Final Report

REG-6293: Managing the Cities in Asia May 2014

Urban Transport Pre-Feasibility Study Peshawar, Pakistan







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I. Introduction

This report summarizes the findings of a pre-feasibility study (PFS) to develop a 20-year public transport roadmap and to assess the potential for a Peshawar rapid transit (PRT) project for the city of Peshawar, Pakistan¹. It specifically highlights the opportunities, challenges and options available to the provincial government of Khyber Pakhtunkhwa (KPK) and the city of Peshawar in their attempt to implement this major public transport initiative. Although the aspiration and vision of the initiative are laudable, translating this vision into a practical project that meets everyone's expectations is where the challenge lies. Nevertheless, as the PFS indicates, the PRT is achievable if conceived and planned properly, if widespread support is garnished and the appropriate resources are sought. Also, the project is more than just a physical investment, it must be transformative in what it hopes to achieve and more critically, it must seek to meet the needs of Peshawar's residents. If this can be achieved, it has the potential to transform the urban landscape of Peshawar and provide vastly improved transportation to a substantial population in Peshawar for decades into the future.

This is a Final Report, and as such, the level of detail of the information contained herein is by necessity, limited. More detailed information on all aspects evaluated during the PFS can be found in Final Report Volume 2 as well as the PFS Interim Report Volume 1 and 2. It must be borne in mind that as a PFS, the level of detail is not comparable with that of a detailed Feasibility Study and Reference Design effort. Nevertheless, the information and conclusions reached are considered sufficiently accurate to commit to the investment, subject to the Feasibility Study and Reference Design being successfully concluded.

II. Peshawar

Peshawar is the capital city of the North Western region of Khyber Pakhtunkhwa (KPK). It covers an area of 1,247km² (438 square miles) and sits in a valley between the Iranian plateau and the Indus valley near the Afghan border (Figure 1). It is considered to be a gateway to Central and South Asia, and has been of historical importance to the region for over 2,000 years. Peshawar is located approximately two-hours drive from the national capital of Islamabad. At the time of the last census (1998) it had a population of just over two million, now estimated to be around 2.8 million (P&D Urban Unit). By 2033, the population is expected to rise to 4.4 million. Rapid population growth has been significantly impacted by Afghan refugee migration and internal displacement, resulting in approximately 280,000 Afghan refugees and a further 100,000 displaced persons currently living in Peshawar². As many of these have limited resources and opportunities, the pressure to maintain infrastructure development and service provision in accordance with the demand for housing, transport and basic urban services is therefore considerable.

Peshawar is linked directly with Islamabad (and beyond) by a dual carriage highway that feeds into the main city road artery also known as the 'east to west GT Road'. This road intersects the main heart of the city, dividing north from south. The city also has a rail link serving national destinations, including three daily passenger train services between Peshawar and Islamabad. Though a popular way to travel in Pakistan, rail as a transport mode has lost ground to road transport, largely due to improved road infrastructure and the improved passenger bus services now plying intercity routes. Peshawar also has an international airport, serving mainly the Middle East as well as regular domestic flights to other cities in Pakistan.

Poverty is widespread in Peshawar. The city has 18 informal settlements or 'katchi abadis' whose cumulative population is estimated to be 250,000. These settlements house most of the internally displaced and migrating refugees arriving in Peshawar daily. Service provision in the katchi abadis is extremely poor. In KPK, almost 44 percent of the population is classified as poor, which is slightly higher than the national average of 40 percent. Also, although almost 90 percent of men are employed, only 10 percent of women are employed due to fewer opportunities for economic

¹ The PFS commenced in Nov-2013, implemented by a team of international and national consultants. The Urban Policy Unit in the KPK Government has been the operational counterpart for the PFS.

² Source: Hashoo Foundation and Urban Policy Unit Reports.

independence. A well designed and accessible public transport system offers substantial benefits to the urban poor.

III. Project Need

There are a number of prime considerations on this aspect. Among the most relevant ones are:

- A. Poor existing traffic conditions: First, declining traffic conditions on key arterials is reaching a stage where the situation is becoming unmanageable for the limited resources available. Traffic police have commented during consultation with the team that they are "fed up" with the growing traffic and the growing impatience of drivers at intersections and U-turn sites.
- **B.** Poor service provision: In addition, existing public transport passengers are highly critical of current conditions of the existing arrangements and have widely supported the improvements proposed indicating they are prepared to pay a premium for a premium system. Businesses and traders have also expressed support for the proposed PRT during consultations.
- **C.** Fleet Condition: The current fleet, although required by Law to have a maximum age limit of 10 years, is dominated with vehicles from the 1980s and 1990's. There is no effective Government oversight on fleet quality or supply against demand and the public must suffer as a result. There has not been a noticeable investment in the public transport sector for a number of decades and even the General Bus Stand is at an advanced state of decay. In contrast, the recent flyover in GT Road, the (under construction) flyover from Charsadda Road and the proposed (approximately USD\$9 million) flyover at Hayatabad reflects the priority for private road transport over the needs of public passenger transport. The time for investment in this sector is long overdue.
- **D. Market demand**: Finally, there is substantial demand for public passenger transport with PFS screen-line surveys indicating mode shares of 60% and above at varying times of the day. Such a market is in itself justification for a more equal share of public expenditure on public transit infrastructure. It is important to retain this market so that the traffic conditions do not worsen as passengers leave their services and use private vehicles in the future. In this context, the project is described below as a basis for undertaking the detailed Feasibility Study.



When consulted during the PFS, the public showed strong dissatisfaction with current public transport services, with the majority of respondents ranking the services as 'poor' to 'very poor', while from a personal safety perspective, a concerning 84 percent of passengers surveyed consider it to be not at all safe (Figure 2). Public transport services are considered to be inadequate during rush hours, women and children are unable to sit, the services are considered to be slow with frequent stops, and there are complaints about the humiliating and bad behavior of drivers and conductors.



Figure 2: The Extent of Public Dissatisfaction

PFS surveys also demonstrate the traveling public's strong support for service improvements, and their willingness to pay for upgraded transport services. PFS screen-line surveys also indicate mode shares of 60 percent and above at varying times of the day. Such a strong market share needs to be retained to dissuade passengers from transitioning from public high capacity transport services to low capacity private vehicles, thereby worsening traffic conditions further. The time for investment in Peshawar's public transport sector is therefore long overdue (Figure 3).

Figure 3: Public Transport in Peshawar



IV. Transport Demand

Peshawar has sufficient travel demand and overall public transport market share to merit an PRT. It has a well-defined corridor network which lends itself to a well-structured and integrated mass transport system radiating out from the city central area. Based on classified vehicle counts and vehicle occupancy surveys taken in a number of corridors during the PFS, the daily public transport market share ranges from a high of 87% in Warsak Road (Corridor 3), 77% in GT Road near the General Bus Stand (Corridor 2), 76% in Bara Road (southern section of Corridor 4) and 64% in AJK Afridi Road (southern section of Corridor 3). These public transport market share levels are high by world standards and reflect the current levels of poverty in and around Peshawar.

Of all the corridors surveyed, Corridor 2 has the greatest daily demand for public transport³. It has daily public transport passenger flows peaking at nearly 393,700 near the General Bus Stand in GT Road. Here, the daily market share being carried by public transport vehicles was 77% and the peak hour passenger demand per direction was nearly 20,750. With this market share being carried by

³ Travel demand survey, Mar-2014. Refer to Volume 2, Appendix 1 for more detailed information.

less than 43% of the total traffic, it underscores the important role public transport currently plays in both servicing the substantial demand as well as reducing traffic flows on the city road network.

In the interests of retaining this market share and helping to manage traffic congestion levels into the future, it is imperative that public transport investments work to ensure the public transport sector is both functionally adequate as well as being a mode of choice for current and future passengers. If these requirements are not met, the current market share will fall, the number of private vehicles required to meet demand will rise, the existing public transport sector will suffer additional financial stress and the city risks rapidly rising congestion levels in the future. At that stage, the cost of traffic management infrastructure (either through capital works or potential operating subsidies⁴) will be a significant burden on the KPK Government annual budget.

As discussed above, surveyed passengers agree with the need for improvements to the deteriorating conditions. Preferences for improvements include neat and clean vehicles, punctual services, better seating arrangements and improvements in the attitudes and behavior of drivers and conductors. When presented with images of what a future PRT (rail or bus) system could look like, 99 percent expressed a willingness to use the PRT system in preference to the current public transport mode. A further 68 percent interviewed expressed a willingness to spend an extra Rs. 10 to Rs. 40 for a quality service⁵. With deteriorating traffic conditions and a large market share for public transport, there is both an increasing opportunity and need for public transport to cement itself as the mode of choice. Table 1 below gives a breakdown of the initial passenger demand based on screen-line counts.

Corridor	rrider Screenline Location/Direction		Daily Pa	assenger D	Demand
Corridor		Station	Private	Public	Total
2	GT Road near General Bus Stand	2			
	Westbound		60,252	219,764	280,016
	Eastbound		55,751	173,934	229,685
	Total		116,003	393,698	509,701
2	Jamrud Road - Christian Grave	8			
	Westbound		88,825	121,264	210,089
	Eastbound		81,350	128,811	210,161
	Total		170,175	250,075	420,250
3	Warsak Road	10			
	Westbound		11,424	47,587	59,011
	Eastbound		7,075	81,395	88,470
	Total		18,499	128,982	147,481
3	AJK Afridi Road - near bridge	5			
	Westbound		32,511	68,117	100,628
	Outbound		40,390	63,774	104,164
	Total		72,901	131,891	204,792
4	Bara Road	7			
	Northbound		12,674	43,624	56,298
	Southbound		16,367	48,202	64,569
	Total		29,041	91,826	120,867

Table 1: Daily Passenger Demand by Corridor and Private/Public Vehicle Category.

V. PRT Options

The six corridors identified in the PFS form the basis of a PRT system for the medium to long term. They are to be developed through a phased, corridor-based investment program, and prioritized

⁴ If the decline in passenger demand for public transport operators makes services unviable, the KPK Government may be forced to consider the prospect of paying operating subsidies to ensure a basic public transport service is retained.

⁵ Social Perception Survey March 2014



through a range of criteria as part of the 20-year public transport roadmap process. Significantly, this approach provides an opportunity for existing transporters to respond and adapt to new mass transit system, eventually becoming an integral part of it. Transporter integration is of crucial significance in Peshawar, particularly given the current security issues⁶.

Corridor 2 is considered to be the priority PRT corridor for initial development. Subsequent corridor investments as part of the roadmap deliverables can then be based on a range of supporting criteria. Although Corridor 2 could conceivably accommodate BRT and LRT, a BRT along Corridor 2 is considered preferable for a number of reasons. Firstly, it could be implemented in a reasonable time frame, if at grade and meet the stated objective of KPK Government. It is the only option considered within the financial capacity of KPK Government to implement and maintain over the medium to long term. It would offer greater flexibility in linking commuters from adjoining corridors and feeder roads. These are important considerations when assessing service accessibility and mobility in Peshawar, particularly for those making journeys to and from Peshawar's katchi abadis. The following further summarizes the justification of this corridor for priority development.

- A. Demand and Capacity: For Corridor 2, the current maximum hourly one-way demand is 20,745. There is the assumption that the new PRT on Corridor 2 must be capable of serving this demand while retaining sufficient redundancy for future growth in demand. Three market share options⁷ (40 percent, 60 percent and 80 percent) have been considered as possibilities. These translate to peak hour per-direction demands of approximately 8,300, 12,480 and 16,550 respectively. Of these, it is unlikely that 80 percent of the existing transporter sector on Corridor 2 will be able to be absorbed in the short term without protests. For this reason, a target of between 8,300 and 12,480 passenger-demand per peak hour per direction is considered a reasonable position at PFS level at the outset, to be refined during further feasibility assessment.
- **B.** Future Demand and Capacity: In time, when the advantages of the mass transit mode along Corridor 2 are more widely appreciated and there is a more widespread desire to transition from the existing transporter services (and even private vehicles), demand for mass transit along Corridor 2 could rise to 16,550 or even higher (20,000 30,000) passengers per hour. This will take time to evolve and will be readily apparent to the KPK Government as it monitors growth trends. At that time, and should the need arise, the option of implementing Corridor 6 (rail) or Corridor 6 (BRT) can be considered.

In addition, at that time Corridor 2A can also be implemented to provide limited stop services along Khyber Road from GT Road to Jamrud Road. This will reduce the need for (up to 50%) of the current passenger market having to travel unnecessarily via Saddar and improve the overall attractiveness of the PRT for travel between GT Road in the east to University Town and Hayatabad in the west. It will reduce the capacity required for the Saddar section of Corridor 2.

C. Financial and Economic Case: The PFS analysis of the rail option found it to be neither financially nor economically viable. The BCR for the rail option at grade, partially elevated and fully elevated raged from 0.6, 0.5 and 0.4 respectively. For the BCR Financial assessment, the respective values were 0.12, 0.1 and 0.07 respectively. These results confirm the investment is not justified. When it is considered that the option of an elevated rail system will require an underground section through Saddar - as there is inadequate space for the elevated track curves through this area, the economic and financial case worsens further.

⁶ The KPK Government has been advised to take this issue seriously or (based on previous Pakistan experience) risk certain failure with the PRT investment.

⁷ That is, the proportion of the existing transporter passenger market to be "transferred" to the PRT.

- **D.** Engagement and Inclusion of Existing Transporters: This is essential if a sustainable PRT is to be achieved. Employment is a key reason for inclusion. The Government and service sectors are the primary employers, while a limited industrial sector also contributes. Unemployment is an on-going issue in the city and is made worse by the presence of refugees and internally Displaced persons, most of whom are unqualified for continuous long-term employment. For this reason, the mode that is best is the one most able to readily accommodate the current skill base (with the relevant training) into the new PRT system is the preferred choice. In this respect, the BRT mode is the preferred option.
- **E.** Flexibility to Serve the Broader Network: Within the context of the corridor network of Peshawar and the at-grade ROW limitations of Corridors 3, 4 and 5, the mode which is most capable of providing direct services between corridors will deliver the most benefits as it will be able to provide flexible service patterns to optimize mobility and operational efficiency. With the limited alignment ROW in these other corridors, the BRT mode offers the best opportunity for such service flexibility and integration.
- **F. Financial Risks:** Considering the anticipated limited financial resources of the KPK Government⁸, the mode on which KPK Government has more influence to limit its financial liabilities will be preferred. In the case of BRT, simple competitive contracts can be issued which specify a range of financial conditions and practices to minimize the financial risk. For an elevated rail mode, such an investment will most likely require an overseas consortium on a build, own and operate (BOO) basis. In this instance, and considering the large capital cost involved in elevated structures, underground alignments, rolling stock and specialist maintenance teams, a financial guarantee will most likely be required from KPK Government from the outset.

Such a guarantee is likely to be in the form of a guaranteed revenue stream in return for supplying services for the term of the concession. The KPK Government can expect the guarantee will also involve reference to uninterrupted power supply. As such a term could involve 25-30 years as a minimum, the KPK Government would need to ensure that adequate financial resources are contained within the annual budget to meet this long term obligation.

Alternatively, with a BRT operation, the terms of contracts can be less (typically the term of commercial loans for the fleet). In this respect, terms of between 7 and 10 years are the norm. In addition, and with the added opportunity to provide flexible services on the PRT network, the BRT mode is more able to generate demand from a range of trip origins and destinations. This helps to reduce the overall financial risk to KPK Government. The BRT is preferred for this criteria.

VI. Priority PRT Line Options

Of five corridors originally identified during the PFS interim phase as having the greatest relevance for a future PRT network, Corridor 2 was selected by the KPK Government as the priority for initial investment. At the conclusion of the final phase of the PFS however, an additional corridor option was raised for consideration. This is referred to as Corridor 6. As Corridor 6 had not been previously documented in the Interim Report, it has been included in this report for completeness. Corridor 2 is described briefly below to provide comparative context. These Corridors are illustrated in Figure 7.

A. Corridor 2

For the bulk of this Corridor it has sufficient overall right of way (ROW) to accommodate either alignment alternatives. For the GT Road section from the Chamkani terminus in the east to the Balir Hisar Fort, the overall ROW⁹ ranges from 35 to 71 metres. For the Jamrud Road section from University Town to the Karkhano market, the overall ROW ranges from 30 to 60 metres. For

⁸ As per advice provided by KPK Government to the PFS team, an expected budget shortfall in 2015 and a requirement that there be no subsidy obligations confirms this view.

⁹ The overall ROW in this context refers to the carriageway including the median as well as any service roads, dividers footpaths or verges.

the corridor middle section on Sunhiri Masjid Road, Sir Syed Ahmad Road, Khyber Road and (if permission is granted by the Cantonment Board) Saddar Road, the alignment is narrower and will require ROW widening at station locations.

This requirement (through the middle section in Saddar) is irrespective of whether a street level or elevated alignment is to be considered in this section. Figure 5 shows the overall conditions of the GT Road section, the Jamrud Road section and the more constrained section in Sunhiri Masjid Road, which characterises the alignment conditions through much of Saddar commercial area. Appendix 4 of Volume 2 contains additional information on the corridor ROW conditions, including a detailed schedule of cross section measurements obtained by the PFS team specifically for this purpose.

Figure 5: Corridor 2 Alignment Conditions



GT Road near General Bus Stand

Jamrud Road, University Town Su

Sunhiri Masjid Road near Saddar

In the case of a street level or elevated BRT, passing lanes will be required at stations to enhance the carrying capacity of the system and to provide flexibility in service patterns as well as redundancy in the event of an unforseen vehicle breakdown. This will require an overall cross section width of up to 18 metres with a single median station platform of up to 15 metres with a staggered platform arrangement. For much of Corridor 2, this provides an opportunity for a corridor transformation to deliver an enhanced urban environment and meet some of the objectives of the Department of Planning and Development city beautification policies. In the case of a street level or elevated LRT alignment, the 2-3 meter pylons will have a minimal operational impact on the corridor. However, the overhead station walkway access footprints will require additional road widening at a number of locations, especially in Saddar.

B. Corridor 6

Corridor 6 could also accommodate a BRT line but is contingent on¹⁰:

- 1. Agreement on access being reached with Pakistan Railways and the Airport Administration.
- 2. The ability to remove encroachments to allow an adequate ROW for a BRT alignment to operate either side of the rail tracks.
- 3. Permission to fence the rail alignment in order to restrict pedestrian movements across and along the alignment as is currently the case.
- 4. Permission from Pakistan Railways to construct pedestrian underpasses under the tracks to ensure continued access between the communities intersected by the rail alignment runs at present.

Although the surveyed ROW details have not been made available to the PFS team, site inspections and relevant observations of satellite imagery suggests there is adequate ROW for a bi-directional BRT operation in addition to the rail for the section from Chamkani to Cantt Station. There will however potentially be a need for widening of the alignment under the Chamkani, Ring Road, Eidagh Road and Bajori Road flyovers. Encroachment currently exists in the market area

¹⁰ These requirements need to be resolved during subsequent Feasibility Study.

of the Eidagh Road flyover and further west on the approach to Charsadda Road. As the alignment rises to the bridge across GT Road and down past Bala Hisal Fort, the BRT alignment will require retaining walls up to a height of some 6 metres (near the Fort). From the Fort to Cantt Station, the ROW is considered sufficient to accommodate a BRT running way on each side of the rail alignment.

At both City and Cantt Stations, and depending on the final BRT alignment design layout, the distances between the alignments could be between 55 and 100 metres respectively. For this reason, detailed discussions and additional design effort is required to design a more integrated alignment design, to be completed during the Feasibility Study. Figure 6 below shows the wide track layout for Cantt Station on which this issue needs attention.

For the section between Cantt Station and the Airport, the ROW is marred by substantial encroachment that has effectively covered the entire ROW in some cases. This represents a substantial challenge for the future if a viable BRT right of way is to be established. Figure 6 shows extent of encroachment.



Figure 6: Corridor 6 Alignment Conditions

Cantt Station: Numerous Tracks and Freight Vehicles

Section 3: Alignment Encroachment

The alignment section ROW from the Airport to Karkhano varies widely and is considered inadequate for a bi-directional BRT alignment at a number of locations. For instance, the distance between the western Airport wall and the current Old Bara Road ranges from 7.0 to 11.5 meters. Then as the residential area of University Town starts, the land is subject to encroachment from middle/upper class housing¹¹. Here the alignment varies from 12 to 17 metres. While this alignment is adequate for a bi-directional BRT alignment, should Pakistan Railways require its track(s) to be retained, the alignment ROW is likely to be inadequate without the removal of encroachment, or the purchase of the relevant houses. Further west, a similar situation exists. Encroachment and the development of a roadway over the rail alignment at North and South Canal Road will present substantial challenges for the BRT project on this corridor.

To the west along the Hayatabad section to Karkhano terminus, there is encroachment by katchi abadis by existing transporters and by a substantial number of livestock market and fruit/vegetable sellers. These, together with the requirement to construct approximately 780 lane meters of bridge for the BRT highlights the range of serious challenges to be faced in delivering an PRT running way in this western section of the overall corridor. Section 1 where a rail service operates and corridor maintenance still exists, there is reasonable satisfactory ROW for a BRT. For the track section beyond Cantt Station which no longer operate trains, the gradual encroachment and (potential) sale of plots encroaching on the ROW during the past two decades has reduced the alignment to being inadequate for such a PRT without wholesale removal or

¹¹ By their appearance, It is considered that these houses are on land which has likely been purchased and therefore are not encroachments.



encroachment and substantial costs being incurred. Should permission be received from Pakistan Railways and the Airport Administration for access rights, then this corridor option can receive further examination during the Feasibility Study if required.

VII. System Specifications

Irrespective of the mode, the technical ROW specifications will be similar for both corridors. This includes an alignment of 27.2 km, approximately 32 stations, with an average distance of 822 meters between them. A depot for fleet refueling is also provisioned for, as this will be needed for either mode. It is also anticipated that in the case of the LRT option, a fleet of potentially between 41 and 47 train sets will be required, and for a BRT option, approximately 63 articulated buses. The maximum of 63 buses are envisioned if the BRT is at grade, whereas if the BRT is partially elevated only 59 buses are required due to marginally higher average operating speeds. Other investments include a control room, parking facilities, communication systems and ticketing systems.

As discussed previously, Corridor 6 emerged subsequently to the other corridors as a potential priority for PRT. Although the ROW is adequate for BRT, in certain sections there are a number of other challenges to overcome. These include substantial encroachments, and as noted above, access being granted by Pakistan Railways and Civil Aviation Authorities along the international airport section.

For a median based PRT, the running way layout options available vary. For the rail mode, a single track each way with either an island station or lateral stations (as per the Lahore Metro Bus layout) is available. For a BRT mode, the options exist for a dual running way in each direction or a passing lane at stations (see Figure 8). This arrangement provides for increased flexibility in service patterns and helps to provide the capacity for peak hour passenger demand. Such flexibility is missing from the Lahore Metro Bus system and this has contributed to its apparent lack of success in delivering the required mass capacity for the mass demand. Peshawar need not follow this path.



Figure 8: Median BRT Alignment Concept

Source: Bus Rapid Transport. Sourcebook for Policy Makers in Developing Cities, Module 3b. Ver 2. GIZ.

The ticketing system shall be a closed system with ticket validation upon entry to the station platform and exit from the station. A simple token/card or a stored value touch card shall be implemented in the first instance. A single zone fare structure should be implemented as a first phase so that passengers need only focus on becoming familiar with the new system. Stations will include a ticket purchase booth as well as an automatic ticket token vending machine. In time, and as the system becomes an integral part of the city infrastructure, token and touch card value adding can be made available off site for added convenience. In due course, a zonal (distance or time) ticketing system can be considered if desired. A Peshawar Mass Rapid Transit (PRT) Control Room will be required to monitor and manage the PRT under normal, degraded or emergency conditions¹². It shall have the primary functions of (i) monitoring and documenting the service provision against contract requirements, (ii) monitoring and assisting passenger needs at stations as they arise, (iii) monitoring and documenting passenger flows, and (iv) monitoring and responding to unforeseen matters (operational and security) as they may arise from time to time.

It shall be linked to the PRT via the necessary and secure primary voice and visual communications system and have the necessary voice backup systems in the event of a major incident causing failure of the primary communications system. This Supervisory Control and Data Acquisition (SCADA) system is to ensure the safety and security of passengers, operating staff, the protection of fleet and the overall PRT infrastructure.

A communications system is required to link road staff (drivers, conductors and station staff) to the operator administration, depot staff and to the PRT Control Room. Components of it could (potentially) be bilingual with Pashtun and English so that where passengers are involved (as is the case when a station help button is pushed) there is an added level of comfort for the passenger involved. The communications system should include at least the following five components; (i) dedicated radio system; (ii) public address system; (iii) passenger information display system; (iv) time distribution system, and (v) closed circuit television (CCTV). The requirements for Corridor 6 (and indeed in time, the entire network) will be similar.

VIII. Outline Financial Costs

As has been suggested by KPK Government stakeholders, outline capital costs have been estimated for the seven project options, namely three BRT and three LRT options for Corridor 2 and a BRT option for Corridor 6. The cost of the Corridor 2 and Corridor 6 street level BRT features have been developed on an itemized basis using knowledge from other similar projects in Pakistan and internationally. At this initial PFS level of evaluation, the costs of elevated BRT features and street level and elevated LRT features have been estimated using mid-range cost-per-km data from ADB sources¹³. At this stage, cost estimates have not been made of any tunnel options for Corridor 6. Table 2 summarizes the outline capital costs for the seven options for comparative purposes.

Outline Capital Costs								
	Corridor 2							
Mode Option	BRT Street Level	BRT Partially Elevated	BRT Elevated	LRT Street Level	LRT Partially Elevated	LRT Elevated	BRT Street Level	
Capital Costs (Rs Million)	11,615.3	17,977.6	51,675.0	130,910.0	141,510.0	199,810.0	25,282.6	
Capital Costs (US\$ Million)	109.6	169.6	487.5	1,235.0	1,335.0	1,885.0	238.5	

Table 2: Outline Capital Costs

Sources: Consultant estimates for Street Level BRT; other estimates for elevated BRT and LRT derived from ADB paper: *Reducing Carbon Emissions from Transport Projects Reference Number: EKB: REG 2010-16 Evaluation Knowledge Brief July 2010* which quotes *L. Wright and W. Hook. 2007. Bus Rapid Transit Planning Guide. Institute for Transportation and Development Policy, New York.* Assumed Exchange Rate: US\$ 1.00 = Rs 106.00

Regarding the Corridor 2 option:

¹² Normal – according to contract conditions; Degraded – reduced service provision due to unforseen operational mishap or security issue; Emergency – rapid response to accident or security incident.

¹³ Reducing Carbon Emissions from Transport Projects (Reference Number: EKB: REG 2010-16 Evaluation Knowledge Brief, July 2010), which quotes L. Wright and W. Hook. 2007. Bus Rapid Transit Planning Guide. Institute for Transportation and Development Policy, New York.

- 1. The at-grade BRT cost is estimated at just under US\$110 million at an equivalent cost of about US\$4.2 million per km. Construction of this option could be completed within two years.
- 2. The partially elevated BRT option cost is estimated at over US\$169 million, equivalent of about US\$6.5 million per km, being operational within two-years.
- 3. An elevated BRT on this corridor would cost approximately US\$488 million, equivalent to about US\$18.8 million per km, completed in about three years.
- 4. The cost for the Corridor 6 BRT option is in the region of US\$240 million, equivalent to about US\$ 9.1 million per km.

For Corridor 2:

- 1. The at-grade LRT will cost approximately US\$1.2 billion, or approximately US\$ 41 million per km for the system. A 'best-case' approximate construction timeframe is three-years with LRT operations commencing within four-years.
- 2. A partially elevated LRT would be in the region of US\$1.3 billion or approximately US\$ 51 million per km.
- 3. A fully elevated LRT over the complete corridor is estimated at US\$1.9 billion or about US\$72.5 million per km, with a 'best-case' construction duration of about four-years.

Should an elevated alignment be considered, it needs to be appreciated that the traffic impact during construction will be significant and needs to be fully appreciated. In the sections of GT Road and Jamrud Road where service roads exist as part of the overall corridor ROW, it may be possible to manage the heavy congestion resulting from the closure of a number of lanes for construction purposes. This will have an immediate impact on the many businesses along the service road and will require detailed consultation and a viable traffic management plan to be implemented during the period of construction. However the streets in Saddar are considered too narrow for such construction without major and severe disruptions. Figure 9 demonstrates this.



Figure 9: Elevated Alignment Construction, Rawalpindi-Islamabad Metro in April 2014¹⁴

IX. Initial Economic & Financial Viability Assessment

Economic benefits and viability vary depending on the PRT mode. Cost benefit analysis (CBA) models have been developed for each of the seven project options¹⁵. The CBA model is the principal evaluation tool used to assess the direct economic benefits and costs of the project option investment when compared to a "Do Nothing" base case. A Benefit Cost Ratio (BCR) greater than 1 and a positive Net Present value (NPV) indicate that the project option is economically justified under the set of assumptions used in the CBA.

The CBA modelling adopts discounted cash flows using the ADB prescribed 10% discount rate and the BCR and NPV are determined from aggregates of the Present Value of Benefits and the Present Value of Costs over the assessment period. In addition to the capital costs, the CBA modeling includes annualized recurrent operator costs and infrastructure maintenance costs. LRT and elevated sections of the BRT will incur higher whole of life costs than an at-grade BRT system. The

¹⁴ Source: PFS Consultant Team.

¹⁵ Refer to Volume 2, Appendix 6 for more details and discussion on this aspect.

results of this initial assessment are listed in Table 3. The CBA model definitions and assumptions can be found in Annex 3 of this document.

To provide a consistent basis for comparison, the daily demand of approximately 223,000 public transit passengers and a base fare of Rs 20 was adopted for all options resulting in the same fare revenue for all options. In summary, the CBA results highlight that the 4 BRT project options are economically viable under the assumptions adopted in the CBA modelling while the 3 LRT projects options are economically unviable. For all options, the key differentiator in determining economic viability is the initial capital cost.

Result Item	BRT Street Level	BRT Partially Elevated	BRT Elevated	LRT Street Level	LRT Partially Elevated	LRT Elevated
Present Value of Benefits (US\$ m)						
Travel time savings	327.6	327.6	403.0	287.2	287.2	271.9
Vehicle operations savings	255.6	255.6	255.7	266.0	266.0	267.1
Accident reduction	27.0	27.0	27.0	27.0	27.0	27.0
CO2 emission reductions	1.2	1.2	1.2	1.2	1.2	1.3
• Fare revenue (Rs 20 fare)	139.0	139.0	139.0	139.0	139.0	139.0
• Total discounted benefits	750.4	750.4	825.8	709.0	709.0	706.2
Present Value of Costs (US\$ m) Total discounted costs (construction, fleet, maintenance and operator costs) 	228.5	294.2	565.4	1,199.9	1,331.8	1,865.6
Net Present Value (NPV) (US\$ m)	521.9	456,2	260.4	(490.9)	(622.8)	(1,159.4)
Benefit Cost Ratio (BCR)	3.3	2.6	1.5	0.6	0.5	0.4
Ranking	1	2	3	4	5	6

Table 3: Economic Cost Benefit Analysis Results (US\$ Million)¹⁶

The following presents a summary of the data presented in Table 3 as well as allocating a ranking to each option. The ranking reflects the most desirable to least desirable investment within the options listed.

A. Corridor 2 Street Level BRT: The at-grade BRT option with the lowest capital cost of all options at Rs11.6 billion (US\$110 million) has the most economically viable NPV of Rs 55 billion (US\$520 million) and a BCR of 3.3 over the 20 year assessment period. This option has the equal 2nd highest total discounted benefits at Rs 79 billion (US\$750 million) including the equal 2nd highest Travel Time savings benefits of Rs 34.7 billion (US\$328 million) over 20 years. An operating speed of 25 km/hr and service frequencies of 2 minutes (i.e. reduced waiting time) utilising a fleet of 61 buses over 454 return trip daily are the key factors influencing Travel Time - Ranked 1

¹⁶ Assumed 10 percent Discount Rate and 20 Year Benefit Assessment Period.

- B. Corridor 2 Partially Elevated BRT: This BRT option is essentially the same as the Street Level BRT option except for the additional capital costs incurred for the proposed elevated section through Saddar. Therefore its benefits are the same while it has a higher capital cost of Rs 18 billion (US\$170 million), the 2nd lowest of all options. Consequently, the Partially Elevated BRT option has the 2nd best economically viable NPV of Rs 48 billion (US\$456 million) and a BCR of 2.6 over the 20 year assessment period Ranked 2.
- **C.** Corridor 6 Street Level BRT: This primarily at-grade BRT option with the 3rd lowest capital cost at Rs 25.3 billion (US\$239 million) has the 3rd best economically viable NPV of Rs 42 billion (US\$395 million) and a BCR of 2.1 over the 20 year assessment period. This option also adopts the same demand and bus operations profile as Corridor 2 Street Level BRT option and therefore has the equal 2nd highest total discounted benefits at Rs 79 billion (US\$750 million) including the equal 2nd highest Travel Time savings benefits of Rs 34.7 billion (US\$328 million) over 20 years. Similarly an operating speed of 25 km/hr and service frequencies of 2 minutes (i.e. reduced waiting time) utilising a fleet of 61 buses over 454 return trip daily are the key factors influencing Travel Time Ranked 3.
- D. Corridor 2 Elevated BRT: The Elevated BRT option has the 4th lowest (i.e. 4th highest) capital cost at Rs 51.7 billion (US\$488 million) and returns the 4th best economic viability of all options with a NPV of Rs 28 billion (US\$522 million) and a BCR of 1.5 over the 20 year assessment period. This option has the highest total discounted benefits at Rs 88 billion (US\$826 million) including the highest Travel Time savings benefits of Rs 43 billion (US\$403 million) over 20 years. Due to a lack of intersections, this option has the fastest operating speed of 45 km/hr compared to other options that positively impacts on Travel Time Ranked 4
- E. Corridor 2 Street Level LRT: This option has the 3rd highest capital cost at Rs 131 billion (US\$1.2 billion). It is economic unviable with a NPV of negative Rs 52 billion (negative US\$491 million) and a BCR of 0.6 over the 20 year assessment period. This option has the highest total discounted benefits are similar to other LRT options at approximately Rs 75 billion (US\$709 million) with Travel Time savings benefits of Rs 30 billion (US\$287 million) over 20 years. The option has an operating speed of 25 km/hr and lesser service frequencies (i.e. longer waiting time) utilising a fleet of 41 trains over 294 return trip daily Ranked 5.
- **F. Corridor 2 Partially Elevated LRT:** This LRT option is essentially the same as the Street Level LRT option except for the additional capital costs incurred for the proposed elevated section through Saddar. It has the 2nd highest capital cost of Rs 142 billion (US\$1.3 billion). It has the same operating speed, fleet size and return trips as the Street Level LRT option and therefore the same benefits. It is economic unviable with a NPV of negative Rs 66 billion (negative US\$623 million) and a BCR of 0.5 over the 20 year assessment period Ranked 6.
- G. Corridor 2 Elevated LRT: The Elevated LRT has the highest capital cost of approximately Rs 200 billion (US\$1.9 billion) and is economically unviable with a BCR of 0.4 and a negative NPV of Rs 123 billion (US\$1.2 billion). In addition to being the most expensive project option, it also has the lowest total discounted benefits at Rs 75 billion (US\$706 million). Travel Time savings of Rs 29 billion (US\$272 million) over 20 years are the lowest of all options resulting from an operating speed of 30 km/hr with 18 trains undertaking 174 trips daily Ranked 7.

These results highlight that there is strong economic case for the project to proceed to full feasibility and in particular to further assess the BRT options for Corridor 2 and Corridor 6.

X. Initial Financial Assessment

This financial assessment has been undertaken by excising only the financial items (i.e. capital costs, annualized maintenance and operating costs and fare box revenue) from the Economic CBA Model. It is noted that the Economic CBA model includes a range of road and public passenger user benefits that are not in scope of the financial assessment. The daily demand of approximately 223,000 public transit passengers and a flat fare of Rs 20 (similar to current fare paid in Peshawar) are adopted

resulting in the same fare revenue for all options. No other revenue sources aside from fare box revenue have been modeled.

	BRT	BRT	BRT	LRT	LRT	LRT
Item	Street Level	Partially Elevated	Elevated	Street Level	Partially Elevated	Elevated
Present Value of Benefits (Rs m)						
Travel time savings	34,729	34,729	42,723	30,447	30,447	28,826
 Vehicle operations saving 	27,100	27,100	27,100	26,987	26,987	28,308
Accident reduction	2859	2859	2,859	2,859	2,859	2,859
CO2 emission reductions	124	124	124	129	129	133
Fare revenue	14,731	14,731	14,730.70	14,731	14,731	14,731
• Total discounted benefit s	79,542	79,542.30	87,535.80	75,153	75,153	74,856
Present Value of Costs (Rs m) • Total discounted costs (construction, fleet, maintenance and operator costs)	24,217	31,189	59,930	127,187	141,175	197,753
Net Present Value (NPV) (Rs m)	55,325	48,353	27,606	-52,034	-66,022	-122,897
Benefit Cost Ratio (BCR)	3.3	2.6	1.5	0.6	0.5	0.4
Economic Internal Rate of Return (EIRR)	162%	63%	22%	NA	NA	NA
Payback Period – All costs (number of years for the economic benefits only to cover all costs)	3	7	12	NA	NA	NA

 Table 4: Financial CBA Results in Rs

 (10% Discount Rate, 20 Year Benefit Assessment Period and excludes Loan Servicing)

At a flat fare of Rs 20 per passenger trip and assuming a daily demand of 223,000 passengers, all the project options are financially unviable under the assumptions. The Corridor 2 Street Level BRT, Corridor 2 Partially Elevated BRT and Corridor 6 Street Level BRT provide the 1st, 2nd and 3rd best BCRs of 0.6, 0.5 0.4 respectively, still financially unviable, with the project costs being the most significant influence on viability and ranking of project options.

The financial model was simulated to determine the flat fare that could be charged for each option to break even on all costs; Corridor 2 Street Level BRT has the lowest break even flat fare of RS 35 followed by Corridor 2 Partially Elevated BRT at Rs 40 flat fare and the Corridor 6 Street Level BRT at Rs 50 flat fare. Break even flat fares were double for LRT options when compared to BRT options ranging from Rs 160 for the Corridor 2 Street Level LRT to Rs 265 for the Corridor 2 Elevated LRT.

All of the above break - even flat fares would be too high when compared to current fare levels in Peshawar and would require a subsidy from government. However, if subsidy is to be minimized, the street level BRT option would best meet this requirement.

Should additional revenues be required to eliminate subsidies, modern mass transit systems can generate revenue from advertising at stations, on the fleet and elsewhere in the corridor. In addition revenue could be generated from concessions at stations. Other revenue generating possibilities include land value uplift and resulting increases in land related tax and the development of paid parking precincts around major stations. However, in the context of Peshawar, these opportunities are likely to generate only minimal additional revenues and therefore, KPK Government should not rely on these items to avoid subsidies.

XI. Project Financing Options

Three options exist at present. The first is where government finances this project through its provincial resources with national support. The second available option would be to capture private sector support. Thirdly an international financing institution such as the ADB could be approached for support. Combinations of these options may also be plausible. A closer examination of the options is warranted.

A. Government Financing

The Government of KPK delivers infrastructure investment through the Development Programme in the annual Budget's Capital Account. This allocation also includes expenditure on Foreign Projects Assistance (FPA) investments received in the form of committed grants and pledges and also from external sources. The Development Programme records the capital expenditure on projects across the full range of sectors including road transport sector comprising Highways, Roads and Bridges expenditure. No specific item for public transport infrastructure exists in the budget. Table 5 identifies capital expenditure and debt servicing in the last 4 years.

Total capital expenditure increased from approximately Rs 55 billion in 2010-11 to approximately Rs100 billion in 2013-14, an increase of Rs 45 billion at an average annual growth of 20.5% over the four-year period. Road Transport Capital Expenditure has been consistently around the Rs16 billion despite between 2010-11 and 2013-14 while its contribution to Total Capital Expenditure has decreased from 30% to 16% over the same period despite increases in population, motor vehicles and economic activity this decrease in percentage contribution is significant and highlights the lessening of importance of Road Transport capital projects when considered against the Provincial government's priorities for other sectors in the Development Programme.

Item	2010-11 Revised	2011-12 Revised	2012-13 Revised	2013-14 Budget
Road Transport Capital Expenditure	16,405	14,174	16,182	15,695
Total Capital Expenditure including FPA (all sectors)	54,726	69,659	73,073	100,116
% Contribution of Road Transport to Total Capital Expenditure including FPA (rounded)	30%	20%	22%	16%
Debt Servicing	7,866	9,508	7,939	8,710
% of Debt Servicing to Total Capital Expenditure including FPA (rounded)	14%	14%	11%	9%

Table 5: Capital Expenditure and Debt Servicing 2010-14 (Rs Million)

The lowest cost project option, namely the Street Level BRT at Rs11.6 billion, would represent approximately 12% of the annual Total Capital Expenditure and 80% of the Road

Transport Capital Expenditure, if government financing were sought. Debt Servicing has been in the consistent range of Rs8 billion–Rs9 billion indicating that debt on the financing of capital projects has been adequately controlled by the KPK government; the ratio in percentage terms has reduced from 14% in 2010-11 to 9% in the 2013-14 Budget over the period which indicates that the KPK Government is in a reasonable position to take on more debt servicing of around Rs2 billion to Rs3 billion annual for capital projects.

The current Development Programme (2013-14 Budget) of approximately Rs100 billion will not be fully expended in the current financial year due to increasing transparency requirements and compliance. A revenue shortfall of around Rs. 55 billion over the next year and beyond may result in spending cuts or increased borrowing. Any Provincial project greater than Rs 2 billion and foreign donor funded projects must have a PC1 approved by the Federal Government's Economic Co-ordination Committee (ECC) and the Central Development Work Program (CDWP). The approval process takes 6 to 8 months. The Government of KPK has limited experience in funding large infrastructure projects and no experience a significant urban transport project such as an PRT so the issue of technical assistance for detailed design and procurement will be important in delivery of PRT.

B. Private Sector Financing

The KPK Government also has revenue reserves that may be used for funding the PRT project outside the Budget process. These revenue reserves are held off budget in development funds, placement in banks and through investment portfolios. Municipal bonds guaranteed by a financial institution are another possibility for off- budget finance raisings though Pakistan's experience with financing through municipal bonds has been poor.

Similarly, limited success has been achieved in attracting international private investment for infrastructure projects. Although highly marketable commercial undertakings including power generation, cellular telephone networks and seaport terminals have been in the domain of the private sector, it is not considered likely that the private sector through a Public Private Partnership (PPP) would be interested in the full scope of the PRT. A limited scale PPP might however be concluded, with for example, the private sector being involved in acquiring and running the PRT bus fleet. Major local Peshawar bus operators have indicatively stated their willingness to explore involvement in the operation of a BRT if this mode is supported. Services outsourcing to the private sector could also easily occur with PRT ticketing, security, cleaning, ITS and possibly parking in the future. This is an area to be further explored in the Feasibility Study.

C. IFI Financing

ADB has shown interest in possible engagement with KPK Government on mass-transit systems for Peshawar. Nonetheless, confirmation of its interest will depend upon the post PFS decisions taken by the government on (i) the overall scope and mode selected for the mass-transit project, and (ii) the institutional arrangements set up by the government to prepare, design and implement the project. At this stage the World Bank, KfW and IFC have not been considered as possible funding sources.

XII. Institutions and Implementation Arrangements

The Chief Secretary (CS) is the bureaucratic head of the Provincial Government of KPK and supervises the functions each department. The CS reports to the political head of government the Chief Minister. Secretaries lead their respective departments. However, the Additional Chief Secretary (ACS) heads the Planning and Development Department. All departmental secretaries are assisted by Additional Secretaries, Deputy Secretaries, Section Officers and supporting staff. The Departments also have attached departments and autonomous or semi-autonomous bodies to look after various functions.

The overall institutional landscape of KPK maintains a focus on provincial, divisional/regional and district level departments/institutions responsible for transport administration and transport infrastructure development at the broader level. For the transport sector, this includes regulations relating and permits and vehicle standards. However field visits and discussions with the transporters revealed a consistent lack of effective governance of the sector. During stakeholder discussions it has become evident that there is a lack of decision-making ability to respond to the needs of the public transport sector and the public who are currently using the system. Some of this stems from the hierarchical nature of decision-making and some from a simple lack of appropriate technical skills.

The urgent establishment of a 'PRT Company' as a special purpose vehicle (SPV) is recommended. A public transport company that is wholly independent, and where the role of government is limited to a consultative and advisory role is considered the most effective model for Peshawar. The company must be supported with appropriate corporate legal coverage to ensure that it is immune from external interference but at the same time able to be held accountable to Government for the outcomes required as per KPK Government urban transport policy. The KPK government should initiate the process of drafting the Articles of Association and enacting the legal framework to enable the creation of the Company as a priority. The PRT Company should be different from the Lahore Transport Authority model, where the government retained a more direct role in its function. For Peshawar, and in the interests of improved governance and accountability, greater autonomy and authority will need to be given to this PRT Company. Figure 10 provides an outline of what is required.



Figure 10: PRT Company Configuration

XIII. Safeguards

Due to resource limitations, a preliminary environmental impact has not been conducted. Such a task has been deferred to the feasibility study. An initial poverty, social and resettlement impact assessment has been undertaken. Poverty is wide spread in Pakistan and more than 40% of the total population is living below the poverty line. The unemployment, law and order situation, increase in the inflation and power crises are the main cause of poverty in the country.

KPK province has the highest incidence of poverty in Pakistan. In KPK, 44% population of the total population is below the poverty line. Rates of poverty in rural areas of Khyber Pakhtunkhwa were high compared to urban areas of Khyber Pakhtunkhwa. Also, there is a direct correlation between poverty and average household size; the household size of extremely poor households (11)

members) is almost half of the non-poor households (6 members). In urban KP, overall, 90.75% men as opposed to only 9.25% women constitutes the work force. The main income sources are services, business management, artisanship, construction work, unskilled labor, highly skilled work, and agriculture.

Land acquisition and resettlement are some of the most emotive issues when infrastructure projects are proposed in Pakistan. In Peshawar, most of the urban areas are characterised by encroachments and unplanned urban sprawl. Careful consideration needs to be given to these issues. For the time being Corridor 2 and Corridor 6 are being discussed as potential PRT project sites in the short term. The initial social and poverty impact assessment for this type of project indicates that about 22,500sq.ft of public and private land (for parking and terminus) is required and about 447 commercial, residential and community structures with 3,707 people will be affected by the PRT project. These impacts are identified in the Karkhano Bazaar, Takal, Sir Syed Ahmad Khan road and Sunhari Masjid road. The project impacts have been assessed as significant and the project is categorized as "A" for involuntary resettlement policy in accordance with the ADBs Safeguard Policy Statement (SPS), 2009. The eventual project executing agency will need to prepare a land acquisition and resettlement plan (LARP) of category 'A' in accordance with the SPS outline of a LARP.

XIV. Project Beneficiaries

If the project is implemented it will act as a catalyst for delivering a broad range of benefits across the transporters and their existing passengers in the corridor. If these guidelines are not supported, then the benefits are likely to be temporary and relevant for passengers only.¹⁷

Assuming that the above guidelines are followed, the immediate and most obvious benefits generated will accrue to those existing passengers who are captive to the combined effects of the often undesirable practices of existing transporters and the inability of Government to improve the situation. Then, with additional training and accreditation, existing transporters will be better skilled to provide improved service standards in the future. With this, the sector will remain financially viable for longer and the traffic congestion can be better managed with the reduced rate of growth in private vehicle ownership. This then creates a win-win situation for all. In this context, it must be appreciated that the initial PRT Project is just the start of a paradigm shift in the way Peshawar addresses its mobility needs. The outcomes in Table 6 reflect start of this paradigm shift.

Following extensive stakeholder consultations, the two primary risks to this Project are firstly, political interference compromising the design of a PRT system - which is practical, achievable and is designed in accordance with good practice. The second primary risk is the inability or unwillingness of Government to engage with the existing transporters to reassure them there is a future for them and to effectively gain their support and manpower resources for the commencement of PRT services.

The social and resettlement surveys have found the transporters are supportive of the PRT project and wish to be involved. To ignore this opportunity is simply illogical. Peshawar already has a serious security situation. It cannot afford to have it deteriorate as a result of transporter unrest.

¹⁷ Based on past experiences with Varan and the Karachi Green Bus, the project will not last for more than a few years (at most).

Investment Project Component	Investment Project Beneficiaries Out Component		mes
nents which principle of er first.	Existing and future public transport passengers	 Reduced waiting times and improved waiting conditions (passenger comfort and safety) for existing and future passengers. 	 Improved service reliability Improved pedestrian access for the elderly and disabled Improved public support and use of PRT
stem compo ance with the the passeng	Current bus, mini bus, van, wagon and suzuki drivers and conductors who become employed by the PRT system	 Reduced stress for drivers through proper training, less in service chaos and guaranteed monthly wages. Improved working conditions 	 Formal career generated through training and regular employment Improved opportunities for employment of women.
New PRT stations and sys deliver services in accorda placing the needs of	PRT operator and other transporters who continue to operate feeder services (eg rickshaws)	 A more efficient operation which supports public transport usage Retention of mode share increases employment security for drivers Retention of market share helps ongoing viability of business. Provides training for additional skills 	 Improved business opportunities for intra and inter-province transporters. Reduced fleet cost via improved maintenance processes. A viable future for the sector as additional networks are developed via the ten-year Plan
PI and CCTV /stems	Existing and future public transport passengers	 Added convenience of no fare gouging Improved service schedule confidence 	 Improved safety and security whilst waiting for services Overall increased level of confidence in walking to and waiting for public transport.
AFCS/RT Sy	Fleet Operator	 Improved confidence in on road operations and in meeting contract conditions 	 Improved investment returns Transparency in contract delivery Improved traffic police practices
. uoo	Fleet Operator	 Transparency in contract compliance and (if relevant) subsidy entitlements 	 Improved response times to unforseen circumstances and operational emergencies
PRT control r	KPK Government	 Improved capacity for contract monitoring and compliance Improved overall security monitoring capability 	 Increased knowledge of mass transit operations and system planning capability

Note: this table of beneficiaries is based on the premise that the investment includes BRT and that the inclusion of existing transporters as per the strategy outlined in this report is followed.

XV. Risks and Mitigation

A preliminary SWOT analysis of a potential PRT priority project has been undertaken to better understand on-going risks associated with the investment and to highlight where additional actions are required to mitigate these risks¹⁸. This analysis is provided to assist with on-going efforts in the feasibility study and any supporting capacity development activities being undertaken in preparation for project implementation. Table 7 contains this analysis.

¹⁸ SWOT: strengths, weaknesses, opportunities, threats.

Strengths	Weaknesses	Opportunities	Threats
The road network structure concentrates the bulk of movement into corridors which are direct and provide the mass demand for a mass transport network.	The KPK Government has had difficulty in appreciating the overwhelming advantages of BRT compared with other modes. This reflects a serious shortcoming in capacity and may impact on the overall success of the project.	The KPK Government has this project as a top priority and is keen to develop and implement this project. Both the Planning and Development Department, and the Department of Transport are fully supportive of the project.	Persistence by selected government advisors and stakeholders with the rail mode and elevated structures from the outset has the potential to drive up costs and reduce the appetite for proceeding with a well designed and relevant project from the outset.
The project complies with national urban policy and is a high priority of the KPK Government.	The political dimension of the KPK Government advisory process is clouding the issue unnecessarily. This places at risk the entire concept of a viable PRT network for Peshawar, both in the short term and long term.	There is a growing awareness of the relative advantages and disadvantages of modal alternatives in the Peshawar context.	Although there is multi institutional support and co-operation, the sheer number of unauthorized passenger vehicles plying routes will make the task of reigning in licenses and permits a difficult one for Government.
Social surveys have revealed a widespread disquiet with existing public transport services. Residents are calling for, a rapid introduction of the PRT and have indicated they are willing to pay a premium for a premium service. The PRT concept is both welcomed and supported	There is a lack of up to date urban transport travel demand data on which to progress the Urban Transport Roadmap plan. This, in addition to the current security position has seen a drain of the necessary technical skill set from the KPK Government. The lack of a unified position on some elements of the	Existing passengers have expressed a widespread disquiet with the existing services and strong support for a PRT project. Together with substantial current demand, this will help sustain a revenue stream and minimize/eliminate the need for ongoing subsidy. There is a willingness of existing hus, minibus and	A sudden resistance and hesitation from existing transporters if they are not included in consultations and the project in general. They will see their livelihood threatened and will have little opportunity for income in the narrow economic base of the city.
by existing transporters. They have requested KPK Government involve them in the future delivery of the PRT services.	project reflects the familiar political process in Pakistan where the emphasis is on high profile and politically beneficial projects rather than projects that are focused on the needs of the public.	wagon drivers and owners to support the PRT concept and have asked to be included in future service delivery. This offers additional impetus for project implementation.	Government can expect a further deterioration of security conditions as transporters engage in the familiar protest rallies and even property damage out of frustration.
The project components have the capacity to provide a good level of support to women and also those with personal mobility limitations and who must rely on inadequate conditions at present.	Frequent staff transfers limit KPK Government capacity for delivery. This is further exacerbated by a general lack of devolution of responsibility/ accountability to those most capable in making PRT technical and management decisions.	The political landscape at the Provincial and National level has generated a "competitive desire" for a successful PRT project to be operational within 2-3 years. This combined with the priority for a PRT project is a major opportunity.	The lack an agreed KPK position (not one of an external stakeholder) on selected technical details, a project champion and an action plan to implement the recommendations of the PFS and the future FS may undermine the viability of the project.

Table 7: Summar	y SWOT	Analysis	of the	PRT	Project
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A PESTLE analysis has also been undertaken to further appreciate the PRT Project investment opportunity in terms of its political, economic, social, technological, legal and environmental context¹⁹. The results of this analysis are presented in Table 8. This analytical framework provides a basis for financing and implementation options going forward into feasibility.

¹⁹ PESTLE: political, economic, social, technological, legal, environmental.

Political	Economic	Social
The ongoing " political competition" between parties across Pakistan and the capacity design shortcomings in the Lahore Metro bus project is clouding the essential technical issues that must drive the design of the PRT project investment. Providing decisions are made promptly and on the basis of rational technical and financial aspects, there exists an adequate window of opportunity for undertaking the FS and securing finance for construction and commissioning in early –mid 2016.	The introduction of the PRT will encourage existing passengers to transfer from transporter vehicles currently serving the route. Unless these transporter vehicle drivers and owners are involved in the future services provided by the PRT, then this will have a negative impact on their finances. The reduction of transporter vehicles on the PRT corridor will result in reduced emissions and improved travel times for passengers and the private vehicles in the corridor.	No lasting adverse social impacts are anticipated on corridor 2. The alignment along the median (or elevated) will provide additional access rather than reduce access, as there will be reduced congestion along GT ROAD section and the intersections along the Jamrud Road to Hayatabad. In parts of the University Town section, kerbside parking will need to be reduced by providing off street parking plazas in addition to those existing. In Saddar, the narrow ROW and the presence of street vendors means social impacts will occur in this section.
If an early election is called and the current KPK Government changes, the preference for the project and/or the corridor/mode may alter. In this case, the overall future of the project and the 20 Year Roadmap cannot be guaranteed.	The complementary measures outlined in the PFS reports will provide opportunities for additional mobility and improved access to employment and commercial opportunities. The reduction in vehicle kilometers as a result of the PRT will result in reduced accident levels.	The PRT and complementary measures proposed will provide improved service standards through frequency and reliability; adequate seating for women; barrier free access to stations and buses. These benefits will be received by those who have few alternatives and are captive to the public transporters.
There is a committed mind-set within KPK Government to provide an PRT which represents value for money, minimal subsidy, is achievable and provides for the long term security and flexibility for travel across the city.	Finally, the PRT investment will create economic benefits through a cleaner environment through reduced air emissions and a more viable public transport system in the long term.	There will be improvements through reducing traffic emissions thereby leading to a cleaner environment and resulting in better respiratory health for those whose lives revolve around the corridor(s) of the proposed PRT.
Technological	Legal	Environmental
The PRT system will bring improvements in fleet conditions and overall capacity for preventive maintenance programs to reflect best practice. In addition, the introduction of supporting system wide components such as AFCS, RTPI, CCTV, security protocols and PRT Control Room will introduce a new era of technology improvements for the public transport sector in general.	There are no legal impediments for the KPK Government establishing a Peshawar Rapid Transit Board or Company to oversee implementation and manage the operations/contracts into the future. In addition, there are no known legal impediments for the passing of Province based traffic legislation specifically related to PRT priority.	At this PFS stage, and subject to there being a project reflecting the decision reached in the Steering Committee meeting of March 7, no significant adverse environment impacts from the PRT project have been identified. Improvements in urban transport will reduce vehicle emissions. In this instance, the PRT project could reduce the CO2 emissions of the transport sector by approximately 12,500 kgs annually or 250 tonnes over the 20 year assessment period.
New policies, planning, community engagement and project implementation ability will require an up-skilling and capacity enhancement of the KPK Government agency allocated responsible for the PRT.	New PRT priority compliance regime, operation and maintenance and monitoring of fleet and infrastructure will require additional technological skills. It may also require additional by-laws to be introduced.	The above observations are based on an at grade PRT option. If there is an appetite for elevated sections (in whole or in part), then the environmental (short and longer term) will need to be further assessed.

Table 8: Summary	PESTLE	Analysis of	the PRT	Project
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XVI Design and Monitoring Framework

A project design and monitoring framework has ben compiled to help with the preparation and implementation of the priority investment package. It is documented in Table 9 below.

						-	
	Design Summary		Performance Targets/Indicators	&	Data Sources Reporting Mechanisms	4	Assumptions and Risks
Imp	act						
•	Maintenance of public support for the public transport mode share with potential for increases. Improved conditions for existing and future passengers, especially women and students. Improved public rating of KPK Government institutions. Reduced emission levels.	•	Reduced congestion growth (below 2% increase year on year) in nominated corridor. Improved conditions for passengers as reported through feedback surveys. Improved capacity and effectiveness of KPK Governance through efforts of PRTC.	•	Classified traffic counts compared with baseline conditions. On board passenger satisfaction surveys compared with baseline PFS conditions. PRTC quarterly reports to Assembly and made public. PRTC Annual Reports and Website containing information. Social and public perception surveys.	Ass • Ris •	An informed Project Champion is created and has the support of ongoing and stable political. Adequate budget to deliver as per the PFS model. ks Lack of Political will fails to create a Political Champion to deliver the project. Declining security. Public rallies from existing transporters who feel threatened by the Project. Elections result in a change of Government
Out	come						or Government.
•	comeA fully functioningBRT system on thepriority corridor, basedon need and reflectingvalue for money.A BRT system whichis operating accordingto a sustainablebusiness model andwhich KPK.Government canmanage.Reduced vehicleemissions along thecorridor.Improved travelconditions for thosepublic passengerswho are disillusionedwith the currentservices.Dedicated seats forwomen on vehicles.	•	15% increase in public transport demand over baseline (driven by the BRT) – measured. 50% increase in public satisfaction in the corridor with the introduction of the BRT (measured from baseline conditions). Acceptance by transporters of BRT as a path for the future. At least 50% increase in support within first 3 months (measured from baseline conditions). The three Park and Ride sites developed with concessions and security conditions in place. Occupancy of 20%. Transporter restructuring complete as per FS.	•	Initial BRT impact reports from PRTC and authenticated by independent assessor. PRTC quarterly and annual reports and Web uploads. Improved passenger, social and environmental conditions as per documented monitoring reports. Peshawar community and media feedback reports – stratified by social and gender indicators.	Ass • • Ris •	sumptions The financing has proceeded according to TA recommendations. There has been a project Champion who has assured cooperation from a whole of Government perspective. Political stability during entire process. ks The KPK Govt. priorities change due to political, security or financial reasons. KPK Government or PRTC elects to vary the business model as recommended by TA. Poor contractual performance and management.
Out 1.1 Tran with reso fina actio PFS FS	put 1 A Peshawar Rapid nsit Company (PRTC) the mandate and purces (human and ncial) to proceed with ons as outlined in this 6 and to work with the to implement the	Ву 6 •	end Q 3 2014 PRTC enabling bylaws passed and key board member appointments made. Board member briefings (technical, operational and management), site visits to appreciate details	•	Briefings of Police on new regulations and public awareness program commenced. Reports by PRTC Board Members to Assembly dealing with technical and operational imperatives of the new BRT in the short	Ass •	sumptions PRTC is mandated, resourced and operational. PRTC Board members undertake relevant site visits and discussions/interaction with International Specialists to ensure a sound knowledge of relevant mass

Table 9: Design and Monitoring Framework for the PRT Investment Package

Design Summary	Performance Targets/Indicators	Data Sources & Reporting Mechanisms	Assumptions and Risks
project.	 of project components and to be able to make decisions based on sound technical and financial basis. Relevant BRT legislation drafted and before Assembly. PRTC Organogram agreed documented (i) staff skill sets required, (ii) job descriptions, (iii) remuneration levels, and (iv) mandatory tenure requirements. Positions advertised. 	 and longer term. Initial Annual BRT Budget prepared and approved. PRTC Quarterly Reports to Assembly according to an agreed format & content. When endorsed, information entered to PRTC website and in local Urdu newspaper. 	 rapid transit issues Finance Structure as per PFS approved by Chief Minister. Risks PRTC is not established in time or is not adequately mandated or resourced. Project finance structure as recommended is not followed. Inadequate support from stakeholders on project design elements.
Output 2 1.2 Standard designs for BRT stations, alignment and other PRT project components. Sample BRT Station constructed and placed on display for public comment and familiarisation whilst FS is being completed. Necessary traffic legislation put in place to (i) provide priority to BRT alignment (ii) to forbid non authorised vehicle access and (iii) to have chelans set as a deterrent for non compliance. BRT Manuals covering network design, operations, contracting and draft BRT Service Contracts as required.	 By end Q2 2015 Detailed designs for alignment components, stations and overhead walkways (rail or bus mode). Detailed design for BRT corridor priority at intersections (bus) or level crossings (rail). Complete functional specifications for AFCS and RTPI. Complete BRT security management plan and prepare operating manuals. Functional design for BRT Control Room. PRTC fully staffed and operational. MOU's signed with Government and transporter stakeholders to proceed with calling for tenders (if bus). Final tenders prepared for issue. Support of ADB TA with international expertise. RFPs prepared and issued to market. 	 Project feasibility reports on passenger demand, infrastructure costs. EIA Report prepared, submitted and approved. BRT Design, Operating and Security Manuals prepared and approved by PTRC and Police. Final Draft of service contracts approved. Final Draft of component supply and maintenance contracts approved. 	 Assumptions Recommended mode and corridor adopted. Recommended finance structure is followed. The PRTC has adequate capacity exists to comprehend and deliver the advice of the international experts under the FS TA. Adequate financial resources are provided and designs are not subject to shortcuts and compromise. Community engagement is successful and designs are realistic. Risks Interference (political) with design process compromises entire project. Security matters Inadequate resourcing of PRTC (human and capital). Inadequate community engagement.
Output 3 1.3 Financing, BRT project complete. Agreements reached with existing transporters regarding their ongoing involvement or exit from the sector in Peshawar. BRT operator companies	 By end Q1, 2015 Feasibility Study complete. Financing as per agreed Financial Structure agreed and complete. Public communication and awareness strategy developed and ready for implementation during 	 Project feasibility and appraisal reports complete and approved. PC1 and PC2 applications approved. BRT project budget approved. PRTC budget approved for next 3 years. 	 Assumptions Recommended financing structure followed. Community awareness program is effective in capturing additional community support. PC1 applications approved. Risks PRTC is not established in

Design Summary	Performance Targets/Indicators	& Reporting Mechanisms	Assumptions and Risks
formed, training for contract accreditation underway. Output 4 1.4 Construction complete, service contracts signed, training complete and	period up to and immediately after BRT commissioning. By end Q2 2015 BRT priority corridor ready for commissioning. BRT concessionaire (if	 Detailed designs & construction records. KPK Government project progress and completion 	 time or another model is inaugurated. Elections interrupt/cancel support for the project. Inadequate or effective community engagement. Assumption KPK Government demonstrates commitment to delivering the
demand/satisfaction surveys complete.	rail) or contractors (if bus) fully accredited and ready to commence in accordance with contract.	 Fully sponsored public relations and BRT operating courses for 	recommended BRT package according to the financial structure, approved designs and with sound
Trial commissioning services and traffic management underway to help with management of BRT when in active	 All baseline public assessments complete. 	aspiring drivers and staff complete.PRTC reports on community awareness	contract management principles <u>and</u> processes. Risks • Political or security factors
service. Documentation of operating manuals in conjunction with Control Room to provide effective BRT management regime.		 and education program results – including public awareness survey results. Baseline measurement reports. 	 Vested interests within Government sector (the competition factor) and community result in tensions and poor project outcomes.
Output 5 1.5 BRT commissioning complete for Corridor 2. Commencement of BRT services under approved contract conditions.	By end year 2016 sioning ridor 2. of BRT pproved ns. By end year 2016 • BRT operational within priority corridor and regular monitoring, contract management and reporting process in place. • BRT project monitoring a reports. • BRT operati passenger r PRTC webs Urdu media		 Assumption KPK Government approves and allocates adequate resources to the project and the PRTC. Security is not a specific issue for the project. Risks Failure of KPK Govt. to agree to a realistic option, allocate sufficient resources (financial and human) and demonstrate an ongoing commitment. Security issues overtake priorities.
Activities with Milestones			Inputs
 Establish a Project Chaproject as per the finan 2014. Submission to ADB for project preparation - by Prepare ToR for Feasite Secure TA funding for the secure the secure	 CDIA/ADB: \$ X million TA Consultants US\$XX FS Team US\$ Civil works: US\$ XX PRTC capacity building: US\$ Contingencies: US\$ XX 		
 Commence household passenger O/D surveys Create PRTC and apport PF team and TA institut operations, manageme Confirm choice of Mode Commence regular distance 	Government: \$ XX million PRTC staff: US\$XX Transport/Logistics: US\$XX Overheads: US\$XX Management: US\$XX Maintenance: US\$XX		

	Design Summary	Performance Targets/Indicators	Data Sources & Reporting Mechanisms		Assumptions and Risks
	by end Q4 2014.			•	Preliminary civil works for
10.	Complete detailed desi	igns of BRT station infrastructure	e by end Q1 2015		BRT demonstration station
11.	Complete detailed desi		and early works on		
	Q2 2015		alignment (for public		
12.	Complete functional de	I SCADA - by end Q2 2015.		confidence building).	
13.	Issue EOI for Infrastruc	cture, AFCS/RTPI, CCTV and S0	CADA components - by end		
	Q3 2015.				
14.	Continue PRTC capital	l building - ongoing			
15.	Select tenders and con	nmence construction of BRT infr	astructure by start of Q1 2016		
16.	Select tenders for AFC	S/RTPI, CCTV,SCADA by start	of Q2 2016.		
17.	Commission, manage a	and maintain the BRT project (a	ccording to the various		
	Manuals as developed	in line item 5 above) -by end 03	2016		

XVII. Conclusions

From the analysis undertaken during the PFS, being aware of the challenges faced by the KPK Government (financial and human capacity) and then applying best practice principles to the project, the following conclusions have been reached:

A. Government Commitment

There has been considerable political and executive good will towards this project from the very first day. This is essential and support through mechanisms such as the project steering committee has been excellent and demonstrate proper ownership. More effort is needed to strengthen capacity at a technical/operational management level. Areas for improvement include operational cooperation and coordination, and an ability to have proactive and transparent consultations with the existing transporters (bus industry, operators or smaller vehicles, etc). A whole of government appreciation of the need to make decisions based on sound technical reasons will be required for the project to be a financial and operational success. Finally, continued political and executive support is essential for the next phase.

B. PRT Demand

The current qualitative and quantitative demand for a PRT is good. A small household survey to assess 'willingness to pay' found that customers and consumers were prepared to pay more if a better service existed. Similarly, screenline counts along key points in corridor 2 found 393,700 trips are made using different public transport modes per day. Based on the professional view of the PFS team, and as has been documented earlier, 50-60% of this demand may be captured by the PRT in the short to medium term. This translates to a maximum demand per hour per direction of between 8,300 and 12,500 passengers. The results of travel demand surveys have been reviewed and the findings validated. These observations were noted and the authors of this study accept that the scale used for the study was limited. However, this was deemed sufficient since this was pre-feasibility work and not detailed feasibility assessment. This data on demand level gives an order of magnitude and its veracity can be confirmed by feasibility work.

C. Corridor Analysis

Corridor 2 has a total daily travel demand more than double that of any other of the corridors. It has a substantial market share with up to 77% travelling by public transport. As mass transit (by definition) requires mass demand, Corridor 2 is the corridor which best meets this criterion. When demand on Corridor 2 rises to a level where additional capacity may be required this can be provided through an upgraded operational plan and the introduction of PRT on Corridor 2A section and ultimately the introduction of Corridor 1 from Chamkani to Cantt Station. The timing

of such initiatives can only be determined when there is a historical record of demand trends. This can be compiled during the first 1-3 years of Corridor 2 operation and appropriate decisions taken then. This will be an important task for the Mass Transit Unit of the Department of Transport (TMTD) going forward.

Other corridors also show the potential in meeting the mobility needs of Peshawar. From a demand and market perspective, Corridor 3 (Warsak-Kohat Roads), with a combined daily public transport demand of nearly 260,000 trips and a market share of 74% is also suitable. On the basis of demand being a prime criterion²⁰ for priority rankings, this corridor would be next in the roll out of the medium to long-term approach. Corridor 4 (Charsadda-Bara roads) implementation could then follow as (based on the conclusions reached during the PFS), this corridor has the next highest demand for public transport. When the demand profile for Corridor 5 is known, the specific investment and timing can be considered further.

By this time, human capacity within the PRT Company and TMTD will be at a level where informed decision-making, based on sound technical evidence can be made. Moreover, by that time, direct access via Corridor 2A between GT Road and Jamrud Road may have been reached to better service the substantial demand²¹ between the GT Road section in the east and University Town/Hayatabad in the west. If this is the case, then it will ensure a more efficient movement of demand along Corridor 2 as well as a more effective integration of Corridor 3 for full flex services to University Town and beyond. The need for additional capacity support from Corridor 1 may then reduce. Only time and reliable data can confirm this.

In addition, by this time a suitable commercial arrangement may have been reached with the Ministry of Railways and Pakistan Railways on the issue of track access from Chamkani to Cantt Station. Should there be a demonstrated demand for additional Corridor 1 or 6 support to University Town and Hayatabad, the task of preparing a suitable corridor alignment can then commence. This task could potentially be as simple as implementing recommendations provided in the upcoming Corridor 1 Feasibility Study soon to be commissioned by the KP Board of Investment and Trade.

D. PRT Mode

A final political decision on the PRT mode is yet to be made by the Government of KPK. Some voices inside the project steering committee have called for more detailed feasibility work to be concluded before a mode can be selected. Others have lamented the need to balance what provincial and city government can afford to pay for before such a decision is made. In the final weeks leading up to the conclusion of this study BRT has emerged as the front-runner for a PRT within representatives of the executive arm of government.

E. Financial and Economic Considerations

The financial costs and economic benefits for both BRT and LRT on corridor 2 have been assessed at a PFS level. The findings reveal that over all implementation of a BRT System would be much less costly than an LRT in Peshawar. In the case of the BRT, three scenarios are envisaged - at street level; partially elevated and elevated. The costs for each of these are respectively; US\$109.6 million; US\$169.6 million and US\$487.5 million. For the LRT system in the same scenarios the costs are respectively US\$1,235 billion, US\$1.335 billion and US\$1,885 billion. The cost of running a BRT on Corridor 6 is approximately US\$ 238.5 million. The BRT is considered economically viable at this stage while the LRT is not²².

²⁰ Social issues would need to be taken into account in this matter. However, from the observations made during this PFS, the presence of demand is directly related to the social needs of the corridors being served.

²¹ Anecdotal advice from local stakeholders suggests this could be 30-40% of total Corridor 2 demand.

²² Current advice from the Ministry of Railways is that a BRT will NOT be permitted to operate on Corridor 6.

F. Transport Institutions

Improvements are needed to the current institutional management of the transport sector in Peshawar. Investment in organisational, technical and management will be necessary if a sophisticated PRT system is to be delivered. The KPK government needs to replenish human resources in key strategic departments. For the duration of this PFS the Urban Policy Unit, within the Planning and Development Department has been a de facto project management unit for the PRT. This is an insufficient arrangement.

A public Authority should be set up to plan, coordinate and regulate Peshawar's urban transport system, and an independent PRT company should be established with the correct mix of skills to implement and manage a modern PRT system. It should be independent of but accountable to KPK Government through the public Authority, from a financial, operational and Urban Transport Roadmap policy compliance perspective. This will create the investor confidence required to fund the project.

XVIII Recommendations

A. Priority Corridor

In the context of demand for mass transit, Corridor 2 has been found to have a total travel demand of nearly 510,000 passenger trips of which 393,700 are made by public transport. This is more than double that of any other of the corridors surveyed. Moreover, it has a substantial market share with up to 77% travelling by public transport. As mass transit, by definition requires mass demand, Corridor 2 is therefore recommended as the priority corridor for implementing a Peshawar Rapid Transit (PRT).

B. PRT Mode

The PFS has recognised a large number of transporters currently plying routes along key corridors. While a number of these are operating without the necessary permits, they respond to market demand in a disorganized, competitive, and overall inefficient manner. Indeed passengers complain about crowded conditions and inadequate services during the rush period. National and international experience shows the dangers of sidelining existing transporters. This must be avoided and any PRT system must work with and benefit existing service providers.

Contemporary practices recognise the need to ensure flexibility of services in a network so that a range of trip origins and destinations between corridors are capable of being served in a seamless manner. This is the essence of the full flex system. For Peshawar, where a number of corridors pass through Saddar, and the commercial/service land use pattern along Corridor 2 frontage is extensive, the demand for cross corridor travel is considered to be both real and significant. The mode best placed to provide direct inter-corridor services, is clearly BRT.

The cost of the mode both from a capital and operating perspective is a most relevant issue for the KPK Government where future budgetary limitations are being anticipated. A PRT which is (taking into account all other factors) affordable and which requires no/minimal annual subsidy must be considered as the priority option. For the options of rail (elevated and underground) or BRT (elevated or at grade), considered in this PFS, the BRT is the obvious choice.

In summary, a mode which (i) is capable of accommodating existing transporters, (ii) is capable of meeting demand in the short and medium (20 years), (iii) is able to offer flexible service patterns and routes will be most valued by the existing public transport passenger market, (iv) is within the financial resources of the KPK Government to fund and maintain and, (v) is able to be guaranteed a reliable power source - is simply the logical choice..

Taking these factors into account, the BRT mode is the most practical and is therefore recommended.

XIX Next Steps: Feasibility Study

This PFS phase of project development has now closed. It has provided the necessary system concept and associated technical analysis to confirm that a PRT Project serving Corridor 2 with a BRT is the logical initial investment within the 20 Year Urban Transport Roadmap. The timing of investments for the five corridors to develop the PRT for the city is shown in Figure 11. The program recognizes the current limited capacity of the KPK Government and suggests that in order to best guarantee success in the initial investment, the focus should be on implementing Corridor 2. Only when that has been implemented and the KPK Government has the capacity to embark on the second priority should this be attempted. At this point in time, it is considered that Corridor 3 or a complemented. However, such a decision should be made when the results of Corridor 2 implementation are known.

Figure 11:	Implementation	timetable
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Corridor - Assessment, Design, Implementation			Year																	
(based on sound technical advice)		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Corridor 2																				
Second priority corridor with associated investments																				
Third priority corridor with associated investments																				
Fourth priority corridor with associated investments																				
Fifth priority corridor with associated investments																				

The conclusions reached to date, while logical and relevant at the PFS level, require further analysis to confirm specific demand levels and profiles, calculate operating costs and revenues, prepare alignment and station design, document a range of operational matters and to prepare a system reference design. A number of these issues have been raised by stakeholders during the PFS process and (for the record) these comments are contained in the Final Report, Volume 2, Appendix 10. As has been acknowledged in these comments and in this report, to address many of these issues and to further prepare the project for investment, a Feasibility Study (FS) is required.

The estimated cost of a Feasibility Study is US\$ 2,000,460 million. Table 10 provides the details.

			Cost Esti	mate	
Feasibility Study - Peshawar Mass Rapid Transit	No.	Unit	Unit Cost US\$	Amount US\$	Total US\$
International Remuneration					\$ 667,000
Team leader, Mass Transit Specialist - Planner/Engineer	7	month	22,000	154000	
Civil/Structural Engineer	1	month	18,000	18000	
Transport Engineer	5	month	18,000	90000	
Traffic Signals Engineer	3	month	18,000	54000	
Architect	1.5	month	18,000	27000	
Travel Demand Modeller	3	month	18,000	54000	
Traffic Modeller	2	month	18,000	36000	
ITS Communcations Engineer	3	month	18,000	54000	
Financial & Economic Specialist	2.5	month	18,000	45000	
Environmental Specialist	2.5	month	18,000	45000	
Social Specialist	2.5	month	18,000	45000	
Public Transport Contracts Specialist	2.5	month	18,000	45000	
National Remuneration					\$ 632,000
Deputy Team Leader, Design Engineer	8	month	8,000	64000	
Cost Engineer	2.5	month	6,000	15000	
Traffic Signals Engineer	5	month	6,000	30000	
Architect	4	month	6,000	24000	
Travel Demand Modeller	4.5	month	6,000	27000	
Traffic Modeller	3	month	6,000	18000	
ITS Communications Engineer	4	month	6,000	24000	
Civil Design Engineer - structures	1.5	month	6,000	9000	
Quantity Surveyor	4.5	month	6,000	27000	
Institutional Specialist	8	month	6,000	48000	
Financial & Economic Specialist	5	month	6,000	30000	
Social/Resettlement/Gender Specialist	7	month	6,000	42000	
Environmental Specialist	3	month	6,000	18000	
Drafter	7	month	6,000	42000	
Travel Demand Surveys	1	unit	80,000	80000	
Social Surveys and LARP preparations	1	unit	25,000	25000	
Survey (land) - team of 3 for 3 months for ROW survey	1	unit	45,000	45000	
Project Office Administration/Documentation Person Support No.1	8	month	4,000	32000	
Project Office Administration/Documentation Person Support No.2	8	month	4,000	32000	
Project Expenses (Assumed @40% remuneration costs)					\$ 519,600
Contingency (10% of remuneration and project expenses costs)					\$ 181,860
Total Cost of Feasibility Study					\$2,000,460

Table 10: Feasibility Study Cost Estimate

In addition, and as part of the task of developing an adequate human capital within the KPK Government and the Peshawar Rapid Transit Company (PRTC) or equivalent special purpose vehicle, a separate specialist team would need to work with Government in parallel to advise, guide and ensure the necessary skills are developed as the FS is being undertaken. The estimated cost of this Technical Assistance is US\$979,440. Table 11 provides the details.

Peshawar Rapid Transit Company	Cost Estimate								
Human Capacity Development	No.	Unit	Unit Cost US\$	Amount US\$	Total US\$				
International Remuneration					\$	348,000			
Team Leader, Mass Transit Specialist	6	month	22,000	132000					
Public Transport Contracts Specialist	2.5	month	18,000	45000					
Institutional/Train the Trainer	4	month	18,000	72000					
Financial Management Specialist	3	month	18,000	54000					
Transit Opertions Specialist (rail <u>or</u> bus - but not both)	1	month	18,000	18000					
Transit Secirity Specialist	1.5	month	18,000	27000					
National Remuneration					\$	288,000			
Deputy Team Leader, Institutional/Train the Trainer	8	month	8,000	64000					
Institutional - Training Specialist	8	month	8,000	64000					
Social/Public Engagement Training Specialist	8	month	6,000	48000					
Legals/Contracts Specialist	4	month	6,000	24000					
Financial/ Accounts/Audit Specialist	4	month	6,000	24000					
Security Specialist/Trainer	6	month	6,000	36000					
Project Office Administration Support/Documentation Person No.3	7	month	4,000	28000					
Project Expenses (Assumed @40% remuneration costs)					\$	254,400			
Contingency (10% of remuneration and project expenses costs)					\$	89,040			
Total Cost of Human Capacity Development					\$	979,440			

Table 11: Huma	n Capacity	Development	Cost Estimate

Annex 1: Breakdown of CAPEX Costs – PRT Corridor 2

Corridor 2 : BRT - street level median alignment- Chamkani Terminus to KarkhanoTerminus (via Sadar)											
ITEM	UNIT	QUANTITY	Rate Rs	COST (Rs)	Cost (US \$)	Source of Rate					
Chamkani to Ringroad											
Road Repair	lane m	2,500	2,549	6,372,500	60,118	PHA/CWD KPK					
Road Widening	lane m	2,000	6,649	13,298,000	125,453	PHA/CWD KPK					
Relocation (encroachment)	unit	0	75,000	-	-	Local Market					
Median installation	m	1,000	1,270	1,270,000	11,981	PHA/CWD KPK					
Median lane separator	m	0		-	-	PHA/CWD KPK					
Intersection upgrade	unit	4.5	95,000,000	427,500,000	4,033,019	TEPA LDA					
Kerbside rehabilition	m	1000	885	885,000	8,349	PHA/CWD KPK					
Traffic/BRT separator	m	2,150	592	1,272,800	12,008	PHA/CWD KPK					
BRT lane marking	m	12,500	62	775,000	7,311	PHA/CWD KPK					
Traffic Signage	unit	40	11,413	456,520	4,307	PHA/CWD KPK					
BRT Priority Signals	unit	3.5	5,200,000	18,200,000	171,698	TEPA LDA					
BRT Stations	unit	3	34,495,500	103,486,500	976,288	TEPA LDA					
Footpath upgrade	m	2150	2540	5,461,000	51,519	PHA/CWD KPK					
Lighting	km	2.5	8,500,000	21,250,000	200,472	TEPA LDA					
Pedestrian crossing (at grade)	unit	6	1,550,000	9,300,000	87,736	PDA KPK					
Pedestrian crossing (U grade)	unit	0	63,840,000	-	-	PDA KPK					
Pedestrian crossing (O grade)	unit	0	37,855,000	-	-	PDA KPK					
Sub Total				609,527,320	5,750,258						
Ringroad to Sunehiri Mesjid R	oad										
Road Repair	lane m	5400	2,549	13,764,600	129,855	PHA/CWD KPK					
Road Widening	lane m	8,000	6,649	53,192,000	501,811	PHA/CWD KPK					
Relocation (encroachment)	unit	0	75 000	55,192,000 501,011							
Median installation		0	75,000	-	-	Local Market					
	m	800	1,270	- 1,016,000	- 9,585	Local Market PHA/CWD KPK					
Median lane separator	m m	800	1,270	- 1,016,000 -	- 9,585 -	Local Market PHA/CWD KPK PHA/CWD KPK					
Median lane separator Intersection upgrade	m m unit	800 0 5	95,000,000	- 1,016,000 - 475,000,000	- 9,585 - 4,481,132	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA					
Median lane separator Intersection upgrade Kerbside rehabilition	m m unit m	800 0 5 1000	95,000,000 885	- 1,016,000 - 475,000,000 885,000	- 9,585 - 4,481,132 8,349	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator	m m unit m	800 0 5 1000 1734	95,000,000 885 592	- 1,016,000 - 475,000,000 885,000 1,026,528	- 9,585 - 4,481,132 8,349 9,684	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking	m m unit m m	800 0 5 1000 1734 96000	95,000,000 95,000,000 885 592 62	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000	- 9,585 - 4,481,132 8,349 9,684 56,151	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage	m m unit m m unit	800 0 5 1000 1734 96000 90	75,000 1,270 95,000,000 885 592 62 11,413	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals	m m unit m m m unit unit	800 0 5 1000 1734 96000 90 4	1,270 95,000,000 885 592 62 11,413 5,200,000	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals BRT Stations	m m unit m m unit unit unit unit	800 0 5 1000 1734 96000 90 4 11	1,270 95,000,000 885 592 62 11,413 5,200,000 34,495,500	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000 379,450,500	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226 3,579,722	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA TEPA LDA					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals BRT Stations Footpath upgrade	m m unit m m m unit unit unit unit m	800 800 0 5 1000 1734 96000 90 90 4 11 2,000	75,000 1,270 95,000,000 885 592 62 11,413 5,200,000 34,495,500 2540	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000 379,450,500 5,080,000	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226 3,579,722 47,925	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA TEPA LDA PHA/CWD KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals BRT Stations Footpath upgrade Lighting	m m unit m m m unit unit unit unit km	800 800 0 5 1000 1734 96000 90 90 4 4 11 2,000 5	1,270 95,000,000 885 592 62 11,413 5,200,000 34,495,500 2540 8,500,000	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000 379,450,500 5,080,000 42,500,000	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226 3,579,722 47,925 400,943	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA TEPA LDA PHA/CWD KPK TEPA LDA					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals BRT Stations Footpath upgrade Lighting Pedestrian crossing (at grade)	m m unit m m unit unit unit unit km km	800 800 0 5 1000 1734 96000 90 4 11 2,000 5 13	1,270 95,000,000 885 592 62 11,413 5,200,000 34,495,500 2540 8,500,000 1,550,000	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000 379,450,500 5,080,000 42,500,000	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226 3,579,722 47,925 400,943 190,094	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA TEPA LDA PHA/CWD KPK TEPA LDA PHA/CWD KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals BRT Stations Footpath upgrade Lighting Pedestrian crossing (at grade) Pedestrian crossing (U grade)	m m unit m unit unit unit unit km km unit unit unit	800 800 0 5 1000 1734 96000 90 4 11 2,000 5 13 0	1,270 95,000,000 885 592 62 11,413 5,200,000 34,495,500 2540 8,500,000 1,550,000 63,840,000	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000 379,450,500 5,080,000 42,500,000 20,150,000 -	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226 3,579,722 47,925 400,943 190,094 -	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA TEPA LDA PHA/CWD KPK TEPA LDA PDA KPK PDA KPK					
Median lane separator Intersection upgrade Kerbside rehabilition Traffic/BRT separator BRT lane marking Traffic Signage BRT Priority Signals BRT Stations Footpath upgrade Lighting Pedestrian crossing (at grade) Pedestrian crossing (O grade)	m m unit m m unit unit unit unit km unit unit unit unit	800 800 0 5 1000 1734 96000 90 4 111 2,000 5 13 0 0	1,270 1,270 95,000,000 885 592 62 11,413 5,200,000 34,495,500 2540 8,500,000 1,550,000 63,840,000 37,855,000	- 1,016,000 - 475,000,000 885,000 1,026,528 5,952,000 1,027,170 20,800,000 379,450,500 5,080,000 42,500,000 20,150,000 - -	- 9,585 - 4,481,132 8,349 9,684 56,151 9,690 196,226 3,579,722 47,925 400,943 190,094 - -	Local Market PHA/CWD KPK PHA/CWD KPK TEPA LDA PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK PHA/CWD KPK TEPA LDA TEPA LDA PHA/CWD KPK TEPA LDA PDA KPK PDA KPK					

Sunehiri Mesjid Road to Jamrud Road						
Road Repair	lane m	2,500	2,549	6,372,500	60,117.92	PHA/CWD KPK
Road Widening	lane m	4,500	6,649	29,920,500	282,268.87	PHA/CWD KPK
Relocation (encroachment)	unit	25	75,000	1,875,000	17,688.68	Local Market
Median installation	m	1,500	1,270	1,905,000	17,971.70	PHA/CWD KPK
Median lane separator	m			-	-	PHA/CWD KPK
Intersection upgrade	unit	8.5	95,000,000	807,500,000	7,617,924.53	TEPA LDA
Kerbside rehabilition	m	2,500	885	2,212,500	20,872.64	PHA/CWD KPK
Traffic/BRT separator	m	10,500	592	6,216,000	58,641.51	PHA/CWD KPK
BRT lane marking	m	43,000	62	2,666,000	25,150.94	PHA/CWD KPK
Traffic Signage	unit	55	11,413	627,715	5,921.84	PHA/CWD KPK
BRT Priority Signals	unit	8.5	5,200,000	44,200,000	416,981.13	TEPA LDA
BRT Stations	unit	7	34,495,500	241,468,500	2,278,004.72	TEPA LDA
Footpath upgrade	m	11,500	2540	29,210,000	275,566.04	PHA/CWD KPK
Lighting	km	6.5	8,500,000	55,250,000	521,226.42	TEPA LDA
Pedestrian crossing (at grade)	unit	12	1,550,000	18,600,000	175,471.70	PDA KPK
Pedestrian crossing (U grade)	unit	0	63,840,000	-	-	PDA KPK
Pedestrian crossing (O grade)	unit	0	37,855,000	-	-	PDA KPK
Sub Total	1			1,248,023,715	11,773,809	
Jamrud Road to Hayatabad	1					
Road Repair	lane m	8.500	2,549	21.666.500	204.401	PHA/CWD KPK
Road Widening	lane m	8.500	6,649	56.516.500	533.175	PHA/CWD KPK
Relocation (encroachment)	unit	53	75,000	3,975,000	37,500	Local Market
Median installation	m	6.000	1,270	7.620.000	71.887	PHA/CWD KPK
Median lane separator	m	0		-	-	PHA/CWD KPK
Intersection upgrade	unit	8	95,000,000	760,000,000	7,169,811	TEPA LDA
Kerbside rehabilition	m	7,000	885	6,195,000	58,443	PHA/CWD KPK
Traffic/BRT separator	m	24,500	592	14,504,000	136,830	PHA/CWD KPK
BRT lane marking	m	144,000	62	8,928,000	84,226	PHA/CWD KPK
Traffic Signage	unit	150	11,413	1,711,950	16,150	PHA/CWD KPK
BRT Priority Signals	unit	8	5,200,000	41,600,000	392,453	TEPA LDA
BRT Stations	unit	18	34,495,500	620,919,000	5,857,726	TEPA LDA
Footpath upgrade	m	14,000	2540	35,560,000	335,472	PHA/CWD KPK
Lighting	km	24	8,500,000	204,000,000	1,924,528	TEPA LDA
Pedestrian crossing (at grade)	unit	16	1,550,000	24,800,000	233,962	PDA KPK
Pedestrian crossing (U grade)	unit	0	63,840,000	-	-	PDA KPK
Pedestrian crossing (O grade)	unit	0	37,855,000	-	-	PDA KPK
Sub Total				1,807,995,950	17,056,566	
Land Acquisition and Resettlement	Refer to Volu	me 2, Appendix	8 for full details	470,000,000	4,500,000	Local Market
System Wide Items						
Fleet		75	16,500,000	1,237,500,000	11,674,528	BRT Islamabad
BRT Control Centre		1	285,000,000	285,000,000	2,688,679	Metro Bus Lahore
CCTV and Security		1	769,285,668	769,285,668	7,257,412	BRT Islamabad
Ticketing		1	594,020,000	594,020,000	5,603,962	M/S Tyco Lahore
Mainteannce Depot		1	825,000,000	825,000,000	000,000 7,783,019 Metro Bus La	
Other		1	759,252,000	867,252,000	8,181,623	BRTs Islamabad/ Lahore
Sub Total	ı 			4,578,057,668	43,189,223	
TOTAL CAPITAL COST CORRIDO	OR 2			9,733,448,451	91,891,023	
Contingencies				1,881,869,790	17,687,451	
G.TOTAL CAPITAL COST CORRI	DOR 2			11.615.318.241	109,578,474	

ANNEX 2: Breakdown of CAPEX Costs – Corridor 6

Corridor "6" : BRT - Chamkani Terminus to Hayatabad Terminus (via rail corridor around the airport) - Length 26.2 km							
ITEM	UNIT	QUANTITY	Rate Rs	COST (Rs)	Cost (US \$)	Source	Comment/Description
Chamkani to Cantt Station (length 10.635Km)							
Road Construction (asphalt)	lane km	21.27	15,000,000	319,050,000	3,009,906	ADB	Assume 3.5 metres wide each direction. Includes all base material.
Stopping Lane (Concrete)	lane km	4.65	18,000,000	83,700,000	789,623	ADB	Allowance of 150 lane metres per platform. Lane width - 3 metres
Road Bridge underpass widening	lane m	264	20,000	5,280,000	49,811	PFS Consultant	Three underpasses of overhead 4 lane bridges required .
Road culvert - nullah (small)	lane m	187	18,000	3,371,400	31,806	PFS Consultant	Allows for a box culvert and associated works - 2 directions.
Road bridge -over GT Road	lane m	202	1,000,000	202,000,000	1,905,660	ADB	Allows for two directions.
Road section - walled (oppositeFort)	lane m	2,200	500,000	1,100,000,000	10,377,358	PFS Consultant	Due to the elevated alignment, will require retaiing walls - 2 way
Road access to and from Station	lane m	4,650	30,000	139,500,000	1,316,038	ADB	Assume an average of 75 metres per station platform - 2 lanes.
Intersection upgrade	unit	2	95,000,000	190,000,000	1,792,453	TEPA LDA	Fomal intersection arrangement at City Station for freight.
Corridor side rehabilition (for ped access)	m	630	2,540	1,600,200	15,096	PHA/CWD KPK	Ped access along alignment - addition to footpath access to station.
Pedestrian underpass across corridor	unit	42	63,840,000	2,681,280,000	25,295,094	PDA KPK	Reduce impact of high freq BRT, allocate add upass every 250m
Pedestrian/BRT alignment separator	m	21,070	13,959	294,116,130	2,774,680	PHA/CWD KPK	Barrier fencing (1.5 metres tall with concrete footings)
BRT lane marking	m	300	62	18,600	175	PHA/CWD KPK	Provide markings for 50 metres at each road crossing.
Traffic Signage	unit	24	11,413	273,912	2,584	PHA/CWD KPK	Signage at approach to each road crossing (both directions)
BRT Priority Signals - road crossing	unit	6	5,200,000	31,200,000	294,340	TEPA LDA	Includes signal and boom gate arrangement.
BRT Stations (ie platforms)	unit	31	34,495,500	1,069,360,500	10,088,307	TEPA LDA	Two platforms of 75 metres each per station.
Elevated 3 metre wide pedestrian pathway	unit	3	25,000,000	75,000,000	707,547	CDA	Walkway to Secretariat and across City & Cantt Station rail tracks
Footpath upgrade	m	6200	11,500	71,300,000	672,642	PHA/CWD KPK	Includes 100 metres in each direction per station platform
Lighting	km	21.27	8,500,000	180,795,000	1,705,613	TEPA LDA	Includes lighting as per normal roadway.
Pedestrian crossing (at grade)	unit	26	1,550,000	40,300,000	380,189	PDA KPK	Includes pavement marking, walk signals and safety signage.
Pedestrian crossing (O grade)	unit	3	63,840,000	191,520,000	1,806,792	PDA KPK	Incorporates walkovers for City & Cant Station & to Secretariat
Sub Total				6,679,665,742	63,015,715	5,925,314	Summary Section Capital US\$ Cost per km

Cantt Station to Airport Boundary (leng	th 3.598 km)						
Road Construction (asphalt)	lane km	7.20	15,000,000	108,000,000	1,018,868	ADB	Assume 3.5 metres wide each direction. Includes all base material.
Stopping Lane (Concrete)	lane km	1.20	18,000,000	21,600,000	203,774	ADB	Allowance of 150 lane metres per platform. Lane width - 3 metres
Road Bridge underpass widening	m	34.50	2,000,000	69,000,000	650,943	ADB	Indequate space for BRT lanes under Amanullah Road bridge.
Road access to and from Station	lane m	1,200	30,000	36,000,000	339,623	ADB	Assume an average of 75 metres per station platform - 2 lanes.
Intersection upgrade	unit	2	95,000,000	190,000,000	1,792,453	TEPA LDA	Fomal intersection arrangements at Cantt Station for freight.
Corridor side rehabilition (for ped access)	m	4596	2,540	11,673,840	110,131	PHA/CWD KPK	Ped access along alignment - addition to footpath access to station.
Pedestrian underpass across corridor	unit	14	63,840,000	893,760,000	8,431,698	PDA KPK	Reduce impact of high freq BRT, allocate add upass every 250m
Pedestrian/BRT alignment separator	unit	6,996	13,959	97,657,164	921,294	LHR BRT Team	Barrier fencing (1.5 metres tall with concrete footings)
BRT lane marking	m	200	62	12,400	117	PHA/CWD KPK	Provide markings for 50 metres at each road crossing.
Traffic Signage	unit	16	11,413	182,608	1,723	PHA/CWD KPK	Signage at approach to each road crossing (both directions)
BRT Priority Signals - road crossing	unit	4	5,200,000	20,800,000	196,226	TEPA LDA	Includes signal and boom gate arrangement.
BRT Stations (platforms)	unit	8	34,495,500	275,964,000	2,603,434	TEPA LDA	Two platforms of 75 metres each per station.
Elevated 3 metre wide pedestrian pathway	unit	1	25,000,000	25,000,000	235,849	CDA	To Stadium to serve pedestrian demand for future games at Stadium
Footpath upgrade	m	1600	11,500	18,400,000	173,585	PHA/CWD KPK	Includes 100 metres in each direction per station platform
Lighting	km	7.196	8,500,000	61,166,000	577,038	TEPA LDA	Includes lighting as per normal roadway.
Pedestrian crossing (at grade)	unit	12	1,550,000	18,600,000	175,472	PDA KPK	Includes pavement marking, walk signals and safety signage.
Pedestrian crossing (O grade)	unit	1	37,855,000	37,855,000	357,123	PDA KPK	
Sub Total				1,885,671,012	17,789,349	4,944,233	Summary Section Capital US\$ Cost per km

Inside Airport Boundary (length 1.513)							
Road Construction (asphalt)	lane km	3.26	15,000,000	48,900,000	461,321	ADB	Assume 3.5 metres wide each direction. Includes all base material.
Road Construction (asphalt)	lane km	0.66	15,000,000	9,825,000	92,689	ADB	Duplicate road to replace existing - assume asphalt
Stopping Lane (Concrete0	lane km	0.15	18,000,000	2,700,000	25,472	ADB	Allowance of 150 lane metres per platform. Lane width - 3 metres
Road access to and from Station	lane m	150	30,000	4,500,000	42,453	ADB	Assume an average of 75 metres per station platform - 2 lanes.
Road crossing upgrade	unit	1	47,500,000	47,500,000	448,113	PFS Consultant	Assumed 50% of street intersection upgrade - due to simple works.
Corridor side rehabilition (for ped access)	m	2,826	2,540	7,178,040	67,717	PHA/CWD KPK	Ped access along alignment - addition to footpath access to station.
Pedestrian underpass across corridor	unt	0					Not required as all inside Airport land and only one station.
Pedestrian/BRT alignment separator	m	0	13,959				Nil barrier fence requred as all is within Airport boundary.
BRT lane marking	m	50	43,000	2,150,000	20,283	PHA/CWD KPK	Provide markings for 50 metres at each road crossing.
Traffic Signage	unit	4	11,413	45,652	431	PHA/CWD KPK	Signage at approach to each road crossing (both directions)
BRT Priority Signals - road crossing	unit	2	5,200,000	10,400,000	98,113	TEPA LDA	Includes signal and boom gate arrangement.
BRT Stations (platforms)	unit	1	34,495,500	34,495,500	325,429	TEPA LDA	Two platforms of 75 metres each per station.
Footpath upgrade	m	200	11,500	2,300,000	21,698	PHA/CWD KPK	Includes 100 metres in each direction per station platform
Lighting	km	3.26	8,500,000	27,710,000	261,415	TEPA LDA	Includes lighting as per normal roadway.
Pedestrian crossing (at grade)	unit	1	1,550,000	1,550,000	14,623	PDA KPK	Includes pavement marking, walk signals and safety signage.
Sub Total			145,357,912	199,254,192	1,879,756.53	1,242,404	Summary Section Capital US\$ Cost per km

Airport Boundary to Karkharno (length 10.44 km)							
Road Construction (asphalt)	lane km	10.44	15,000,000	156,600,000	1,477,358	ADB	Assume 3.5 metres wide each direction. Includes all base material.
Road Construction (Concrete)	lane km	3.15	18,000,000	56,700,000	534,906	ADB	
Stopping Lane (Concrete0	lane km	3.15	18,000,000	56,700,000	534,906	ADB	Allowance of 150 lane metres per platform. Lane width - 3 metres
Road Bridge -nullah	lane m	776	1,000,000	776,000,000	7,320,755	ADB	
Road culvert - nullah (small)	lane m	42	18,000	756,000	7,132	PFS Consultant	Assumed 50% of street intersection upgrade - due to simple works.
Road access to and from Station	lane m	3,150	30,000	94,500,000	891,509	ADB	Assume an average of 75 metres per station platform - 2 lanes.
Corridor side rehabilition (for ped access)	m	16,680	2,540	42,367,200	399,691	PHA/CWD KPK	Ped access along alignment - addition to footpath access to station.
Pedestrian underpass across corridor	unit	41	63,840,000	2,617,440,000	24,692,830	PDA KPK	Reduce impact of high freq BRT, allocate add upass every 250m
Pedestrian/BRT alignment separator	m	20,880	13,959	291,463,920	2,749,660	PHA/CWD KPK	Barrier fencing (1.5 metres tall with concrete footings)
BRT lane marking	m	550	43,000	23,650,000	223,113	PHA/CWD KPK	Provide markings for 50 metres at each road crossing.
Traffic Signage	unit	44	11,413	502,172	4,737	PHA/CWD KPK	Signage at approach to each road crossing (both directions)
Road Crossing Upgrade	unit	13	47,500,000	617,500,000	5,825,472	PFS Consultant	Assumed 50% of street intersection upgrade - due to simple works.
BRT Priority Signals - road crossing	unit	11	5,200,000	57,200,000	539,623	TEPA LDA	Includes signal and boom gate arrangement.
BRT Stations (platforms)	unit	21	8,500,000	178,500,000	1,683,962	TEPA LDA	Two platforms of 75 metres each per station.
Footpath upgrade	unit	4200	11,500	48,300,000	455,660	PHA/CWD KPK	Includes 100 metres in each direction per station platform
Lighting	km	20,880	8,500	177,480,000	1,674,340	TEPA LDA	Includes lighting as per normal roadway.
Pedestrian crossing (at grade)	unit	29	1,550,000	44,950,000	424,057	PDA KPK	Includes pavement marking, walk signals and safety signage.
Sub Total			178,728,912	5,240,609,292	49,439,710.30	4,735,604	Summary Section Capital US\$Cost per km
System Wide Items							
Fleet	unit	59	16,500,000	973,500,000	9,183,962	Metrobus Lahore	Fleet size based on 60% share of current PT market in Corridor 2
BRT Control Centre	unit	1	285,000,000	285,000,000	2,688,679	Metrobus Lahore	
CCTV and Security	unit	1	769,285,668	769,285,668	7,257,412	BRT Islamabad	
Ticketing	unit	1	594,020,000	594,020,000	5,603,962	M/S Tyco Lahore	
Mainteannce Depot	unit	1	825,000,000	825,000,000	7,783,019	Metrobus Lahore	
Other	unit	1	759,252,000	867,252,000	8,181,623	BRT Islamabad/La	hore
Resettlement and Rehabilitation	unit	1	1,128,890,000	1,128,890,000.00	10,649,906	PFS Consultant	Refer to Final Report for details
Sub Total				5,442,947,668	51,348,563		
TOTAL CAPITAL COST CORRIDOR 6				19,448,147,906	183,473,093		
Contingencies				5,834,444,371.80	55,041,928		Contingency of 30% and excludes PAK Railway & Airport access fee
G.TOTAL CAPITAL COST CORRIDOR 6				25,282,592,278	238,515,021	9,103,626.77	Summary Capital, and Resettlement US\$ Cost per km

Annex 3: CBA modeling glossary and assumptions

Item	Description
Cost Benefit Analysis (CBA)	CBA is a decision-making process using discounted cash flows that compares the costs and benefits of the proposed project options on an objective basis against the base case (i.e. "do nothing option"). Total discounted benefits in Present Value terms must exceed total discounted costs to economically and financially justify the project.
Project Options	Six project options (i.e. 3 BRT and 3 LRT) for Corridor 2 and a BRT option for Corridor 6 have been modeled in the CBA. These options are described in detail in the report.
Base Case	The Base Case assumes that the current corridor traffic and infrastructure conditions will prevail.
Present Value of Benefits	Total value of discounted benefits over the assessment period.
Present Value of Costs	Total value of discounted costs over the assessment period.
Benefit Cost Ratio (BCR)	Ratio of the total Present Value of benefits over the Present Value of costs. BCR greater than 1.0 indicates that the project is economically viable under the CBA assumptions.
Net Present Value (NPV)	Calculation of net value (i.e. total Present Value of benefits minus total Present Value of costs) over the assessment period. A positive NPV indicates that the project is economically viable under the CBA assumptions.
Internal Rate of Return	The discount rate that makes the NPV =0 (break-even point)
Discounted Cash Flows	The process of converting money values that occur in future years to a common year; that is the value of a \$ will be worth more in 2014 than in 2024.
Discount rate	The interest rate at which future values are discounted to the present. A 10 % discount rate has been adopted in line with ADB guidelines. The discount rate represents a combination of the loan borrowing rate and a premium for risk (i.e. currency fluctuation, project risk etc.).
Prices	All cash flows are in real (i.e. non- escalated) 2014 prices.
Assessment period	Benefits are projected across a 20 year assessment period post construction. The assessment period generally represents the effective life of the infrastructure asset with appropriate routine and periodic major maintenance.
Project Costs (for Economic and Financial Assessments)	Capital costs includes preliminaries, construction, fleet and system wide costs; Recurrent costs include annual maintenance and operating costs
Project Benefits for Economic Assessment	The economic road user and public transit benefits that are monetized in the CBA model comprise:Travel time savings

	Vehicle operating costs savings				
	Road safety				
	CO2 emissions reductions				
Assessment	For the PFS level, only fare box revenue has been modeled to represent the direct financial benefit from the PRT services.				
Traffic data	Traffic survey screenline counts were undertaken during the PFS at a number of location including at GT Road (Sikandarabad) close to General Bus Stand, and a potential share of the current public transport market at 60%. Public passenger transit daily demand for Corridors 2 and 6 has been estimated at approximately 223,000 with a realistic maximum per hour per direction of approximately 12,500 during the 8.00-9.00am period. The demand estimate is considered to be on the aggressive since it predicated on government being able to facilitate a reduction of existing public transport vehicles operating in both Corridor 2 and Corridor 6.				
Traffic Annualisation	Annualisation is the expansion factor that converts daily passenger data to annual data. The estimate used was 330 which accounts for lesser traffic on Sundays and public holidays.				
Standard Trip Distance	A standard average trip distance of 7 km was used in the calculation of all economic and financial benefits for all options based primarily on distance from General Bus Stand to Saddar and to a lesser extent on trips beyond Saddar to University Town.				
Travel Time Savings	The primary inputs into this benefit stream are:				
	 Daily demand of 223,000 public transport passengers per day using the 60% aggressive factor for the screen line data at General Bus Stand on GT Road 				
	 Base case daily public passenger data segmented by vehicle type from the traffic survey was as follows: 				
	Suzuki Pick-up 119,582				
	Large bus 39,501				
	Rickshaw 82,211				
	≻ Taxi 49,902				
	➢ Mini Bus 43,275				
	≻ Wagon 50,006				
	Datsun Pickup 9,219				
	≻ Total 393,696				
	 Modal shift in public passenger numbers from current PT modes (i.e. base case) to future BRT/LRT(i.e. project options) including percentage shifts are 				
	➢ Suzuki Pick-up 71,749 (60%)				
	➤ Large bus 33,576 (85%)				
	Rickshaw 36,995 (45%)				

	➢ Taxi 19,961 (40%)
	Mini Bus 25,965 (60%)
	> Wagon 30,004 (60%)
	Datsun Pickup 4,610 (50%)
	➢ Total 222,859
	 PT vehicle occupancies taken from screen line data
	 Monetary value per public transport passenger per hour has been generally assumed at Rs 88 per hour (Lahore Urban Transport Masterplan data was sourced, CPI applied to update to 2014 prices and finally moderated using Pakistan Statistics HIES data for KPK (Urban)
	 Existing (i.e. base case) and project case travel speeds for private and PT respectively based on in-car surveys and social surveys:
	\rightarrow Car 18 km/hr 20 km/hr
	Motor Cycle 20 22
	Suzuki Pickup 12 14
	Large bus 10 12
	Rickshaw 15 18
	➢ Taxi 18 22
	➢ Mini Bus 12 14
	➢ Wagon 12 14
	Datsun Pickup 12 14
	 Operating speeds assumed for BRT and LRT BRT Street Level and Partially Elevated 25km/hr BRT Elevated 45km/hr LRT Street Level and Partially Elevated 30km/hr LRT Elevated 30km/hr
Vehicle Operating Cost (VOC)	The primary inputs into this benefit stream are:
Savings	 Daily demand of 109,667 total trips including approximately 63,000 PT vehicle trips for the screen line data at General Bus Stand on GT Road
	 Base case daily PT vehicle trip data segmented by vehicle type from the traffic survey was as follows:
	Suzuki Pickup 9,610
	Large bus 1,404
	Rickshaw 28,302
	➤ Taxi 16,675
	Mini Bus 1,984
	> Wagon 3,766
	Datsun Pickup 1,208
	➢ I otal 62,949

	Modal shift in PT vehicle trips from current PT modes (i.e. base case) to future BRT/LRT(i.e. project options)				
	including percentage shifts are				
	➢ Suzuki Pick-up 3,844 (60%)				
	➢ Large bus 211 (85%)				
	➢ Rickshaw 15,566 (45%)				
	≻ Taxi 10,005 (40%)				
	➢ Mini Bus 794 (60%)				
	➢ Wagon 1,506 (60%)				
	Datsun Pickup 604 (50%)				
	 Monetary values for Vehicle Operating Costs per km (by vehicle segmentation) taken from Lahore Urban Transport Masterplan data and CPI applied to update to 2014 prices 				
	➢ Car 51 Rs/km				
	Motor Cycle 5				
	Suzuki Pick-up 76				
	Large bus 140				
	Rickshaw 10				
	≻ Taxi 51				
	Mini Bus 89				
	≻ Wagon 89				
	Datsun Pickup 76				
Road Safety Benefits	Persons killed and injured in KP obtained from Pakistan Statistics Year Book 2010-11 (latest) and estimate determined for Corridor 2 based on screen line data vehicle and Peshawar population as a percentage to KP population. Fatal (Rs27.4m), serious (Rs1.4 m) and injury/property (Rs0.4m) values derived from <i>Estimating the Value of a Statistical Life in</i> <i>Pakistan</i> (Sandee Working Paper 63-11).				
CO2 Emissions	Net km differences in current and future vehicle trip data including BRT/LRT taken from VOC modelling; CO2 emissions kg/km for each vehicle segment determined; and net emission value determined using EU Emission Trading Scheme (ETS) value of 7 Euros (Rs 1000) per tonne applied.				
Fare Box Revenue	A daily public passenger demand of 222,859 (annualised by330) and a flat fare of Rs 20 has been used for all BRT and LRT project options to determine annual fare box revenue. BRT/LRT ridership has been modelled to increase by 2.4% annually over 20 years and this annual increase is included in the fare revenue calculations.				