: Grade Separation between King Abdallah Ben Al Hussein II and new road linking into development in the West (street South of Nafel Ben Amer)
- H48: Amman Ring Road West Section (Optional)
- 49: Amman Ring Road North Section(Optional)

Figure 28 - Highway Improvements



Public Transport Strategy

Why is this strategy needed?

In order to function efficiently, to optimise economic activity and to provide a high quality of life for residents, it is necessary for modern cities to develop a sophisticated and comprehensive public transport system. Such a system is lacking in Amman, where public transport is currently characterised by the following:

- Although overall service is reasonable, the system is complex, non-integrated and lacks any effective marketing or publicity;
- Public transport mode choice is restricted to buses, minibuses and taxis;
- Terminal locations are unsatisfactory and facilities generally very poor;
- There has been a lack of effective public transport planning;
- Many services do not operate to a proper timetable and are unpredictable and unreliable;

The net impact of the above factors results in the mode share for public transport being currently about 14%, which is very low in comparative terms with other city economies in both Europe and the Middle East and North Africa, which have successfully tackled the problems of congestion and poor accessibility.

In order to tackle the ever increasing problems caused by traffic growth and congestion, particular emphasis needs to be placed on using public transport to promote mode shift from the private car. Consequently, a high priority must be to establish a comprehensive public transport system based upon a clear hierarchy of needs. Social cohesion and economic growth are also very important for Amman, and an improved public transport system would be the most effective way of ensuring increased accessibility and social inclusion.

Public Transport is thus regarded as one of the most important elements of the overall strategy for the TMMP, as it has a primary potential to reduce the future growth of trips by private car, as well as attracting those who currently use the car.

To provide a suitable environment in which to achieve these public transport objectives, it will also be necessary to ensure that the regulatory, contractual and organisational system in place is structured to provide a stable, predictable and high quality public transport network and encourage private sector investment and innovation.

What are the principles behind this strategy?

The public transport strategy within the Amman TMMP is based on internationally accepted good practice, with the core principles being:

- To establish a comprehensive public transport system based upon a clear hierarchy of needs;
- To create an accessible public transport system which addresses social inclusion and promotes modal shift from private car use;
- To ensure that the development of new and extended public transport services is designed to address the needs of the Amman Plan and land use planning in general;
- To design the public transport system so that it optimises benefits to the economy of Amman and Jordan;
- To undertake a comprehensive upgrade to passenger facilities across the whole network in order to encourage modal shift;
- To integrate the public transport system with other transport strategies and plans;
- To segregate fully the level 1 public transport network, and to introduce bus priority measures elsewhere in order to minimise the impact of traffic congestion on the public transport network;
- To introduce a regulatory and contractual system which provides a stable, predictable and high quality public transport network and which encourages private sector investment and innovation.

What are the strategy objectives?

The strategy objectives, and the programme schemes designed to achieve them, have been divided into four broad areas of activity, which are as follows:

Hierarchy: the objective for designing and delivering the improved public transport network will be to create a hierarchy of services to meet the differing needs of passengers in terms of destinations and capacity. This will be accompanied by a hierarchical approach to the provision of interchange facilities between the various public transport modes;

Accessibility: to ensure the system offers a high level of accessibility in the widest sense of the term, to include not only ease of access to public transport vehicles, but also the ability of people to access bus stops and LRT/BRT stations from where they live and where they work through improved pedestrian facilities and feeder service networks;

Priority: to enhance average speeds and reliability of public transport services through highway segregation and prioritisation of intersections and junctions wherever feasible. Specifically, all LRT and the core BRT network will be fully segregated to ensure journey times are optimised and remove the impacts of network congestion;

Infrastructure: to encourage usage of public transport services by addressing the waiting environment at bus stops and interchange points, as well as by improving vehicles and services. It is also proposed to identify the most appropriate terminal locations and to undertake a comprehensive upgrade to passenger facilities across the whole network.

How will the strategy be delivered?

Redesigning and introducing substantial changes to the public transport network in Amman is a complex exercise, which needs to take into consideration current trip patterns by all modes, future development and changes in population sizes, and access patterns to employment, education and health facilities. In order to consider a range of potential options, four broad public transport scenarios were designed, tested through the modelling process and subsequently refined. These were then combined with various other measures, including a number of demand management ones, to try to derive an optimal solution. The four public transport scenarios chosen were:

1. An entirely bus based service provision. This assumed that there would be no BRT or LRT lines constructed in the period up to 2025, but that there would be a fundamental redesign of the route network, including additional services and high frequencies to address the growing population and expansion of Amman. In terms of the hierarchical approach, it relied on high quality and high frequency bus services to provide the core Levels 1 and 2 services.

2. The second scenario was similar to the first, but included the BRT network currently being planned and designed by GAM. As the selected lines for the proposed LRT system are potentially amongst the most heavily used public transport corridors in Amman, it is envisaged that their proposed routings will need to be replicated as closely as possible by new BRT services in this scenario. On a practical note, these BRT services would operate on street, however it would be extremely difficult to provide them with the level of segregation necessary to ensure speedy and reliable operation. Both this and the first scenario assumed that the Level 4 network of local feeder services would be operated to conventional timetables by white taxis and small minibuses, and would be centred around providing services to areas of the City inaccessible to conventional buses and feeding key interchange points, in particular the stops/stations on the BRT network.

3. This scenario included three LRT Lines covering the major predicted flow corridors in the City, supplemented by an expanded BRT network, with the remainder of the bus network being similar in concept to the first two scenarios. Under this scenario, some Level 4 feeder services covering the LRT and principal BRT stations would operate on a demand responsive transport (DRT) basis, which would be intended to minimise fuel consumption whilst providing an enhanced

and more convenient service to local residents.

4. The final scenario was essentially similar to the third, but consisted of achieving an expanded LRT network by 2025. This was based on the concept that some of the BRT Lines constructed in the early part of the TMMP period would be replaced by a combination of LRT Lines and adjusted bus services, which might be justified by the additional demand created.

The modelling and strategy appraisal processes indicated that the optimal strategy for public transport development in Amman was likely to be one based on the third scenario. This proposed network is shown in Figure 29 and Figure 30.

The following section thus summarises the details of how the chosen public transport strategy should be delivered.

To address the requirements of the hierarchical approach:

- Design, secure and implement a core Level 1 Public Transport network, which will consist of three high capacity fixed route rail-based lines. Line 1 would run from Al Mahatta to Area C, Line 2 from Beituna to Medical City, and Line 3 from Umm Al Hairan to Sport City. The system would be engineered such that alternative routings could be facilitated, for example Al Mahatta to Medical City.
- Implement and develop a supplementary Level 1 Public Transport network of bus based rapid transit routes (BRT), designed to integrate fully with the LRT lines. These would consist, firstly, of a number of circular services linking Sweileh, the University of Jordan, North Terminal, Al Mahatta, Beituna, Umm Al Hairan, Area C and West Amman, with extensions covering Area B and Al Bayader. In addition, further services around the periphery of the city would connect Sweileh, the University of Jordan, North Terminal and the proposed LRT Station on the Zarqa to Amman system at Al Shaheed, and another service would operate from Shafa Badran via the University of Jordan, Sweileh and Airport Road to terminate at Area C. Secondly, a series of BRT routes would connect Al Azher and Tabarbour with Al Mahatta, and then operate through the City Centre to terminate at Wadi Al Seer, Wasfi Al Tal and Abu Nasyr. A further set of BRT services would provide connections between areas of North Amman (including Area B) and the University of Jordan. BRT services would also be used to provide a substantial improvement to the South and South East of Amman, with connections to other core services at Umm Al Hairan and Al Mahatta. This would provide for both existing and new development in the Sahab area and the planned ADC. Level 1 BRT services would probably be operated initially by 12 metre single deck buses, but these would need to be replaced by 18 metre articulated buses or 24 metre bi-articulated buses in view of the projected passenger usage.
- Design and implement a range of Level 2 services, which will provide supporting radial and orbital routes designed to integrate with the Level 1 network. These will be operated either by conventional full size buses or by BRT vehicles operating on both segregated and non-segregated highway ('partial BRT').
- Design and implement a complementary non-core network of Level 3 bus services designed to fill missing links and serve local and longer movements around Amman not covered by the Levels 1 and 2 core services. These routes would be operated by either conventional buses or minibuses.
- Develop a 'hub and spoke' series of Level 4 networks using minibuses and white taxis designed to serve areas not covered by conventional bus services and which will connect residential areas with both major and minor interchange points on the core LRT and BRT networks. Ultimately, where these services feed into LRT stations, and major stops/stations on the BRT network, it is proposed that some be operated on a Demand Responsive Transport (DRT) basis. DRT control centres would be established to cover LRT and BRT Line corridors, and the operation of the services would be based on area wide principles with no fixed routes, or by means of semi fixed routes with flexibility to divert as required, and only operate when required to do so by known demand.

To address the requirements of the accessibility approach:

- Implement a suitable fares structure devised by GAM, in which the current direct linkage between fuel cost fluctuations and fares is replaced by a system designed to smooth such fluctuations, relate to wider inflation indices and ensure that public transport fares remain at a competitive advantage when compared with the perceived costs of using the private car.
- Implement a city wide smartcard system and means of payment, utilising the latest vehicle technology and specifications.
- Provide high quality marketing and information systems through the creation of a Public Transport Marketing and Publicity Unit as part of the Passenger Transport Authority activities of GAM.
- Install ticket machines at key locations to minimise bus/BRT waiting times.
- Introduce a Real Time PT Information system to cover all scheduled services.
- Determine the minimum specification for each type of vehicles used at each level to provide a uniform high quality standard.

To address the requirements of the priority approach:

- Ensure that all Level 1 public transport services are fully segregated.
- Ensure that other core public transport services are provided with systematic priority measures based on an assessment of engineering effectiveness and operational requirements. These will include:
  - Bus lanes
  - Selective Vehicle Detection (SVD)
  - Bus gates

To address the requirements of the infrastructure approach:

- Expand the provision of new bus shelters, bus stops and information to cover the entire GAM area.
- Provide Enquiry Offices and accommodation for Inspection Staff at Major Public Transport Terminals.
- Construct new Interchange Points at key locations to connect LRT and BRT Level 1 services with other public transport services.
- Design and construct new Interchange Terminals at main locations, some new and some replacements for existing sub-standard or poorly located facilities and improve access for pedestrians where necessary.
- Design and construct Park and Ride facilities at major public transport terminals and interchange points around the periphery of the Amman urban area.

Vehicle Fleet Size

In view of the population of Greater Amman, and the comparatively low mode share of trips held by public transport, it is clear that the overall passenger carrying capacity of the current fleet mix is inadequate. This is primarily because of the large number of white taxis, with a maximum capacity of 4 passengers, and the low number of full size buses available, amounting to less than 400 vehicles. As BRT services are implemented and bus services improved, we would envisage that the vehicle fleet mix would not only increase during the period up to 2025, but also that the proportions within the different categories of vehicle would change in view of the introduction of new services and the increased demand.

Table 14 shows the potential changes required in the vehicle fleet size. Please note that is purely indicative and not definitive, and will be dependent on the timing of the introduction of both LRT and BRT services, together with the scale and speed of planned developments in Amman and consequential capacity requirements. Figures for 2025 are based on a detailed analysis of the modelled demand forecasts and planned public transport network for that year, whilst figures for 2015 and 2020 are suggested estimates.

Table 14 - Approximate Public Transport Operational Vehicle Requirements (excluding LRT)

Vehicle Type	Current	2015	2020	2025
White Taxi	3230	2800	2250	2150
Minibus 12 seats	0	0	200	300
Midibus <8.5m	310	300	270	220
Medium Bus 9.5-11m	342	800	100	90
Large Bus 12m			850	640
Articulated Bus 18m	0	200	680	1050
Bi-articulated Bus 23m	0	0	200	480
TOTAL	**3882**	**4100**	**4550**	**4930**

- **White Taxis:** The role played by white taxis would change significantly by 2025, although there is a strong need to retain them as an integral part of the public transport fleet mix. White taxis should not be retained where they operate in parallel with large buses along major public transport corridors, but are needed to provide links to the city centre from hilly areas where the terrain is unsuitable for conventional buses, either directly or by means of interchange to the Level 1 LRT or BRT services. In addition, they would provide vital 'hub and spokes' services for many of the new developments planned in the Greater Amman area.
- The role of white taxis might be supplemented by the longer term introduction of some 12 seat **minibuses**, which would fulfil the same role, but where there are more passengers than can easily be accommodated by white taxis. The change in role would need to be handled sensitively through a phased planning process, which might require compensation payments for the reduction in fleet size and subsidy for displaced white taxis, in cases where there is an adverse impact on income.
- **Midibuses:** These would be buses with a seating capacity in the range of 20-30 people. Such vehicles would be to new designs, similar to the prototype vehicles sponsored by GAM, which are based on VW running units. They would be designed for use on the Level 3 network, where passenger demand or the local terrain would make it impractical to operate full size buses.

- **Medium and Large Buses:** These would consist of conventional single deck buses from 9.5 metres to 12 metres long, for use on both the Level 2 and Level 3 networks.

- **Articulated Buses:** Although the first BRT services may see the introduction of very modern 12 metre conventional buses, the projected passenger trip generation figures produced through detailed modelling indicates that higher capacity buses would be needed for future years. This could most easily be met by using standard 18 metre articulated single deck vehicles, which could be used in either segregated or non-segregated mode. Conventional 12 metre buses replaced by these would then be 'cascaded' to operate on the Level 2 and Level 3 networks.

- **Bi-articulated Buses:** For those Level 1 BRT services which experience the highest potential passenger trip generation, it would be advisable to invest in bi-articulated buses, each of which could carry approaching 200 passengers, albeit with a high proportion of standees. In cases where frequencies would need to be as high as every 2 minutes, this type of bus would be essential, however, from an operational perspective, they would only be practical on BRT routes which were totally segregated from normal traffic.

Interchange Terminals

The function and location of Interchange Points and Terminals are critical in ensuring that public transport journeys are as seamless as possible to users. We are proposing that both existing and new interchange facilities are graded into a hierarchical structure, and that some existing facilities are moved, become only a parking facility or are no longer required as bus terminals.

Our proposed hierarchy is based on the following definitions:

- Type A. Major Interchanges where there is connectivity between LRT, BRT and other PT services (plus, where suitable, Park & Ride facilities)
- Type B. Second tier major interchanges, where there is significant connectivity between either LRT or BRT and other PT services (plus, where suitable, Park & Ride facilities)
- Type C. Third tier minor interchanges, where there is connectivity between LRT or BRT stations and local bus networks (minibuses, white taxis, DRT)
- Type D. All Park & Ride sites not covered in the other three categories (classified as minor interchange points)

The Type A major interchanges would consist of:

- **Al Mahatta Terminal** – the current temporary arrangements will need to be upgraded in the short term, and in the medium to longer term to be rebuilt to accommodate a major interchange between LRT Lines and BRT services.
- **Saqf Al Sail Terminal** – this facility should be redesigned in the medium to longer term to accommodate major interchange between LRT Lines and BRT services, as well as displaced services from Al Muhajareen terminal, which should be closed. It is appreciated that space is limited in this area, but the need for this terminal should be regarded as a very high priority due to its accessibility to the city centre.
- **North Terminal** – This well designed and modern terminal should receive minor improvements and be retained as the major terminal point for PTRC bus services arriving in Amman from the north of Jordan.
- **Raghadan Terminal** – This facility is unlikely to be acceptable as an operational terminal, despite being purpose built, but in the medium to longer term, it is likely to be partially subsumed into a major interchange point between LRT Line 1 and connecting BRT or bus services passing in the street. Over the next 15 years, it is envisaged that the number of white taxi services in the Downtown area generally will continue to be reduced in number, following recent consolidation. Whether the remaining white taxi services should be retained at Raghadan Terminal, or moved into suitably identified and traffic engineered facilities on street at different locations

in the Downtown area is a decision that is dependent on the success of development proposals for the Amman Plaza and urban strip areas in generating significant additional trips. If the latter is achieved, the Raghadan Terminal will become a more central and attractive terminus.

- **Umm Al Hairan Terminal (plus P&R)** – If LRT Line 3 is successfully implemented, this new facility will provide a major interchange point with BRT and bus services. It would also be highly desirable if a new custom designed facility could include room for terminating PTRC bus services currently using South Terminal. The latter facility could then be closed, with some space retained for bus parking purposes in order to avoid unnecessary congestion at the new interchange terminal.
- **Medical City (plus P&R)** – this existing terminal facility will need to be redesigned and enlarged in the medium to long term to accommodate a major interchange with LRT Line 2, together with major growth in employment in the immediate area.
- **Beituna Terminal (plus P&R)** – If LRT Line 2 is successfully implemented this new facility will provide a major interchange point with BRT and bus services.
- **City Hall** – If LRT Lines 1 and 3 are successfully implemented this new facility will provide a major interchange with passing BRT and bus services. Whilst engineering feasibility has not yet been undertaken, it is very likely that these two LRT Lines will be significantly grade separated, resulting in the need for a fairly complex design.
- **King Abdullah Complex** – This busy location will be served by an intersection of LRT Line 2, if successfully implemented, and a BRT service, together with several terminating bus services. Consequently, a carefully designed on-street interchange facility will need to be built at this location.
- **Sport City** – This terminal would need to be created if LRT Line 3 is successfully implemented, as there would be an important interchange with both BRT and bus services.
- **Area C Terminal (plus P&R)** - This terminal would need to be created if LRT Line 1 is successfully implemented, as there would be an interchange with both BRT and bus services.

The following Type A interchange terminals would be created provided that the LRT network is successfully implemented: **Ministry of Interior** (Station 10 on LRT Line 3), **King Faisal Square** (Intersection between Station 3 on LRT Line 2 and Station 4 on LRT Line 1), **Hejaz Railway LRT Station**, **Al Shaheed LRT Station** (plus P&R) and **Marka LRT Station** and **Station 11 on LRT Line 2**.

The Type B interchanges would consist of Sweileh Terminal (plus P&R), Marka Intersection (King Abdullah/Ash Shahid), Marka Airfield Terminal, Madouna Centre, Sahab Centre, Jawa Street, Area A, Albn Ayiat, University of Jordan, Zatyounah Terminal, Al Bayader Terminal and Wadi Al Seer Terminal.

Type C interchanges would consist of all other LRT and BRT stations not included as Type A or Type B above. Type D would consist of all Park and Ride sites not included in the above categories; Madounah, Sahab Outer By-pass, Al Muwaqqer, Airport Road, Area C (LRT Station 11, Line 1) and Area C (LRT Station 12, Line 1).

External Bus Services

Bus services entering Amman from areas outside the GAM boundary currently terminate at a variety of different points, and are the responsibility of the PTRC. Decisions of principle will need to be taken as to how such services will operate in the future, given the changes resulting from the introduction of comprehensive LRT and BRT networks. It is unlikely that, given the current laws relating to responsibilities for public transport, such decisions can be made unilaterally by either party, and thus changes will need to be made by mutual agreement.

One possibility would be for interchange points to be concentrated at the new locations to be created by the LRT and BRT networks. This would have the advantage of reducing congestion in the inner city areas and enabling an easy transfer to high frequency local services. Conversely, this might cause additional journey time and costs to large numbers of passengers, which would not be welcomed and might deter the increased use of public transport.

We believe that any compromise agreement regarding future changes to cross boundary bus services needs to be based on logical, equitable and mutually agreed principles, and would suggest that the following should form a basis for this:

- A fundamental principle should be that any changes can clearly be demonstrated to benefit bus passengers, and that existing users do not suffer any significant disbenefits;
- A distinction should be made between bus routes serving the urban areas adjacent to Greater Amman, and longer distance services from other areas of Jordan. The former should be treated in the same way as bus services operated under GAM's auspices, whereas the latter should terminate at one of the proposed outer terminal points;
- Local passengers travelling wholly within the GAM area should not be permitted to travel on PTRC longer distance bus services.

Park and Ride

Park and Ride is often regarded as an interim solution to achieving a reduction in congestion in city centres and encouraging the use of public transport. However, in the case of Amman, with a number of potential LRT and BRT terminals likely to be constructed in the outer urban areas, it could be a valuable tool in deterring car trips to the City Centre without the need to provide dedicated bus services, as the LRT and BRT services would offer an attractive service to the central areas. Park and Ride would thus form an integrated element of the Parking Strategy.

Indicative construction costs for 11 park and ride sites have been included in the economic appraisal, some requiring multi level car parks, but with the majority able to be constructed as open at grade facilities. Table 15 demonstrates the potential modelled usage by 2025 for the preferred scenario.

Bus pictures courtesy of Caio Induscar of Brazil.

Table 15 - Park & Ride

Name of Park & Ride Site	Projected Usage in 2025
Sweileh P&R	1,000
North Terminal P&R	400
Shaheed Street P&R	400
Beituna Terminal P&R	1,500
Madouna P&R	300
Sahab P&R	850
Garden Zone P&R	850
Area C Terminal P&R	504
LRT2/Stn11 P&R	300
LRT2/Stn10 P&R	100
Medical City P&R	500

Figure 29 - Proposed Public Transport Network - Inner

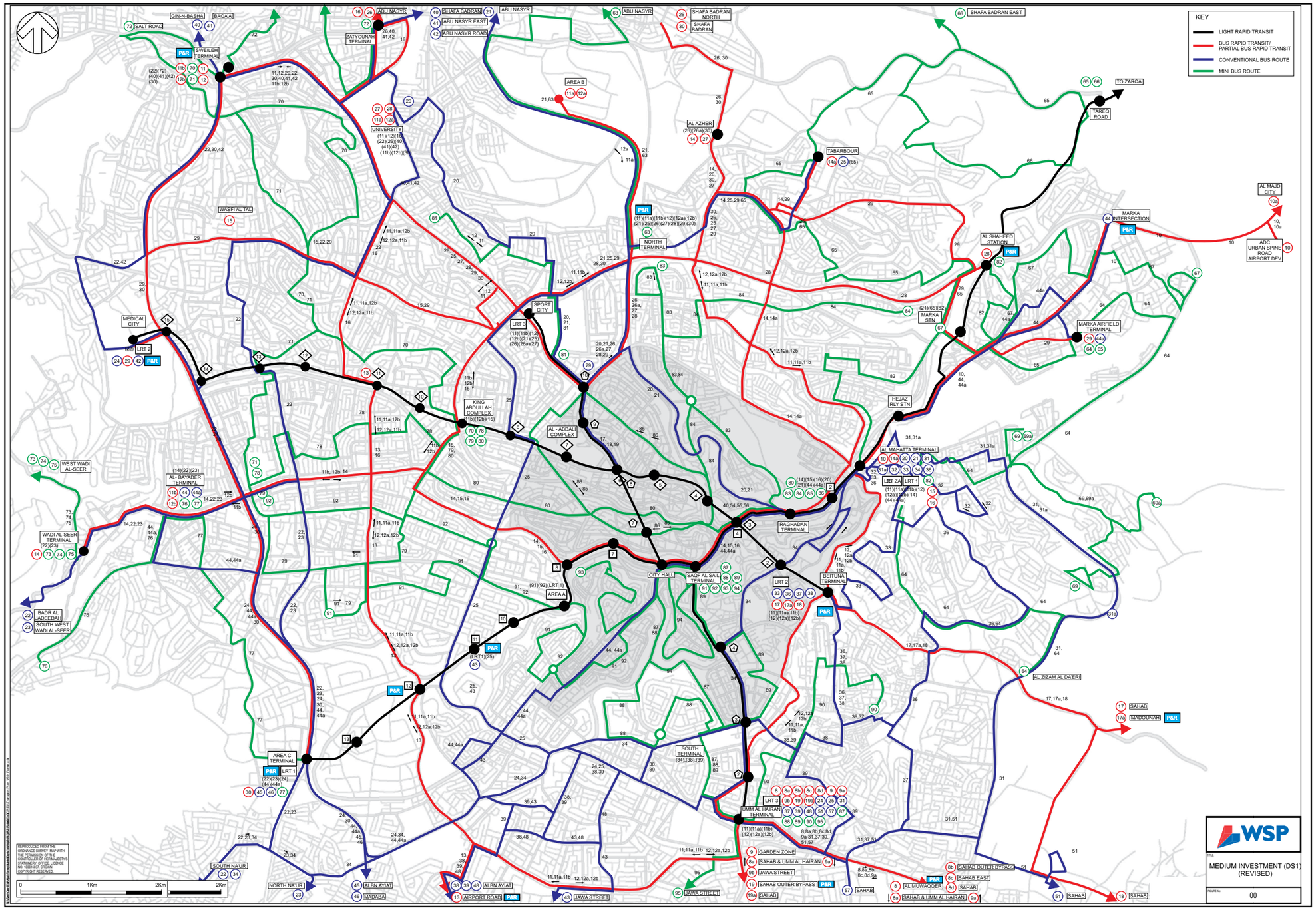
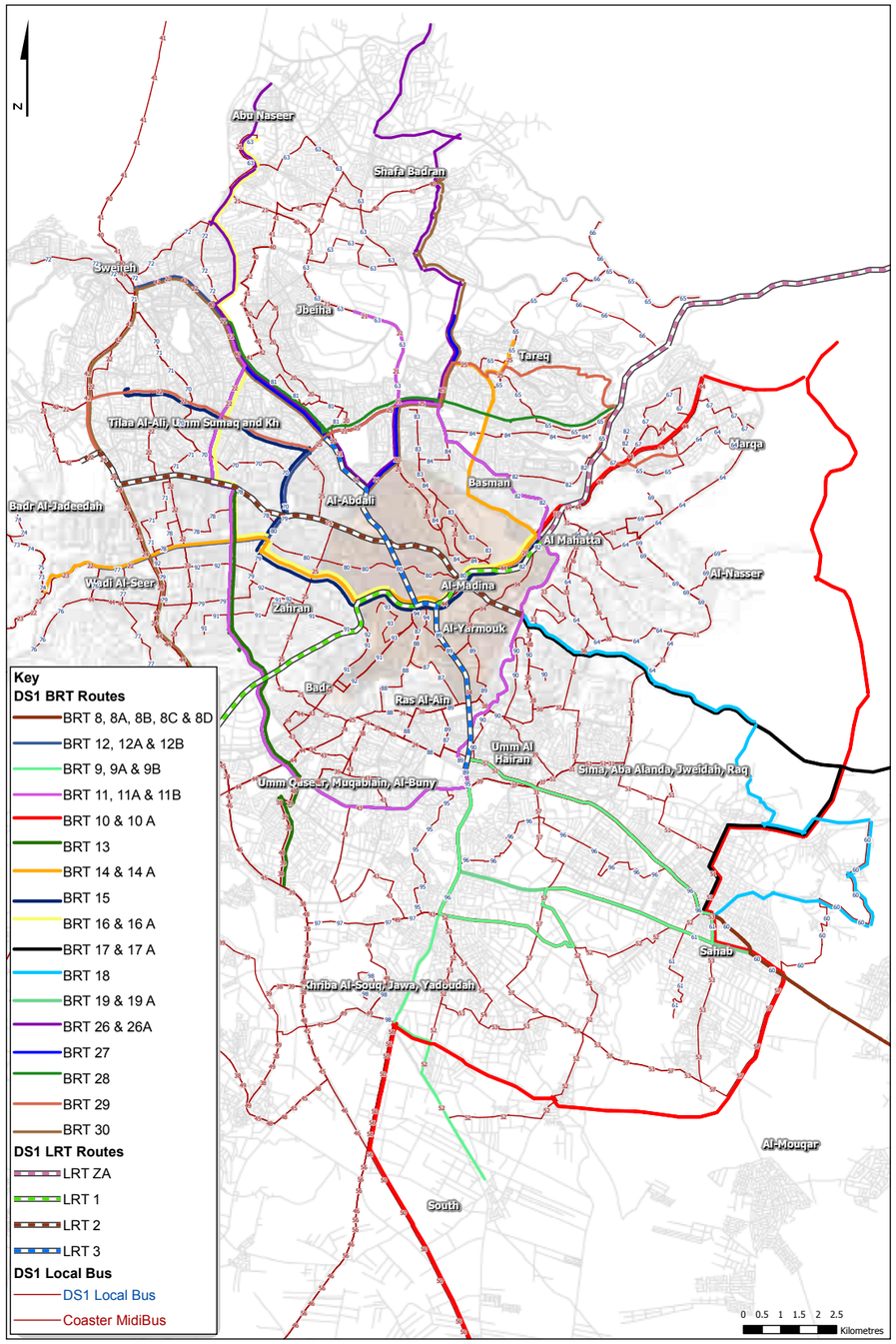


Figure 30 - Proposed Public Transport Network - Outer



Safety Strategy

Why is this strategy needed?

Whilst the accident rate in Jordan is currently lower than some other Middle Eastern countries, the direct economic cost of road accidents to the country is significant – the World Health Organisation reported that deaths on Jordan's roads could cost up to US$ 200 million per annum.

Accident rates are likely to increase in future, and minimising these accidents forms an integral element of the transport strategy. Overall, as income increases, an increasing proportion of the population will have access to a car. Increased congestion will result in greater overall exposure to accident potential, and as highways are upgraded speeds will increase in the off peak, leading to the potential for more serious accidents.

The legalisation of motorcycles will also have an impact on road safety as motorcycles are inherently more dangerous than cars. In Europe more than 18% of all fatalities are associated with mopeds and motorcycles. As Amman is increasingly redesigned as a pedestrian and tourist friendly location, the resulting greater levels of pedestrian activity will increase the possibilities of accidents occurring. As pedestrians are the most vulnerable of road users, it is anticipated that, without intervention, this will result in increases in serious and fatal accidents.

For these reasons, the TMMP requires a road safety strategy, which includes better education and enforcement measures, as well as engineering solutions to safety issues.

What are the principles behind this strategy?

Safety is a key issue for the city of Amman and improvements to safety will be integrated as part of the overall strategy. The core principles of the safety strategy are:

- To deliver a sustainable long term support structure at national and local government level;
- To deliver the safety strategy through a balanced approach between education, enforcement and engineering;
- To support and complement wider transport and development objectives; and
- To improve transport safety not just for road users but for all users of the transport system
- To use a solid data base of accident data and statistics to help prioritise strategy

What are the strategy objectives?

The overall strategy to deliver improved road safety will aim to achieve the following objectives:

- Safer driver behaviour
- Safer speeds
- Safer transport infrastructure
- Safer design
- Safer vehicles

Whilst the delivery of many safety interventions is, by necessity, the responsibility of local city authorities, such as GAM, much of the support information and enforcement activities must be delivered at a national level. The Higher Council for Traffic Safety provides the highest level strategic guidance and direction, supported by a number of public and private bodies.

The national level support mechanisms need to be formalised to centralise all aspects of transport safety into one body to allow integration of data and planning in an effective manner. Clear roles and responsibilities needs to be agreed with other supporting organisations.

How will the strategy be delivered?

The strategy will include Education and Training initiatives as well as improvement schemes. The improvement schemes are on Figure 31 and Figure 33.

Engineering Schemes

- Signal controlled junctions
- Reduced speed limits and complex junctions (e.g. Jamal Abdul Nasser intersection)
- Residential traffic calming
- Local highway realignment
- Provision of new crossings/drop kerbs
- Local pedestrianisation
- Route Treatments (Al Malekah Alya, Al Istikal, Khaled bin al Waleed, Queen Nour Al Ameer Hashem bin al Hussein, Al Dustour, Al Ameer el Hassan and Ali Bin Abi Taleb – Omar Matar – Al Malek Talal – Quraysh)
- Area Safety Schemes (Tareq, Al Jaysh, Al Hashemi, Al Ridha, Anas bin Maalek, Al Islamiyah)
- School safety zones

Education, Training and Publicity Initiatives

- Robust and accurate data capture for all accidents involving personal injury - currently there is no distinction in traffic police recording time between personal injury accidents and non-injury accidents
- Centralised collation and detailed analysis of traffic accident data using state-of-the-art analytical software to improve understanding
- Development of a skilled and resourced team specialising in education, training and publicity (ETP) strategies
- Support to Police through consistent provision and review of road traffic legislation
- Fully funded ETP programme building on the KAFA projects being run by the Ministry of Education
- Improved training for highway and traffic engineers.
- Development of a highway asset management plan
- Post-completion scheme review process
- Cost benefit analysis approach

Delivering greater road safety is an important part of the wider integrated transport strategy and requires the long term interplay of a number of different strategy elements to include physical infrastructure improvements, training and enforcement. These components have been identified as key requirements for Amman, following a review of available data, consultation and experience gained on site.

In terms of infrastructure a range of schemes have been identified and these should be supported by a structured and targeted maintenance programme.

Education of transport system users (drivers, pedestrians and passengers), provides the basis for long term changes in behaviour. It is proposed to deliver education and training needs in different ways to different aspects of the community.

Enforcement provides the means by which correct behaviour is reinforced and through which those who break the law are caught and punished effectively. Essential elements that need to be in place for this to be delivered include police training, enhanced enforcement and automatic enforcement through available technology.

Figure 31 - Greater Amman Road Accidents (fatal, severe), 2007

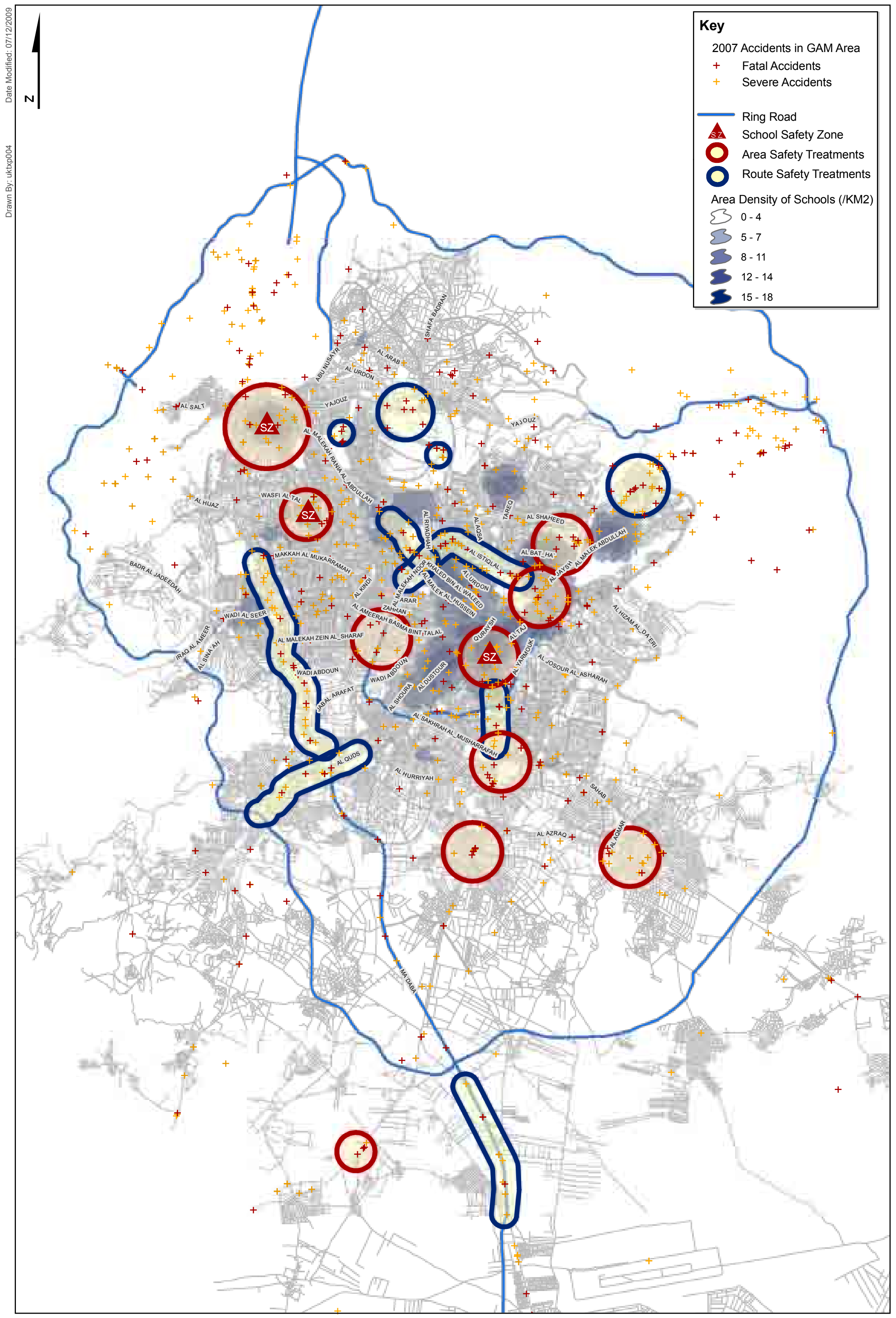


Figure 32 - Greater Amman Road Accidents (fatal, severe), 2008

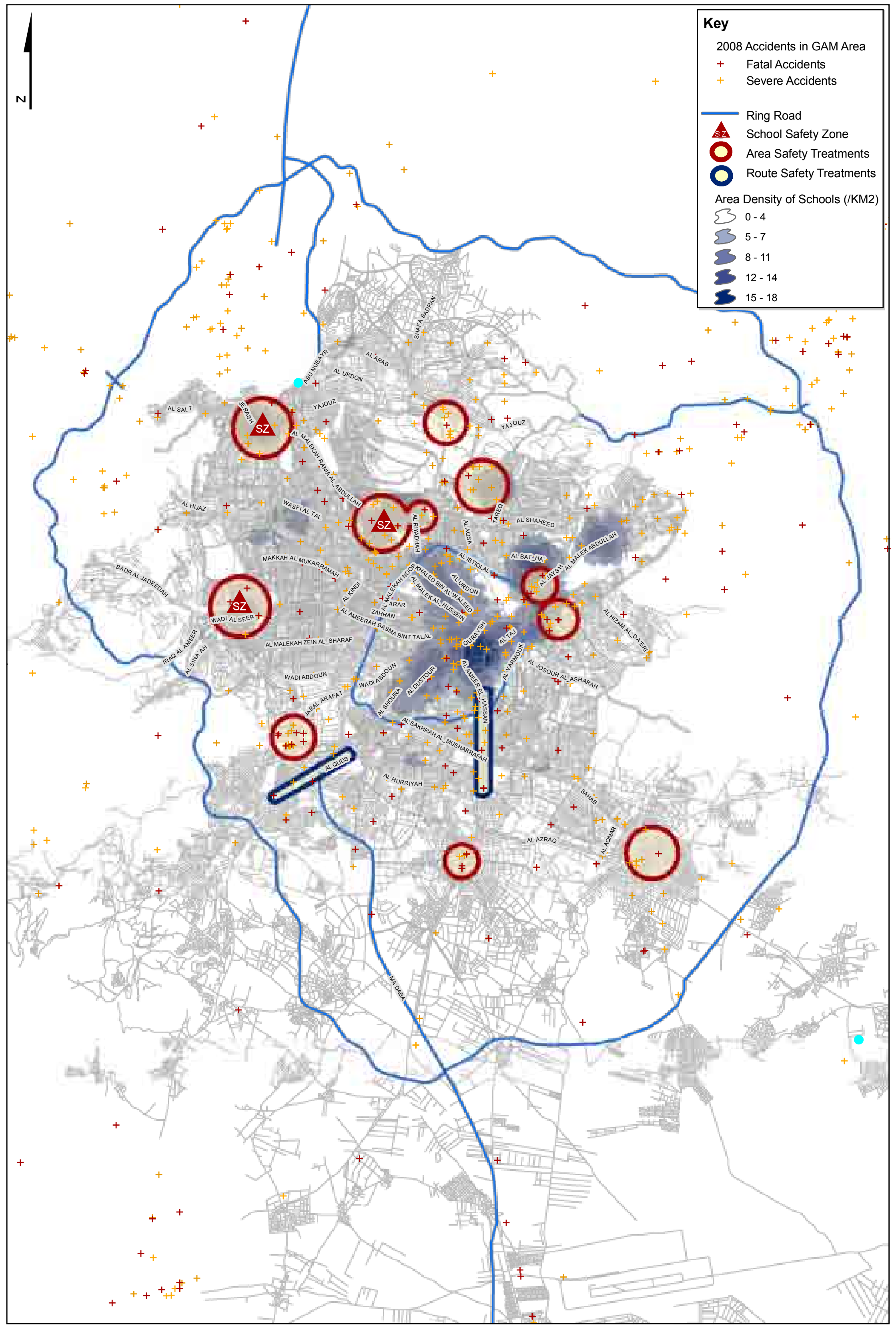


Figure 33 - City Centre Road Accidents (fatal, severe), 2007

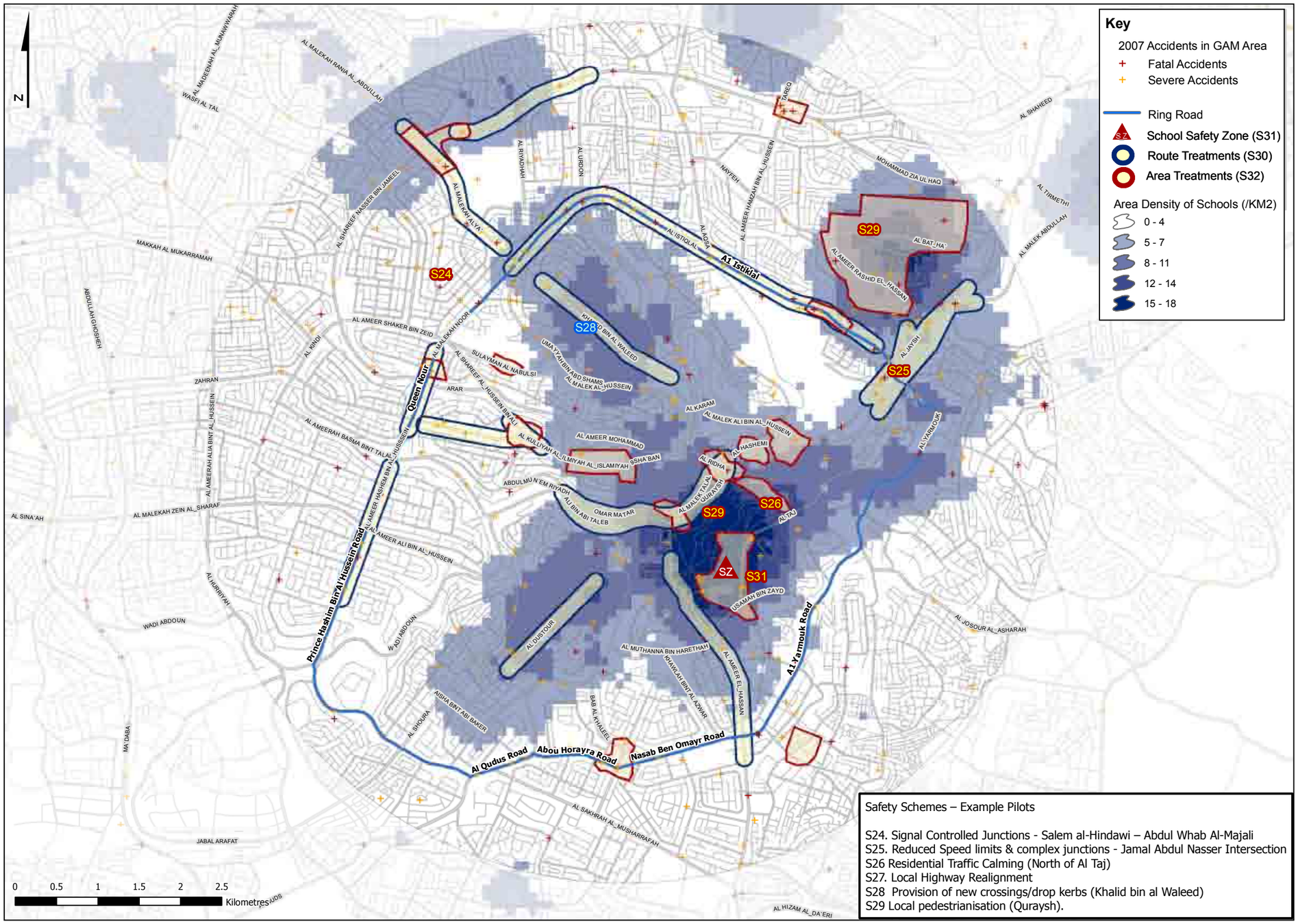
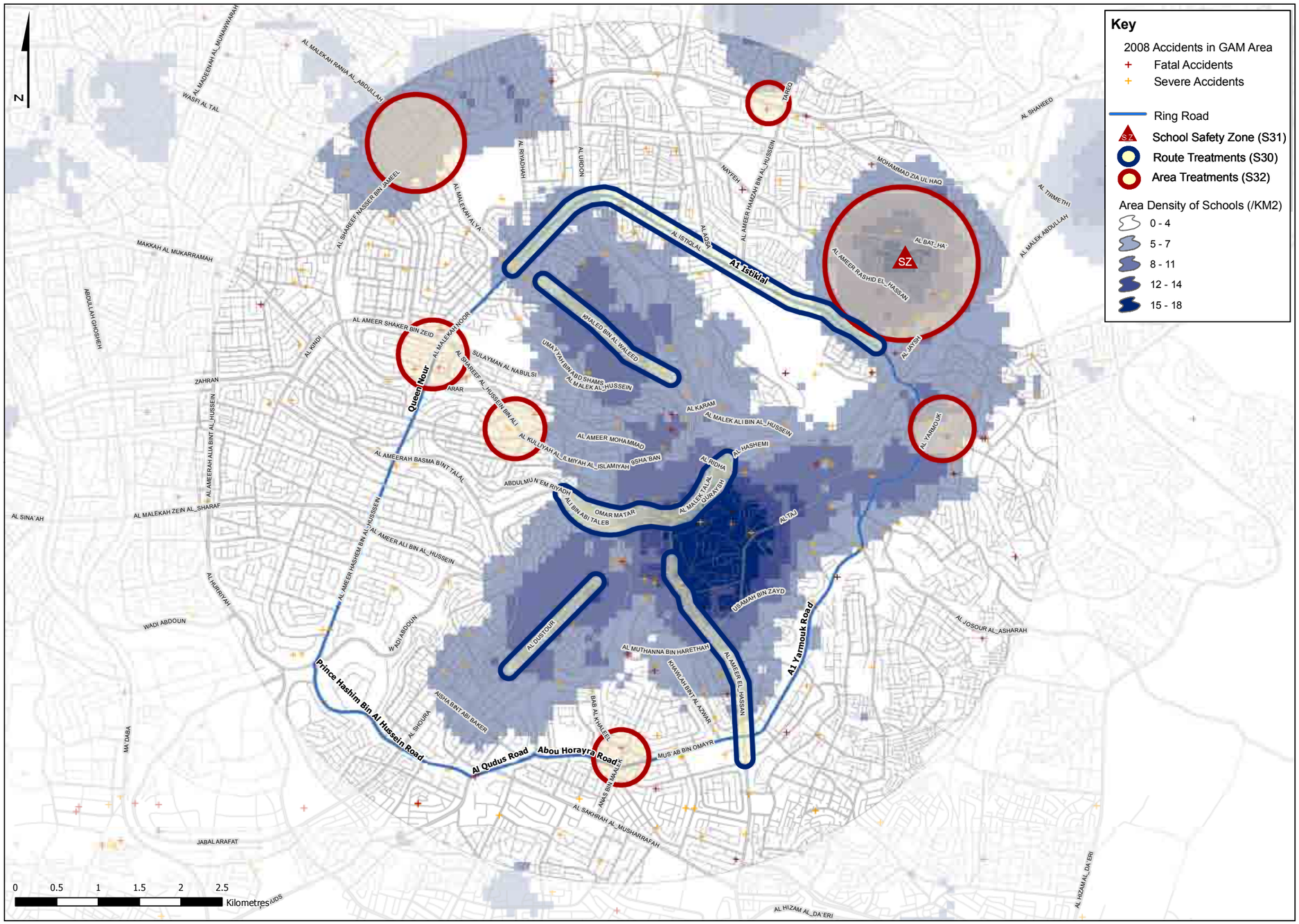


Figure 34 - City Centre Road Accidents (fatal, severe), 2008



Pedestrian Strategy

Why is this strategy needed?

The development of a walkable city is integral to Amman's liveability and the achievement of the aspired modal shift to public transport as part of the TMMP. Being able to walk comfortably and conveniently within a city is a basic expectation and Amman should be no exception to this. Currently, the pedestrian network within Amman is disaggregated and there are limited facilities in the form of highway crossings. There is a clear hierarchical disparity between the private car and pedestrians; a key issue that needs to be addressed as much through political will as engineering solutions. Pedestrians should form the top tier of the transport hierarchy and pedestrian links should be continuous and above all accessible. Whilst impossible to change, the topography and climate of Amman (particularly during summer months) do reduce the attractiveness to walk by all except those who have no alternative. Thus, pedestrian networks that better traverse steep gradients should be promoted with use of trees and vegetation to provide shade and cover.

What are the principles behind this strategy?

Following an examination and first hand experience of the range of issues which pedestrians are presented with on a daily basis within Amman, a framework of pedestrian core principles has been developed to structure the Pedestrian Strategy.

Firstly, a shift in priority is required to put greater emphasis on the importance of pedestrians within Amman with streets designed to accommodate and encourage walking over and above other modes.

Secondly, pedestrian desire lines should be accommodated to provide direct connection and, where appropriate, specific existing routes should be upgraded to better support pedestrian network accessibility that provides a genuine choice of movement.

Thirdly, to achieve network accessibility and offer improved priority to pedestrians, infrastructure within Amman should be better designed and implemented to include crossing facilities and to accommodate primary pedestrian desire lines.

What are the strategy objectives?

The development of a walkable city is integral to Amman's liveability and the achievement of the aspired modal shift to public transport as part of the TMMP. The key objective of the pedestrian strategy is to increase the proportion of trips made by walking.

How will the strategy be delivered?

The strategy will be delivered through the development of a number of programmes based on the core areas of priority, network accessibility and infrastructure.

Priority

Pedestrian movement should be regarded as the top of the transport mode hierarchy and streets should be designed to accommodate and encourage walking over and above other modes.

The strategy for improved pedestrian priority seeks to readdress the transport mode hierarchy and emphasize greater the importance of pedestrians within Amman. Across the GAM area the measures detailed below should be implemented as a means of starting the process of re-addressing the balance.

- Introduce push button demand at pedestrian signals;
- Provide signal cycle times to reduce pedestrian waiting times at signalised intersections;
- Extend the provision of pedestrian phases at signalised intersections; and
- Improve accessibility of subways.

Network Accessibility

A well connected pedestrian network provides a genuine choice of movement. It ensures that streets are safe and accessible to all and extends the street beyond just a link function that allows movement from A to B but also supports a sense of place, allowing land uses such as retail and recreation to be supported.

Pedestrian desire lines should be accommodated to provide direct connection and where appropriate specific existing routes should be upgraded to better support pedestrian network accessibility.

- To achieve the strategy for improving the accessibility of Amman by foot, it is important that the following measures are delivered across wider Amman;
- Provide suitable route approaches to and from designated crossing points;
- Ensure flagship developments are fully pedestrian/mobility impaired accessible;
- Provide a Travel Planner website to disseminate travel information;
- Install Internet Kiosks with travel information;
- Pedestrianise the Downtown area to link up with streetscape works within the vicinity of the amphitheatre also linking across to the Citadel;
- Full pedestrian improvements should be introduced on BRT routes as they are constructed;
- Pedestrian approach improvements to improve access to LRT stations;
- Package of upgraded pedestrian facilities along primary corridors as follows;
  - along Prince Mohammed leading to Arar and 9 Sha'ban
  - Wasfi Al-Tal and Abdulhameed Sharaf to better serve these streets largely fronted by commercial premises;
  - adjacent to University of Jordan;
  - adjacent to Sports City;
  - the northern section of Khaled Bin Al-Waleed;
  - corridor along Al-Muhajereen;
  - the northern section of Al-Dustour;
  - along Prince El-Hussein;
  - along the boundary of Al-Abdali development;
  - along King Hussein; and
  - along Prince El-Hassan to the junction of Al-Yarmouk.
- Package of upgraded pedestrian facilities along secondary network;
  - within Al-Thira;
  - within Jabal Al-Akhdhar;
  - within Al-Awdah;
  - within Jabal Al-Taj;
  - within Jabal Al-Hussein;
  - within Jabal Amman

Infrastructure

Pedestrian infrastructure should be designed and implemented to support the core principles of Priority and Network Accessibility. Priority for pedestrians should be elevated above vehicular traffic and the movements of the two modes should only converge when pedestrian and vehicular areas converge, such as at crossings.

Pedestrian infrastructure within Amman should be designed and implemented to provide a successful streetscape that incorporates, shelter, shade and protection from extremes of temperature.

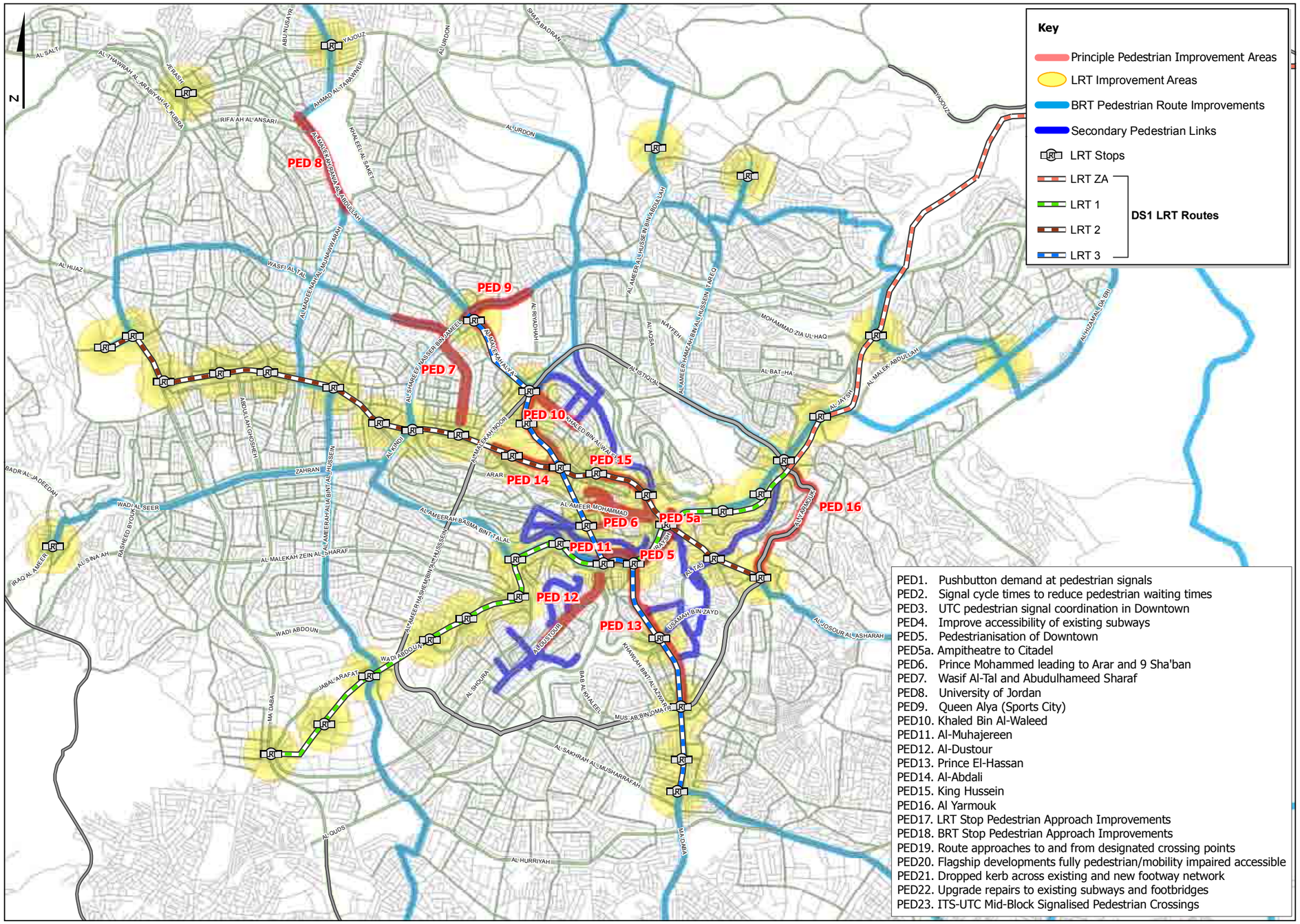
To ensure a high quality pedestrian environment and ensure pedestrian crossings shall be provided on all streets to accommodate primary pedestrian desire lines. Crossing facilities should provide suitable maximum pedestrian crossing distances and signalled crossings should be suitable for average walking speeds.

The implementation of basic pedestrian infrastructure is a key requirement of delivering an accessible and safe pedestrian network across Amman. It is proposed to implement the following measures across wider Amman;

- Installation of dropped kerbs across the existing and new footway network;
- Upgrade repairs to existing subways and footbridges; and
- Installation of mid-block pedestrian signals.

The outline programme for pedestrian improvements is shown on Figure 35.

Figure 35 - Pedestrian Strategy



Parking Strategy

Why is this strategy needed?

Currently parking provision within Amman varies significantly in terms of quality and supply across the city. There is clearly a lack of willingness by car drivers to pay for parking which results in large sections of indiscriminate parking along the primary and secondary highway network, with only major routes not susceptible due to focused levels of enforcement within these areas. Where off street parking provision exists it is frequently on informal areas of spare land and provided free to users. The quality of provision tends to be limited with no demarcation of parking bays or clear circulatory routes for both vehicles and pedestrians. Those off street car parks that are not free to use tend to be very poorly utilized, with drivers tending to risk parking on street where enforcement is limited. This exacerbates highway congestion and obstructs pedestrian networks.

What are the principles behind this strategy?

Whilst parking provision is not explicitly defined as a key transport objective, the development of a comprehensive parking strategy is a key contributor to delivering against the overall objectives. In developing the car parking strategy and responding to the identified weaknesses within the current situation a framework of parking elements has been developed which seeks to manage parking demand (and therefore traffic) through control mechanisms on supply (Balance of Provision) and disincentives on demand (Pricing Mechanism). This is to be supported through enhanced legislative and enforcement which will serve to influence drivers current behavioural approach to parking.

What are the strategy objectives?

The development of a parking strategy which provides effective management of supply will help support the achievement of the aspired modal shift to public transport as part of the TMMP.

The parking strategy objectives have been divided into four general activity areas

- Balance of Provision – Balance provision of long and short term parking provision in a way which maintains the economic viability and vitality of Amman. The objective for providing parking will be to provide short stay parking within the town centre, longer stay parking on the edge of town centre. Controlled parking zones in residential areas will allow greater control of parking in central areas.
- Pricing Mechanism – to introduce a cross city charging policy to manage car parking demand;
- Parking Standards - to introduce parking standards for private development to be based on specific criteria including accessibility based standards;
- Enforcement – to enforce use of, and payment for parking to ensure that revenue generated from fines and tariffs is collected effectively and hypothecated for transport investment;

How will the strategy be delivered?

Table 16 - Summary of Strategy Measures

A - Parking Provision (shown on Figure 36)	B - Parking Charges	C - Parking Standards	D - Education & Enforcement
Remove all on-street parking from defined set of routes	Parking tariff to be introduced across the city	Define parking standards for development	Implement changes in legislation to consolidate parking
Implement controlled parking zones	Private non residential parking levy to be applied across all PNR	Develop guidelines for on-street parking in private developments	Raise the profile of parking enforcement
Remove inappropriate use of on-street spaces by loading	Parking revenue to be used to help fund transport improvements	-	Review parking officer numbers and coverage bi-annually
Locate appropriate parking to inner and edge of town centre	-	-	ITS – Parking Guidance
Modify parking arrangements in Downtown	-	-	ITS – Park and Ride Guidance
Support with Park and Ride where appropriate	-	-	ITS – On-Street Parking Payment Systems

1. Manage the use of short stay on-street parking to improve traffic circulation

- Remove all on-street parking from a defined core network of routes specifically (in order of stringency);
  - King Talal, Quraysh and King Faisal Square; plus
  - King Al-Hussein, Al-Muhajereen, Omar Matar; plus
  - Ali Bin Abi Taleb, plus
  - Full primary network (where not currently within inner city area)
- Implement Controlled Parking Zones in key locations surrounding;
  - West Amman,
  - Downtown;
  - Khaldi;
  - Prince Mohammed; Arar and southern section of King Al-Hussein;
  - Al-Abdali area including Sulaymanal-Nabulsi, Majiles Al-Ummah and northern section of King Al-Hussein;
  - University section of Queen Rania Al-Abdullah;
  - King Talal Square
  - Prince Rashid El-Hassan
- Remove the inappropriate use of on street spaces by loading vehicles.
  - Allocated loading bays to be provided in proximity to retail centres
  - Restricted loading times to be implemented in
    - King Talal;
    - Quraysh;
    - Al Urdon;
    - King Faisal Square;
    - King Al-Hussein;
    - Khaled Bin Al-Waleed

2. Provide parking to maintain high turnover of short stay spaces in central areas, and longer stay parking to the periphery of the town centre.

- Increased utilisation of under used car parks (Al Shabsoch MSCP, King Al Hussein MSCP, Al-Jaleel MSCP, King Tala Square) through designation of areas for permit use and reduction of informal parking areas (Khaled Bin Al-Waleed, Quraysh)
- Reduction of formal (Al-Shabsoch, King Al Hussein) and informal (Quraysh, Omar Matar) long stay parking in the Downtown area;
- Provision of formal short stay parking in the Downtown area

3. Support the on and off-street central parking provision with Park and Ride where appropriate, such as:

- sites linked by the LRT and BRT at Sweileh Terminal
- Medical City
- Area C
- South Terminal
- Beituna Terminal
- Sahab Ring Road
- Madounah Ring Road
- Al Mahatta Terminal
- North Terminal

Table 17 - Current and Recommended Tariffs (JD)

Tariff Profile	<1 hr	1 hr	1-2 hr	2-3 hr	3-4 hr
Current Tariff	0.35	0.35	0.90	1.25	1.60
On Street Inner	0.55	1.05	2.10	3.20	4.25
On Street Outer	0.45	0.95	1.95	2.80	3.65
Off Street Inner	0.45	0.75	1.80	2.70	3.50
Off Street Outer	0.35	0.75	1.80	2.70	3.50
Park & Ride (all day)	2.00	2.00	2.00	2.00	2.00

Tariff Profile	4-5 hr	5-6 hr	6-7 hr	7-8 hr	>8 hr
Current Tariff	1.95	2.30	2.45	2.65	2.80
On Street Inner					
On Street Outer					
Off Street Inner	4.30	5.10	5.90	6.60	6.60
Off Street Outer	4.30	5.10	5.90	6.60	6.60
Park & Ride (all day)	2.00	2.00	2.00	2.00	2.00

Proposed Controlled Parking Zones

Using the Amman TMMP multi-modal model, an assessment of parking demand was undertaken both today and in the future to identify areas within central Amman where Controlled Parking Zones should be initially implemented. Suggested areas outside of the inner ring road are also included.

Figure 36 details the overall car parking demand. The highlighted zones are those with the highest current demand and therefore potential candidate CPZ zones. As can be seen, most of the potential CPZ zones are located towards the west of Amman reflecting the retail activity in that area.

Figure 37 provides an indication of future high growth patterns in parking activities in Greater Amman .

The areas identified in Figure 36 represent those areas where parking activities are currently highest, whilst the areas shown in Figure 37 show areas that are likely to show a significant increase in demand during the period of the TMMP during the next 15 years.

Figure 36 - Potential Controlled Parking Zones (2008)

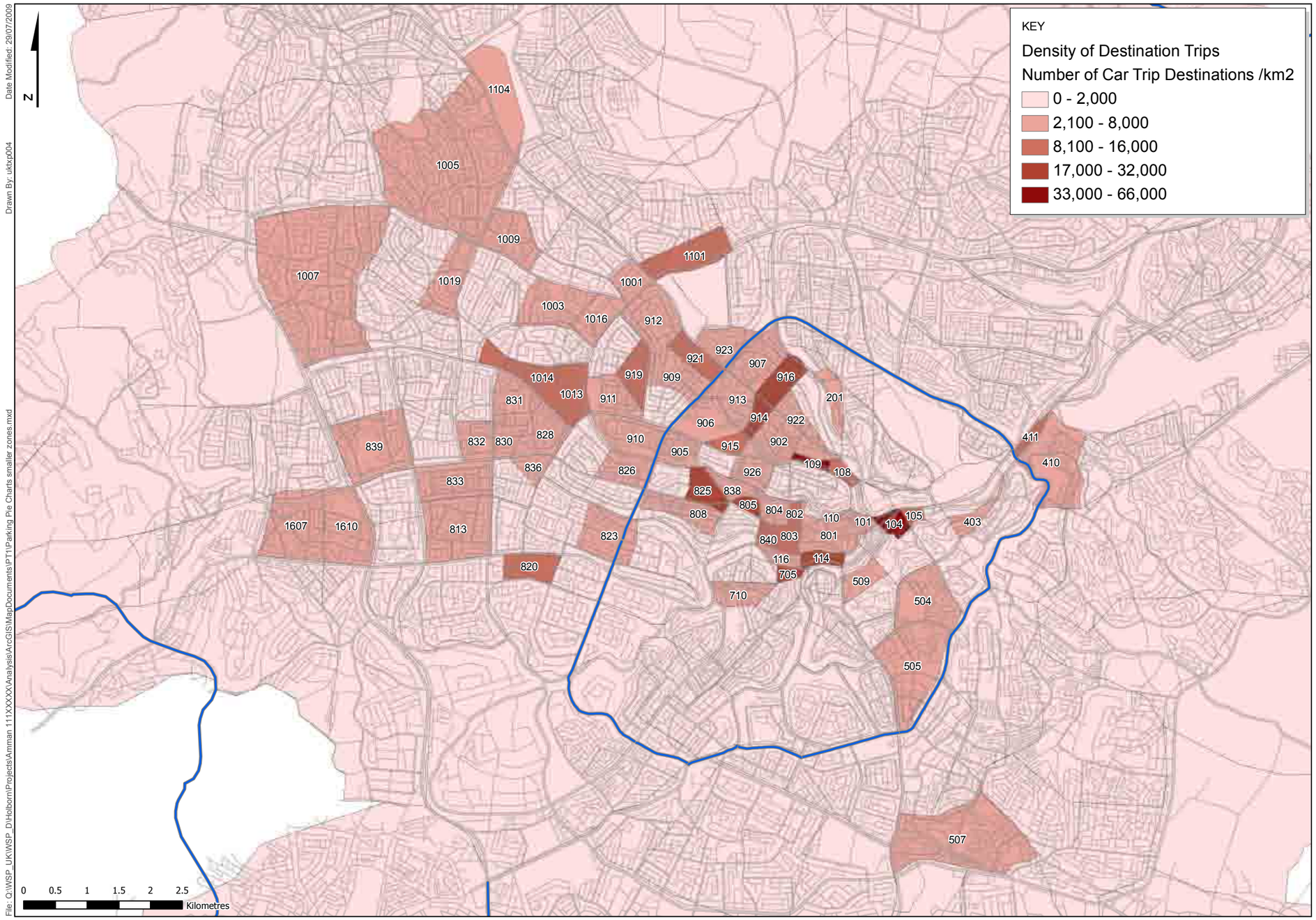
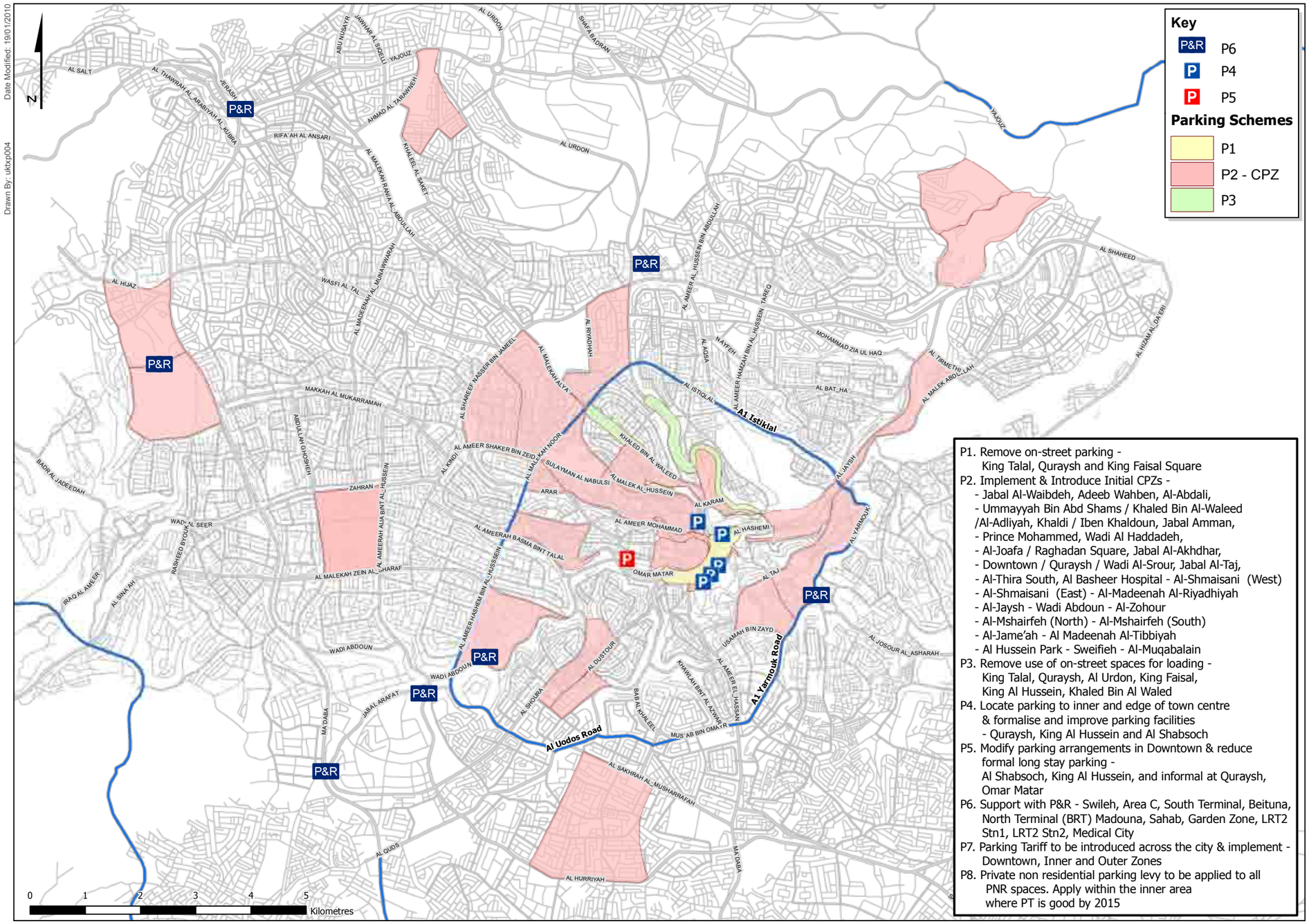


Figure 37 - Future High Growth Parking Activity



Freight Strategy

Why is this strategy needed?

The highway network within central Amman is relatively constrained, with significant congestion experienced during peak traffic hours. This can be exacerbated by movement of freight, in particular by deliveries being undertaken to businesses. Conversely, freight movement is also hindered by the existing congestion, affecting reliability of deliveries to businesses within the Municipality.

Large volumes of freight movements occur in particular to the north and east of the city centre, with further areas of large volumes of movements to south and west of the city centre. These routes tend to accord with the existing major goods flows from the Port of Aqaba (south of Amman), both to Amman itself and to other countries further east such as Iraq and Kuwait.

The freight analysis and subsequent strategy was based upon a number of data sets, namely the external origin-destination survey and the freight survey. The sector zone used for the assessment of freight demand shown below and the desire line diagram of freight movement shown in the following figures.

The origin-destination desire line diagram clearly shows that the majority of freight activity is towards the north east and south east of the city. From the traffic surveys, the percentage of goods vehicles entering and leaving the city is 15% where as for the inner cordon (city centre) it is just 2%. As can be seen, the primary movements of traffic from the north and south east of the city highlighting the major routes into and out of Amman, via Zarqa, Mouwaqer and Queen Alia International Airport / Jeeza area. The main external import and export countries are Iraq, Saudi Arabia and Syria and many of the routes taken to deliver are via Omari, Azraq, Jaber, Ramtha, Al Qastel and Queen Alia International Airport.

The Amman Growth Strategy has recommended a plan to manage growth to support a strong and competitive industrial economy. Bringing together the freight analysis with the Amman Plan, the figure overleaf provides a snap shot of the key freight generators, zoned industrial land, major industrial applications already made and the Amman Plan proposed industrial areas.

The primary demand for industrial land currently sits within the un-zoned south eastern area of the city. The area has gradually developed informal clusters without any real land use framework to guide development with very little supporting transport infrastructure and public transport.

The freight strategy primarily focuses on identifying the central delivery cordon, the identification of key truck routes in and out of the city, reinforcing the truck ban times and the introduction of a freight consolidation centre that facilities the deliver of goods to the City centre.

The sector to sector desire line diagram for freight is shown on Figure 38 and Figure 39. The proposed freight route into Amman is shown on Figure 40.

What are the principles behind this strategy?

Jordan provides a key strategic transit link for the distribution of freight between Jordan, Syria, Lebanon, Saudi Arabia and Iraq. As a consequence of the strategic road network within Jordan, Amman has become a hub of freight activity for the following movement types:

- Construction / Servicing and Maintenance / Retail / Utilities

What are the strategy objectives?

The development of the freight transport strategy for Amman should be underpinned by the following overarching freight objective:

- To achieve the safe, reliable and efficient movement of freight and servicing trips to, from, within and around Amman to support both Jordan's and Amman's economy whilst balancing the needs of other transport users, the environment and the quality of life in the city.

The separate types of freight traffic (Municipality and Transit Traffic) have their own issues and requirements which need to be met by the strategy. Thus specific sub-strategies have been categorised into municipality traffic and transit traffic as follows:

Municipality Traffic

The key objectives of the strategy with respect to Municipality traffic are:

- Ensure the reliability of inward and outward deliveries from the Municipality, to support and encourage economic growth.
- Safe delivery vehicle movements within the Municipality, in particular in central Amman where pedestrian numbers are higher.
- Reducing the impact of delivery traffic on the existing congestion in the city centre, to improve conditions for other transport users, in particular public transport.
- Reducing the environmental impact of deliveries to the Municipality, including noise and air quality issues in the city centre.

Transit Traffic

The key objectives of the strategy with respect to transit traffic are:

- To ensure transit traffic is provided with appropriate, efficient and safe routes through the Municipality, taking into account the key origins and destinations and the location of the Customs depot.
- To reduce transit traffic passing through central Amman, in particular through the congested areas of the city centre which also have significant pedestrian movements.
- To reduce the impact which transit traffic has on congestion within the wider Municipality area.
- To assist with effective road maintenance by encouraging transit traffic to use suitable routes.

How will the strategy be delivered?

General Measures

A range of specific measures has been developed which it is considered will assist in achieving the key objectives described above. Again, these are to be applied to Municipality Traffic and Transit Traffic separately. These measures are coded F1 to F10.

Specific Measures - Municipality Traffic

- F1 - Central Amman Delivery Cordon - encompassing the most sensitive and congested areas of highway, areas of high pedestrian activity, and areas in which air quality and noise are a particular concern. The enforcement of a central delivery cordon would naturally fall within the Amman Inner Ring Road and would run in parallel with the improvement and upgrading of the Inner Ring Road. Whilst the percentage of goods vehicles circulating within the city centre is relatively low, reinforcing a central delivery cordon would ensure proper management of freight distribution through the city.
- F2 - Central Amman Delivery and Service Plans to cover businesses within the Municipality, with particular guidance and restrictions for those within the central cordon.
  - Delivery Routing – identification of key radial corridor routes suitable for goods vehicles to move in and out of the city centre are identified within the strategy.
  - Delivery Time Restrictions - The truck banning policy for Amman has been very successful and the city is truck free for the majority of the peak hour periods. The intention is to remove delivery vehicles from pedestrian areas during the busiest times for shopping and other pedestrian movement and activity. This reduces the goods vehicle / pedestrian conflicts. In parallel with the development of a consolidation centre, we would recommend introducing two banning periods, with say a delivery 'window' during the middle of the day or the evening.
  - Loading and Waiting Restrictions - dedicated delivery bays and areas be identified within central Amman, from which loading and unloading can be undertaken efficiently and in safety with minimal impact on pedestrians and other traffic.
  - Vehicle Type Restrictions
- F3 - Urban Freight Consolidation and Distribution Centre - Given most of the industrial activity is towards the north, south and east of the city, it would be logical to locate the centre along the eastern section of the Amman Ring Road where a proportion of inbound goods for the city centre can be received at the consolidation centre, where they can be consolidated from multiple vehicles into one vehicle for onward delivery to the city centre. This one vehicle movement could then drop deliveries at a number of different businesses. Possible locations include Jeeza, north of Queen Alia International Airport, or Sahab/ Mouwaqer. The centre could also form part of the new customs /inland port depot located adjacent to the Amman Ring Road.

Specific Measures - Transit Traffic

- F4 - Relocation of Customs depot (planned)
- F5 - Freight parking - overnight freight parking and / or rest stops could be located at strategic points along the transit freight network.
- F6 - Inland port and distribution centre

Specific Measures - For both Municipality and Transit Traffic

- F7 - Freight Quality Partnership and Freight Operator Recognition Scheme
- F8 - Road maintenance
- F9 - Signage and VMS - In terms of route signage, in its most basic form we envisage simply fixed signage on all identified key routes into the city, directing freight traffic towards the key radial corridors which have been identified as suitable for freight traffic. On a more local level, fixed signage is to be used to direct traffic towards individual delivery areas such as Abdali and the Downtown area. As an extension to the above, it is recommended that a VMS signage system be introduced as part of the wider package of schemes and this is covered under the ITS strategy.
- F10 - Advertising and Promotion - the freight strategy and the measures within it will be advertised via the Freight Quality Partnership. Marketing the measures and the benefits which can be achieved will be crucial to achieving stakeholder 'buy in' and support for the measures within the strategy.

Figure 38 - Greater Amman Sectors

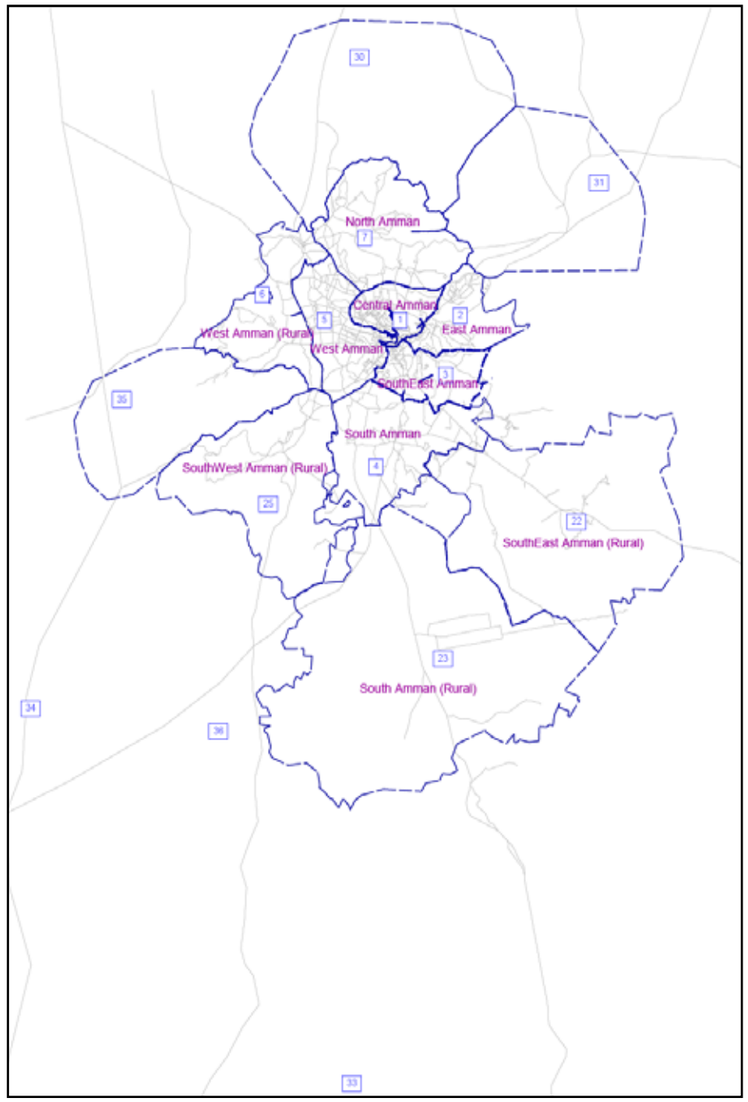


Figure 39 - Freight Desire Line Diagram

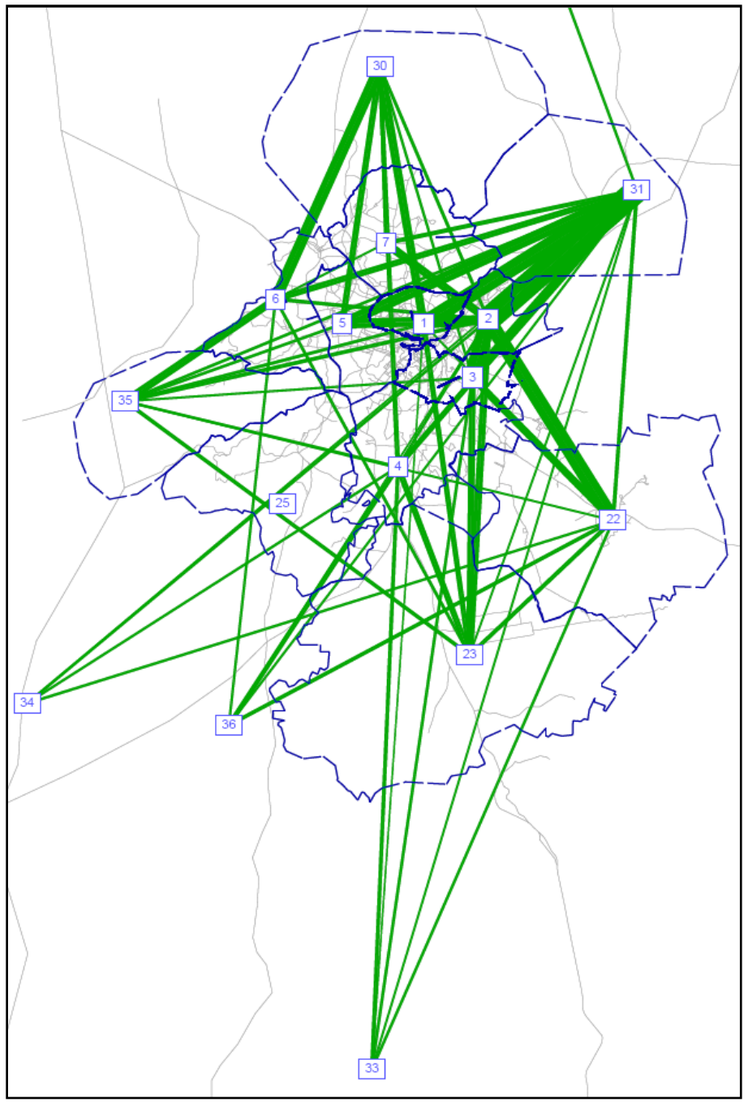
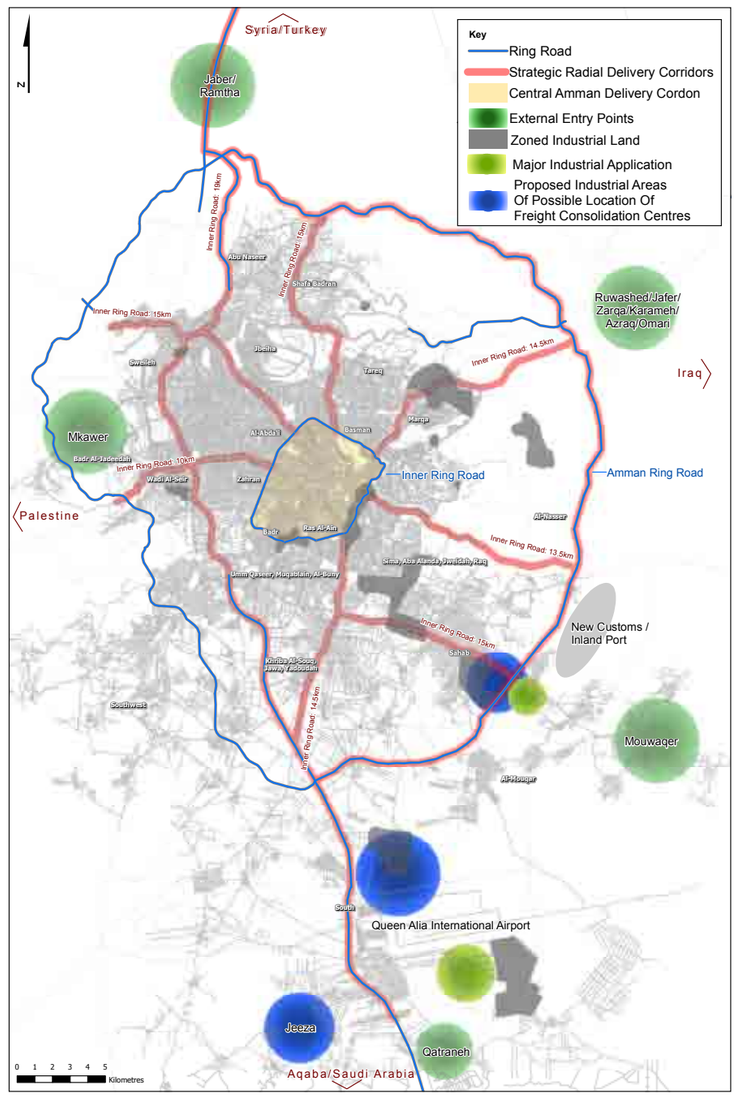


Figure 40 - Proposed Freight Routes



ITS Strategy

Why is this strategy needed?

The ITS Strategy measures have been identified in consultation with other TMMP subject specialists and aimed to deliver ITS technology in parallel with physical and institutional measures that have been proposed. The ITS Strategy has been developed specifically to support other topic strategies of TMMP and the core principles and targets concerning improvements to Congestion, Public Transport, Pedestrian Mode and movement of Freight in and around the city. Each of these policy themes has been considered to identify ITS measures that offer aid and support these themes both individually and as an integrated combination.

From site visits to GAM Traffic Control Centre and Traffic Police Control Centre, the level of existing ITS and system integration was determined, together with identification of gaps and any weaknesses of the existing ITS. The existing core ITS at the GAM Traffic Control Centre forms a sound basis for implementing alternative traffic control scenarios and provides the institutional framework that may procure and install additional ITS to support TMMP strategies.

What are the principles behind this strategy?

The proposed measures within the ITS Strategy support modal shift to Pedestrian Mode and Public Transport, whilst recognising the need to manage private car and freight trips into sensitive areas prone to congestion and adverse air quality. This includes adaptation of existing CCTV and UTC systems within the GAM Traffic Control Centre to manage traffic restraint and give priority to pedestrians and public transport. Also investment in additional systems including Real-Time Public transport Information (RTPI), and Variable Message Signs (VMS) to deliver traffic and travel information to interested agencies as well as the travelling public.

What are the strategy objectives?

The ITS Strategy addresses the following areas:

- Congestion (traffic management, flow optimisation and restraint)
- Public Transport (reliable service and information to passengers)
- Pedestrians (additional and improved at-grade pedestrian facilities)
- Freight (journey optimisation and access management)

ITS Strategy is based on a programme of inter-related projects, some of which will build on existing ITS systems already in place and others which will require investment in new ITS systems.

The objective of the ITS Strategy is specifically to support the Amman TMMP transport strategy themes (Congestion, Parking, Public Transport, Pedestrian Mode and Freight) by use of appropriate electronics and computer systems technology. As parking and congestion themes are interrelated, measures for these are combined below.

How will the strategy be delivered?

The proposed ITS Strategy contains measures aimed to support each of the policy themes either individually or collectively as follows:

1. Managing road congestion, noise and pollution.

- Congestion Measurement and Monitoring
- Congestion Management
  - Congestion avoidance (delay onset of congestion – demand management)
  - Congestion recovery (controls needed to clear congestion – incident management)

2. Promotion of a quality public transport service.

- Public Transport priority at traffic signals
- Real-Time Public transport tracking and service Information (RTPI)

3. Promoting pedestrian mobility within the central area.

- Signalised Pedestrian Crossings (at signalised junctions and new mid-block signalised pedestrian crossings)
- Demand Dependant Pedestrian Crossing operation and Pedestrian Detection on crossings

4. Addressing movement of freight both into and around the city.

Initiatives to improve road freight movements in and around the city as defined in the Freight Strategy can be aided by ITS. Long-haul trucking that have no calls within the City Centre can be routed away from the City Centre on preferred routes by journey planning software applications and use of strategic VMS. Tracking and access controls can also be applied to smaller delivery trucks serving commercial areas within the City Centre.

- Preferred truck routes and truck journey planning
- Freight vehicle tracking and access control

The following ITS projects are candidates for early implementation as they have fewer infrastructure and/or institutional prerequisites:

- UTC mid-block signalised pedestrian crossings and junctions infill.
- CCTV cameras at UTC infill junctions.
- UTC incident management and traffic restraint signal timing plans
- Strategic VMS at decision points on inner ring road and its approaches.
- Emergency vehicle priority at signals.
- ANPR Journey Time Monitoring system.
- Control Centre systems integration: common database and common data viewer.
- Roadworks information base.
- Traffic and Travel website.

Congestion & Parking

Congestion management and parking management ITS are both focussed on network utilisation and demand management. The projects are focussed on the City Centre, within the Inner Ring Road, and also arterial routes and major commercial centres outside the Inner Ring Road. Traffic signal coordination and better provision of pedestrian crossings can be improved within the City Centre and designated pedestrian improvement areas by deployment of additional junction and pedestrian crossing signals as infill on existing long links. Despite best efforts, congestion may still impact the network as a result of unplanned events and incidents. Incident management and congestion recovery will rely on vehicle detectors (UTC), CCTV and Journey Time monitoring to quickly detect incidents and congestion, UTC signal timing plans and VMS then used to invoke control strategies to overcome congestion and to pass information to the travelling public as to the location of incidents and diversion routes. The underlying principle is *Monitor*, *Control* and *Inform*.

- UTC Traffic Adaptive Signal coordination (expansion and infill)
- Traffic surveillance CCTV (expansion and infill)
- Parking Guidance VMS (directions to major City Centre car parks)
- Park & Ride Guidance VMS (directions to Park-and-Ride sites outside Inner Ring Road)
- Diversion VMS (strategic VMS at decision points on Inner Ring Road, also outer Ring Road)
- Control Centre integration and Data exchange between Control Centres
- Journey Time monitoring (on Arterial routes in and out of City Centre, also on Inner Ring Road)
- UTC traffic restraint signal timings – Congestion/ Air Quality (metering of traffic into City Centre)
- Roadworks management and information base
- Emergency vehicle priority at traffic signals
- Electronic Road User Charging and Enforcement (City Centre demand management)
- On-street Parking payment system (City Centre demand management)

Public Transport

Public Transport services can be supported and enhanced by ITS by use of traffic signal priority to pubic transport vehicles, also by providing service information to

the travelling public at termini, bus stops, on vehicles and via internet and mobile phones. These pubic transport ITS initiatives should be integrated with proposed smart-card automatic fare collection and plans for introducing LRT and BRT.

- Public Transport Real Time Information (RTPI)
- Public Transport priority at traffic signals, segregated bus gates, bus lanes/ links.
- Traffic & Travel Information website, internet kiosks, cellphone subscription services.

Pedestrian Mode

Pedestrian mode can be promoted and pedestrian safety improved by the introduction of additional at-grade signalised pedestrian crossings linked to the SCATS traffic adaptive UTC system. The UTC system can also be programmed to give additional time to pedestrians over traffic. These ITS projects are included within the Pedestrian Strategy and deployment particularly aimed at pedestrian improvement areas.

- Mid-block signalised pedestrian crossings
- UTC Demand Dependant Pedestrian Phases at Junctions
- UTC Pedestrian signal frequency - by cycle time
- UTC Pedestrian signal frequency - multiple pedestrian phases
- UTC Pedestrian signal coordination

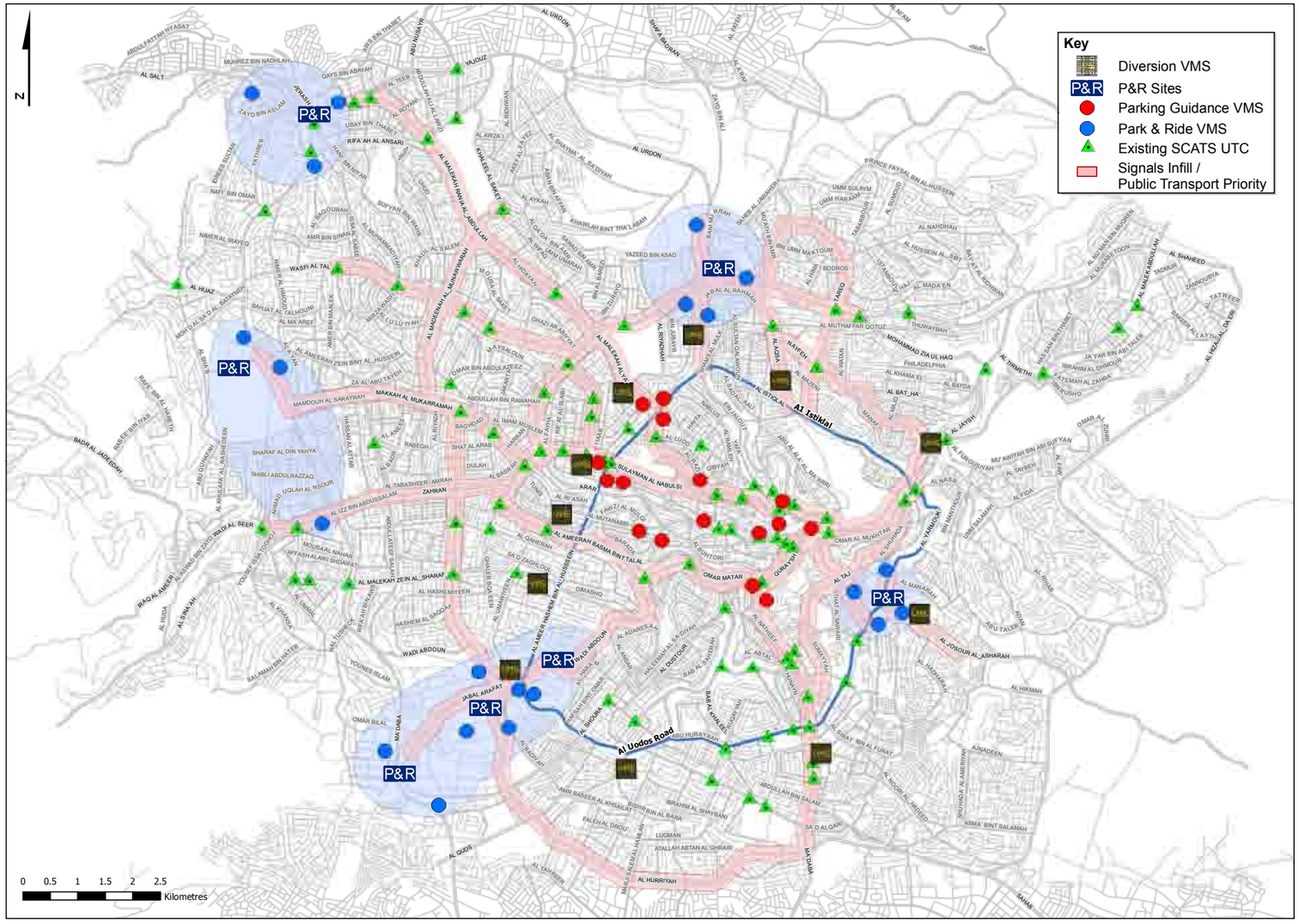
Freight

- Freight Route Planner and Load Tracking
- Restricted Freight Mobility enforcement system

Infrastructure

Infrastructure for ITS strategy comprises physical (control centre building, cable ducts, gantries etc), power supply infrastructure and communications infrastructure (broadband cable and wireless networks) to support deployment of electronic systems. GAM have invested in a Traffic Control Centre and use modern IP communications methods that are commercially available in the city. There is a potential opportunity for installation of fibre-optic cable communications infrastructure in parallel with the physical infrastructure along the proposed LRT, and BRT routes. This GAM fibre-optic cable network could be used for ITS and other GAM services. Metropolitan wireless communications infrastructure (MESH, WiMax) is an available option which has adequate bandwidth for ITS applications including CCTV. However, it is unlikely that installation of a dedicated municipal communications network, whether Fibre-Optic cable or a wireless alternative can be justified purely for ITS.

Figure 41 - ITS Strategy



City Centre Strategy

The City Centre

The City centre is more or less defined by the Inner Ring Road and is of significant importance in terms of cultural, environmental, economic and social activity with several existing and proposed key land uses including:

- the down town souk,
- Opera House,
- Museum,
- Faisal Square,
- the Grand Hussein Mosque,
- the Amphitheatre,
- the Citadel,
- the Abdali development.

The City Centre also includes some key transport corridors that facilitate the movement of passengers and freight. As shown in Figure 57, these include:

- Al Quds Street
- Prince Al Hassan Street
- Princess Basma Street
- Zahran
- Mecca
- Queen Alia
- Jordan Street
- Al Jayish
- King Abdullah I

Traffic surveys show that over 335,000 vehicles cross the City Centre between 0700 and 1900 hours and over 880,000 vehicles cross the inner cordon during the same time period with 92% made up of private vehicles (66%), pickups/vans (12%) and taxis (14%). Average journey times during the AM peak in and around the City Centre range between 12 kph and 22 kph.

In terms of car parking, the City Centre suffers from a variety of problems including indiscriminate parking, illegal parking, double parking, parking near junctions and pedestrian crossings and this, coupled with the lack of enforcement, generates significant capacity problems to the City Centre network. Based upon the reconnaissance surveys, the off street parking spaces is estimated at around 6,000. Using the household survey data, there are around 60,000 daily work trips seeking a car parking space.

The overall strategy has been described in Section 9 Under this section, we elaborate the City Centre strategy by providing further detail and some typical demonstration projects that can be undertaken.

Also provided is an “integration matrix” showing how the various strategies integrate, contribute and support each other strategy.

The Public Transport Strategy: The public transport strategy is intended to provide connectivity at clearly defined transport interchanges, thus facilitating journeys through the City Centre, to encourage easy access to all major facilities within the City Centre area, to ensure that the public transport system encourages tourism and to use the opportunities created by new public transport infrastructure to facilitate road safety and encourage walking.

The Pedestrian Strategy: The pedestrian strategy focuses around identifying key public transport interchange zones where pedestrian improvements are required. It also assess the walk time between key transport hubs and the way.

The Safety Strategy: The safety strategy pivots off the overall strategy for Amman but focuses on safer routes to school and presents a typical set up for a school zone in Amman.

The Parking Strategy: The parking strategy focuses on key target areas and provides best practice for setting up Controlled Parking Zones (CPZ). A demonstration project has also been presented for one area within the City Centre which included a very broad based economic assessment of the CPZ scheme.

The Freight Strategy: In terms of freight, the City centre strategy focuses on the advantages of freight consolidation, lorry parking and key routes servicing the city centre.

The ITS Strategy: The ITS strategy includes measures that aid congestion and parking, public transport, pedestrian mode, safety and freight mode.

The Downtown Strategy: The downtown strategy looks at a number of options at accommodating a dedicated public transport system.

Given the above, the proposed strategy needs to address:

- Increasing traffic congestion
- Inadequate pedestrian facilities
- Indiscriminate parking activity
- Poor localised public transport coverage
- Poor access to key cultural facilities
- Poor air quality
- A need to regenerate the local economy

Developing the City Centre Strategy

In developing the City Centre strategy, some of the key drivers considered are:

- The overall GAM strategy and its integration and support of the City Centre
- The public transport strategy
- Proposed regeneration areas
- Pedestrian traffic
- Integration of strategies

What are the principles behind this strategy?

The key principles behind the strategy are:

- Develop specific zones for economic development and growth
- Create a vibrant urban neighbourhoods for retail and commercial activities
- Reduce traffic congestion in city centre
- Enhance attraction for tourism
- Improve road safety
- Improve and regulate both on and off street parking provision
- Facilitate mobility between key locations

What are the Specific objectives?

- Reduce through traffic especially in the downtown area
- Develop a coherent and integrated controlled parking zones to manage car parking demand
- Provide a pedestrian friendly network / areas that supports social and cultural activities, particularly within the downtown area
- Improve safety, particularly to pedestrians
- Provide a platform for BRT and LRT systems
- Provide opportunities for increased economic activity in and around the major public transport hubs
- Reduce air pollution levels

Strategies and Best Practice

Public Transport

Background

As everywhere else in Greater Amman, the only current form of public transport in the City Centre is provided by bus, minibus or white taxi. There are few formalised large terminals in the City Centre, other than the temporary facilities at Al-Mahatta, which is on the north east boundary of the area under consideration. The newly built terminal at Raghadan houses a number of white taxi routes, but is not popular due to its distance from where passengers wish to travel to and from. White taxis also pick up and set down passengers along King Talal and Quraysh Streets, causing significant congestion problems, and a small number of minibus and white taxi routes terminate at Saqf Al-Sail Terminal and at Wadi Sir Bus Station (Al Muhajareen).

Generally, local routes to the South West and South East of the City Centre have been provided by white taxis and 'Coaster' type minibuses, although that is changing as GAM retenders franchises. On the main approach streets to the Downtown area of the City Centre from the North, the North West and the West, in particular Al-Urdon, Khaled bin Al-Waleed, King Al-Hussein, Prince Mohammad and Ali bin Abi Taleb, there are currently a significant number of bus routes being operated by large single deck vehicles, most of which pass through the Downtown area to terminate at Al-Mahatta Terminal.

Overall, bus service coverage of the City Centre area is reasonably extensive, but gives the impression of being uncoordinated and almost impossible to understand for the non-user of public transport. Congestion is endemic in the City Centre, particularly in the Downtown area, and if the local economy and the environment of the area is to be improved, it is important to include within the strategy for the City Centre provision for an attractive and efficient public transport system to enhance accessibility.

Principles

In addition to the general public transport principles described in Chapter 9, the following are specific to the City Centre area:

- Provide connectivity at clearly defined transport interchanges to facilitate journeys through the City Centre;
- Encourage easy access to all the major facilities (health, work, education and leisure) located within the City Centre area;
- Ensure that the public transport system encourages tourism;
- Use the opportunities created by the construction of new public transport services infrastructure to facilitate road safety and encourage walking.

Public Transport Strategy Objectives for the City Centre

Our Public Transport strategy objectives are centred round the four broad areas of hierarchy, accessibility, priority and infrastructure. We propose to apply these objectives to the City Centre as follows:

Hierarchy: We believe that the City Centre needs to be knitted together by a strong interconnectivity of major public transport corridors. These corridors must consist of high frequency services offering high capacity for users, and they must provide a reliable and predictable transport experience.

Accessibility: As elsewhere in the City, there will be subsidiary services to the core public transport corridors, which will provide local connections, including the ability to link together the foremost business, retail and tourist attractions within the City Centre. To optimise accessibility, it is crucial that the pedestrian and public transport strategies are closely integrated to allow easy movement from public transport interchanges and stops to all areas of the City Centre.

Priority: In many parts of the City Centre highway space will be at a premium due to the constrained nature of the built up area, much of which constitutes the oldest parts of the City. Despite the impact of our various strategies to tackle the impact of the additional trips which will be generated by the substantial growth in population in Greater Amman, the streets of the City Centre will still be busy, and public transport services need to be given priority over other traffic in order to be able to operate to the level of reliability needed.

Infrastructure: Investments in infrastructure will be a very important element of the City Centre public transport strategy. Our proposals include both LRT and BRT as forming the backbone of the future public transport system, and both systems will require substantial investment. In addition, well designed interchange stations, terminal facilities and stops and stations themselves will be required.

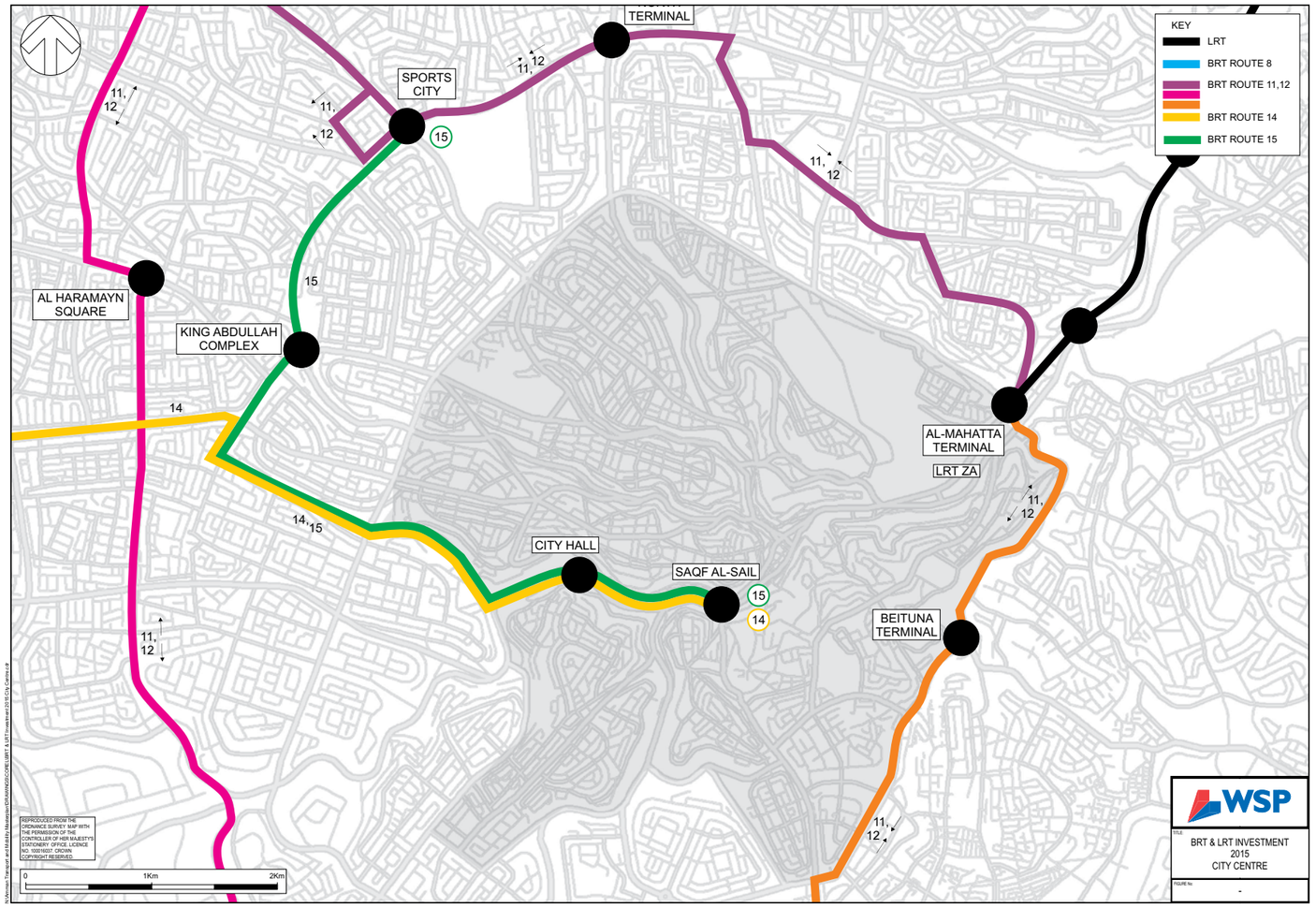
City Centre Public Transport Strategy

2010 to 2015

The core element for public transport in the City Centre will be the proposed LRT and BRT systems. However, these modes will not make an early impact on the area because the BRT routes planned for the period up to 2015 only skirt the City Centre area, or terminate on the periphery, except for two Lines from the western side of the City, which are planned to serve City Hall and then terminate at a rebuilt terminal at Saqf Al Sail. The BRT routes proposed by 2015 are shown in Figure 42 below. It is unlikely that any LRT routes will be constructed by 2015, other than, possibly, the Zarqa to Amman Line.

Modern LRT System

Figure 42 - BRT Lines Operational by 2015



Improved bus services will be introduced elsewhere in the City Centre area, operating to a published timetable at higher frequencies than is currently the case. This will include a Local route serving some of the major attractors in the area, operating to a high frequency using new technology minibuses. It will connect the Wadi Amman area from Raghadan Terminal with the traditional City Centre, King Abdullah Square, the Al Abdali development, returning to the City Centre via Khaled Bin Al-Waleed Street. This circular service will operate in both clockwise and anti-clockwise directions.

Until the further development of the LRT and BRT systems, the majority of white taxi services will remain in place. Most of these start from Raghadan Terminal, but it is recommended that improved and formalised pick up and set down facilities are created in the Downtown area to permit them to serve the most important destinations for passengers in the City Centre.

As far as infrastructure is concerned, it will be important to identify a suitable location and design for a revised Terminal at Saqf Al-Sail. Current facilities are highly space constrained, but this location is of particular importance as the closest point to the City Centre served by BRT routes. It is envisaged that temporary work will be undertaken in this period to redesign the terminal facility and that major work to integrate it with LRT Lines 1 and 3 will be undertaken in the 2015 to 2020 period.

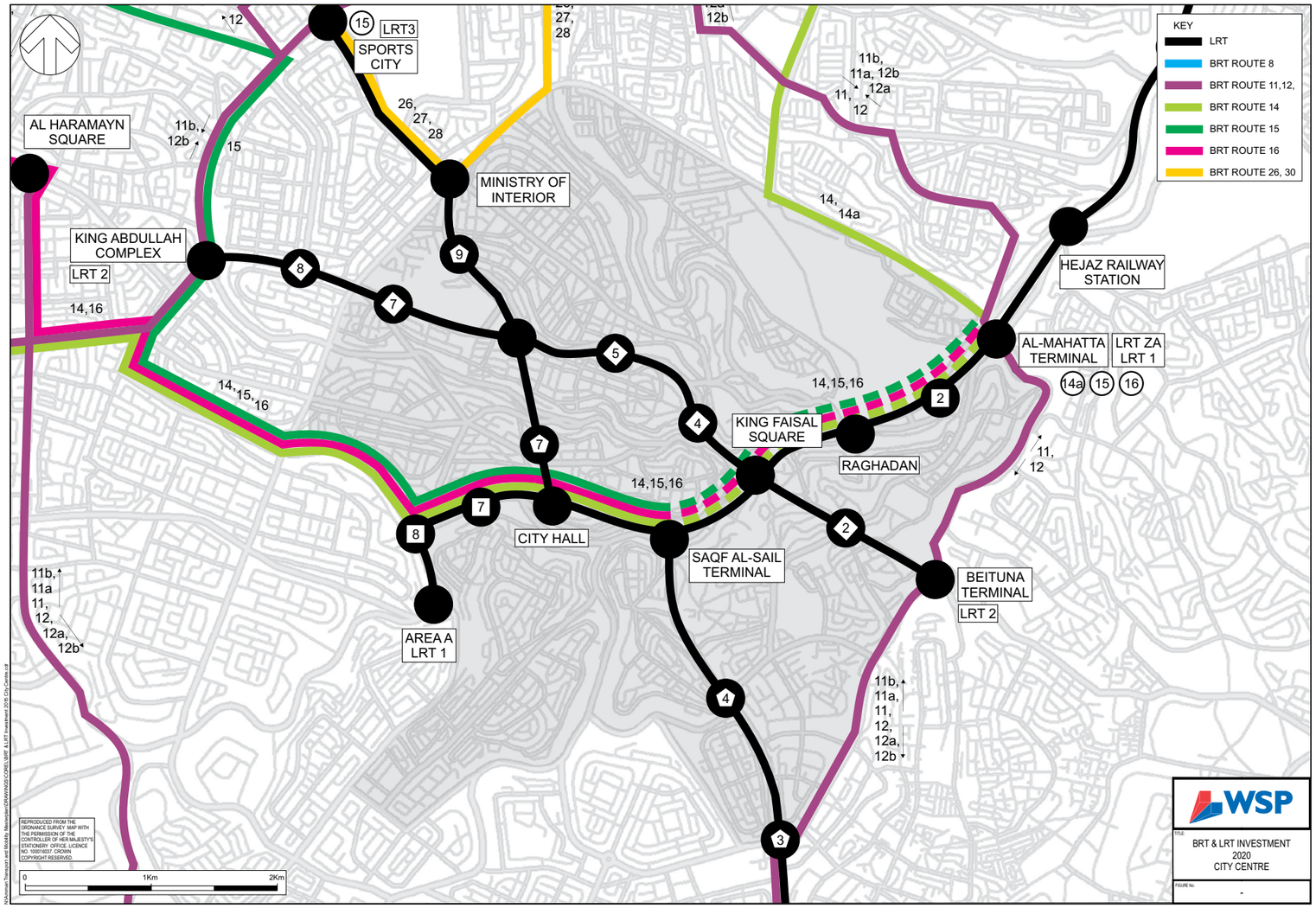
A great deal can be achieved to improve the perception of public transport between 2010 and 2015 by revising the fares structures into a zonal system, introducing universal smart cards, locating and constructing bus stops and shelters with service information throughout the City Centre and undertaking a publicity and marketing campaign based on the promotion of bus services operating to fixed timetables.

2015 to 2020

The period from 2015 to 2020 will see the greatest number of improvements for public transport in the City Centre area. The three LRT Lines should be constructed within the City Centre, although in the case of Line 1 to Area C and Line 2 to Medical City, they would initially terminate at Area A and the King Abdullah Complex respectively.

The LRT Lines within the City Centre area will be totally segregated from the highway network, with the majority of construction being underground. This will provide the reliability required, together with a strong interconnectivity based around the three major intersections where transfers from one LRT Line to another will be made. These will be located at King Faisal Square, City Hall and the King Abdulla Mosque. In addition, a number of stations on all three LRT Lines will provide access to wide areas of the City Centre. The proposed pedestrian and road safety improvements, based on walking distances radiating from these LRT stations, will enable people to make pleasant, safe and seamless trips from doorstep to doorstep. The LRT and BRT network to be operational by 2020 is shown in Figure 43 below.

Figure 43 - LRT and BRT Lines Operational by 2020



In the previous period up to 2015, new BRT services are planned to operate to Saqf Al-Sail Terminal. We believe that a key objective should be to find the means to extend these services through the Downtown area as far as Al-Mahatta Terminal, which will be rebuilt completely to provide an important multi-modal public transport hub for LRT, BRT and bus services. It is appreciated that this will be challenging from an engineering perspective, given the congested nature of the Downtown area. However we believe that a combination of the demand management measures due to be implemented, which should reduce congestion in the immediate Downtown area, together with the pedestrianisation proposals described in this City Centre Strategy, will provide a unique opportunity to provide a streetscape which combines priorities for both pedestrians and the BRT system.

We therefore envisage that the enhanced BRT services from the west and north-west of Amman will be extended to Al-Mahatta Terminal, and, indeed, one of the services will operate through to Prince Al-Hussein Bin Abdullah Street in the north of the City to provide a valuable through City Centre facility. Whilst these BRT services will parallel LRT Line 1 between City Hall and Al-Mahatta, this should not be regarded as a duplication, but as a means of spreading the very high demand indicated for public transport in this area, as well as providing through services from different parts of the City to those served by the LRT system.

Further improvements would be made to the bus network in the City Centre area, and the existence of a high capacity and very frequent LRT and BRT network would result in the need to transition the white taxi routes from longer services paralleling bus routes to a network of feeder services designed to provide public transport facilities in those areas of the City where the topography makes it impractical to operate conventional buses or where local connectivity to LRT or BRT stations is essential.

The period from 2015 to 2020 will also see the full reconstruction of Terminal facilities at both Al-Mahatta and Saqf Al-Sail.

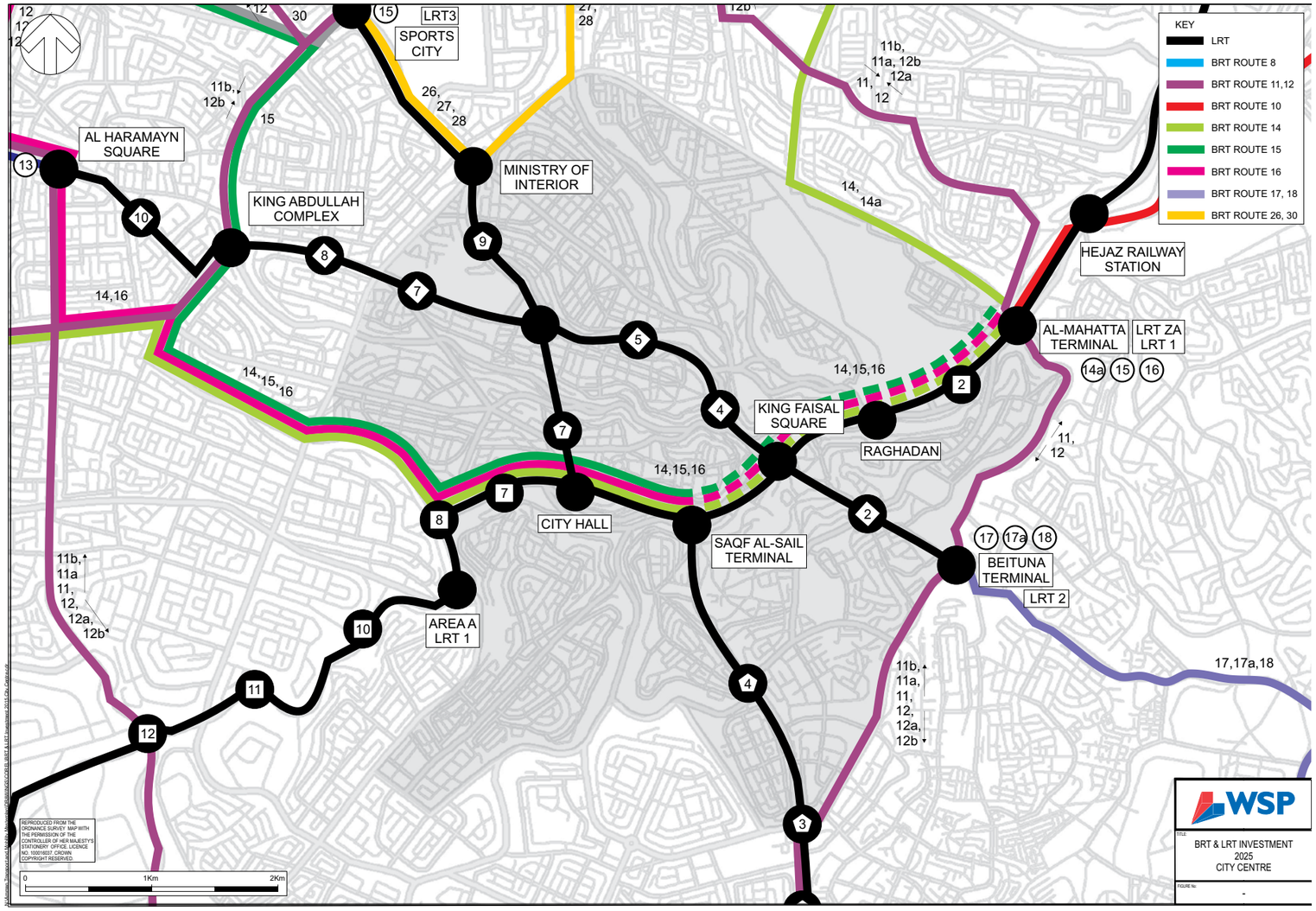
2020 to 2025

The period from 2020 to 2025 will see extensions to two of the LRT Lines, outside the City Centre, and further enhancements to the BRT service network, also outside the City Centre area. Further enhancements and improvements to the local bus and white taxi services will be implemented.

In the case of the latter, we recommend that those services providing connectivity to the key LRT and BRT interchange points within the City Centre be considered for Demand Responsive Transport (DRT) operation. DRT would need to utilise a call centre using specialised software in order to collate requests and calculate optimum trip generations for the vehicles used. The current white taxi services do not require any form of subsidy, despite their fares being determined by GAM.

Conversion to a feeder network, with or without DRT, may not offer the same level of commercial profit, hence it may be necessary to consider subsidy payments to ensure minimum earnings for white taxis. This would be in conjunction with the need to offer integrated through ticketing on these revised services.

Figure 44 - LRT and BRT Lines Operational by 2025



By 2025, it is intended that the City Centre will be served by a comprehensive, modern 21st Century public transport system offering an integrated and seamless travelling experience from doorstep to doorstep for citizens of Amman.

Parking

Background

A range of studies, assessments and site visits across the entire network have undertaken, both as part of developing the parking strategy and responding to known parking issues. These include:

- Review of parking within central Amman;
- Parking and enforcement technology paper for on-street and off-street;
- Best practice review of parking;
- Controlled Parking Zone review;
- Parking assessment of Khaldi Medical Area;
- Parking assessment of Al-Swaifiyah; and
- Parking assessment of Umm Uthaynah Al-Sharqi

Across central Amman there are approximately 6,000 off street parking spaces which supplies the observed level of daily demand for parking derived from the model. On the primary road network within central Amman there is provision of approximately 2,500 on-street parking spaces. Low amounts exist within the downtown area and other areas with retail frontage. Lay-by parking is also provided in the vicinity of GAM. On the remainder of the primary network parking restrictions apply to ensure traffic movement is efficient as possible. On sections of highway with large volumes of traffic and limited retail frontage, there are very few incidences of indiscriminate parking. However, all sections of the primary network adjacent to commercial retail and residential land uses experience indiscriminate parking.

Along the secondary and tertiary highway network the household survey results show that approximately 33,000 work based vehicle trips utilise on-street parking. A further 6,600 vehicles are shown to park in “non-designated parking places” and these are likely to be on-street, perhaps indiscriminately. Taking this, an estimated 40,000 vehicles park on street on a daily basis.

Public parking conditions across the central area of Amman are generally to a poor standard as presented in the photos to the right. A large number of car parks are informal in nature and are not hard-surfaced. The car parks are unattractive with gravel or concrete surfaces often in poor repair and limited use of landscaping to make them more ‘user friendly’ while in vehicles or when on foot. There are examples where parking bays and circulatory layout are inefficient and access and egress not always identifiable. Pedestrian routes through car parks are poor with little provision of safe routes.

Downtown Off-street Parking

Multi-storey Car Park Entrance

Lighting and security within the identifiable car parks is also limited and no car parks with formal security measures such as CCTV have been identified.

Parking Conflicts

Indiscriminate Parking for Loading

Car park signage within Amman is limited with very few car parks signposted from any great distance away. There is not a consistent approach to the way in which car parks are prioritised above one another in relation to their capacities and likely demand from different routes. This is likely to result in the inefficient circulation of traffic around the town as visitors make decisions on which car park to use.

Key Target Areas

Within the defined city centre area there are a range of land uses that generate parking activity and due to areas of high density and mixed land use, there are areas where parking demand is significant and creates areas of parking conflict. Whilst, there is a general parking pressures across much of the city centre, in particular the north-west quadrant (where commercial activity is greatest) there are key target areas for improvement;

- Majles Al-Ummam (Al-Abdali)
- Ali Bin Abi Taleb
- Al-Muhajereen
- King Al-Hussein
- King Talal
- Al-Shabsoch
- Al Yarmouk.

Our strategy

- Manage the use of short stay on-street parking to improve traffic circulation by removing all on-street parking from a defined core network of routes specifically;
  - King Talal, Quraysh and King Faisal Square; plus
  - King Al-Hussein, Al-Muhajereen, Omar Matar; plus
  - Ali Bin Abi Taleb, plus
- Implement Controlled Parking Zones in key locations surrounding;
  - Downtown;
  - Khaldi;
  - Prince Mohammed; Arar and southern section of King Al-Hussein;
  - Al-Abdali area including Sulaymanal-Nabulsi, Majiles Al-Ummah and northern section of King Al-Hussein;
  - University section of Queen Rania Al-Abdullah;
  - King Talal Square
  - Prince Rashid El-Hassan
- Remove the inappropriate use of on street spaces by loading vehicles by allocated loading bays in proximity to retails centres and restricting loading times in the following areas.
  - King Talal;
  - Quraysh;
  - Al Urdon;
  - King Faisal Square;
  - King Al-Hussein; and
  - Khaled Bin Al-Waleed.
- Provide parking to maintain high turnover of short stay spaces in central areas, and longer stay parking to the periphery of the town centre.
  - Increased utilisation of under used car parks
    - Al Shabsoch MSCP;
    - King Al Hussein MSCP;
    - Al-Jaleel MSCP; and
    - King Tala Square.
  - Reduction of formal (Al-Shabsoch, King Al Hussein) and informal (Quraysh, Omar Matar) long stay parking in the Downtown area;
  - Provision of formal short stay parking in the Downtown area
- Support the on and off-street central parking provision with Park and Ride
  - Implementation of Park and Ride sites in strategic sites linked by the LRT and BRT at Sweileh Terminal, Medical City, Area C, South Terminal, Beituna Terminal, Sahab Ring Road, Madounah Ring Road, Al Mahatta Terminal and North Terminal
- Support with an appropriate charging tariff

Best practice car parking (CPZs)

Implementing Controlled Parking Zones (CPZs) has been identified as key measures within the city centre area. This is to allow some vehicles to park without restrictions whilst limiting demand from other users i.e. in a predominantly residential area where resident's parking is unrestricted but limits are put on the number of visitors or employment uses parking in the area. This ensures all on-street parking is controlled to keep roads free from dangerous parking and give priority to particular users (usually residents and local businesses) who must display a valid permit.

Figure 36 highlights zones which could be suitable for CPZs within central Amman based on current parking demand. Controlled Parking Zones are implemented by dividing an area up into separate zones with residents permits only valid within the defined zones. These are clearly marked at the boundaries with on street signs. Those with the relevant zone permit can park without restriction. Commonly there is an annual permit charge and only residents can apply by providing their proof of address. To restrict the number of multi-car households, the cost of purchasing additional parking permits is high.

Disabled spaces can be designated to a registered number plate which is indicated on the disabled parking sign. In controlled parking zones this ensures disabled drivers can park outside their own homes/place of work.

CPZs are commonly supported with the implementation of on-street parking payment technologies such as Pay and Display to allow infrequent short stay visitors to park. Alternatively, specific parking bays can be demarked for short stay parking and Parking Meters can be installed.

Controlled Parking Zones require the following support/back-office functions to be in place:

- Registration and Administration;
- Charge Collection / Processing (where paid on street parking is also provided); and
- Enforcement.

Administration processes are required, to register users and issue the appropriate parking permit. This needs to be accompanied with clear permit instructions. Where paid on street parking is also provided is cash collection is required.

Enforcement is required to ensure parking restrictions and payment requirements are being adhered to. Enforcement is commonly carried out through visual checks by officers on foot carrying out sporadic checks in a given area. Penalty notices can then be issued where valid parking tickets are not presented.

CPZ Process

Initial Consultation

- Initial consultation with residents and businesses through letters and public meetings should be undertaken to identify the issues and needs of the CPZ to issues such as office workers, shop owners, retail business and visitor parking.
- During this consultation process, it is recommended that the Traffic Police and Car Parking Enforcement Police are also included.
- A clear statement of the overall strategy must be made so that the stakeholders acknowledge and appreciate the wider strategy and policy.
- Discussions must also be held with prospective operators and hardware providers to ensure that the “right system” is installed in terms of ticketing, cash collection and enforcement.

The CPZ Design Scheme

- The CPZ should be designed with regards to the needs and preferences identified in the Initial Consultation. A benchmark survey of current usage should be undertaken to identify current parking patterns i.e. whether there is sufficient space and what are the average duration of stays.
- Consideration must be given to the volumes of residents wishing to park as well as shops and businesses. The type of shops and any off-street parking they have should be considered and spaces designated to them if required. If resident parking during working hours is minimal then permits could be given to local businesses enabling parking during these hours.
- The level of signage must also be sufficient so that users are aware of restrictions on duration or when parking is permitted either with or without permits in the given zone. However it is also necessary to be mindful of causing visual intrusion on streets within the zone.
- Road markings should clearly indicate restrictions in force to ensure parking is only in spaces designated for that user i.e. marking indicating disabled space for any disabled user or that the space available is only for one designated user.
- The areas outside the CPZ must be part of the considerations taken into account during the design process, as some parking may otherwise transfer to these areas.

Formal Consultation

- Once the design is finalised, it must be subject to consultation by the Emergency Services, Transport Providers and other concerned parties. Legal approval must be sought at this stage if required.

Implement

- The works require the implementation of the relevant infrastructure i.e. road markings and signage. The removal of existing lines and/or markings and the painting of new ones may require partial road closures and parking restrictions.
- Awareness of the scheme and date of implementation is vital to ensure compliance and reduce disruption when implemented. Public awareness could be gained through publicity in the local media or signs in the affected areas.
- A sufficient time frame is needed so that permits can be acquired by residents and other users. Permits should be issued by whoever is responsible for enforcement. The process depends on the scheme to be implemented generally, for example, resident permits are granted on proof of address to a designated vehicle and business permits assigned to businesses for usage as they wish.

Review

- Once the CPZ has been in effect for a sufficient amount of time, a review of the operation should be undertaken and changes made if appropriate. It should then be reviewed annually to ensure restrictions remain suitable.

Demonstration Controlled Parking Zone

A demonstration Controlled Parking Zone was developed for Khaldi which is identified as having an existing parking problem, due to conflict of uses and pressures for both high and low turnover car parking. The study area (see Figure 45) is bounded by (but does not include) the following highways:

- Zahran;
- Mataar Al-Malekah;
- Sa'eed Al-Mufti; and
- Princess Alia Bint Al Hussein

In general on street parallel parking exists across the entire area and within the north of the study area on-street parking does not tend to conflict with general traffic except perhaps in proximity to junctions where parking is obstructive. This hinders pedestrians as vehicles often block pedestrian desire line crossing points.

There are sections where full no parking restrictions apply although these are largely not adhered to and no enforcement was observed. Some sections allow parking subject to time restrictions. Large areas are not subject to any parking restrictions.

Within the south of the area, where medical and financial facilities are located, the level of conflict created by the lack of parking management is significant. Many of the facilities provide off street parking that are from observations are well utilised.

On street parking is provided free of charge across the study area.

In order to evaluate the number of residents' vehicles parking on-street it is necessary to record all vehicles parked very late at night or early in the morning (when it is most likely that residents will be at home and very few non-residents will be parked in the area). Within the data analysis it is assumed that all vehicles parked during the first beat are vehicles belonging to residents.

A range of potential parking management schemes were considered further following review of identified constraints and parking demand data within the area. They are presented as individual schemes but many could and indeed need to be implemented in combination;

- Introduce charges (pay and display) for on-street parking;
- Increase on-street parking stay to a maximum of 2 hours to accommodate the majority of trips and ensure there is a turnover of spaces;
- Introduce increased levels of enforcement.
- Create a Controlled Parking Zone.

An indicative economic appraisal of the Khaldi Controlled Parking Area was undertaken based on the follow cost assumptions

- Pay and Display machines: Typical installation costs for an individual ticket machine including purchase are JD2,000 to JD5,000 per unit, depending on the range of technologies used. For the area of Khaldi, we envisage needing some 50 units at JD3,500 each totalling JD175,000.
- Back Office Processes: Pay and display parking systems require support/ back-office functions to be in place. The support back/office functions required to operate a successful parking system include Monitoring and Maintenance and Fare Collection / Processing. We envisage requiring circa JD20,000 per annum
- Parking Space Layout Marking: To layout and white line the area of Khaldi would cost circa JD10,000.
- Controlled Parking Zone Signage: In order to provide adequate signage within the area of Khaldi using locally made signs, we envisage a cost of around JD7,500.

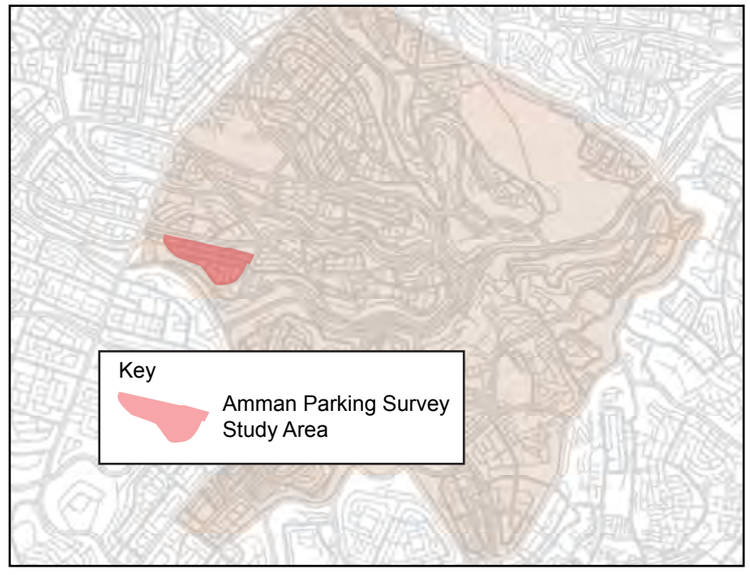
In terms of potential revenue, the following assumptions were made:

- Only charge non residents
- Maximum stay 1 hours
- Charge of JD1 / hr
- Potential daily revenue of JD2,199
- Revenue loss assumed at 40%
- Daily revenue JD 1,320
- Assumed days of revenue per year: say 260
- Total annual revenue: JD 343,000 per annum
- Total annual costs 1st year: JD 205,000, JD64,000 thereafter
- 10 year contract period to 2020
- Discount rate of 12%

Applying the above assumptions, over a ten year contract period, the economic rate of return (ERR) is 136% and the annual revenue after costs JD 283,000 per annum. Applying a parking charge of JD0.5/ hr would yield a revenue, after costs of JD 107,500 per annum and an ERR of 52%. If annual costs doubled (excluding pay and display machines) and the parking charge of JD0.5/hr was maintained, this would yield, a revenue of JD 43,500 per annum after costs and an ERR of 13%.

Example Off-Street Car Park

Figure 45 - Amman Parking Survey Study Area



Pedestrians

Background

The quality of the pedestrian environment within the city centre varies significantly across the area, due in large part to the range of land use types across the defined area and associated rates of new development. Where new development has occurred there are significant improvements to the public realm, including within Downtown adjacent the Amphitheatre. A key influence on the design of pedestrian infrastructure within the city centre is the topography and the balance of achieving desire lines whilst also mitigating steep gradients, as presented in the photograph of the steep stairways to the right.

There are a limited number of pedestrian crossing facilities at junctions, and these are in varying states of repair, with pedestrian push-buttons frequently inoperative. There are no at-grade, controlled crossing facilities away from junctions with provision being made in the form of footbridges (refer to photo). Crossing away from the footways is problematic and pedestrians were observed walking in the road alongside the footway in an effort to avoid obstacles such as trees, broken footway and high kerbs. Further problems exist in residential areas, including poorly defined pedestrian routes, wide streets (refer to photo showing severance created by median) and cross-roads without clear priority.

Pedestrian Overbridge

Steep Stairway

Example Crossing Signals

Median causing Severance

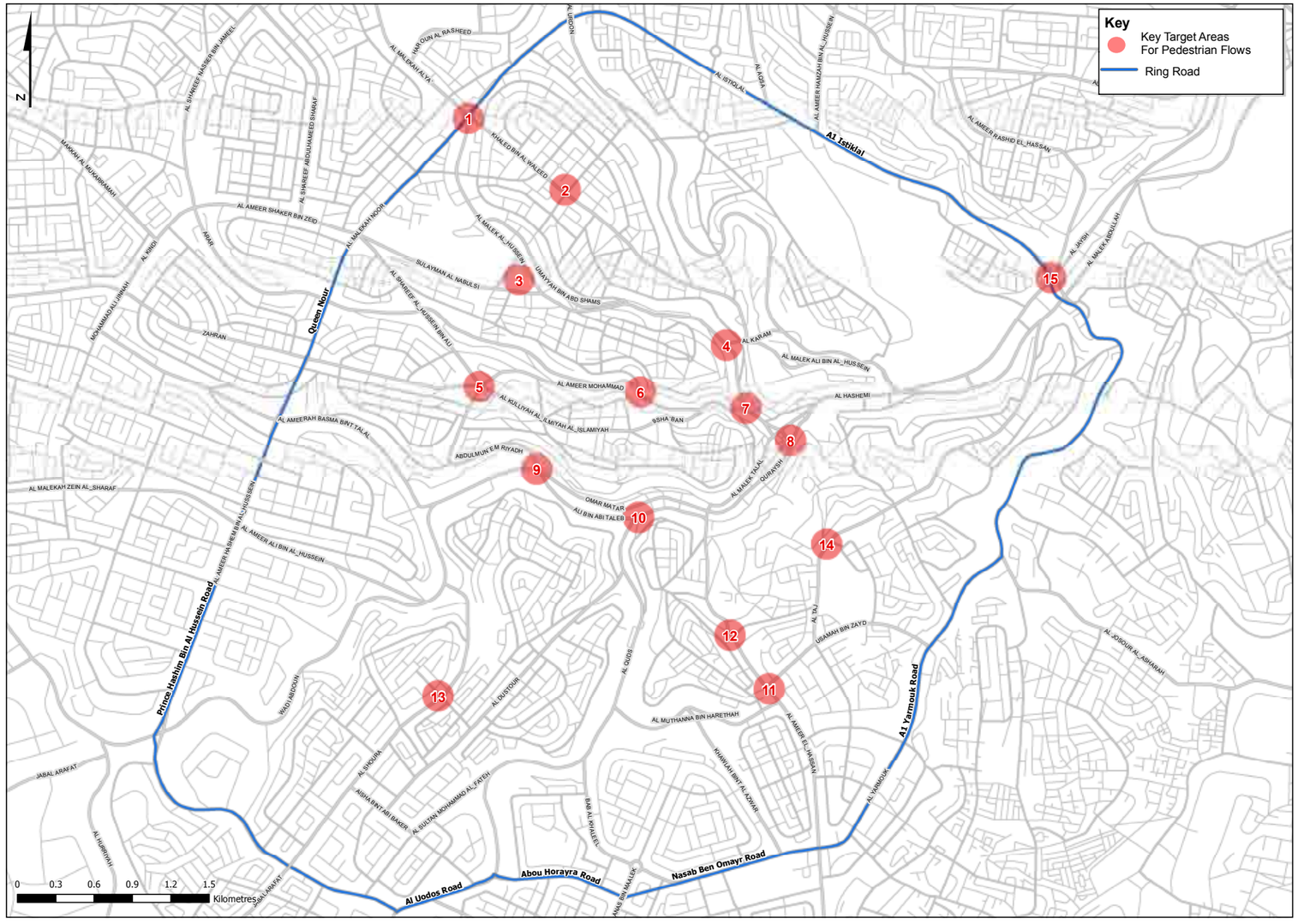
Mid-block Crossing

Key Target Areas

Using data derived from the TMMP model, key pedestrian desire lines have been identified. These have been used to highlight key locations (supported by areas identified thorough site visits) where pedestrians cross highways. These locations are as follows and are included on the map on Figure 46:

- Jamal Abdulnasser Intersection (1);
- Khaled Bin Al Waleed / Al-Jaleel (2);
- Al-Abdali / King Abdullah Mosque (3);
- King Al- Hussein / Al-Haddadeh Tunnel / Al-Urdon (4);
- Kind Talal Square (5);
- Arar / Prince Mohammed (6);
- King Al-Hussein / Prince Mohammed / King Faisal Square (7);
- King Faisal Square / Quraysh (8);
- Princess Basma / Abdul Mun'em Riyadh / Omar Matar (9);
- Ali Bin Ali Taleb / Al-Quds (10);
- Prince El-Hassan / Usuamah Bin Zayd (11)
- Prince El-Hassan / Al-Imam Al-Shafe'I (12);
- Al-Shoura Square (13);
- Al-Taj / Al-Abbasiyah (14); and
- Al Yarmouk / Kings Abdullah / Al Istiqlal (15)

Figure 46 - Target Areas for Pedestrian Flows



Uncontrolled Crossing Conflicts

Our Strategy

The strategy for improved pedestrian priority seeks to readdress the transport mode hierarchy and emphasize greater the importance of pedestrians within Amman. Within the city centre there are key corridors where pedestrian provision should be improved.

- Pedestrianise the Downtown area to link up with streetscape works within the vicinity of the amphitheatre;
- Prince Mohammed leading to Arar and 9 Sha'ban;
- Khaled Bin Al-Waleed;
- Al-Muhajereen;
- Northern section of Al-Dustour;
- Prince El-Hussein;
- Boundary of Al-Abdali development;
- King Hussein;
- Prince El-Hassan to the junction of Al-Yarmouk;

Pedestrian's Zones in/around BRT and LRT Stations

To support the implementation of the BRT and LRT lines, access to stations for pedestrians is paramount to ensure the system is accessible and attractive to potential users. A network of pedestrian improvements is presented in the wider pedestrian strategy and this includes key radial linkages within central Amman. To supplement this network areas representing indicative 5 minute walking zones around LRT and BRT stops are presented on Figure 47 and Figure 48. These areas should be enhanced to accommodate and promote increased walking activity offer improved opportunity to interchange with the new public transport system.

Best Practise Pedestrian Street Design

A key element of providing an enhanced pedestrian priority as part of the overall pedestrian strategy is to improve public realm as part of street design. Within the city centre, whilst the layout of the overall highway is defined, there is scope to provide improvement for pedestrians as part of street design. A best practice "typical scene" is presented below outlining the key zones within pedestrian realm which should be accommodated within the kerb and property line:

- Frontage;
- Through ;
- Furnishing
- Cycle (where provided)
- Edge

Frontage	Through	Furniture	Cycle (optional)	Edge

The frontage zone is the area adjacent to the building or property line. It should be kept as clear as possible to ensure access to buildings accesses are retained, in addition, allowing door openings, steps, signs etc to be located. Any differences in levels that need to be accommodated should be contained within this zone.

The principal area for moment is the Through zone. This should offer unhindered passage, both horizontally and vertically to pedestrians, providing direct through movement and accommodating pedestrian desire lines. Surfacing within the through zone should be firm, even and set at an appropriate width to accommodate peak pedestrian flow demands.

Street furniture, landscaping (which provides natural shading) and public transport stops should be located within the furniture zone, locating out of the direct line of the through zone. This area could also be utilized to provide vendor and kiosk type services. To accommodate public transport stops the furniture zone and the edge should be combined.

Cycle zones can be provided where required between the furniture zone and the edge. This provides a separate area to remove conflicts between pedestrians and cyclist

The edge demarks the interface between the public realm area and the vehicle highway or on-street parking, providing an unobtrusive barrier preventing vehicle and pedestrian conflict.

Figure 47 - Pedestrian Walk Times

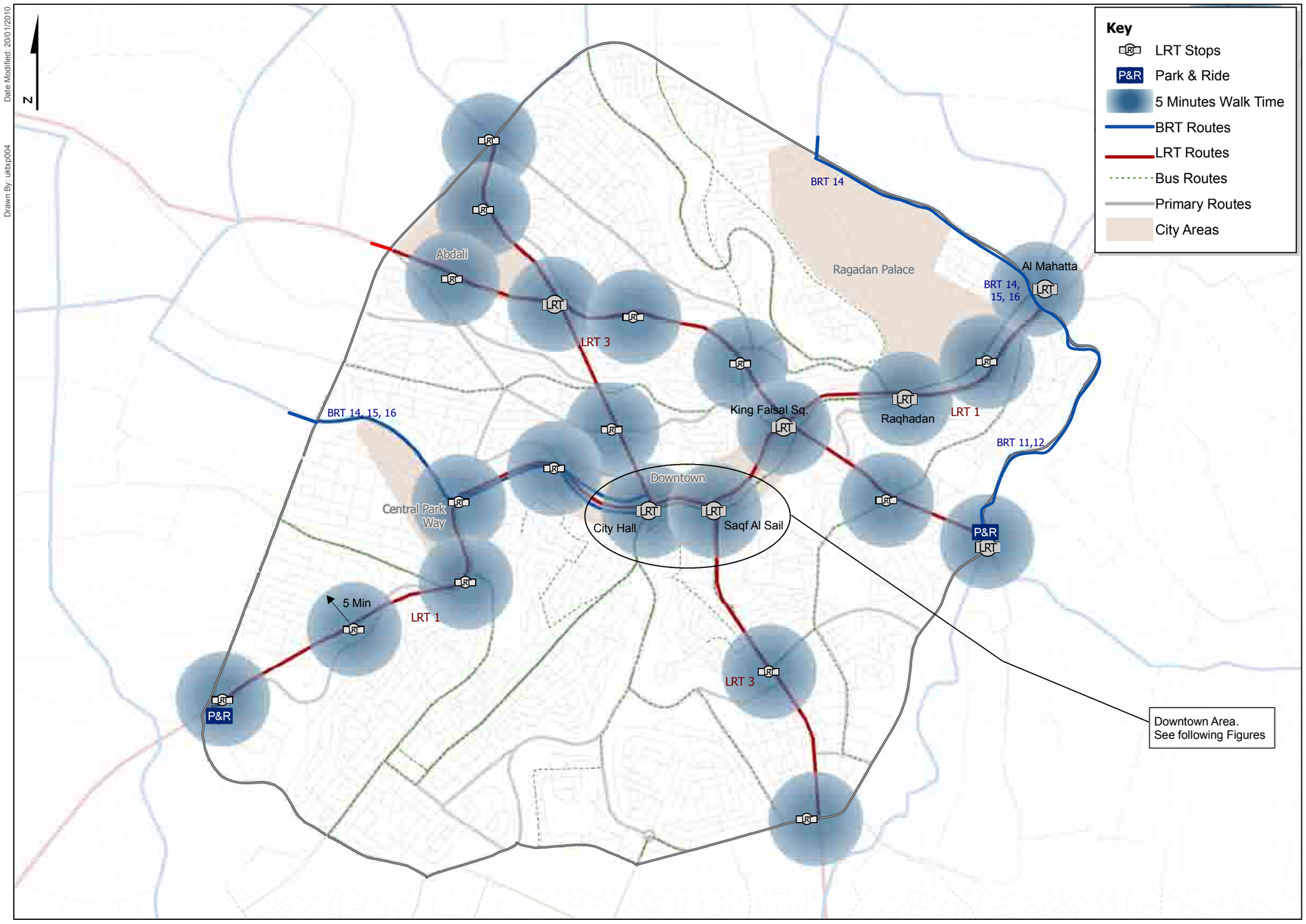
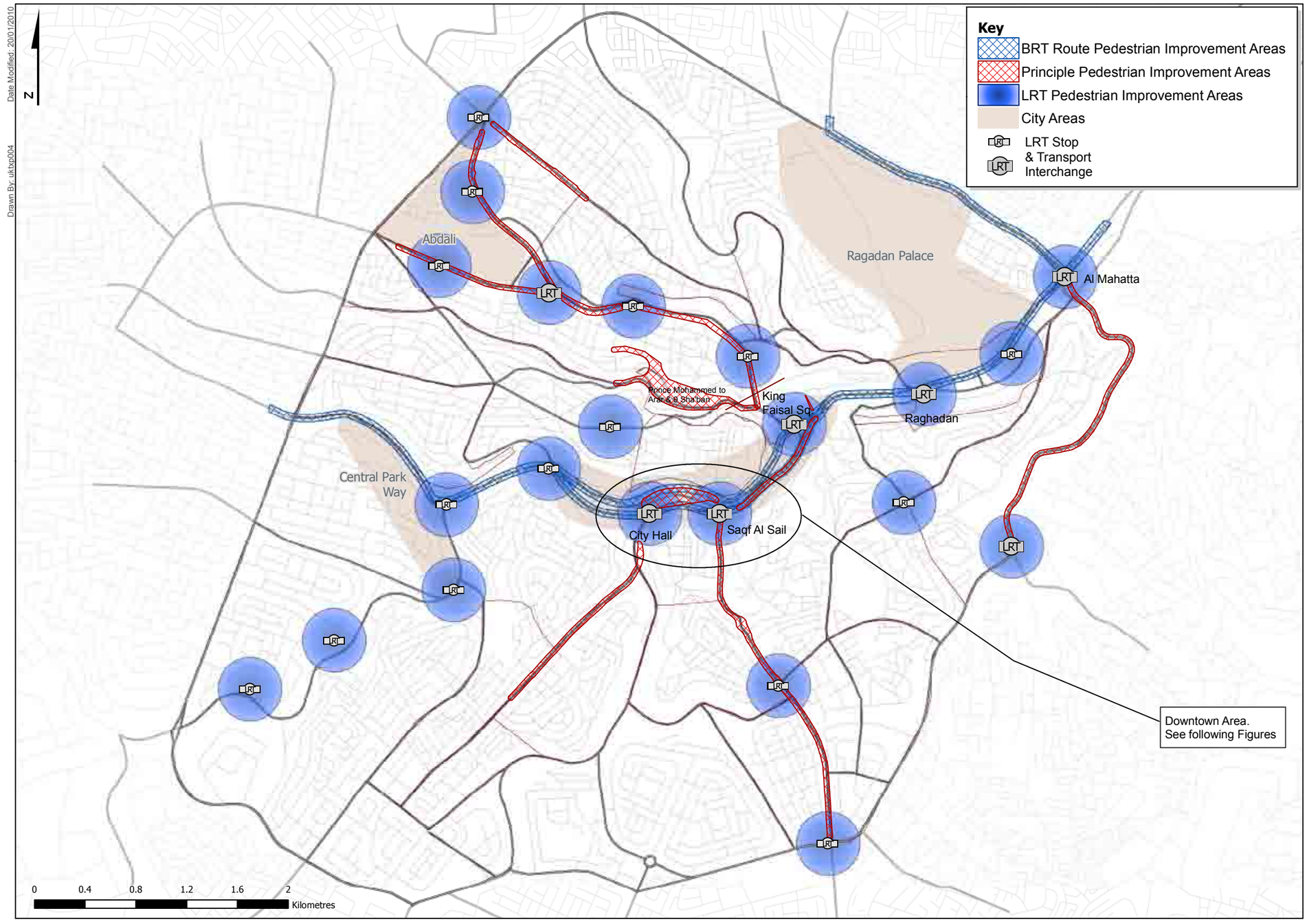


Figure 48 - Public Transport Pedestrianisation



Safety

Background

The overall safety strategy has identified a range of policy and strategy measures to improve road safety within Amman. The greatest number of physical measures have been identified within the city centre due to the increased level of activity for all modes of transport and the resulting increased risk of conflict. Accident data has been utilitised (for 2007 and 2008) to identify specific areas within the city centre where road safety measures should be implemented. Generally there are current infrastructure issues which do not actively support road safety principles. These include:

- Lack of maintenance of controlled crossing facilities, rendering them inoperable and perhaps resulting in pedestrians taking risks to cross the carriageway;
- Vehicle crossovers protruding into the carriage, having the potential to force vehicles to take avoiding action by veering off line, resulting in sudden lane changes.;
- Uneven footway surfaces, sudden differences in levels and lack of footway, perhaps resulting in pedestrians opting to use the carriageway, putting them at conflict with traffic;
- Indiscriminate parking on footways forcing pedestrians into the carriageway putting them greater risk to traffic.;
- Road marking demarcations are faded or lacking, perhaps leading to late and erratic lane changes. This could also result in overshoots at priority junctions. ;
- Approaches to Traffic Islands are often unmarked with no warning signs.

Our Strategy

The strategy for Road Safety requires the delivery of physical infrastructure, enforcement and training / education. Enforcement, training and education are to be delivered across the wider city and will therefore deliver improvement at the City Centre level. The physical infrastructure improvements are more specific to the City Centre area as it within this area that the greatest number of conflicts occur causing accidents. Within this are the following measures are proposed:

- Al-Istiqlal route and area safety treatment;
- Khaled Bin Al-Waleed route safety treatment;
- Queen Noor route and area safety treatment;
- Al Ameer Hashem Bin Al-Hussein route safety treatment;
- Al Dustour route safety treatment;
- Al Ameer El Hassan route safety treatment;
- Al Hasemi route and area safety treatment;
- Zahran / Al Hussein Bin Ali route and area safety treatment;
- Downtown route safety treatment as part of pedestrianisation options;
- Anas Bin Maalek area safety treatment
- Al-Kulliyah Al-Ilimyah Al-Islamiyah route and area safety treatment.

School Safety Zones

School Safety Zones aim to enable more young people to walk and cycle to school. Initiatives work best when they are tailored to a school's needs and are 'owned' by all members of the school community: pupils, parents, local residents, teachers, and the local authority.

In some places small and inexpensive measures can have a dramatic effect. In others, substantial investment is needed in traffic calming measures and engineering works to separate child pedestrians and cyclists from fast moving traffic.

Safer routes to School

Local transport authorities should regularly review the cycle and pedestrian routes that children use to travel to school and improve them as needed with infrastructure measures such as:

- Improved pavements and crossings
- Traffic calming
- Lower speed limits

School crossings

Road crossings are the greatest area of conflict between young pedestrians and traffic. The implementation of controlled crossing points represents an effective, low-cost solution to improving the child pedestrian environment. The implementation of crossings needs to consider appropriate location in relation to desire lines and end destination, traffic flows and speeds of highway being crossed and means to priority (signalised etc).

Manned school crossing patrols can also be used to encourage walking to school, reassuring parents and complementing engineering measures.

Traffic calming

Traffic calming measures can be implemented to promote lower vehicle speeds and reduce the number of child pedestrian casualties. GAM should consider what measures might be appropriate to make the area around a school a safe place for children to enter and leave from a range of the following types of measures;

- Lane width reductions;
- Speed cushions / humps / tables;
- Raised pedestrian crossing; and
- Speed sensitive signals.

Lower Speed Limits

30 kph zones can be considered to enforce lower traffic speeds around schools, the routes children take to school and other routes used. Where local transport authorities decide to introduce a 30 kph zone, legislation requires these should be supporting by engineering measures to ensure that the zone is largely self-enforcing.

Alternatively, speed limits could be set to reduce traffic speeds during periods where child pedestrian movements are greatest.

Supporting infrastructure and soft initiatives

Infrastructure measures associated with Safer routes are not always enough to encourage significantly more children to walk or cycle to school. Children who cycle need somewhere safe to leave their cycles, and pedestrians as well as cyclists may need lockers and changing facilities.

Walking buses

Walking buses are a further initiative encouraging use of the safer route to school facilities. Until children reach an age where their parents are happy for them to travel independently, there is often time pressure on parents associated with the school run.

To help address this, schools can introduce 'walking buses'. Children are collected from along a pre-arranged route at an agreed time and escorted to school by responsible adult volunteers (usually parents). If children live too far from the school to walk all the way, their parents can drop them off at a convenient meeting point, and they are then escorted to school as part of a group.

Examples

Jordan - Hikmat Road Safety successfully continues its 'Safer School Zones' project

Through partnership with Greater Amman Municipality, Traffic Department, Ministry of Education, and all Municipalities and Housing and Public Work Departments, Hikmat Road Safety has completed over 100 'School Zone' projects.

The road safety improvements have included pedestrian crossings, railings to guide the children to cross from the designated area and speed bumps to reduce the speed of the cars before entering the school zones.

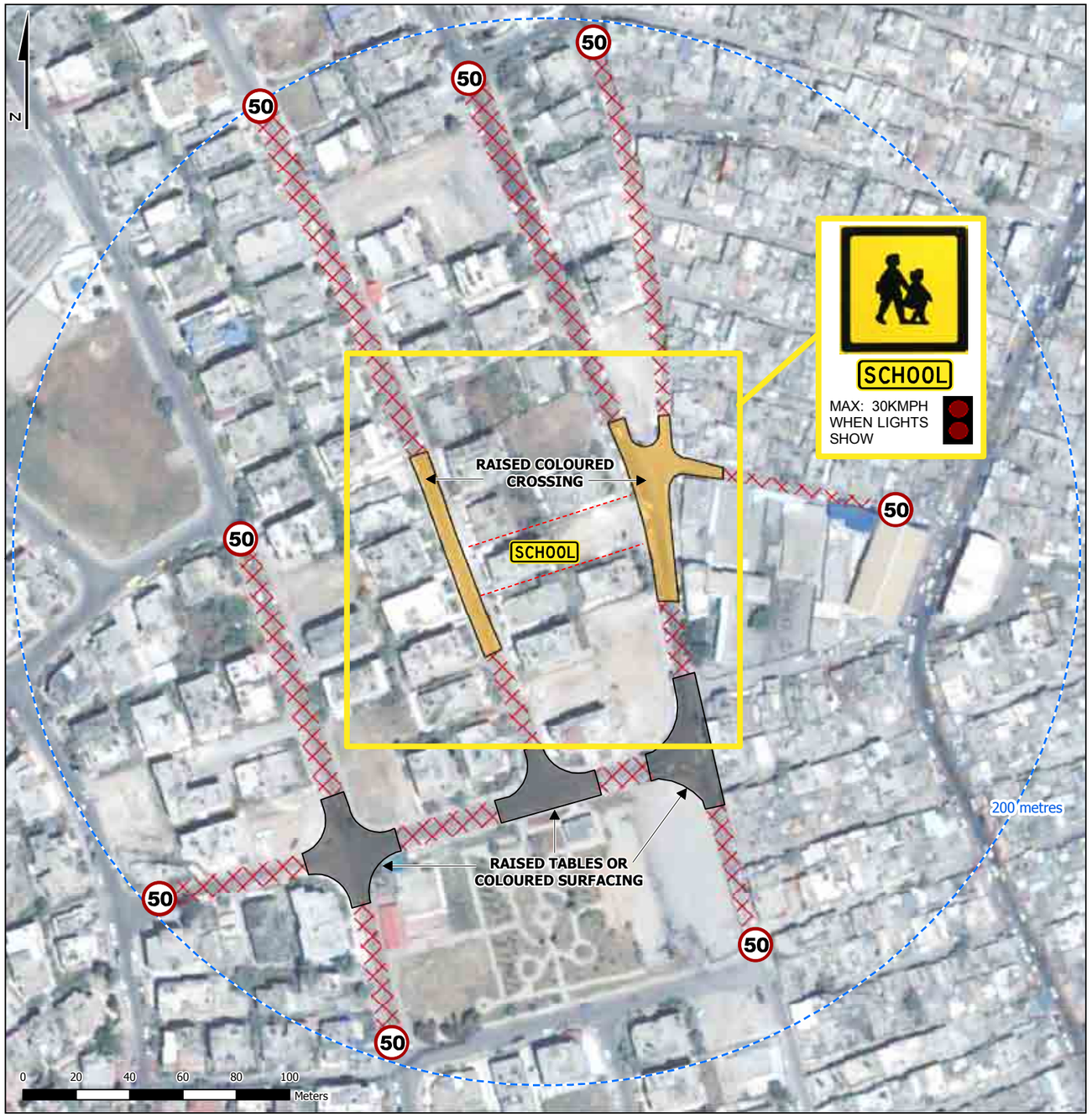
These improvements have had a dramatic impact on the students, the teachers, the parents, and the community at large; giving all parties involved a safer day at school and for a long term.

Demonstration School Safety Zone

Implementing School Safety Zones has been identified as a key component of the road safety strategy. These physical safety measures will complement road safety training and education target at children of school age.

Figure 49 provides an example of the types of measures that could be implemented within the area surrounding a school. The school location has been identified from GAM GIS data.

Figure 49 - Demonstration School Safety Zone



The scheme design above assumes that the area surrounding the school is subject to a 50kph speed limit since it is a residential area. It is recommended this is in place within 500m radius of the school with repeater signs at 200 metres. In the first instance all approach roads (including major routes) are reduced to 50kph using regulatory signs. On roads directly approaching the school at a distance of between 150m and 100m a 30kph School Zone should be implemented.

The boundaries to the School Zone should be marked with signage for 'advisory 30kph speed limits when lights are in operation'. This is then complemented with 'SLOW' carriageway markings and coloured carriageway surfacing in addition to keep clear markings and raised pedestrian crossings within the vicinity of the school entrance.

The 30kph School Zone is implemented only a short distance from the school so it can be enforced with other traffic calming techniques as described above. A more widespread 30kph limit without such features is unlikely to be obeyed.

Further from the school, junctions which are identified as being on route to school for pedestrians should have Raised Table designs. This will slow traffic on approach from all directions and give informal crossing opportunities to pedestrians.

Raised Table Example

Mid Block Pedestrian Crossings

The necessity to ensure suitable pedestrian crossing facilities are provided is a key component of the both the safety and pedestrian strategy. There are a range of types of pedestrian crossings, each appropriate to particular pedestrian and traffic flow parameters. Independent of crossing type, the location of provided crossings is paramount to ensure primary desire lines are met whilst considering pedestrian safety. Presented below is a illustrative example of a signalised mid-block pedestrian crossing.

In terms of the mid-block crossing design parameters the following considerations should be made;

- Design;
- Markings;
- Demarcation surfacing;
- Signals; and
- Refuges.

In terms of design, a maximum of 12m uninterrupted crossing distance is recommended between kerbline and mid-block pedestrian refuge.

Markings should be provided at traffic-controlled junctions inline and at the same width as the adjoining walkway. Pedestrian ramps should be provided at the end of all crosswalks.

Signals can be fixed, or provided by push button and once activated provide a high degrees of prioritisation to pedestrians. Overhead signage and lights should be provided supported by audible pedestrian signal alerts.

The pedestrian refuge should be a minimum of 2 metres wide, with the refuge flush with the crosswalk. Sightlines from the refuge to the traffic should not be restricted and this can be enhanced by adding a stagger into the refuge which orientates pedestrians to view oncoming traffic.

Figure 50 - Mid Block Pedestrian Crossing

Freight

The overall freight strategy has recommended a number of policy/strategy measures. In this section and of particular significance to the City Centre and the Downtown area is the Freight Consolidation centres and the Freight Quality Partnerships which is described further in more detail. These are viewed as some of the key policies that need to be taken to be able in place to assist and support the coordination of goods delivery in the city centre and downtown area.

City Centre Freight Consolidation Centre (FCC) Set Up

We would envisage the centre to operate much as set out within our overall strategy, i.e. that the centre would be located on the outskirts of the city, and a proportion of inbound goods for the city centre and the downtown area can be received at the consolidation centre, where they can be consolidated from multiple vehicles into one vehicle for onward delivery to the city centre. This one vehicle movement could then drop deliveries at a number of different businesses.

The concept of freight consolidation is that a number of service vehicle movements to and from major shopping and commercial areas such as Abdali or the downtown area is reduced by the operation of a FCC at a storage location remote from the activity centre itself. Supplier deliveries are made to the FCC, where deliveries are grouped onto dedicated delivery vehicles for onward delivery.

Figure 51 - Traditional Deliveries

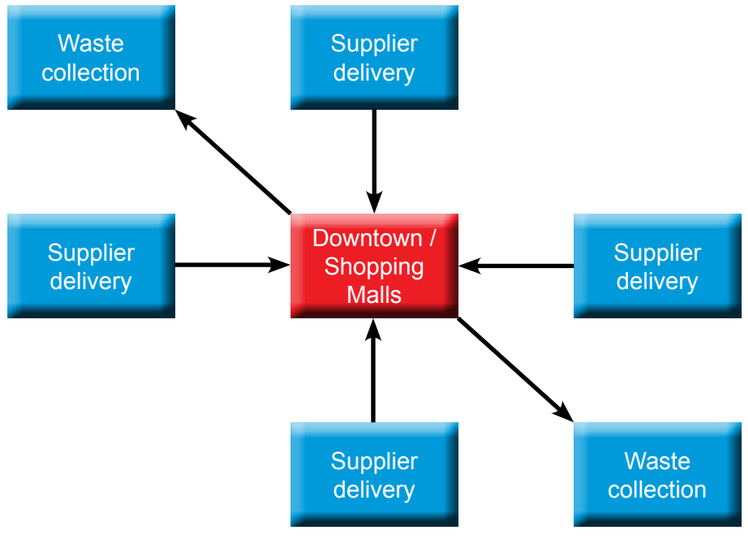
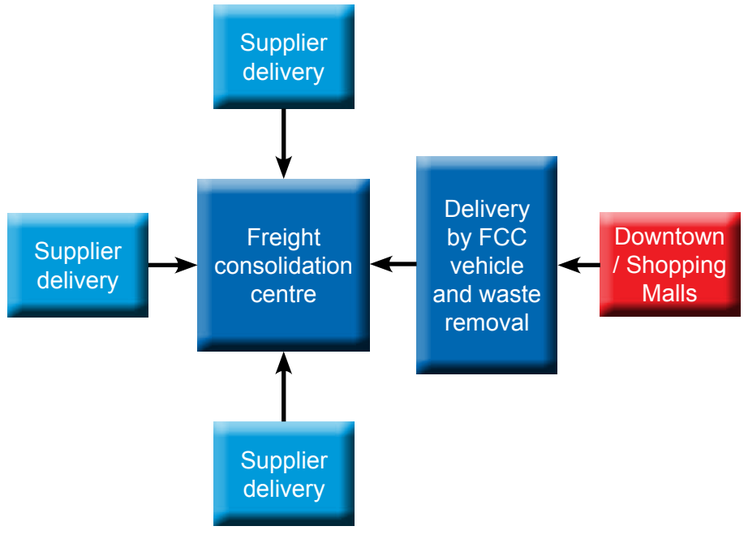


Figure 52 - Deliveries using Freight Consolidation



The FCC is likely to be a warehouse style facility ideally located at the edge or outside the city centre. In its simplest form, an FCC can be an off site stock room and although remote from the retail centres or markets, close enough to provide stock in a short timescale when required. This can result in much reduced requirements for storage within the retail units themselves.

The use of an FCC for processing deliveries can allow a greater number of deliveries to be made and at different times of the day. If one adopts a 24 hour FCC centre, then deliveries can take place at any time, day or night. Many commercial or retail centres or shopping areas experience many benefits from a 24 hour / 7 day a week delivery service including flexibility over delivery time, avoiding the peak hours and the option of scheduling vehicles and drivers at times which are traditionally quieter. This is particular important to areas that have limited access such as the downtown area. The following photo provides some indication of the type of congestion experiences during the busy periods. Empty pick up trucks double and triple parked reducing road capacity are a danger to pedestrians and cause additional air and visual pollution.

Clearly, one of the most important benefits of an FCC is reduced vehicle movement to the city centre or downtown centre. This reduction in vehicle movement can offer the opportunity to enhance the public realm in the areas in and around the shopping centres to benefit both pedestrians and shoppers.

In implementing such a scheme, our experience suggests that the key cost elements are:

- Property costs (land purchase, construction of warehouse, fit out, maintenance, security)
- Staff costs (warehouse staff for unloading and loading, drivers for consolidated deliveries, administration staff, security staff).
- Vehicle costs (lease or purchase of a number of vehicles to operate the consolidated deliveries, potential for ‘green’ vehicles such as electric vehicles can add to cost).

Minimising the set up and early year running costs has proved crucial in the feasibility of existing schemes in the UK. In particular, if retailer participation is to be voluntary, then the initial costs can be minimised by only acquiring a small property, with the potential for expansion later once retailer participation and hence the freight volumes pick up.

In terms of the actual cost, this is entirely dependent on the anticipated number of retailers participating and hence volume of freight, which determines the size of property, number of staff and number of vehicles.

To give an indication, on a scheme we were recently involved in at Newcastle upon Tyne in the UK, the estimated start up costs were approximately JD 75,000, with running costs of approximately JD 35,000 per month. This was to serve 25 retailers within an individual city centre retail development. The cost would increase if additional retailers were to be served.

To give a better estimate we would need an understanding of the likely level of retailer participation (and hence freight volumes). It would also be useful to understand local property costs, staff costs and vehicle costs within Amman.

Freight Consolidation Partnerships (FCP)

The FCP is open to any business with an interest in distribution. The partnership should aim to have a balanced range of views, representing the interests of the many groups involved.

Potential Members

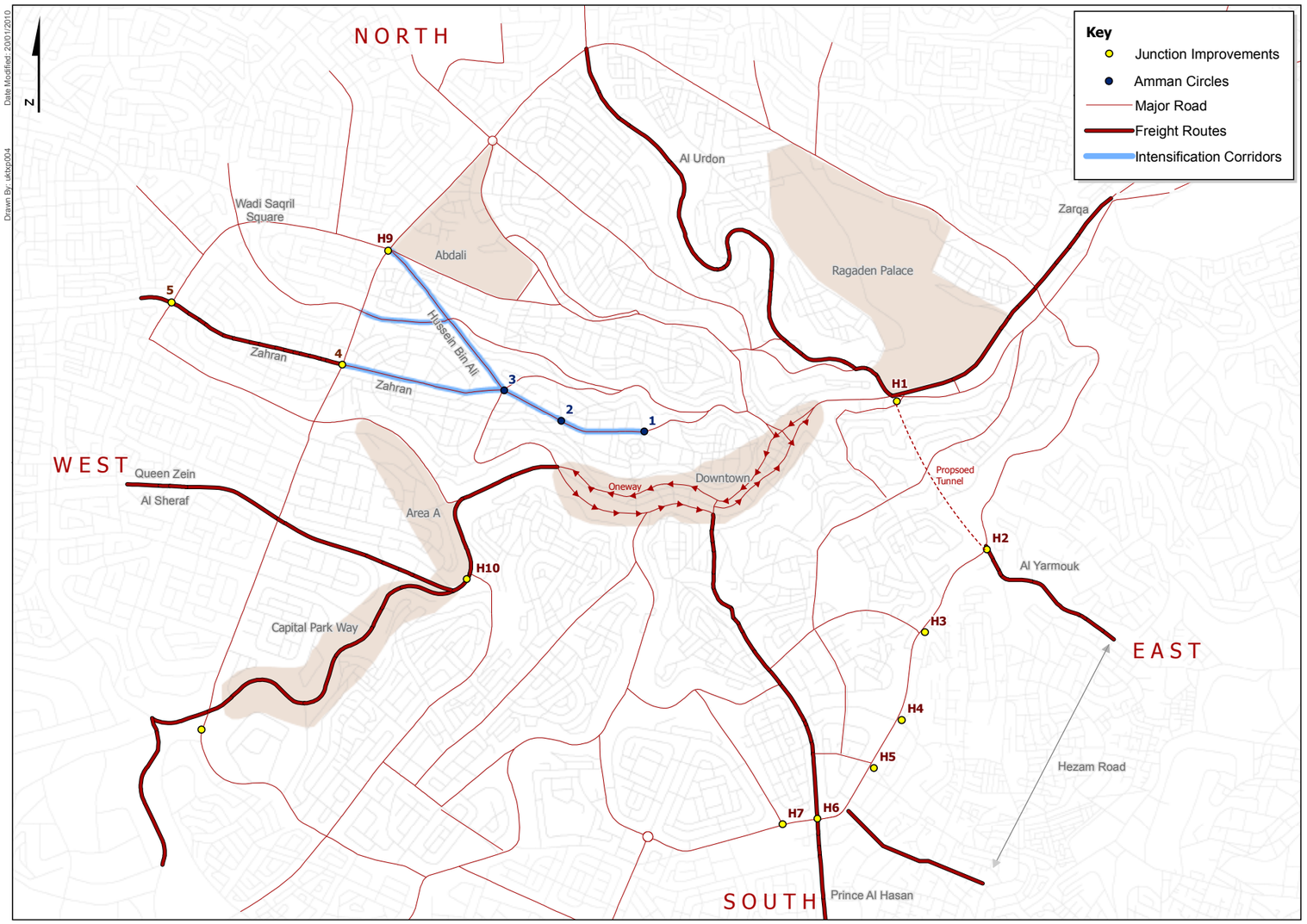
- Greater Amman Municipality
- Association of International Courier & Express Services (DHL, FedEx, etc)
- Major supermarkets and stores inside and outside the City centre including:
  - Abdali
  - The Downtown Area
  - City Mall - situated in King Abdullah II St
  - Mecca Mall is situated in Western Amman,
  - Abdalli Mall
  - Amman Mall
  - Plaza Mall
  - Cozmo Mall
  - Safeway

Some of the barriers to success that would need to be overcome include:

- General sense of apathy towards the scheme
- Resistance to individual stall/market owners
- Concerns regarding costs, delay and increased handling
- Access restrictions and banning of vehicles at various times of the day
- Retail chains will not change system to one location
- Independent traders feel they are unable to influence the supply chain
- No incentives to encourage participation

The freight routes have been designed to ensure effective delivery to some of the major commercial and retail destinations which include the downtown area, Area A, the proposed Capital Parkway and the Intensification Corridors. Whilst significant highways based improvements are not needed, effective signing, parking management and the implementation of the FCC is needed to ensure the freight routes function. Routes are provided for traffic from all directions.

Figure 53 - Freight Routes



ITS

Introduction

ITS refers to the application of Information and Communication Technologies to the transport sector. The ITS measures that have been identified for the City Centre area of Amman are a selected subset of those proposed in the ITS strategy described for the greater area. ITS measures that support and promote Pedestrian mode are highlighted here as being particularly relevant to aid mobility within the City Centre and Downtown areas of Amman

Current Situation in the City Centre

GAM have already implemented a SCATS traffic adaptive Urban Traffic Control system in two phases covering a total 94 signalised junctions. However, not all these sites are within the City Centre area bounded by the Inner Ring Road. The density of SCATS junctions is low with long links (>500m) between junctions on arterial routes between Inner Ring Road and Downtown. The long links result in breakdown of traffic platoons into random arrivals at the next junction which is not best suited to signal coordination regardless of method. GAM also have automatic traffic counters installed at strategic sites but these are in addition to SCATS traffic detection.

Pedestrians are not well served by signalised pedestrian crossings. Whilst most signalised junctions have demand dependant pedestrian crossing phases, called using pedestrian push-button devices, during our site visits in August 2008, some of these were discovered not to be working correctly and were reported by us to GAM Traffic Control Centre. There is only one mid-block signalised pedestrian crossing in the City Centre and this was found not to be working correctly and only showed flashing amber signals.

With long distances between signalised junctions that have pedestrian phases, pedestrians have no option except to attempt to cross busy roads unaided. This is then a deterrent to pedestrian mode.

Most signalised junctions in the City Centre are furnished with full function digital traffic surveillance CCTV cameras. GAM have CCTV cameras installed at 32 junctions, some of which are at junctions outside the City Centre. The colour CCTV cameras are fitted in dome housings and on pan-tilt-zoom mounts which can be controlled from the GAM traffic Control Centre. The cameras are used by GAM Control Centre staff both to monitor traffic behaviour on the network and also to aid management of congestion and incidents e.g. road traffic accidents.

Traffic rules enforcement is supported by installation of fixed red light cameras at some signalised junctions. The Amman Traffic Police also have portable speed cameras to record speed violations.

GAM have also begun to invest in GPS tracking of buses and in smartcard technology as means of electronic payment. Smartcard payment could be used to collect revenue relating to public transport fares, parking charges and other city services.

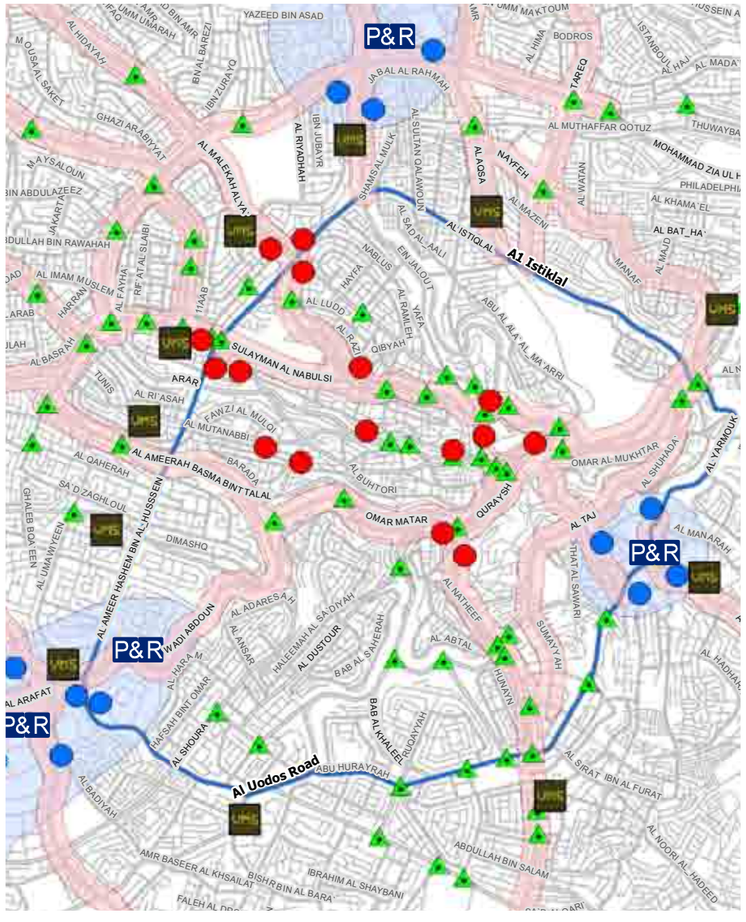
Mid-Block Signalised Pedestrian Crossing (Amman)

Proposed Strategy

The ITS Strategy for the City Centre is similar to that prescribed for main arterial routes and commercial centres both inside and outside the Inner Ring Road. The ITS strategy is formulated to support the other topic strategies developed for the central area. The ITS Strategy includes measures that aid:

- Congestion
- Parking
- Public Transport
- Pedestrian Mode
- Safety
- Freight

Figure 54 - City Centre - Area within Inner Ring Road



ITS support to Congestion and Parking Strategies – City Centre

Congestion management and particularly the management of onset of traffic congestion can be aided by additional network monitoring using existing systems and new methods.

By reducing link lengths to <500m between signals, better signal coordination can be achieved by UTC as traffic is moved in recognisable platoons of vehicles. Long link lengths results in platoon dispersion with random arrivals detected at the downstream signal stop line. Link lengths can be reduced by signalising smaller intermediate junctions (infill) or by inserting mid-block signalised pedestrian crossings coordinated by the SCATS UTC system. Both of these measures create additional safe pedestrian crossings and aid pedestrian mode.

Signal control by UTC can be modified according to the required traffic management strategy. UTC can optimise signal timings for minimum delay and journey time but equally should be capable of implementing traffic restraint plans or special purpose congestion management plans. This should be possible using the existing SCATS Urban Traffic Control system. Additional network performance and congestion data can be provided by deploying additional sensors on the network for this purpose. Automatic Number Plate Recognition (ANPR) cameras should be deployed at start and end points along arterials which feed coded data to a central Journey Time Monitoring Systems (JTMS). A JTMS can detect abnormal travel conditions in near real-time by reference to corresponding historical data. This can be used in the Traffic Control Centre to trigger a “congestion alarm” and possibly to trigger a congestion management plan invoked by UTC and aided by a Variable Message Sign (VMS) system. An example would be to reduce green time to traffic approaching the congested area and correspondingly set VMS outside the area to divert traffic to alternative routes.

Congestion is sometimes created by vehicles looking for parking spaces close to their destinations. This is particularly true for the city centre commercial areas. Whilst on-street parking may be discouraged by introduction of Controlled Parking Zones with enforced parking restrictions, safe off-street parking may be encouraged by implementation of a Parking Guidance System that monitors available spaces in off-street car parks (which can be multi-storey parking garages) and presents this information to motorists by means of Variable Message Signs at key decision points to car parks. Motorists are then able to see if there are spaces available in their preferred car park or whether to divert to an alternative car park if it is showing “FULL”. By responding to this advance warning, the motorists avoid travelling first to a car park that cannot accommodate them then either queuing outside causing congestion or driving around in search of another car park in hope of finding a space, again contributing to congestion.

In the Downtown area of Amman vehicular access to pedestrian areas, delivery areas and narrow side streets may be controlled by tag operated Rising Bollard road blockers. Access for authorised vehicles can be enforced by Automatic Number Plate Recognition cameras.

Typical Strategic VMS displaying journey time information (UK)

Typical ANPR Camera on entry link to city centre. (UK)

Parking Guidance Variable Message Sign (UK)

ITS support to Public Transport Strategy – City Centre

At the periphery of the city centre, Park & Ride sites may be created at key transport interchanges to encourage motorists to switch to more efficient and quicker public transport for their journey into the central area. The removal of these vehicles, particularly single occupant private cars, from city centre routes will help to avoid city centre congestion. To promote Park & Ride and Public Transport mode, a Parking Guidance System may be used to direct motorists to Park & Ride Sites with available spaces.

Public Transport, and the perceived quality of public transport services, by the travelling public can be enhanced by monitoring and aiding the progress of public transport vehicles along their designated routes and presenting this information to users at stations, stops and on vehicles using electronic display boards. A Real-Time Passenger Information (RTPI) system should first be implemented on high capacity LRT and BRT, then for Large Bus services serving the central area.

Within public transport interchanges and large indoor public places, Travel Information Kiosks can be installed to aid passengers plan or complete their journeys by public transport. Travel Information Kiosks are one element of a wider Traffic and Travel Information (TTI) service, brought to the public via the internet. The travelling public may then access Travel information either at home or on internet enabled mobile phones etc.

Public Transport mode may also be supported (and private car use deterred) by implementing segregated lanes and bus gates at traffic signals only for public transport use. These combined with Bus Priority at traffic signals, implemented either centrally (integration of RTPI-UTC systems) and/or locally using Selective Vehicle Detectors (SVD) linked direct to the traffic signal controller.

Downtown – Access Control by Rising Bollards System (UK)

Mid-Block Signalised Pedestrian Crossings (UK)

ITS support to Pedestrian Mode – City Centre

The existing City Centre area is currently severely deprived of at-grade mid-block signalised pedestrian crossings. Pedestrians are expected to cross roads with fast moving traffic unaided or walk hundreds of metres to either a footbridge or a signalised junction that may have an appropriate pedestrian crossing phase. These additional physical hurdles do not act to encourage walking within the city centre as a safe and healthy mode of transport. The installation of mid-block signalised pedestrian crossings and additional infill signalised junctions (with pedestrian crossing phases) will aid pedestrian mobility, reduce traffic speeds and benefit safety and improve traffic control overall.

ITS support to Safety Strategy – City Centre

The introduction of "School Zones" is proposed as part of the Safety topic strategy. ITS can support School Zones in the form of Variable Speed Limit Signs or School Zone speed limit signs (highlighted by yellow hazard flashers) which are activated at school arrivals and departure times. In addition, these speed limits may be enforced by fixed point speed cameras or average speed enforcement cameras.

Safety may be enhanced on the inner ring road and city centre arterial routes by better delineation of traffic lanes. It is recognised that there is a problem of white lines being erased or being obliterated by tyre rubber over time. However, it is unclear why this is a problem in Amman and not a problem in other cities e.g. Singapore, Hong Kong and Kuala Lumpur, which also have hot climates. ITS can assist with carriageway and lane delineation by use of LED illuminated road studs of different colours. LED road studs may also be used to delineate traffic lanes within pedestrian zones e.g. Amman Downtown area.

Effective street lighting can play some part in reducing accidents. Research is now being undertaken in UK (e.g. by WSP for UK Highways Agency) into energy efficient Intelligent Street Lighting systems. This technology is very new and is therefore not included in the ITS Strategy at this time, but could be viable and worthy of consideration within the full time horizon of TMMP.

ITS support to Freight Mode – City Centre

GAM imposes a ban on large trucks, with exception of those bearing a special permit, which is seen to be effective in operation. The TMMP Freight Strategy supports the setting up of Distribution Centres at the edge of the city where goods can be offloaded from large inter-city trucks and aggregated for delivery by small trucks and vans to shops and premises within the city centre.

Freight movements and deliveries in and out of the city centre can be aided by freight logistics Journey Planning systems which can assist multi-drop deliveries by planning an optimum route between drops and plan the vehicle loading sequence corresponding with the delivery unloading sequence.

Freight deliveries within the city centre may also face time or other access restrictions subject to air quality or congestion. Such controls can be applied using Variable Message Signs (VMS) and enforced using Automatic Number Plate Recognition (ANPR) cameras.

Best Practice ITS Strategy Model

The ITS Strategy is based on three functions, namely Monitor, Control and Inform.

At the centre of this arrangement is a Traffic Control Centre. GAM have already invested in a purpose built Control Centre and this provides the central monitoring and control focus for the existing UTC and CCTV systems.

The City Centre area, as defined within the Inner Ring Road, includes arterial routes that converge towards the historic Downtown area. The City Centre includes commercial, leisure and cultural attractions, which have car parking needs and suffer traffic congestion. The same traffic congestion adversely affects public transport circulation and access to public transport hubs in this area.

The introduction of additional ITS specific to the City Centre is expected to be implemented in phases parallel with the timeline for measures that have been identified for the City Centre topic strategies. An ITS concept demonstrator corridor (e.g. Jabal Arafat-Wadi Abdoun-Omar Matar-Quaraysh) can be designated where ITS solutions can be tested and evaluated in the Amman city environment prior to investment in systems replication for wider area deployment.

The City Centre ITS Strategy aims to promote Pedestrian and Public Transport modes whilst regulating deliveries of goods and controlling access to the City Centre by private car. The SCATS UTC system already implemented by GAM is a powerful traffic management tool which can be used to either aid flow of traffic or restrain flow of traffic. Some early gains can be made by making some configuration changes to UTC to restrain traffic from entering a congested area, also to coordinate additional infill junctions and signalised pedestrian controllers.

Figure 55 - Potential ITS Elements grouped as Monitor, Control and Inform

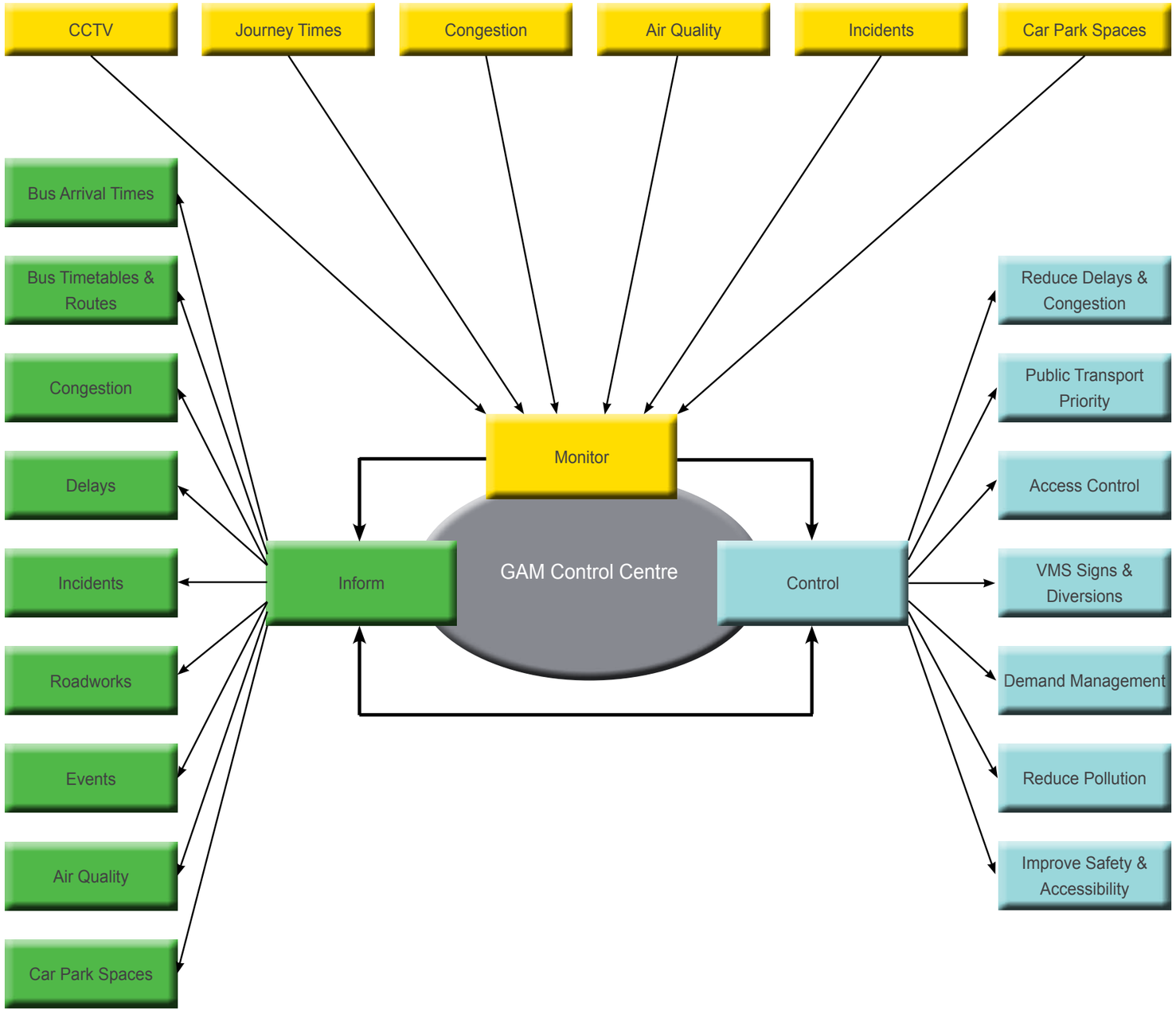
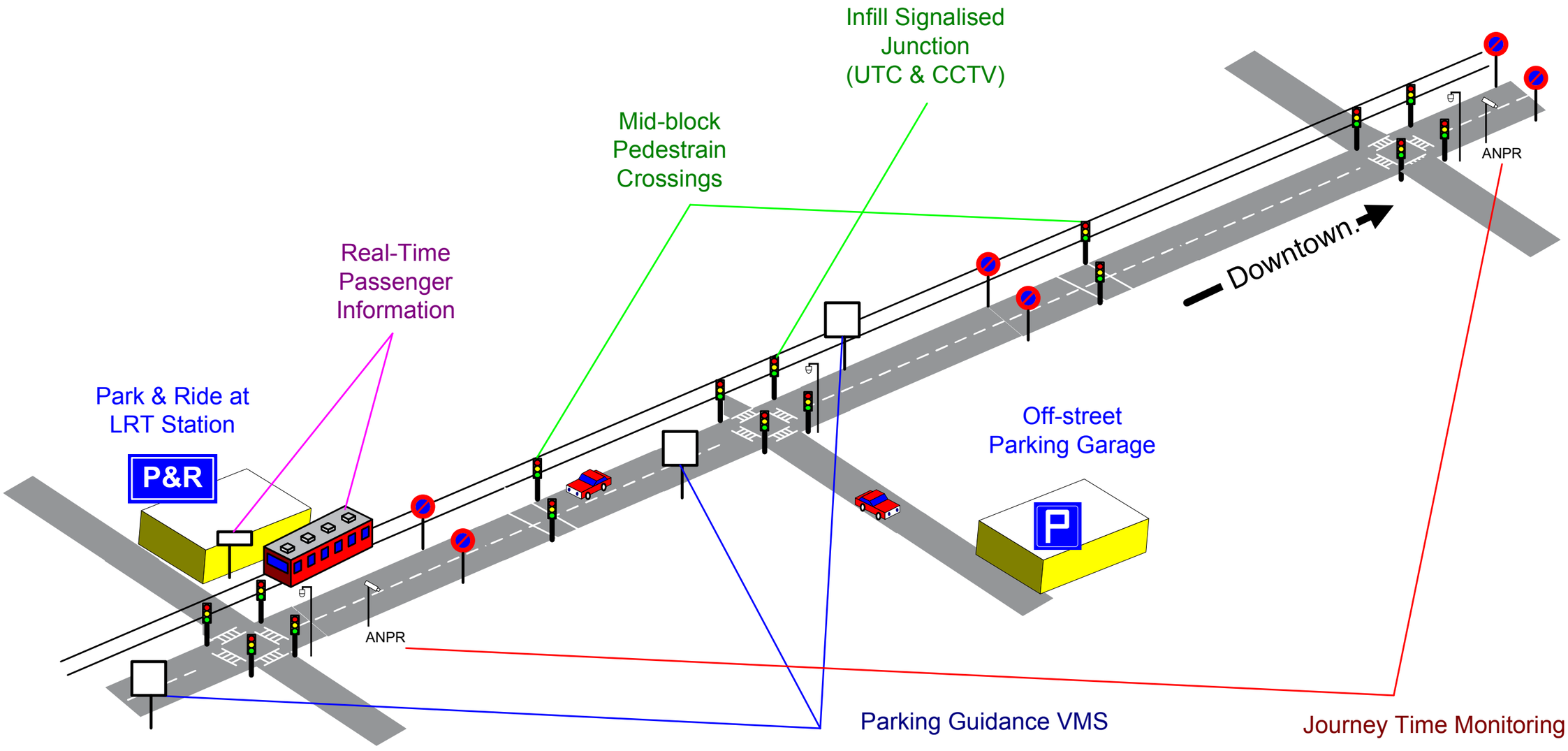


Figure 56 - City Centre - ITS Concept Demonstrator Corridor Scheme



Downtown

Why is this strategy needed?

The downtown area is of significant importance both in terms of cultural, commercial and social activity with several key land uses including the downtown souk, the King Hussein Mosque, the Amphitheatre, large pedestrian areas, as well as a key transport corridor moving traffic between east and west Amman. With this in mind, a transport strategy is required to ensure that the area is developed in such a way that it supports the cultural activity, but at the same time facilitates the movement of passengers and freight, primarily through public transport means.

What are the principles behind this strategy?

The downtown strategy looks at options that will facilitate traffic in and around the Wadi Amman corridor between Ras Al Ain and the Souk. The key principles behind the strategy are to:

- Enhance attraction for tourism
- Develop a centre for economic development and growth
- Create vibrant urban neighbourhoods for retail and commercial activities
- Improve accessibility
- Providing new business opportunities

What are the strategy objectives?

Four options were considered ranging from one-way schemes with varying degree of public transport and pedestrianisation. The objectives are to:

- Remove through traffic
- Provide a pedestrian-friendly area that supports social and cultural activities
- Improve safety through the reduction of through traffic
- Provide a platform for the surface based BRT system
- Ensure the development reduces air pollution levels

Four options were tested using the transport model and the criteria for assessment, which were:

- Percentage of through traffic removed
- Minimal impact to existing land uses
- Vehicle kilometres
- Vehicle hours
- Ease of construction

Issues

The Downtown corridor will be served by the proposed LRT running underground between Mahatta and City Hall. Stations are proposed at Mahatta, Ragadan, King Faisal Square, Saqf Al Sail and City Hall. However, there is a need to better serve the downtown Souk corridor between Mahatta and Al Ain with a form of surface public transport between. In considering potential public transport links along the Souk area, the following constraints need to be considered:

- Intensive pedestrian activity
- Extensive shop frontage activity
- Extensive pick up and drop off activity
- Extensive shop delivery activity

Taking into account the above, we have considered a number of options that would minimise the impacts on the Souk's activity but at the same time would enhance the environment and facilitate the use of public transport and the pedestrian realm. In terms of public transport, the two options considered are:

- Dedicated bus way link
- BRT link

A basic lane way may have the following features:

- Segregated bus way
- Single corridor service
- On board fare collection
- Basic bus shelters
- Standard bus vehicle

A BRT 'Lite' System would include:

- Some form of bus priority but not fully segregated busways
- Improved travel times
- Higher quality bus shelters
- Cleaner vehicle technology options
- Marketing identity

A full BRT system would include:

- Segregated bus way
- Pre board fare collection / verification
- Higher quality stations
- Cleaner vehicle technology
- Marketing identity

The minimum right of way along both sections of the one way system is about 19m. In developing a bus lane or BRT system, the maximum width required would be around 12m.

Strategy Options

The downtown strategy looks at options that will facilitate traffic in and around the Wadi Amman corridor between Ras Al Ain and the Souk. With this in mind, the strategy is to ensure that the area is developed into a cultural centre with several activities as well as facilitating the movement of traffic primarily through public transport. Four options were considered ranging from one-way schemes of varying degree of public transport and pedestrianisation.

In assessing the downtown options, 4 options were initially considered ranging from partial pedestrianisation to complete pedestrianisation. The two options taken forward for testing are described below.

Option 1:

- Pedestrianise King Talal Street
- Run 2 way BRT system along King Talal Street
- Make Koraysh a single 2 lane urban street
- Retain the one way loop system along Ali Ibin Abi Raleb Street and Omar Matar Street
- Run BRT along Omar Matar Street
- Reduce Omar Matar Street to a 2 lanes of traffic
- Run BRT along Omar Matar one way Street
- Reduce Omar Matar Street to a 2 lanes of one way traffic
- Retain Al Shabsough as a one way street

Option 2:

- Part pedestrianise Koraysh Street and Ali Ibin Abi Raleb Street
- Retain the one way loop along Koraysh Street and Ali Ibin Abi Raleb Street
- Run BRT along Koraysh Street and Ali Ibin Abi Raleb Street
- Reduce traffic lanes along Koraysh Street and Ali Ibin Abi Raleb Street to a single
- Retain the one way loop system along Ali Ibin Abi Raleb Street and Omar Matar Street
- Run BRT along Omar Matar Street and Ali Bin Abi Taleb Street
- Reduce Omar Matar Street to a 2 lanes of traffic
- Reduce Ali Bin Abi Taleb Street to a 2 lanes of traffic
- Retain Al Shabsough as a one way street

Figure 57 - Existing Downtown Traffic Circulation

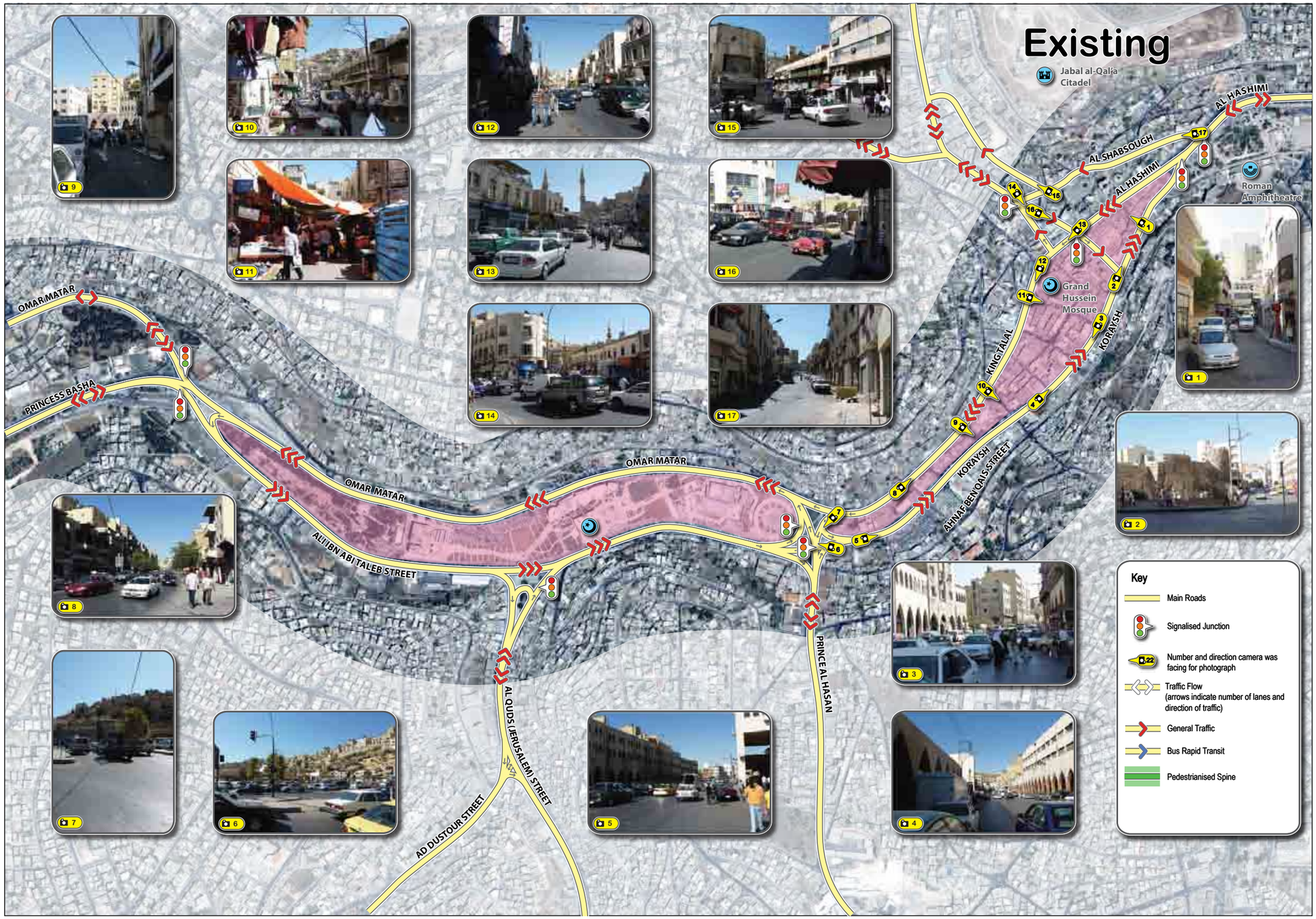


Figure 58 - Option 1: Pedestrianisation of King Talal

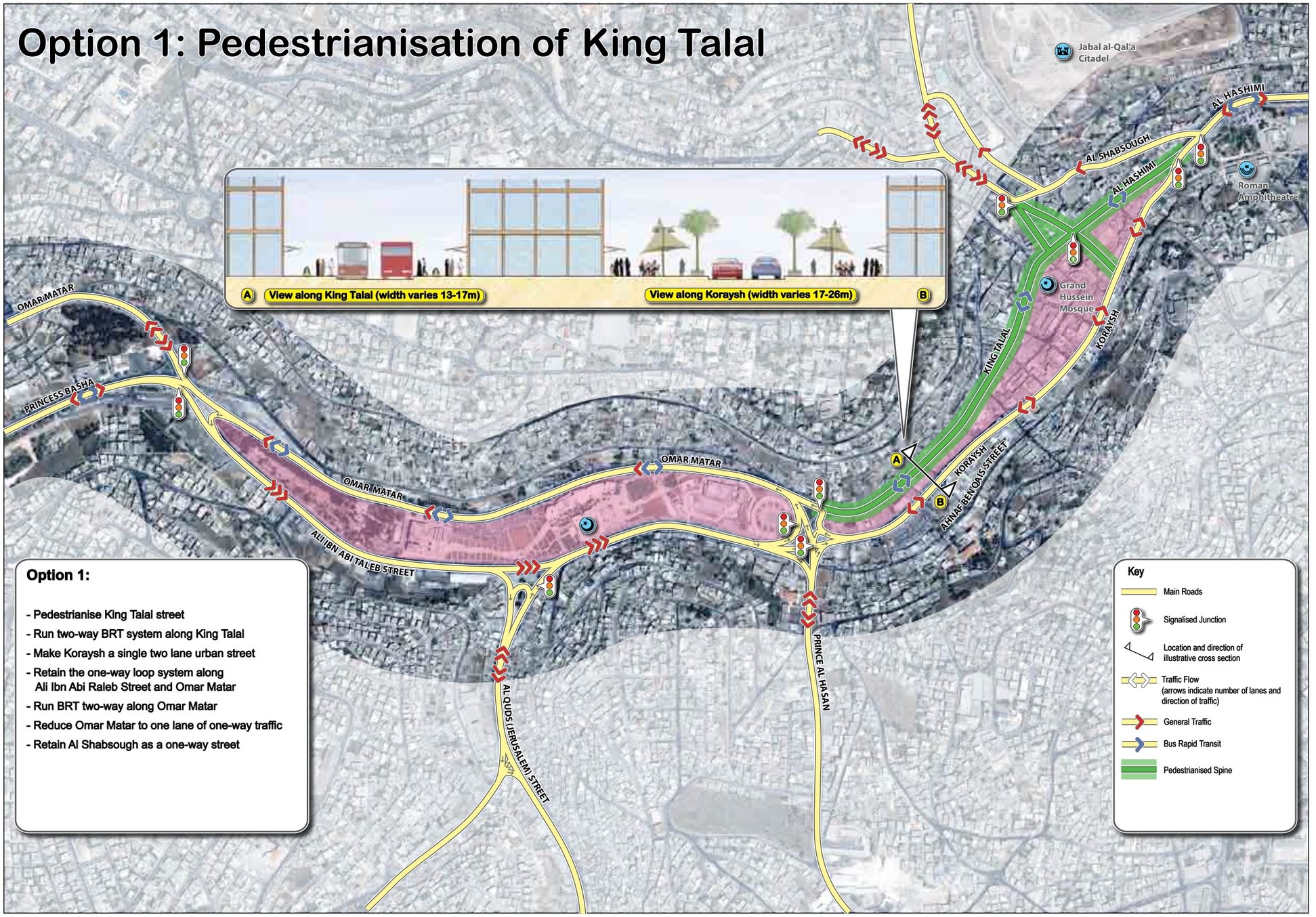
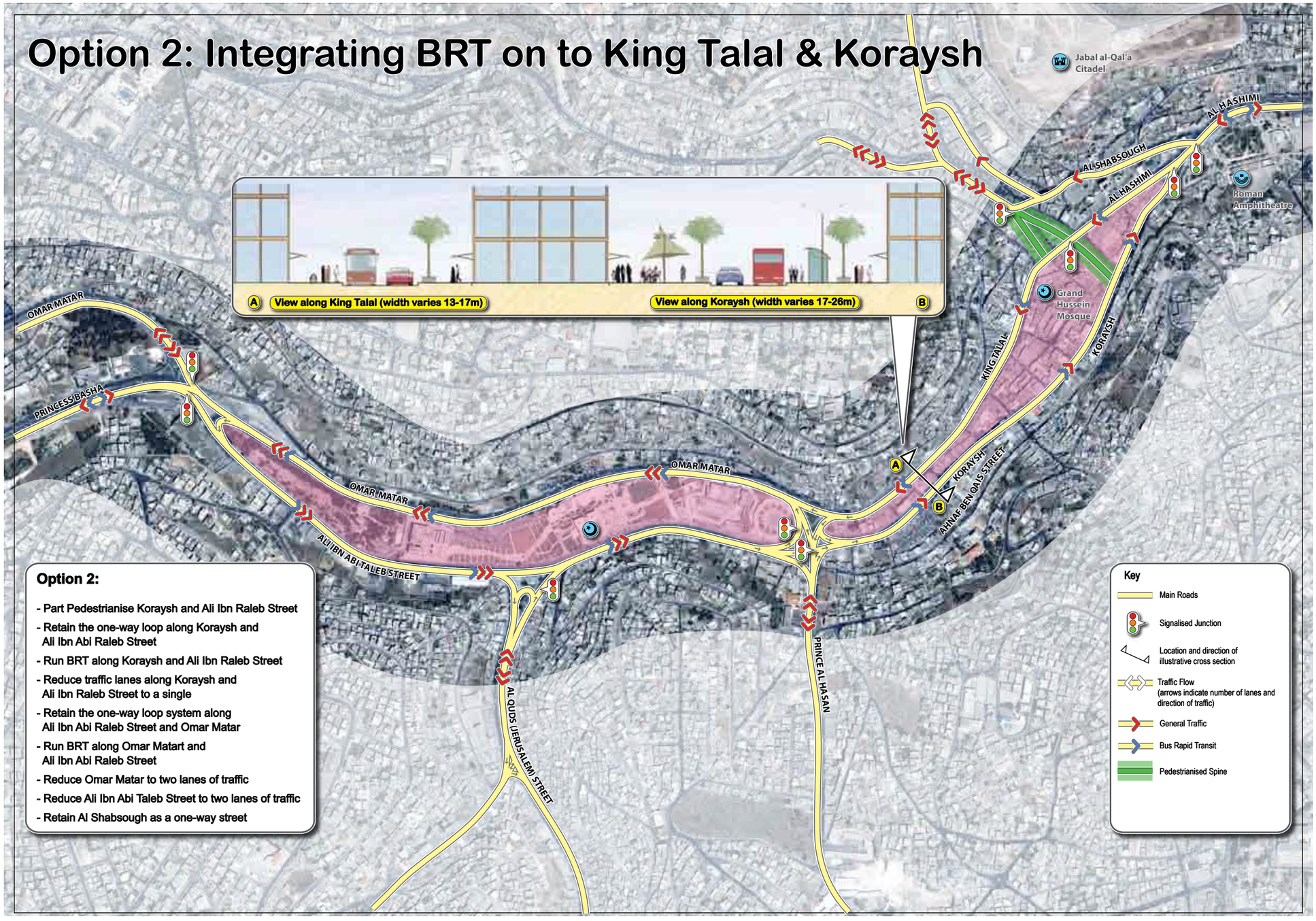


Figure 59 - Option 2: Integrating BRT on to King Talal & Koraysh



The analysis of the two options was made using the transport model and the key highlights are presented below.

- Option 1 reduces through traffic by some 33%
- Option 2 reduces through traffic by 27%
- Option 1 reduces private vehicle kilometres in the down town area by 43%
- Option 2 reduces private vehicle kilometres in the downtown area by 36%
- For Options 1, private vehicle average speeds through the downtown area is 10km/hr
- For Options 2, private vehicle average speeds through the downtown area is 10.5 km/hr
- Option 1 reduces NOx emissions in the downtown area by 36%
- Option 1 reduces CO2 emissions in the downtown area by 54%
- Option 2 reduces NOx emissions in the downtown area by 25%
- Option 2 reduces CO2 emissions in the downtown area by 55%
- The impacts upon the surrounding networks are less in Option 2 than in Options 1.

The above analysis provides two viable and more or less equal options with regards to the downtown area. One of the major issues that would need to be taken into account would be the commercial and social impacts on pedestrianising King Talal Street against allocating all traffic along Koraysh Street, which would have a detrimental impact for that particular street.

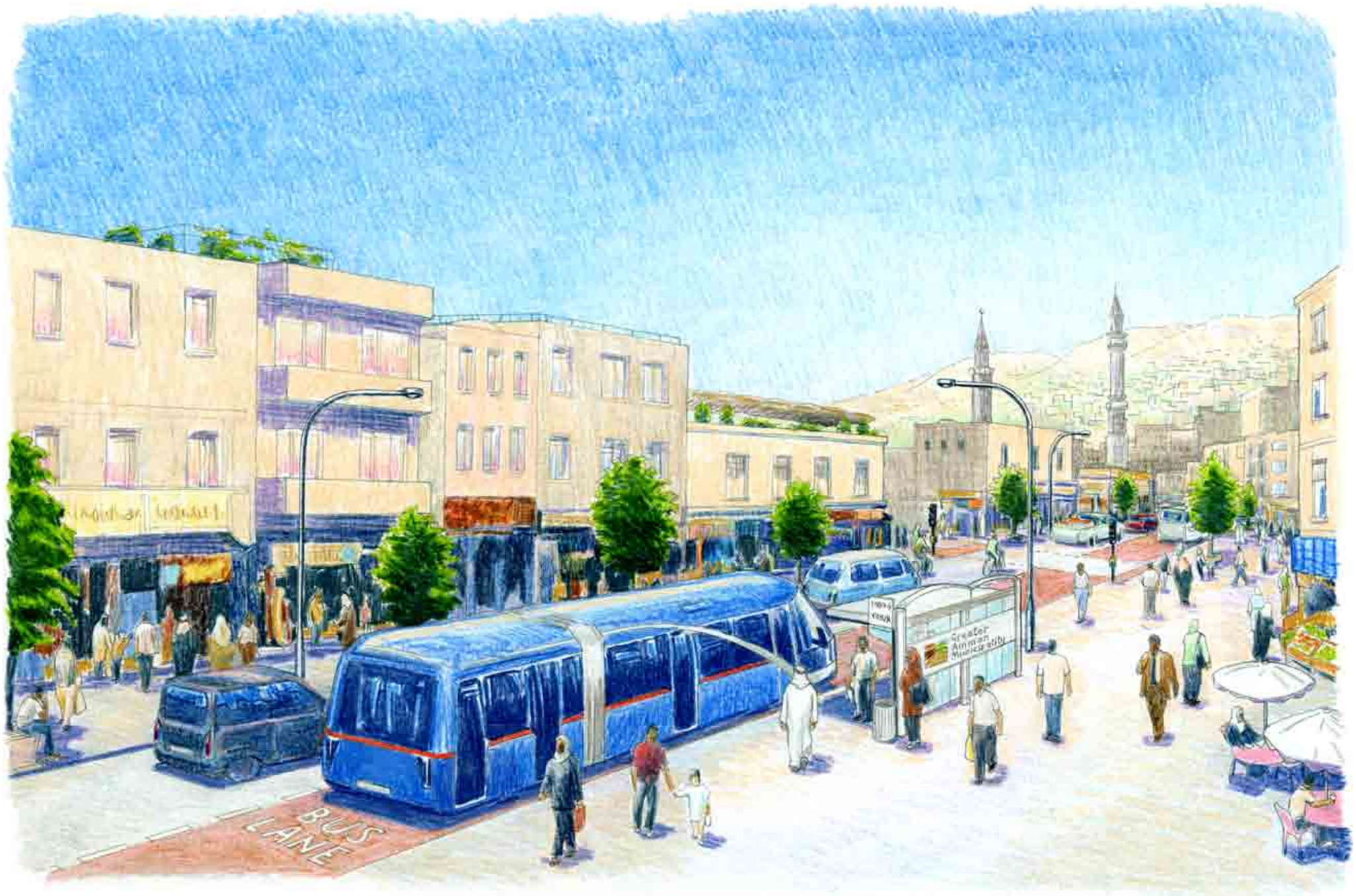
The two scenarios previously looked at providing public transport options along with the corridor, but at the same time allows for traffic to continue to use the link. To simply stop public transport services running along the downtown corridor is also not a satisfactory option.

The preferred option, Option 2, is one that can facilitate both a BRT Lite system and a normal bus system. Both are equal in appearance and functionality.

A streetscape illustration of the way a simple dedicated bus way system would look if implemented a two lane one way system, with one lane dedicated to public transport is shown in Figure 60.

This option is the preferred scenario as it accommodates normal traffic albeit at a reduced capacity, it allows for a dedicated bus way system to operate, and at the same time improves the streetscape environment by allocating more space to the pedestrian, street stalls/markets, etc than previously allowed.

Figure 60 - Streetscape Illustration



One of the key issues with regards to the overarching strategy is to ensure that each individual component strategy supports the other and that, overall, the TMMP demonstrates a cohesive, integrated and holistic approach. This process is thus also intended to ensure that the strategy implemented applies common policy and uniformity across the transport sector.

Table 18 details how the strategies interact with one and other, and how one strategy is designed to support the other.

Clearly, the backbone of the entire strategy is the implementation of a major step change in the quality, quantity and integration of public transport, including major investment in well designed LRT and BRT systems. Most of the other strategies have been designed specifically to support the development of a 4 level hierarchical public transport system across the city. This system will provide a high capacity core network covering the major movement corridors, it will implement other key radial and orbital routes, together with local bus and minibus services and a feeder network based on the major public transport interchange points. A specific aim of the strategy is to facilitate the “doorstep to doorstep” journeys made by residents of Greater Amman through the use of public transport, and in this respect the part to be played by the pedestrian, safety, demand management and ITS strategies, in particular, is crucial.

Table 18 - Integration Matrix

Apply the Strategies along top to strategies down side	Public Transport Strategy	Road Safety	Pedestrian Environment	Parking Strategy	Freight Transport Strategy	ITS Strategy	Demand Management Strategy	Downtown Strategy
Public Transport Strategy		In construction of LRT and BRT, ensure that safety audits are undertaken.	In construction of LRT and BRT, ensure good ped connections to nearby housing and employment.	Provision of Park & Ride. Remove delays on the public transport network through parking removal.		Support PT mode by RTPI and PT priority at signals.	Support modal shift to public transport.	Key destination for public transport services.
Road Safety	In construction of LRT and BRT, ensure that safety audits are undertaken.		Improved safety of pedestrians across the footway network.	Removal of indiscriminate parking.	City centre truck ban reduces potential for serious accidents.	Additional signals to reduce speeding on long links. Signage and enforcement at school zones.	Policy designed to reduce private vehicle travel in support of PT.	Improved pedestrian environment.
Pedestrian Environment	In construction of LRT and BRT, ensure good ped connections to nearby housing and employment.	Improved safety of pedestrians across the footway network.		Removal of indiscriminate parking.	City centre truck ban reduces potential for serious pedestrian accidents.	Additional signalised pedestrian crossings.	Promote modal shift to walking.	Partial pedestrianisation of Downtown area. Radial pedestrian network towards Downtown.
Parking Strategy	Provision of Park & Ride. Remove delays on the public transport network through parking removal.	Removal of indiscriminate parking.	Removal of indiscriminate parking.		New Inland port provides safe off street parking environment for freight.	Parking Guidance VMS.	Increased parking charges supports modal shift to PT.	Reduction of long stay car parking in central area. Additional off street parking (GAM multi storey Car Park).
Freight Transport Strategy						Journey Planning and Access Control.	Banning of trucks within Amman currently very effective.	
ITS Strategy	In construction of LRT and BRT, consider opportunity to build in comms system.			Parking Guidance VMS.				
Demand Management Strategy				Increased parking charges supports modal shift.		Traffic restraint signal timings. Diversion VMS. Congestion charging.		Car parking restraint supports area regeneration.
Downtown Strategy	Key destination for public transport services.	Reduced capacity and introduction of dedicated PT lane reduces ped-car conflicts.	Pedestrianisation of central Downtown area. Radial pedestrian network towards Downtown.	Reduction of long stay car parking in central area.	Freight consolidation and freight partnership approach reduces size of trucks within City centre.	Air Quality monitoring. Diversion VMS.	Increased cost of private vehicle ownership supports modal shift to PT.	

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Transport Model 11

Transport Model

Background

The Greater Amman Multi-Modal Transportation model has been developed as part of the Transport Mobility Master Plan study for Greater Amman. Various transport related studies have taken place in Amman in the last 10 years:

- The Greater Amman Urban Transport Study (1999)
- The Greater Amman Urban Transport Update Study (2005)
- Public Transport Service Needs in Amman (2006-2008)
- Amman Plan (2006) – ongoing

The Greater Amman Urban Transport Study (1999) was a highway based project which resulted in significant improvements to the main urban highways and interchanges in Amman. A base year model was developed using SATURN highway modelling software.

In 2005, the Greater Amman Urban Transport Update Study commenced. This involved transferring the SATURN model to the VISUM software. Base year matrices for 2005 were estimated by factoring up 1999 matrices to match 2005 traffic counts. No origin-destination demand data was collected to update the base year matrices.

In 2006, the Public Transport Study for Amman commenced. This study was carried out on behalf of the Public Transport Regulatory Commission (PTRC) which, at the time, regulated the public transport provision for Greater Amman. Since 2006, the Amman Plan has been under development. This proposes significant changes to the scale of population/employment levels and also the spatial distribution of land uses.

The object of this study is to formulate a transport mobility master plan for Greater Amman. This is a strategic study which examines the characteristics of the existing transport supply for all modes, and the behavioural demand of the travelling public and goods. It had been over 20 years, since household interview surveys were carried out in Amman to capture the trip making behaviour of all citizens by all modes, including slow modes. Hence, a major component of the study is to carry out a large scale household survey to understand the travel choices by different segments of Amman society. A strategic transport model has been developed to enable future transport patterns to be examined and to guide the formulation of the TMMP. Analysis is executed for different planning scenarios to produce an optimal transport master plan.

A common thread throughout the study is the need for an analytical planning tool to inform and evaluate the master planning options. A strategic multi modal transport model has been built based on the existing transport supply and demand. This is then forecast to different time horizons, to estimate the transport requirements in terms of transport provision and policy changes. A series of scenarios are developed and evaluated by reference to the transport model outputs, which then feed into a Multi-Criteria Assessment Framework (MCAF) which considers other non-tangible benefits or costs.

The whole master planning process is underpinned by the robustness of the transport model and the data used to calibrate the transport model. Therefore, great care is taken when carrying out surveys and constructing transport models to ensure that they are fit for the strategic needs of the study.

The GAM Transport model is founded on the PTRC multi-modal VISUM transport model (2007). For the 2008 base year validation, modal networks were updated from 2007 to 2008, and passenger demand matrices are now largely derived synthetically.

A base year strategic transport model was developed to represent the current transport situation in Amman in 2008. This is an estimation of the existing conditions based on the complex relationship between transport supply and demand.

A multi modal transport model was constructed in PTV VISUM software developing on the existing PTRC multi-modal model for Amman (2007).

Base Year Demand Modelling

Transport Demand data are derived from a combination of two main sources:

- Household Surveys
- Road Side Interviews (RSIs)

The survey data is intended to provide base year matrices by mode for two distinct movements:

- Intra-Urban (internal movements)
- Inter-Urban (external-internal movements)

These two main movements are modelled separately, so that the different behavioural characteristics can be captured for the different levels of data resolution.

A four stage demand model is developed for intra-urban movements based on the household data. The observed origin destination from the RSIs is used to create a base year external-internal and external-external modal matrices.

The internal four stage demand model is calibrated based on the existing demand, supply and planning data. This enables important socio-economic factors to be incorporated into the forecasting, such as:

- Population
- Demography
- Employment
- Educational and Retail locations
- Gross Domestic Product (GDP)
- Income
- Car ownership
- Spatial distribution of land uses
- Transport provision
- Transport policies, such as parking and pricing

Intra-Urban Demand

The intra-urban demand approach is comprised of the following 4 steps:

- Trip Generation/Attraction
- Trip Distribution
- Modal Split
- Multi Modal Assignment

The above approach is applied at the daily level. For peak hour modelling an additional *time of day* step is introduced.

Household Surveys

The household surveys provide information about household characteristics and trip making habits of residents of Amman. Respondents are asked to provide three types of information:

- General information about the household including number of persons, vehicle availability, household income range, etc.
- Characteristics about each member of the household such as age, gender, occupation, possession of a driving license, work status, work or study place, etc.
- Characteristics of the trips made by each member of the household on the previous weekday over a 24-hour period. This information includes trip origin, trip destination, start and end time of trip, mode, purpose, etc.

The household surveys are used as a basis for the transport model demand. Thus, the household interview survey provides critical input to the study. The household surveys provide key characteristics of trip making and behavioural relationships. The surveys are input into a statistical database and a cleaned process to remove erroneous data or responses.

Importantly, the database provides an array to relational cross tabulations to better understand the transport choices in the city. The surveys provide important information such as:

- Working status
- Working population by sex and industry
- Households by income level and car ownership
- Trip purpose
- Distance travelled by mode
- Trip timing and daily profile
- Trip generated and attracted by sector
- Trip distribution (daily and peak hour)
- Mode share by purpose and car availability
- Trip distribution by mode (desire lines)
- Transfer between modes and mixed mode trips

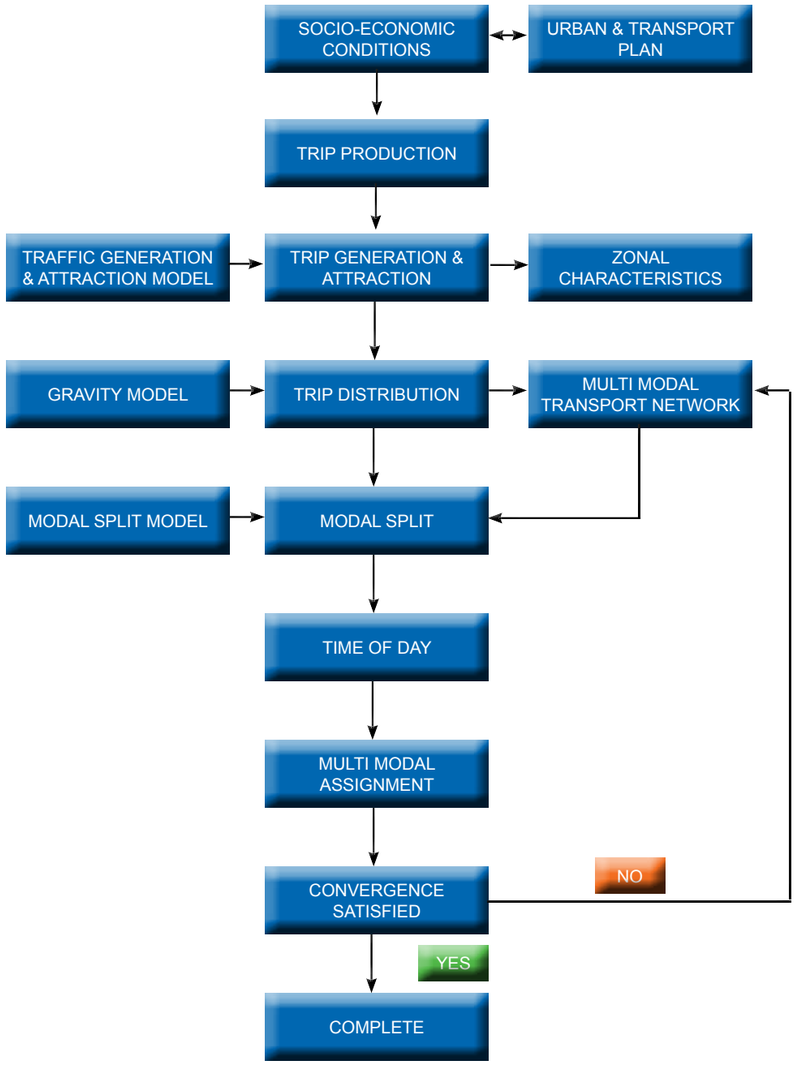
Some survey highlights are presented below:

- 68% of households have access to a vehicle
- Average monthly household income is 528 JD
- 1.73 trips/week/person
- 73% of residents make 2 trips/day
- 44% of trips are home-based education
- Public Transport mode share is 15%
- 50% of trips are under 30 minutes.

The household surveys provide trip making data for trips wholly within each city (internal to internal), and to a certain extent, trips from each city to locations outside of the city (internal to external). This is used to calibrate the 4 stage demand model.

Figure 61 presents a simplified flowchart of the steps involved.

Figure 61 - Four Stage Demand Model Flowchart



Intra-urban demand estimation and model calibration is carried out for all sub-model components, including important realism tests.

Forecast Year Demand Modelling

The demand model was updated to reflect the range of expected future scenarios in the period to 2025 as follows:

- The land use planning in accordance with GAM Master Plan forecasts, including committed or planned large scale developments, such as Abdali
- Road networks in accordance with GAM Master Plan strategic transportation networks, including committed schemes, development related road schemes, road hierarchy strengthening and major junction improvements
- Public transport improvements covering a range of stepped changes including:
  - Bus network restructuring
  - Bus network restructuring with a Bus Rapid Transit (BRT) network introduced
  - Bus network restructuring with both Light Rapid Transit (LRT) and BRT introduced
  - Bus network restructuring with further expansion of the LRT and BRT services
- Policy testing including:
  - Car fuel costs, taxi fare and public transport fares
  - Parking costs and strategy (spatial and land use type)
  - Congestion charge cordon

The outputs of the modelling exercise provide key performance indicators of the different strategies, such as:

- Highway and public transport volumes, link volume/capacity ratios and speeds
- Network vehicle hours and kms, average highway speed, journey time and distance
- Network person hours and kms, average public transport speed, journey time and distance
- Network pollutants, such as CO, CO2, NOx
- Accessibility indicators

The model outputs provide inputs to the overall multi criteria framework to compare the different strategy costs and benefits. The evaluation of policies set out for the TMMP have been undertaken through qualitative methods as well as by transport modelling and the modelling of a number of demand management

policies representing various intervention levels. A detailed description of the intervention policies are described below.

In order to provide a quantitative basis for the assessment of some policy measures, different levels of intervention and cost implications to these levels has been developed. Three levels of intervention have been developed and applied through the demand management policies during the testing of various scenarios and these are as follows:

- Soft level of intervention: introduction of pricing at today's prices, but assuming enforcement is rigorously applied.
- Moderate level of intervention: pricing that represents an increase over today's costs
- Strong level of intervention – aggressive level of policy intervention designed to impact behaviour change

If the assessment of the current strategy indicates a shortfall between the desired target level, and the level that the strategy is achieving, then supplementary policy actions can be implemented to strengthen the effect of the strategy measures.

These policy measures are largely demand management measures and can be applied in soft, moderate or strong terms. These can be tested separately within the model, and supplemented by further strategy measures if required.

Scenario Options

Following discussions with GAM, seven project scenarios have been developed for assessment within the framework appraisal process. This includes the reference case which represents the known future committed projects, including BRT and LRT. The scenarios are described in Table 19.

Table 19 - Scenario Options

Name	Scenario Code	Description	Demand Management
Base Case	DM1 Bus Only – No Demand Management	This Scenario consists of a substantially improved bus-based public transport system, with redesigned routes added coverage and with increased frequencies. There would be no bus rapid transit or light rapid transit schemes. Actions are: No demand management policies are introduced. Improved the existing public transport service network based upon improved bus services Bus feeder system operated by white taxis/minibuses Planned Highway Improvements excluding the Amman Ring Road West and North Sections	None
Base Case plus BRT	DM2 BRT/Bus – No Demand Management	This Scenario includes the bus improvements introduced under the DM1 scenario, but with the addition of 6 key bus routes being converted to bus rapid transit. This Scenario does not include any light rapid transit lines. : Actions: Improved PT network (as in DM1) Convert bus key bus routes to GAM's proposed 6 BRT lines Bus feeder system operated by white taxis/minibuses Highway Improvements but excludes the Amman Ring Road West and North Sections	None
Base Case plus BRT plus demand management	DM3 BRT/Bus – Soft Demand Management	This scenario includes all the measures in DM2, but also includes the application of soft demand management measures Actions: Improved PT network (as in DM1) Convert bus key bus routes to GAM's proposed 6 BRT lines Bus feeder system operated by white taxis/minibuses Demand Management soft measures Highway Improvements but excludes the Amman Ring Road West and North Sections	Soft Measures
Substantial Public Transport Investment	DS1 LRT/BRT/Bus – No Demand Management	This scenario involves additional investment to the public transport network, combining bus rapid transit and three light rapid transit lines and is supported by a strong bus feeder system as developed under Scenarios DM1, DM2 and DM3. This scenario involves a significant increase in capital costs through the implementation of the LRT system. Actions: Additional BRT lines 3 LRT lines Bus feeder system operated by white taxis/minibuses Highway Improvements but excludes the Amman Ring Road West and North Sections	None
Base Case plus BRT plus Highway Investment	DS2 BRT/Bus/ Highways – No Demand Management	This scenario is the "Highways" dominated scenario with the only public transport actions includes the 6 bus rapid transit lines. This scenario includes heavy investment in highways through the implementation of the western and northern sections of the Amman Ring Road. Actions: Improved PT network (as in DM 2) Bus feeder system operated by white taxis/minibuses Highway Improvements including the construction of the Amman Ring Road West and North Sections	None
Substantial Public Transport Investment with extended LRT Lines	DS3 Extra LRT/ BRT/Bus – No Demand Management	This scenario represents a higher level of investment in infrastructure than DS1, with some of the elements of the BRT network being replaced by extensions to the LRT Lines. Actions: Extensions to the LRT system Extension, readjustments and withdrawal of certain sections of the BRT system Bus feeder system operated by white taxis/minibuses Highway Improvements excluding Amman Ring Road West and North Sections.	None

Name	Scenario Code	Description	Demand Management
DS1 plus soft demand management	DS4 LRT/BRT/Bus – Soft Demand Management	This scenario represents the DS1 scenario but is supported by soft demand management measures. The demand management option is introduced to assist and support shift to public transport. Actions: Public transport as per DS1 with three LRT Lines and BRT network Bus feeder system operated by white taxis/minibuses Soft Demand Management measures Highway Improvements but excluding the Amman Ring Road West and North Sections	Soft Measures
DS1 plus moderate demand management	DS5 LRT/BRT/Bus – Moderate Demand Management	This scenario represents the DS1 scenario but is supported by moderate demand management measures. The demand management option is introduced to assist and support shift to public transport. Actions: Public transport as per DS1 with three LRT Lines and BRT network Bus feeder system operated by white taxis/minibuses Moderate Demand Management measures Highway Improvements but excluding the Amman Ring Road West and North Sections	Moderate Measures
DS1 plus moderate demand management plus cordon pricing (peak hour only)	DS5a LRT/BRT/Bus – Moderate Demand Management plus Cordon Charging in City Centre	This scenario represents the DS1 scenario but is supported by moderate demand management measures, including the imposition of cordon pricing in the City Centre area in the AM peak hour only. Actions: Public transport as per DS1 with three LRT Lines and BRT network Bus feeder system operated by white taxis/minibuses Moderate Demand Management measures Cordon Pricing scheme in AM peak Highway Improvements but excluding the Amman Ring Road West and North Sections	Moderate Measures plus Cordon Pricing
DS1 plus moderate demand management plus higher charge cordon pricing (peak hour only)	DS5b LRT/BRT/Bus – Moderate Demand Management plus Higher Cordon Charging in City Centre	This scenario represents the DS1 scenario but is supported by moderate demand management measures, including the imposition of higher cost cordon pricing (compared with DS5a) in the City Centre area in the AM peak hour only. Actions: Public transport as per DS1 with three LRT Lines and BRT network Bus feeder system operated by white taxis/minibuses Moderate Demand Management measures Higher cost Cordon Pricing scheme in AM peak Highway Improvements but excluding the Amman Ring Road West and North Sections	Moderate Measures plus higher cost Cordon Pricing
DS1 plus strong demand management	DS6 LRT/BRT/Bus – Strong Demand Management	This scenario represents the DS1 scenario but is supported by strong demand management measures. Actions: Public transport as per DS1 with three LRT Lines and BRT network Bus feeder system operated by white taxis/minibuses Strong Demand Management measures Highway Improvements but excluding the Amman Ring Road West and North Sections	Strong Measures
DS1 plus strong demand management plus workplace parking levy	DS7 LRT/BRT/Bus – Strong Demand Management plus Workplace Parking Levy	This scenario represents the DS1 scenario but is supported by both strong demand management measures and workplace parking levy. The latter is a charge to employers who allow their staff or customers to have free parking on their own land. Where public car parking (both on and off street) is charged, free parking on private land creates a distortion in the number of car trips undertaken. Actions: Public transport as per DS1 with three LRT Lines and BRT network Bus feeder system operated by white taxis/minibuses Strong Demand Management measures, plus Workplace Parking Levy Highway Improvements but excluding the Amman Ring Road West and North Sections	Strong Measures plus Workplace Parking Levy

Key Modelling Highlights

In terms of model outputs, we have highlighted the key results detailing the performance of each of the scenarios in terms of:

- Daily Public transport mode share
- Number of daily PT trips
- Person and Vehicle Kms
- Daily CO2 Pollutants from vehicles (Kg)
- Daily NOx Pollutants from vehicles (Kg)

Daily Mode Share

Figure 62 provides an indication of mode/shift for each scenario. It can be seen that PT mode share increases as demand management policy is implemented in increasing levels. The 40% PT mode share target is only achieved with scenarios 6 and 7 which include strong demand management measures.

Figure 62 - Daily Mode Share

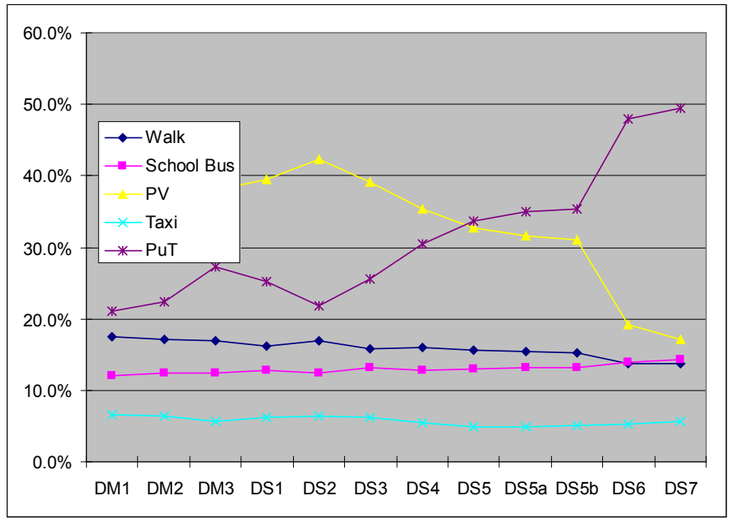


Figure 63 - Person and Vehicle Kms

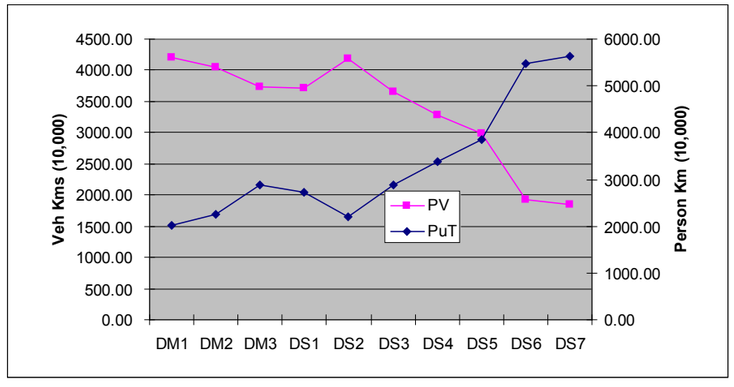


Figure 63 shows the impact on vehicle kms and person trips for each of the scenarios. Private vehicle trips decrease from 4.5 million to just under 2 million. Public transport trips increase from 1.5 million to 5.5 million.

Figure 64 - CO2 Emissions

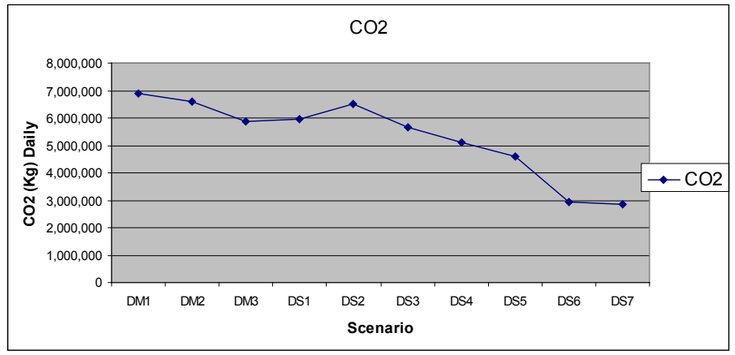
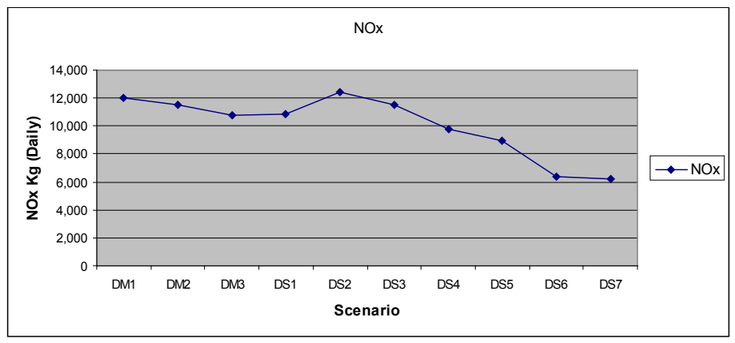


Figure 65 - NOx Emissions



The daily CO2 emissions in DM1 is 7,000 kg. DS7 reduces CO2 emissions by more than 50%. DS4 reduces emissions by 28%. Nox emission with DM1 is in the region of 12,000 kg/day. Implementing DS4 scenario reduces this by 17%.

The volume/capacity ratio diagrams overleaf provide an indication of the impacts each strategy has on the city centre road network. Figure 66 to Figure 71 show v/c ratios for DM2 through to DS7. The impact of increasing strategy and policy intervention is shown with DS6 and DS7 providing a relatively free flowing network.

Figure 66 - Forecast Year Network: DM2 AM

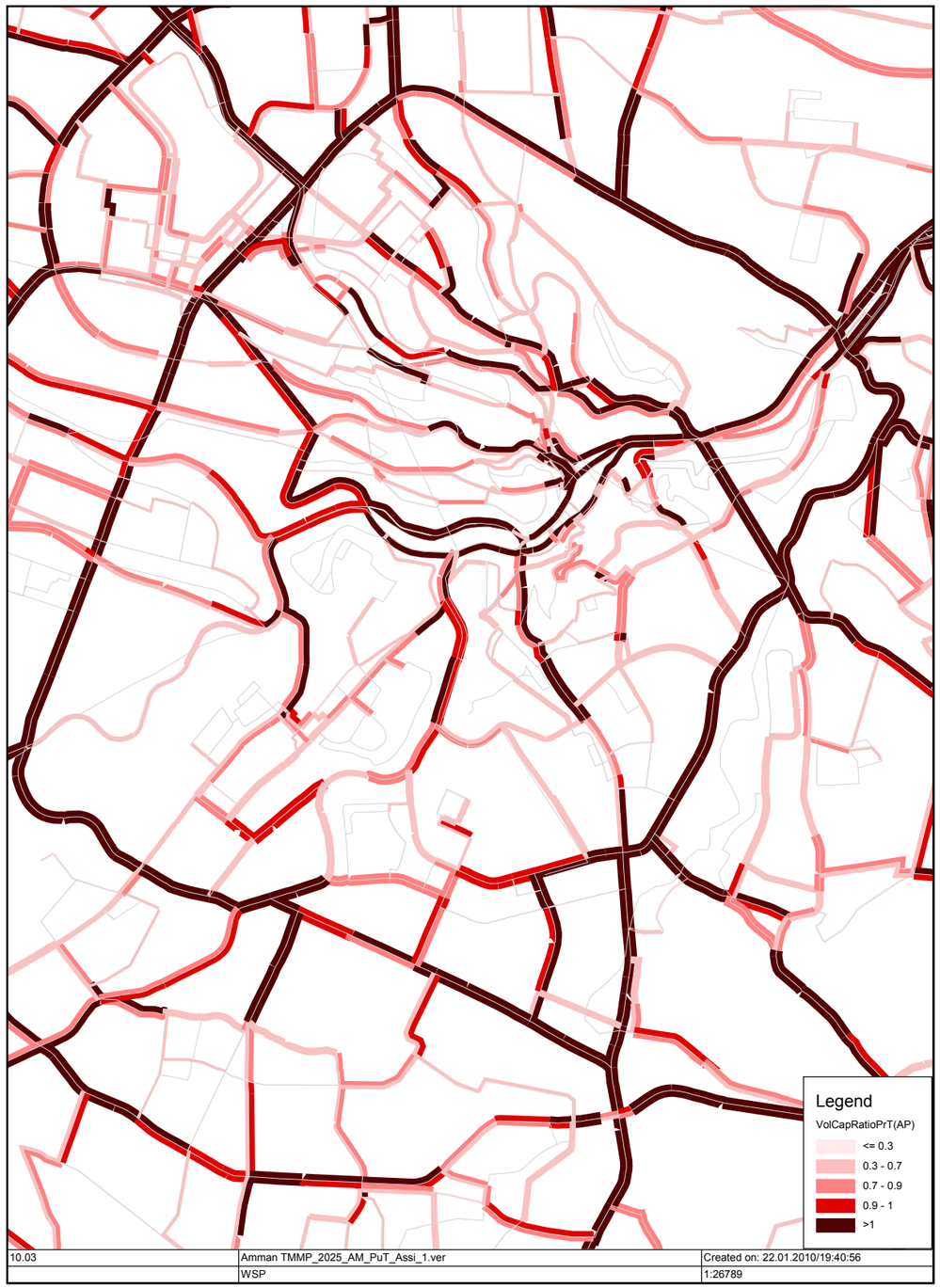


Figure 67 - Forecast Year Network: DM3 AM

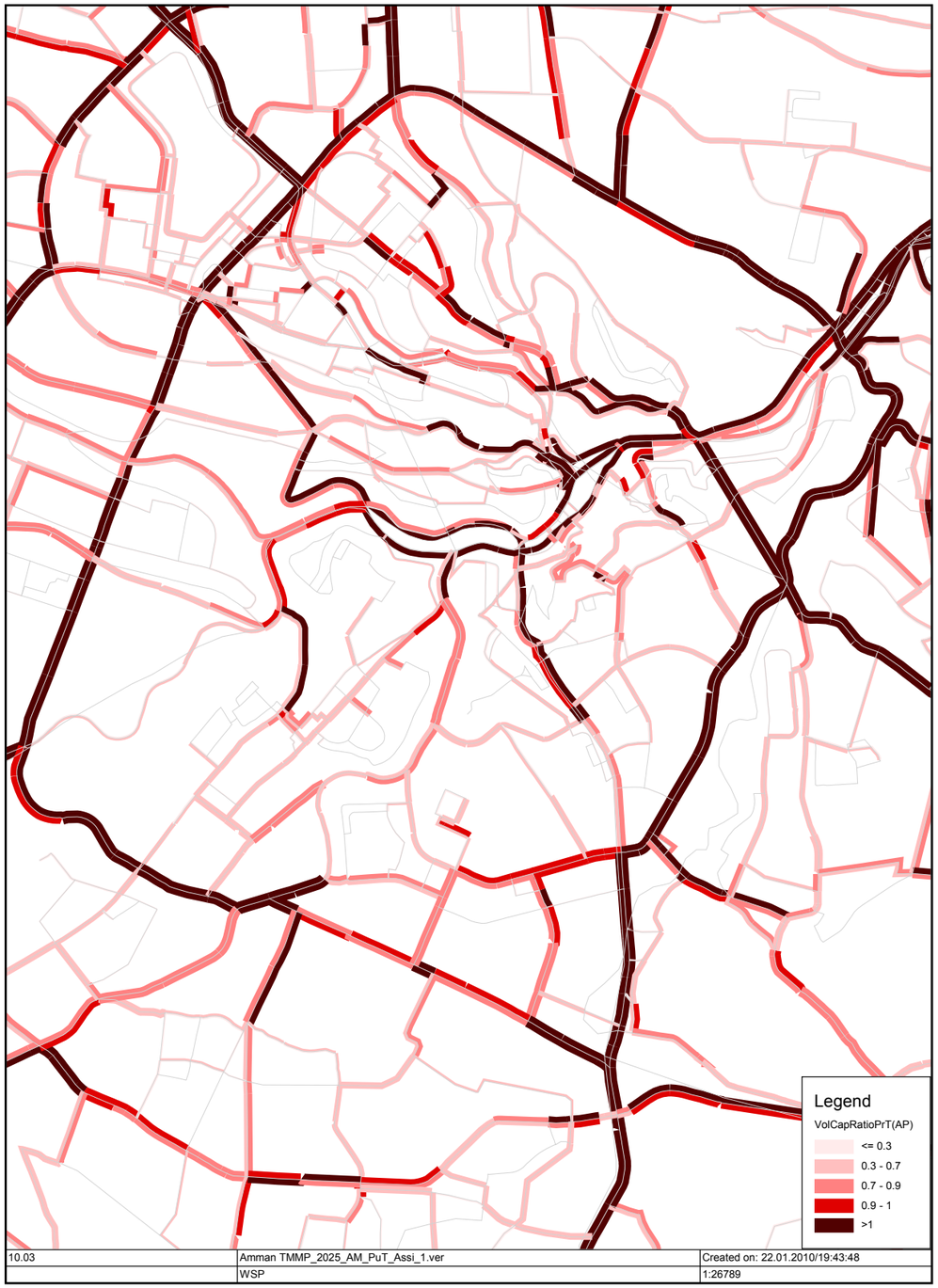
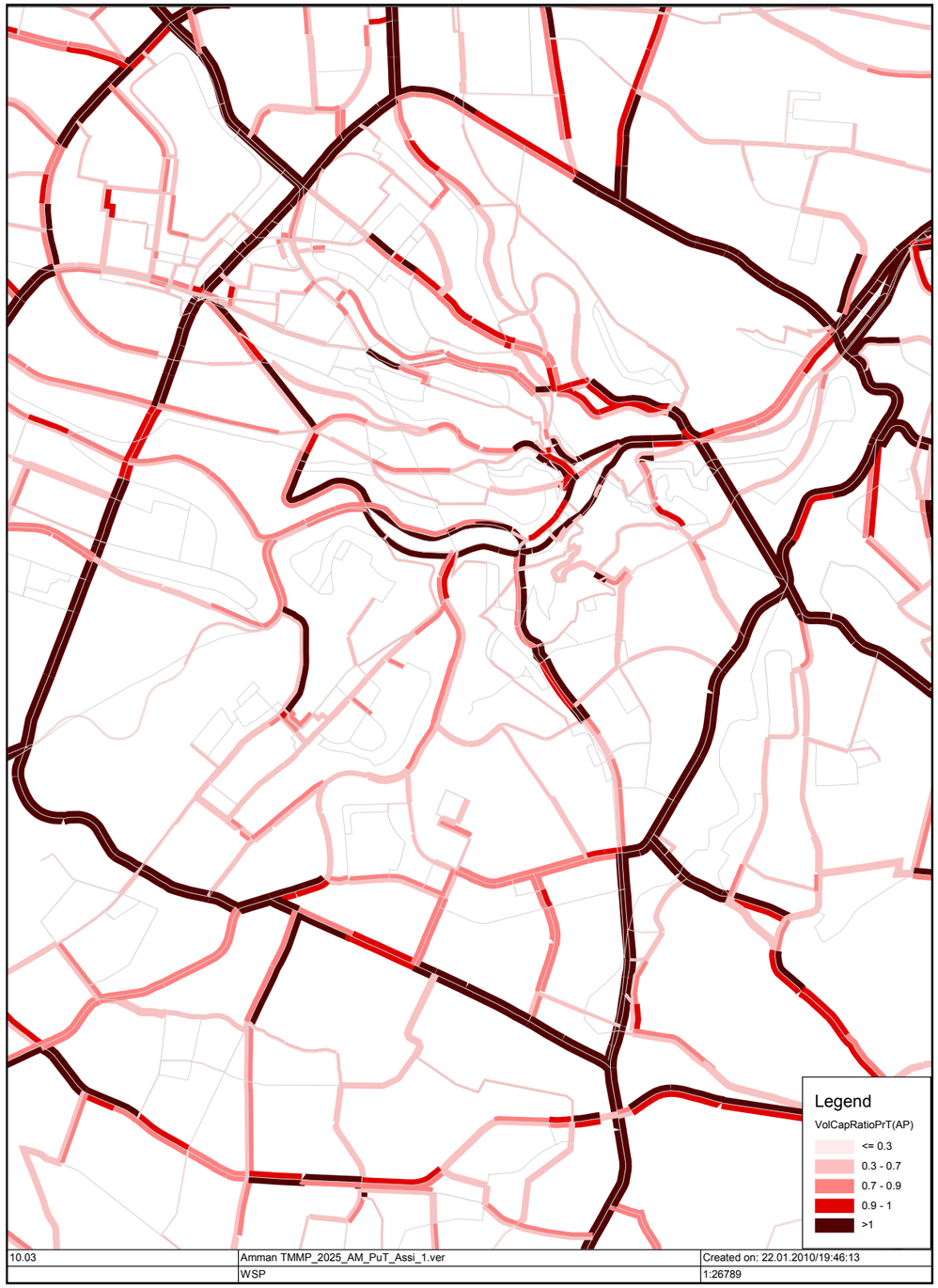
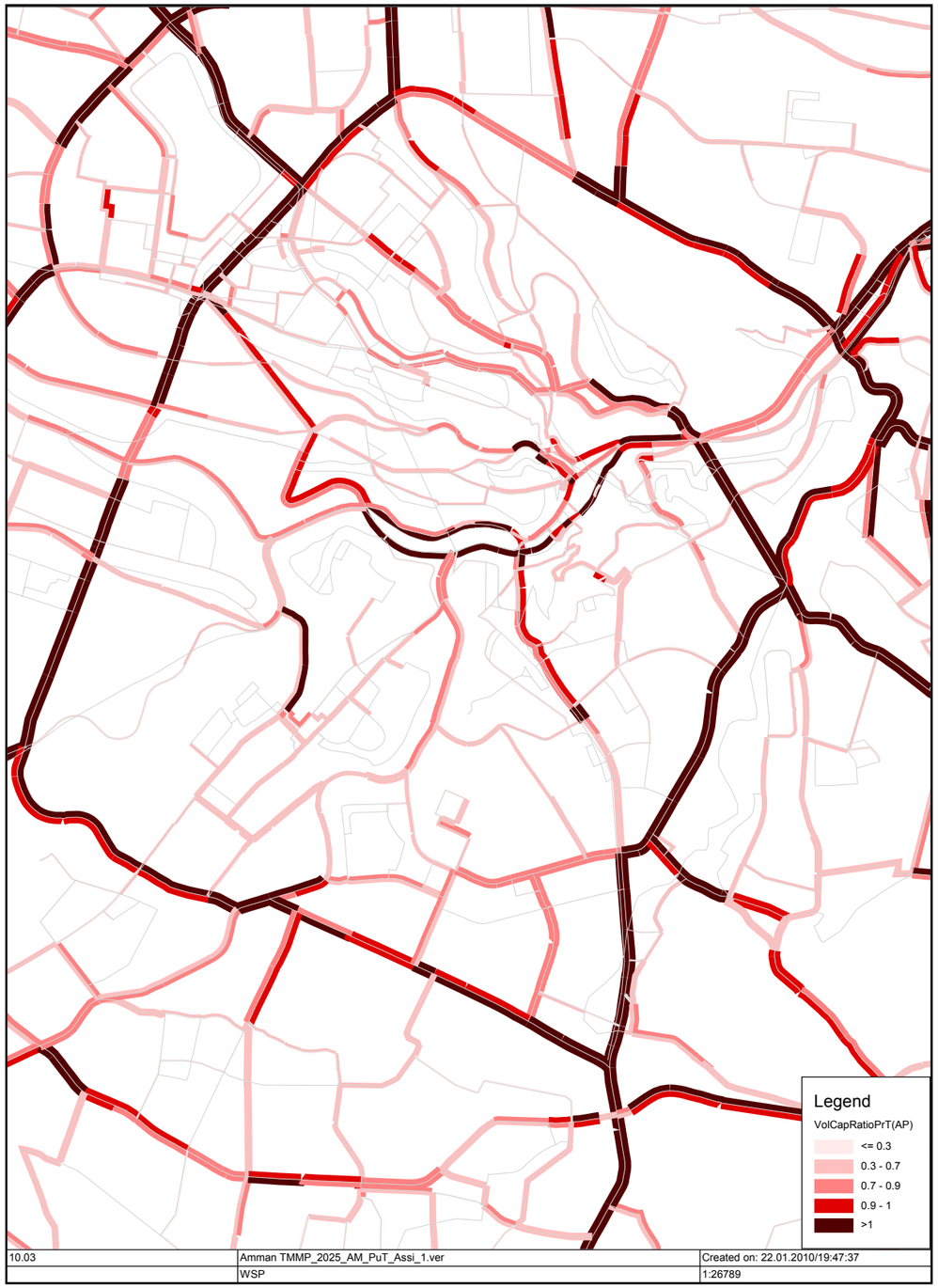


Figure 68 - Forecast Year Network: DS4 AM



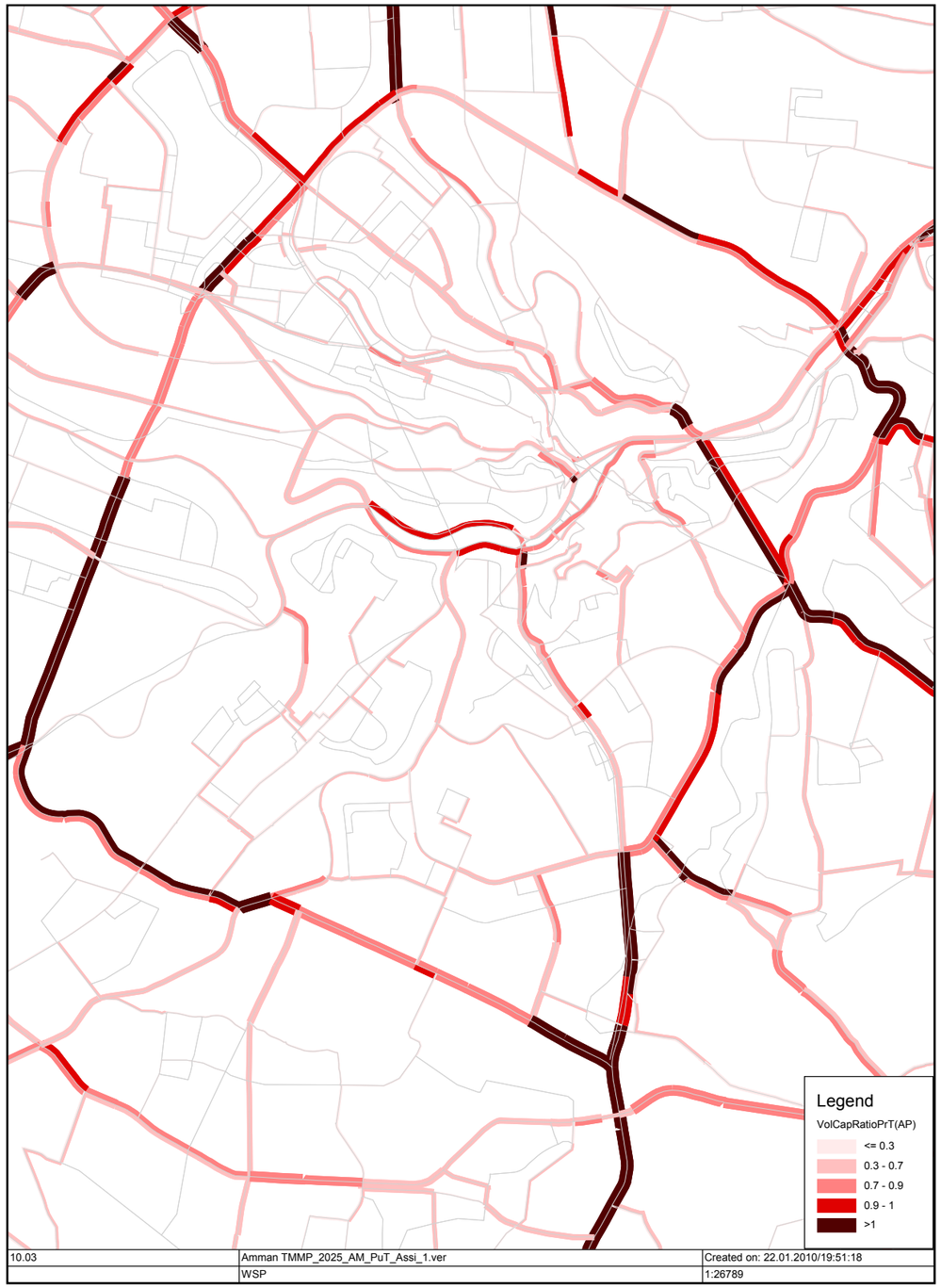
10.03	Amman TMMP_2025_AM_PuT_Assi_1.ver	Created on: 22.01.2010/19:46:13
	WSP	1:26789

Figure 69 - Forecast Year Network: DS5 AM



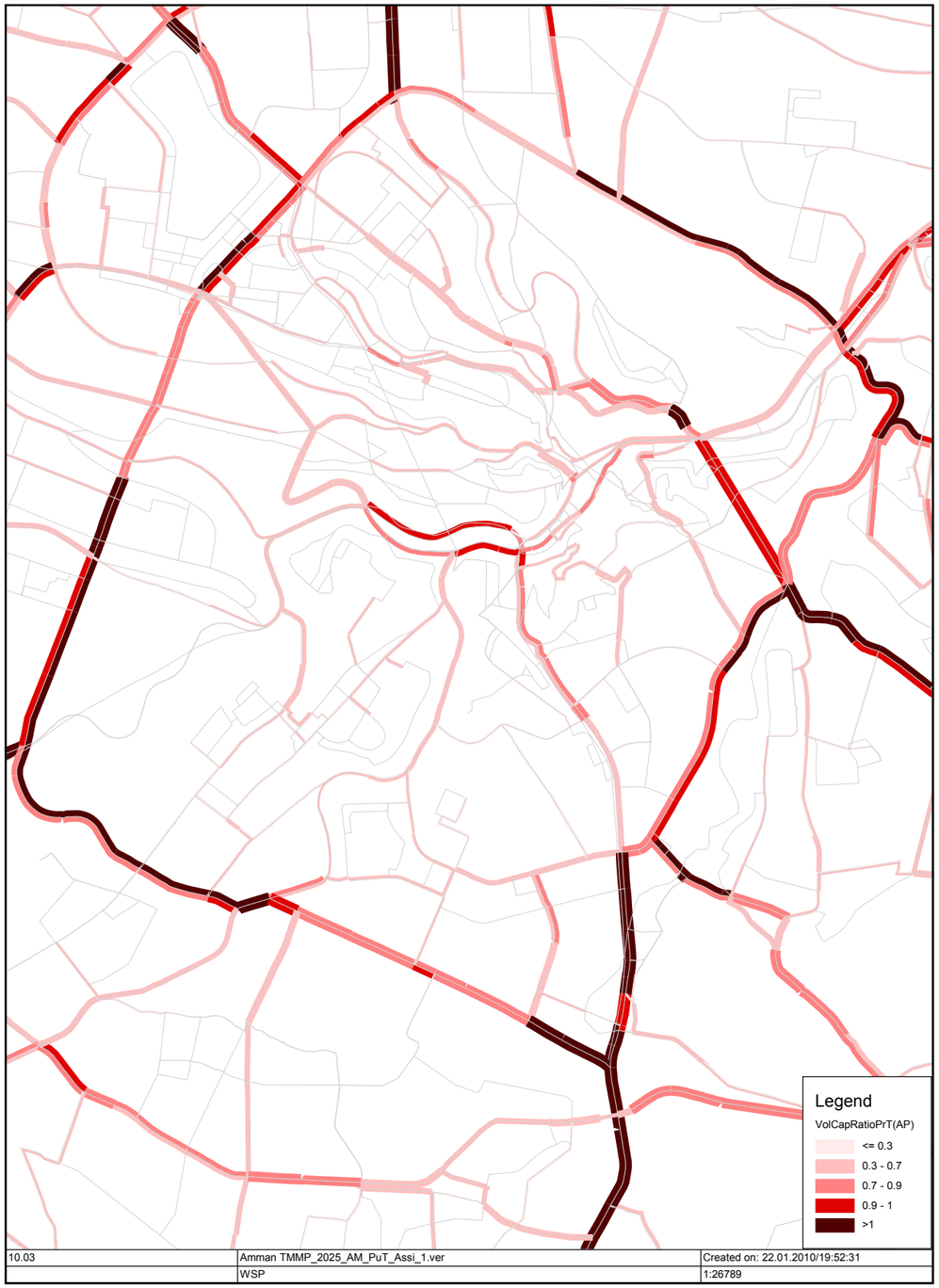
10.03	Amman TMMP_2025_AM_PuT_Assi_1.ver	Created on: 22.01.2010/19:47:37
	WSP	1:26789

Figure 70 - Forecast Year Network: DS6 AM



10.03	Amman TMMP_2025_AM_PuT_Assi_1.ver	Created on: 22.01.2010/19:51:18
	WSP	1:26789

Figure 71 - Forecast Year Network: DS7 AM



10.03	Amman TMMP_2025_AM_PuT_Assi_1.ver	Created on: 22.01.2010/19:52:31
	WSP	1:26789

Strategy Appraisal 12

Strategy Appraisal

Introduction

The evaluation process used to assess the policies and strategies developed to meet the TMMP objectives uses a multi criteria one that takes into account three areas of assessment. These are:

- Economic
- Social, and
- Environmental

This Multi Criteria Appraisal Framework (MCAF) is a tool for assisting decision makers in taking strategic decisions relating to transport strategy options. It includes a wide range of individual measures within each strategy, and these strategies are then joined together to create a range of scenarios. This approach will enable GAM to make a choice between competing measures, and will, in turn, allow for an "emerging" or "composite" scenario to be developed from the original range of scenarios. The individual measures can be tested for effectiveness and compliance with objectives, and thus assist in the process of constructing the most beneficial strategies.

Clearly, the number and combinations of scenarios that could be envisaged is almost limitless, but for the TMMP, we have tested a total of 12 scenarios, which cover a wide range of potential measures. These can be broadly divided into three general categories as follows:

- Three scenarios that concentrate on providing the basic required level of public transport services to accommodate the proposed level of development and population increases. They include planned and committed highway schemes, and also include measures to deliver safety, pedestrian and freight improvements. Two include an extensive development of the proposed BRT system, whilst the other is entirely bus based. One scenario considers the implication of introducing soft demand management measures through the application of parking charges and restraints in the central area of the City;
- A further three scenarios were designed to test increased transport investment compared with the first three scenarios, but without the introduction of any demand management measures. One added Light Rail Transit (LRT) to the proposed BRT system, another considered the impacts of further highway investment without further improvements to public transport, whilst the third included further investment in LRT towards the latter part of the Plan timescale through extensions and partial replacement of a limited number of BRT services.
- The final six scenarios considered a range of demand management measures, including parking charges both within the City Centre and over a wider area, cordon pricing, where all trips entering the City Centre area would be obliged to pay a toll, and workplace parking charges, which would involve a parking charge to employers for the number of car parking spaces provided on their premises for employees. These measures were further tested through the use of 'soft', 'medium' and 'strong' pricing for parking charges and the cost of fuel and use of taxis.

Having identified the specific objectives for the study, each of the measures was scored on a seven point scale (major negative impact through to major positive impact). Further refinement occurs when objectives are weighted, giving more importance to some objectives and less to others. In addition to this weighting, the measures are grouped into strategy packages, which in turn are joined together to form the scenarios. Scoring is done on a measure by measure basis but reported at strategy package level.

As part of the assessment, the specification of the objectives was required, which needed to be in accord with the key transport objectives. Once specified, they have been broadly placed into three categories – Economy, Social and Environmental – with each category having several sub-objectives. These objectives have been specified to achieve GAM's economic social and environmental goals, the key transport criteria in order to achieve sustainable development.

Approach

The aim of the appraisal is to score individual measures against set objectives. This involves both quantitative and qualitative evaluation on the economic, social and environmental components. The quantitative assessment involves assessing projects that cannot technically be included in the transport modelling (non-modelled), and the qualitative assessment (modelled) involves assessing projects across the network system that are included in the transport modelling.

The appraisal process for the non-modelled measures follows a standard methodology where measures are scored against specific objectives on a seven point scale (from -3 to +3). This assessment has been tailored for this project by adding weightings to the objectives, giving more importance to some objectives and less to others. In addition to this weighting, the objectives are grouped into strategy packages called scenarios, with scoring undertaken on a measure by measure basis but reported at the scenario level.

The appraisal process for the modelled measures is more straightforward, with the output results from the transport model measured against the eight key targets as specified in Table 20.

The main difference is that the non-modelled measures are scored subjectively, whilst the modelled measures are measured on how they actually perform against the targets definitions. In order to allow direct comparisons, the modelled measures are also subjected to the same subjective scoring methodology as the non-modelled measures.

This approach provides the decision maker with a more comprehensive understanding of the main benefits or adverse impacts of each scenario, measured using common criteria. It also allows the benefits and disbenefits of individual measures to be directly compared.

Weighting

A simplistic but clear approach to weighting of projects has been adopted, and an initial view taken on the relative merits for each objective, i.e. economic, social and environmental. These are as follows:

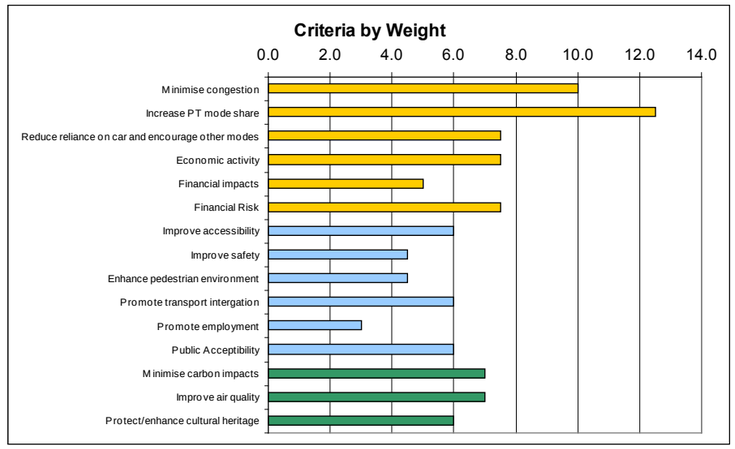
- Economy: 40%
- Social: 40%
- Environment: 20%.

These weightings may easily be changed according to GAM's views and assessments. Once the primary objectives and weightings are selected, the sub-objectives are then identified and scored as follows:

- Economic
  - Minimise congestion: 20%
  - Increase PT mode share to meet TMMP policy targets: 25%
  - Reduce reliance on the car and encourage other modes of transport: 15%
  - Economic activity: 15%
  - Financial impacts on users: 10%
  - Financial risk: 15%
- Environmental
  - Minimise carbon impacts: 35%
  - Improve air quality: 35%
  - Protect/enhance cultural heritage: 30%
- Social
  - Improve accessibility: 20%
  - Improve safety: 20%
  - Enhance pedestrian environment and promote walking: 15%
  - Promote transport integration: 15%
  - Promote employment: 10%
  - Public acceptability: 20%

The weightings chosen for this higher level exercise are based on the view that importance of minimizing congestion, increasing public transport usage, improving accessibility and safety and improving air quality are of the highest concern.

Figure 72 - Criteria by Weight



Project Appraisal Summary

The results of the project appraisal process are detailed in the following sections. Firstly, we provide a summary of the performance of the various scenarios against the target definitions developed earlier in the process. The overall MCAF results are then presented , in which the target definition analysis is incorporated.

Target Definitions

A summary of the performance of the target definition appraisal is presented on the following pages. This analysis is a product of assessing and evaluating scheme measures using the multi modal model, and the outcomes are then measured against the target definitions. The summary clearly shows the significant influence demand management plays in helping to meet the target definitions set. It is noticeable that scenarios DS3 through to DS7 provide more significant shifts towards meeting the target definitions than scenarios DS1 and DS2. For example, only scenarios DS6 and DS7, which have the strongest demand management measures, meet the 40% public transport mode share target, although the public transport network is very similar to scenarios DS1, DS4 and DS5.

Legend

- 3 Fully meets target
- 2 Substantial move towards target
- 1 Minor move towards target
- 0 No change
- -1 Minor negative impact
- -2 Substantial negative impact
- -3 Show stopper

Table 20 - Target Definition Scores

	DM1	DM2	DM3	DS1	DS2	DS3	DS4	DS5	DS5a	DS5b	DS6	DS7
Target Definition 1 Number of private vehicle kilometres travelled by road to be confined to current levels: Amman is to ensure that traffic volumes on the roads are decreased, or at least stabilized.	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1
Target Definition 2 Public Transport Mode Share: Amman is looking to increase the proportion of personal travel made by public transport from 15% to 40%.	0	+1	+1	+1	0	+2	+2	+2	+2	+2	+3	+3
Target Definition 3 Average Journey Time by Public Transport: Amman is to reduce the average journey time by public transport in peak hour from 45 minutes to 30 minutes.	-1	0	0	+1	0	+2	+2	+2	+2	+2	+2	+2
Target Definition 4 Reduce levels of pollutant and greenhouse gas emissions: Amman is to reduce the average greenhouse gas emissions from road based traffic by 12 %	-1	-1	0	0	-1	0	+1	+1	+1	+1	+2	+2
Target Definition 5 Increasing the number of households within 400 metres of a public transport service with a peak frequency of at least one service every 10 minutes from 12.1% to 20%: Amman is to increase the proportion of households within 400m of the public transport network	+1	+1	+1	+1	+2	+2	+2	+2	+2	+2	+2	+2
Target Definition 6 Achieving 40% of jobs within 2km of the city's major transport nodes Amman is to increase the proportion of jobs within 2km of the city's major public transport nodes	0	+1	+1	+1	+2	+2	+2	+2	+2	+2	+2	+2
Target Definition 7 Reduction in the number of pedestrian personal injury accidents.	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1
Target Definition 8 To increase the mode share of walking for short-distance trips	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2

MCAF Appraisal Results

The MCAF overall appraisal results are shown in the table below. This analysis takes into account economic, social and environmental aspects of the scenarios and combines the modelled and non modelled assessment of each scenario.

The economic appraisal has been omitted from the overall MCAF analysis to ensure clarity is achieved in its analysis, and is thus presented in Chapter 12. The MCAF process also takes into account technical and financial risk and public acceptability to the schemes and to the overall public sector spending programme each scenario generates. Therefore, whilst a scheme may meet all target definitions, it may either be technically difficult to implement and/or financially difficult for Government to implement.

Furthermore, on schemes of this nature, particularly when they are being developed as PPP projects, “Value for Money” appraisals will be required and then compared with other projects from other sectors, to determine which the Government decides to implement.

The MCAF analysis shown in Table 21 indicates that the scenarios best addressing the target definitions are DS6 and DS7. The reasons for this are that they both have strong demand management policies supporting the public transport strategy. The next best scenarios are DS4 followed by DS5. DS4 adopts a softer demand management policy, whilst DS5 adopts a moderate demand management policy. DS2 represents a highway investment scenario, and, as expected, thus scores poorly in terms of addressing the targets.

In our view, however, scenarios 6 and 7 are very unlikely to be publicly acceptable at the current time. Given that these scenarios involve combinations of strong demand management measures including higher parking charges both on and off-street, higher fuel costs and taxi fares and either cordon pricing or workplace parking levies, it is likely to have an adverse impact on economic activity and be strongly resisted by the general public, particularly if introduced as a phased programme over a short period of time.

We believe that the scenario with the best overall balance between target meeting performance and public acceptability is DS4. This scenario includes a very substantial investment in high quality public transport services, but combined with a comprehensive parking policy designed to address both existing and future mismatches between supply and demand through a pricing structure. If the benefits of a public transport based approach become self evident through personal experience for the general public during the implementation of the TMMP, it is, of course, quite feasible to adjust the demand management measures to make them stronger and thus to make the overall strategy more closely meet the targets set.

If investment at the high rate proposed in DS4 should not be practically achievable during the period of the TMMP, the best alternative scenario to apply would be, in our opinion, DM3. This still represents a very significant investment in BRT services, and also includes soft demand management measures regarding parking charges.

Table 21 - Appraisal Results

Scenario	Overall Weighted Score	Ranking
DM1 (Baseline)	0.07	11
DM2	0.23	10
DM3	0.28	8
DS1	0.44	7
DS2	0.25	9
DS3	0.55	4
DS4	0.59	2
DS5	0.54	5
DS5a	0.53	6
DS5b	0.56	3
DS6	0.76	1
DS7	0.76	1

Figure 73 to Figure 84 provide a snapshot of performance when scenarios are compared.

Figure 73 - DM2 vs DM3

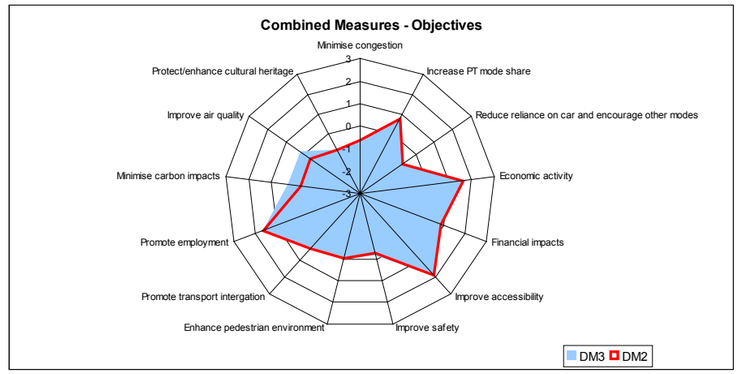


Figure 74 - DM2 vs DS1

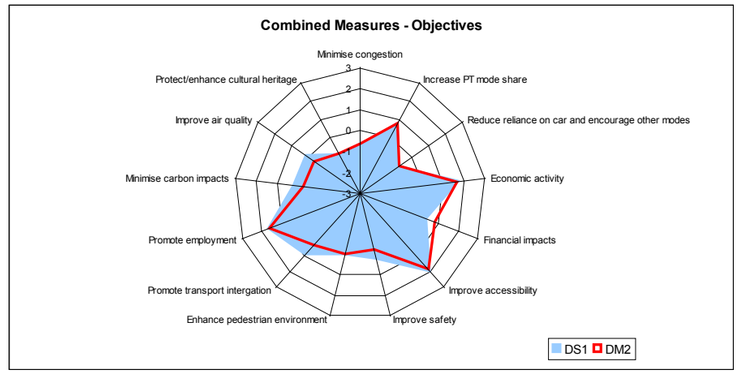


Figure 75 - DM2 vs DS2

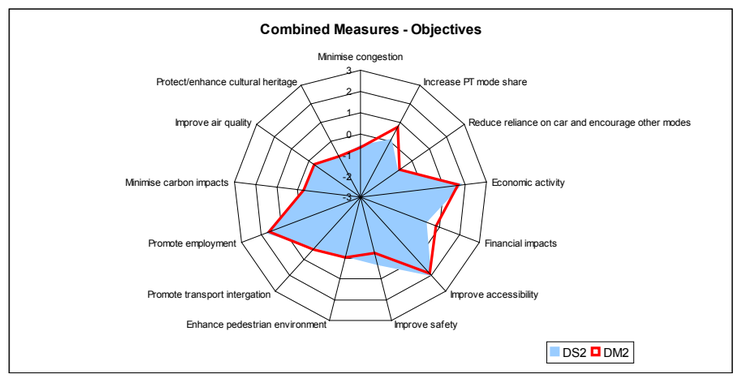


Figure 76 - DM2 vs DS3

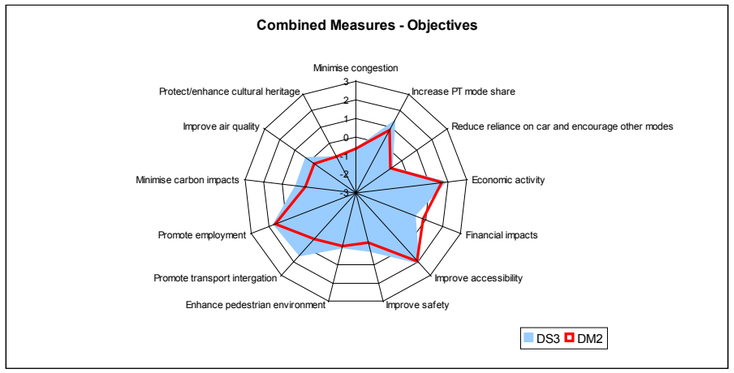


Figure 77 - DM2 vs DS4

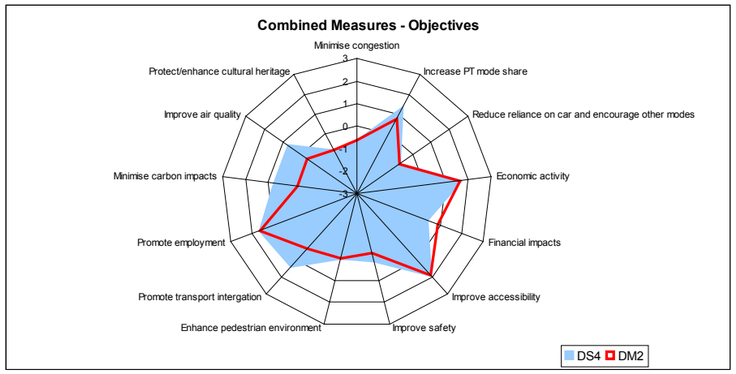


Figure 78 - DM2 vs DS5

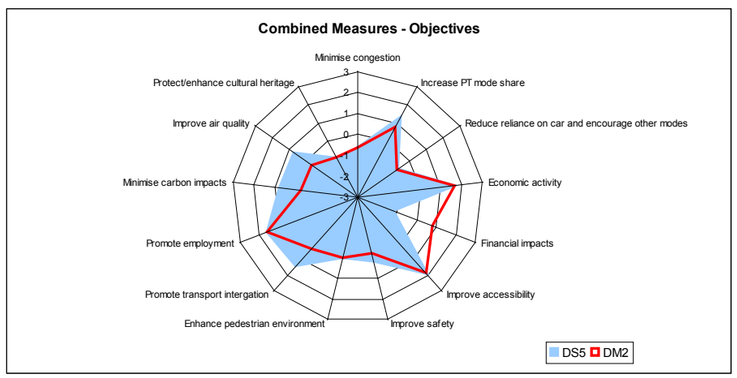


Figure 79 - DM2 vs DS6

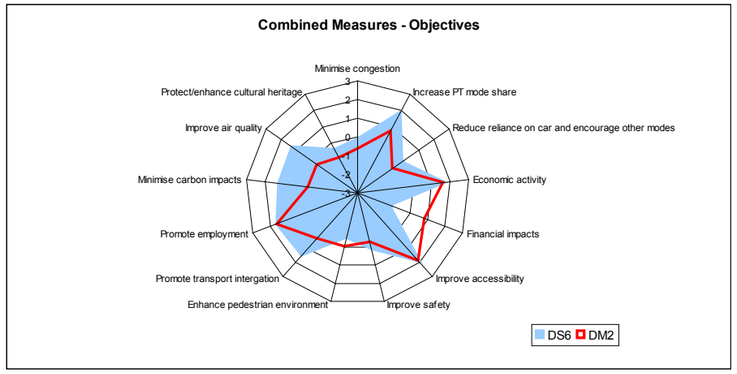


Figure 80 - DM2 vs DS7

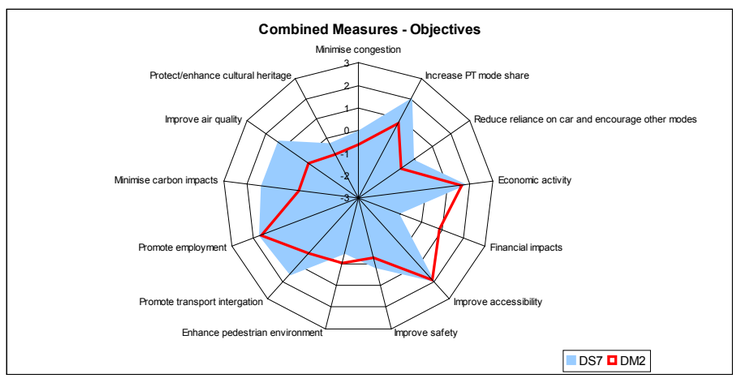


Figure 81 - DS3 vs DS4

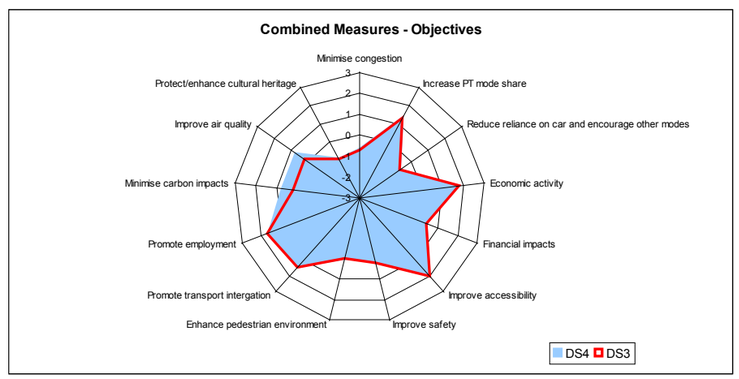


Figure 82 - DS4 vs DS5

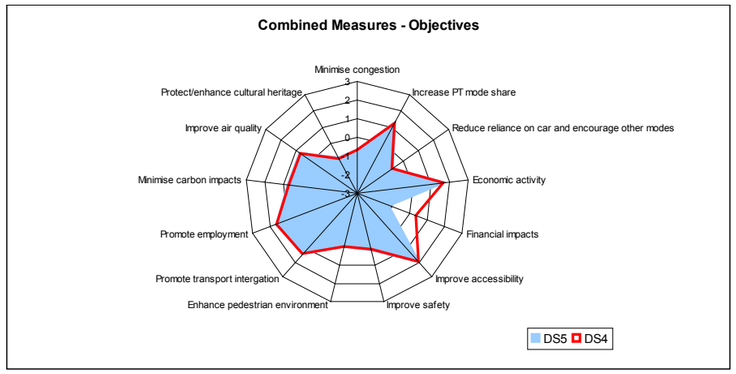


Figure 83 - DS5 vs DS6

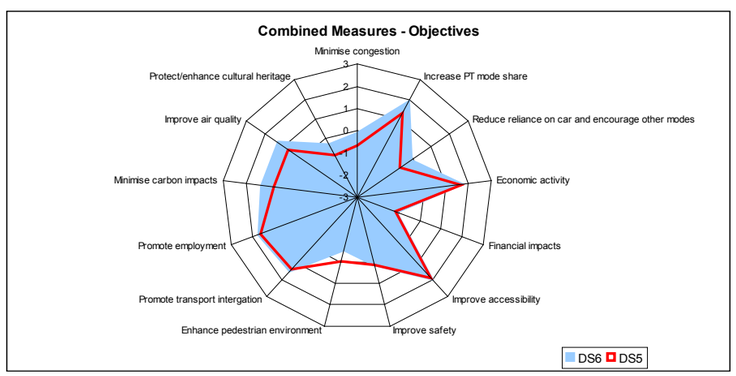
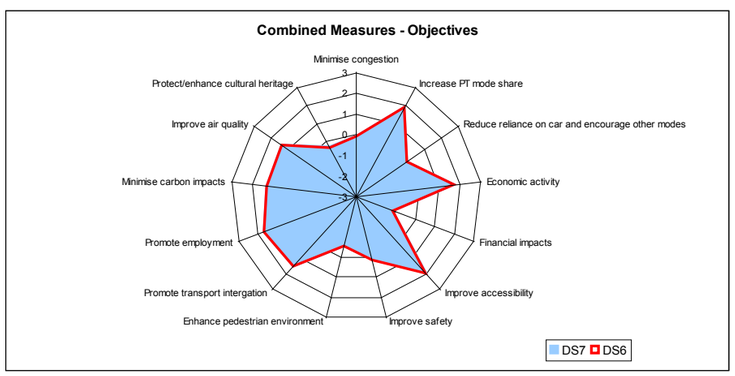
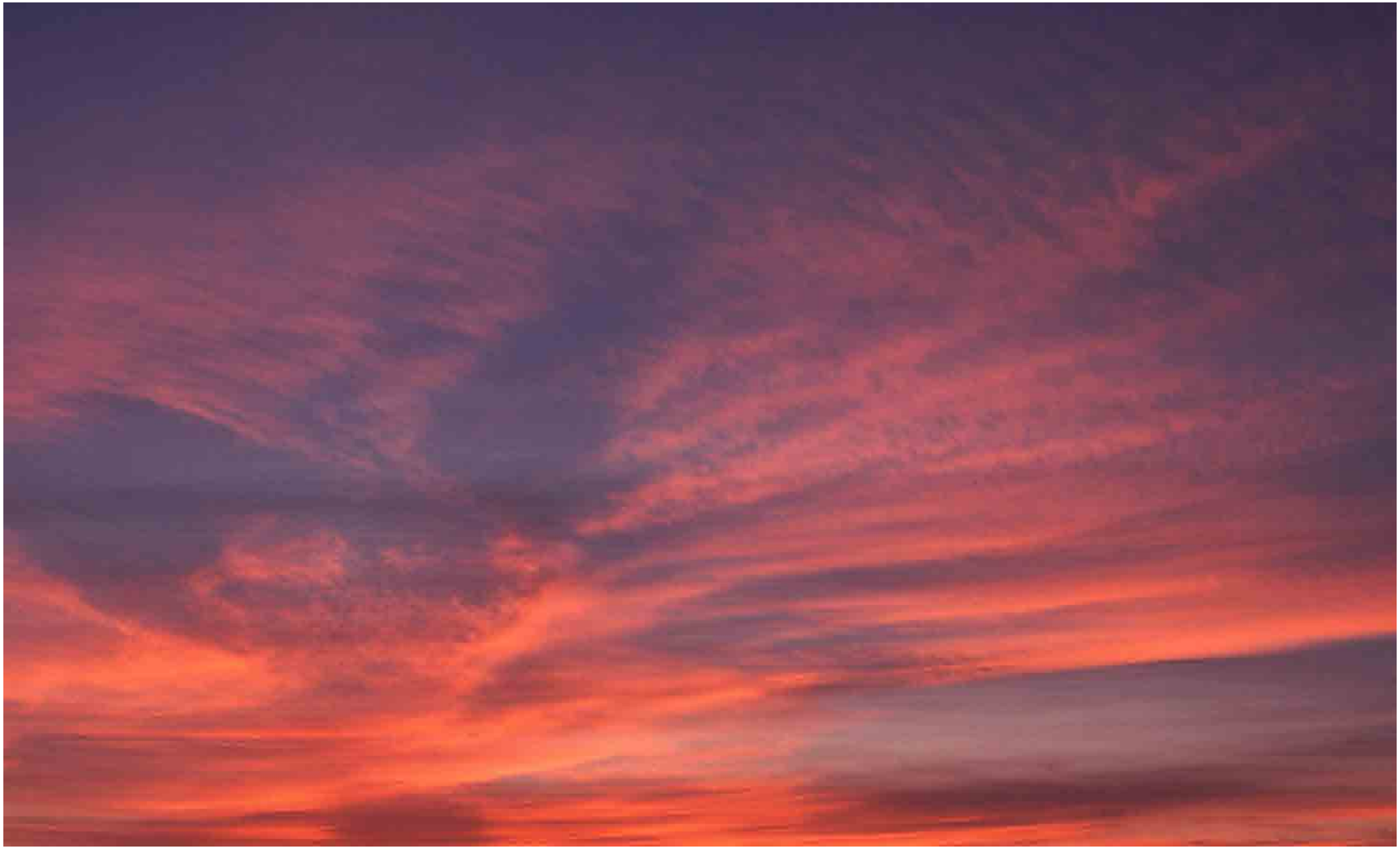


Figure 84 - DS6 vs DS7





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Economic Appraisal 13

Economic Appraisal

Approach

In economic terms, a scheme is appraised based on its impact as a function of benefit to society as a whole minus its cost to society. The benefits to a project are the stream of user cost savings evaluated over the life of the project and discounted to the present value year. The costs taken into account are principally the construction and maintenance costs. The cost elements included in this appraisal are:

- Vehicle operating costs
- Travel time costs
- Accident costs
- Highways construction costs
- Maintenance costs
- BRT costs
- LRT costs
- Bus costs
- ITS costs
- Demand management costs
- Pedestrian improvement costs
- Freight costs

Other costs, such as resettlement and land acquisition costs, compensation costs and mitigation costs have not been accounted for.

In economic appraisals, one unit of benefit is valued more highly if it is received today than at a given point in the future, on the basis that if received today it can be enjoyed today. Likewise, one unit of cost is seen as worse if it is accrued today than at some point in the future. Thus the nearer to the present day costs and the benefits are accrued, the more valued they are.

It should be noted that this is not the same as price inflation, which pertains to the decreasing value of money. The analysis is based on the assumption of price neutrality wherein it is assumed that prices will increase uniformly across time hence prices remain constant in real terms. This is assumed for all costs except Value of Time (VOT) which will increase as a function of increased income.

In order to quantify costs and benefits over time, Discounted Cash Flow (DCF) Analysis is used. This discounts future costs and benefits as a function of their distance into the future. Future year costs and benefits are divided by (1+r)t wherein t is the number of years into the future (or after the start of the evaluation period) and r is termed the discount rate.

The estimation of construction costs have been based upon local contracting unit prices and basic cost estimates utilised by previous design work. Since costs and comparisons are drawn from previous work, a similar cost basis has been adopted.

For additional costs over and above the basic construction costs, 30% has been allocated to allow, contingency, study costs, design costs, site supervision costs, etc.

The base year for traffic data and costs as well as the present value year, to which all costs are discounted, has been set to 2008 in this appraisal. The discount rate is 12 % and the calculation period, during which costs and benefits are calculated, is set to 15 years starting with the opening year of the road. A discount rate of 12% is used to reflect the expected increase of bank interest rates over the next 15 years.

The benefits and costs of the Scenario alternatives are compared with the DM2 alternative. In order to evaluate the scheme a Net Present Value (NPV) is calculated. The objective of NPV analysis is to proceed with any scheme for which NPV>0. The NPV is specified as follows:

Ct = net cash flow (or benefits minus cost) in period t (year)

r = the discount rate (in %)

n = number of years in the evaluation period

Another measure of project performance derived by discounted cash flow analysis, which are both complementary to and an alternative to NPV is the Internal Rate of Return (IRR). Put simply, the IRR is the discount rate at which a project exactly breaks even (NPV=0).

Ct = net cash flow (or benefits minus cost) in period t (year)

NPV = Net Present Value

n = number of years in the evaluation period

IRR = Internal Rate of Return

The objective of IRR-based analysis is to proceed with a project for which IRR is greater than the required return. In practice, this means to proceed with the scheme when an IRR greater than the discount rate is attained.

It should however be noted that a project with the highest NPV is not necessarily the project with the highest IRR. Larger schemes have higher NPV, as this is an absolute measure. Meanwhile, smaller schemes might offer a greater relative return on expenditure (i.e. a higher IRR).

It should be further noted that although NPV and IRR attempt to monetise all aspects and impacts of a scheme, in reality not all aspects can readily and reliably be monetised, which is why a broader Multi-Criteria Assessment has been applied.

Project Assumptions

The following assumptions are made in the analysis:

- Base Year Evaluation: 2008
- Evaluation Period: The evaluation period for the strategy has been taken to be 17 years, i.e. 2008 to 2025.
- Discount Rate: A rate of 12% has been assumed for the discounting of all costs and benefits.
- Currency: The economic evaluation has been carried out entirely in Jordanian Dinars.
- A 30% contingency has been included.

Assessment

The MCAF assessment has provided the best schemes to take forward to the economic appraisal as follows

- DS3: Substantial Public Transport Investment with extended LRT Lines
- DS4: Substantial Public Transport Investment plus soft demand management
- DS5: Substantial Public Transport Investment plus moderate demand management
- DS6: Substantial Public Transport Investment plus strong demand management
- DS7: Substantial Public Transport Investment plus strong demand management plus workplace parking levy

The economic appraisal results are detailed in Table 22.

Table 22 - Economic Results - Pre-Feasibility Study

Scenario	Cost (JD billion)	Contingency (JD mill)	Total Cost (JD billion)	Benefit-Cost Ratio	NPV (JD mill)
DS3	2.904	871.1	3.775	1.16	137
DS4	2.668	800.5	3.469	1.69	511
DS5	2.704	811.2	3.515	2.01	764
DS5a	2.732	819.6	3.552	2.06	847
DS5b	2.732	819.6	3.552	2.08	877
DS6	2.802	840.5	3.642	2.97	1,574
DS7	2.821	846.4	3.668	2.89	1,529

The economic appraisal has shown, as expected, that the most economically viable scenarios, are those (DS6, DS7) that include medium and strong demand management policy. Both DS6 and DS7 have B/C ratios approaching 3.0

DS3 has a B/C ratio of just over 1 and under normal economic principles would not justify selection as it is less than 1.25.

Scenarios DS5a and DS5b also provide high ratios but include cordon pricing which is deemed to be an extreme measure at this stage.

The ratios of scenarios DS4 and DS5 are 1.69 and 2.01 and both these options include soft and moderate demand management policies, respectively.

Given demand management policy has never really been implemented in Greater Amman, the recommendation is that GAM starts off its action plan by implementing an infrastructure programme that is supported by soft demand management policies and would recommend DS4 as the preferred scenario.

Preferred Scenario

The preferred scenario DS4 has emerged taking into account many factors including economic, social and environmental, as well as risk, acceptability and economic appraisal.

The components and policies which combine to make up the preferred scenario include infrastructure, public transport and policy elements that have been developed a result of the project appraisal process.

The preferred scenario addresses a key element in that there is an urgent need for increased public transport, but at the same time takes into account the need for demand management policy as well as public acceptability on the strength of these measures. In other words, whilst recognising the need for change, it is acknowledged that change will occur over time.

The primary highlights of the preferred scenario are as follows:

- 230 kms of BRT
- 37 kms of LRT
- Public transport mode share 30%
- PT travel time AM 35%
- Soft demand management policy
- Investment costs JD 2.67 billion
- Average investment costs per year: JD 178 million/year
- Benefit-Cost ratio: 1.69
- Net Present Value: JD 511 million

Having assessed the scenarios, it can be seen that all scenarios tested are economically viable. However, if you look at the overall expenditure, the Do Minimum option with a B/C ratio provides a “lower cost” option than the other scenarios.

Assessing the Do Something scenarios, whilst DS5, DS5a, DS5b, DS6 and DS7 all yield B/C ratios, they also include medium to strong demand management policies.

DS4, with 15 BRT and 3 LRT lines, is supported by a soft demand management policy, which is far more acceptable from a social point of view.

Our recommendation therefore, taking into account capital expenditure and all other factors, would be to implement DS4.

Revenue Potential

Based upon the preferred scenario, the GAM funding requirements will be in the region of JD 3.47 billion, including contingency. GAM will need to adopt a funding approach that will be affordable and sustainable. And will need to tap into a number of sources including:

- Annual sources available to GAM
- The cost and availability of private sector funding
- The cost of available public sector funding (EC, World Bank, etc)
- Government funding

Some of the key funding sources will include:

- Users: these include funds from the public transport fare box, tolls, parking charges, fuel taxes, vehicle registration fees, travel demand charges and charges raised through the enforcement of traffic laws and regulations
- Commercial Business: these include leveraging commercial opportunities generated on the back of the transport system and includes air rights near or above major transport interchanges, advertising, naming rights, shops, restaurants, etc.
- Carbon Credits: through the Clean Development mechanism (CDM)

In order to gauge the revenue to be generated a result of the alternative scenarios developed, we have estimated three sets of potential revenue as follows:

- Public transport revenue, i.e. revenue from fare box only
- Parking revenues as a result of the implementation of the CPZ zones
- Cordon charging for Scenarios DS5a and DS5b
- Camera enforcement of speed limits, traffic signal violations and bus lanes.

Public Transport

Using the outputs from the transport model and the average fare applied within that model, an estimate of potential revenue can be made. From Table 24, it can be seen that average revenues assuming the average fare and 320 days of the year range from JD 73 million per annum through to JD 236 million per annum.

Table 24 - Estimate of Potential Revenue

Scenario	Total Trips	Average Fare Fils	Daily Potential Revenue JDs	Annual Potential Revenue assuming 320 days per year JDs (million)
DM1	1,940,066	343	666,000	73
DM2	2,063,419	355	733,000	83
DM3	2,488,699	353	880,000	99
DS1	2,306,501	419	970,000	1302
DS2	2,024,371	355	720,000	82
DS3	2,380,793	405	960,000	125
DS4	2,803,148	416	1,170,000	155
DS5	3,129,166	416	1,300,000	173
DS6	4,523,700	400	1,800,000	231
DS7	4,578,217	402	1,800,000	235

Parking Revenue

An assessment of parking demand to identify areas within central and Greater Amman where Controlled Parking Zones should be initially implemented, has been undertaken. This assessment has been undertaken utilising the Amman TMMP multi-modal model to derive base and future year demand that has then been analysed within a Geographical Information System (GIS). For the purposes of this assessment the revised DS4 scenario has been used as the future year since this best represents the likely demand based on implementation of parking charges. The assessment has been undertaken in three stages:

- A) Production of GIS maps using the model data to show current and future parking demand and the difference between the current and future years;
- B) Prioritisation of zones using the above data to define potential areas for implementation of CPZs; and
- C) Use of model outputs to identify potential likely revenue operated from each CPZ zone (no account is made for capital, operational or maintenance costs).

Based on this assessment process, indicative forecast revenue that could be generated from the CPZ’s during the revised future year, under a non-work based and work based scenarios has been derived. The assessment assumes that;

- Parking revenue is derived from shopping, other and work trips (not residential or education);

- Half of the demand for work trips derives revenue at the hourly levels indicated. This may be through on-street parking or public off-street parking. The other half are assumed not to pay for parking. This is important as the proportion of work trips can influence the revenue generated significantly.

Based on this the Future Year Forecast CPZ is presented in Table 23.

Table 23 - Future Year Indicative CPZ Revenue

CPZ Zone	Area Description	Total Average Future Revenue JD			Daily Zone Total JD 50% work demand apportioned)	Daily Non Work JD	Daily Zone Total JD Assuming 25% Leakage	Daily Non Work JD Assuming 25% Leakage	Annual Zone Total JD (50% work demand apportioned)	Annual Non Work JD
		Work (50% demand apportioned) 0.50JD	Shop 1.5JD	Other 1JD						
1091	Jabal Al-Waibdeh	7,060	10,020	8,950	26,030	18,970	19,525	14,230	4,685,880	3,415,150
1092	Adeeb Wahben	1,470	2,300	1,750	5,515	4,050	4,140	3,035	992,880	728,510
1093	Al-Abdali	6,325	3,365	14,950	34,330	21,680	25,750	16,260	6,179,490	3,902,640
1102	Ummayyah Bin Abd Shams / Khaled Bin Al-Waleed / Al-Adliyah	1,545	1,005	1,245	2,520	1,750	1,890	1,310	453,760	314,580
1161	Khaldi / Ibn Khaldoun	1,200	40	1,880	3,120	1,920	2,340	1,440	561,915	345,770
1173	Jabal Amman	1,500	730	1,880	4,115	2,615	3,090	1,960	740,845	470,450
1180	Prince Mohammed	1,020	1,170	1,340	3,530	2,510	2,645	1,880	635,130	451,810
1200	Wadi Al Haddadeh	670	90	1,255	2,010	1,345	1,510	1,010	362,235	241,960
1230	Al-Joafa / Raghadan Square	1,075	1,470	1,670	4,220	3,140	3,160	2,360	759,005	565,580
1272	Jabal Al-Akhdhar	350	375	1,350	2,075	1,720	1,555	1,290	373,500	310,015
1290	Downtown / Quraysh / Wadi Al-Srour	1,960	2,825	2,515	7,300	5,340	5,470	4,005	1,313,570	961,280
1311	Jabal Al-Taj	695	650	2,530	3,880	3,185	2,910	2,340	697,990	573,125
1382	Al-Thira South	185	90	665	940	755	705	570	169,345	136,050
1402	Al Basheer Hospital	2,280	2,740	3,450	8,470	6,190	6,350	4,645	1,524,705	1,114,505
Inner Area Total		**27,335**	**26,870**	**45,430**	**108,055**	**75,170**	**81,040**	**56,335**	**19,450,250**	**13,531,425**
1011	Al-Shmaisani (West)	24,790	15,690	20,930	61,410	36,625	46,060	27,470	11,054,040	6,592,360
1012	Al-Shmaisani (East)	20,290	11,245	16,945	48,480	28,190	36,360	21,140	8,725,780	5,073,890
1021	Al-Madeenah Al-Riyadhiyah	18,810	2,190	15,530	36,530	17,720	27,400	13,290	6,575,800	3,190,155
1072	Al-Jaysh	44,990	14,080	36,280	95,350	50,360	71,510	37,770	17,162,830	9,064,850
1353	Wadi Abdoun	28,400	12,655	23,115	64,170	35,770	48,125	26,825	11,550,250	6,438,305
1451	Al-Zohour	12,005	17,645	10,020	39,670	27,660	29,750	20,750	7,140,240	4,979,380
2312	Al-Mshairfeh (North)	11,685	7,890	10,630	30,200	18,515	22,650	13,890	5,436,310	3,332,860
2350	Al-Mshairfeh (South)	11,810	14,635	11,030	37,475	25,660	28,105	19,250	6,745,450	4,619,420
3081	Al-Jame'ah	26,700	1,190	24,490	52,380	25,680	39,285	19,260	9,428,170	4,622,310
3181	Al Madeenah Al-Tibbiyah	59,860	13,850	48,625	122,340	62,480	91,755	46,860	22,021,340	11,246,060
3182	Al Hussein Park	21,210	390	16,900	38,500	17,290	28,875	12,970	6,929,810	3,112,440
3381	Sweifieh	10,000	12,760	7,670	30,425	20,430	22,820	15,320	5,476,745	3,676,975
3382	Sweifieh	6,340	8,315	4,860	19,510	13,175	14,635	9,880	3,512,245	2,371,300
4081	Al-Muqabalain	19,035	1,685	16,315	37,035	18,000	27,775	13,500	6,666,300	3,239,880
Full Greater Area Total (including Inner Area)		**343,260**	**161,090**	**308,770**	**821,530**	**472,725**	**616,145**	**354,510**	**147,875,560**	**85,091,610**

Cordon Charging

For Schemes, DS5a and DS5b, a cordon charge of JD1 per entry per vehicle (DS5a) and JD2 per entry per vehicle (DS5b) was charged. Both School buses and taxis are assumed exempt from this analysis

Peak Hour Cordon Charge

For the Am Peak Hour Analysis, Table 25 shows the amount of traffic that is entering and leaving the City centre on a daily basis.

Table 25 - AM Peak Hour Analysis

AM Peak - Vehicles entering City Centre			
	PV	GV	Total
DS5	21,000	2,900	23,900
DS5a	9,500	4,100	13,600
DS5b	5,300	4,650	9,950

AM Peak - Vehicles leaving City Centre			
	PV	GV	Total
DS5	29,300	3,700	33,000
DS5a	21,200	4,700	25,900
DS5b	18,400	5,300	23,700

Assume 260 days per year					
	Days	JD	AM Traffic	Revenue per day	Revenue per year
DS5a	260	1	13,600	13,600	3,536,000
DS5b	260	2	9,950	19,900	5,174,000

Assuming a 260 days year, DS5a, charging JD1 per entry would generate around JD 3.5 million per year in revenue. For Scenario DS5b, charging JD2 per entry, this would generate JD 5.1 million per year.

Daily Cordon Charge

For the 12 Hour daily Analysis, Table 26 shows the amount of traffic that is entering and leaving the City centre on a daily basis. Both School buses and taxis are assumed exempt from this analysis

Assuming a 260 days year, DS5a, charging JD1 per entry would generate around JD 5.6 million per year in revenue. For Scenario DS5b, charging JD2 per entry, this would generate JD 9.5 million per year.

Table 26 - Daily 12 Hour Analysis

Daily 12 hour - Vehicles entering City Centre			
	PV	GV	Total
DS5	207,000	29,000	236,000
DS5a	95,000	41,000	136,000
DS5b	52,000	46,000	98,000

Daily 12 hour - Vehicles leaving City Centre			
	PV	GV	Total
DS5	350,000	45,000	395,000
DS5a	253,000	56,000	309,000
DS5b	220,000	63,000	283,000

Assume 260 days per year					
	Days	JD	Daily Traffic	Revenue per day	Revenue per year
DS5a	260	1	136,000	136,000	35,360,000
DS5b	260	2	98,000	196,000	50,960,000

Assuming a 260 days year, DS5a, charging JD1 per entry would generate around JD 35 million per year in revenue. For Scenario DS5b, charging JD2 per entry, this would generate JD 51 million per year.

Camera Enforcement Fines

Revenue is also available from fines resting from enforcement of traffic rules. This revenue can be derived from the deployment of camera enforcement systems in conjunction with the Amman Traffic Police

- Fixed Red Light violation cameras (some already installed)
- Fixed Speed Limit violation cameras
- Mobile Speed Limit violation cameras
- Fixed Bus Lane violation cameras
- Mobile Bus Lane violation cameras on busses and/or BRT.

Parking Enforcement Fines

Parking penalties are also a source of revenue which could be utilized by GAM to support sustainable transport projects. Increased levels of enforcement to better manage and mitigate against indiscriminate and illegal parking should be accompanied by a consistent approach to parking penalties, that create a suitable level of financial disincentive to park illegally.

Carbon Credits

The carbon market now provides an opportunity for projects that reduce GHC emissions to secure revenue. Each tonne of CO2 not emitted as a result of the project generates one single Certified Emission Reduction (CER).

Through the scenario testing analysis, the CO2 emissions have been assessed in terms of CER reductions as compared to the Do Minimum options. The CER reduction has come mainly from the reduction in car travel and the significant model shift to bus, BRT and LRT. Using the preferred scenario 4, this would generate around 2 million tonnes of CO2 savings in 2025. CER value is now at around €11 each. Assuming 100% CDM feasibility, i.e. €11 or JD 10.65 each, this equates to JD 21.3 million in 2030. Taking a conservative view and assuming 50% CDM feasibility, around JD 10 million can be raised in 2025.

The above is a very high level estimation and based upon CDM eligibility across the TMMP project. Two key conditions that are required are that:

1. Projects must have an approved methodology, normally through the World Bank, European Commission or United Nations
2. Projects must demonstrate ‘additionality’

Most projects developed under the TMMP can be further detailed to meet both the above mentioned criteria. However, for this purpose, over the 15 year evaluation period, one can assume that an average of JD 5 million per annum revenue from Carbon Credits may be achieved.

Developer Contributions

The current status with regards to developer investment in Jordan is that the developer is sometimes granted land and they then finance, design and build the infrastructure. The Government usually funds access and services to/from the site.

In many countries across the world, including the United Kingdom, the 'value sharing' approach is adopted where developers pay a premium to develop the land. Some countries have raised revenue through the sale of land or through the right to develop over a major transport interchange or terminal. This is a very effective source of additional revenue that can contribute to the development of the interchange it self as long as it does not impact the functionality of the system.

The cost sharing, in terms of transport infrastructure is a very attractive mechanism and one that should be formally considered. For example, in Dubai, the Law 'Contribution of Beneficiary Parties in Road and Public Transportation Contracts' sets out the formal procedures for determining proportional cost sharing for off-site highway infrastructure. In summary the guidelines relate to specific contributions required to provide and improve transport infrastructure as follows:

Beneficiary parties shall contribute towards the following:

- All transport facilities within the wider development site; i.e. the masterplan area;
- Direct access(es) into and out of the wider development site; and
- Off-site transport facilities used by the beneficiary party even if they do not provide direct access to the development.

Beneficiary parties shall pay 100% of the cost of the following:

- All transport facilities within their individual development site; i.e. the individual plot area and
- Direct access(es) into and out of their individual development site.

Beneficiary parties are exempted from sharing the cost of the following:

- All surface roads outside the development but not grade separated interchanges or signal controlled junctions

The Roads and Transport Authority (RTA) set the geographical area within which developers have to contribute towards infrastructure in line with the above. These are dependent on the level of Traffic Impact Study (TIS) required for the development.

The approved RTA Traffic Model shall be used for the target year to establish the area where the development is expected to generate more than 20% of the total traffic volumes. This area is established by drawing an imaginary line between the intersections which experience this.

As a minimum the area shall include all RTA roads on the outer boundary of the development, regardless of whether they provide access into the development

Dubai requires the developer to enter into a conceptual agreement on the cost share prior to formally approving the TIS and on the principle that the final confirmed contribution will be agreed at a later date. The signing of this contract then permits the developer to start constructing the internal road network and temporary accesses into their site.

The contribution is then calculated as a direct correlation between the proportional increase of traffic at a junction or on a link as a result of the development with the infrastructure improvements required to address those problems.

The approach taken by the Department of Transport (DoT) in Abu Dhabi towards cost sharing agreements is very similar to the approach described above by the RTA in Dubai.

In terms of cost sharing or contributions to the required development mitigation or improvement measures, estimates of between 5% and 15% of the construction cost can be attributed to specific developments.

Advertising Revenue

Commercial revenue through the future development of the public transport system will prove to be one of the most significant revenue generators out side the fare box source. Discussions with operators in Amman indicate that advertising revenue on buses alone far exceeds the current fare box revenue.

Some options for alternative revenue include:

- Vehicle Advertising: outside and inside the vehicle - currently a significant source of income on buses in Amman
- Non vehicle advertising: at stations, train stops, platforms, back of tickets, ticket machines, etc
- Station naming rights
- Station / interchange concession rentals such as food stalls, paper kiosks, retail outlets
- Telecommunication links

Land Capture Revenue

There are alternative mechanisms for revenue through land value capture for both residential and commercial developments around major public transport corridors. More specifically, these may include:

- Land and real estate: identifying positive land and real estate value impact to accessibility in the corridor of say an LRT system. Capture instruments could be tax based on accessibility, betterment tax, joint development projects;
- Fiscal angle: i.e. identify and quantify all sources of revenue generated by the project that will accrue to public entities, e.g. value added tax, business tax revenues and land tax;
- Interface angle: revenue spin off from say the LRT to connected (transport) businesses and impact on 'necessary' future investments in infrastructure etc.

This is a new area and one that will take time to develop and mature. It is not envisaged that any revenue through land value capture will be generated.

Funding Options – An Illustration

The preferred Scenario DS4 amounts to JD 2.67 billion excluding contingency and JD 3.47 including a 30% contingency over a 15 year period, averaging at around JD 178 million per year excluding contingency. The total revenue in 2025 which includes fare box revenue, but excludes advertising, carbon credits, etc is estimated at about JD 155 million per annum.

It is clear that some of the more costly and more difficult projects may not be implemented until well beyond 2025. In order to fund the preferred TMMP strategy, we recommend that a mixture funding sources are used that will include:

- Project related private finance
- PPP
- Developer cost sharing contributions
- Government backed borrowing

The approach will vary depending upon the economic climate and the following will influence the approach:

- Performance of the Amman property market
- Developers and/or operators appetite for investment in Amman
- Sources of funds available to GAM / Government
- The availability of loans and/credits to fund public sector projects (World Bank, EIB, EC, AfD, etc)

A typical funding scenario may well be:

- Developer funding: 15%
- Private Project Finance: 35%
- Government Debt: 25%
- Government Grants: 25%

The TMMP preferred scenario capital budget is very large and new sources of funding must be identified in order to limit GAM and the Governments contributions to sustainable levels. Policy must be put in place to ensure that the correct mechanisms are in place to maximize revenue from a variety of sources.

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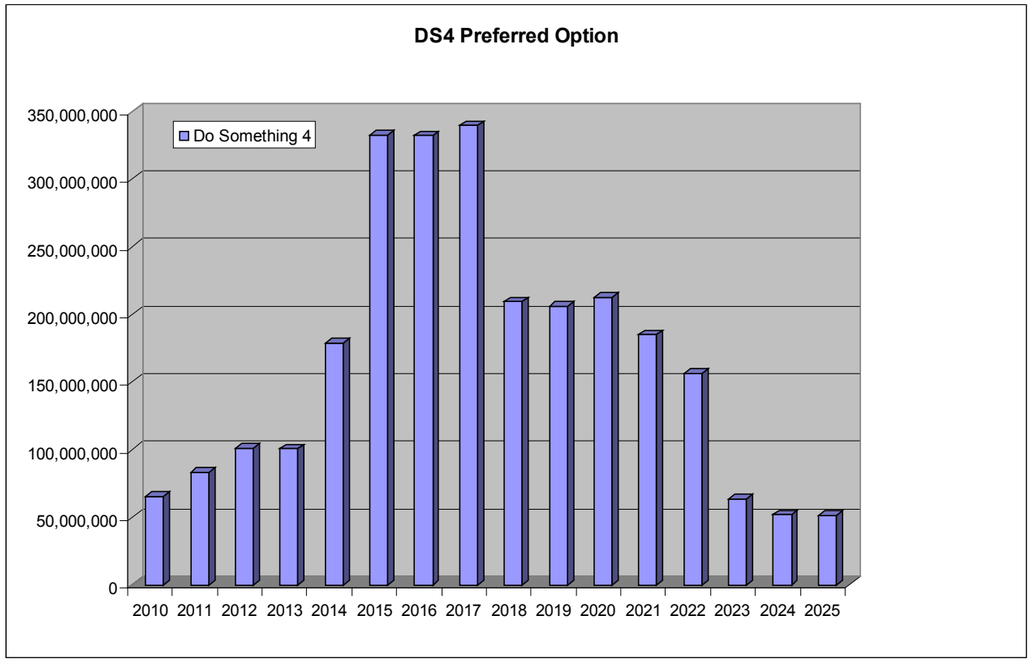
Costs

Following the economic appraisal, we highlight the cost breakdown of the preferred scenario by topic strategies.

The total cost DS4 is JD 2.67 billion excluding contingency and JD 3.47 including a 30% contingency.

Table 27 - Cost Stream JD DS4 (Capital Costs only)

Years	Highways	Traffic Management	Public Transport	Safety	Pedestrian Realm	Parking	Freight	Demand Management
2010	10,000,000	826,027	46,365,747	899,167	6,246,820	1,322,153	0	0
2011	10,400,000	1,211,577	59,445,913	899,167	9,718,452	1,322,153	50,000	0
2012	32,525,000	1,211,577	56,562,579	899,167	8,257,555	1,322,153	275,000	46,429
2013	32,525,000	96,360	54,396,639	899,167	9,998,817	852,153	1,823,077	46,429
2014	24,025,000	96,360	144,581,639	899,167	7,410,313	849,653	673,077	46,429
2015	49,283,333	164,817	271,056,909	4,212,833	1,909,259	1,662,653	4,006,410	46,429
2016	25,258,333	164,817	294,485,480	3,313,667	2,861,544	825,986	4,906,410	46,429
2017	25,258,333	164,817	303,263,258	3,313,667	1,628,516	825,986	4,906,410	46,429
2018	21,425,000	47,850	178,736,704	3,313,667	549,655	96,319	4,906,410	46,429
2019	21,425,000	0	176,259,292	3,313,667	68,605	85,208	4,906,410	46,429
2020	25,850,000	151,800	172,925,958	5,897,000	2,469,619	85,208	4,906,410	46,429
2021	12,050,000	151,800	166,744,140	2,583,333	2,433,619	1,875	673,077	46,429
2022	12,050,000	151,800	139,672,712	2,583,333	1,219,542	1,875	673,077	46,429
2023	4,425,000	0	54,697,390	2,583,333	1,219,542	1,875	673,077	46,429
2024	4,425,000	0	43,834,295	2,583,333	120,000	1,875	673,077	46,429
2025	4,425,000	0	43,834,295	2,583,333	0	1,875	673,077	46,429
Total Cost	**315,350,000**	**4,439,600**	**2,206,862,950**	**40,777,000**	**56,111,856**	**9,259,000**	**34,725,000**	**650,000**



Implementation

Table 28 - Public Transport

Project	Cost (JD)	DS4	Implementation Dates
PT1: LRT Line from Zarqa to Amman (Al Mahatta)		Y	
PT2: LRT Line 1 - Al Mahatta to Area C (Airport Road) via City Hall	413,678,000	Y	2015 - 2025
PT3: LRT Line 2 - Beituna to Medical City/King Hussein Business Park via Abdali	459,374,000	Y	2015 - 2022
PT4: LRT Line 3 - Customs Square to Sport City via City Hall and Abdali	360,740,000	Y	2014 - 2017
PT5: Designed to take the simplistic modelled assumptions for fares and replicate them practically through zones, together with a general inflation tool to apply to fares to replace direct fuel cost relationship		Y	
PT6: Smartcard system designed to be applicable to all public transport modes and companies in the GAM area	2,000,000	Y	2012 - 2012
PT7: Organisational change to provide adequate skills and capacity to produce well designed and comprehensive publicity material	500,000	Y	2011 - 2011
PT8: Branding, marketing and promotion campaign to encourage use of PT services	2,000,000	Y	2010 - 2025
PT9: Travel Planning Kiosks and Offices at key locations, together with facilities for expanded inspection personnel	1,500,000	Y	2013 - 2025
PT10: Physical Interchange facilities to allow seamless transfer from LRT to BRT/bus services	49,000,000	Y	2017 - 2025
PT11: New facility to be constructed at the main road intersection in Sweileh, on the site of a small park to allow for interchange between external PT services and the BRT services	6,475,000	Y	2010 - 2011
PT12: Upgrade Bus Stop signs and shelters, in accordance with current contract and extended to cover the entire GAM area	6,000,000	Y	2010 - 2021
PT13: Design and construct new Interchange facility adjacent to the proposed terminus of LRT Line 3 at Customs Square, which would replace South Terminal	10,000,000	Y	2017 - 2019

Public Transport (cont.)

Project	Cost (JD)	DS4	Implementation Dates
PT14: Construct pedestrian facilities at North Terminal to permit direct access to the BRT stops on main road	500,000	Y	2010 - 2010
PT15: Provide new Interchange Facility at Saqf Al Sail to integrate local bus services with the proposed LRT station	3,000,000	Y	2015 - 2018
PT16: Implement BRT Lines proposed by GAM (Sweileh to Al-Mahatta via North Terminal and Al-Mahatta to South Terminal via Beituna) and operate as bi-directional circular service in conjunction with service from Sweileh to South Terminal via Al-Swaifiyah and Area C	198,500,000	Y	2010 - 2017
PT17: Implement BRT Lines connecting areas including Marka, and Tabarbour with Wadi Al Seer, Wasfi Al Tal and Shafa Badran via the City Centre	77,500,000	Y	2011 - 2017
PT18: Implement BRT Lines from Customs Square and Beituna to Sahab and the ADC area	186,000,000	Y	2015 - 2021
PT19: Implement BRT Lines from Abu Nasyr and the University of Jordan to areas including Shafa Badran, Al Azher, Area B and Area C	164,000,000	Y	2016 - 2022
PT20: Redesign Level 2 bus services to provide direct services not provided by the LRT or BRT network	137,800,000	Y	2010 - 2023
PT21: Redesign Level 3 services to provide local links connecting non-primary destinations with primary bus, BRT and LRT Lines	13,700,000	Y	2010 - 2023
PT22: Redesign Level 4 services provided by minibuses and servis taxis to become feeder services into main interchange points	5,000,000	Y	2010 - 2020
PT23: Construct Park and Ride sites at the end of various LRT and BRT Lines	33,000,000	Y	2015 - 2022
PT24: LRT Line 1/1A to operate from Medical City to Al Mahatta (and through to Zarqa)	2,550,000	N	2023 - 2025
PT25: LRT Line 2 to operate from Area C to Beituna via City Hall	60,000,000	N	2022 - 2025
PT26: LRT Lines 3/3A to operate from Zatyounah to Sahab (3) or Garden Zone (3A) via University of Jordan, Sports City, City Hall and Customs Square	236,000,000	N	2019 - 2023

Public Transport (cont.)

Project	Cost (JD)	DS4	Implementation Dates
PT27: Extension of some services, with other replaced by LRT extension	0	N	2023 - 2025
PT28: Revisions to bus networks to expand them in line with LRT/BRT changes	0	N	2023 - 2025
PT29: Extension of use of ticket issuing machines at LRT/BRT stations stops to cover all bus stops	500,000	Y	2012 - 2023
PT30: Introduce Real Time Public transport Information (RTPI) at bus stops and termini.	13,819,300	Y	2011 - 2018
PT31: Introduce separate bus phases at junctions plus phase extension/ recall measures to give signal priority to busses.	363,550	Y	2011 - 2012
PT32: Introduce segregated bus phases at junctions plus phase extension/recall measures to give signal priority to busses.	199,100	Y	2011 - 2012
PT33: Introduce local DRT Control Centres at key stations on the LRT and BRT networks	4,339,000	Y	2018 - 2025
PT34: Temporary arrangements at Al Mahatta Terminal require upgrading to facilitate BRT services	2,375,000	Y	2010 - 2011
PT35: Redesign Al Mahatta Terminal to accommodate Zarqa to Amman LRT and LRT Line 1	3,000,000	Y	2018 - 2020
PT36: Complete bus network to cover all services under scenario DM1 (no LRT or BRT)	396,000,000	N	2010 - 2020
PT37: BRT Level 1 services where no LRT	272,900,000	N	2010 - 2018
PT38: BRT Level 2 services where no LRT	241,400,000	N	2010 - 2018
PT39: All other bus services for scenario DM2	151,800,000	N	2010 - 2018
PT40: Additional costs of DM3 services compared with DM2	28,600,000	N	2010 - 2018
PT41: Additional costs of DS2 services compared with DM2	0	N	2010 - 2018
PT42: Additional costs of DS4 services compared with DS1	52,000,000	Y	2010 - 2020
PT43: Additional costs of DS5 services compared with DS1	86,000,000	N	2010 - 2020
PT44: Additional costs of DS5a/DS5b services compared with DS1	115,000,000	N	2010 - 2020

Public Transport (cont.)

Project	Cost (JD)	DS4	Implementation Dates
PT45: Additional costs of DS6 services compared with DS1	182,200,000	N	2010 - 2020
PT46: Additional costs of DS7 services compared with DS1	201,300,000	N	2010 - 2020

Table 29 - Highways

Project	Cost (JD)	DS4	Implementation Dates
H1: Tunnel Link between Al Yarmouk Rd and Al Jaysh Rd	17,000,000	Y	2012 - 2013
H2: Grade Separation between Al Yarmouk Rd and Al Yarmouk Rd (Al Jusoryr Al-Asharah Rd)	11,000,000	Y	2012 - 2015
H3:Grade Separation between Al Yarmouk Rd and Usama Bin Zayed Rd	10,500,000	Y	2012 - 2015
H4: Grade Separation between Al Yarmouk Rd and Khaled Bijan Rd	12,000,000	Y	2012 - 2015
H5: Grade Separation between Al Yarmouk Rd and Al Aaydeen Rd	3,500,000	Y	2012 - 2015
H6: Grade Separation between Al Yarmouk Rd and Prince Al Hassan Rd and Mosaab Ben Omayr Rd	9,000,000	Y	2012 - 2015
H7:Grade Separation between Mosaab Bin Omayr Rd and Khawia Bent Al Azwar Rd	8,500,000	Y	2012 - 2015
H8: Grade Separation between Prince Hashim Bin Al Hussein Rd and Wadi Abdoun Rd (under construction / the proposed Capital Parkway Masterplan)	8,500,000	Y	2015 - 2020
H9: Grade Separation between Queen Nour Rd and Prince Shaker Bin Zayd Rd (at Abdali)	0	Y	2012 - 2013
H10: Grade Separation between Wadi Abdoun Rd and Prince Ali Bin Al Hussein Rd and Prince Abdallah Al Salem Al Sabah Rd	10,000,000	Y	2011 - 2015
H11: New Link between Prince Hashim Bin Al Hussein Rd (grade separation H8) and the junction Wadi Abdoun Rd and Prince Abdallah Al Salem Al Sabah Rd (grade separation H10)	1,800,000	Y	2015 - 2022
H12: Grade Separation between Al Kodos Rd and Al Horreyya Rd and Al Horreyya Rd (under construction)	11,000,000	Y	2015 - 2022
H13: Grade Separation between Queen Alia Airport Rd and King Abdallah Bin Al Hussein II Rd bordering Area C (South)	0	Y	2010 - 2012
H14: Grade Separation between Queen Alia Airport Rd and King Abdallah Bin Al Hussein II Rd and Wadi Abdoun Rd (under construction) bordering Area C (North)	0	Y	2010 - 2012
H15: Grade Separation between Wadi Abdoun Rd (under construction) and Al Horreyya Rd (under construction)	11,200,000	Y	2015 - 2022

Highways (cont.)

Project	Cost (JD)	DS4	Implementation Dates
H16: Grade Separation at Area C between Al Horreyya Rd (under construction) and the new road (under construction) linking Queen Alia Airport Rd and Prince Hashim Bin Al Hussein Rd	15,000,000	Y	2015 - 2022
H17: New Link (Al Horreyya Rd under construction) between Al Horreyya Rd and Princess Alia Bent Al Hussein Rd passing the Eastern border of Area C	10,000,000	Y	2015 - 2022
H18: New Link between Queen Alia Airport Rd and Prince Hashim Bin Al Hussein Rd and the proposed Capital Parkway (Wadi Abdoun Rd under construction)	10,000,000	Y	2015 - 2022
H19: New Link (Wadi Abdoun Rd under construction) between the junction at Queen Alia Airport Rd/King Abdallah Bin Al Hussein II Rd and Al Horreyya Rd (under construction) passing the Northern border of Area C	2,000,000	Y	2015 - 2022
H20: Grade Separation between Queen Rania Al Abdallah Rd and Ahmad Al Tarawina Rd	11,000,000	Y	2011 - 2015
H21: Grade Separation between Yajouz Rd and Shafa Bardan Rd	9,000,000	Y	2015 - 2020
H22: New proposed link between junction Yajouz Rd/Shafa Bardan Rd and Jordan Street passing the West of Area B and linking into the area South of Jordan Street crossing the junction with Al Hakeem Al Nazsabouri Rd	1,500,000	Y	2015 - 2020
H23: Grade Separation between Jordan Street and the new proposed link (H22) passing the West of Area B	11,000,000	Y	2015 - 2020
H24: Grade Separation between Yajouz Rd and Prince Al Hussein Bin Abdallah Rd	8,500,000	Y	2015 - 2017
H25: Grade Separation between Al Shaheed Rd and Prince Al Hussein Bin Abdallah Rd and Al Aksa Rd	3,000,000	Y	2015 - 2017
H26: New proposed link between Prince Al Hussein Bin Abdullah Rd and Yajouz Rd on the existing Al Azhar Rd and the Northern part of Tabarbour Rd	450,000	Y	2020 -2025
H27: New proposed link between junction Al Azhar Rd/Tabarbour Rd (H26) linking into Prince Faysal Bin Al Hussein Rd (H28)	3,600,000	Y	2020 -2025

Highways (cont.)

Project	Cost (JD)	DS4	Implementation Dates
H28: Grade Separation between Prince Faysal Bin Al Hussein Rd on the new proposed link (H27) and the road linking into Al Shaheed Rd	10,000,000	Y	2010 - 2010
H29: New proposed link between junction Prince Faysal Ben Al Hussein Rd/the road linking into Al Shaheed Rd (H28) linking into the Northern part of Al Nahda Rd and crossing over Yajouz Rd	1,500,000	Y	2020 -2025
H37: Road Upgrade between Al Shaheed Rd (H31) and King Abdullah I Rd (H32)	8,500,000	Y	2015 - 2020
H38: Road Upgrade between King Abdullah I Rd (H33) and Al Hezam Al Daeri Rd (H34), crossing Al Hezam Al Daeri Rd and linking into the area South	1,500,000	Y	2015 - 2020
H39: Road Upgrade between junction Al Hezam Al Daeri Rd /Al-Fida Rd/Al Faw Rd (H35) linking Al Faw Rd with King Abdullah I Rd	1,800,000	Y	2015 - 2020
H40: Grade Separation between King Abdallah Ben Al Hussein II and Rifaa Al Ansari and Jarash	11,000,000	Y	2015 - 2020
H41: Grade Separation between King Abdallah Ben Al Hussein II and Wasfi Al Tall	10,000,000	Y	2015 - 2020
H42: Grade Separation between King Abdallah Ben Al Hussein II and Saeed Khayr	10,000,000	Y	2015 - 2020
H43: Grade Separation between King Abdallah Ben Al Hussein II and Makka Al Mokarrama	10,000,000	Y	2015 - 2020
H44: Grade Separation between King Abdallah Ben Al Hussein II and Zahran and Al Bayader	12,000,000	Y	2020 - 2025
H45: Grade Separation between King Abdallah Ben Al Hussein II and Queen Zein Al Sharaf and Al Sinaa	10,000,000	Y	2011 - 2015
H46: Grade Separation between King Abdallah Ben Al Hussein II and Queen Rania Al Abdallah and Jarash	21,000,000	Y	2011 - 2015
H47: Grade Separation between King Abdallah Ben Al Hussein II and new road linking into development in the West (street South of Nafel Ben Amer)	9,000,000	Y	2020 - 2025
H48: ARR West Section	150,000,000	N	2020 - 2025
H49: ARR North Section	300,000,000	N	2020 - 2025

Table 30 - Traffic Management

Project	Cost (JD)	DS4	Implementation Dates
TM1: Maintain and improve existing traffic adaptive UTC traffic signal coordination in parallel with changes to network and behaviour.	481,800	Y	2010 - 2012
TM3: Introduce a Driver Information VMS system to warn motorists of planned events and unplanned incidents and congestion.	853,600	Y	2010 - 2012
TM4: Extend traffic surveillance CCTV to grade separated junctions on ring road to support incident monitoring and management.	336,600	Y	2010 - 2012
TM7: Integration of ITS systems in Control Centre to enable coordinated command and control.	180,950	Y	2015 - 2017
TM8: Linking of Control Centres for sharing of traffic, transportation and incident data.	169,950	Y	2015 - 2017
TM10: Introduce Traffic and Transportation Information website to deliver information to homes, mobile phones and public display kiosks.	117,700	Y	2011 - 2012
TM11: Introduce ANPR Journey Time monitoring system to give early warning of congestion and exceptional network conditions.	653,400	Y	2011 - 2012
TM12: Use of UTC to implement traffic restraint signal timing plans to meter traffic into central area during periods of excess demand.	750,750	N	2010 - 2012
TM13: Use of UTC to vary signal timings and meter traffic into central area according to measured Air Quality.	618,750	N	2012 - 2014
TM14: Introduce a roadworks management database with output to Traffic and Travel Information website and driver information VMS.	152,900	Y	2010 - 2012
TM15: Introduce emergency vehicle priority calls (phase preemption) at traffic signals.	364,100	Y	2010 - 2012
TM17: Introduce Traffic and Transportation Information website to deliver information to public display kiosks.	257,400	N	2015 - 2017
TM18: Improve UTC traffic signal coordination by introducing infill junctions and signalised pedestrian crossings.	481,800	Y	2010 - 2014

Traffic Management (cont.)

Project	Cost (JD)	DS4	Implementation Dates
TM19: Implement a road user charging and enforcement systems to effect demand management within sensitive downtown area.	169,752	N	2020 - 2025
TM25: Enhance Traffic and Transportation Information service to add personalised subscription travel information to mobile phones.	191,400	Y	2015 - 2018
TM27: Introduce a freight route planner and associated tracking system for hazardous and precious loads.	455,400	Y	2020 - 2022
TM28: Enhancement of freight route planner and associated tracking system to manage and enforce freight movement restrictions	1,468,500	N	2020 - 2022

Table 31 - Safety

Project	Cost (JD)	DS4	Implementation Dates
S1: Consistent Log of accident data.	250,000	Y	2010 - 2015
S2: Introduce a Road Safety Audit procedure for all highways schemes.	250,000	Y	2010 - 2015
S3: Team specialising in Education, Training and Publicity	250,000	Y	2015 - 2020
S4: Consistent provision and review of road traffic legislation	125,000	Y	2010 - 2015
S5: Fully funded ETP programme building on the KAFA projects	500,000	Y	2015 - 2020
S6: Improved training for highway and traffic engineers	5,000	Y	2015 - 2020
S7: Development of a highway asset management plan	1,000	Y	2015 - 2020
S8: Post completion scheme review process	500,000	Y	2010 - 2015
S9: Costs benefit analysis approach	1,000	Y	2015 - 2020
S10: Pre-school education	40,000	Y	2010 - 2015
S11: In school education	35,000	Y	2010 - 2015
S12: Young Driver Training	50,000	Y	2010 - 2015
S13: Police training and enhanced enforcement	125,000	Y	2010 - 2015
S14: Fine developers who extend vehicle crossovers into the line of the main carriageway.	400,000	Y	2010 - 2015
S15: Remove parking from sidewalks; lining of parking bays on carriageways and in car parks	500,000	Y	2015 - 2020
S16: Pavement management and maintenance	4,000,000	Y	2015 - 2020
S17: Signing and lining maintenance	1,250,000	Y	2010 - 2015
S18: Fine vehicle owners with significant amounts of oil or diesel spillage.	1,000,000	Y	2010 - 2015
S19: Use lining to a greater extent at junctions and on the approach to Islands (e.g. Hatching). Refresh existing lining when it gets worn.	1,250,000	Y	2010 - 2015
S20: Engineered parking restrictions	375,000	Y	2015 - 2020
S21: Re-kerbing	250,000	Y	2015 - 2020
S22: Ensure sufficient drop kerbs are provided to allow mobility impaired pedestrians to access the sidewalk.	1,000,000	Y	2015 - 2020
S23: Re-allocation of road space	5,000,000	Y	2015 - 2020
S24: Signal controlled junctions	2,250,000	Y	2015 - 2020
S25: 'Virtual' narrowing of junctions and lanes to reduce vehicles speeds	10,000	Y	2010 - 2015

Safety (cont.)

Project	Cost (JD)	DS4	Implementation Dates
S26: Introduce parking restrictions preventing parking within 15m of junctions.	1,000,000	Y	2015 - 2020
S27: Physical narrowing of some junctions to reduce the speed of vehicles through the junction.	750,000	Y	2015 - 2020
S28: Provision of new crossings/drop kerbs	100,000	Y	2010 - 2015
S29: Introduce Pedestrianisation to busy shopping streets.	7,500,000	Y	2020 - 2025
S30: Route Treatments: Al Malekah, Al Istikal, Khaled Bin Al Waleed, Queen Noor, Al Ameer Hashem bin Al Hussein, Al Dustour, Al Ameer el Hassan and Ali Bin Abi Taleb/Omar Matar/Al Malek Talal/Quraysh	8,000,000	Y	2020 - 2025
S31: School safety zones and complementary measures	4,000,000	Y	2015 - 2020
S32: Ensure all current traffic signals are linked with a pedestrian phase and CCTV monitoring introduced.	10,000	Y	2010 - 2015

Table 32 - Pedestrian Realm

Project	Cost (JD)	DS4	Implementation Dates
PED1: Introduction of pushbutton demand at pedestrian signals crossings across all parts of the network specifically junctions	300,200	Y	2011 - 2012
PED2: Adjustment of signalised phasing plan to reduce pedestrian wait times across all parts of the network, including signal cycle times and multiple ped phases.	349,800	Y	2015 - 2017
PED3: Improve pedestrian crossing servicing at downtown junctions by coordinating ped signals according to ped route flows.	137,930	Y	2015 - 2017
PED4: Approaches to subways to be upgraded to provide efficient and safe route. Where possible disabled ramps should be implemented	600,000	Y	2020 - 2024
PED5: Implementation of a fully pedestrianised zone within Downtown linking providing hub of pedestrian network where links to commerical radial streets, streetworks at the Ampitheatre and access to the Central Public Transport hub can be achieved. This includes complimentary traffic management, traffic circulatory and parking management changes.	2,619,308	Y	2010 - 2011
PED6: Pedestrian Enhancements linking commerical and retail areas to LRT Line 3 Stop 7 and LRT Line 2 to Stop 4	1,832,569	Y	2016 - 2017
PED7: Pedestrian Enhancements linking commercial land use corridor to LRT Line 2 Stop 8, LRT Line 3 Sport City and BRT 11, 12, 15 and 29	2,748,854	Y	2020 - 2021
PED8: Pedestrian Enhancements linking University and local retail to BRT 11a, 12a, 27 and 28	2,290,712	Y	2013 - 2014
PED9: Pedestrian Enhancements linking retail and leisure land uses to LRT 3 and BRT 11, 11b,12 and 12b	2,199,083	Y	2014 - 2016
PED10: Pedestrian Enhancements linking retail and residential land uses to LRT Line 3 Stop 10	962,099	Y	2017 - 2018
PED11: Pedestrian Enhancements in the vicinity of City Hall linking to Downtown and key Public Transport corridor	1,649,312	Y	2013 - 2014
PED12: Pedestrian Enhancements providing improved access from commerical corridor to conventional bus services	1,878,383	Y	2020 - 2021
PED13: Pedestrian Enhancements linking commercial area to LRT 3 Stops 3, 4 and Saqf Al Sail Terminal	2,657,225	Y	2012 - 2014

Pedestrian Realm (cont.)

Project	Cost (JD)	DS4	Implementation Dates
PED14: Pedestrian Enhancements linking key administration and mix land use development to LRT Line 2 Stop 7 and 6 and LRT Line 3 Stop 9	2,473,968	Y	2010 - 2011
PED15: Pedestrian Enhancements linking commercial corridor to Downtown and LRT Line 2 Stops 4 and 5	962,099	Y	2015 - 2016
PED16: Pedestrian Enhancements linking light industrial corridor to BRT 11 and 12 group, LRT Line 2 Beituna Terminal and LRT ZA an 1 Al Mahatta Terminal	2,199,083	Y	2022 - 2023
PED17: Pedestrian Enhancements linking to LRT stations outside of the specific key upgrades to provide a hub and spoke radial network linking residential land uses to LRT	13,286,127	Y	2011 - 2014
PED18: Pedestrian Enhancements linking to BRT stations outside of the specific key upgrades to provide a hub and spoke radial network linking residential land uses to LRT	13,286,127	Y	2010 - 2013
PED19: Implementation of footway improvements linking to designated crossing points across the full network	180,000	Y	2016 - 2020
PED20: Ensure adoption of pedestrian accessibility design principles within new developments	0	Y	2010 - 2025
PED21: Implementation of dropped kerb across existing and new footway network to provide points of access across road junctions and on to the pedestrian network	163,027	Y	2015 - 2019
PED22: Upgrade of repairs to existing subways and footbridges to offer improved facilities across the pedestrian networks	600,000	Y	2010 - 2011
PED23: Introduce enhanced demand dependant pedestrian signals at mid-block pedestrian crossings.	235,950	Y	2010 - 2012
PED24: Pedestrian Enhancements on secondary network Al-Thira, Jabal Al-Akhdhar Al-Awdah, Jabal Al-Taj, Jabal Al-Hussein and Jabal Amman	2,500,000	Y	2012 - 2016

Table 33 - Parking

Project	Cost (JD)	DS4	Implementation Dates
P1: King Talal, Quraysh and King Faisal Square	100,000	Y	2010 - 2012
P2: Introduce CPZs in Downtown, Khaldi, Al Abdali, University, King Talal, Prince Rashid	500,000	Y	2010 - 2012
P3: King Talal, Quraysh, Al Urdon, King Faisal, King Al Hussein, Khaled Bin Al Waled	500,000	Y	2010 - 2012
P4: Formalise and improve parking facilities off Quraysh, King Al Hussein and Al Shabsoch	200,000	Y	2010 - 2012
P5: Reduce formal long stay parking at Al Shabsoch, King Al Hussein, and informal at Quraysh, Omar Matar	100,000	Y	2010 - 2012
P6: Implement across Downtown, Inner and Outer Zones	5,000,000	Y	2010 - 2015
P7: Apply within the inner area where PT is good by 2015	500,000	Y	2015 - 2020
P8: Hypothecation of parking revenue	0	Y	2012 - 2025
P9: Accessibility based parking standards	10,000	Y	2010 - 2012
P10: Ensures that new development conforms to similar standards to those provided in public parking	10,000	Y	2010 - 2013
P11: Enforcement of existing parking restrictions	20,000	Y	2010 - 2015
P12: Increased Enforcement and Penalties to deter drivers from illegal parking	100,000	Y	2010 - 2018
P13: To ensure the number of officers is sufficient to enforce parking regulations	10,000	Y	2010 - 2025
P14: Specific areas to be targeted for intensive enforcement for short periods of time	10,000	Y	2010 - 2025
P15: Repeat offenders with more than 3 penalty tickets in a 6 month period will be required to attend a follow up learning session	10,000	Y	2010 - 2025
P16: Introduce a Parking Guidance system to monitor major car parks for spaces and direct motorists to alternative car parks when full.	870,100	Y	2010 - 2025
P17: Introduce a Parking Guidance system to route traffic to Park-and-Ride sites according to congestion and/or air quality triggers.	1,318,900	Y	2015 - 2017
P18: Introduce centrally managed on street parking payment system.	757,900	N	2015 - 2017

Table 34 - Freight

Project	Cost (JD)	DS4	Implementation Dates
F1: Develop a cordon around the city centre, within which delivery and freight vehicle movement will be restricted according to delivery and service plans.	75,000	Y	2012 - 2012
F2: Establish plans for delivery and servicing to businesses within the Municipality, with particular guidance and restrictions for businesses within the central cordon.	300,000	Y	2012 - 2013
F3: Implement a consolidation centre to reduce delivery vehicle movements into the centre of Amman.	20,000,000	Y	2015 - 2020
F4: Relocate existing customs depot from central Amman to a location on the edge of the city, with good access to the proposed ring road.	0	Y	2016 - 2017
F5: Locate freight parking areas along the strategic freight traffic routes.	4,500,000	Y	2016 - 2020
F6: Locate the proposed inland port and distribution centre along the strategic freight traffic routes.	0	N	2017 - 2019
F7: Set up partnership of freight and logistics companies to share and communicate best practice.	1,600,000	Y	2013 - 2025
F8: Improve and maintain the condition of key strategic freight routes to a standard appropriate to the levels of freight traffic likely to be experienced.	6,500,000	Y	2013 - 2025
F9: Develop a signage strategy to encourage freight traffic to use appropriate routes both for transit across the municipality and for deliveries to central Amman.	1,000,000	Y	2013 - 2013
F10: Marketing of the benefits which can be achieved from the strategy, for the environment, for businesses, for freight companies and for all city centre users.	750,000	Y	2011 - 2025

Table 35 - Demand Management

Project	Cost (JD)	DS4	Implementation Dates
DM1: Fuel: Soft; Raise by 1% per annum	150,000	Y	2012 - 2025
DM2: Fuel: Moderate; Raise by 1.5% per annum	150,000	N	2015 - 2025
DM3: Fuel: Strong; Raise by 2% per annum	200,000	N	2020 - 2025
DM4: Taxi Fares: Soft; raise by 1% per annum	150,000	Y	2012 - 2025
DM5: Taxi Fares: Moderate; Raise by 1.5% per annum	200,000	N	2015 - 2025
DM6: Taxi Fares: Strong; Raise by 2% per annum	250,000	N	2020 - 2025
DM7: Public Transport Fares: Soft; As base case	100,000	Y	2012 - 2025
DM8: Public Transport Fares: Moderate; 10% reduction (subsidy)	150,000	N	2015 - 2025
DM9: Public Transport Fares: Strong; 25% reduction through use of travel card	200,000	N	2020 - 2025
DM10: Parking Costs: Soft; Leisure JD1.5 / Work JD 2.5 / Education JD 2.5	250,000	Y	2012 - 2025
DM11: Parking Costs: Moderate; Leisure JD 2.5 / Work JD 3.0 / Education JD 3.0	250,000	N	2015 - 2025
DM12: Parking Costs: Strong; Leisure JD 2.5 / Work JD 3.0 / Education JD 3.0	25,000	N	2020 - 2025
DM13: Work Place Levy: Soft; Leisure JD 1.5 / Work JD 2.5 / Education JD 2.5	200,000	N	2012 - 2025
DM14: Work Place Levy: Moderate; Leisure JD 2.5 / Work JD 3.0 / Education JD 3.0	200,000	N	2015 - 2025
DM15: Work Place Levy: Strong; Leisure JD 2.5 / Work JD 3.0 / Education JD 3.0	200,000	N	2020 - 2025
DM16: Cordon Charging: Soft; As Base Case	1,000,000	N	2012 - 2025
DM17: Cordon Charging: Moderate, JD 1 per entry	1,000,000	N	2015 - 2025
DM18: Cordon Charging: Strong; JD 2 per entry	1,000,000	N	2020 - 2025

Quick Win Projects

As part of the programme, a number of quick win projects have been identified and brought forward to the first three years of the Plan (2010 to 2015). Their identification has been based upon a number of factors, intended to demonstrate that:

- Contribute significantly to meeting the objectives of the strategy
- Easy wins in the first 5 years, i.e. 2010-2015
- They provide visible evidence of change
- They provide a framework for larger scale projects
- They encourage greater use of public transport
- Project already at an advanced stage, i.e. design complete and financing arranged
- They provide benefits for areas away from those selected for major infrastructure improvements
- Address symptoms currently evident and severe in their effect
- They help to optimise the use of existing services and infrastructure

Many of the schemes proposed in the TMMP will take a long period of time to implement fully, or involve transport infrastructure projects which cannot be started until lengthy feasibility, design work and identification of funding sources have been completed. These quick wins are intended to increase the 'buy in' and commitment of local residents to the long term benefits which will be achieved through the success of implementing the TMMP.

Public Transport

Five Public Transport projects have been identified as follows, to bring forward as quick wins in the 2010 to 2013 period:

Project	Cost (JD)
PT5: Designed to take the simplistic modelled assumptions for fares and replicate them practically through zones, together with a general inflation tool to apply to fares to replace direct fuel cost relationship	assumed to be cost neutral
PT6: Smartcard system designed to be applicable to all public transport modes and companies in the GAM area	2,000,000
PT8: Branding, marketing and promotion campaign to encourage use of PT services	2,000,000
PT9: Travel Planning Kiosks and Offices at key locations, together with facilities for expanded inspection personnel	1,500,000
PT29: Extension of use of ticket issuing machines at LRT/BRT stations stops to cover all bus stops	500,000

The capital cost to implement these quick win projects is estimated to be JD 5,000,000. These quick wins are projects scheduled for completion in the 2012 to 2015 period. In the case of PT9, a total of 10 Enquiry Offices were scheduled up to 2025, and this envisages that 3 of them will be brought forward for completion in the period up to 2013.

The Public Transport 'quick wins' are intended to produce visible evidence of change and improvement ahead of the really major projects such as the LRT system. They will complement the construction of the first BRT Lines, and will encourage greater use of public transport in those areas that will not immediately benefit from BRT through extensive marketing and information provision. There is little knowledge about the current bus service network outside existing users, and these measures are intended to demonstrate the opportunities available for more people to use public transport services.

Highways

A number of highways projects have been recommended and these involve, for example, providing additional capacity to strategic links such as the Inner Ring Road or development based roads that open up new area.

The projects generally fall into two categories,

- Improvements to the Inner Ring Road
- Improvements to the Airport Road
- Improvements in support of future developments such as Area A, B,C and King Hussein Business park.

Given the slowing down of the economy, Areas A, B and C as well as King Hussein Business Park are not envisaged to be fast tracked over the next 5 years. However, the grade separation of the Inner Ring Road and the improvement of junctions in the Sweileh area are a priority. The development and construction of the Amman Ring Road west and north sections are also strategic long term projects and will not be built within the next 10 years.

Therefore, quick win highways based projects are considered to include the grade separation of the Inner Ring Road and the tunnel between Yarmouk and Al Jaysh.

Project	Cost (JD)
H10: Grade Separation between Wadi Abdoun Rd and Prince Ali Bin Al Hussein Rd and Prince Abdallah Al Salem Al Sabah Rd	10,000,000
H20: Grade Separation between Queen Rania Al Abdallah Rd and Ahmad Al Tarawina Rd	11,000,000
H45: Grade Separation between King Abdallah Ben Al Hussein II and Queen Zein Al Sharaf and Al Sinaa	10,000,000
H46: Grade Separation between King Abdallah Ben Al Hussein II and Queen Rania Al Abdallah and Jarash	21,000,000

The capital cost to implement the quick win projects is estimated to be JD 52 million.

Traffic Management

ITS (or ex ITS) projects have been identified as follows:

Project	Cost (JD)
TM1: Maintain and improve existing traffic adaptive UTC traffic signal coordination in parallel with changes to network and behaviour.	481,800
TM3: Introduce a Driver Information VMS system to warn motorists of planned events and unplanned incidents and congestion.	853,600
TM4: Extend traffic surveillance CCTV to grade separated junctions on ring road to support incident monitoring and management.	336,600
PED23: Introduce enhanced demand dependant pedestrian signals at mid-block pedestrian crossings.	235,950
TM10: Introduce Traffic and Transportation Information website to deliver information to homes, mobile phones and public display kiosks.	117,700
TM11: Introduce ANPR Journey Time monitoring system to give early warning of congestion and exceptional network conditions.	653,400
TM12: Use of UTC to implement traffic restraint signal timing plans to meter traffic into central area during periods of excess demand.	750,750
TM14: Introduce a roadworks management database with output to Traffic and Travel Information website and driver information VMS.	152,900
TM15: Introduce emergency vehicle priority calls (phase preemption) at traffic signals.	364,100
PED1: Introduction of pushbutton demand at pedestrian signals crossings across all parts of the network specifically junctions	300,200
TM18: Improve UTC traffic signal coordination by introducing infill junctions and signalised pedestrian crossings.	481,800
PED2: Adjustment of signalised phasing plan to reduce pedestrian wait times across all parts of the network, including signal cycle times and multiple ped phases.	349,800
PED3: Improve pedestrian crossing servicing at downtown junctions by coordinating ped signals according to ped route flows.	137,930

The capital cost to implement the quick win projects is estimated to be JD 5,139,200

The criteria for ITS Strategy “quick wins” are those measures that may be implemented without substantial investment in new infrastructure, control systems or regulatory change. GAM already operates a SCATS traffic adaptive UTC system, which provides immediate opportunities to implement different traffic control strategies over a wide area of the city where SCATS signal controllers are installed. Pedestrian mode, Congestion management and Public Transport would be jointly assisted by the introduction of infill SCATS junctions and mid-block signalised pedestrian crossings.

Safety

Seven safety projects have been identified as follows:

Project	Cost (JD)
S4: Consistent provision and review of road traffic legislation	125,000
S10: Pre-school education	40,000
S11: In school education	35,000
S12: Young Driver Training	60,000
S13: Police training and enhanced enforcement	125,000
S17: Signing and lining maintenance	1,250,000
S31: School safety zones and complementary measures	4,000,000

The capital cost to implement the quick win projects is estimated to be JD 5,635,000.

Safety Strategy “quick wins” are those identified not to need extensive amendments to policy and legislation such as changes to enforcement criteria. The training measures can be implemented without substantial investment and would receive wide spread public acceptance, particularly if supported with media coverage. Remarking highway lining will cause relatively minor inconvenience, but will offer a tangible improvement for all road users to see.

Pedestrian Realm

Three pedestrian projects have been identified as follows:

Project	Cost (JD)
PED1: Introduction of pushbutton demand at pedestrian signals crossings across all parts of the network specifically junctions	300,200
PED14: Pedestrian Enhancements linking key administration and mix land use development to LRT Line 2 Stop 7 and 6 and LRT Line 3 Stop 9	2,473,968
PED22: Upgrade of repairs to existing subways and footbridges to offer improved facilities across the pedestrian networks	600,000

The capital cost to implement the quick win projects is estimated to be JD 3,374,168.

Pedestrian Strategy “quick wins” are those identified which offer increased reduce severance barriers to pedestrians and increase the level of priority afforded to pedestrians. They are also upgrades to existing infrastructure which requires less consultation to be implemented.

Parking

Two parking project has been identified as follows:

Project	Cost (JD)
P2: Introduce CPZs in Downtown, Khaldi, Al Abdali, University, King Talal, Prince Rashid	500,000
P12: Increased Enforcement and Penalties to deter drivers from illegal parking	100,000

The capital cost to implement the quick win projects is estimated to be JD 600,000.

The key “quick win” for the Parking Strategy is to raise the profile for enforcement, which would ensure that there is a general reduction in the level of indiscriminate parking, which would offer tangible benefits to traffic highway conditions, pedestrians and avertedly road safety.

Freight

Project	Cost (JD)
F1: Develop a cordon around the city centre, within which delivery and freight vehicle movement will be restricted according to delivery and service plans.	75,000
F2: Establish plans for delivery and servicing to businesses within the Municipality, with particular guidance and restrictions for businesses within the central cordon.	300,000
F9: Develop a signage strategy to encourage freight traffic to use appropriate routes both for transit across the municipality and for deliveries to central Amman.	1,000,000

The capital cost to implement the quick win projects is estimated to be JD 1,375,000.

The quick win projects involve setting up strategy and delivery plans to better manage freight delivery within the City. This includes establishing a single delivery strategy to encourage freight traffic to use specific/dedicated routes at specific times of the day.

Organisational Structure to deliver Master Plan

Organisational Structure to deliver Master Plan

Providing the appropriate Organisational Structure to deliver the TMMP

The strategies outlined in this report are designed to achieve the agreed vision and objectives of the TMMP. However, in order for them to be implemented effectively, the appropriate regulatory and organisational structure needs to be in place. The Draft Provisional Law relating to the regulation of public transport and traffic within the borders of the Greater Amman Municipality (dated 2007) sets out the change in responsibility and brings significant opportunity for increased control over the quality of public transport network for GAM and thus the opportunity for Amman's citizens to benefit from a significantly improved public transport system. However, integrated project delivery, in depth detailed transport planning and the ability to impose contractual terms and conditions on the public transport operating industry are also all essential prerequisites to achieving a successful transport system.

What principles should be applied?

One of the most important principles required is the need to identify experience from public transport authorities (PTAs) from around the world in order to determine how such a body can be established to deliver a sustainable and efficient public transport network in Amman. This worldwide experience demonstrates that the changes that have been implemented within GAM over the past two years have laid a sound foundation for the development of a fully functioning PTA.

The legislative and contractual situation has also been examined to ensure that both are satisfactory in terms of facilitating the required transport planning, project feasibility work and programme delivery activities necessary to achieve the objectives of the TMMP.

Finally, the organisational structure required to provide a completely integrated approach to delivering the multiplicity of strategies has been considered, referring to best practice from successful examples elsewhere.

What are the most appropriate objectives?

The primary objective in this area is to propose an optimal regulatory and organisational structure to facilitate the delivery of the detailed strategy programmes determined as most appropriate to achieve the vision and objectives of the TMMP.

Delivering improvements

Proposals for delivering improvements to the organisational structure are divided into the areas of regulatory, organisational structure and legal/contractual. A summary of proposed changes is set out below.

Regulatory

The draft provisional law proposals represent a sound and effective means of underpinning GAM's future work in developing a high quality public transport system, however the precise role of the Committee of Public Transport Affairs may need further clarification. Overall responsibility for delivery of the public transport improvement strategy must clearly reside with the Mayor and the Municipality, but it is an important principle that users of public transport services, whether they reside within or outside the GAM area, should not be significantly disadvantaged in making their journeys as a result of the reorganisation of public transport services.

Particular attention needs to be given to local bus services which operate across GAM's boundaries. Whilst these are the responsibility of the PTRC, they often form an integral part of the public transport network, and GAM needs to be able to work closely with the PTRC to agree a mutually satisfactory fares and service level policy for such services, which ensures a co-ordinated approach and with similar fares and conditions to those services operated under contract to GAM. The regulations within the provisional law need to be examined to ensure that this can be implemented successfully in practice, together with a suitable arbitration process.

Organisational Structure

Appropriate governance needs to be put in place to facilitate the process of a step change in the quality and coverage of public transport services in Amman, and thus it is important to retain strong leadership and political commitment. Consequently, the Mayor needs to continue to play a leading role, with a clear and short line of responsibility through the City Manager to those charged with implementation.

We believe that GAM should be recognised formally through legislation as a Transport Authority, and that the newly created Transportation Planning Department should be further strengthened by giving it the responsibility of taking ownership of the TMMP, being responsible for developing all transport policies and determining and ensuring the delivery of all transport strategies.

In line with a City the size of Amman, an appropriate staffing level needs to be determined within the Transportation Planning Department in order that the main activity streams are properly resourced with appropriately qualified and skilled staff. The following areas of activity need to be considered in designing the structure of the Transportation Planning Department:

- Development of transport planning policies and strategies
- Liaison with internal and external organisations regarding the relationship of transport planning to land use planning and development
- Implementation of the TMMP in all areas of transportation, including public transport network development
- Detailed public transport network and service design
- Public transport infrastructure, ITS and maintenance requirements (e.g. bus stations, bus stops, Real Time Passenger Information, client side management of LRT and BRT projects)
- Contracts and finance, including fares determination, licensing and concessionary fares

Legal/Contractual

GAM should improve the quality of public transport service provision through implementing more challenging licensing requirements for both vehicles and drivers.

All contracts should be converted to gross cost type as they are replaced. Initially, contracts should be on a cost bid basis, with the specification of payment per km per vehicle. This would retain maximum flexibility for GAM, at a time when it is anticipated that there will be major network design changes, however, it will also be necessary to ensure that a mechanism is agreed, which allows for the quite severe changes in the cost of fuel, whilst at the same time simplifying and protecting the public transport user from fares fluctuations. As the new network stabilises, it would be advisable to retain the cost bid basis, but to switch to full timetable specification with revenue bonus.

GAM will need to give very careful consideration to how the market can be adjusted in order to ensure that there is a genuine competition for the award of tenders. The packages of contracts tendered may need to be reduced in size, and a major effort made to ensure that there are at least three operators capable of bidding for tenders.

It may be necessary for GAM to consider the creation of an 'arms length' bus operating company, as a measure of last resort, in the event that competition for tenders ceases to exist. This would require a change in legislation.

As a PTA, GAM will need to give careful consideration to its relationship with private bus operators. Unless bus services are provided by an associated publicly owned company, a regulatory organisation needs to divorce itself from active involvement financially with one or more operators. Without such clarity, it will be difficult to achieve genuine competition in the market.

GAM will be in a better position than the operators to shoulder the burden of the risk of having to assess accurately fares income from revised or new public transport services, thus strengthening the argument for gross cost contracts. There is a very strong case for GAM to subsidise the provision of bus services, as it is in a position to control fares income to determine the most appropriate balance between fares surpluses and subsidy.