

Terms of Reference for a consultancy assignment to elaborate the Khyber Pass Economic Corridor development plan, based on a combined spatial and cluster competitiveness assessment in Western Greater Peshawar

1. Background of the Assignment

The global integration of South and Central Asia is intertwined with the Khyber Pass. Over recent decades, constraints on trade through the Khyber Pass have hindered the development of Afghanistan, Pakistan, and Central Asia and undermined the stability of northwestern Pakistan. Economic development has been especially constrained in the erstwhile Federally Administered Tribal Areas (FATA).

With the improvement in the security situation in the newly merged regions of Khyber Pakhtunkhwa (KP) the forthcoming construction of the China Pakistan Economic Corridor (CPEC) and ongoing investments to address electricity shortages, unprecedented opportunities exist to increase economic growth, support local community development and reduce poverty in the region.

To increase trade between Afghanistan and Pakistan and accelerate economic growth in Peshawar, the capital of the province KP, the Government of Pakistan and the World Bank have agreed upon the development of the Khyber Pass Economic Corridor (KPEC) Project.¹ For an amount of US\$ 462.6 million, the KPEC project includes two components:

- **Component I.** Expressway development from Peshawar to Torkham (PTEX), with a new alignment next to the existing N5 road and with a planned completion data of 2023.
- **Component II.** Development of the Khyber Pass Economic Corridor, that will, in conjunction with other initiatives, maximize the benefits of PTEX for the population in the KP by preparing transformational road infrastructure, urban development, cultural heritage protection and other area-based public investments for Western Greater Peshawar and by alleviating constraints to local employment, in particular for women, and to the integration of local producers and other private sector actors into global value chains.

To be able to fulfill component II of the KPEC project, it is key to draft a **KPEC Development plan**, based on a combined spatial and cluster competitiveness assessment in Western Greater Peshawar. This plan will enable the institution of needed strategies, structures, and processes for:

- (i) prioritizing investments in public infrastructure and detailed local development plans in Western Greater Peshawar (SMP-WGP)
- (ii) identifying key policy, regulatory, administrative, and institutional barriers to private sector development in WGP and to trade through the Khyber Pass, including undertaking a risk and resilience assessment and an assessment of the PPP framework in erstwhile FATA.
- (III) recommending the most appropriate policies and framework to enable implementation of the plan.
- (iv) coordinating development activities between federal, provincial, bilateral, multilateral, and private sector stakeholders.

To ensure that the KPEC investment will have maximal effect on the local level, detailed masterplans for the urban centers of Jamrud and Landi Khotal, two towns situated in the KPEC area, are also needed. These masterplans will ensure also that the

¹ See Annexe 1: The World Bank/IDA, Project Appraisal Document for a Khyber Pass Corridor Project, May 2018

urban development of the two urban centers will maximally support the KPEC investment (see ToR for the detailed masterplans for the urban centers at section-II).

The Government of Khyber Pakhtunkhwa seeks to recruit a consultant that gathers the necessary qualifications to successfully elaborate the KPEC Development plan for infrastructure investment and institutional improvement programs and develop masterplans for the urban centers.

2. Context of Western Greater Peshawar

2.1 The gate between South and Central Asia

The roadway between Peshawar and Kabul, the capital of Afghanistan, through the Khyber Pass represents a section of Corridors 5 and 6 of the Central Asia Regional Economic Cooperation (CAREC)² and has served as the key node in trade between South and Central Asia for hundreds of years. Corridor 5 has the potential to provide the shortest link between the landlocked countries of Afghanistan, Tajikistan and Uzbekistan, and the Arabian sea; while Corridor 6 provides access to Europe, the Middle East and Russia. Improvements in transport connectivity are a key driver of regional economic cooperation among CAREC countries.

Despite strong demand for Pakistani products such as surgical instruments, textiles, fruits, rice, sugar, and cement and a market of nearly 70 million people, trade between Pakistan and the Central Asian Republics (CARs) is minimal, with Pakistan's exports in 2016 making up less than one percent of total imports by the CARs. While trade between Afghanistan and Pakistan nearly doubled in the decade up to 2015,³ flows dropped by about 30 percent over the past 2 years.

Yet, improvements in security, infrastructure investments, and renewed regional economic cooperation provide hope for the revival of cross-border trade and bolstering of economic growth.

The security situation in northwestern Pakistan has improved over the past few years. Also, the energy shortfall is gradually being addressed by the establishment of micro-hydro power plants, while investments in transportation infrastructure are addressing bottlenecks to connectivity between Peshawar and the rest of Pakistan. Transformational projects, such as the Central Asia-South Asia Electricity Transmission and Trade Project (CASA-1000) and the Turkmenistan-Afghanistan-Pakistan-India Pipeline, are ushering in a new era of cooperation between governments in South and Central Asia.

2.2 The historic cradle of urbanization

The Khyber Pass Economic Corridor spans between Peshawar, the capital of KP and situated at the junction of the Khyber and Kabul river, and Torkham, the town at the border with Afghanistan. The KPEC project will not only integrate this area into global value chains, but also build on the historic and existing local assets.

Peshawar is the capital and largest city of the province KP, with a population of 1.9 million inhabitants and a district population of more than 4 million. As it doubled its population in only 20 years' time in a highly urbanized region that is marked by a youth bulge, the KPEC project can build upon the promise of an urban and demographic dividend. The potential of a young professional generation, agglomeration economies, urbanization and territorial cohesion provides the opportunities for erstwhile FATA to become integrated into global value chains. and equally revitalize its district important economic sectors. With current vocational and technical training programs, in particular for women and youth, and other support such as the

² CAREC is a partnership of 11 countries (Afghanistan, Azerbaijan, China, Georgia, Kazakhstan, Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan) and is supported by six multilateral institutions.

³ Afghanistan is Pakistan's fourth-largest export market, accounting for 7.9 percent of exports in 2015.

⁴ See 2017 Pakistan census at www.pbscensus.gov.pk/sites/default/files/DISTRICT_WISE_CENSUS_RESULTS_CENSUS_2017.pdf

Community Infrastructure Development Project, the Urban Center Project and investments in local infrastructure (streetlights, pavement and drainage), erstwhile FATA is already targeting the increase of the well-fare of the local population.

Regarding existing and local assets, the KPEC project will additionally look in particular to promote the cultural heritage of the Khyber Pass and to develop mechanisms to leverage this cultural heritage for economic development, identify sites of cultural significance; and promote sites and products of special cultural and/or historical interest. As the oldest city in Pakistan and one of the oldest in the world, Peshawar lays in the middle of this region that used to be a key destination for both foreign and local tourists, with its unparalleled cultural and historical value, imported and diversified along the Khyber Pass. Although security conditions in erstwhile FATA are currently not conducive to substantial growth in tourism, the preservation of sites of cultural and historical value and the development of museums and cultural products along the Khyber Pass is a smart endowment to safeguard the tourist potential of the area for development when security conditions permit.

2.3 The KPEC Project as backbone for revitalization of Western Greater Peshawar

Recent research indicates that complementary investments in trade and transport facilitation infrastructure and services as well as policy and institutional reforms to alleviate business constraints are necessary to realize the economic benefits of major investments in major transport infrastructure in northwestern Pakistan.⁵

The Khyber Pass Economic Corridor Project is, therefore, a strategic opportunity to develop a strong regional economic area, transforming the western part of KP in a performant logistic, industrial and service corridor and hub on the scale of the transnational region and the province, but also supporting Peshawar and the interconnected settlements of other secondary cities and towns as an attractive and sustainable urban agglomeration. With its two components, the KPEC project will respond to the infrastructural needs, enhance connectivity between economic and urban centers and help to realize the economic potential of the region, thereby building upon the ongoing investments by various actors.

3. OBJECTIVE OF THE ASSIGNMENT

The overall objective of the assignment is to elaborate an Economic Corridor Development Plan for the KPEC investment and infrastructure program, based on combined spatial and economic cluster assessment of Western Greater Peshawar's potential, and masterplans of two urban centre.

The scope of work of the assignment is segregated in two sections Section-I, and Section -II, with the selected consultant to be expected to carry out the assignments in parallel.

Section-I: Khyber Pass Economic Corridor development plan, based on a combined spatial and cluster competitiveness assessment in Western Greater Peshawar"

Based on a strategic spatial and economic analysis, the plan will offer a focused, yet integrated, economic and territorial vision of Western Greater Peshawar, which will improve the ability of authorities to align infrastructure investments with the needs of the private sector, thereby enhancing the capacity of the KPEC project to not only transform the PTEX high-way corridor in an economic backbone for WGP but also catalyze spatial transformation and sustainable development of the territory of WGP as a whole, as well as in specific strategic locations and urban centers.

The plan should build on existing assets and optimize the future KPEC investments, but also consider challenges and opportunities regarding:

⁵ Asian Development Bank, Department for International Development, Japan International Cooperation Agency, and the World Bank. 2018. The WEB of Transport Corridors in South Asia. Washington, DC: World Bank.

- demographic changes (residential needs and services)
- urban centers of economic activity (mixed-use settlements, transport and logistic networks)
- recreation and tourism (cultural and historic monuments and sites, landscape, green and blue networks, forest and protected areas)
- energy and circular resources systems (transition towards clean energy, sustainable mobility, food, circular economy)

By including a spatial diagnostic module in this mission, the assignment will allow to identify the needed spatial characteristics and functional organization of infrastructure and other relevant investments in the KPEC on the scale of WGP and on the scale of specific strategic location. In order to achieve that, the plan will also include detailed studies for strategic investments and locations, such as (potentially):

- Parking terminals upstream from Torkham to complement ADB investments and support to the implementation of the TIR to reduce waiting time at the border.
- An international bus terminal to service buses traveling between Afghanistan and Pakistan.
- Integrated logistics hubs and industrial / commercial infrastructures to support SME development in viable locations in WGP (e.g. existing and viable industrial zones); and
- branch roads connecting PTEX to local and national road networks.

The assignment will allow WBG and the Government of KP to define:

- i) the specific constraints and economic potentials in key sectors, and the strategic interventions (including, but not restricted to, infrastructure) that could leverage WGP's natural capital and geographic position and underpin a private sector led growth.
- ii) the specific spatial policies, regulations and (infrastructure) investments needed to catalyze economic growth in WGP.
- iii) the potential urban growth patterns based on the above pull-factors and determine urban development strategies, policies and investments (short, medium and long terms) to create interlinked centers of economic activity.

In this section the consultant will cover 5 modules focused on 2 complementary areas of research and analysis.

Module I: Strategic Spatial diagnostic for Western Greater Peshawar.

Module II: Rapid assessment of cluster competitiveness and opportunities.

Module III: KPEC Development Plan for the investment and infrastructure program, including identification of subsequently needed detailed masterplans for strategic locations.

Module IV: Feasibility studies and preliminary designs for strategic economic investments locations

Module V: Implementation roadmap, including phasing of investments identified in the KPEC Development Plan but also the needed enabling environment such as institutional reforms, reforms of policies and regulations, and needed capacity building.

Modules I and II need to be implemented simultaneously by the consultant, in a synchronized and intertwined manner, allowing analytical phases to happen simultaneously, to feed into a concept economic growth strategy with several scenarios that can only be defined based on the integration of both perspectives. The outputs of Modules I and II will serve as inputs into Module III: KPEC Development Plan for the investment and infrastructure program. Module IV and Module V will also be executed in parallel and cover zoom-ins on infrastructure and investment locations that are critical to the implementation of the KPEC Development Plan and that are financed by the WB project. Module VI delivers a roadmap on needed reform and strengthening of institutions, coordination mechanisms and on capacity building of local agencies.

The below schedule suggests modules implementation and integration:

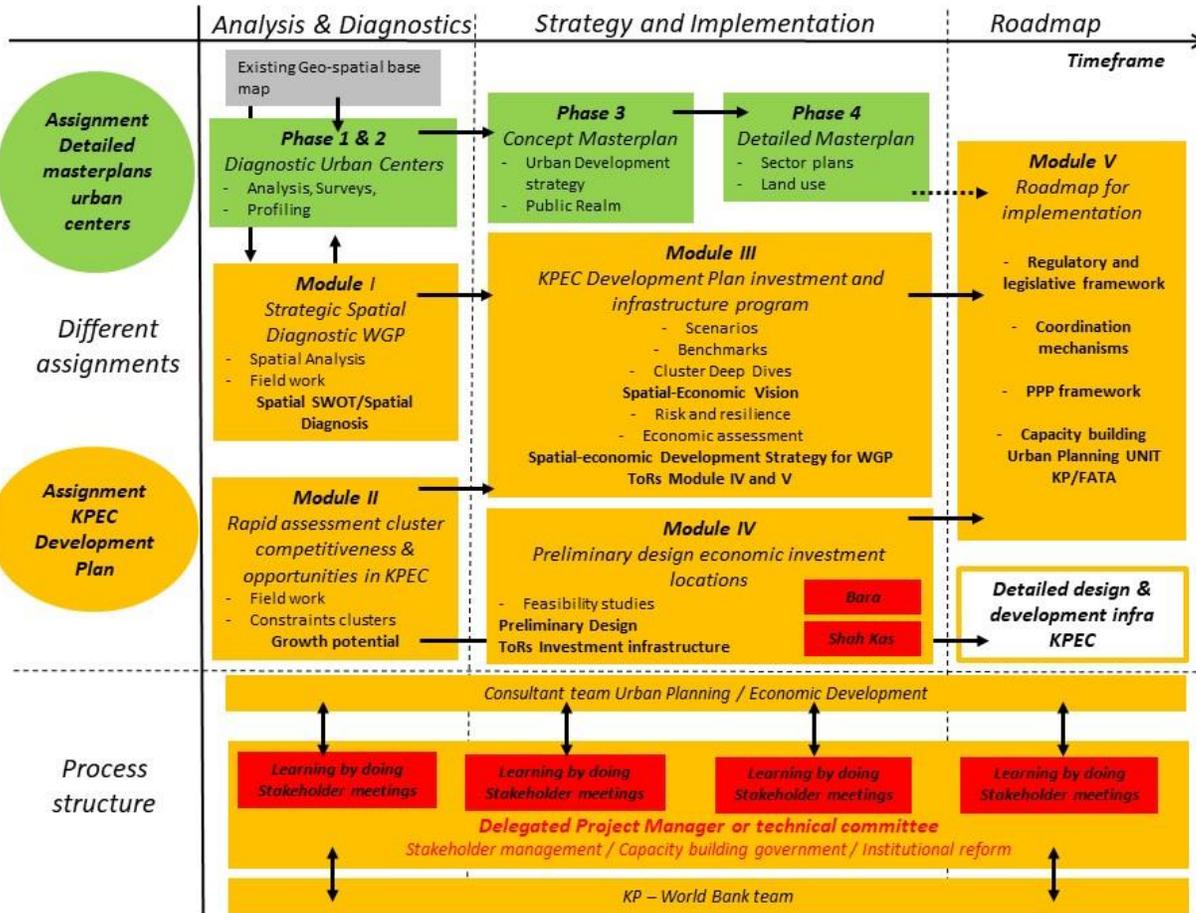


Chart with schedule of module implementation in parallel and in coordination with detailed masterplans urban centers and KPEC Development plan

In his technical proposal, the consultant will propose a methodology (key aspect of the evaluation of the technical proposal) that demonstrates how he will effectively integrate both perspectives (economic and spatial) covered by modules I and II, into one coherent and cohesive whole (in module III).

Each module will require specific deliverables, defined in the detail description of every module. In general, the following deliverables are requested:

- Preparation and presentation of international experience and lessons learned related to the specific intervention, with a focus on best fit models that consider the particular challenges of lagging regions. The presentations will be made through workshops to the implementation entities and other stakeholders.
- A series of structured discussions and consultations with the implementation entities and other stakeholders to transfer international knowledge, learn about WGP and KP challenges, and devise approaches uniquely suited to the operational scope and design of the Khyber Pass Economic Corridor project.
- Preparation of a PPT report on design/reforms/approaches to be used as inputs for a more consolidated and comprehensive solution for the Khyber Pass Economic Corridor along the above mentioned overall objectives.

Section II: Detailed masterplans for the urban centers of Jamrud and Landi Khotal

The other objective of the assignment is to elaborate detailed Masterplans for two towns situated in the KPEC area.

Based on a detailed diagnostic of the existing situation and the formulation of the needs for these two towns, and informed by the larger development strategy and vision that will be elaborated in the development plan for the KPEC investments and infrastructure program, these masterplans will ensure that the KPEC investment will have maximal effect on the local level and that the urban development of the two urban centers will maximally support the KPEC investment

A final report will be delivered to the Government of KP. The consultant(s) will also be requested to report periodically to the Government of KP as progress is made in each module.

4. Module I: Strategic Spatial Diagnostic for Western Greater Peshawar

4.1 Objectives

The objective of this module of the assignment is to conduct a strategic spatial diagnostic, in order to define the KPEC Development Plan (Module III), informed by the rapid assessment of cluster competitiveness and opportunities in the KPEC (Module II).

This Strategic Spatial Diagnostic will also inform the feasibility studies and preliminary designs for strategic economic investments locations (Module IV), thanks to its critical reading and analysis of spatial structures, environmental and social characteristics, as well as the functional organization requirements of infrastructure, as this will determine the urbanistic conditions for the planned infrastructural investments that are part of the KPEC project. It will also support a broad stakeholder process towards community and private sector engagement that is required to formulate a clear road map for institutional strengthening, policy reform and capacity building (Module VI).

4.2 Scope of work and key tasks

The scope of work will cover both a WGP-wide territorial scale and a scale of strategic locations and urban centers. This will involve both desk research utilizing existing data and resources, as well as undertaking trips to WGP to collect information and conduct interviews with the public authorities, private sector and relevant community stakeholders. More formalized consultations will also be conducted in Peshawar and Torkham.

The assignment and resulting deliverables will be comprised of the following tasks. It is expected that many of the tasks will be carried in parallel with Module II, with multiple teams working simultaneously. Both Module I and II are organized in 3 phases, in order to facilitate the synchronization and interaction between the two Modules in the process. The final report will be encompassing and synthesizing the findings of the tasks:

- **Task 1: Refine and finalize mission schedule and methodology**
- **Task 2: Review and assess existing reports and studies on WGP**
- **Task 3 Production of a base map of the study area**
- **Task 4 Transportation survey of the study area**
- **Task 5: Conduct a Spatial Analysis of Western Greater Peshawar**
- **Task 6: Conduct field work in the study area**
- **Task 7: Make a critical spatial diagnosis of opportunities and challenges related to the KPEC**
- **Task 8: Intermediate report Spatial Diagnostics**

4.3 Detailed description of tasks

Phase 0: Inception

Task 1: Refine and finalize mission schedule and methodology

Following consultations with the client, and considering the review made in Task 1, the consultant should propose a note refining the implementation schedule and methodology of the mission in no later than 2 calendar weeks after contract signing.

Phase 1: Descriptive analytics

Task 2: Review and assessment of existing reports and studies on WGP

Immediately upon contract signing, the consultant should review the existing body of geo-spatial data, mapping of existing and planned infrastructure and developments, as well as relevant spatial planning policies, governance bodies and strategic projects. A major reference is the interim 'Geo-Referenced Local Master Plan (GeoLoMaP) for the Peshawar-Torkham Economic Corridor (PTEC) and Surrounds (see attachment 2). The consultant will also consult with NHA- KP/FATA Planning agencies to obtain data and planned infrastructure not captured in the GeoLoMap.

Task 2 should be conducted for the entire KPEC. This should be achieved in 3 to 4 calendar weeks.

Task 3 Production of a base map of the study area

A GIS/MIS **based detail land use Base Map** will be prepared for the quantification of built up, infilling, brown fields and open land available for future development for the projected administrative boundary. A detailed land use map for the entire project area will also be prepared. Land uses shall be registered separately for both built-up and open area (within the agreed planning boundary).

The satellite imageries will be acquired from authentic source and shall to develop an updated base map including surrounding areas in order to support suitability analysis of existing and proposed land uses for urban development and other ancillary uses. Land use survey of each type is a necessary prerequisite of this study. A GIS based digital Land use map which can be reproduced at various scales according to the need will be developed accordingly. Following layers and attributes (but not limited to) should be included in the base map:

The consultant will produce a base map of the existing situation, with the following data:

- A base map with accurate representation of natural and human-made features, including water, green, topography and major infrastructures.
- A population density map
- An administrative map with institutional boundaries, including the reference of names and hierarchy of settlements and administrative institutions.
- A detailed land use classification map including existing land-uses, road networks, transportation connectivity and clear-cut boundaries of the municipal facilities will be prepared.
- A detailed parcel and built-up area map allowing to differentiate public and private properties, street alignments, built and unbuilt areas, height, and floors of buildings
- Maps with socio-economic indicators on various administrative levels

The consultant will maximally use existing geo-referenced data available amongst the public agencies. If survey maps are not available, the consultant will have to propose a technical methodology adopted to map density, land use, infrastructure and built-up areas in the region, such as collecting digital and analogue data or maps from public authorities in Pakistan and KP in particular, using open-data sources (open street maps, WorldPop, NASA, Global Land Cover, GeoNode, UNSpider, WaterAction hub, and digitalizing satellite imagery or other techniques. This technical methodology has to include details on the data verification methodology adopted to optimize accuracy within the given timeframe and scope of the assignment.

Task 3 should be conducted for a consistent perimeter along the KPEC. This should be achieved in calendar weeks.

Task 4 Transportation survey of the study area

The consultant will collect all information on transportation to comprehend the transport network and movement of trucks and commuters in the KPEC area, considering decision already made regarding transportation infrastructure investments as part of the KPEC project.

It would include following sub-tasks.

- Inventory of the existing road networks, relevant regarding the KPEC investments: physical characteristics of the identified road network in terms of right-of-way, carriage way, number of access points, surface type, abutting land use; physical constraints and bottleneck points along the identified road network; capacity potential of the road network.
- Quick-scan of existing Traffic Counts Survey (vehicular flows, junction movements, peak hour volume and volume to capacity ratio), Origin Destination Surveys (Route Choice, Travel Time, Mode Choice from and to important locations (urban centers, existing economic zones, border, ...); Public Transport Surveys (Journey Time, Safety, Comfort, Fare Rates, Driver/Conductor attitude. Occupancy etc.)

The consultant will maximally use existing data available amongst the public agencies. If data is not available, the consultant will have to propose a method to make a robust diagnostic regarding transport, which is key to take evidence-based decisions in the Development Plan phase (scenario's, development strategy, ToRs feasibility studies in Module IV, ...).

Task 4 should be conducted for a consistent perimeter along the KPEC. This should be achieved in 6 calendar weeks, in parallel with task 3.

Task 5: Conduct a Spatial Analysis of Western Greater Peshawar

The consultant will conduct a spatial analysis of the existing situation and planned interventions on the scale of the region of WGP, with the following information available in different layers and a geo-referenced database:

- administrative boundaries
- district level data with socio-economic indicators
- land-use classification map
- territorial characteristics, such as topography, soil, green, forest and water bodies.
- human settlements, public amenities (density, morphology, location, hierarchy)
- parcel structures, ownership, and functions of un-built and built space
- open spaces, parks and playgrounds.
- transportation infrastructure with modes and hierarchy (roads, public transportation, ...)
- economic infrastructure, services and areas (industrial and commercial zones, agriculture, logistics,
- planned public interventions and relevant private planned and projected investments

This analysis results in geo-referenced plans on various scales and in synthetic schemes. The consultant will specify scales in the proposal and ask confirmation to the client at the beginning of this task.

Task 5 should be conducted for all of Western Greater Peshawar. This should be achieved in 8 calendar weeks.

Task 6: Conduct field work in the study area

On-site field surveys will cover the study area of Western Greater Peshawar and include detailed surveys on specific locations that will be part of the feasibility studies and preliminary designs for strategic economic investments locations (Module IV).

Meetings can be done in focus groups as well as individually. The Consultant should make full use of the convening power of the KP planning agencies, to meet with relevant government officials and administrations, but also needs to ensure direct and meaningful consultation with communities and other relevant stakeholders. The consultant should prepare an informal questionnaire to help structure questions with public authorities and stakeholders, and to ensure consistency across types of groups and territorial coverage of the Western Greater Peshawar.

Field work results in photograph reports and minutes of interviews and meetings.

Task 6 should be achieved in 8 calendar weeks, in parallel with task 5.

Phase 2 Critical diagnostics

Task 7: Make a spatial SWOT analysis of the planned KPEC project

The consultant will make a spatial diagnostic of Western Greater Peshawar, based on a critical reading and analysis of the existing situation and the planned investments, thereby revealing opportunities and threats related with the planned economic development and infrastructure projects.

Schemes and text with quantitative and qualitative data will underpin the SWOT that is broken down in various themes:

- the regional and local accessibility, proximity and intramodality (existing and future road network with capacity potential and gaps, origin-destination zooms between specific strategic economic zones and urban centers, public transport network).
- the accessibility and availability of public services (existing and future needs)
- the characteristics of the urban fabric (existing and future settlement needs).
- the availability and capacity for transformation of land and infrastructure to address shortage in housing, industrial areas, services and other programs (spatial and programmatic densification).
- the potential integration, juxtaposition or buffering of different activities.
- the high-level impact of the planned infrastructure for the KPEC and other initiatives on parcels, ownership, buildings, needed relocation
- the environmental assets.
- the potential spatial structures and components to support circular economy and sustainable resource management (energy, materials, water, food, ...)

The diagnosis will reveal and illustrate key questions regarding the relation between spatial context and economic development, to inform relevant scenarios to be elaborated and evaluated in module III.

This diagnosis results in geo-referenced plans on various scales and in synthetic schemes on separate layers and in a synthetic comprehensive plan.

Task 7 should be achieved in 4 calendar weeks.

Task 8: intermediate report Spatial Diagnostics

In this task, the consultant should prepare a draft report on the outputs of tasks 1-7 immediately upon the end of task 7 (25 weeks after launch of the mission). A more elaborated version of the draft will be submitted 4 weeks later (including a 10-day period for the client to provide feedback). The final report on Module I will be due no later than 29 weeks after the launch of the mission.

5. Module II: Rapid assessment of cluster competitiveness and opportunities in the KPEC

5.1 Objective

The objective of this assignment is to conduct a rapid assessment of cluster competitiveness and opportunities in the KPEC. The firm selected for this assignment will assess economic sectors and clusters WGP that may have potential to respond to new markets and opportunities.

5.2 Scope of work and key tasks

The assignment involves both desk research utilizing existing data and resources, as well as undertaking trips to WGP to collect information and conduct interviews with relevant public and private actors.

The assignment and resulting deliverables will be comprised of the following tasks. It is expected that many of the tasks will be carried in parallel, with multiple teams working simultaneously. The mission is also organized in 2 phases, in order to align with the deadlines facing the Government of KP, and to ensure that the economic assessment is made in close coordination with the spatial diagnostic (module I).

The assignment includes the following tasks:

- Task 1: Refine and finalize mission schedule and methodology
- Task 2: Review and assess prior consultant reports and studies on WGP
- Task 3: Conduct field work to identify main clusters and confirm the level linkages between firms within relevant specific clusters/sectors in WGP
- Task 4: Identify constraints on two targeted clusters/sectors
- Task 5: Market trends analysis for key value chains to which the clusters participate.
- Task 6: elaborate a market-based estimation of Cluster growth potential
- Task 7: Intermediate report on assessment of cluster competitiveness and opportunities

Phase 0: Inception

Task 1: Refine and finalize mission schedule and methodology

Following consultations with the WB team, and considering the review made in Task 1, the consultant should propose a note refining the implementation schedule and methodology of the mission in no later than 2 calendar weeks after contract signing.

Task 2: Review and assess prior consultant reports and studies on the KPEC

Immediately upon contract signing, the Consultant should review the existing body of analytical work on economic activities in WGP and identify gaps. This should be achieved in 3 to 4 calendar weeks.

Phase 1: Expedited deep dive into specific sectors

The assignment will include at least two field missions: the first to complete Task 3 and identify 2-3 clusters of focus; the second will deep dive into these 2-3 clusters and determine their constraints and needed policy interventions to unleash their growth.

Task 3 will thus be conducted first, while tasks 4, 5, and 6 will simultaneously be conducted next.

Task 3: Conduct field work to identify 2-3 clusters/sectors of focus

Research on clustering has identified seven dimensions that can support the formation of clusters. It also suggests that clustering can be fostered by any one of these following factors:

- Labor market pooling (sharing workers with comparable skills)
- Supplier specialization (specialized suppliers are available to provide inputs)

- Knowledge spillovers (being close together fosters knowledge exchange)
- Entrepreneurship (skill of businessmen and women to grow and make businesses successful)
- Path dependence and lock-in (clusters typically develop from existing conditions, they usually do not pop up out of the blue—and once they area started, they usually continue—the lock-in effect)
- Culture and embeddedness (are local social relationships conducive to sharing? Is there trust?)
- Local demand (local demand is important to ensure that the clusters remain viable, and local demand can help companies and clusters achieve scale.)

Since data availability is limited in KPEC, the consultant will conduct field interviews to identify 2-3 clusters that have, both, a critical mass of motivated firm leaders, and a viable pathway to reach growing markets (national or regional), provided constraints can be removed or alleviated by the project.

To make its recommendation on which 2-3 clusters to focus on (in the absence of reliable data for a more thorough analyses), the consultant will interview at least 40 private sector actors in various economic sectors and locations, including leaders of Chambers of Commerce / Industry or trade associations, but also ensure direct and meaningful consultation with firm leaders in the field. The consultant will also consult with relevant government officials or specialists in the academic world (e.g. economist that have researched the region). Finally, the Consultant will also interview development partners from the donor community that have worked or are currently working on the region.

To assess the degree of cluster-related linkage activities in the most promising clusters (based on the above fact-finding mission), the Consultant will also meet with an additional number (10-15) industrial and business leaders in a short list of 4 clusters. These meetings can be done in focus groups as well as individually.

In conducting both aspects of this field work, the Consultant should prepare an informal semi-structured questionnaire to help organize the conversation and the analysis of findings—and to ensure consistency across industry groups.

Based on this field work, the Consultant shall recommend to the client two clusters to become the focus of tasks 4, 5 and 6. The report needs to substantiate the recommended choice in terms of critical mass of actors with strong buy-in to the cluster development process conducted in this project, as well as a rapid and preliminary market diagnostic (to be later detailed in task 6) in order to ensure that the choice is addressing a growing market.

Task 4: Identify key constraints and competitive advantages in targeted clusters/sectors

For clusters confirmed in task 3, the firm will analyze competitiveness factors with a view towards those who may have the potential to respond to new markets and emerging opportunities, as well as have possible spillover effects to other sectors. In this task, the firm will use the Porter Diamond framework, and look at current competitiveness level of clusters, and the areas where most of the constraints are concentrated. In doing that, the firm must consider at least the following aspects:

1. Using available strategic studies, sector studies, value chain analysis, and input from industry experts, assess key factors contributing to or detracting from competitiveness of each cluster, examining how these factors manifest in each of the clusters and more broadly in each of the governorates, including:
 - a. Access to inputs (availability and cost of key inputs and services, natural endowments contributing to the cluster)
 - b. Access to markets (size and potential of current markets, potential markets, links/ spillovers to other sectors in the local market)
 - c. Labor availability and costs (wage competitiveness, availability of skilled labor, ability to attract quality management)
 - d. Serviced land/ venue (availability of industrial space, commercial space, power, water, telecom),

- e. Regulatory issues (key constraints related to licensing, barriers to entry (monopolies, SOEs), or related government regulations or requirements, opportunities created by new or emerging laws and regulations) as well as informal payments.
- f. Transportation and Logistics: (trade, logistics, transport),
- g. Access to capital (key constraints in equity and debt financing)
- h. Capacity and strength of existing firms in the sector: existence (or lack of) of strong anchor firms, coordination mechanisms among firms, quality, productivity, or other advantages/ disadvantages of the exiting sector base.

The consultant will be expected to undertake this analysis based on existing information and industry interviews or working sessions with representative working groups from the clusters, providing qualitative and quantitative data emerging from these interviews/workshops. As in task 3, the Consultant should prepare an informal semi-structured questionnaire to help organize the conversation and the analysis of findings.

Task 5: Market trends analysis for key value chains to which the clusters participate.

The analysis methodology of the targeted clusters should incorporate an analysis of the evolution of markets and consumer trends for key /anchor products and services produced in the clusters. Indeed, a constraint can be valid for a current value chain linking to a currently targeted market segment (which will transpire from interviewing actors currently operating in the cluster) but be irrelevant for firms shifting their production to respond to emerging (or higher value add) market segments. To ensure a dynamic, market focused assessment of constraints and opportunities of targeted clusters, the Consultant will incorporate in his assessment a rapid strategic segmentation exercise that would highlight segments where the beneficiary firms in targeted clusters in WGP could build a strong and sustainable comparative advantage, considering evolving market trends. The Consultant will therefore analyze 1-3 value chains within the cluster that target strategic market segments. The consultant will then identify the constraints that seem to impede a shift by current firms from current lower added-value products towards such strategic segments, and the actions and investments that could eliminate such constraints.

The consultant will identify and assess constraints identified in tasks 4 and 5 with a view towards which constraints may be considered ‘binding’ and at the same time which have more potential for some resolution.

These constraints should be documented in a matrix listing category of impediments. Physical impediments should be mapped using GIS based on field inspection and key-informant information. This output should be presented in the linkage impediment report.

Task 6: Cluster growth potential

Based on data and interviews (including with potential/existing buyers – firms - in destination markets, which can be conducted by teleconferencing technology); and taking into consideration shifts between current market orientations and new ones based on market trend analysis, linkage advantages and constraint uncovered in the interviews, the consultant should prepare a range of growth projections of the future (2030) of each cluster. Projections should be in-terms of both GDP/output and employment.

Task 7: Intermediate report on assessment of cluster competitiveness and opportunities

In this task, the consultant should prepare a draft report on the outputs of tasks 1-6 immediately upon the end of task 6. A more elaborated version of the draft will be submitted 4 weeks later (including a 10-day period for the client to provide feedback).

The final report on Module II will be due no later than 28 weeks after the launch of the mission.

6. Module III: KPEC Development plan

6.1 Objectives

The objective of this module is to integrate the spatial diagnostics (Module I) and Rapid assessment of cluster competitiveness and opportunities in the KPEC (Module II) in an integrated spatial-economic development plan that is the result of the elaboration and evaluation of various scenarios.

The plan will inform the drafting of specific detailed masterplans for strategic locations (module IV) and a roadmap for further implementation (Module V).

6.2 Scope of work and key tasks

The scope of work will cover two scales, as already anticipated in the spatial diagnostic phase: a WGP-wide territorial scale and a scale of strategic locations and urban centers.

The assignment and resulting deliverables will be comprised of the following tasks. The mission is organized in 2 phases, in order to emphasize the importance to develop and evaluate scenario's, thereby integrating both spatial and economic angles and knowledge, before drafting a masterplan based on an optimal scenario.

The final report will be encompassing and synthesizing the findings of the tasks:

- **Task 1: Propose and assess various spatial development scenarios**
- **Task 2: Benchmarks and best fit practices**
- **Task 3: Develop a spatial-economic vision on WGP**
- **Task 4: Undertake a risk and resilience assessment**
- **Task 5: Undertake a revised assessment of economic activity in WGP**
- **Task 6: Elaborate a spatial-economic development strategy of WGP**
- **Task 7: ToRs for feasibility studies and preliminary designs for strategic economic investments locations**
- **Task 8: Report KPEC Development Plan**

6.3 Detailed description of tasks

Phase 1 An integrated spatial economic vision for WGP

Task 1: Propose and assess various spatial-economic development scenarios

Based on the spatial SWOT and economic assessment, the consultant will propose minimum 3 scenarios that each of them represents a relevant development strategy that responds to the objectives of the assignment: to align infrastructure investments with the needs of the private sector; to ensure the KPEC will be an economic backbone on the scale of the corridor but as well on the scale of strategic location and urban centers.

The consultant will propose a rationale on how to define these scenario's (for example conservative, ambitious, realistic; or focus on one or various economic sectors or spatial areas; ...

The consultant will also propose a multi-criteria evaluation method, considering for example and as a minimum:

- Spatial-Economic development criteria:
 - Spatial proximity to inputs, labour market
 - Increased potential land development (availability of space in various time frames)
 - Increased access to economic services
 - Improved transport and storage options (trucks, logistics)
- Urban development criteria
 - Increased potential to respond to demographic growth and changes (improved settlements, densification, relocation, expansion) and following principles of Transit Oriented Development (TOD)
 - Improved transportation in different modes (including gender- and youth perspective for improved road safety, safe streets, and public spaces)
 - Increased access to urban services

- Financial criteria
 - Needed infrastructure cost (part of the KPEC and additional requirements)
 - Estimated economic gains
- Environmental criteria:
 - Protection of natural and historic resources
 - Improved soil, air, and noise quality
 - Minimal use and maximal re-use of resources (energy, waste, water, ...)

This multi-criteria analysis is key to allow the client to communicate in a transparent and rational way the chosen optimal scenario and the Development plan to all relevant stakeholders.

The scenario's and evaluation will also allow to set up a Monitoring and Evaluation system, based on a result framework of the Development Plan.

This multi-criteria scenario building will be supported by an evaluation report, with matrices, geo-referenced plans on various scales and synthetic schemes.

Task 1 should be achieved in 6 calendar weeks.

Task 2: Benchmarks and best fit practices

Inspired by best fit practices in Central and East-Asia, task two will support task 1, to illustrate specific scenarios and provide information on similar situations that allow fact-checking. Task 2 will allow to select and elaborate an optimal scenario to be translated in a full-fledged spatial-economic vision in task 4.

Task 2 should be achieved in 6 calendar weeks, in parallel with task 1.

Task 3: Spatial-economic vision on WGP

Based on the spatial diagnostic, development scenarios and best fit practices, the consultant will elaborate a spatial-economic vision plan reflective of stakeholder needs and economic interests and highlighting the importance of spatial structures as a supporting layer to ensure that the planned investments and transformations will be economically efficient, as well as socially, environmentally effective, culturally equitable, and gender sensitive.

It includes:

- a spatial structure plan of key economic corridors and economic centralities (economic areas, logistic hubs such as the parking terminal upstream from Torkham, trucks terminals, branch roads connecting PTEX, logistic hubs/ industrial commercial zones to support SME development, trucks and goods terminals/cold storage etc.) to highlight integration with other programs (residential areas and services, blue and green network, ...);
- a conceptual Masterplan that illustrates spatial key concepts, areas of spatial and economic development, covering the entire WGP area with specific zooms on the major existing and planned public infrastructure and urban centers.

Task 3 should be achieved in 4 calendar weeks.

Phase 2 Development Plan for WGP

Task 4: Undertake a risk and resilience assessment and make resilience -related recommendations to be incorporated during development phases. The consultant will define together with the client, what are the different dimensions to consider during the assessment, such as security, natural hazards, economic development, institutional capacity, gender, environment, and climate.

This task should be completed in no more than 4 weeks.

Task 5: Informed by the spatial-economic scenario's and economic deep-dives, conduct a revised assessment of economic activity in WGP

The objective of this task is to offer a comprehensive and coherent reading of the analytical work achieved in previous tasks, informed by the deep-dives made in the field, but also by a higher level analytical work done on KPEC as a whole. Utilizing existing data sources such as economic census data, the establishment census, government strategic plans, and other documents, the first output of this task should be a descriptive assessment of current economic activity and existing clusters in WGP, not limited to the 4 clusters that were subject of deep-dives in tasks 1-8.

In order to do so, the firm is expected to:

1. Gather available data on economic activity in the governorates including data on employment, economic output, trade, etc. disaggregated by sector and governorate (as available in the latest Economic Census Industrial Survey, or other data sources).
2. Identify potentially emerging sectors based on recent or upcoming economic developments. This should be based on the consultant's knowledge of economic developments in Pakistan and further informed through desk review and interviews with government and private sector stakeholders.
3. Assess and map the structure and characteristics of all active economic clusters in WGP including the number of firms, size of firms, contributions to employment, output, etc. (this would be drawn from the above-mentioned databases).
4. Draw comparisons, where relevant, to Pakistan overall (i.e. broadly speaking how does contribution of sector X in WGP compare to Pakistan overall), and provide the revealed competitive advantage for Pakistan in the identified sub-sectors (using economic census data).

To the extent possible, the assessment should utilize time series data to generate some observations on the dynamics of the sector and clusters (growing or contracting).

The scope of this assessment will cover agriculture, manufacturing, and services. There is particular interest in (subject to change):

- Agro-industrial sub-sectors such as processed fruits and vegetables,
- Fresh horticulture exports (particularly organic),
- Livestock and dairy,
- Industries based on agricultural waste (sorghum or cane),
- Furniture,
- Textiles,
- Handicrafts,
- Minerals processing (as linked to potential developments under the Golden Triangle program),

For the purposes of this assignment, the focus should be on services that are most likely linked to productive activity including the following (subject to change):

- Transport and logistics
- Professional services (accounting, legal services, health services, IT consulting)

In completing this assessment, the consultant should compare and contrast his results with earlier work and explain the sources of differences. The Consultant will also build on the knowledge acquired through the deep dives.

The consultant will finally redraft a high-level assessment of economic opportunities in WGP, as well as high-level recommendations to remove constraints preventing firms from materializing such potential.

This will be incorporated in the output of task 6.

This task should be completed in no more than 4 weeks, in parallel with task 4.

Task 6: Elaborate a spatial-economic development strategy of WGP based on a risk and resilience assessment and an economic assessment, that

- articulates the vision in a prioritization of investments in public infrastructure and propose development phases.

- recommends timelines for rolling out of the proposed components: construction projects /plans for priority infrastructure, connecting roads and securing major investment initiatives to promote broaden private sector economic activities in industrial zones etc...
- identifies anchor investors if applicable for public/private partnerships.
- defines needed review of spatial regulations (land use, density, ...).

It includes:

- A combined economic and urban development plan, focusing on relevant areas for economic development (existing, upgraded and new economic zones) and mixed-use urban development (settlement upgrading, urban expansion, resettlement). It highlights planned hierarchy of settlements and economic zones, as well as integrated and systematic growth of trunk infrastructure and services in the study area. It will also describe guidelines for the emerging developments corridors, strategic locations and suggest parameters for densification, floor areas, programs.
- A transportation plan, highlighting the existing and planned investments in transportation infrastructure
- A strategic interventions plan, highlighting the strategic locations and their support system (road and mobility infrastructure, services, access to resources). This plan includes zoom-ins plans on strategic location, that highlights the context of every strategic location and connectivity between them and/or with the overall KPEC area.
- A management plan, highlighting needed spatial plans and policies (adapted land use, ...) as well as economic regulations and policies.
- Phasing plans, highlighting various phases on a timeline 2025
- 3D Computer generated images (3D walkthroughs and perspectives, multimedia presentation)

This task should be completed in no more than 4 weeks.

Task 7: ToRs for feasibility studies and preliminary designs for strategic economic investments locations

The consultant will define the ToRs for the strategic economic investments locations to be elaborated in Module IV:

- Parking terminals upstream from Torkham to complement ADB investments and support to the implementation of the TIR to reduce waiting time at the border.
- An international bus terminal to service buses traveling between Afghanistan and Pakistan.
- Integrated logistics hubs and industrial / commercial infrastructures to support SME development in viable locations in WGP (e.g. existing and viable industrial zones-Sha Kas, Bara, new zone near Jabba Dam, any other viable zone along the corridor);
- Other locations to be selected, based on the spatial-economic development strategy of the KPEC Development Plan

The ToR will include a description of the spatial existing situation, economic profile, and requirements for planned development.

This task should be completed in no more than 4 weeks.

Task 8: Final report Module III: KPEC Development plan for investments and infrastructure programs

In this task, the consultant should prepare a draft final report 'KPEC Development plan for investments and infrastructure programs, based on a combined spatial and cluster competitiveness assessment in Western Greater Peshawar', based on the outputs of all tasks, in addition to a presentation and an executive summary of the entire project. The draft should be available for review no more than 2 weeks after the finalization of task 7.

The draft will be reviewed by the client within 3 weeks. The consultant will submit a final report one week later.

7. Module IV: Feasibility studies and preliminary designs for strategic economic investments locations

7.1 Objectives

The objective of this module of the assignment is to study in depth specific strategic economic investments locations that have been selected in the KPEC development plan (elaborated in Module III), as well as to accelerate its development, through stakeholder engagement and preliminary design of infrastructure investment. This study entails the analysis, conceptualization of a realistic future development of these sites, as well as the elaboration of an implementation strategy.

7.2 Scope of work and key tasks

The consultant will define in Module III the ToRs for the strategic economic investments locations to be elaborated in this Module IV. The selection of the locations will be made during the development of KPEC Development plan, based on a preliminary list (see Module III, task 7).

For every selected strategic economic location, the following tasks will be executed. The description of tasks below is based on the needed details in terms of feasibility, spatial design requirements and economic programs (industrial and/or other economic activities, logistics, mobility hub, ...).

The assignment and resulting deliverables will be comprised of the following tasks. It is expected that many of the tasks will be carried in parallel for two or more strategic locations, with multiple teams working simultaneously. The final report will be encompassing and synthesizing the findings of the tasks:

- **Task 1: Refine and finalize mission schedule and methodology**
- **Task 2: Situation analysis existing situation**
- **Task 3: Conduct field work and stakeholder interviews in the study area**
- **Task 4: Development urban planning framework**
- **Task 5: Masterplan strategic location**
- **Task 6: Final report feasibility study and preliminary design strategic location**

7.3 Detailed description of tasks

The ToR for this Module IV will already be made in Module III, task 7. The following structure of tasks is therefore illustrative but describes a clear sub-set of tasks to be included in the ToRs.

Phase 0: Inception

Task 1: Refine and finalize mission schedule and methodology

Following consultations with the client and based on the ToR for the strategic economic investments locations that has been elaborated in Module III, the consultant should propose a note refining the implementation schedule and methodology of the mission in no later than 2 calendar weeks after the start of this part of the assignment.

Phase 1: Feasibility and masterplan phase

Task 2: Situation analysis existing situation

Based on the ToRs drafted in Module III and that include a description of the spatial existing situation, economic profile and requirements for planned development, the consultant will describe in more detail and in a strategic way the existing situation of the specific strategic location.

The situation analysis will build on the information previously gathered in Module I, II and III: existing body of geo-spatial data, mapping of existing and planned infrastructure and developments, as well as relevant spatial planning policies, governance bodies and strategic projects.

The situation analysis for the strategic location will include the following themes:

- Spatial situation analysis: territorial characteristics, functional uses, morphology and typology existing buildings and infrastructure
- Land use and ownership: administrative boundaries, land use, parcel structures, ownership
- Stakeholder map: owners and users, accountabilities public authorities, investors and influencers
- Base map: topography, administrative borders, land use, parcels, built-up area

This analysis results in geo-referenced plans on various scales and in synthetic schemes. The consultant will specify scales in the proposal and ask confirmation to the client at the beginning of this task.

This task should be completed in no more than 6 weeks.

Task 3: Conduct field work and stakeholder interviews in the study area

On-site field surveys will cover the strategic location and its direct surroundings. As most strategic locations had been visited in Module I the visits will focus on stakeholder meetings on-site, in focus groups as well as individually. The Consultant should make full use of the convening power of the KP planning agencies, to meet with relevant government officials and administrations, but also needs to ensure direct and meaningful consultation with relevant stakeholders. The consultant should prepare an informal questionnaire to help structure questions with public authorities and stakeholders

Meetings can be done in focus groups as well as individually. The Consultant should make full use of the convening power of the KP planning agencies, to meet with relevant government officials and administrations, but also needs to ensure direct and meaningful consultation with communities, key owners, investment associations, and other relevant stakeholders. The consultant should prepare an informal questionnaire to help structure questions with public authorities and stakeholders, and to ensure consistency across types of groups and territorial coverage of the area of and around the location.

Field work results in photograph reports and minutes of interviews and meetings.

Task 3 should be achieved in 6 calendar weeks, in parallel with task 2.

Task 4: Development location development framework

The consultant will develop an urban planning framework for the strategic location, based on a critical reading and analysis of the existing situation, the site visits and stakeholder interviews, thereby revealing opportunities and threats related with the planned economic development and infrastructure projects.

Schemes and text with quantitative and qualitative data will underpin the urban planning framework that is broken down in various themes:

- Spatial vision and guidelines.
- Functional programs and zoning.
- Quantification of existing and required space, uses and infrastructure.
- Description of economic profiles and conditions.

In this task, the consultant should prepare an intermediate report.

Task 3 should be achieved in 4 calendar weeks.

Task 5: Masterplan strategic location

The consultant will develop scenarios based on the urban planning framework, test feasibility and optimize to a masterplan that includes the following elements:

- Conceptual plan of the strategic location that shows its integration in wider spatial and functional context.
- Land Use Distribution and Public Utilities Layout Plan.
- Preliminary Design of Infrastructure and Infrastructure Planning.
- Initial Environmental Examination (IEE).
- Plan Development/Implementation Scheme.
- Visualizations with 3D Computer generated images (3D walkthroughs and perspectives, multimedia presentation)

This task should be completed in no more than 8 weeks.

Task 6: Final report feasibility study and preliminary design strategic location

In this task, the consultant should prepare a draft report on the outputs of tasks 1-4 immediately upon the end of task 4. A more elaborated version of the draft will be submitted 3 weeks later (including a 10-day period for the client to provide feedback).

8. Module V: Roadmap for implementation

8.1 Objectives

The objective of this module is to develop a roadmap for implementation, that ensures implementation of the KPEC Development Plan. Implementation has two levels: pursue the further development of planned investment projects as elaborated in Module III and Module IV, but also the strengthening of the needed enabling environment to obtain structural development on all levels and with a horizon that goes further than the investment program.

8.2 Scope of work and key tasks

The consultant will develop a roadmap to support the client in implementation of the KPEC Development Plan with at least the following topics covered. To address these topics effectively already during the entire assignment, the consultant will integrate these topics in the process methodology to propose for every module and the entire assignment.

Therefore, the consultant will formulate which support it will develop to support the process of the entire assignment and that will facilitate the elaboration of following specific tasks of Module V:

Task 1: Review the current regulatory and legislative framework and make recommendations for the most appropriate legislative and regulatory framework (comprising new or existing legislation), to support private sector development in WGP and to trade through Khyber Pass.

Task 2: Review current coordination mechanisms between federal, provincial, bilateral, and multilateral and private stakeholders and propose the most appropriate mechanism with all stakeholders to enable collective decision making, preparation and implementation of the KPEC Development Plan. The mechanisms should foster private sector and local communities' engagement in implementing the program.

Task 3: Undertake an assessment of PPP framework in KP/FATA and make recommendations for the most appropriate institutional, legal and regulatory framework to encourage private sector participation as prime movers in the implementation of the program, especially identify pipeline PPP priority projects and make recommendations for PPP transactions;

Task 4: Develop a **capacity development plan**, proposing adapted coordination mechanisms between federal, provincial, bilateral, and multi-lateral and private stakeholders, as well as enhancing technical capacity **of KP Urban planning unit**.

These tasks should be completed in no more than 16 weeks.

These tasks will accumulate in a report 'Road map for the KPEC Development Plan'. The consultant should prepare a draft report on the outputs of tasks 1-4 immediately upon the end of task 4. A more elaborated version of the draft will be submitted 3 weeks later (including a 10-day period for the client to provide feedback).

Section-II: Detailed Masterplan for the development of the Urban Centers of Jamrud and Landi Kotal in Western Greater Peshawar.

Specific context of the two urban centers Jamrud and Landi Khotal

The two urban centers are important due to their specific location in the KPEC corridor

- Jamrud: Jamrud Fort and gate, Chaura Khwar river and overpass, 17 km west from Peshawar
- Landi Kotal: collection of villages packed in a valley between mountains, north of the historic N5, 2 km east from border with Afghanistan, historic terminal of Khyber Pass Railway (closed), tourist destination, major market in the region (Bazar);

The masterplans need to respond to specific needs and take specific challenges into consideration:

- Both: existing demand in housing and related amenities (parks, playgrounds, museums, art, cultural center, sports), local public services (town hall and administration, education, health, judicial and policy, social well-fare, fire brigade), tourist infrastructure (museums, points of historic, natural and cultural interest), economic services (commercial zones, industrial zones, agricultural and green sector facilities, skill centers), local transportation infrastructure (bus network and stops, parking, walkways), required resource infrastructure (energy, land fill, water, sewage treatment, ...)
- Landi Khotal: deficiencies in road infrastructure which impede movement and trade with KA, with unpaved roads to villages and marble deposits in the hinterland villages. The KPEC corridor development is expected to influence the urban center, due to expected growth of the market, with close proximity to the new PTEX highway and improved connectivity of the KPEC infrastructure sub-projects within the region; with reduction of traffic or shift of modes of traffic
- Jamrud: The KPEC corridor development is expected to influence the urban center, with the planned Shah Kas Industrial Zone, upgrades of existing industrial estates, and development of bypasses.

Main Objective

The overall objective is to elaborate detailed Masterplans **for the urban centers of Jamrud and Landi Khotal**, two towns situated in the KPEC area.

Based on a detailed diagnostic of the existing situation and the formulation of the needs for these two towns, and informed by the larger development strategy and vision that will be elaborated in the development plan for the KPEC investments and infrastructure program, these masterplans will ensure that the KPEC investment will have maximal effect on the local level and that the urban development of the two urban centers will maximally support the KPEC investment

The masterplans will foster a long term holistic planning vision through a collaborative process, to

- Identify and delineate a comprehensive and common administrative boundary which will be adopted as administrative limits for integrated spatial planning, phased urban development, resource management and service delivery.
- Identify areas/corridors for the future spatial growth of the district headquarter while addressing environmentally sustainable & equitable opportunities, disaster resilience and enhanced mobility & accessibility.
- Identify housing needs in terms of quantity, typology and affordability, responding to estimated demographic growth and changes, to provide affordable, diverse and environmentally sustainable housing to cater for the demands arising from all income groups and classes from society
- Identify local development growth and spatial conditions that strengthen livelihoods and enhance an investment climate on the scale of the urban center
- Identify natural and cultural resources, that should be protected and integrated in a regional vision
- Enhance accessibility and mobility for local residents and entrepreneurs
- Enhance access to urban municipal services, following principles of sustainability and affordability for all.

The masterplans will also describe specific strategies to address thematic issues:

- a housing plan with comprehensive strategies that responds to the identified needs, and specifies locations, density, quantity of provision of a variety of housing in terms of typologies (including vertical condos, mixed use, vertically shared 2-3 storied residences) and affordability (mixed-income housing and the in-demand suburban housing), as well as development and financing mechanisms, and architectural quality standards.
- a local development plan with comprehensive strategies for the promotion of sustainable local economic growth, informed by a diversified local & regional economy.
- a protection plan with comprehensive strategies to conserve and maintain the natural terrain of the area and promote local tourism to enhance livelihood opportunities, including projects to protect the physical environment, land fertility and other natural and cultural resources of the area, in order to utilize its potential at regional level.
- a mobility plan that supports planned growth of the urban center and augmented by ancillary road infrastructure. This augmentation and enhancement should be primarily focused on pedestrian infrastructure and public modes of commuting.
- An infrastructure plan for the provision of improved and environmentally sustainable infrastructure to extend essential urban municipal services at affordable price including water, electricity, gas, sewerage, drainage and telecommunication across the town limits, to enhance quality of life and to enable transition towards clean energy, circular economy and use of resources.
- An urban resilience plan with comprehensive strategies to enhance risk informed planning and preparedness against natural disasters.

The masterplans will also describe specific actions to ensure implementation of the masterplan:

- A roadmap for Institutional re-structuring/reforms and capital Improvement Planning to support effective plan implementation, monitoring, review and revision at regularly anticipated intervals.
- Devising Action Plans for different areas of plan implementation, project development and financing. These plans should assign implementation responsibilities, phasing for different plan tiers and options for revenue generation and cost recovery.

- Assessment of the feasibilities for development of workable framework for plan implementation and projects development through public private partnerships (PPP), joint ventures, BOT and through standalone public interventions.
- Strategies to establish an improved system of urban governance to enhance livability, improved service delivery and financial sustainability.

The consultancy assignment(s) is/are designed to support the client in achieving that and will have two modules, with every module referring to one urban center.

Modules 1 and module 2 will be elaborated in parallel in phase 0, 1 and 2. They will seek consistency between each other, although they deal with two separate urban centers.

The consultancy assignment will be elaborated in parallel with another assignment for the KPEC Development Plan in its analytics and diagnostics phases.

Module x: Detailed masterplans for every urban center

The description of tasks below is based on a needed strategic local masterplan for the urban centers Jamrud and Landi Kotal.

The assignment and resulting deliverables will be comprised of the following tasks. It is expected that many of the tasks will be carried in parallel for two or more strategic locations, with multiple teams working simultaneously. Every detailed masterplan is developed in three phases. The final report will be encompassing and synthesizing the findings of the tasks:

- **Task 1: Refine and finalize mission schedule and methodology**
- **Task 2: Review and assess existing reports and studies on WGP**
- **Task 3 Production of a land use and base map of the study area**
- **Task 4. Land Cover Analysis**
- **Task 5: Conduct field work in the study area**
- **Task 6: A focused spatial analysis**
- **Task 7: A profile of the urban center**
- **Task 8: Security & Safety**
- **Task 9: Urban development strategy**
- **Task 10: Urban Design and Public Realm Profiling**
- **Task 11: Historical/Social/Culture Heritage**
- **Task 12: Establish a detailed masterplan for every urban center**
- **Task 13: Final report for every Detailed Masterplan**

All works in the master planning level (analysis, diagnostics, concept and definitive detailed masterplan,) will accommodate at a minimum, technically feasible infrastructure components. The consultant has the discretion to suggest additional complementary urban centers, which may be added to assignment.

Phase 0: Inception

Task 1: Refine and finalize mission schedule and methodology

Following consultations with the client, and considering the review made in Task 1, the consultant should propose a note refining the implementation schedule and methodology of the mission in no later than 2 calendar weeks after contract signing.

Phase 1: Descriptive analytics

The existing situation will be studied in detail through field investigations/studies, best practice knowledge, and background studies/analysis including disaster and earthquake studies, and shall essentially develop profiles for these socio-economic components and same shall be used to analyze to assess opportunities and constraints which will be helpful to develop land use zoning and strategic framework.

The consultant should develop a comprehensive base map, which shall be turned over to the client at the end of the assignment. This base map and the underlying geospatial data should be fully compatible with GIS based decision support applications that can be used further by the client.

Task 2: Review and assessment of existing reports and studies on the urban center

Immediately upon contract signing, the consultant should review the existing body of geo-spatial data, mapping of existing and planned infrastructure and developments, as well as relevant spatial planning policies, governance bodies and strategic projects. The Consultant will in particular reach out to the GIS Cell P&D Department that is in the process of mapping most of the public infrastructure.

For every town area, following categorization to define:

- Existing urban center,
- Potential settlements around the urban center and their impact and role on the promotion after implementation of the master plan
- Peri-urban area and their commuter impact on nearby commercial hub
- If relevant, the agglomeration of villages, which are completely depended on the Town

Task 2 should be conducted for the entire town and relevant adjacent areas. This should be achieved in 3-4 calendar weeks.

Task 3 Production of a land use and base map of the study area

A GIS/MIS **based detail land use Base Map** will be prepared for the quantification of built up, infilling, brown fields and open land available for future development for the projected administrative boundary. A detailed land use map for the district headquarter will also be prepared. Land uses shall be registered separately for both built-up area and peri-urban area (within the agreed planning boundary).

The satellite imageries will be acquired from authentic source and shall to develop an updated base map including surrounding areas in order to support suitability analysis of existing and proposed land uses for urban development and other ancillary uses. Land use survey of each type is a necessary prerequisite of this study. A GIS based digital Land use map which can be reproduced at various scales according to the need will be developed accordingly. Following layers and attributes (but not limited to) should be included in the base map:

1. Administrative Boundaries at UC and mauza level
2. All major and minor streets, roads, (Roads and Streets to include Right-of-Ways Information
3. Water supply, sanitation, sewer, telephone and data networks
4. Water bodies (spring, streams, river and other water bodies) and mapping of topography, natural resources, natural drainage, seasonal and permanent ponds and storage, and the overall watershed

5. Risk mapping of environmentally sensitive areas and areas prone to natural disaster such as earthquakes, flood prone areas and zones with potential land slides
6. All land parcels with attribute information on their land uses, planned/unplanned status, building heights and pictures etc.
7. Amenities (education, health, religious, banks, police stations, libraries, community halls,...)
8. Historic and heritage sites
9. Parks and playgrounds
10. Brown fields and Greenfields
11. Open spaces (agriculture all types, vacant, parks, play areas, green spaces both planned/unplanned and graveyards,...)

Additionally, the consultant undertakes a **detailed survey** of the whole peri-urban area, surrounding agriculture areas and natural features, allowing to recommend growth directions and land use for future development. The survey shall be adequate to develop topographic surveys further during design and implementation.

Task 3 should be achieved in 6 to 8 calendar weeks.

Task 4. Land Cover Analysis

A land cover classification of the district headquarter shall be performed by acquiring at least 5 raster images (having min 7 bands) in last 30 years. The results of the land cover classification will further be used for various tasks under this assignment such as employing GIS-based Land Suitability and spatio-temporal growth analysis.

Task 4 should be achieved in 4 to 6 calendar weeks, in parallel with task 5 and 6.

Task 5: Conduct new field work in the study area

On-site field surveys will cover the area of the urban center and its immediate surroundings.

Meetings can be done in focus groups as well as individually. The Consultant should make full use of the convening power of the KP/FATA planning agencies, to meet with relevant government officials and administrations. The Consultant needs to ensure direct and meaningful consultation with communities and other relevant stakeholders through public hearings and stakeholder meetings at different levels, so that the community owns the outcomes of the analysis and diagnostics that will lead to the masterplan. Surveys need to be conducted to enrich socio-economic situations, transportation and commercial activities in task 6.

The consultant should prepare an informal questionnaire to help structure questions with public authorities and stakeholders—and to ensure consistency across types of groups and territorial coverage of the Western Greater Peshawar.

Field work results in photograph reports and minutes of interviews and meetings.

Task 5 should be achieved in 4 to 6 calendar weeks, in parallel with task 4 and 6.

Task 6: A focused spatial analysis

The consultant will conduct a spatial analysis of the existing situation and planned interventions on the scale of the strategic locations. The analysis will cover the following themes:

- **6A Household Sample Survey for Gathering Essential Data on Housing, Transport Services and Amenities**

A sample-based household surveys will be conducted to obtain the following but not limited to:

- a. Household characteristics: Number of household members; ages; ...
- b. Housing: existing number of houses; condition of house, type of structure, age, construction material (floor, walls, roof), attached or detached; housing tenure; number of habitable rooms, occupancy; services; access and quality of services; rent in relation to the income of the family.
- c. Transport: place of employment; type of employment; mode of transport; time taken to travel to place of employment
- d. Neighborhood characteristics: distance from primary or middle school to home; mode and cost of travel from home to school; availability of basic and specialized health facility; distance from basic health facility; mode and cost of travel and health services; place of recreation; type of recreation for adults and children; access and distance to be travelled; perception of safety and security in neighborhood (by gender and age, if possible)

The survey will allow to develop scenarios of change after implementation of the KPEC development plan and investments.

- **6B Density**

The density analysis will be performed to identify following elements

- a. The relationship between different built up area and population density
- b. Assessment of infrastructure requirements
- c. Identification of encroachment of public land
- d. Appropriate availability of land for specific activities and services required by residents for good quality of life.
- e. Areas suffering from and causing congestion

- **6C Infrastructure**

The infrastructure surveys of existing infrastructure within and surrounding the study area will be conducted to determine the consistency and accessibility of infrastructure. Such surveys would include the quantity and quality of existing social and physical infrastructure survey. Physical Infrastructure surveys would include the survey of transportation, water supply, waste water, sewerage, solid waste management and telecommunication infrastructure. Social infrastructure would include the educational, civic and utilities, health care, recreation infrastructure etc.

Most of the public infrastructure is in the process of being mapped by GIS at the P&D Department.

- **6D Transportation**

Comprehensive transportation surveys will be conducted to comprehend the transport network and movement of commuters in the district headquarter. It would include following surveys as well.

- a. Inventory of road network
 - To identify the physical characteristics of the identified road network in terms of right-of-way, carriage way, number of access points, surface type, abutting land use.

- To identify physical constraints and bottleneck points along the identified road network.
- To assess the capacity potential of the identified road network etc.
- b. Traffic Counts Survey. To find the vehicular flows, junction movements, peak hour volume and volume to capacity ratio
- c. Parking Counts. To find the Availability of Parking Space, Type of Parking, Occupancy, Frequency, and Turnover.
- d. Parking Inventory. To find the Geometry, Generated Parking Demand, Site Constraints and Local Conditions.
- e. Cordon Line Survey. To find the Incoming and Outgoing traffic flow rates, External-Internal, External-External and Internal-External Trips Information
- f. Origin Destination Survey. To find the Route Choice, Travel Time, Mode Choice,
 - g. Public Transport Survey. To find the Journey Time, Safety, Comfort, Fare Rates, Driver/Conductor attitude. Occupancy etc.
- h. Traffic Signage Survey. To find the Current Condition and requirement of Signs
- i. Mobility Survey. To find the Synergy between Land-use and Transport.

- **6E Historical Resources Including Tourist Sites**

A survey will be conducted within the Study Area for any cultural, historical or archaeological resources (i.e. areas, landscapes, sites, structures or buildings) having local, regional or provincial significance or potential future significance. A report shall be furnished regarding its assessment on preservation, conservation and integration of such resources within the entire WGP area. The task will allow to identify the economic value of tourism in the area, looking at it from the angle of economic development or the earning potential of it for the local people, organization, public sector bodies.

Task 6 should be achieved in 4 to 6 calendar weeks, in parallel with task 4 and 6.

Phase 2: Critical diagnostics

Task 7: A profile of the urban center

The consultant will describe the profile of the urban center. The analysis will cover the following themes:

- **7A Regional Accessibility**

The existing regional accessibility and its potential to accommodate the future commuting requirements etc. shall be evaluated in relation to the proposed zoning and development opportunities. A Regional Accessibility Map showing settlements in 100 km radius, with volume of traffic and commuting requirement in phases will be produced with narrative analysis.

- **7B Economy (Industry, Trade & Local Commerce)**

A detailed profiling of industry and commerce sector of Urban Hubs will be prepared including but not limited to the following:

- a. A sectoral profile of commerce and industry of the district headquarter in terms of type of activities, spatial growth, employment and share to the district headquarter's economy.
- b. Past and present development interventions in commerce and industrial sector

- c. Local, provincial and national level policies of commerce and industrial sector
- d. Collecting information from available secondary sources.
- e. Information about the adequacy of facilities and infrastructure that support these activities.

- **7C Housing and informal Settlements**

A comprehensive profile will be prepared for the housing situation of Urban Hubs focusing on following:

- a. Mapping of existing housing areas
- b. Inventory of housing institutions and their services
- c. Inventory of existing government and privately developed housing areas
- d. Inventory of settlements and abadis
- e. Inventory of government and privately-owned land banks for housing, if any
- f. Assessment of housing shortage and potential housing need in future
- g. Past and present development interventions in housing sector
- h. Local, provincial and national level policies of housing sector
- i. Collecting other relevant information from available secondary sources

- **7D Social Infrastructure**

A profile of social infrastructure situation that heavily contributes towards a quality life.

It would include the profiling of infrastructure like education facilities, health care facilities, religious facilities, arts and cultural facilities, recreational facilities, sports facilities and police services etc.

Primary data to include mapping of all physical assets of all departments within the district headquarter, preparing inventory and developing a GIS based database for future use and updating.

- **7E: Tourism Potential Assessment**

A quick-scan analysis to determine the existing tourism potential of the specific urban center and its related surrounding environment will be performed, based on the Tourism Potential Assessment for the entire region FATA (2009). This will be in relation to the existing tourism spots around and within the district headquarter. Further, the potential impact of this intervention which is likely to attract local, national and regional tourism in to this district headquarter and areas around in planning phase will be analyzed. Based on the assessment and criteria for ranking proposed a Map of potential Tourism sites, spots shall be produced.

The assessment will also take into account the Tourism project that the World Bank is preparing in KP. Although it does not include FATA, some of the actions taken by KP will be deployed in FATA most promising cultural heritage areas.

- **7F Water Supply, Sanitation and Waste Management**

Following studies will be conducted in this sector:

- a. Profiling of all Municipal Services including the identification of new and existing sources water supply (depletion rates of water and sub-soil aquifer data) & their mapping, sanitation and solid waste management along with existing conditions of (sources of water and their depletion rates as sub-soil aquifer data and surface run off calculation), Sewage flows and their mean calculation, solid waste tonnage calculation, methods of collection and disposal (landfills capacity and locations) etc.
- b. Identification of the depressed areas in term of services and facilities. Policy directions and action plan is required to generate funds for construction, maintenance and operation of public amenities at feasible locations.
- c. Collecting relevant information from available secondary sources, such as NGOs who have worked on water supply schemes to the region. These mini-projects can produce plenty of input on the viability of such initiatives in the future vs large scale urban water supply plans.

- **7G Environment Profile**

The environment will be analyzed in order to safeguard and improve through SEA the likely negative environmental impacts of the proposed new developments. Study of various resources responsible for environmental pollution (air and water) is necessary and remedial measures are required through this study. For the task, the following surveys within the agreed planning boundary for both urban and peri-urban components will be conducted:

- d. Air quality survey at various points
- e. Water quality analysis (drinking water supply and water courses)
- f. Soil contamination surveys
- g. Soil and geological survey/data
- h. Analysis of Noise level at various points
- i. Identification of environmental sensitive areas
- j. Reviewing Local, provincial and national level polices of environment sector

Task 7 should be achieved in 6 calendar weeks.

Task 8: Security & Safety Assessment

Natural hazard confronting the community of the urban center will be assessed, in particularly seismic studies. Elements of built environment at a risk from natural hazards will also be taken in due consideration. Analysis of Current and projected needs in terms of enabling policies, support infrastructure, etc. will be carried out

Task 8 should be achieved in 3 calendar weeks.

Phase 3: Concept masterplan of the urban center

Based on the spatial conditions (historic and culture, nature, ...) and functional conditions (mobility, land tenure and structure), the consultant will draft a concept masterplan with the following content:

Task 9: Urban development strategy

Based on minimum three scenario's and inspired by best fit practices in bordering regions of Central and East-Asia, a development strategy is defined and elaborated:

- Localisation of needed urban expansion, upgrading areas, resettlement
- Localisation of existing and new local services
- Calculation of density, built-up area, functional zones
- Visualization of adapted parcel and building structures

Task 9 should be achieved in 8 to 10 calendar weeks, in parallel with task 10 and 11.

Task 10: Urban Design and Public Realm Profiling

The existing building lines, public spaces, vistas, sidewalks, street lighting, monuments, parks etc., for improvements will be analyzed to identify opportunities for creating new such sites.

Urban design aspects for the existing and new development will be proposed using the historical buildings and structures' vocabulary, to promote walkability, accessibility, social interactions, celebration of physical heritage, etc.

Task 10 should be achieved in 8 to 10 calendar weeks, in parallel with task 9 and 11.

Task 11: Historical, Social and Cultural Heritage Protection Strategy

Appropriate guidelines for preservation, renovation and re-use of existing historical monuments/places, socio-cultural heritage of the district headquarter and suburbs (within 10 km radius) will proposed.

The strategies will be formulated to capitalize the economy and create social, cultural hubs and identify opportunities within and outside district headquarter

Task 11 should be achieved in 8 to 10 calendar weeks, in parallel with task 9 and 10.

Phase 4: Detailed masterplan

Task 12: Establish a detailed masterplan for every urban center

The following comprehensive plans of sector will be prepared.

- Land use zoning plan (reclassification plan)
- Housing development plan including neighborhood plans for new proposed zones as well as housing for the urban poor
- Urban regeneration and slums upgradation plan
- Economic development plan
- Traffic and transportation plan
- Water supply, sewerage & drainage plan
- Natural energy resources and conservation plan
- Solid waste management plan
- Tourism plan
- Social infrastructure and services plan (health, education, community facilities etc)
- Heritage conservation and preservation plan
- Urban security and disaster preparedness/management plan
- Environmental protection plan

- Implementation plan with institutional framework and financial options
- Financing plan, expected revenues, cost recovery potential and potential areas for PPPs or private sector involvement

The masterplan will also formulate recommendations for

- the review of current regulatory and legislative framework and make recommendations for the most appropriate legislative and regulatory framework
- the review current coordination mechanisms between federal, provincial, bilateral and multilateral and private stakeholders and propose the most appropriate mechanism with all stakeholders to enable collective decision making, preparation and implementation of the Masterplans for Urban Centers
- the most appropriate institutional, legal and regulatory framework to encourage private sector participation as prime movers in the implementation of the masterplans
- the needed capacity development and adapted coordination mechanisms between federal, provincial, bilateral and multi-lateral and private stakeholders, as well as enhancing technical capacity of local urban development agencies.

These recommendations will be elaborated more in detail in the KPEC Development Plan, Module V Roadmap for implementation.

Task 12 should be achieved in maximum 14 calendar weeks.

Task 13: Final report for every Detailed Masterplan

In this task, the consultant should prepare a draft final report ‘Detailed Masterplan urban center x’, based on the outputs of all tasks, in addition to a presentation and an executive summary of the entire project. The draft report will be prepared immediately upon the end of task 14. A more elaborated version of the draft will be submitted 3 weeks later (including a 10 days period for the client to provide feedback).

The consultant will also turn over all digital information (orthophotos, GIS, 2D and 3D vectoral plans, CAD designs, other documents).

DELIVERABLES, TIMELINE & PAYMENT SCHEDULE

The proposed duration for completion of the exercise, ideally looking at a period of 1 year or 365 calendar days from the date of signing of a contract, for completion of Modules I, II and III,

For modules IV, parts of the analytical work might be able to be started during Module I/II/III, to optimize the duration of exercises.

For module V, parts of the assignment also can be integrated during Module I/II/III.

Deliverable	Deadline	Payment Schedule (payment will be made upon acceptance of Deliverable)
Inception Report	2 weeks after commencement of services	10%
Draft Report Module I (section-1) and draft urban center master plan (section-II)	25 weeks after commencement of services	—
Final Report Module 1 (section-I) and Final	28 weeks after commencement of services	25%

Master urban center Master plans (section-II)		
Draft Report Module II	25 weeks after commencement of services	—
Final Report Module II	28 weeks after commencement of services	10%
Draft Report of Module III	22 weeks after Module II	—
Final Report Module III	28 weeks after Module II	15%
Draft Report Module IV	26 weeks after Module II	—
Final Report of Module IV	28 weeks after Module II	20%
Final Report of Module V	16 weeks after Module III received	20%

9 ESTIMATED WORKLOAD

The estimated total level of effort for the assignment is approximately 129 person-Months for Module I, II and III, to be implemented in one single calendar year.

10 REQUIRED EXPERTISE

10.1 Experts

The firm should employ at least the following key experts, with the following years of experience:

	Position	No. of Post	No. of Person Months	Required Experience
A	Key Experts			
1	Urban Planning Specialist/Team Leader	1	12	12 years
2	Expert Economist	1	12	12 years
3	Expert Urban Development Control/Regulation Zoning Laws Specialist	1	4	8 years
4	Ecological/Environmental Specialist	1	3	7 years
5	Transport Planning Specialist	1	4	7 years
6	PPP Specialist	1	6	7 years
		6	41	
B	Non Key Experts			
1	GIS/ MIS Specialist	1	6	7 years

2	Urban Finance/Revenue Generation Expert	1	3	7 years
3	Urban Infrastructure (WATSAN) Specialist	1	4	7 years
4	Statistical Analyst	1	1	5 years
5	Senior Research Analyst (Economics, Urban Planning, Transport, Environment & SWM)	2	24	5 years
6	Research Associate (Economics, Urban Planning, Transport, Environment & SWM)	4	48	2 years
7	Graphic Designer	1	2	2 years
	Total Input Non Key Experts		88	
	Total Input Key & Non Key Experts		129	

The Team Leader will be full-time **based in Peshawar** dedicated to the assignment with following responsibilities:

- Responsible for the overall coordination of the consulting assignment.
- In charge of the general planning of the activities.
- Responsible for informing the client of the evolution of the project and the progress of the activities.
- Directly responsible for the conduct and coordination of the different tasks of the mission.
- Responsible for the team of consultants based totally or partially in Pakistan.
- Responsible for informing the client of the evolution of the project and the progress of the activities.
- Responsible for selecting and engaging the necessary technical assistance for the organization and monitoring of reference trips.

Qualification & Experience of Key Experts

10.2 i. Urban Planning Specialist/Team Leader

- A Master's degree (or equivalent) or Ph.D. in the field of Urban Planning or Economic Development (or equivalent) or other relevant degree
- Preferably 12 or more years of relevant experience in the field of strategic consulting, analysis, design, and implementation of initiatives to strengthen regional economic and territorial planning
- Fluent in English, capacity to speak and understand Pashto, Urdu is a plus.

ii. Expert Economist

- A Master's degree (or equivalent) or Ph.D. in the field Economic Development (or equivalent) or other relevant degree
- Preferably 12 or more years of relevant experience in the field of strategic consulting, analysis, design, and implementation of initiatives to strengthen regional economic and territorial planning
- Fluent in English, capacity to speak and understand Pashto, Urdu is a plus.

iii. Expert Urban Development Control/Regulation Zoning Expert

- A Master's degree (or equivalent) in Urban Planning or Economic Development (or equivalent) or other relevant degree

- Preferably 08 or more years of relevant experience in the field of urban planning, land use planning and zoning, analysis, design, and implementation of initiatives to strengthen regional economic and territorial planning
- Fluent in English, capacity to speak and understand Pashto, Urdu is a plus.

iv. Ecological/Environment Specialist

- A Master's degree in a relevant field (e.g. environmental sciences, natural sciences; environmental engineering, civil engineering or other relevant disciplines, with demonstrated interest and experience in environmental management and environmental sustainability);
- Preferably 07 or more years of experience in the environmental management sector at the national level and international level with the same projects.
- Fluent in English, capacity to speak and understand Pashto, Urdu is a plus.

v. Transport Planning Specialist

- Master's Degree, or equivalent, in Transport/Civil Engineering, Transport Economics and/or Business or other related fields.
- Preferably 7 or more years of relevant professional experience in the transport sector, including preparation and implementation of transport projects, in any of the following areas: (i) highways and rural roads; (ii) road asset management, road financing, and road user charges; (iii) road safety; (iv) urban transport, including road, non-motorized transport, and travel demand management; (v) multi-modal logistics and cross border transport; (vi) intelligent transport systems; (vii) private sector participation in transport including public- private partnerships;
- Fluent in English, capacity to speak and understand Pashto, Urdu is a plus.

vi. PPP Specialist

- Master's Degree in Economics, Business and/or other related fields. University degree with specialized experience in Business Administration, Finance, Economics, Public-Private Policy in similar organization/s, may be considered in lieu of a Master's degree Extensive expertise in PPP development, preferably with experience in developing countries;
- Excellent analytical skills and sectoral expertise relevant to the investigation of key PPP policy issues
- Substantial track record of participation in infrastructure PPPs in as feasibility consultant.
- Strong experience in transport planning with preferably 07 or more years' experience, past involvement in informal transport in developing country an advantage.
- Substantial track record in successfully undertaking similar support roles providing high level advice on PPPs.
- Fluent in English, capacity to speak and understand Pashto, Urdu is a plus.

10.3 Skills

In addition to strong technical expertise, the team should also possess the following competencies and skills:

- Ability to synthesize and analyze substantial amounts of information from various sources (both qualitative and quantitative) and present it in a clear, compelling manner.
- Ability to work autonomously under limited supervision on a high visibility project.
- Excellent organizational and project management skills.
- Experience in WGP strongly preferred
- Excellent written and oral communication skills in English.

11 ANNEXES

- Annex 1: IDA – PAD Khyber Pass Economic Corridor Project (May 2018)
- Annex 2: Support in Development of Geo-Referenced Local Master Plan (GeoLoMaP) for the Peshawar-Torkham Economic Corridor (PTEC) and Surrounds (January 2018)
- Annex 3: Traffic Study Report For (Peshawar –Torkham Section), part of the feasibility study and preliminary design of Peshawar-Kabul motorway project (July 2017)
- Annex 4: Traffic and economic analysis report - Peshawar –Torkham Economic Corridor Project (March 2018)

- **Annex 1: : IDA – PAD Khyber Pass Economic Corridor Project (May 2018)**

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Report No: PAD1936

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT

IN THE AMOUNT OF SDR 320.3 MILLION
(US\$ 460.6 MILLION EQUIVALENT)

TO THE

ISLAMIC REPUBLIC OF PAKISTAN

FOR A

KHYBER PASS ECONOMIC CORRIDOR PROJECT
May 25, 2018

Transport & Digital Development Global Practice Finance, Competitiveness and Innovation Global Practice
South Asia Region

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CURRENCY EQUIVALENTS

(Exchange Rate Effective April 30, 2018)

Currency Unit =	Pakistan Rupee (PKR)PKR
115.77 =	US\$1
US\$ 1.43806 =	SDR 1

FISCAL YEAR

July 1 – June 30

Acting Regional Vice President: Ethel Sennhauser

Country Director: Patchamuthu Illangovan

Senior Global Practice Director: Jose Luis Irigoyen, Ceyla Pazarbasioglu-Dutz

Practice Manager: Olivier P. Le Ber, Nabila Assaf

Task Team Leader(s): Zafar Iqbal Raja, Moustafa Baher El-Hefnawy, Andrew Beath

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
APTTA	Afghanistan Pakistan Transit Trade Agreement
ASEAN	Association of South East Asian Nations
ATTA	Afghanistan Transit Trade Agreement
CARs	Central Asian Republics
CAREC	Central Asia Regional Economic Cooperation
CASA	Central Asia-South Asia Electricity Transmission and Trade Project
CIPK	Competitive Industries Project for Khyber Pakhtunkhwa
CoC	Codes of Conduct
CPEC	China-Pakistan Economic Corridor
CPF	Country Partnership Framework
CPS	Country Partnership Strategy
D&B	Design and Build
DA	Designated Account
DFID	U.K. Department for International Development
DPD	Deputy Project Director
EDI	Electronic Data Interchanges
EIA	Environmental Impact Assessment
EIRR	Economic internal rate of return
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ERKF	Economic Revitalization of Khyber Pakhtunkhwa and Federally Administered Tribal Areas
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
EU	European Union
FATA	Federally Administered Tribal Areas
FBR	Federal Bureau of Revenue (Pakistan Customs)
FC	Frontier Constabulary
FCS	Fragile and Conflict-Affected Situations
FDA	FATA Development Authority
FIDIC	International Federation of Consulting Engineers
FM	Financial management
FUCP	FATA Urban Centers Project
FWO	Frontier Works Organization
GBV	Gender-based violence
GDP	Gross domestic product
GeoLoMaP	Geo-Referenced Local Master Plan
GM	General Manager
GoA	Government of Afghanistan
GoP	Government of Pakistan
GRM	Grievance Redress Mechanism
GRC	Grievance Redress Committee
GRS	Grievance Redressal System
HDM-4	Highway Development and Management - 4
HO	Head office
IA	Internal audit
IP	Indigenous People
IPF	Investment Project Financing

IRI	International Roughness Index
IT	Information Technology
JBC	Joint Business Council
JEC	Joint Economic Commission
KfW	<i>Kreditanstalt für Wiederaufbau</i> (German government-owned development bank)
KP	Khyber Pakhtunkhwa
KPEC	Khyber Pass Economic Corridor
LAC	Land Acquisition Collector
MDTF	Multi Donor Trust Fund
MoC	Ministry of Communications
MoF	Ministry of Finance, Revenue and Economic Affairs
M&E	Monitoring and Evaluation
NGO	Non-governmental Organization
NHA	National Highways Authority
NPV	Net Present Value
NWFC	North West Frontier Constabulary
P&CA	Procurement and Contracts Administration
P&D	Planning and Development
PAP	Project Affected Person
PCR	Physical Cultural Resources
PD	Project Director
PDO	Project Development Objective
PIU	Project Implementation Unit
PKR	Pakistan Rupee
PPP	Public-private partnerships
PPRA	Pakistan Procurement Regulation Authority
PTEX	Peshawar Torkham Expressway
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SAFRON	Ministry of States and Frontier Regions
SCD	Systematic Country Diagnostic
SDR	Special Drawing Rights
SEA	Sexual exploitation and abuse
SMEs	Small- and medium-sized enterprises
SMF	Social Management Framework
SMP	Spatial master plan
STEP	Systematic Tracking and Exchange in Procurement
TIR	International Road Transportation (transit) Convention
TRS	Time Release Study
USAID	United States Agency for International Development
WB	World Bank
WGP	Western Greater Peshawar



BASIC INFORMATION

Country(ies)	Project Name	
Afghanistan, Pakistan	Khyber Pass Economic Corridor Project	
Project ID	Financing Instrument	Environmental Assessment Category
P159577	Investment Project Financing	A-Full Assessment

Financing & Implementation Modalities

<input type="checkbox"/> Multiphase Programmatic Approach (MPA)	<input type="checkbox"/> Contingent Emergency Response Component (CERC)
<input type="checkbox"/> Series of Projects (SOP)	<input type="checkbox"/> Fragile State(s)
<input type="checkbox"/> Disbursement-linked Indicators (DLIs)	<input type="checkbox"/> Small State(s)
<input type="checkbox"/> Financial Intermediaries (FI)	<input type="checkbox"/> Fragile within a non-fragile Country
<input type="checkbox"/> Project-Based Guarantee	<input type="checkbox"/> Conflict
<input type="checkbox"/> Deferred Drawdown	<input type="checkbox"/> Responding to Natural or Man-made Disaster
<input type="checkbox"/> Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
14-Jun-2018	28-Jun-2024

Bank/IFC Collaboration

No

Proposed Development Objective(s)

The PDO is to expand economic activity between Pakistan and Afghanistan by improving regional connectivity and promoting private sector development along the Khyber Pass corridor.

Components

Component Name	Cost (US\$, millions)
I. Expressway Development	402.75
II. Development of the Khyber Pass Economic Corridor	75.00



III. Project Management 5.00

Organizations

Borrower: Islamic Republic of Pakistan (acting through Economic Affairs Division [EAD])

Implementing Agency: National Highways Authority (NHA)

PROJECT FINANCING DATA (US\$, Millions)

SUMMARY

Total Project Cost	482.75
Total Financing	482.75
of which IBRD/IDA	460.60
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Development Association (IDA)	460.60
IDA Credit	460.60

Non-World Bank Group Financing

Counterpart Funding	22.15
Borrower	22.15

IDA Resources (in US\$, Millions)

	Credit Amount	Grant Amount	Total Amount
Pakistan			
National PBA	153.53	0.00	153.53
Regional	307.07	0.00	307.07
Total	460.60	0.00	460.60

Expected Disbursements (in US\$, Millions)



WB Fiscal Year	2018	2019	2020	2021	2022	2023	2024	2025
Annual	0.00	27.00	45.45	77.92	111.49	135.05	47.91	15.78
Cumulative	0.00	27.00	72.45	150.37	261.86	396.91	444.82	460.60

INSTITUTIONAL DATA**Practice Area (Lead)**

Transport & Digital Development

Contributing Practice Areas

Finance, Competitiveness and Innovation

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag**Does the project plan to undertake any of the following?**

a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF	Yes
b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment	Yes
c. Include Indicators in results framework to monitor outcomes from actions identified in (b)	Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	● Substantial
2. Macroeconomic	● Substantial
3. Sector Strategies and Policies	● Moderate
4. Technical Design of Project or Program	● Substantial
5. Institutional Capacity for Implementation and Sustainability	● Substantial
6. Fiduciary	● Moderate
7. Environment and Social	● Substantial



8. Stakeholders	● Moderate
9. Other	● Low
10. Overall	● Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

Yes No

Does the project require any waivers of Bank policies?

Yes No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
Natural Habitats OP/BP 4.04		✓
Forests OP/BP 4.36		✓
Pest Management OP 4.09		✓
Physical Cultural Resources OP/BP 4.11	✓	
Indigenous Peoples OP/BP 4.10		✓
Involuntary Resettlement OP/BP 4.12	✓	
Safety of Dams OP/BP 4.37		✓
Projects on International Waterways OP/BP 7.50		✓
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants

Sections and Description

FA, Schedule 2, Section I.B. 2, 4 and 5 and PA, Schedule, Section I.B.2, 4 and 5:

The Recipient shall, and shall cause the Project Implementing Entity to, ensure that:

- (i) the Project shall be implemented in accordance with the guidelines, procedures, timetables and other specifications set forth in the Safeguard Documents;
- (ii) prior to commencing any works under the Project: (A) all necessary governmental permits and clearances for



such civil works shall have been obtained from the competent governmental authority/ies; (B) all pre-construction conditions imposed by the governmental authority/ies under such permit(s) or clearance(s) shall have been complied with/fulfilled; and (C) all resettlement measures for the respective civil works set forth in the applicable Resettlement Action Plan, shall have been fully executed, including the full payment of compensation prior to displacement and/or the provision of relocation assistance to all Displaced Persons, as per the entitlements provided in the Resettlement Policy Framework and/or the applicable Resettlement Action Plan;

(iii) any contracts for civil works under the Project include codes of conduct in form and substance acceptable to the Association, detailing measures on environment, health and safety and preventing and responding to HIV/AIDS, gender-based violence, and violence against children;

(iv) safeguard reporting requirements shall be complied with; and

(v) a grievance redress mechanism for the handling of any stakeholder complaints arising out of the implementation of the Project activities shall be maintained throughout Project implementation.

Sections and Description

PA, Schedule, Section I.C:

The Project Implementing Entity undertakes that any decision to toll the Expressway shall apply in the same manner (and at same rate) to the alternative national highway.

Sections and Description

PA, Schedule, Section I.A.1:

No later than one (1) month after the Effective Date, the Project Implementing Entity shall establish, and thereafter maintain a steering committee, with terms of reference, composition and resources satisfactory to the Association, to provide overall direction and strategic guidance to the Project.

Sections and Description

PA, Schedule, Section I.A.2(a):

No later than one (1) month after the Effective Date, the Project Implementing Entity shall establish, and thereafter maintain, a project implementation unit with terms of reference, composition and resources satisfactory to the Association.

Sections and Description

FA, Schedule 2, Section I.C and Section III.A:

The Recipient shall provide an amount of not less than the equivalent of twenty-two million one hundred and fifty thousand Dollars (\$22,150,000) as counterpart funds for the Project, to be allocated to Land Expenditures and expenditures related to security during construction.

Conditions

Type

Disbursement

Description

FA, Schedule 2, Section III.B.1(b) (and dated covenant to be complied with no later than 1



	month after effectiveness, under PA Schedule, Section I.D.1): the Project Operation Manual has been prepared and adopted by the Project Implementing Entity in form and substance acceptable to the Association.
Type Effectiveness	Description FA, Section 4.01: Signature of the Subsidiary Agreement between the Recipient and the Project Implementing Entity



PAKISTAN

PAKISTAN: KHYBER PASS ECONOMIC CORRIDOR PROJECT

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I. STRATEGIC CONTEXT

A. Country Context

- 1. Pakistan has recently achieved high levels of economic growth and poverty reduction; and the focus now needs to be on the continuing development challenges.** With over 207 million people, Pakistan is the world's sixth most populous country. Provisional government estimates suggest that GDP grew by 5.8 percent for FY18, up from 5.4 percent in FY17. Economic growth has reduced poverty, with the poverty headcount halving from 64.3 percent in FY02 to 29.5 percent in FY14. However, inequality persists and Pakistan continues to underachieve in human development, ranking 147th out of 188 countries in the United Nation's 2016 Human Development Index. Pakistan also exhibits a large gender gap, with only 25 percent of women participating in the labor force compared to 83 percent of men.¹ The Government of Pakistan (GoP) has committed to achieve gender equality as a part of the United Nations Sustainable Development Goals (SDGs).²
- 2. *The global integration of South and Central Asia is intertwined with the Khyber Pass.*** The roadway between Peshawar and Kabul through the Khyber Pass represents a section of Corridors 5 and 6 of the Central Asia Regional Economic Cooperation (CAREC)³ and has served as the key node in trade between South and Central Asia for hundreds of years. Corridor 5 has the potential to provide the shortest link between the landlocked countries of Afghanistan, Tajikistan and Uzbekistan, and the Arabian sea; while Corridor 6 provides access to Europe, the Middle East and Russia. Improvements in transport connectivity are a key driver of regional economic cooperation among CAREC countries.
- 3. *Over recent decades, constraints on trade through the Khyber Pass have hindered the development of Afghanistan, Pakistan, and Central Asia and undermined the stability of northwestern Pakistan.*** Over the past century, border disputes, diplomatic tensions, successive waves of conflict, and dilapidated infrastructure have stifled the development of cross-border value chains spanning the historical trade route through the Khyber Pass. Despite strong demand for Pakistani products such as surgical instruments, textiles, fruits, rice, sugar, and cement and a market of nearly 70 million people, trade between Pakistan and the Central Asian Republics (CARs) is minimal, with Pakistan's exports in 2016 making up less than one percent of total imports by the CARs. While trade between Afghanistan and Pakistan nearly doubled in the decade up to 2015,⁴ flows dropped by about 30 percent over the past 2 years.
- 4. *Economic development is especially constrained in the Federally-Administered Tribal Areas (FATA).*** According to Pakistan's 2016 Multidimensional Poverty Index, 73 percent of the people in FATA live in multidimensional poverty compared to 43 percent in Khyber Pakhtunkhwa (KP) and 39 percent nationally.⁵ Revitalizing the historical trade route through the Khyber Pass is therefore important not

¹ Labor force participation rates for ages 15+. World Bank Gender Statistics 2017.

² See Annex 3 for further details on gender issues.

³ CAREC is a partnership of 11 countries (Afghanistan, Azerbaijan, China, Georgia, Kazakhstan, Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan) and is supported by six multilateral institutions.



⁴ Afghanistan is Pakistan's fourth-largest export market, accounting for 7.9 percent of exports in 2015.

⁵ The incidence of MPI is used because the Cost of Basic Needs National Poverty line for Pakistan, is not available as yet for FATA. However, as per the national poverty line, the overall poverty rate in KP in 2013-14 was at about 28 percent, compared



just for the economic development of countries across Central and South Asia, but also for the stability of an area vital to global security.

5. ***Appropriate reforms and public investments can enable northwestern Pakistan to not just serve as a conduit for international trade, but also to anchor regional and global value chains.*** Northwestern Pakistan has historically served as a node of trade between South and Central Asia and the area possesses the natural and human resources to support broad-based, export-oriented manufacturing. A ‘youth bulge’ in the population creates the potential for a demographic dividend, while the high urbanization levels offers the benefits of agglomeration economies.⁶ Finally, northwestern Pakistan’s large stocks of overseas migrant workers represent an under-exploited source of development finance, technology transfer, and export linkages.

6. ***Improvements in security, infrastructure investments, and renewed regional economic cooperation provide hope for the revival of cross-border trade and bolstering of economic growth.*** The security situation in northwestern Pakistan has improved over the past few years. In 2015, the reported number of insurgent attacks fell by almost one half, and a further drop of 28 percent in terrorist attacks was reported in 2016. And while the number of attacks increased in the first half of 2017, it dropped in the second half. The energy shortfall is gradually being addressed by the establishment of micro-hydro power plants, while investments in transportation infrastructure are addressing bottlenecks to connectivity between Peshawar and the rest of Pakistan. The planned merger of FATA with KP over the next five years will help remove regulatory differences between the two areas that have discouraged investment, reduced productivity, and limited access to essential inputs.⁷ Transformational projects, such as the Central Asia-South Asia Electricity Transmission and Trade Project (CASA-1000) and the Turkmenistan-Afghanistan-Pakistan-India Pipeline, are ushering in a new era of cooperation between governments in South and Central Asia.

B. Sectoral and Institutional Context

7. ***Infrastructure deficiencies restrict cross-border trade between Pakistan and Afghanistan.*** Large stretches of the road between Peshawar and the border at Torkham consist of a two-lane, 6.0-meter-wide carriageway with earthen shoulders, steep gradients and sharp curves considerably slowing travel by multi-axle commercial trucks. Previous efforts to improve the existing highway have been constrained not just by the terrain but by adjacent settlements and a historical railway line that parallels the road. At the border crossing, inadequate infrastructure and the need to exchange lanes creates bottlenecks that further slow cross-border traffic. Expensive informal levies assessed on the existing road by local and national agents further increase the costs of transiting the Khyber Pass.

to 29.5% for the country as a whole, with rural KP at 30 percent and urban KP at about 16 percent. While the MPI provides much higher estimates of both rural and urban deprivation in KP, and across the country, it shows the same declining trend in MPI over time.



⁶ According to *International Growth Centre (2015)*, two-thirds of KP's population lives within an hour from Peshawar.

⁷ Since independence, FATA has existed as a special region of the federation of Pakistan and has been managed under the Frontier Crimes Regulation (FCR), which represents a special set of laws enacted by the British in 1901. In the current transitional period, FATA is expected to receive about 3% in the National Finance Commission (NFC) award so that the region can be developed to bring it at par with the adjoining districts in KP.



8. **Administrative and regulatory barriers, institutional weaknesses, and infrastructure gaps also constrain the development of cross-border value chains anchored in northwestern Pakistan.** Afghan cargo transiting through Pakistan is subject to high levels of container insurance and security and detention charges, as well as multiple handling and inspection regimes. Closures of the border further increase costs and uncertainty. A 2016 Time Release Study (TRS) of the Torkham border observed average dwell times associated with processing formalities of shipments from Pakistan to Afghanistan of 12 hours and 23 minutes.⁸ Regulatory barriers, bureaucratic fragmentation, and the administrative disjuncture between KP and FATA weaken the ability of firms to increase productivity and discourage private investment. Essential infrastructure is often unreliable and expensive to access and firms and entrepreneurs have difficulty obtaining finance.⁹
9. **Realizing the economic potential of northwestern Pakistan requires the coordination of investments and complementary reforms.** Recent research indicates that complementary investments in trade and transport facilitation infrastructure and services as well as policy and institutional reforms to alleviate business constraints are necessary to realize the economic benefits of major investments in major transport infrastructure.¹⁰ Towards this end, GoP is addressing critical transport connectivity deficiencies, as well as reforming policies and regulations to alleviate barriers to trade movements and institutional impediments to the economic development of FATA.
10. **GoP is upgrading roads linking Peshawar to the Indian Ocean and to other cities in Pakistan.**¹¹ A key activity of Pillar-VII of the GoP's Vision 2025 is the development of road infrastructure for regional connectivity. Pakistan's National Highways Authority (NHA) is constructing a high speed, access-controlled transport corridor linking Peshawar, Islamabad, and Karachi. The on-going development of the China-Pakistan Economic Corridor (CPEC) – a US\$ 54 billion package of investments in road, rail, fiber-optic cables, and oil and gas pipelines – is designed to upgrade the infrastructure linking major cities in Pakistan to western China and the Indian Ocean.¹² NHA is also developing a connectivity program that will link Afghanistan to CPEC via border crossings at Chaman in Baluchistan and Torkham in FATA.
11. **Various actors are upgrading infrastructure between Kabul and Torkham, which in conjunction with KPEC, will enhance connectivity between South and Central Asia.** The Government of Afghanistan (GoA) has committed to enhancing connectivity between Kabul and Torkham. GoA is upgrading a 155-kilometer road between Kabul and Jalalabad (financed by the Asian Development Bank [ADB]) and a 76-kilometer additional carriageway between Jalalabad and Torkham (financed by GoP). GoA has also requested that the World Bank support a detailed feasibility study and preliminary design for a

⁸ IFC, World Customs Organization, and Federal Bureau of Revenue (2016). Time Release Study, Torkham Border, Pakistan – 2016. The dwell time for shipments from Afghanistan to Pakistan was an average of 34 hours and 8 minutes. Strikes by import agents during the study period contributed to the longer release times.

⁹ Only about 1% of banking system credit (PKR 52 billion; US\$ 508 million) is deployed in KP and FATA as of December 2016, despite these regions containing over 10 percent of the country's population as well as GDP (State Bank of Pakistan Data [December 2016]). There are very few banks and microfinance providers in FATA.

¹⁰ Asian Development Bank, Department for International Development, Japan International Cooperation Agency, and the World Bank. 2018. The WEB of Transport Corridors in South Asia. Washington, DC: World Bank.



¹¹ Roads carry 96% of Pakistan's inland freight. traffic movements are primarily concentrated along the 1,189 Km National Highway N-5 corridor, which connects Torkham, Peshawar, Islamabad, Lahore, and Karachi. Ports, roads and railways along the N-5 Corridor handle 96% of external trade and 65% of inland freight.

¹² Of the overall US\$ 54 billion CPEC investment, US\$ 35 billion is earmarked for electricity generation projects and US\$ 11 billion for transport infrastructure.



modern 4-lane controlled access expressway from Kabul to Torkham, which would connect to the proposed Peshawar-Torkham Expressway (PTEX).

12. ***Beyond transport, key investments are being made to reduce the costs of trade between Pakistan and Afghanistan.*** GoP is investing in electronic data interchanges (EDI) at the Afghanistan border through its accession to the International Road Transportation (TIR) convention and ADB is financing the upgrading of cross-border infrastructure at Torkham,¹³ including installing modern equipment, cargo inspection sheds, weigh bridges, and warehousing, truck parking, and immigration, communication, and power facilities. The Federal Board of Revenue (FBR) is also developing a National Single Window (NSW) through technical assistance provided by USAID. Afghanistan is also upgrading its border/custom processes with the support of the World Bank (WB). Pakistan and Afghanistan have recommenced dialogue to reverse declining trade between the two countries. Improving border infrastructure and systems at Torkham will address some of the trade bottlenecks. This project, along with the ADB's project, support the development of an efficient border crossing.
13. ***The legal framework for reviving trade among Afghanistan, Pakistan, and Central Asia is in place and is developing.*** Pakistan's provision of transit trade facilities to Afghanistan was first formalized under the Afghanistan Transit Trade Agreement (ATTA) signed in 1965. The agreement was enhanced in 2010, with the Afghanistan Pakistan Transit Trade Agreement (APTTA) providing reciprocal transit trade privileges to Pakistan to enter the Central Asia markets and Iran via Afghanistan. Recently, Tajikistan has requested to be part of a trilateral transit trade agreement; a draft agreement has been prepared, to which Pakistan has consented. The Kyrgyz Republic and Turkmenistan have also indicated their interest in being part of the agreement.
14. ***GoP and its development partners are promoting private sector development in FATA.*** The FATA Secretariat receives funds from bilateral and multilateral development partners, including USAID, the European Union (EU), Italy, Germany (GIZ-KfW), Switzerland, Kingdom of Saudi Arabia, United Arab Emirates, ADB, United Nations, and the Multi Donor Trust Fund (MDTF) for KP/FATA and Balochistan. Among the key initiatives, USAID funded the completion of Gomal Zam dam in FATA, and secondary road infrastructure around Peshawar; ADB funded the FATA Rural Development Project to support local farmers; the United Nations Development Program launched a US\$ 15 million FATA Economic Revitalization Program and the EU and KfW financed the Sarhad Rural Support Program to develop competitive value chains in KP and FATA. GoP is also upgrading several industrial zones in KP.
15. ***The FATA Development Authority (FDA) and FATA Secretariat are promoting skills development.*** FDA has provided vocational training to about 55,000 women and men in equal numbers. The FDA also supports on-the-job training and has established a job placement center.¹⁴ The FATA Secretariat is also implementing several skills development and technical training activities, with various line departments running short-term programs. The Prime Ministers Youth Skill Development Program is also implemented across FATA.
16. ***The World Bank is supporting inclusive economic development in FATA and KP.*** Since 2011, the WB-administered MDTF has financed several projects in FATA, including the Economic Revitalization of KP and FATA Project (ERKF), the FATA Emergency Rural Roads Project, the Rural Livelihood and



¹³ ADB Project No. 46378-002 – US\$ 250.0 million: Central Asia Regional Economic Cooperation Improving Border Services.

¹⁴ FATA Development Authority website--<http://fatada.gov.pk/skills-development/>



Community Infrastructure Development (RLCIP) Project, the FATA Urban Centers Project (FUCP), and the Governance Support and Policy (GSP) project. ERKF has provided matching grants to over 400 businesses across FATA; FUCP developed urban areas in FATA by installing streetlights, constructing pavements and drainage systems, and improving the solid waste management systems; and RLCIP supported the skills development of FATA residents. The WB is also supporting a KP Tourism Development Project and plans to support a KP Agriculture Development Project.

c. Higher Level Objectives to which the Project Contributes

17. ***The Proposed Project is consistent with the WBG Country Partnership Strategy/Framework for Pakistan¹⁵ and Afghanistan. The proposed Project*** supports two of the four Results Areas in the Pakistan CPS: (ii) Private Sector Development, and (iii) inclusion by improving regional connectivity and promoting private sector development in the Khyber Pass hinterland. The Khyber Pass Economic Corridor (KPEC) Project specifically supports the following CPS Outcomes: Outcome 2.1: Improved Business Environment for Private Sector by addressing key obstacles to private sector operations in the Khyber Agency; Outcome 2.4: Improved Trade tariff and Ports/Border Logistics by reducing physical and non-physical barriers to trade through Torkham; and Outcome 3.3: Increased Resilience to Disasters in Targeted regions by incorporating the climate resilience into the design of PTEX and the connecting infrastructure under Component II. Under Pillar 2 of Afghanistan's CPF, Objective 2.2 is to improve transport and ICT connectivity to improve Afghanistan's growth prospects and enhance regional integration. PTEX will reduce the cost of Afghanistan's connectivity to the Indian Ocean and has the potential to enhance economic cooperation between Pakistan and Afghanistan. In addition, KPEC is aligned with various IDA18 themes by: supporting cooperation in a region where intraregional trade accounts for just 5 percent of total trade; creating job opportunities for women; and reducing fragility through economic development in FATA. Furthermore, KPEC contributes to the World Bank Group's priority of maximizing finance for development by undertaking activities that will improve firm productivity and mobilize private investment.
18. ***Financing for the Project by the World Bank is expected to mobilize additional private investment, while enhancing the quality of design and implementation.*** While PTEX is economically viable, construction costs cannot be recovered through tariffs / tolls and, as such, public sector financing is the appropriate vehicle for the Project. Nonetheless and in conjunction with the Project, NHA is developing a national tolling strategy to enable the financing of operations and maintenance costs. Component II envisages the use of public private partnership (PPP) modalities and private financing to develop clusters of economic activity, potentially through the creation and/or revitalization of economic zones. The WBG adds value to the Project through its global experience in enhanced design, construction quality control, sustainable road maintenance and asset management, sound environmental and social management, and in the development of economic corridors and the creation of jobs.



¹⁵The CPS was discussed by the Board on May 1, 2014 (Report no. 84645). It was extended to FY20 in the Performance and Learning Review, discussed by the Board on June 15, 2017 (Report No. 113574).



II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

The PDO is to expand economic activity between Pakistan and Afghanistan by improving regional connectivity and promoting private sector development along the Khyber Pass corridor.

B. Project Beneficiaries

19. **Consumers, producers, and traders along the Khyber pass will benefit from reductions in transit costs and times for goods and from investments in private sector development.** Project beneficiaries will comprise: road users; employees and owners of small and medium enterprises (SMEs); consumers of tradeable goods and services; owners and employees of firms producing tradeable goods and services along the Khyber Pass corridor and/or served through the secondary roads and other private sector investments.

20. **Project beneficiaries will extend beyond Pakistan to road users, traders, and consumers from Afghanistan and the CARs; and also include the disadvantaged segments of society.** Afghan medical patients, and students enrolled in Pakistani schools crossing to Pakistan will benefit from better infrastructure and a more efficient border crossing. Project beneficiaries will also include internally-displaced persons, women, and youth, all of whom are expected to have increased access to socio-economic and job opportunities. Increases in economic activity generated by the Project is expected to improve the security situation in FATA and eastern Afghanistan.

c. PDO-Level Results Indicators

21. Expanded economic activity will be measured by the reduction in truck travel time along the corridor and in border clearance time as well as by the increase in the annual volume of cross-border trade. Improved private sector development will be measured by the increase in number of firms (including those managed and/or owned by women) benefiting from the project's investments.

III. PROJECT DESCRIPTION

A. Project Components

22. **Component I: Expressway Development** (US\$ 402.75 million of which expected IDA financing is US\$ 383.60 million). The Project will finance the detailed design, construction and supervision of the proposed four-lane PTEX and associated road-user and administrative infrastructure facilities, the



laying of fiber optic cables in trenches along PTEX, land acquisition and resettlement, afforestation along PTEX, and technical and independent reviews and studies for the preparation of new projects. GoP will finance land acquisition and resettlement and the cost of securing safe access for designers and contractors. PTEX will reduce transit time and costs for regional and international trade transiting the Khyber Pass and will extend the Karachi – Lahore – Islamabad – Peshawar Trans-Pakistan Expressway System and form an integral part of the planned Peshawar – Kabul – Dushanbe Motorway.



23. **PTEX will be a dual highway with a much-improved geometry compared to the existing road.** PTEX will feature a 7.3-meter-wide carriageway on each side and 3.0-meter-wide treated shoulders. Since the Project location is prone to climactic and geophysical hazards such as seismic activity, landslides and flash floods, the design and implementation will incorporate technical parameters to increase PTEX' adaptation to the climatic risks in the region (see Annex 1 for details). The design will be subject to road safety audits to identify opportunities for improving road safety.

24. **Component II: Development of the Khyber Pass Economic Corridor** (US\$75 million, of which IDA is US\$72 million). Component II will, in conjunction with other initiatives, maximize the benefits of PTEX for Western Greater Peshawar (WGP) by alleviating key constraints to the integration of private sector actors in the Khyber Agency into global value chains. Component II will have two main sub-components:¹⁶

a. **Technical assistance (US\$7 million)** consisting of four distinct activities:

The sub-component will develop a **Spatial Master Plan for Western Greater Peshawar (SMP-WGP)**. The SMP-WGP will extend the interim Geo-Referenced Local Master Plan (GeoLoMaP), which mapped existing and planned infrastructure and identified constraints impeding firm productivity and private sector investment.¹⁷ The SMP-WGP will institute structures and processes for: (i) coordinating development activities between federal, provincial, bilateral, multilateral and private-sector stakeholders; (ii) prioritizing investments in public infrastructure; (iii) identifying key policy, regulatory, administrative and institutional barriers to private sector development in WGP and to trade through the Khyber Pass, including undertaking a risk and resilience assessment and an assessment of the PPP framework in FATA.

The sub-component will finance **feasibility studies and engineering designs** for priorities identified by the GeoLoMaP.¹⁸ These priorities include: (i) an integrated logistics hub and industrial / commercial infrastructure to support SME development in viable locations in WGP; (ii) branch roads connecting PTEX to local and national road networks; (iii) parking terminals upstream from Torkham to complement ADB investments and support to the implementation of the TIR to reduce waiting time at the border; (iv) the development of the urban centers of Jamrud and Landi Kotal;¹⁹ and (v) an international bus terminal to service buses traveling between Afghanistan and Pakistan.

The sub-component will finance activities to: **document, preserve, and promote the cultural heritage of the Khyber Pass** and to develop mechanisms to leverage this cultural heritage for economic development; identify sites of cultural and historical significance; and develop and promote sites and products of special cultural and/or historical interest.



¹⁶ Khyber Agency is one of the eight agencies (tribal areas) that comprise FATA. The majority of PTEX runs through FATA with a few kilometers running through the Peshawar District in KP. At the request of both the governments of KP and FATA, Component II focuses on FATA specifically, where the needs are the greatest and where initiatives are relatively limited.

¹⁷ The GeoLoMap also mapped existing and planned hard infrastructure in WGP; identified other initiatives to address the identified constraints; and facilitated the prioritization of future investments by the FATA Secretariat; FATA Development Authority, Government of KP, and other key stakeholders.

¹⁸ These are to be undertaken concurrently with the preparation of the SMP-WGP.

¹⁹ This will build on preparation work completed by the WB's FATA Urban Centers project.



The sub-component will finance an **impact evaluation** to assess the effects of Component II of KPEC on the welfare of the local population.

- b. **Infrastructure investments and institutional improvements (US\$68 million) to promote the integration of local producers into global value chains.** Subject to the results of the SMP-WGP and feasibility studies, the second sub-component will finance infrastructure and other investments across WGP including: (i) local road infrastructure and urban development, including the provision of rest areas with special facilities for women along PTEX and connecting roads; (ii) sites of special cultural, historical, and tourist value; (iii) traffic management mechanisms for the N-5 (existing Peshawar Torkham road); (iv) the development of an integrated logistics hub and industrial/ commercial infrastructure in viable locations in WGP (in partnership with private sector actors, when appropriate); (v) the construction and/or upgrading of roads to ensure connectivity between PTEX, urban centers in WGP, and Aza Khail Dry Port etc.; and (vi) an international bus terminal to connect bus services to/from Afghanistan, the Peshawar Bus Rapid Transit system, and domestic bus services.
25. **Activities expected to be financed by Component II will provide regional benefits, address drivers of fragility, and benefit women.** Such activities will ease infrastructural and regulatory constraints to the development of cross-border value chains and by linking PTEX – and, by extension, Afghanistan –to both local communities and the broader Pakistan transport network, including the Indus Highway. These activities are further expected to mobilize financing for development improving the business environment and infrastructure and by leveraging private sector financing for the development of economic zones following a transparent, inclusive and competitive PPP process. Component II is expected to address drivers of fragility by stimulating employment and livelihood opportunities through the promotion of private sector development in FATA.²⁰ Financing of economic clusters by Component II aims to address various obstacles to women’s employment in these clusters, including gender-sensitive transportation, workplace infrastructure such as separate prayer rooms, toilet facilities and child care centers, and a harassment-free workplace (see paragraph 68).
26. **Component III: Project Management** (US\$ 5.0 million). This component will finance costs associated with project management, including incremental operating costs and the competitive hiring of a firm/individual consultants for support in project implementation.

B. Project Cost and Financing

27. **Loan Instrument.** The lending instrument is an Investment Project Financing (IPF). The GoP is the borrower and will pass on the proceeds of the IDA Credit to NHA in accordance with the Subsidiary Agreement. The Project cost and sources of financing (in millions of US dollars) are presented below.



²⁰As identified by the Pakistan Post-Crisis Needs Assessment (PCNA) 2010, such drivers include high unemployment rates among young men, inadequate livelihoods, and absence of sufficient employment opportunities.



Table 1: Project Cost and Financing

Project Components	Project Cost	IDA Financing	of Which Region IDA	Counterpart Funding
I. Expressway Development – comprising:	402.75	383.60	255.73	19.15
(a) Civil Works including associated road-user and administrative infrastructure	297.40	297.40	198.27	0.00
(b) Land acquisition and resettlement	13.15	0.00	0.00	13.15
(c) Afforestation	0.86	0.86	0.58	0.00
(d) Consultant Services for construction supervision, independent EMP and RAP implementation and monitoring, and third-party validation; studies	22.31	22.31	14.87	0.00
(e) Fiber-Optic Installation	0.52	0.52	0.35	0.00
(f) Contingencies (price and physical)	62.51	62.51	41.67	0.00
(g) Security during construction	6.00	0.00	0.00	6.00
II. Economic Development – comprising:	75.00	72.00	48.00	3.00
(a) Technical Assistance for Master Plan and Feasibility Studies	7.00	7.00	4.67	0.00
(b) Infrastructure and Regulatory Improvements	65.00	65.00	43.33	0.00
(c) Land Acquisition and Resettlement	3.00	0.00	0.00	3.00
III. Project Management – comprising:	5.00	5.00	3.33	0.00
(a) Incremental Operating Costs	2.00	2.00	1.33	0.00
(b) Component II Implementation Support	3.00	3.00	2.00	0.00
Total Project Costs	482.75	460.60	307.07	22.15
Total Financing Required	482.75	460.60	307.07	22.15

28. The proposed Project meets all four regional IDA funding eligibility criteria:

- a. ***The Project is part of a coordinated regional effort to enhance cross-border connectivity and is linked to roads connecting with Central Asia and China.*** The Project involves two countries, including one affected by Fragility, Conflict and Violence (FCV). PTEX will facilitate cross-border movements and trade at the main crossing point between Pakistan and Afghanistan. While PTEX provides significant time and cost savings that will benefit both countries, the full benefits of the corridor will be realized with the completion of the sections in both countries. See paragraphs 11 and 12 for complementary investments to improve connectivity between Kabul and Torkham.
- b. ***The Project is expected to both generate positive externalities and mitigate negative ones.*** PTEX is expected to reduce the time and cost of regional and international trade and benefit transporters, traders and consumers in both countries. PTEX and complementary investments under Component II will increase the attractiveness for Afghanistan of the trade route through Torkham, enhance prosperity on both sides of border and reduce threats to security



- c. ***There is strong regional support for the Project.*** PTEX has been endorsed by Joint Economic Commissions (JEC) between Afghanistan and Pakistan and Pakistan and Tajikistan; and it is a priority link for two CAREC corridors. Three coordination mechanisms exist: (i) JEC; (ii) Pakistan-Afghanistan Joint Business Council (JBC);²¹ and (iii) bilateral arrangements between NHA and the Ministry of Public Works of Afghanistan. Following the recent meeting between the Prime Minister of Pakistan and President of Afghanistan, regional connectivity through development of economic corridors between the two countries has assumed high significance. The proposed Project and its possible future expansion provide the basis for regional corridor development.
- d. ***The Project provides a platform for policy harmonization.*** The Project leverages the existing bilateral institutional mechanisms between Pakistan and Afghanistan, as well as regional fora such as CAREC, to promote the harmonization of trade facilitation and transit measures.

c. Lessons Learned and Reflected in the Project Design

29. The project design takes stock of country-specific lessons and of international best practices and recommendations of the Independent Evaluation Group:²²

- a. ***The Project design follows the ‘economic corridor’ approach.*** In recognition that the full potential of transport corridors cannot be achieved without complementary interventions, the Project incorporates investments in infrastructure and policy interventions while ensuring coordination and complementarity with existing and planned initiatives. Given the large number of initiatives in FATA in both infrastructure and governance, the Project is coordinating with development partners when projects interface as well as with GoP, the FATA Secretariat, the KP Government, and other stakeholders (see paragraphs 11, 12 and 14 for key ongoing initiatives).
- b. ***Project preparation has secured the commitment of both countries to regional connectivity by demonstrating the mutual benefits of the Project.*** The project team engaged with both countries to outline the benefits to each from the development of the KPEC and the broader Kabul – Peshawar – Karachi corridor.
- c. ***Implementation arrangements have been designed to leverage the relative strengths of NHA and FATA.*** The implementing arrangements have been designed to use NHA’s experience in project implementation and its familiarity with IFI guidelines, while enabling the FATA Secretariat (as the owner of Component II) to incorporate its technical expertise in the Project Implementation Unit (PIU).
- d. ***Engineer (supervision consultant) will ensure that all contractual clauses are followed.*** Recent experiences have indicated that some contractual clauses may not be strictly followed. The PIU will ensure that the Engineer will enforce that all contractual arrangements are strictly followed, and particularly if water pipes are damaged during construction, potable water will be provided to the affected community, as stipulated in contract, until the situation is remedied.



²¹The Council provides opportunity to businesses of both countries to devise strategies for enhancing bilateral trade and to discuss issues which are hindering trade.

²²The World Bank Group (2007). The Development Potential of Regional Programs. An Evaluation of World Bank Support of Multi-Country Operations. A report by the Independent Evaluation Group.



- e. ***NHA will follow the Design and Build (D&B) approach for implementation of PTEX.***²³ Given the delays in procurement associated with the detailed design and construction processes, the positive experience that NHA has had with the D&B approach, and the increasing popularity of this approach in South Asia, PTEX will be implemented using D&B. NHA will use the World Bank's Procurement Regulations and Bank support in procuring the D&B Contract after Initial Selection (IS) which is one of the new features under the Procurement Framework.

- f. ***The Project design incorporates the recommendations of the Global Gender-Based Violence (GBV) Task Force to assess risks for Sexual Exploitation and Abuse (SEA) and to define mitigation measures.***²⁴ In particular, the Project has been designed to ensure: (a) the identification of SEA risks and define commensurate mitigation measures; (b) the identification of partners which can provide timely services to survivors of SEA; (c) the strengthening of contractor obligations to address SEA; (d) the strengthening of project-level grievance redress mechanisms (GRM) to integrate protocols related to SEA; and (e) the assurance of sufficient contract supervision capacity for monitoring SEA performance (see Annex 3). In addition, the PIU will include a gender specialist to ensure that women could participate in and benefit from the Project.

- g. ***The Bank team has assessed the risk of using security personnel for providing safe access to the site during design and construction and has introduced risk mitigation measures commensurate to the level of perceived risk.*** Guided by the Bank's recent experience with the use of security forces in IPF and considering the good reputation of the security forces that will be used in the Project, the Project incorporated appropriate mitigation measures (see paragraphs 40 and 65); and the Bank team will assess security risks during supervision and ensure reporting of any incidents or complaints (see Annex 3, paragraphs 13c and 13e).

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

- 30. ***Implementation Period of the Project is 6 Years*** (June 14, 2018 to June 28, 2024).

- 31. ***Project oversight will be the responsibility of a Project Steering Committee, chaired by NHA and comprising representatives*** of the different concerned government agencies. The Steering Committee will be established within one month of Credit Effectiveness (see Annex 2 for details).

- 32. ***NHA is the Project Implementation Entity. NHA will establish a PIU in its North Zone Office in Peshawar to implement both Components I and II with representatives from NHA, the FATA Secretariat*** and supported by technical specialists as necessary (see Annex 2 for details). The PIU will be established within one month of Credit Effectiveness.

²³ D&B is a form of contracting arrangements where the contracted party is responsible for completing the design and construction activities within a certain time and budget.



²⁴Report of the Global Gender-Based Violence Task Force (2017): Working together to prevent sexual exploitation and abuse: recommendations for World Bank investment projects
(<http://documents.worldbank.org/curated/en/482251502095751999/Working-together-to-prevent-sexual-exploitation-and-abuse-recommendations-for-World-Bank-investment-projects>)



33. **NHA has demonstrated capacity in implementing large highway projects, having contracted a total of over USD 8 billion in 77 contracts.** See Subsection D (Procurement) in Section VI (Appraisal Summary) and Annex 2 for more information on NHA's capacity and project readiness.
34. **Preparation of the procurement documents for the Engineer, the D&B contract and the spatial master plan for WGP is underway.** The request for Expressions of Interest (EOI) for the Engineer will be issued in May 2018 and the Engineer will be expected to mobilize by December 31, 2018. The prequalification documents for the D&B contract are expected to be submitted to the Bank for its no objection by July 31, 2018; and the contract signed in July 2019. The FATA Secretariat is expected to share the Terms of Reference for the SMP-WGP with the Bank by June 30, 2018.

B. Results Monitoring and Evaluation

35. **The indicators and baseline data to monitor the outputs and outcomes of the proposed Project are presented in the Results Framework (see Section VII).** Data needed for monitoring and evaluation (M&E) of Component I consists of: (a) vehicle operating cost; (b) commercial traffic travel times; (c) border crossing times, (d) road fatalities data; and (e) user satisfaction survey data. NHA will collect these data (except for border crossing times, which will be provided by FBR and through surveys if necessary) as part of its annual network-level surveys. NHA will report the outcome indicators in its annual report and the output indicators in the semi-annual interim unaudited financial reports (IUFs). Data needed for M&E of Component II consists of: (a) extent to which firms benefit from economic infrastructure financed by the Project; and (b) female-managed and/or owned firms among firms benefiting from economic infrastructure financed by the Project. This data will be collected by the FATA Secretariat and through surveys.
36. **Reporting on the requirements set forth in the EMP and RAP, SMF and RPF will be prepared by the PIU and submitted quarterly to the Bank for review.** Brief monthly progress reports will also be submitted to the Bank for review. An Engineer will be procured by NHA to, *inter alia*, monitor and report progress on design and construction. The firm will include experts in geometric design, tunnels, bridges, safety, environmental and contract management among others. In addition, semi-annual implementation progress reviews shall be carried out each year jointly by the Borrower and the Bank. These reviews will cover, *inter alia*: (a) progress in meeting the Project's objectives; and (b) overall Project performance against Project monitoring indicators. A Mid-Term Review will be undertaken not later than 36 months after Effectiveness to more comprehensively assess implementation progress and set out any measures to ensure continued efficient implementation and the achievement of the PDO by the Project's closing date.

C. Sustainability

37. **Investments made by the Project are expected to be highly sustainable.** The primary measure of sustainability is whether PTEX will provide efficient operations and satisfactory ride quality over the design life. NHA has an appropriate road asset management system which will facilitate maintenance along the corridor after the completion of construction. NHA relies mostly on its own resources, raised



from toll revenues, for the maintenance of the National road network. Sustainability of infrastructure investments under Component II will be ensured by the maintenance carried out by the respective



local governments and stakeholders. Wherever feasible, investments made under Component II will be undertaken through Public Private Partnerships (PPP) to ensure the financial sustainability of infrastructure. The Project will pursue the necessary arrangements for the sustainability of the interventions under Component II.

D. Role of Partners

38. See paragraphs 11,12 and 14.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

39. The overall risk of the Project is rated as Substantial.

Table 2. Key Risk Rating

Risk Category	Rating
Political and Governance	Substantial
Macroeconomic	Substantial
Sector Strategies and Policies	Moderate
Technical Design of Project	Substantial
Institutional Capacity for Implementation and Sustainability	Substantial
Fiduciary	Moderate
Environment and Social	Substantial
Stakeholders	Moderate
Overall Risk	Substantial

40. **Political and governance risks are Substantial.** Despite border skirmishes in 2017, relations between Pakistan and Afghanistan have recently improved and the Prime Minister of Pakistan and the President of Afghanistan have jointly committed to improving bilateral relations.²⁵ The Bank team has engaged governments in both countries and has sought the support of other partners to mitigate the risk of disruption to project implementation and operation. While security in the region has shown improvement in the past few years (see paragraph 6), security remains a risk that could impact implementation. The Project will involve the political administration in FATA as well as the Jirgas (traditional village councils of elders in FATA) to mitigate the risk. The involvement of local tribes in transport and trade will also help mitigate security risks. Moreover, the Project will engage personnel from Frontier Constabulary (FC) ²⁶ a well-trained and disciplined federal paramilitary police force, whose leadership comes from the Civil Armed Forces, to provide a safe working environment during the design and construction of PTEX. The FC is a reputable institution with no known negative legacy issues.²⁷ The FC personnel will be from the area and will receive mandatory training/sensitization on



²⁵ Discussions took place during the visit of the Prime Minister of Pakistan to Afghanistan on April 6, 2018.

²⁶ The FC was established as an independent force in 1915 to provide security to internal borders of the settled areas of KP but its mandate has expanded and now includes security duties in other parts of the country as required by the federal government..

²⁷ Two highly-regarded provincial civil service organizations working on GBV confirmed to the Bank team that there were no reported cases to their knowledge of misconduct or abuse on GBV grounds against the FC. This was further confirmed by a media scan. Further assurance comes from the fact that, the Implementation Entity, NHA, used FC in the implementation of the



gender issues (including gender based violence and SEA) in the context of relevant national and provincial laws, including the Pakistan Penal Code and its sections covering protection of women and minors (see paragraph 65).

41. **Macroeconomic risks are Substantial.** The past year has seen a deterioration of the macroeconomic environment caused by worsening current account and fiscal deficits, declining external balances and an overvalued rupee despite recent devaluation. The Bank and development partners are separately engaging with the authorities to address the macro risks. Some of these risks could affect project implementation, like restrictions on imports needed for the project, deferred release of budgetary allocations and rising trade imbalance with Afghanistan. The upcoming national elections would add some uncertainties but expected to be resolved soon after a new elected government takes office.
42. **Technical design risk is Substantial.** Given that not all investments under Component II have been defined, there is a certain degree of risk to achieving the PDO resulting from the potential for delays. The risk is mitigated by the fact that many of the proposed interventions are addressing constraints that have been identified and are not dependent on the completion of the masterplan. The risk of delays is being mitigated by the on-going preparation of TORs for several activities.
43. **The institutional capacity for implementation and sustainability risk is Substantial.** Having NHA implement both components addresses capacity issues which might otherwise affect the delivery of Component II activities, but it creates a need for coordination between NHA and the FATA Secretariat. The large scope of Component II requires a large set of skills which may not always be available in the PIU, which will be met by technical experts to support implementation.
44. **Environmental and social risks are Substantial.** Environmental risks are high because of changes in land use and landscape transformation caused by the clearing of vegetation in an arid environment through blasting and excavation (see paragraph 70). There are physical cultural resources (PCRs)²⁸ in the Project area which could be adversely impacted. The Project will significantly impact about 4,300 people, which will require intensive monitoring and 500-700 skilled and semi-skilled laborers will be employed during construction, with potential host communities lacking capacity to manage any influxes. Per the risk classification defined by the Bank's Labor Influx Guidance Note,²⁹ the anticipated influx creates SEA-related risks are substantial (see Annex 3). The risks of damage to utilities such as water supply will be mitigated by ensuring that the Engineer would provide the appropriate remedy as stipulated in the contract—by providing potable water in the case of damage to water pipes. Also, large economic corridor projects could lead to an increase in sex trafficking of women, girls, and boys, especially around labor camps and transport terminals leading to an increase in HIV transmission. Measures to mitigate these risks are described in paragraphs 65 and 66.

Lowari Tunnel project in Chitral which is close to completion with no negative incidents related to FC reported or known. The Bank also has a prior satisfactory experience dealing with the Frontier Works Organization (FWO), a military engineering organization of the Pakistan Army, implemented the Bank-financed 2005 Earthquake Damaged Roads without any known negative incidents relating to the FWO.



²⁸ Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.

²⁹ <http://wbdocs.worldbank.org/wbdocs/viewer/docViewer/indexEx.jsp?objectId=090224b084778e75&respositoryId=WBDocs&standalone=false>



VI. APPRAISAL SUMMARY

A. Economic and Financial (if applicable) Analysis

45. **Component I:** PTEX is estimated to have an Economic Internal Rate of Return (EIRR) of 12.6 percent and an Economic Net Present Value (NPV) of PKR 21 billion (US\$ 182 million) at an 8 percent discount rate. About half of the Afghanistan traffic that currently uses the alternative ports on the Arabian Sea is expected to shift to Karachi port through PTEX once the Project is completed as it is a significantly shorter route. The reduction in distance travelled will result in an overall slight decrease in GHG emissions. The EIRR for the Project is therefore slightly lower if GHG emissions are not considered (12.5 percent). See Annex 5 for the details.
46. **The major benefit expected to be generated by Component I of the Project is the time savings associated with traffic flows.** Time savings associated with diverted traffic are estimated to amount to PKR 35.5 billion in present value terms. This is a result of relatively large traffic volumes (which average 7,000 vehicles per day) and the slow speeds attained on the existing road due to steep gradients and passage through urban areas (semi-trailer trucks currently travel the 40 km stretch in over two hours). While the new alignment is 8 km longer, it is expected to result in substantial savings in vehicle operating costs of PKR 18.0 million in present value terms due to the lower gradients and wider curves of PTEX. Semi-trailers will be able to make the trip in about an hour. The benefits to generated traffic have been conservatively estimated at 10 percent of the benefits to existing traffic. In addition, a sensitivity analysis carried out to determine the impacts of an increase in costs and decrease in benefits on the economic viability of the Project (Table 3) shows the robustness of the results. Road safety benefits have not been included in the analysis. While the economic benefits of laying fiber optic cables to establish broadband connectivity have not been estimated, studies have shown significant benefits to such investment. Annex 5 details the economic analysis.

Table 3. Summary of EIRRs with Sensitivity Analysis

Road Section	Proposed Strategy	Increase in Cost by 20%	Decrease in benefits by 20%	Increase in cost by 20% and reduction in benefits by 20%
Peshawar - Torkham	12.6%	11.0%	11.0%	9.5%

47. **Component II:** Based on the experience of similar interventions, the EIRR of Component II, is expected to be least 15 percent (see Annex 5).

B. Technical

48. **PTEX will offer a much-improved geometric design that is climate resilient.** The current road is 40 km long, while PTEX will be 48 km with the new alignment. The minimum radius on the current road



is 15 meters, which – when combined with gradients of slightly over 10 percent – reduces the speed of heavily loaded trucks to a few km per hour. Curves on PTEX will have radii of 125 meters or more and slopes with gradients more than 6 percent. Road safety audits will be carried on the design in line with NHA policies and codes to identify opportunities for making PTEX safer. As the project location

is prone to potential climatic and geophysical hazards, NHA will take adaptation measures to mitigate the impact of these risks (see mitigation measures in paragraph 73). Table 4 shows the number of structures based on the preliminary design.

Table 4: Number of Length of Structures Project to be Constructed for PTEX

Type of structure	Number of structures	Length (linear meters)
Pre-stressed bridges	25	1,858
Interchanges	2	150
Flyovers	2	110
Subways/underpasses	8	44
Box Culverts	123	495
Cattle Creeeps	2	5
Total	162	2,662

49. ***The detailed design and civil works of PTEX will be financed by the Project following a D&B approach.*** This approach will include value for money analyses to ensure the selection of optimum design choices. NHA has positive experience following this approach. The bid package including preliminary designs, technical specifications and procurement documents will be prepared under the guidance of experienced international consultants working in close coordination with NHA. The package is expected to interest reputable national and international designers/contractors.

c. Financial Management

50. ***NHA, being an autonomous body, has engaged professionals for the creation of an effective financial management system.*** NHA has previously successfully implemented World Bank funded projects and has a designated accounting section within the Finance Wing for foreign-funded projects. An assessment of current FM arrangements was carried out for NHA. The review shows significant improvement in the financial management and reporting system of NHA, with its regional offices linked to head office through a Virtual Private Network. While the financial management system is adequate for reporting purposes, it would benefit from an improved computerized accountingsystem. The FM Assessment is detailed in the project files.³⁰

d. Procurement

51. ***NHA is the implementing agency for the Project.*** NHA currently maintains a portfolio of about US\$ 15.3 billion and is implementing construction works are valued at around US\$ 3.0 billion per year. This has been achieved through NHA's Procurement and Contracts Administration (P&CA) Cell with

³⁰ <http://wbdocs.worldbank.org/wbdocs/drl/objectId/090224b085acdd9b>



assistance from consulting firms on a project-specific needs basis. NHA has a procurement management system developed per the guidelines of the Public Procurement Regulatory Authority (PPRA). The P&CA Cell is also conversant with development partners' procurement regulations and guidelines. NHA will assign a dedicated staff member of its P&CA Cell for the Project. The contract

³¹ <http://wbdocs.worldbank.org/wbdocs/drl/objectId/090224b085acdd9b>



approving mechanism is well-established and documented. Contract approving authority for all procurements rests with the Chairman of the NHA and/or NHA Executive Board.

52. **An assessment of NHA indicates that the authority is implementing large value works contracts following both the conventional item-rate basis and the D&B mode.** NHA has completed several procurements where contracts were awarded to international and national contractors. Contracts worth US\$ 5.7 billion were procured based on the D&B concept for the construction of over 700 km long expressways/motorways. In addition, traditional item-rate based contracts were procured for 185 km long expressway and 290 km of highways worth US\$ 615 million and US \$1 billion respectively in the recent past. Implementation of the three D&B-type contracts remains on target for two contracts and faster than planned for the third. Progress under item-rate based contracts has not been as good with achieved progress about 68 percent of planned progress for 12 recent contracts.
53. **Notwithstanding NHA's experience in the implementation of large value contracts, the overall Procurement Risk to achieving the PDO is currently assessed as "Substantial"** due primarily to the use of single large contract under the D&B mode for which NHA has relatively less experience. The details of the procurement assessment and findings are summarized in the project files.³¹
54. **The project procurement profile indicates that Component I will finance a large works procurement estimated at US\$ 362 million and supervision consultancy contracts estimated at US\$ 22 million.** In addition, there will be a small contract for environmental monitoring which could be taken up by any commercial consulting firm, NGO or academic entity.
55. **Component II is estimated to cost US\$ 75 million, of which US\$ 65 million are for infrastructure and regulatory improvements.** Component II will require contracting for the provision of consulting services to prepare the SMP-WGP and feasibility studies. The procurement of specialized firms / contractors would be required for design and construction of works / infrastructure related contracts. The majority of contracts would be procured by the PIU. Representatives of the FATA Secretariat will be involved in the procurement of activities related to Component II.
56. **NHA will establish the PIU and identify its core staff including the procurement professionals within one month of Credit Effectiveness.** The procurement function will be provided by a qualified procurement professional from the NHA Head Office (HO) who will be managing all the project procurement activities to be financed under the Project. If deemed necessary, the NHA procurement specialist will be supported by a specialist based in the field.
57. **All procurement activities under the Project will be made using the World Bank's Procurement Regulations for IPF Borrowers** (July 2016; revised November 2017). The Borrower has developed a PPSD (project procurement strategy for development) in line with the Bank's guidelines. The Bank's web-based online procurement management system STEP (systematic tracking of exchanges in procurement) will be used for managing procurement under the Project. All procurement activities

³¹ <http://wbdocs.worldbank.org/wbdocs/drl/objectId/090224b085acdd9b>



will be agreed with the Bank prior to initiating the procurement process. All approvals / agreements on procurement activities under the Project will be agreed through STEP only.

³¹ <http://wbdocs.worldbank.org/wbdocs/drl/objectId/090224b085acdd9b>



58. **NHA will further develop its procurement management system under this Project.** The existing procurement management system will be upgraded to provide real-time features for monitoring project procurement activities using online platforms. NHA will also establish Open Data Portal and Regime aligned with NHA's information disclosure platform, in a manner and substance satisfactory to the Association, including: (i) Open Data Standards; (ii) Platform for Open Data Analysis; and (iii) Training on Open Data and Analysis. The use of procurement management information systems including an open data portal increases transparency and mitigates the risk of fraud and corruption.
59. **The bidding documents will include specific requirements that minimize the use of expatriate workers and encourage hiring of local workers.** Bidders will be required to submit Codes of Conduct (CoC) with their bids meeting minimum standards as outlined in the Standard Procurement Documents (SPDs). The CoC will set clear boundaries for acceptable and unacceptable behaviors and will be signed by contractors, their sub-contractors and any consultants that have physical presence at the project site. Annex 3 provides further details.
60. **The Bank will provide periodic procurement training for all PIU staff.** Since NHA will be implementing the Project under the World Bank's new procurement regulations, the NHA and PIU staff will receive periodic training on the new regulations. In addition, NHA will need capacity building in (i) FIDIC accredited training in D&B Contracts; and (ii) estimation techniques for lumpsum contracts. The training will also include red flag detection in civil works and consultancy contracts to help curb fraud and corruption.

E. Social (including Safeguards)

61. **OP 4.12 on Involuntary Resettlement applies given the physical and economic displacement expected to be caused by construction of PTEX and by sub-projects under Component II.** Major potential adverse impacts of the Project are expected from land acquisition, loss of trees and crops, and loss of livelihoods. A Resettlement Action Plan (RAP) for Component I has been prepared. For other social impacts, a social impact assessment has been prepared as a part of the consolidated Environmental and Social Impact Assessment (ESIA) for Component I.
62. **Under Component I, the Project will acquire approximately 1,193 acres of land.** Of this, 137 acres are individually owned (including agriculture, barren, hilly, commercial and other types of land), 1,055 acres are owned collectively by different clans (*khels*), and one acre is public land. There are population centers of varying density along the alignment and within the right of way (RoW). Livelihood impacts will also be experienced as some agricultural land falls within the alignment and will need to be acquired. PTEX will have significant social impacts on approximately 500 households (comprising 4,300 persons) who will permanently lose land, houses, trees, crops and/or other non-movable assets, out of which 1,400 persons will self-relocate to individual sites and structures of their own choice. In addition, public infrastructure including two mosques, one school, a hospital, two water supply plants, four water tanks, four pylons, about 163 electric poles and three dug wells will need to be rebuilt or relocated. Of a total of 189 business operators, 46 owner operators and 143 tenant operators will be affected. 72 employees will lose their income and will be compensated.



- 63.** As the specific investments to be financed by Component II are not yet known and the scope and scale of impacts cannot yet be determined, a framework approach has been adopted. The FATA



Secretariat has prepared a Resettlement Policy Framework (RPF) and Social Management Framework (SMF). The RPF will guide the preparation of RAPs / Abbreviated Resettlement Action Plans (ARAPs) where required. The SMF will guide consultations / citizen engagement processes, inclusion of marginalized groups, management of labor and gender issues and other social aspects. The SMF will formulate appropriate social safeguard principles and provide technical guidelines to identify impacts, prepare safeguard plans, and devise mitigation measures to address adverse social impacts of the Project focusing on stakeholder engagement, gender, labor and other social issues.

64. **Safeguard documents have been disclosed by NHA and the FATA Secretariat.** In addition to the Bank's internal procedures of safeguard documents disclosure, the RAP has been disclosed by NHA on its website and by the Bank on January 30, 2018; and the draft RPF and SMF have been disclosed by the FATA Secretariat on its website and by the Bank on February 13, 2018. A revised version was disclosed on the FATA Secretariat's website and by the Bank on May 8, 2018 and May 9, 2018, respectively. NHA has translated the Executive Summary and Entitlement Matrix of the RAP into Urdu language and disclosed the same.
65. **The Project is undertaking comprehensive measures to mitigate project-related SEA risks from the anticipated labor influx.** The Project will undertake various actions to mitigate these risks. A mapping exercise is identifying partners who can inform on SEA risks, undertake worker training and community outreach activities on SEA, and provide referral services to SEA survivors. The Project will coordinate with agencies active in addressing GBV, such as the KP Social Welfare Department, KP Health Department, FATA Secretariat (especially its Social Welfare Directorate and Health Directorate), and the Provincial Commission on the Status of Women, to design effective awareness campaigns for at-risk groups. Ministries and agencies engaged in anti-trafficking initiatives, as well as border control, transport and other relevant government officials, will be approached to ensure such initiatives are active and relevant to PTEX. The Project will also coordinate with UN and civil society organizations for peer education about HIV/AIDS awareness and prevention and various NGOs working on GBV prevention in both FATA and KP to develop linkages.³² The Project will incorporate actions consistent with the IFC's Good Practice Handbook on "Use of Security Forces: Assessing and Managing Risks and Impacts" and will use personnel from Frontier Constabulary, a well-trained and disciplined federal paramilitary force, recruited from FATA and governed by the North West Frontier Constabulary (NWFC) Act 1915³³ and NWFC Rules 1958.³⁴ Criminal offences committed by FC personnel are prosecuted under the Pakistan Penal Code 1860 (Amended 2006) which has elaborated provisions on the protection of women and children.³⁵ All security personnel will receive training/sensitization on gender awareness, GBV and SEA in accordance with Pakistan Penal Code and other relevant laws. Upon completion of the training, participants will sign certificates showing the list of topics covered and indicating their understanding of the issues and implications. Interaction

³² KP-based NGOs engaged in GBV service provision assist survivors of GBV hailing from FATA. Peshawar-based shelters house women from FATA and government hospitals provide medico-legal services. However, the system of service provision is ad-hoc and could be strengthened so that such facilities are made available in Khyber Agency closer to potential victims.

³³ Clause 8 of the FC Act 1915 has specific punishments for heinous and non-heinous offences, including 8 (j) which provides punishment if any FC personnel "uses criminal force, or commits an assault on, any person bringing provision or other necessities to camp or quarters, or forces a safeguard or, without authority, breaks into any house, or any other place for plunder, or plunders, destroys, or damages any property of any kind".



³⁴ Available at: <http://www.fc.gov.pk/fcact/Default.html> and <http://www.fc.gov.pk/fcrules/Default.html>.

³⁵ Chapter XVI-A of the penal code provides detailed explanation with illustrations on wrongful restraint and wrongful confinement, criminal force and assault, abduction and forced labor, and rape.



between FC and the community is expected to be limited as the alignment of PTEX is mostly in an uninhabited area. Moreover, interaction with women is expected to be extremely limited due to the conservative culture in the region. In addition, the Project will work to strengthen contractor obligations to address SEA; ensure contract supervision capacity to monitor SEA performance, and strengthen contractor obligations for HIV/AIDS training. All the contractors staff will sign the CoC (see paragraph 59). Contextual GBV/SEA risk factors are detailed in Annex 3.

66. **A multi-tier GRM will respond to complaints received from project-affected people and other stakeholders and provide a prompt, transparent and fair resolution.** A three-tier GRM will be set up at the *jirga* / village level; *tehsil* / district sub division level; and at the PIU or Project Steering Committee. Details for GRM functioning are outlined in the relevant safeguard documents. The GRM will be gender responsive, culturally appropriate, and readily accessible to the Project-affected persons (PAPs) at no cost and without retribution. The GRMs will provide specific culturally-sensitive reporting mechanisms regarding issues relating to security after consultation with the local organizations experienced in SEA issues (see mitigation measures in Annex 3). The GRMs will also have survivor-centered protocols for recording and addressing SEA-related complaints and will include appropriate mechanisms for referral to service providers. The Project will also consider developing an Interactive Voice Response System to receive complaints and suggestions from citizens. The results framework contains an indicator to measure grievances responded to and/or resolved within the stipulated service standards.
67. **Across Pakistan, KP and FATA have the lowest levels of female economic participation.** Female labor force participation in KP and FATA stand at 14 percent (59.4 percent for males)³⁶ and 8.6 percent (56.4 percent for males),³⁷ respectively, compared to a national average of 25 percent (83 percent for males). A general lack of gender-sensitive amenities (e.g. safe transport options, separate washrooms for women, day care centers, harassment-free public spaces and workplaces) impede women's access to economic opportunities, resulting in a low number of women which operate businesses in KP and FATA. The ERKF project, which awarded 36 (or 2.35 percent) of 1,526 project grants to women-owned businesses in KP and FATA, identified numerous constraints to female economic empowerment, including restricted mobility, social norms, weak application of property rights, and low literacy. About half of women-owned businesses operated in areas such as boutiques, beauty parlors, and stitching / tailoring, whilst the rest were in manufacturing industries including pharmaceuticals or in education, merchandise and food processing sectors.
68. **In response to the large gender gaps, the Project will seek to ensure that at least 10 percent of firms which benefit from investments in economic infrastructure financed by the Project are owned and/or managed by women** (PDO indicator). The target, while modest at first glance, represents a challenge given a context where between 0 to 4.9 percent of businesses are managed and/or owned by women. To achieve this goal, the Project will, in the context of examining key policy, regulatory, administrative and institutional barriers to private sector development in WGP, shed further light on context-specific barriers to female economic participation in WGP and seek to ensure that these barriers are addressed through investments in economic infrastructure (such as by providing gender-sensitive transportation, appropriate amenities, and harassment-free workplaces) under the second sub-component of Component II. Potential complementarities with the World Bank's Women

³⁶ Pakistan Bureau of Statistics: Pakistan Labor Force Survey 2014-15.





Entrepreneurs Finance Initiative (WeFi) will be explored to maximize efforts to promote female entrepreneurship in WGP. Activities financed under Component II to leverage the cultural heritage of the Khyber Pass for economic development will, wherever feasible, be targeted to maximize the participation of women and of women-owned and -managed businesses. The Project will facilitate the appointment of qualified women from FATA women in agencies associated with the Project such as NHA, FATA Secretariat, Project Contractor, selected Security Agency, and National Motorways Police (if jurisdiction is provided).³⁸

69. ***The Project has several avenues to enable citizen engagement.*** The ESIA and RAP for Component I and EMF, RPF and SMF for Component II were prepared following a consultative process which included focus group discussions and village level public meetings with stakeholders, including women. Future Environment and Social Management Plans (ESMPs) and RAPs to be prepared during implementation will follow a similar consultative process. The establishment of multi-tier GRMs (see paragraph 66) will improve engagement with project-affected persons and communities.

F. Environment (including Safeguards)

70. ***The Project is expected to have substantial environmental impacts.*** The Project triggers OP 4.01 and OP 4.11 and is Category A. To address potentially negative environmental and/or social impacts, NHA has conducted a project-specific ESIA and has prepared an Environmental Impact Assessment (EIA) for Component I. The potentially negative impacts of the construction of PTEX include: soil erosion; improper disposal of spoil; land and landscape transformation resulting from loss of vegetation; destabilization of mountain slopes; reduced water availability and change/blockage in drainage patterns; air pollution from asphalt plant, vehicles and construction machinery; noise and vibration from blasting, construction works and machinery movements; waste from construction activities as well as from the labor camp; restrictions and disturbance to the public movement and transportation; displacement of population, disturbance to people, disruption of traffic and some possible impacts on the health and safety of general public and workers. Mitigation plans that have been put in place to address these issues include avoidance of unnecessary clearance of vegetation, maintaining existing natural drainage and construction of surface waterbody crossing structures, water wastage reduction guidelines, imposing speed limits and sprinkling of water, implementing proper blasting procedures, crossing points for local public and cattle passages, and a labor influx management plan. Once operational, an increase in noise pollution is expected due to the increased volume of traffic. Damages to utilities during construction will be promptly addressed as stipulated in the contract (see paragraph 44.)

71. ***The main environmental impacts of Component II will be caused by increased traffic and industrial activities.*** Such impacts include the deterioration of air quality from increased economic activity and particulate matter, stress on water resources, noise and vibration, loss of vegetation, waste and effluent disposal, community safety and occupational health-related aspects. PCRs may be impacted as well. As the exact nature of the interventions is not yet known, a framework approach has been adopted. An Environmental Management Framework (EMF) has been developed, reviewed by the Bank, and disclosed in Pakistan and by the Bank on February 2, 2018. The EMF identifies the screening



³⁸The appointments will be merit based. The project will play an active role to disseminate the information among communities (especially women) when a position is advertised in agencies associated with the Project.



criteria for evaluation of subprojects under Component II and recommends appropriate safeguard instruments for mitigating and monitoring of environmental and social risks associated with each subproject. Initial screening will be done through site visits and completion of checklists. The checklist has been developed in accordance with the World Bank Policies as well as the regulatory requirement of the Pakistan Environmental Protection Agency (EPA) as per Schedule I and II of the Initial Environmental Examination (IEE) / EIA regulations. Its purpose is to determine the level of impact and document safeguards required for each subproject. If screening identifies significant irreversible impact, a full environmental impact assessment (EIA) will be carried out. If, the screening concludes that the subproject is likely to have low to moderate levels of negative impacts, an EMP will be prepared prior to initiating the subproject. For all other subprojects potentially causing low levels of environmental and or social impacts, the only assessment required will be the screening carried out with the help of checklists.

72. The total gross Carbon Dioxide (CO₂) emissions over the 25-year evaluation period under the without-project scenario are estimated at 5.0 million tons and under the with-project scenario at **4.75 million tons, a net decrease of CO₂ emissions of about 250,000 tons, or 10,000 tons per year with the project** (see Annex 5).

73. **Climate Co-Benefits:** The Project provides substantial climate adaptation co-benefits as well as some mitigation co-benefits. Pakistan is one of the most vulnerable countries to climate change. A district-level climate risk and hazard assessment by ADB has recently classified the Peshawar District in KP and the Khyber Agency in FATA (the two main districts that PTEX traverses) at high risk of floods, landslides and earthquakes.³⁹ The design and implementation of PTEX, and secondary roads under Component II will incorporate resilience considerations to better cope with increased precipitation and potential landslides. Climate smart engineering will be applied to the road surface, sub surface, and side drainage. While these interventions are focused on adaptation, Component I also supports mitigation with an improved geometrical design for PTEX, the diversion of truck traffic to Karachi port from significantly longer routes to alternative ports on the Arabian Sea (see Annex 5) and afforestation along PTEX. Also, the envisioned master plan under Component II will be climate-informed.

G. Other Safeguard Policies (if applicable)

Not Applicable.

H. World Bank Grievance Redress

Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel



which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit

³⁹ "Climate Change Profile of Pakistan". ADB (2017).



http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service_ For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.



VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

Project Development Objective(s)

The PDO is to expand economic activity between Pakistan and Afghanistan by improving regional connectivity and promoting private sector development along the Khyber Pass corridor.

PDO Indicators by Objectives / Outcomes	DLI	CRI	Unit of Measure	Baseline	End Target
Expand economic activity between Pakistan and Afghanistan					
Reduction in travel time for heavy trucks (semi trailers) between Peshawar and Torkham			Minutes	120.00	72.00
Reduction in time spent by commercial trucks (all types) crossing into Pakistan at Torkham			Hours	13.00	6.00
Number of firms benefiting from investments in economic infrastructure financed by the project			Number	0.00	500.00
Of which, 10 percent are women owned and/or managed firms			Number	0.00	50.00
Annual volume of cross border trade at Torkham border in both directions			Percentage	100.00	120.00



Intermediate Results Indicators by Components	DLI	CRI	Unit of Measure	Baseline	End Target
Component II: Development of the Khyber Pass Economic Corridor					
Kilometers of developed or upgraded secondary roads connecting to the Peshawar Torkham Expressway			Kilometers	0.00	40.00
Master plan completed for the Western Greater Peshawar region			Number	0.00	1.00
Transportation terminals constructed			Number	0.00	2.00
Expressway Development					
Reduction in fatal road accidents			Percentage	0.00	10.00
Components I and II					
Grievances responded and/or resolved within the stipulated service standards of response times			Percentage	0.00	100.00



Monitoring & Evaluation Plan: PDO Indicators	
Indicator Name	Reduction in travel time for heavy trucks (semi trailers) between Peshawar and Torkham
Definition/Description	Reduction in travel time for heavy trucks (semi trailers) between Peshawar and Torkham
Frequency	Annual
Data Source	Traffic Surveys
Methodology for Data Collection	The National Highways Authority will use standard methodology for measuring travel time between two points.
Responsibility for Data Collection	National Highways Authority through the PIU
Indicator Name	Reduction in time spent by commercial trucks (all types) crossing into Pakistan at Torkham
Definition/Description	Reduction in time spent by commercial trucks (all types) crossing from Pakistan into Afghanistan at Torkham.
Frequency	Once at the end of the Project.
Data Source	Federal Board of Revenue
Methodology for Data Collection	Surveys
Responsibility for Data Collection	Federal Board of Revenue will collect and provide the data to the PIU.



Indicator Name	Number of firms benefiting from investments in economic infrastructure financed by the project
Definition/Description	Number of firms benefiting from investments in economic infrastructure financed by the project.
Frequency	Once at the end of the Project
Data Source	Survey
Methodology for Data Collection	Survey will be designed to capture all the improvements of the Project
Responsibility for Data Collection	The FATA Secretariat
Indicator Name	Of which, 10 percent are women owned and/or managed firms
Definition/Description	Firms benefitting from the Project that are owned and/or managed by women
Frequency	once at the end of the Project
Data Source	Survey
Methodology for Data Collection	Survey
Responsibility for Data Collection	The FATA Secretariat



Indicator Name	Annual volume of cross border trade at Torkham border in both directions
Definition/Description	Annual volume of cross border trade at Torkham border in both directions
Frequency	Once at the end of the Project
Data Source	Federal Board of Revenue
Methodology for Data Collection	Custom's systems of the Federal Board of Revenue
Responsibility for Data Collection	Federal Board of Revenue to collect and provide the data to the PIU

Monitoring & Evaluation Plan: Intermediate Results Indicators

Indicator Name	Kilometers of developed or upgraded secondary roads connecting to the Peshawar Torkham Expressway
Definition/Description	number of km of secondary roads providing connectivity to PTEX
Frequency	Once at the end of the year
Data Source	The Supervision Consultant
Methodology for Data Collection	Civil works completed and certified by the Supervision Consultant
Responsibility for Data Collection	The PIU



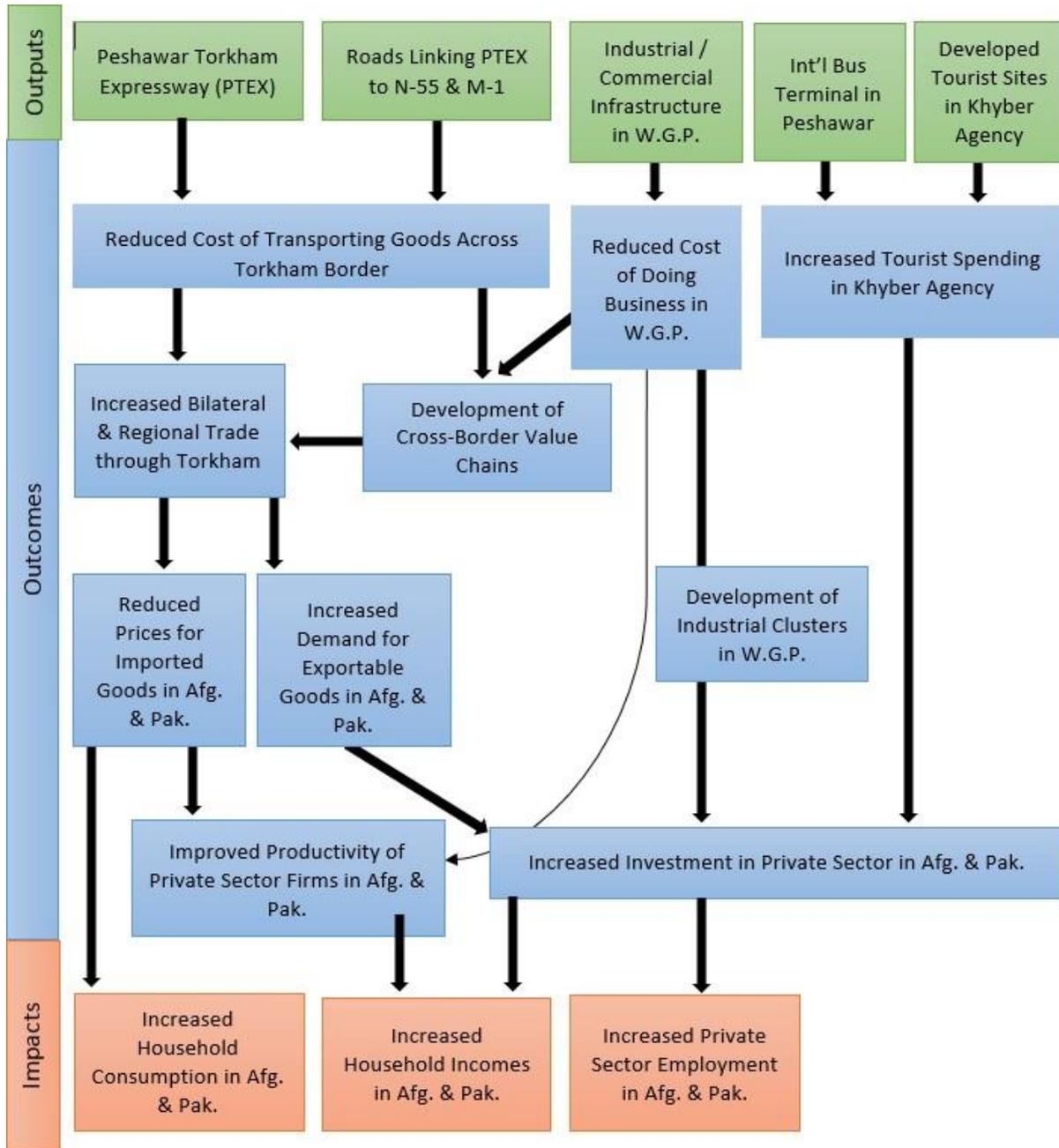
Indicator Name	Master plan completed for the Western Greater Peshawar region
Definition/Description	Master Plan for the WGP prepared
Frequency	once
Data Source	The Supervision Consultant
Methodology for Data Collection	Certification of preparation by the Supervision Consultant
Responsibility for Data Collection	The PIU
Indicator Name	Transportation terminals constructed
Definition/Description	bus and/or freight terminal as confirmed by the feasibility studies
Frequency	once at the end of the proejct
Data Source	The Supervision Consultant
Methodology for Data Collection	Certification of Completion by the Supervision Consultant
Responsibility for Data Collection	The PIU



Indicator Name	Reduction in fatal road accidents
Definition/Description	reduction in fatal accidents for travel between Peshawar and Torkham or any origins/destinations along that route (adjusted for traffic growth)
Frequency	Once at the end of the Project
Data Source	Local traffic police
Methodology for Data Collection	Police reports
Responsibility for Data Collection	the PIU
Indicator Name	Grievances responded and/or resolved within the stipulated service standards of response times
Definition/Description	Grievances responded and/or resolved within the stipulated service standards of response times
Frequency	Annual
Data Source	The GRM
Methodology for Data Collection	based on the GRM
Responsibility for Data Collection	The PIU



Figure 1: Theory of Change for KPEC





ANNEX 1: DETAILED PROJECT DESCRIPTION

COUNTRY : Pakistan

PAKISTAN: Khyber Pass Economic Corridor Project

1. This annex complements the information in Section III of the main document: “Project Description”.
2. **PTEX will be designed to be resistant to environmental shocks.** The project location is prone to potential climatic and geophysical hazards such as seismic activity, landslides and flash floods. River flood hazard in the region is classified as high with potentially damaging and life-threatening river floods expected to occur at least once in the next 10 years.⁴⁰ The National Climate Change Policy (NCCP) of 2012, the guiding policy document for Pakistan on climate change, identifies erratic monsoon rains as a major threat that may cause frequent and intense floods and droughts. In Pakistan, past experiences of climate events have shown vulnerability of infrastructure located in risk areas due to extreme weather. Between 1950 and 2010, 21 floods occurred in the Indus Basin, killing 8,887 people, leading to damages or destruction of 109,822 villages, and causing cumulative direct economic losses of about \$19 billion.⁴¹ The 2010 flood was Pakistan’s most damaging on record, killing 1,600 people and causing damage over \$10 billion. The July and August 2010 rainfall was almost double the historical levels for the same months.⁴² The climate change projections of the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) for the Asia region show that the warming is likely to be above the global mean and climate change will impact the glaciers’ melting rate and precipitation patterns, affecting the timing and strength of monsoon rainfall.
3. **Besides floods, landslides are a frequent hazard phenomenon for the area and pose a significant threat to the country’s transportation infrastructure.** Climate change is likely to alter slope and bedrock stability through changes in precipitation and/or temperature. Raises in rainfall in turn raise the risk of landslides in the region.
4. **Taking into account these climate change risks, NHA will mitigate these impacts** by (i) designing cross-drainage structures using hydrological calculations based on the highest flood levels in the last 100 years, (ii) designing concrete structures with specified seismic zoning of the project area, (iii) benching of slopes, provision of retaining walls, plantation and other slope stabilization measures to mitigate against land/rock slides, and (iv) afforestation within the project area. In addition, in the event of any climactic events that may negatively impact PTEX travel between Peshawar and Torkham, could still be possible along the existing N-5 highway. The introduction of PTEX, therefore also provides resilience/redundancy to the highway network in this region.
5. **The Project will also include the laying/installation of fiber optic alongside PTEX.** NHA has made the provision of fiber optic connectivity mandatory in all its projects. On the recently completed Khunjarab-Raikot section of the Karakoram Highway (KKH), the infrastructure was provided by NHA, while the cable itself was installed by the Strategic Communications Organization (SCO). On the Faisalabad-Khanewal section of the M-4 Motorway, the cable was installed by Pakistan Tele



⁴⁰ Think Hazard: Pakistan (thinkhazard.org)

⁴¹ A. Ali. 2013. *Indus Basin Floods: Mechanism, Impacts and Management*. Manila: ADB.

⁴² Ibid.



Communications Ltd. As service providers, these organizations pay NHA a rental for using the infrastructure i.e. duct, manhole etc. For the Peshawar-Torkham, NHA intends not only to provide the infrastructure, but also install the cable. This will allow more service providers to utilize NHA's fiber optic cables, resulting in increased competition, and generate additional revenue for NHA.

6. **Activities to be financed under Component II will, in coordination with other initiatives, maximize the benefits of PTEX for WGP by alleviating key constraints to the integration of local producers into global value chains.**⁴³ During project preparation, an interim 'Geo-Referenced Local Master Plan (GeoLoMaP)' was completed, which identified constraints impeding firm-level productivity and private sector investment in WGP; mapped existing and planned hard infrastructure in WGP; ascertained information of other initiatives to address these constraints; and facilitated the prioritization of future investments by the FATA Secretariat and other key stakeholders. Constraints identified include (in decreasing order of importance): insecurity; access to markets; and access to land, utilities, skills, and finance.
7. **Activities under Components I and II will help address deficiencies in road infrastructure which impede movement and trade within the Khyber Agency.** Landi Kotal, the main trading hub of the Pass, is currently connected by unpaved roads to villages and marble deposits in the hinterland villages. Other towns in the Khyber Pass, such as Ali Masjid and Chagai, are similarly connected to nearby settlements by unpaved roads. Organized transport terminals for cargo and passengers do not currently exist in Landi Kotal and other towns in Khyber Agency, with informal bus/van stands within the market bazaars. Heavy duty trucks (including semi-trailers and articulated vehicles) currently park on shoulders of the existing road and heavy traffic within Landi Kotal and other towns creates heavy congestion, traffic jams, and blockage of roads. The construction of PTEX, secondary roads in the Khyber Agency, and self-contained freight and passenger terminals will thereby alleviate existing constraints to transport within the Khyber Agency.
8. **Component II activities will seek to increase the productivity of existing enterprises and attract new investments, with a particular focus on marble production, agriculture, light manufacturing, and tourism.** Two economic sectors which provide opportunities for FATA to become integrated into global value chains are marble production, for which FATA has 446 processing units accounting for 20 percent of Pakistan's production,⁴⁴ and horticulture. Although marble exports are currently limited, the mineral can fetch prices around five to ten times higher in international markets than in local markets.⁴⁵ Fruits and vegetables, which may be further processed, already comprise a substantial share of export volume through Torkham. Both sectors have substantial participation by SMEs, and given their relatively high labor intensity, show great potential for employment of internally displaced people (IDPs), women, and youth. In the longer term, investments may catalyze investment in light manufacturing, a sector in which Chinese investors have already expressed interest to FDA, and the potential for which will grow with increased regional connectivity through CPEC. While security conditions in FATA are currently not conducive to substantial growth in tourism, the Khyber Pass – with its unparalleled historical import and its cultural diversity – was previously a key destination for

⁴³At the request of both the governments of KP and FATA, Component II focuses on FATA specifically, where the needs are the greatest and where initiatives are relatively limited.



⁴⁴ FATA Development Authority, 2010, Survey of Industries, Service Sector, Labor Force and Constraints; FATA Development Statistics, 2013

⁴⁵ Emergency Project Paper, Competitive Industries Project for KP (CIPK), The World Bank



both foreign and local tourists. The preservation of sites of cultural and historical value and the development of museums and cultural products (such as the antiquated railway line between Peshawar and Landi Khana) can safeguard the tourist potential of the area for development when security conditions permit. Annex 4 provides further information on the structure of the private sector in the Khyber Agency.

9. **Component II will be climate-informed.** Taking into account the above-mentioned climate change risks, Component II will address the climate change impacts in two main ways. First, the master plan will incorporate climate factors in the selection and prioritization of interventions. Second, the designs of connecting roads, transport terminals and other infrastructure under this component will be informed by climate data in addition to the economic and social considerations.

10. **Component-III shall finance costs associated with incremental operating costs under the Project incurred by the Recipient and the Project Implementing Entities.** Such expenses may be incurred for purposes of the implementation, management, and monitoring and evaluation of the Project, on account of office supplies and consumables, utilities, bank charges, communications, mass media and printing services, vehicle rental, operation, maintenance, and insurance, office space rental, building and equipment maintenance, domestic travel, lodging, and subsistence allowances, and salaries of contractual and temporary staff, but excluding salaries, fees, honoraria, and bonuses of members of the Recipient's civil service.



ANNEX 2: IMPLEMENTATION ARRANGEMENTS AND IMPLEMENTATION SUPPORT PLAN

COUNTRY : Pakistan

PAKISTAN: Khyber Pass Economic Corridor Project

1. **Implementation Period:** 6.0 Years (June 24, 2018 to June 28, 2024).
2. **Project oversight will be the responsibility of a Project Steering Committee.** The Committee will be chaired by NHA and will comprise representatives of of the Economic Affairs Division (EAD) of the Ministry of Finance, Revenue and Economic Affairs, MoC, Ministry of States and Frontier Regions (SAFRON), NHA, FATA Secretariat and possibly the Government of KP. Process coordination will be ensured through regular interactions between the NHA Member for Planning (Committee Secretary), KPEC Project Manager and the Chief Engineer of the FATA Secretariat as well as through joint supervision of both components by the World Bank project team.
3. NHA will establish a PIU in its North Zone Office in Peshawar to implement both Components I and II. NHA will depute competent staff from within the Authority to serve in the PIU, including a Project General Manager (GM), and a Project Director (PD). The PIU will also include representatives from the FATA Secretariat including a DPD and technical experts on industrial zones and archaeology / heritage. The PIU will be supported by consultants in the implementation of Component II activities that are beyond the remit of NHA and for which the FATA Secretariat requires support. The legal, procurement and financial management functions will be provided by NHA staff in HO and will be supported by staff in the North Zone Office if deemed necessary. The PIU staff will include an Environmental Specialist; a Social Development/Resettlement Specialist; and a Gender Specialist to identify opportunities for employment generation for women, and for the implementation of GBV protocols. The PIU will be established within one month of Credit Effectiveness.
4. **NHA was created, in 1991, through an Act of the Parliament, for planning, development, operation, repair and maintenance of National Highways and Strategic Roads.** NHA's (HO) of NHA is situated in Islamabad with ten regional offices under four zonal offices.⁴⁶
5. **NHA has demonstrated capacity in implementing large highway projects using both item-based contract and the D&B-type contracts.** Since 2012, NHA has contracted out a total of over USD 8 billion in 77 contracts. The value of highest contract awarded by NHA was as much as USD 3 billion to a Chinese agency for the Multan - Sukkur motorway in 2014. NHA has started recently showing a preference for implementation using D&B-type contracts (see table below). NHA's experience suggests that item-rate contracts typically involve time-overruns and cost-overruns whereas D&B contracts pass the risk of quantity variations and price fluctuation to the designer/contractor. Therefore, projects typically stay within schedule or go ahead of schedule, unlike progress under item-rate contracts. While the cost of D&B type-contracts in Pakistan has been about 46 percent higher than cost estimates, these contracts are fixed cost without price escalation. Consequently, a proper comparison should be between D&B rates and the final cost of item-rate contracts including all



escalations/variatio

over the construction period. Moreover, D&B contracts typically include a longer defect liability period that is often three or more times the standard one-year under item-

⁴⁶ See NHA's website for details on its mandate and organizational structure: <http://nha.gov.pk/en/>



based contracts.

Table 5: Design-and-Build type contracts

Contract name	Cost in billion: PKR (\$US)	Planned progress	Achieved progress
Construction of PKM (Peshawar - Karachi Motorway) Section-3 (Multan (Abdul Hakeem) - Lahore) 230 Km (M-3)	131 (1.2)	78	79
China - Pakistan Economic Corridor, (CPEC) KKH - Phase-II (Havelian - Thakot) Section (120 KM)	120 (1.1)	46	45
Construction of PKM (Peshawar-Karachi Motorway) Section-2 (Sukkur - Multan 375 km)	260 (2.4)	36	48

6. **An Engineer will be procured by NHA to, inter alia, support NHA in the evaluation of the technical bids for the D&B contract for PTEC, review the designs and supervise construction.** The Engineer will also monitor the implementation of contractual clauses/conditions.

7. **The Project Director (PD) will be responsible for the implementation of the RAP and cross-agency coordination, including grievance redress.** The PD shall be assisted by a Social Development/Resettlement Specialist. A Land Acquisition Collector (LAC) and additional representatives, if deemed necessary, will acquire land. A RAP Coordination Committee (RAP CC), comprising the DPD and LAC, shall ensure that all agencies involved in RAP implementation are fully informed of RAP and WB Policy requirements, while assisting in RAP implementation. In addition, the Social Development/Resettlement Specialist will: (i) review and verify internal monitoring reports; (ii) identify and select impact indicators; (iii) conduct an impact assessment through formal and informal surveys with PAPs; (iv) consult with PAPs and NHA in preparing review reports; and (v) assess the resettlement efficiency, effectiveness, impact and sustainability. Monitoring will focus on the status of Project-affected vulnerable groups, such as female-headed households and economically backwards families. Indicators are expected to include: (i) socioeconomic conditions of PAPs; (ii) reactions from PAPs on entitlements and compensation; (iii) changes in housing / business restoration; (iv) grievance procedures, including recording, processing time, and redress; (v) progress of community development schemes; (vi) disbursement of compensation; and (vii) satisfaction of PAPs in the post-resettlement period. An independent agency (NGO, academic institute or a consultant) will conduct periodic M&E and third-party validation of RAP activities.

8. **Multi-tiered Grievance Redressal Committees (GRCs) will be created and established at village/jirga, tehsil, and PIU levels to consider complaints.** The GRCs will be composed of representatives of: (a) Board of Revenue/LAC; (b) NHA or FATA Secretariat; and (c) PAPs. The GRCs will respond to complaints received from affected people and provide timely, transparent and fair resolutions. Details of the GRM will be widely disseminated, the GRM registers will be accessible to communities and other stakeholders, and complete information on the corrective actions taken in response to the grievances will be shared with stakeholders. In addition to on-site GRMs, the Project will consider developing an Interactive Voice Response System to receive complaints and suggestions from citizens. The GRM will be gender responsive, culturally appropriate, and readily accessible to the PAPs at no cost and without retribution. The system will be accessible to women and girls; female PAP



representatives can be included in the GRC (if needed) to help redress grievances specific to women.



The GRM will have specific survivor-centered protocols for recording and addressing SEA complaints. This will include appropriate mechanisms for referral to service providers for survivors of SEA.

9. ***An EMP will be made an integral part of the civil works bidding and contract documents, with the contractor responsible for implementation.*** The Engineer will: (i) assure that contractors comply with EMP requirements; (ii) review site-specific EMPs prepared by the contractor; (iii) ensure that construction activities are environmentally sound and sustainable; (iv) develop good practices to assist contractors in implementing EMPs; and (v) prepare and submit regular environmental progress reports including contract-wise breakdown of non-compliance and rectification by contractors and monitoring results. In addition, Independent Environmental Monitoring Consultants will monitor environmental quality parameters ([i] ambient air quality; [ii] ground and surface water quality; and [iii] noise levels) at locations identified in the EMP. An Environmental Specialist in the PIU will provide oversight. For Component II activities, the contractor will be responsible for implementation and compliance of the EMP of each sub-project. For this purpose, the contractor will hire an Environmental Specialist and the EMP will be an integral part of each contract document. The bid will include a detailed environmental mitigation budget as part of the costs. The supervision consultant for these activities will ensure implementation and monitoring of EMPs and will submit periodic reports on implementation status. The supervision consultant's Environmental Specialist will be responsible for EMP implementation and reporting any non-compliance to the relevant authority. All reports will be provided to the Bank for review, after which certain remedies may be undertaken by the Steering Committee or the PIU as necessary.
10. ***To ensure implementation of ESMP, training and capacity building will be provided by the Engineer for PTEC and the Supervision Consultant for Component II.*** Environmental and social training will build knowledge of the PIU and the contractor's staff on key environmental and social issues associated with the proposed interventions.
11. ***The disclosure of information by the Project, as well as the governance and accountability of Project activities, will be guided by NHA's policies and procedures.*** NHA operates within three sets of guidelines: those of the PPRA, its own Code, and Freedom of Information Ordinance 2002 (FOI). All provide mechanisms to enhance the transparency of decision processes during preparation and implementation, including those for procurement, financial management and safeguards, and grievance and comment handling.

Implementation Support Plan and Resource Requirements

12. ***The Project's Implementation Support Plan has been developed in view of possible limitations on access to the Project area.*** The possibility of the access of the Bank's task team to the Project area requires alternative ways for field supervision and monitoring of ongoing operations. Following the United Nations decision to raise its security risk levels to Phase III for KP, the Bank teams have adopted several innovative measures to continue supervision and monitoring of projects in these areas.
13. Proposed supervision mechanisms include:



- a. **Field Supervision Missions.** Six-monthly regular supervision missions shall be fielded in the NHA Headquarters at Islamabad and project areas in KP and FATA. Participants shall include the Bank's task



team, NHA officials, project managers of the civil works contractors, Resident Engineer of the Construction Supervision Consultant and representatives of PAPs.

- b. **Third Party Monitoring.** For quality assurance and cross verification, a third-party monitoring team will be hired after six months of implementation for an independent progress assessment. The monitoring will cover all technical, environmental and social aspects including GBV- and SEA-related issues. The monitor will report to the Bank team.
- c. **Reporting:** Reporting by the local organization on SEA- and GBV-related issues and by the third-party monitors, will be directly to the Bank. All other reports by the Engineer/Supervision Consultant on technical, environmental, or social matters will be sent to the Bank through the PIU for review.
- d. **Reassessing security conditions:** The Bank team will reassess security conditions on the ground periodically and revisit the arrangements in place and needs based on such assessments.
- e. **Incident checking:** During site visits, the Bank team, will check incident reporting and complaint management to ensure that review processes are in place to document and report incidents.
- f. **Innovative Measures:**⁴⁷ The Project will consider using geo-referencing through Global Positioning System (GPS) enabled cameras for physical asset verification and mobile phone based voice messaging for beneficiary participation, tracking, and verification.
- g. **Project M&E System.** Progress in achieving the project's objectives against the performance indicators will be measured through a comprehensive M&E system.
- h. **Financing for the Supervision.** Sufficient resources for supervision will be committed for the full six years.



⁴⁷ Similar measures are being tried out by DFID for its ongoing projects in KP and FATA.

Table 6: Proposed Supervision Resources

Time	Focus	Skills Needed	Resource Estimate	Expense Estimate
FY 16, 17 & 18	Preparation	Project Design	US\$ 507,500	US\$ 600,000
Six Years	Supervision	Implementation	US\$ 1,500,000	US\$ 1,500,000
Other	-			

Table 7: Supervision Skills Required

Skills Mix Required

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Highway Engineer	30	12	
Transport Specialist	20	12	
Transport Economist	8	6	
Economist	12	6	
Private Sector Specialist	20	20	
Regional Integration	4	4	
Procurement Specialist	30	24	
Financial Management	15	12	
Environmental	30	12	
Social Development	30	12	
Program Assistant, ACS	40		2 staff assistants



ANNEX 3: GENDER ANALYSIS AND PROPOSED ACTIONS

COUNTRY : Pakistan

PAKISTAN: Khyber Pass Economic Corridor Project

Overview

- In Pakistan, there are large gender inequalities in health, education and economic opportunities.*** Women's access to economic opportunities varies across Pakistan with KP and FATA having the lowest percentage of female labor force participation at 14% (59.4% for males)⁴⁸ and 8.6% (56.4% for males)⁴⁹ respectively, compared to the national average of 25% (83% for males). Women's jobs are mainly concentrated in agriculture and education. There are stark differences in women's rural and urban employment: 16.2% of all employees are women in rural KP compared to 1.65% in urban areas.⁵⁰ This difference reflects the fact that in rural areas, women's jobs are concentrated in agriculture whilst women in urban areas find it particularly hard to find wage employment. There are marked gender gaps in female literacy rates in both regions. At just 12.7%, female literacy rates in FATA lag those of males at 49.7%, while in KP 35% of females are literate compared to 71% for males. Public and private sector entities do not generally offer many women friendly amenities (separate washrooms, safe transport options for women, etc.) to encourage women to join the labor force.
- There is evidence that significantly fewer women than men operate businesses in KP and FATA.*** According to the World Bank Enterprise Surveys 2013-15, only 4.9% of the manufacturing firms surveyed in KP, had women in ownership, and none had a woman manager; and only 1.8% of the employees in the surveyed firms operating in manufacturing and services were female. These figures are likely to be even lower in FATA although data is scarce. ERKF, a Bank-supported project, which awarded 36 (or 2.35%) of 1,526 project grants to women-owned businesses in KP and FATA, identified numerous constraints to women entrepreneurship. Key among them are restricted mobility and social norms; low literacy rates, and limited access to finance due to weak application of property rights, which limits women's ability to own property and pledge it as collateral.
- In response to the large gender gaps identified in the labor market, the Project will endeavor to ensure that least 10% of firms benefiting from investments in economic infrastructure financed by the Project are owned and/or managed by women.*** While this target may seem modest, it represents a bold effort in this challenging context where the share of women managed and owned businesses ranges from zero to 4.9% depending on the source used. The Project will also identify and address obstacles to women's employment such as gender-sensitive transportation, workplace infrastructure, harassment-free workplace to support women gain and retain employment.

Sexual Exploitation and Abuse

- Project-related risks for SEA from the anticipated labor influx are considered substantial based on**



⁴⁸ *Pakistan Bureau of Statistics: Pakistan Labor Force Survey 2014-15*

⁴⁹ *FATA Development Indicators* Bureau of Statistics, FATA Secretariat. 2015

⁵⁰ Pakistan Labor force statistics: <http://www.pbs.gov.pk/content/labour-force-statistics>



the risk classification defined by the Bank’s Labor Influx Guidance Note.⁵¹ According to this Note, the adverse impacts of labor influx can be amplified by the relatively high volume of expected labor and the low local capacity to manage and absorb it. It is estimated that about 500-700 skilled and semi-skilled labor will be employed during construction of the Project where the host community is small and rural.

- 5. **Transport corridor projects could lead to a sharp increase in sex trafficking and unsafe migration practices.** Pakistan is a source, transit, and destination country for women, men and children subjected to forced labor and sex trafficking.⁵² HIV transmission can also increase, through male and female sex workers⁵³ as well as from men in the trucking industry transmitting to wives and other sexual partners. Male child prostitution and sexual exploitation around transport hubs such as bus/truck terminals is a prevalent and documented phenomenon in Pakistan as reported by National Commission for Child Welfare and Development and UNICEF. Pakistan has signed Child Rights Convention, KP has a Child Protection and Welfare Commission with offices in several districts of KP, and FATA has a Child Protection Policy.

- 6. **Although the envisaged camp accommodation for labor is likely to reduce chances of unlawful conduct, the volume of the anticipated labor influx, small rural community context, acceptance and under-reporting of GBV in these communities⁵⁴ and the potential for increase in sex-trafficking have triggered substantial SEA risks. The Project will take the following measures to mitigate these risks:**

Mitigation Measures

Safeguards documents, community engagement and identification of service providers	
<i>Strengthening safeguards documents</i>	<ul style="list-style-type: none"> • The project design has incorporated SEA mitigation measures and reflected them in safeguards instruments as the SMF, and will incorporate them including the CoC in ESMPs & Labor Influx Management Plan.
<i>Identifying a local organization with in-depth expertise in GBV prevention/case management</i>	<ul style="list-style-type: none"> • The PIU will map project-affected communities to assess local risk factors for SEA and to identify and hire a local organization with in-depth expertise in GBV prevention/case management and strong local presence in and community trust – using credit proceeds. The organization will report to the Bank team. • The local organization, which will report to the Bank team, will undertake a range of SEA related activities: developing specific survivor-centered protocols for recording and addressing SEA complaints, conducting ex-ante SEA prevention activities and providing referral services to link service providers with survivors. • The local organization will i) educate communities and raise their awareness about SEA risks and their legal rights and services



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<http://wbdocs.worldbank.org/wbdocs/viewer/docViewer/indexEx.jsp?objectId=090224b084778e75&respositoryId=WBDocs&standalone=false>

⁵² *<https://www.state.gov/documents/organization/258876.pdf>*

⁵³ See Abbas 2002 for a study on risk of HIV transmission risks through sex workers in Pakistan

⁵⁴ Pakistan Demographic and Health Survey (PDHS) 2012-13



	<p>available to them, ii) monitor that services for survivors are in place during the life of the project, iii) monitor the contractor’s obligations with respect to signing the CoC and the implementation of mandatory and repeated training/sensitization of workers on CoC and sexual harassment policies, and iv) undertake mandatory SEA awareness and prevention training/sensitization of workers.</p>
<p><i>Identifying service provider/s for survivors of SEA, and for HIV/AIDS support</i></p>	<ul style="list-style-type: none"> • Service providers will be identified to offer services for survivors of violence (e.g. health, psycho-social, legal) as well as HIV/AIDS support. Concrete modalities of working with the service providers vis-à-vis the functioning of GRM and referrals will be defined in consultations with them and the local partner organization. • Ways of strengthening existing GBV/SEA services in both KP and Khyber Agency that available to survivors from Khyber Agency will be explored.
<p>Grievance Redress Mechanism</p>	
<p><i>Strengthening GRM to address SEA</i></p>	<ul style="list-style-type: none"> • The GRM will have multiple channels to initiate a complaint. It will ensure confidential reporting with safe and ethical documenting of SEA cases and will include appropriate mechanisms for referral to service providers. The PIU will disseminate GRM procedures in the communities.
<p>Contractors and consultants</p>	
<p><i>Codes of Conduct (CoC) with specific prohibitions against SEA</i></p>	<ul style="list-style-type: none"> • The bidders will be briefed on the Environmental, Social, Health and Safety Standards and the Occupational Health and Safety Standards and their responsibilities related to preventing and mitigating SEA. • The bidders will be required to declare whether any contracts have been suspended or cancelled or bid bonds called for incidents related to SEA. Any such incident will trigger more intensive due diligence. • The bidders will be required to submit with their bids CoC meeting minimum standards as outlined in the Standard Procurement Documents. The CoC will set clear boundaries for acceptable and unacceptable behaviors and will be signed by contractors, their sub-contractors and any consultants that have physical presence at the project site. • The bidding documents will include specific requirements that minimize the use of expatriate workers and encourage hiring of local workers, thereby minimizing labor influx. • CoC will include i) specific prohibitions against, and commensurate sanctions, for SEA, especially of children (anyone younger than 18). Contractors will be required to: i) establish anti-sexual harassment policies that govern conduct in the workplace; (ii) develop a SEA action plan to operationalize the CoC; iii) discuss the CoC with employees and disseminate them in the surrounding communities to make the project affected community aware of them and iv) report SEA incidents.



	<ul style="list-style-type: none"> Provisions will be set in contracts for dedicated payments to contractors for SEA prevention activities (e.g. training) against evidence of completion. The portion of the contract price will be guaranteed by a performance security linked to environmental and social contractor performance. The PIU will ensure that the contractor provides separate, safe and easily accessible facilities for women and men working on the site. Locker rooms and/or latrines will be in separate areas, well-lit and include the ability to be locked from the inside. The PIU will ensure that the contractor maintains all areas and public spaces around the project grounds well-lit.
Security Personnel	
<i>Training and enforcement</i>	<ul style="list-style-type: none"> The PIU will provide mandatory training/sensitization on GBV and SEA to all personnel deployed to provide security services related to the Project. The Project will promptly report any unlawful behavior of the security personnel to the government, and request their sanctioning and removal according to national laws.
Human trafficking and HIV/AIDS	
<i>Addressing human trafficking and HIV/AIDS transmission</i>	<ul style="list-style-type: none"> The Project Implementation Entity will (i) coordinate with ministries and agencies engaged in anti-trafficking initiatives to mitigate the risk of trafficking focusing on PTEX (ii) for HIV/AIDS, see below.
Enhancing PIU's and the local governments' capacity to address SEA and HIV/AIDS	
<i>Targeting the PIU, local governments and other sub-national administrations to enhance their capacity to address SEA</i>	<ul style="list-style-type: none"> The PIU and local government training to enhance their capacity in preventing and responding to SEA and HIV/AIDS. Where feasible, the training and awareness raising sessions will include government partners responsible for addressing SEA and HIV/AIDS. Where feasible, the PIU will establish linkages between project-level responses and government strategies to build broader frameworks and action plans to address SEA and HIV.
Monitoring SEA	
<i>Requests for proposals to set explicit expectations for the consultant's role in monitoring contractor's performance of its SEA obligations.</i>	<ul style="list-style-type: none"> The Supervision Consultants/Engineer's requests for proposals will specify the need for appropriately-qualified and capable social safeguards specialists to monitor the contractors'/consultants' performance of its SEA obligations. Staff will be employed upon the Bank team's no-objection. The reports by the Engineer will be sent to the Bank.



ANNEX 4: OVERVIEW OF PRIVATE SECTOR IN KHYBER AGENCY AND ADJACENT AREAS

COUNTRY: Pakistan

PAKISTAN: Khyber Pass Economic Corridor Project

Khyber Agency

- The Khyber Agency is more economically developed than other agencies in FATA, but still exhibits low levels of urbanization and literacy.** Khyber Agency is divided into three sub-divisions – Jamrud; Landi Kotal; and Bara – and has a total population of just under a million people.⁵⁵ The Agency is overwhelmingly rural, with just 10 percent of the population living in the urban areas of Jamrud, Landi Kotal and Bara and/or along the existing Peshawar-Torkham road or the Bara road. Per the FATA Development Indicators Household Survey (FDIHS) 2013-14, the Agency has the highest literacy rate of any agency in FATA, with a male and female literacy rate of 76.3 and 16.6 percent, respectively. Adult unemployment is estimated at 5 percent and 4 percent of households have at least one member working abroad. Across FATA generally and as of 2013-14, services were the largest employer in FATA (79 percent), following by agriculture (15 percent) and manufacturing (3 percent). Khyber Agency is likely to exhibit a higher concentration in manufacturing.
- The construction industry in the Khyber Agency has experienced rapid growth in recent years.** As of 2013-14 and across FATA, the construction industry (46 percent) was the largest employer of all service sub-sectors, followed by transportation and logistics (22 percent) and wholesale and retail trade and public services (16 percent). As of 2010, approximately 2,000 units were engaged in the services sector in the Khyber Agency. The Pakistan Engineering Council has registered 100 construction companies in FATA, a substantial proportion of which are in the Khyber Agency. The construction industry has boomed in FATA over the last decade due to increased funding for infrastructure both by donor-funded projects and by FATA's annual development budget and by post-conflict reconstruction enabled by improved security in the area.⁵⁶
- With the Khyber Agency situated between Peshawar and the border crossing at Torkham, trade and commerce are important components of the local economy.** The *Shinwari* and *Afridi* clans, which straddle the border separating the Khyber Agency from Afghanistan, dominate cross-border trade and transport. Two major markets exist at Bara and Landi Kotal and had historically attracted shoppers from across Pakistan. More recently, however, a market of smuggled goods has developed at the starting point of the Peshawar – Torkham road at Jamrud Tehsil and now is the predominant destination for non-local shoppers. To cater to local traffic, a strip of markets has also developed along the existing Peshawar – Torkham and Bara roads.
- Marble processing is a major industrial activity in the Khyber Agency, despite a low level of marble deposits.** As of 2010, approximately 300 units operated in the marble sector in Khyber Agency as of 2010. Although only 5 percent of the total marble extraction in FATA happens in the Agency, it has almost 60 percent of the total marble processing units in FATA, with a total of 266 units in 2010



⁵⁵ 2017 Pakistan census

⁵⁶ FATA's annual development fund over the past decade increased from a little less than PKR 13 billion in 2009-10 to PKR 25 billion in 2017-18.



(mostly clustered in Mulagori). The Khyber Agency may lose its regional dominance in marble processing, however, with the opening of Mohmand Marble City in neighboring Mohmand Agency.

5. **The Khyber Agency, which is the most industrialized agency in FATA, hosts an industrial cluster at Bara.** According to an industrial enumeration survey conducted in 2010 by the FATA Development Authority, Khyber Agency hosts 537 industrial units. However, these industrial units are mostly small or medium-sized, with only two large manufacturing units present in the Agency. The industrial cluster at Bara features a variety of industries including, power looms, steel billets, matchsticks, plastics (including pipes and bags), and other construction material, with plastics (38 units) and cloth (53 units) representing the two main sectors. However, the industrial cluster at Bara has been badly damaged during military operations over recent years.
6. **Although much of the Agency's land is unsuitable for agriculture, many households earn income from animal husbandry.** As in most of FATA, farms in the Khyber Agency generally do not produce crops for trade or export due to the arid nature of the terrain. A significant proportion of households in the Khyber Agency, however, earn income from raising poultry and livestock.
7. **While FATA has currently few tourists, the unique heritage of the Khyber Pass and the improving security situation provide potential for the development of a tourism industry.** In addition to shopping at Bara and Landi Kotal, a key draw for tourists in the past was the now-defunct 'Khyber Steam Safari', which traversed the Khyber Pass Railway constructed by the British Raj between 1905 and 1926 to thwart a potential invasion of the sub-continent by Russia.⁵⁷ Other sites of historical or cultural interest in the Khyber Pass include a 2nd century Buddhist stupa,⁵⁸ a prison reportedly built by the famous conqueror Tamerlane at the base of the Torkham valley; three forts from different eras (Ali Masjid Fort, Jamrud Fort, Shagai Fort); the Michni post which provides a view of the Torkham valley into Afghanistan; and the Bab-e-Khyber. Given its decisive role in world history, the Khyber Pass is itself a site of tourist interest.

Adjacent Agencies and Frontier Regions

8. **The Mohmand and Orakzai agencies are smaller and less developed than Khyber Agency.** The two agencies of Mohmand and Orakzai run to the north and south of the expressway respectively. Mohmand has a population of 470,000 and Orakzai 250,000, with entirely rural populations in both agencies. The male literacy rate is 40 percent in Mohmand and Orakzai agencies and the female rate is 12 percent in Orakzai and 7 percent in Mohmand. Adult unemployment rate is 6 percent in Mohmand and 4 percent in Orakzai Agency. The major economic sectors in the two agencies are agriculture and mining. As elsewhere in FATA, agriculture in both agencies is primarily at subsistence level, with about 29 percent and 18 percent of rain-fed cropland in Mohmand and Orakzai agencies respectively. However, unlike in Mohmand where most of the terrain is bare, 40 percent of Orakzai is covered with forests and the dense forests that Khyber's Tirah Valley share with Orakzai may represent a future tourist destination.



⁵⁷ Due to damage to sections of the track and bridges by monsoon floods in 2008, trains have not run along the line in ten years. (https://en.wikipedia.org/wiki/Khyber_Pass_Railway)

⁵⁸ https://en.wikipedia.org/wiki/Sphola_Stupa



9. **Mining of natural resources dominate the economies of Mohmand and Orakzai, with services playing a much smaller role than in Khyber.** According to the FATA Secretariat, Mohmand produces 478 thousand tons of marble per year, which represents 95 percent of FATA's output. However, only 32 percent of marble processing plants (144 units as of 2013) are in Mohmand. According to the FATA Industries Enumeration Survey 2010, there were a total of 227 industrial units in Mohmand. In 2010, about 170 industrial units were reported in Orakzai Agency, of which almost all were in the coal sector. Recently, production of natural gas has started in Orakzai, although is still at an infant stage. Industrial units tend to be bigger in Orakzai and Mohmand as compared Khyber, with 4 and 9 large units respectively. The service sector tends to be much smaller in both Mohmand and Orakzai agencies, with 300 and 348 units respectively. This is primarily because both agencies are not part of any major transport corridor and, with smaller and predominantly rural populations, retail stores are less viable than in other areas.

10. **Industrial clusters currently exist at Dara Adam Khel in FR Kohat and at Hayatabad in western Peshawar.** FR Kohat, which is south of Bara sub-division along the Indus Highway, is the most industrialized area in FATA. In 2010, 599 industrial units operated in FR Kohat, of which more than 550 were in arms manufacturing and located in Dara Adam Khel. To help regulate the industry and encourage industries with transferable skills, proposals have been advanced to establish industrial zones in FR Kohat. An industrial zone currently exists in Peshawar's Hayatabad area, which is adjacent to Shah Kas in Khyber, and which hosts firms producing pharmaceuticals, marble processing, iron, plastic pipes, match sticks, bottling, furniture, and food processing. The zone is adjacent to one of Peshawar's main townships, prompting to the Government of KP and the FATA Secretariat to encourage industry to relocate to Shah Kas in the Khyber Agency.

11. **The health cluster at Hayatabad is the primary provider of health services to Afghans seeking treatment in Pakistan.** A health cluster has been developed in Phase 5 of Hayatabad township in western Peshawar (at the edge of Khyber Agency) to serve both locals and patients from Afghanistan.⁵⁹ The cluster has grown rapidly and now features some of the leading private and public hospitals in KP. Supporting infrastructure – including hotels, restaurants, and transportation services – have developed along with the cluster.



⁵⁹ Afghans have been attracted to hospitals in the cluster due to the poor state of health services in Afghanistan and because the cluster at Hayatabad eliminates the need to travel through the city of Peshawar, where visa documentation is often requested from visitors.



ANNEX 5: ECONOMIC ANALYSIS

COUNTRY: Pakistan

PAKISTAN: Khyber Pass Economic Corridor Project

A. Economic Evaluation Assumptions

1. ***To ensure that the Project generates sufficient economic benefits that warrant the investment, a Cost Benefit Analysis was conducted for PTEX using the Highway Development and Management (HDM-4)⁶⁰ that computes annual road agency and users' costs for each project alternative over the evaluation period.*** The quantities of resources consumed and vehicle speeds are calculated first and then multiplied by unit costs to obtain total vehicle operating costs and travel time costs and CO₂ emissions. The resources consumed and vehicle speeds are related to traffic volume and composition, and road surface type, geometric characteristics, and roughness.
2. ***The quantified benefits computed by HDM-4 comprise savings in vehicle operating costs, travel time costs, road maintenance costs due to the road improvements, and a reduction in costs of CO₂ emissions with the Project.*** For the HDM-4 calculations, the following assumptions were applied:
 - A discount rate of 8 percent and an evaluation period of 25 years.
 - A conversion factor of 0.85 to convert financial costs into economic costs to remove taxes from financial costs.
 - The road works will commence in 2019 and construction will be carried out in 4 years.
 - The average daily traffic annual increase rate is 4.5 percent per year for passenger vehicles and 5.0 percent per year for trucks over the evaluation period.
 - Generated traffic is 19 percent of normal traffic, based on the expected reduction of travel time and cost with the project for cars (31 percent).
 - About 50 percent of Afghanistan's transit trucks travelling to alternative ports on the Arabian Sea (estimated at about 130-135 in 2017) will switch to Karachi port through Torkham after the completion of the Project.
 - Social cost of carbon of US\$57.5 per metric ton in 2018 increasing to US\$98.0 per metric ton in 2042, based on medium scenario for the social cost of carbon derived from the 2017 World Bank guidance note on shadow price of carbon in economic analysis.⁶¹



⁶⁰ HDM-4 is a tool (software package) for the analysis, planning, management and appraisal of road maintenance, improvements and investment decisions.

⁶¹ The guidance note presents low and high scenarios of the social cost of carbon over time, from which a medium scenario (average values) was obtained.



- The table below presents the vehicle fleet economic unit, basic characteristics, and the traffic composition on the project road.

Table 8: Vehicle Fleet Economic Unit Costs, and Characteristics.

	Car	Wgn/Mbus	Truck 2xl	Truck mxl
New Vehicle Cost (US\$)	9,320	52,160	81,124	89,052
New Tire Cost (US\$)	60.03	104.04	416.22	441.83
Fuel Cost (US\$/liter)	0.47	0.47	0.47	0.47
Lubricant Cost (US\$/liter)	3.32	3.32	3.32	3.32
Maintenance Cost (US\$/hour)	1.04	1.04	1.04	1.04
Crew Cost (US\$/hour)	0.00	1.04	1.36	1.36
Overhead Cost (US\$/year)	0.38	0.38	0.38	0.38
Interest Rate (%)	6	6	6	6
Work Time (US\$/hour)	4.41	2.20	1.47	1.47
Non-Work Time (US\$/hour)	1.47	0.73	0.49	0.49
Cargo Time (US\$/hour)	0.00	0.00	0.25	0.50
Annual Utilization (km)	23,000	30,000	70,000	86,000
Annual Utilization (hours)	550	750	1,800	2,050
Service Life (years)	10	8	12	14
Number Passengers (#)	3	10	1	1
Operating Weight (tons)	1.2	1.5	25.0	45.0
Standard Axle Loading (#)	0.0	0.0	5.0	4.0
Traffic Composition (%)	52.0%	33.0%	5.0%	10.0%

- The Peshawar-Torkham Expressway to be constructed under the project totals 48.0 km.** The existing road from which the traffic will be diverted to the new expressway is 40.0 km. The current average annual daily traffic on the existing road is 9,114 vehicles per day of which 6,651 vehicles per day are expected to divert to the new expressway. The existing road is a two-lane road in fair condition on which cars travel at an average speed of 43 km per hour and trucks at 19 km per hour due to congestion and high grades and curvature. The new expressway is expected to have better geometry and a speed limit of 80 – 100 km per hour.
- The total financial capital cost for the construction of the expressway (including design and supervision) is estimated at US\$322 million, corresponding to US\$6.7 million per km in financial terms and US\$5.7 million per km in economic terms.

B. Economic Evaluation Results

- The EIRR of the construction of the Peshawar-Torkham Expressway is 12.5 percent and the NPV is US\$178 million corresponding to a B/C ratio of 2.2.** Normal traffic benefits account for 90 percent of the project benefits and generated traffic benefits for 10 percent. When the projected reduction in CO₂ emissions associated with the Project is taken into account (see Section C below), the EIRR increases slightly to 12.6 percent.



- 7. **Sensitivity analysis shows that PTEX is economically justified even if construction cost is 20 percent higher or if the annual traffic growth rates are 20 percent lower or both.** If construction costs were 20 percent higher and the annual traffic growth rates were 20 percent lower, the EIRR would drop to 9.0 percent.

Road Section	Proposed Strategy	Increase in Cost by 20%	Decrease in benefits by 20%	Increase in cost by 20% and reduction in benefits by 20%
Peshawar - Torkham	12.6%	11.0%	11.0%	9.5%

- 8. **Switching values analysis shows that construction costs would have to increase by 65 percent for the EIRR to reach 8 percent.** An increase of 35 percent would result in an estimated EIRR of 10 percent.
- 9. **Road safety benefits have not been included in the analysis.** As NHA is establishing a baseline for road accidents and fatalities in order to estimate the expected improvements resulting from PTEX, these benefits have not been yet estimated and hence were not included in the economic rate of return.
- 10. **The benefits to generated traffic have been conservatively estimated at 10 percent of the benefits to existing traffic.** At present, no passenger cars or buses are allowed across the border. Pedestrians including patients have to walk, often with luggage, about one km to cross the border. Once passenger cars can be processed and go through the border (after the completion of the ADB border improvement project), the generated traffic is expected to further increase. Daily pedestrian crossings at Torkham are estimated at about 10,000.
- 11. **Component II:** Based on the experience of similar interventions, the EIRR of Component II, is expected to be least 15 percent. Interventions will be identified to maximize the economic and social returns. Road infrastructure The EIRR of this component will be reassessed after specific investments have been identified.



12. **Broadband connectivity further increases the economic benefits of the Project.** While the economic benefits of laying fiber optic cables for broadband connectivity have not been estimated, studies have shown significant benefits to such investment. For example, a World Bank study found that in low- and middle-income countries every 10-percentage point increase in broadband penetration accelerates economic growth by 1.38 percentage points—more than in high-income countries and more than for other telecommunications services.⁶² On the recently completed Khunjarab-Raikot section of the Karakoram Highway (KKH), the infrastructure was provided by NHA, while the cable itself was installed by the Strategic Communications Organization (SCO). On the Faisalabad-Khanewal section of the M-4 Motorway, the cable was installed by Pakistan Tele Communications Ltd. As service providers, these organizations pay NHA a rental for using the infrastructure i.e. duct, manhole etc. For PTEX, NHA intends not only to provide the infrastructure, but also install the cable. This will allow more service providers to utilize NHA’s fiberoptic cables bringing in additional revenue for NHA and introducing more competition in the market.

⁶² World Bank (2009) Information and Communication for Development: Extending Reach and Increasing Impact.



13. ***While the rates of return are investment-specific, certain types of investment when appropriately selected, typically generate high rates of return.*** For example, the estimated economic rates of return for all weather rural roads in FATA under the 2013 MDTF FATA Emergency Rural Roads Project were about 19 percent, and later revised in the Implementation Completion and Results Report to 26 percent. Similarly, the economic rates of return for emergency roads (including provincial highways) in KP under the 2014 KP Emergency Roads Recovery Project were estimated at about 30 percent. In general, the rehabilitation of well-travelled roads has high rates of returns. Well-located freight consolidation centers could generate high rates of economic and financial returns and reduce the carbon footprint of freight. Given that there are no freight terminals in FATA, there is a strong rationale for assessing the optimal design and location, and feasibility of such a terminal. Similarly, the large number of pedestrians crossing Torkham everyday (averaging 10,000 and estimated to reach 40,000 on busy days--according to the 2016 TRS) suggest the economic viability of an investment in an international bus terminal to support services provided by the private sector.

c. GHG Accounting

14. The total gross Carbon Dioxide (CO₂) emissions over the 25-year evaluation period under the without-project scenario are estimated at 5.0 million tons and under the with-project scenario at ***4.75 million tons resulting in a net decrease of CO₂ emissions of about 250,000 tons, or 10,000 tons per year.*** The reduction in GHG emissions can be attributed to two reasons: (1) PTEX provides a much-improved geometrical design with significant reductions in vehicle operating cost and GHG emissions per vehicle km ranging from 15-35 percent depending on the vehicle type. (2) The difficult terrain of the current road, together with uncertainties caused by recent border closures and other regulatory and pricing inefficiencies related to container and truck movements, have diverted the Afghanistan transit trade to alternative ports on the Arabian Sea, routes which are about 300 km longer than those via Torkham. Once PTEX is developed and operating and regulatory efficiencies addressed, truck traffic would be expected to switch to Karachi port resulting in reductions in GHG emissions. One would have expected a larger decrease in emissions. However, the fact that PTEX is 20 percent longer than the existing road, that PTEX would generate new traffic, and that the number of Afghanistan trucks using alternative ports on the Arabian Sea is still fairly small (estimated at about 130 – 135 trucks in 2017) have contributed to the low value of reduction in GHGs.



D. Public Sector Financing and World Bank Value Added

15. Public sector financing is the appropriate vehicle for financing the construction of proposed road because the construction costs cannot be recovered through tariffs. Public investment in road infrastructure is desirable because it is a way the Government plays a key role in the country's development by handling a range of issues that can only be accomplished or implemented through government actions, such as axle weight controls and road safety regulations. The World Bank's role is justified because of the project's economic and social benefits and because of the value added it brings beyond financing in areas such as construction quality control, sustainability of road maintenance, transport planning, environmental risk management, safeguards, procurement, and FM.



The World Bank

Khyber Pass Economic Corridor Project (P159577)



MAP



**Annex 2: Support in Development of Geo-Referenced Local Master Plan
(GeoLoMaP) for the Peshawar-Torkham Economic Corridor (PTEC) and
Surrounds (January 2018)**



January 05, 2018

Submitted by

Associates in Development Pvt. Ltd.





Executive Summary

The purpose of this report is to provide a detailed account of overview of activities performed, methodology and geo referencing technology utilized for the development of final product – The GeLoMAP. Two major tasks are described as high level technical meetings (stakeholder’s consultation) and field data collection under permissible geographic boundaries of area under study. The datasets for restricted areas is covered by secondary sources described in this report.

The packages used consist of ArcGIS Info (Desktop Application), Map Coordinates (Android Application), Global Mapper , Google Earth, Google Maps API. The reference dataset was first geocoded using the Arc info Geocoding Platform which incorporated parcel centroid matching accuracy, and then each match was verified and/or corrected using a combination of tools including Internet information searches, Google Earth and/or the Google Maps API.

A spreadsheet inventory on existing, planned and ongoing interventions is prepared along with connectivity and linkage features to nearby CPEC developments. The inventory is also presented in this report by associated maps built under geocoding systems. The findings are presented in the form of a detailed map produced as a final result of this study and should assist the WB in their aim of deciding investment priority for the PTEC.



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Introduction

The Transport and associated infrastructure seeks to connect people, goods and services to jobs, schools, hospitals, local, regional and international markets, using faster, cheaper, safer and more efficient solutions, while keeping traffic fatalities, congestion, greenhouse gas emissions, and local air pollution in check. It responds to the needs of developing countries and transition economies for modern and reliable transport and trade solutions. These needs are growing exponentially under the combined effect of globalization, population growth, rapid urbanization, economic development, and technological progress – making ‘Economic Corridors’ a global development investment agenda.

The Central Asia Regional Economic Cooperation (CAREC) Initiative has identified various corridors from the CARs to Pakistan through Afghanistan and China. Each corridor improves access for CAREC countries to at least two large Eurasian markets. Afghanistan is connected through Pakistan by two border posts. The Afghanistan’s imports from and exports to neighboring (bilateral trade) and non-neighboring countries (transit trade) enter and exit Pakistan at the Torkham border-crossing in FATA, which is just 50 km from the closest city of Peshawar in Khyber-Pakhtunkhwa (KPK) province, and the key entry and exit point of Afghanistan’s international transit trade is the Karachi Port. The Chaman border-crossing in Baluchistan province is the second most important border-crossing. The National Highways Authority (NHA) is working on an overall internal and regional transport connectivity program that includes three regional economic corridors for CPEC – Western, Central and Eastern Corridors. The Western corridor includes the National Highway N-25 that provides access to Afghanistan through Chaman border-crossing which is part of the CAREC-6 corridor.

The Eastern corridor (PTEC) includes the Peshawar-Torkham-Kabul Motorway a new alignment alongside existing Khyber Pass also termed as PTEX. The Peshawar-Kabul Motorway is part of the CAREC-5 corridor as well as part of the Asian Highway Network (AH-1). A Joint Economic Commission (JEC3) headed by the finance ministers of Afghanistan and Pakistan have endorsed the proposed Peshawar-Kabul Motorway and its extension to Tajikistan. The Peshawar-Kabul Motorway can be termed as the gateway to Central Asia.

Team Composition

The following key team members from AiD Consultants Pvt. Ltd. were involved in the development of Geo referenced Local Master plan (GeLoMap) for Peshawar – Torkham Economic corridor and surroundings;

1. A Rashid Khan : Team Leader
2. Khurram Saeed : Transport Specialist
3. Sheraz Ahsan : GIS Expert

Scope Outline



Development of a Geo-Referenced Local Master Plan (GeLoMaP) that describes and geo-references existing infrastructure and on-going as well as planned interventions along the corridor, in the vicinity of the corridor, and which otherwise support economic activity along the Peshawar Torkham Economic Corridor (PTEC) and its linkages with CPEC.

Geographic Scope

The geographic boundaries of this assignment are as following;

PRIMARY:

- Peshawar – Torkham Border (PTEC)

SECONDARY:

- Peshawar City and vicinity
- FATA Region (Khyber Agency, Mohammad Agency)
- CPEC connectivity in East of Peshawar



Fig 1: Region under Study

Thematic Scope

The conceptual scope for developing GeLoMap is comprised of following;

1. In conjunction with stakeholders, partners, and additional agencies and utilizing documentation and materials provided by these entities and from additional sources, compile an inventory of completed and ongoing as well as planned investments that fall within the geographic scope of GeLoMaP.
2. Identify and obtain geo-references and descriptive information for planned, existing and ongoing investments that fall within the geographic scope of GeLoMaP.

Items of Interest for Georeferencing

The following infrastructure / transport / trade related items were considered during the project assignment



1. Rail and Roads Transport infrastructure
2. Trade Routes
3. Industrial zones
4. Economic zones
5. Trucking and Bus terminals
6. Dry ports
7. CASA 1000 power line
8. Border facilitation terminal near Torkham.
9. CPEC linkages via motorway M1
10. FATA small Dams
11. BARA river irrigation
12. River channels in Khyber agency

Key Activities Performed

1. Preparation of Workshop Material

Based on the agreements reached in the inception meetings, for the organization of a stakeholder's consultation workshop in Peshawar. The draft workshop materials were prepared by AiD consultants and shared with WB team included the following:

- WS invitation letter
- WS stakeholders List
- WS Agenda

2. Stakeholder's Consultation

After the contract signing, several meetings have been held with WB team and relevant stakeholders in KPK and Islamabad.

These meetings have broadly focused on the following:

- Building the understanding about PTEC
- Introduction of the project assignment, consultants team and WB objectives
- The data/information to be collected
- Data gathering process and output format of GeLoMAP
- Development of key informant interview guidelines
- Agreement on List of stakeholders,
- Developing the study work plan.
- Preparatory work for Stakeholder workshop
- Initiate the "mapping exercise" with a focus on what exists in the field, including the available plans and proposals.

The following sections capture a brief summary of the stakeholder meetings held and the data accessed to date.

7.1.1 Stakeholders Consultation Meetings

Meeting # 1: Meeting at the World Bank Islamabad (August 7th 2017)



Venue: The World Bank, Level 2, Serena Business Complex, Islamabad

Purpose: The purpose of the meeting was to participate in a joint meeting called by the WB. The participants included representatives from NHA, C&W FATA, NHA consultants (i-e ACC Pvt Ltd. On behalf of AiD Pvt Ltd Mr Abdul Rashid Khan (TL), Mr Ijaz Husain Rizvi and Mr Ahsan Gulzar participated.

The ACC team and C&W representatives provided a detailed briefing on the progress of the various on-going and planned projects. Subsequently the ACC team also shared soft copies of the alignment for the Peshawar-Torkham Expressway project for which they have been contracted by NHA, Islamabad. Mr Shahab Khattak (Chief Engineer, C&W –FATA also shared a presentation on the various projects that are being planned in/around the PTEC. The WB reps introduced the AiD team to the participants and requested facilitation for data access and further discussions. At the close of the meeting it was agreed to reconvene at a mutually convenient date.

Meeting # 2: Meeting at the World Bank, Islamabad (October 2, 2017)

Venue: The World Bank, Level 2, Serena Business Complex, Islamabad

Purpose: The purpose of the meeting was to discuss the progress AID has been making on their mapping exercise and from the Bank's side to provide update AID on further developments of this project. On behalf of the WB, Andrew L. Beath- Senior Economist and Mr Tristan Reed – Economist, participated. While AiD team was represented by Mr Abdul Rashid Khan (Team Leader); Mr Ijaz Rizvi – Director Operations and Mr Khurram Saeed, (Transport Specialist)

7.1.2 Discussions:

Andrew Beath from WB and Rashid Khan from AiD team respectively made opening remarks and briefed the participants on the following points;

Stakeholder Consultation Workshop:

Rashid Khan noted that the draft workshop materials were shared with the WB on Sept 14, 2017. However further feedback is awaited. Andrew noted that there has been some internal mis-communication on the subject. Hence the delay. A principle go ahead has been given to Mr Ghazan and Mr Farid who will take further actions. Due to other commitments his presence at the workshop was not necessary. It was further agreed that based on the draft materials shared by Aid, the WB will write to ASC FATA to schedule a firm date for the workshop. Mr Ghazan and Mr Farid will advise AiD on the date so that further actions can be planned.

Andrew told that he has reviewed the material and the feedback would be given by Ghazan in a week.

Interim Map for WB Appraisal Document :

Consultants shared the draft maps to the WB team and also briefed the items described in those maps. Andrew and Tristan suggested following improvements in the interim map activity before final submission;

- Display the items with different and more prominent color scheme
- Use separate symbols for various physical infrastructure
- Location and status of interchanges should be marked properly
- Mark the roads status with different colors clearly describing controlling authority



- Hold follow up meetings Mr. Shahab (CE- FATA) to reconfirm the FATA infrastructure planned

Preparation for a New CPEC Map

In addition a new task was given to develop a map for western CPEC extension and related economic activity planned on the east of Peshawar city thus creating a link to PTEC developments.

Geo- Referencing / Primary Data collection

The draft map and the progress on the secondary data information was broadly discussed and agreed.

Meeting # 3: Meeting with Chief Engineer (CW) – FATA (September 19, 2017)

This initial meeting was very informative; Mr. Shahab Khatak (CE- FATA) provided clarity about the FATA development proposals, including the transport / trade and mobility options under consideration. The discussion also covered location and linkage of existing industrial estates and proposed site for a container terminal in FATA region along proposed Mattini – Surkamar bypass. He also requested AiD to include this proposal in the workshop agenda for possible WB funding to implement. The issue of connectivity links with east side of Peshawar was also discussed. It was noted that NHA – Islamabad should be accessed for gaining additional information.

Meeting # 4: Meeting with the General Manager Design – NHA Islamabad (October 3, 2017)

Due to a long leave and his official commitments the GM Design was unavailable till October 3rd. The meeting was finally held at his office in the NHA headquarters, Islamabad. Mr. Asim Amin (GMD) was briefed about the project and workshop activities by the Transport Specialist – AiD team. For PTEX possible alignment options he referred to consultants firm named ACC in Islamabad. For connectivity information / options referred to Member Planning – NHA.

Meeting # 5: Meeting with Member Planning – NHA Islamabad (October 6, 2017)

Mr. Raja Nowsherwan (M Plg.) was briefed on the project and launch workshop planned in the coming weeks. Mr. Nowsherwan noted that the north side connectivity for eastern trade traffic is under consideration; however on the eastern bypass loop NHA is currently not interested. He also suggested that the eastern connection along with the Mattini bypass may be implemented by FATA authorities through own funding or perhaps through funds from the WB.

Meeting # 6: Meeting with Peshawar-Torkham Expressway (PTEX) Design Consultants, ACC pvt. Islamabad (October 9, 2017)

A meeting was held with Mr. Akhtar Mir (Tech. Director) who provided details on the three possible options for PTEX and the specific option which has been approved by NHA. Based on this option the technical feasibility and design is under preparation. The coordinates for the selected alignment were also obtained from ACC and transferred to the Interim plan attached at annex. A.

Meeting # 7: Meeting with General Manager Technical – FATA Development Authority (October 11, 2017), Peshawar

A meeting was held with Mr. Maqsood Anwar (GM/FATA DA) at the FDA office in Hayatabad, Peshawar. Mr Maqsood expressed a high interest in the connectivity of the various industry hubs and population with PTEC and provided useful information. In addition he also made a request for WB assistance for the funding



/ provision of CFTC, effluent plant and local mobility in FATA economic zones. He also referred to the Skills development section FATA.

Meeting # 8: Meeting with Manager Skills – FATA Development Authority (October 12, 2017)

A follow up meeting was held with Manager Skill Development at FDA head offices in Peshawar. Mr. Arshad Farroq provided general information on the plans for FATA and highlighted that federal government and the donors are being approached for the following:

- Jamrud TTC enhancement support for DAE Civil, Mining, Mechanical technologies.
- Common Facility Trainings (CFTC) in all industry zones
- Enhancement of women skill development centers

Meeting # 9: Meeting with Projects Manager – KPK economic zone development and management company (October 12, 2017)

During this meeting, vital information about the KPK economic zones development and specifically industrial zones was obtained. The Hayatabad and Shakas industrial zones are closely associated in terms of manpower, transport and trade. These also share common transport routes to deliver goods to and from Pakistan and towards Torkham border. The official was taken on board for launch workshop and cooperation in the near future.

Meeting # 10: Meeting with DS- Peshawar, Pakistan Railways (October 12, 2017)

A useful meeting was held with the Divisional Superintendent, Pakistan Railways in Peshawar. The following points were discussed and information collected.

- Railways is considering Peshawar – Jalalabad section as an important freight carrying corridor
- Peshawar – Jalalabad section as an option for central Asian regional connection
- This project is under feasibility and new alignment phase consideration
- Railways have their own technical survey capability which is not present in any other Pakistani organization.
- Capacity building of Pak Railways was requested to WB.

Meeting # 11: Meeting with Projects Manager- FATA Infrastructure program, USAID (December 19, 2017)

The meeting was held in Peshawar with Mr. Jalil ur Rehman from USAID, informed us that USAID is ready to fund Jamrud bypass at a cost of 8.5 million USD. The proposal is under decision with FATA and NHA authorities. Also told that USAID doing solarization of existing tube wells in Khyber and Mohammand agencies. Following key notes were made for WB consideration in their future plans;

Since USAID has recently spent 86 million USD for the improvement of road infrastructure of Khyber Pass (existing Peshawar – Torkham Road), a minimum damage / obstruction should be maintained during new construction projects. An interchange should be considered in designs for any possible overlaps with Jamrud bypass alignment.

Meeting # 12: Meeting with Projects Manager- ADB Pakistan (December 22, 2017)

The meeting was held in Islamabad with Mr. Shaukat Safi from ADB, informed that ADB is interested in financing urban development projects for Peshawar city. Bus Rapid Transit (BRT Peshawar) is under



progress and will improve transport and mobility for the City. Other urban development schemes are in planning stage for water, sanitation, waste management etc. For PTEC relevant items he further referred to another associated project as follows.

Meeting # 13: Meeting with Project Director- ITTMS (ADB Project) (January 03, 2018)

This is basically an international border management and facilitation project funded by ADB. The meeting was held at Islamabad along with Dr. Zubair Yousfani. The PD briefed about the project which is about to start. The Torkham border would be improved to provide state of the art transit / trade facilities. For which massive infrastructure will be built up with the provision of yards and intelligent trade checking facilities separately for IN / OUT transport and passengers. The development contract is awarded to National Logistic cells (NLC) on single source bidding process. The operative capacity of Torkham border control after completion would be enhanced to 200 vehicles an hour in 2022.

Meeting # 14: Meeting with Project Director Small Dams- FATA Regions (December 20, 2017)

The meeting held in FATA development authority (FDA) in Hayatabad Peshawar. Mr. Shazad Behram (PD small dams) was requested to provide some information about JABA DAM in Khyber agency. He told that project site is located at 24 km south west of Peshawar city. The site is accessible from Jamrud – Bara road about 10 kms left to it. Estimated initial cost is 6000 Million PKR. Some useful about this dam information is placed in appendix and site location is geo-referenced in our finalized master plan.

Meeting # 15: Meeting with Director Irrigation- FATA Regions (December 20, 2017)

Director Irrigation FATA further referred to Mr. M Tariq Khan (Water Management officer), who provided a little information on subject and provided a general presentation .ppt file to review. However consultant has obtained canal and river channels’ information and included in the Master plan.

3. Preparation of Interim Plan / Map

Under the advice from WB task team leader, an interim plan based on GIS platform was developed for Bank’s PAD and shared with WB team at inception stage.

4. Data Collection

Data collection exercise was done in conjunction with key stakeholders, utilizing documentation and materials provided by these entities and from additional resources, to compile an inventory of completed and ongoing as well as planned investments that fall within the geographic scope of GeLoMaP. Following sets of information / data were obtained keeping in view the movement restrictions for FATA regions.

REGION	SOURCE
Peshawar – Torkham Border (PTEC)	Secondary, KIIs



Peshawar City and vicinity	Primary , Secondary, KIIs
FATA Region (Khyber Agency, Mohammad Agency)	Secondary, KIIs
CPEC links / connectivity in East of Peshawar	Primary , Secondary, KIIs

5. Key Site Visits by Consultant’s Team

The senior team carried out (KIIs), the field researcher/engineers performed the field visits along the corridor to obtain any information about the relevant infrastructure. However all field visits in FATA will be subject to the issuance of the NOC from Fata Secretariat. Based on the field visits the team will also ‘ground truth’ information from the secondary sources and the (KIIs). In addition necessary pictures/coordinate will be added.

The following site visits were conducted for the primary data collection purposes included site information, route details, GPS capturing and photographs;

7.1.3 Trade and Transportation focused:

- Peshawar city and surroundings
- Peshawar ring road north and south loops
- Northern bypass existing alignment
- Eastern side of Peshawar bypasses leading to Indus highway N55, trade route 1
- Badabher town, Mattini village, kohat road
- Mattini - Bara- Jamrud existing Link , trade route 2
- Lateral western ext. link of CPEC, near M.1 motorway, alternate route to CPEC
- Barhma – Bahtar interchange , CPEC connection at motorway M1
- Jamrud – Karkhano link , N5 trade transit to Torkham

7.1.4 Economic / Industry Related

- Hayatabad Industrial Area
- Shakas Industrial Area
- Bara Industrial Area
- RaShakai Industrial zone
- Risalpur Industrial zone

6. Spreadsheet Inventory

The information collected through primary / secondary sources and fieldwork was used to prepare an inventory of relevant infrastructure features and investments in a spreadsheet format. Coloring scheme of text has been matched with item assigned colors on GeLoMAP. Coordinates have also been mentioned in the form of latitude and longitude and camera photographs have been embedded through these coordinates.

Geospatial Database management System – Development of GeLoMAP

GIS



Geographic Information System (GIS) allows managing, analyzing and storing geographic data. GIS has strong capabilities to integrate information and geometry which play vital role in project planning and building feasibility and appraisal documents.

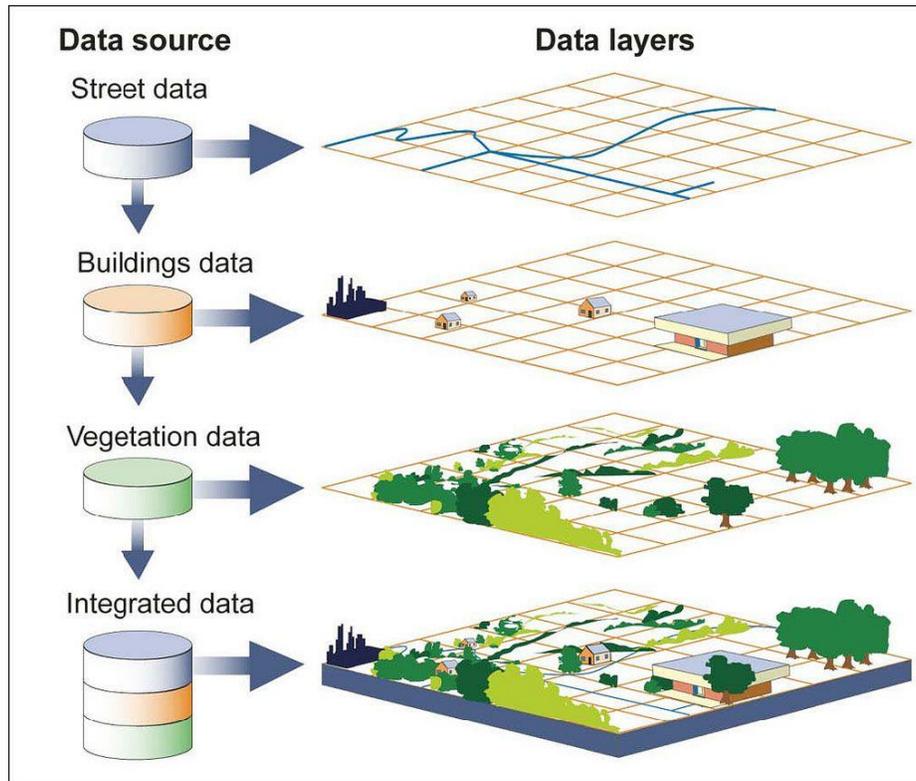


Fig 2: GIS Mechanism (Source: [National Geographic Society](#))

Geo Referencing

GIS incorporates verity of the datasets and it may happen that all datasets do not align properly with each other. The two main datasets used in GIS i.e Vector and Raster data. Vector data is obtained using coordinates (latitude and longitudes) and raster data is commonly obtained by scanning maps or collecting aerial photographs and satellite images. Scanned map datasets don't normally contain spatial reference information (either embedded in the file or as a separate file). With aerial photography and satellite imagery, sometimes the location information delivered with them is inadequate, and Thus, to use some raster datasets in conjunction with your other geospatial data, it is required to align or geo-reference them to a common map coordinate system. A map coordinate system is defined using a map projection (a method by which the curved surface of the earth is portrayed on a flat surface).

To geo-reference a raster data, location is obtained using map coordinates and assigned to the coordinate system of the data frame. Geo referencing of a data allows it to be viewed, queried, and analyzed with other geographic data.

In general, Geo referencing can be termed as a process of bringing various geospatial datasets to a common coordinate system.



Methodology

Scheme Adopted

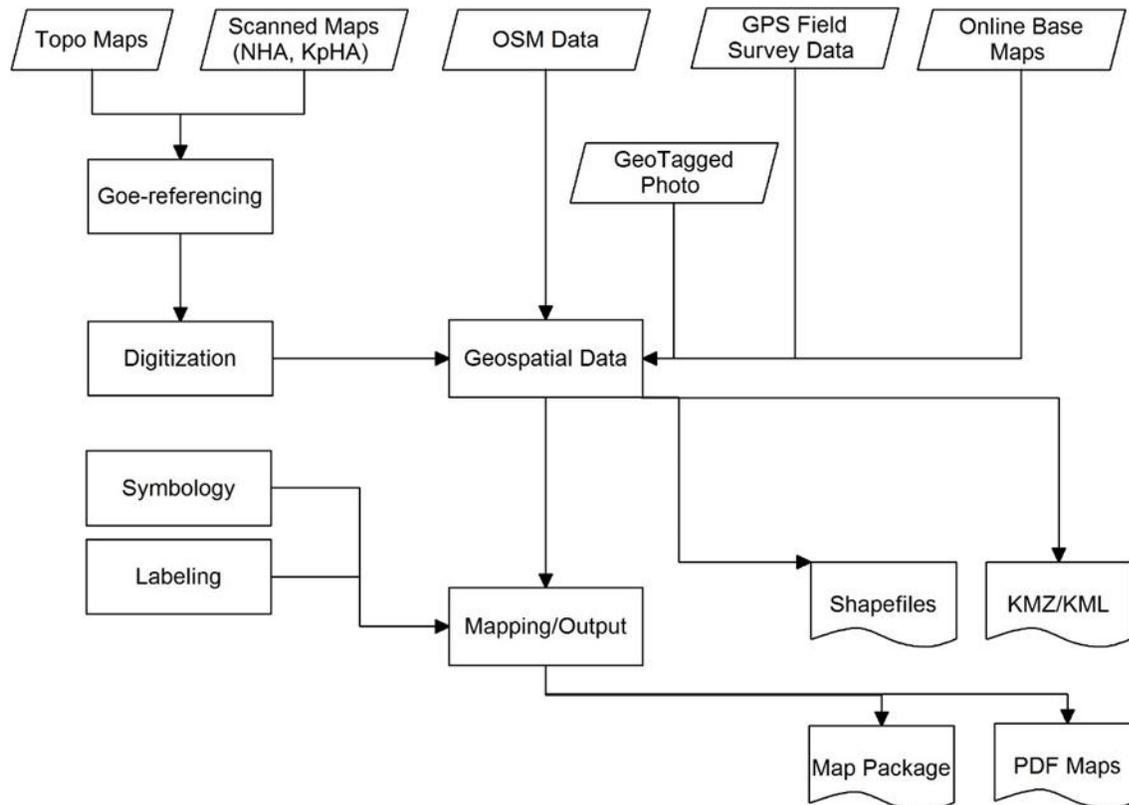


Fig 3: Schematic Flow diagram for the development of GeLoMAP (Aid consultants)

Software and Applications

The study used following software/Applications during the preparation of GeLoMAP

- ArcGIS Info (Desktop Application)
- Map Coordinates (Android Application)
- Global Mapper (Desktop Application)
- Google Earth (Desktop Application)
- Google Maps (web Application)
- Base Maps (web Application)

‘ArcGIS Info’ is leading GIS product for mapping, analysis and data management of geographic data.

‘Map Coordinates’ is Android phone application used to collect coordinates of a location. It works without internet as well. The precision offered by the product is about 5-15-meter accuracy. Like other GPS products, it works well in the open spaces.



Global Mapper is also GIS software used to convert KMZ/KML file to Shape file and vice versa.

Google Earth is also a online GIS software which offers variety of function i.e draw KML/KMZ files, Search location, Variety of base map layers, live traffic, 3D earth representation etc. Google Maps offer more of less same capabilities and its online application while Google Earth is Desktop application.

There is variety of base maps like topographic maps, Satellite imagery, Shaded relief map, Open Street Maps etc. These maps can be used along with other geographic data to obtain better prospects of earth data.

Data Capturing

8.7.1 Mobile GPS Field Survey

Global Positioning System (GPS) is satellite based system to precisely identify the location of any object on the ground. GPS capability is included in the smart phones now a day which has made it easy to carryout field surveys. A team of surveyors having smart phones surveyed the locations to identify the locations and geo spatial data.

8.7.2 On-Desk

On-desk GIS Data collection included variety of source data like topographic maps, Scanned Maps, Online source geospatial data (Airports, River and Road etc). Locations of major towns was also collected using on-desk GIS data capturing tools.

We have used ‘ArcGIS Info’ application to capture/create the GIS data for Mapping. Field Survey data in tabular form was converted into Shapfile format. The Northern bypass and PTEX alignment of corridor was received from National Highway Authority (NHA) in KMZ format and later it converted into Shapfile. The proposed alignments (Mattani bypass, MMC link and Easter bypass) created using field surveys and hard copy maps. Open Street Map (OSM) offers rich GIS datasets in Shapefile format. Following datasets of OSM used ;

- Motorway
- Highway
- River
- Railway line
- Main Road/ primary
- Airport

The information of Warehouses, Truck Terminals, Bus terminals, Fruit Market, Interchanges, Proposed MMC bridge and main locations had been created from Mobile GPS field survey data. The district boundary of Pakistan is obtained from Humanitarian Community Web portal managed by OCHA, Pakistan. All the geospatial data is converted into a common geo-referenced system which has enabled the feasibility to overlay all the data

Cartographic mapping was used to visualize the geospatial data. The 18 different map items required different symbols and labels to distinguish each item in the map. ArcGIS Info mapping capability made this possible to manage symbols and labels.



8.7.3 Photo Geotagging

In this process the GPS coordinates were assigned to a photo. Now a day's Smart phones and GPS enabled cameras have capability to capture the Geotagged photo. Using GIS application like ArcGIS and Google Earth, a geo tagged photo can be displayed on its actual location on ground

8.7.4 Shape file and KMZ

ArcGIS Info stores geometry of a feature as well as information related to the feature in a database format. Shape file is one type of data format created by ArcGIS Info to store geometry and information.

Output

While performing the activities described above the final output is delivered in the following forms;

- KMZ/KML
- PDF Maps
- GeoTagged Photos
- ArcGIS Map Package
- Shape file

Viewing Results

The KMZ/KML is xml based goggle earth readable format which allows user easy data viewing using Google Earth software.

The PDF maps are Geo-referenced maps which allow obtaining information about coordinates and measurement.

ArcGIS map package retains symbols of features and its portable form to carry mapping data and mapping layouts.

Shape file form of data (GeLoMaP) is the display form of geo-space database can be reviewed by the stakeholders.

CITATION

World Bank's Project Information Document/ Integrated Safeguards Data Sheet (PID/ISDS)

FATA Presentation for Mattani Bypass

ACC consultant's Presentation on Alignment Study Peshawar – Torkham Section I

PKHA Presentation on Eastern Bypass new alignment



NTDC database in KMZ formats and relevant literature

Swift JN, Goldberg DW, and Wilson JP 2008 Geocoding Best Practices: Review of Eight Commonly Used Geocoding Systems.



Appendix I: Link for Map outputs, main GeLoMAP product.

[Main GeLoMAP with CASA 1000 Power line](#)

[1 Area Google Map.pdf](#)

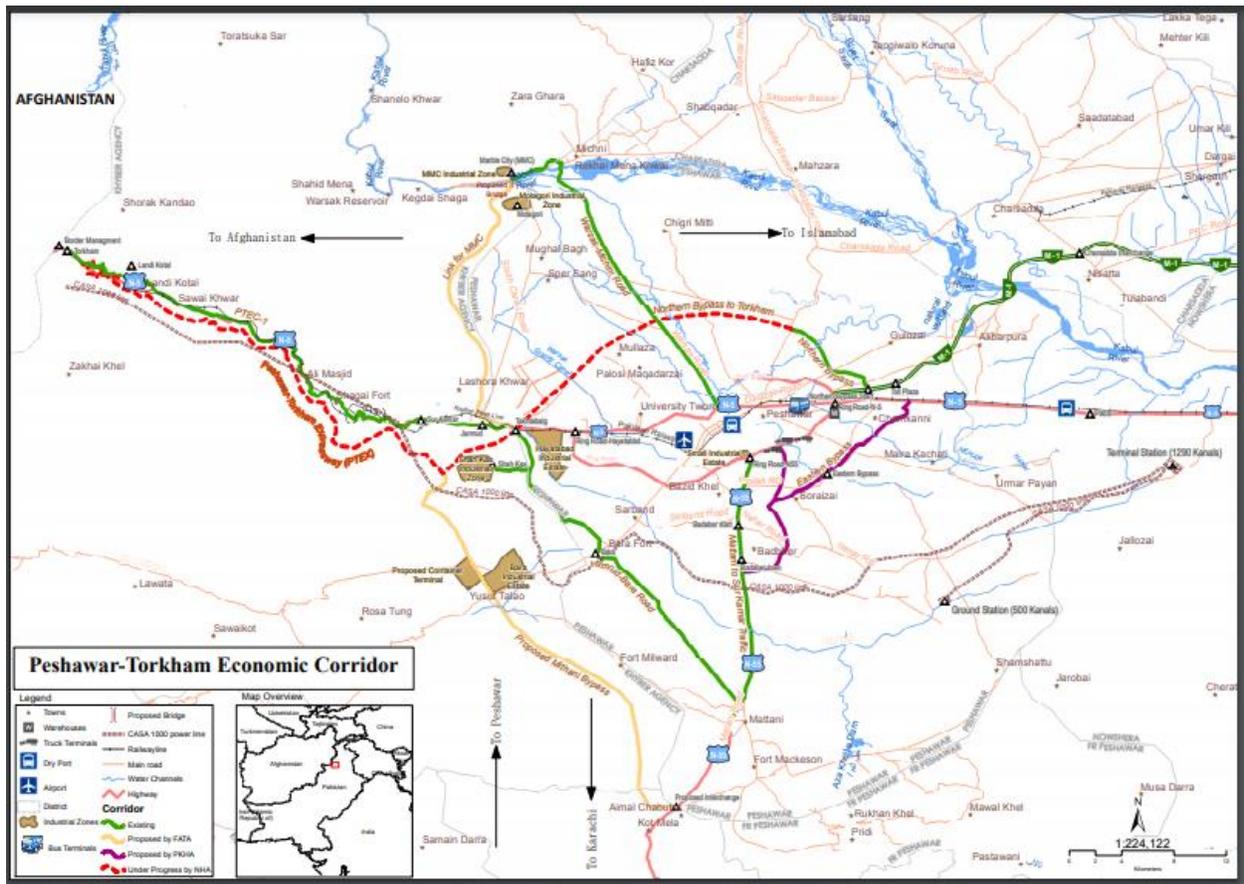
[2 Area Google MapII.pdf](#)

[3 GeLoMAP Main Part I Revised Sat Img](#)

[3 GeLoMAP Main Part I Revised](#)

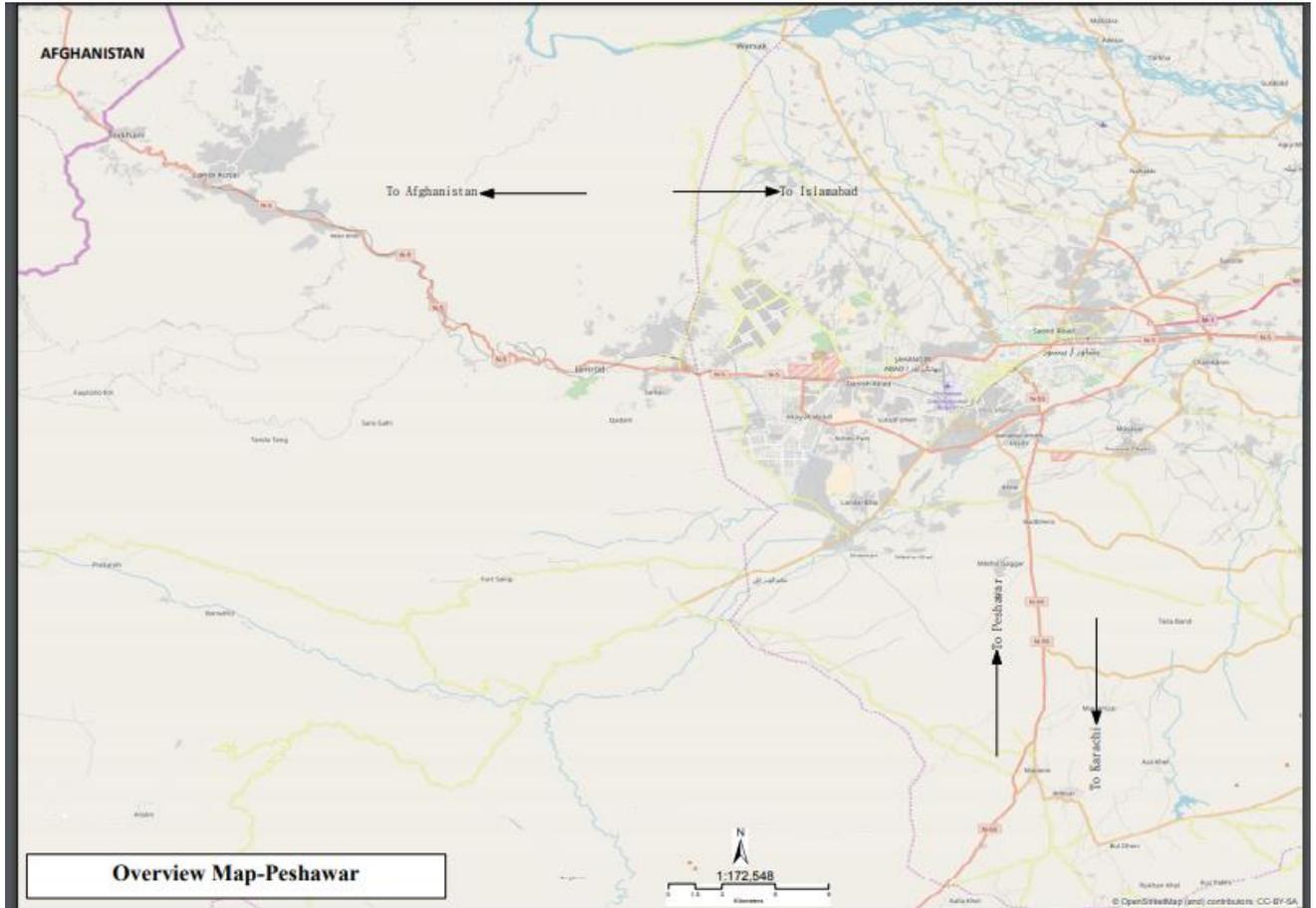
[4 GeLoMAP Main Part II.pdf Pak-KP-Torkham Peshawar Economic Corridor Map II SatImg.pdf](#)

[Main GeLoMAP with CASA 1000 Power line](#)



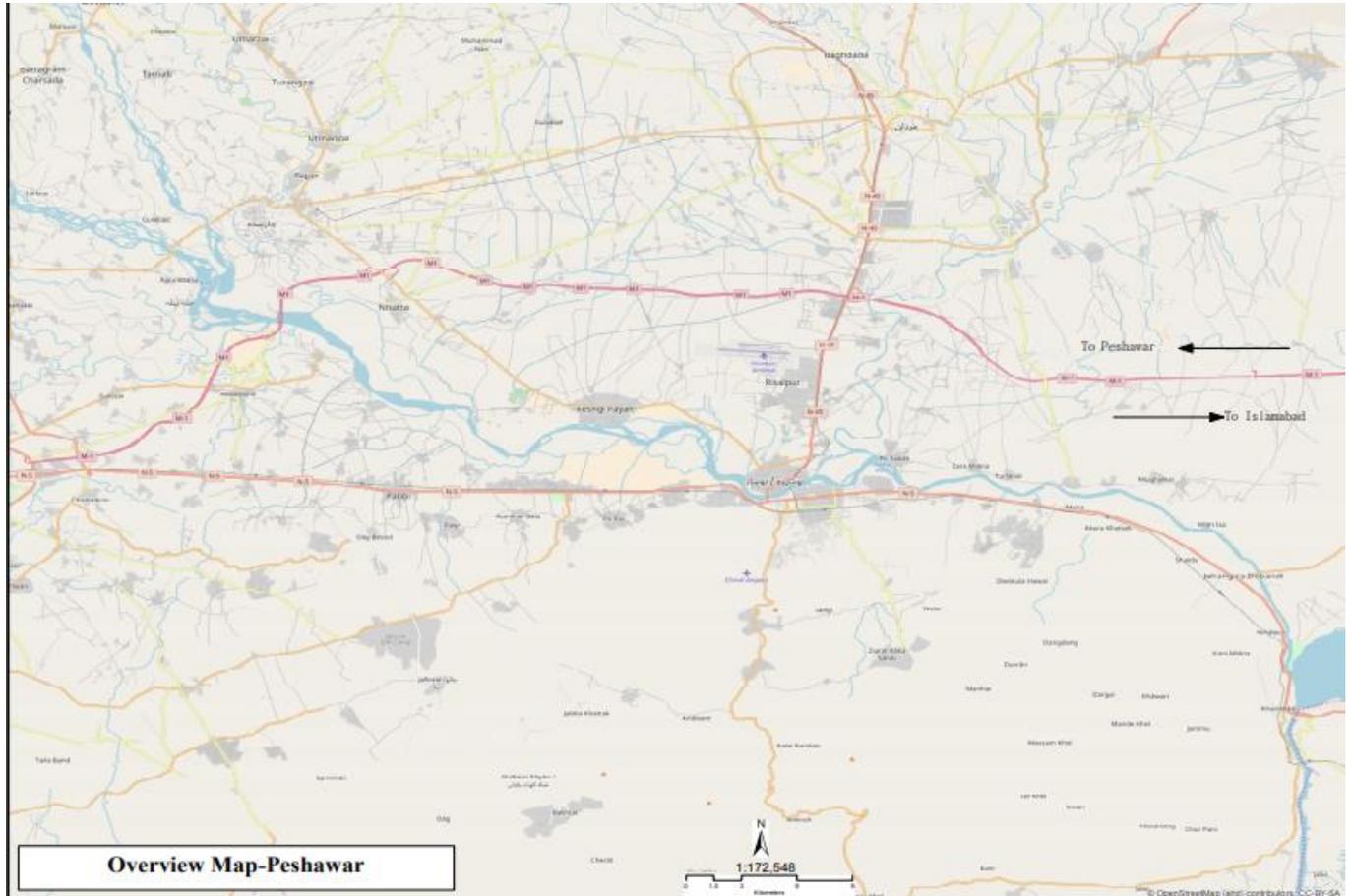


[1 Area Google Map.pdf](#)



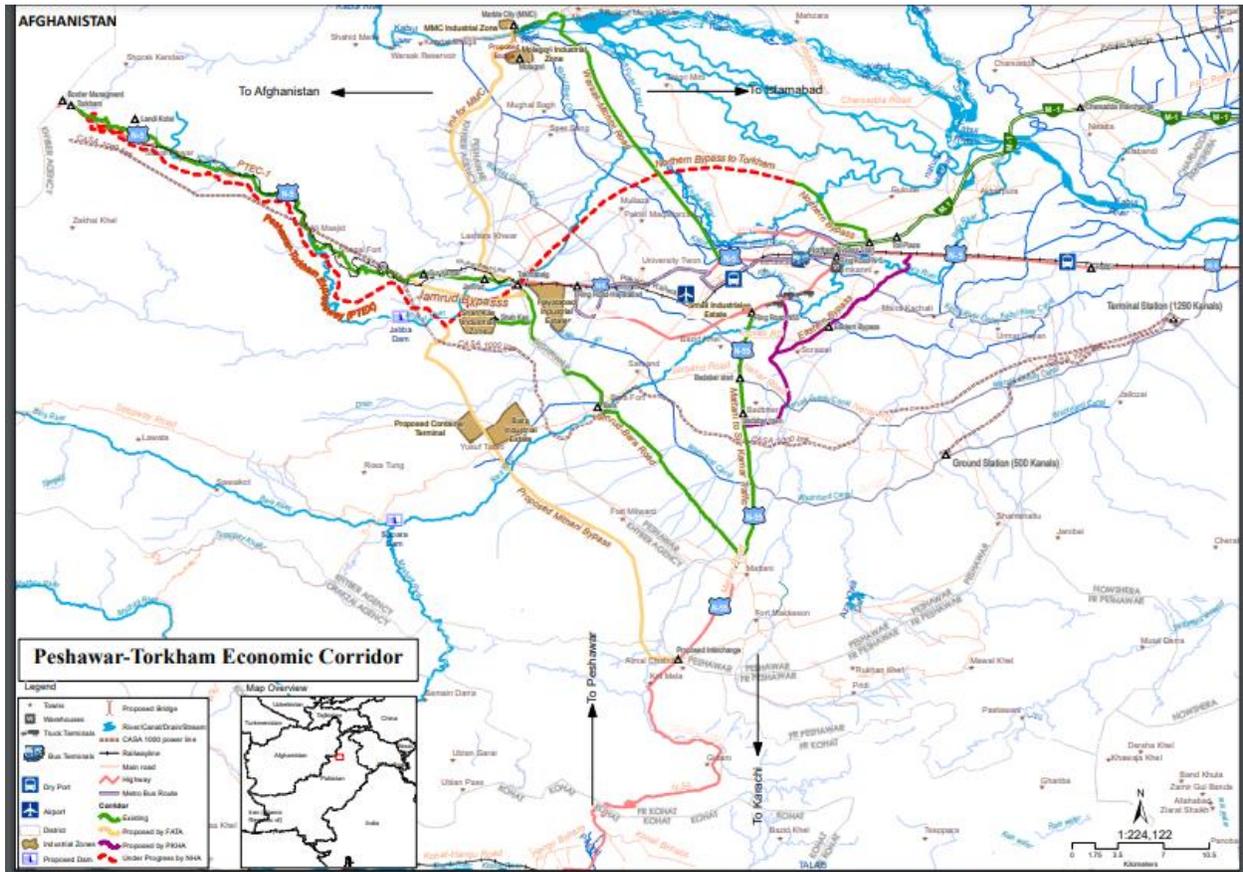


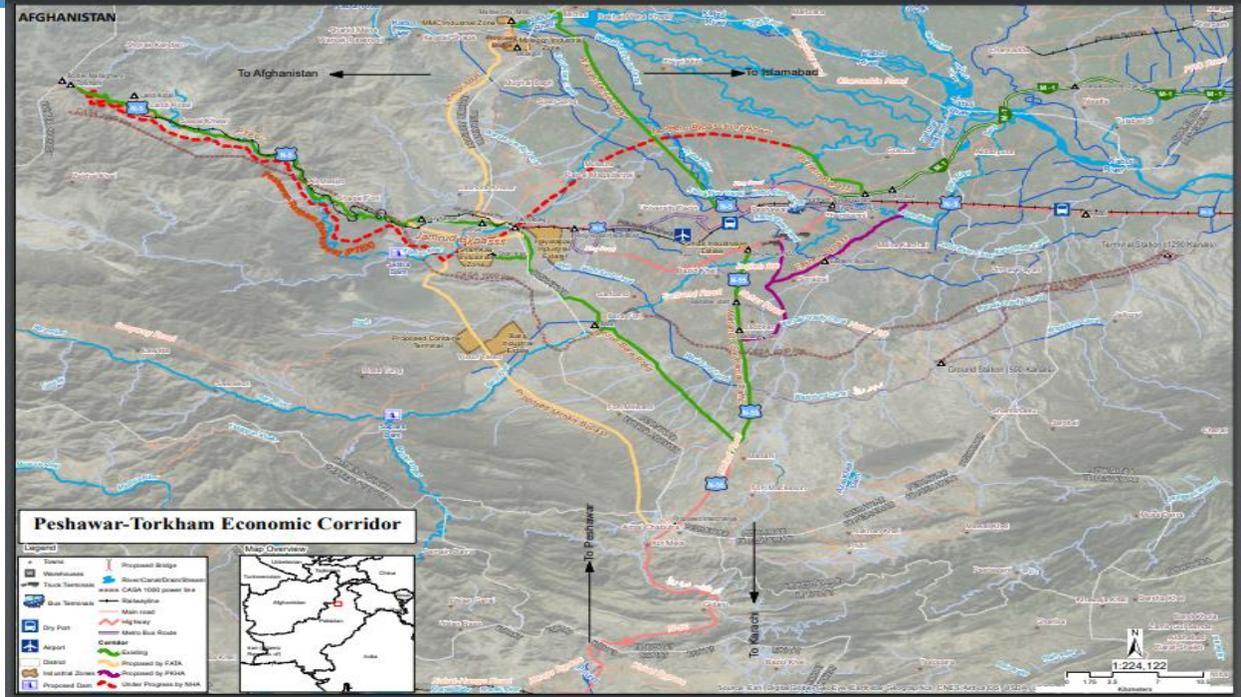
[2 Area Google MapII.pdf](#)





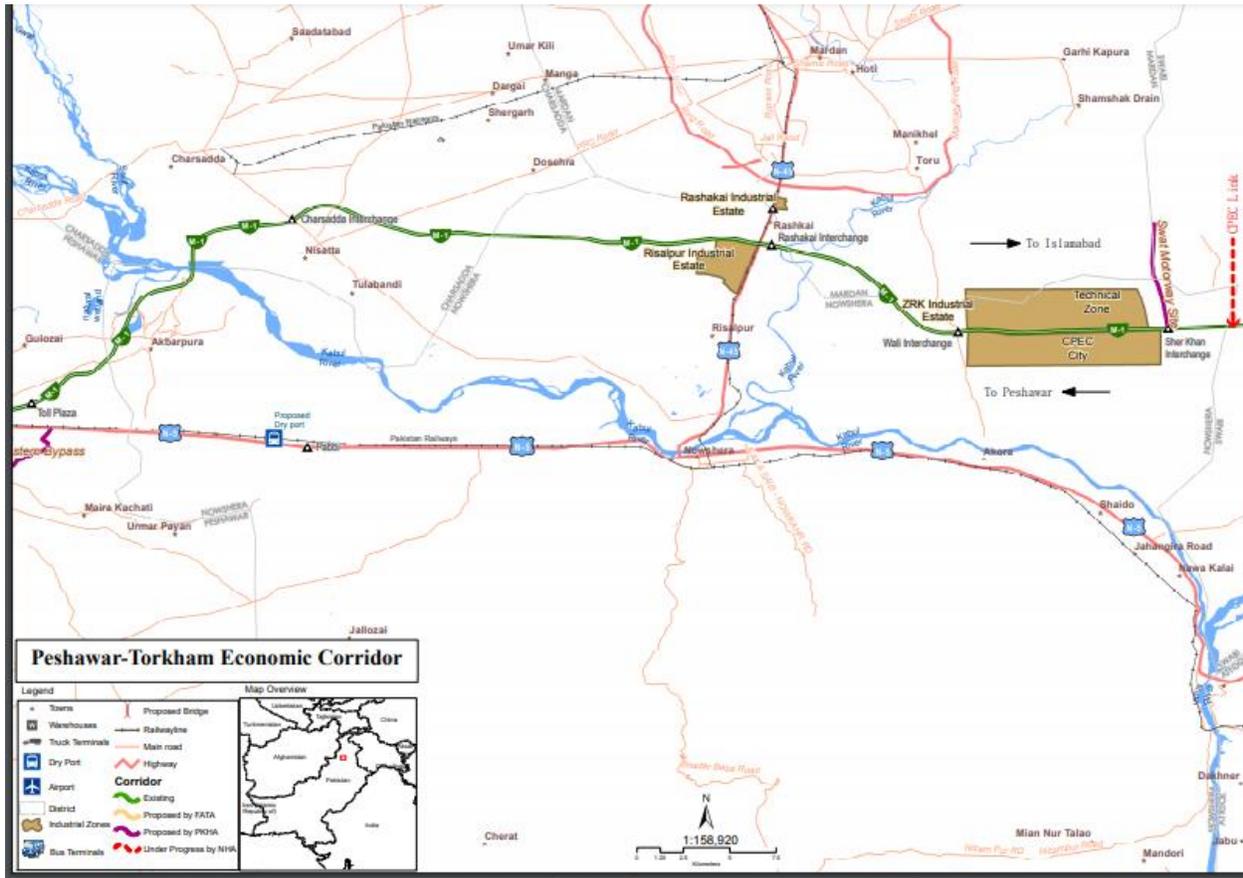
3 GeLoMAP Main Part I Revised Sat Img





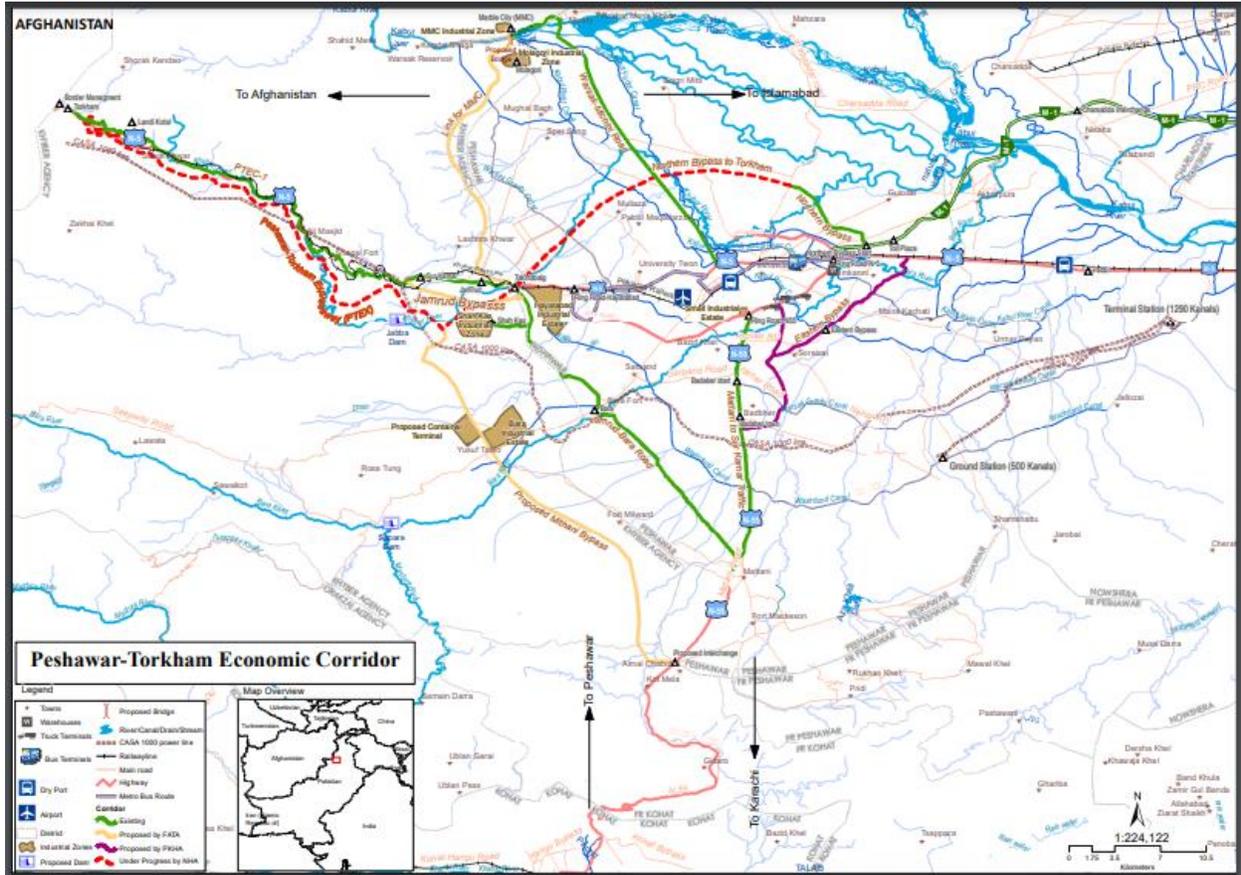


3 GeLoMAP Main Part I Revised





[4 GeLoMAP Main Part II.pdf Pak-KP-Torkham Peshawar Economic Corridor Map II SatImg.pdf](#)



Appendix II: Spreadsheet Inventory

MS Excel File attached as 'SF Inventory'

Location	Longitude	Latitude	Description
Connectivity through links			
PTEC-1 Start	71.402874	33.998387	Peshawar torkham existing road or khyber pass and surroundings
PTEX Start	71.403100	33.998101	Peshawar torkham road new expressway alignment under progress
PTEX End	71.095184	34.121454	by NHA.
Northern Bypass End	71.592088	34.068104	existing partially completed
Northern Bypass Start	71.644955	34.026777	existing partially completed
Proposed Northern Bypass Start	71.592200	34.068055	under progress by NHA
Proposed Northern Bypass TakhtaBaig	71.402780	33.998141	under progress by NHA
Ring Road-N-5 Junction Chamkani	71.622428	34.016936	southern loop, PKHA
Ring Road- N5 Junction Hayatabad	71.443986	33.997331	southern loop, PKHA
Ring Road-N55 Junction	71.563973	33.979541	existing trade corridor N55
Badaber start	71.555892	33.933411	existing trade corridor N55
Badaber town	71.558011	33.909651	existing trade corridor N55
Matini road	71.560311	33.814797	route to mattini village
Mat. Bara.jamrud road start	71.556209	33.810635	existing trade route to Jamrud
Proposed Bridge on Link MMC	71.400244	34.169391	on kabul river , proposal FATA
Eastern Bypass Start	71.673721	34.018226	Chamkani to connections at Badaber N55, Hazar khani RR Pew. Proposal by PKHA
Eastern Bypass End	71.559477	33.900485	Chamkani to connections at Badaber N55, Hazar khani RR Pew. Proposal by PKHA
Jamrud Bypass start	71.047000	33.993000	Proposal by FATA authority
Jamrud Bypass end	71.329000	34.002000	Proposal by FATA authority
Proposed Interchange N-55	71.513219	33.739626	Proposal by FATA authority
Mattani Bypass Start	71.512802	33.739388	Proposed trade route 3, by FATA
Mattani Bypass End	71.354508	33.967468	Proposed trade route 3, by FATA authority
Link MMC Start	71.402275	33.998630	proposed link by FATA authority
Link MMC End	71.396565	34.174948	
Infrastructure Features and single locations			
Border Managment	71.089391	34.125129	Facilities under construction near Torkham



Takhtabaig	71.403001	33.998197	
Torkham	71.095134	34.121534	
Sur Kamar	71.337972	34.005388	
Jamrud	71.380085	34.002015	
Landi Kotal	71.139261	34.111703	
Rashakai Interchange	72.022335	34.107397	
Charsadda Interchange	71.790131	34.119930	
Fruit Market Peshawar	71.593892	34.016619	
Rail station Peshawar	71.550414	34.003146	
Bus Terminal-Both Sides	71.597653	34.014686	Chamkani Peshawar
Proposed Container Terminal	71.3694363	33.8993604	Proposed by FATA on Trade route 3
Bara town	71.457803	33.914008	Khyber Agency
Shah Kas	71.386997	33.975179	Khyber Agency
Mohmmand Marble City (MMC)	71.400068	34.175847	Mohmmand Agency
Peshawar Airport	71.515218	33.991803	
Molagori	71.404148	34.153150	Khyber Agency
Truck Terminals			
Truck Terminals	71.566709	33.981099	on Ring road southern loop
Truck Terminals	71.573885	33.984623	on Ring road southern loop
Truck Terminals	71.593011	33.990464	on Ring road southern loop
Warehouse , Goods terminals			
Warehouse -Both side	71.622034	34.012720	on Ring road southern loop
Dry Ports			
Pabbi	71.797438	34.009496	Between Peshawar and Nowshera
Proposed Dry port Pabbi	71.780101	34.012704	Proposed by Pak Railways
Peshawar Dry port existing	71.550216	34.002618	under control of Pak Railways
INDUSTRY ZONES			
Molagori Industrial Zone	71.4039620	34.1538095	FATA
MMC Industrial Zone	71.3955193	34.1759661	FATA
Shah Kas Industrial Zone	71.3757412	33.9716954	FATA
Hayatabad industrial estatae	71.423480	33.995121	KPK
Risalpur Industrial Estate	72.0011931	34.0987154	KPK
ZRK Industrial Estate	72.1266447	34.0704875	KPK
Bara Industrial Estate	71.3966008	33.9005905	FATA
Hayatabad Industrial Estate	71.4263722	33.9851546	KPK
Rashakai Industrial Estate	72.0267782	34.1269089	KPK



Small Industrial Estate	71.5601588	33.9815720	KPK
FATA DAMS			
Jabba Dam	71.3220000	33.9700000	Feasibility done
Sapara Dam	71.3200000	33.8340000	Feasibility done
CPEC Related East of Peshawar			
Peshawar M-1 Toll Plaza	71.663871	34.030546	
Col Sher Khan Interchange	72.214484	34.067134	start of Swat motorway
Wali Interchange	72.112660	34.065431	
CPEC City	72.1642567	34.0568782	along Motorway M1
Technical Zone	72.1593971	34.0760710	along Motorway M1
CPEC CONNECTIVITY THROUGH M1			
CPEC Link Brahma Bahtr	72.704741	33.743893	western route will cross motorway M1 at this interchange near Islamabad, under construction by NHA
CPEC Link Swat Motorway	72.210000	34.089000	Lateral western alignment by PKHA, under construction

Appendix III: Geospatial Database Package and Use Guidelines

Geospatial Database Package for the GeLoMAP

The Consultant’s team has devised a geospatial database system for the projection of collected geo referenced information to different geospatial interfaces.

The output geo referenced information is delivered in the following formats. KMZ/KML and Geo-database are geospatial data files while PDF and Map package are the maps output.

- KMZ/KML
 - GeoTagged Photo
 - Corridor
 - Locations (Surveyed data/Inventory)
 - Warehouse/Bus/Truck Terminals
 - Industrial Zones
 - Propose Bridge
 - CASA1000 Line



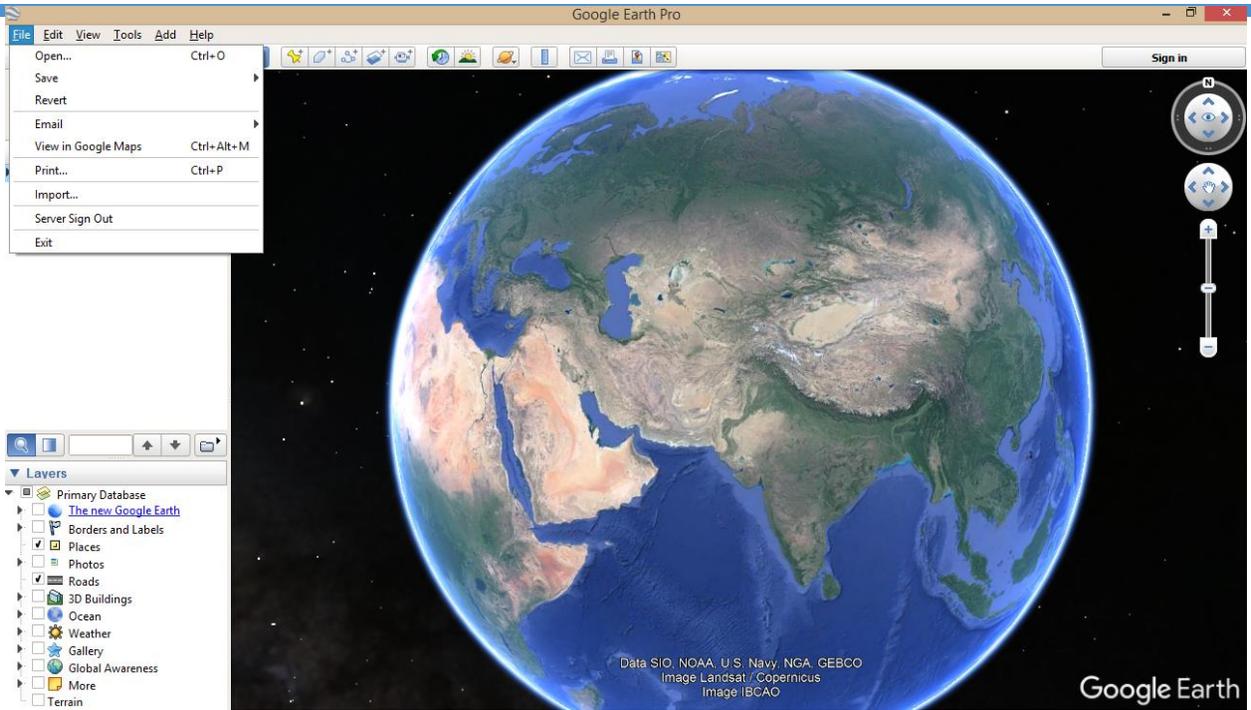
- PDF Maps
 - 2x maps having Google background only
 - 2x maps showing key information about project
 - 2x maps showing satellite imagery and key information
- ArcGIS Map Package
 - 2x Map packages
- Geodatabase
 - GeoTagged Photo
 - Corridor
 - Locations (Surveyed data/Inventory)
 - Warehouse/Bus/Truck Terminals
 - Industrial Zones

- Propose Bridge
- Motorway/Highway/Main Road
- Water Channel/River
- Towns
- CASA1000 Line

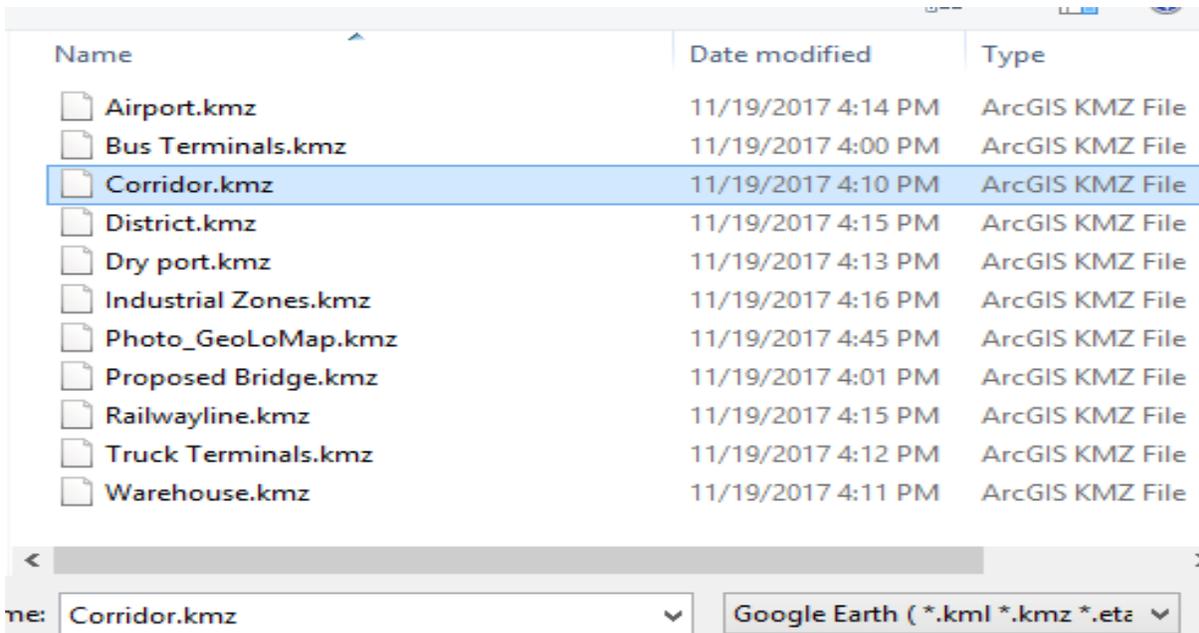
GUI Guidelines

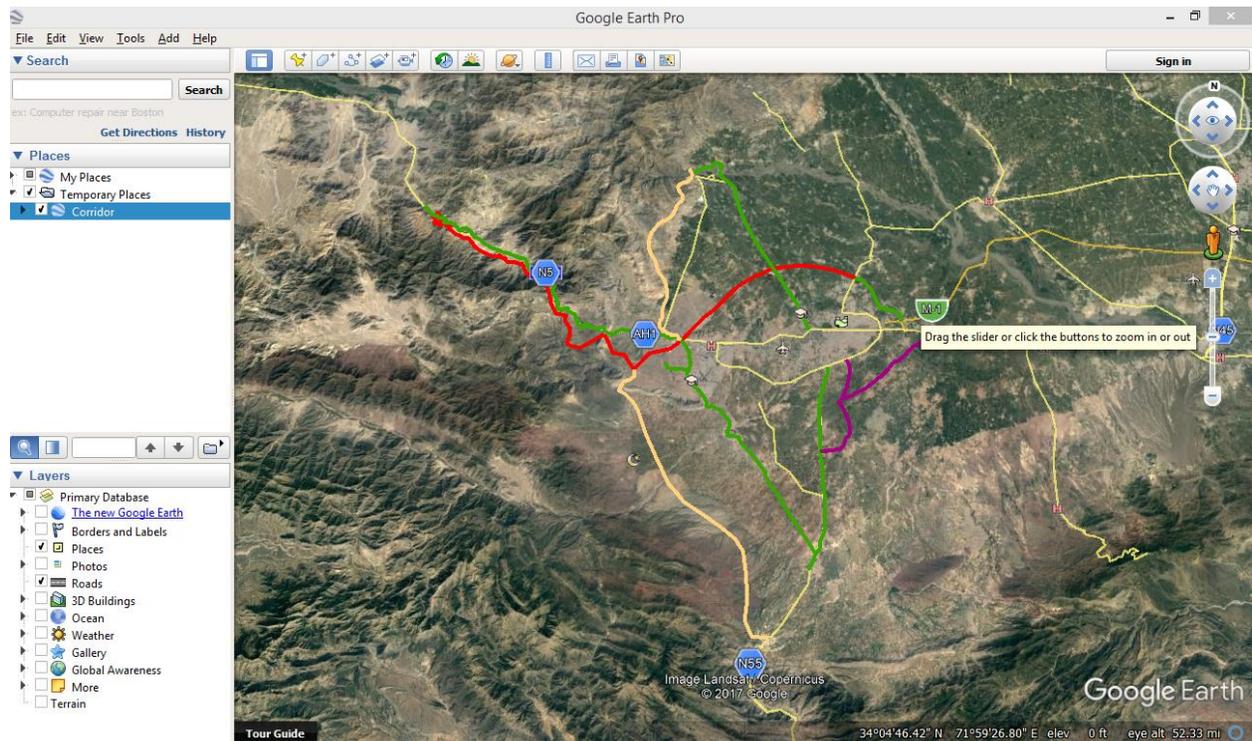
The KMZ/KML is an .xml based format which will allow easy data viewing using Google Earth software. Following steps are required to view the geo referenced information in Google Earth.

Open Google Earth > File > Open.



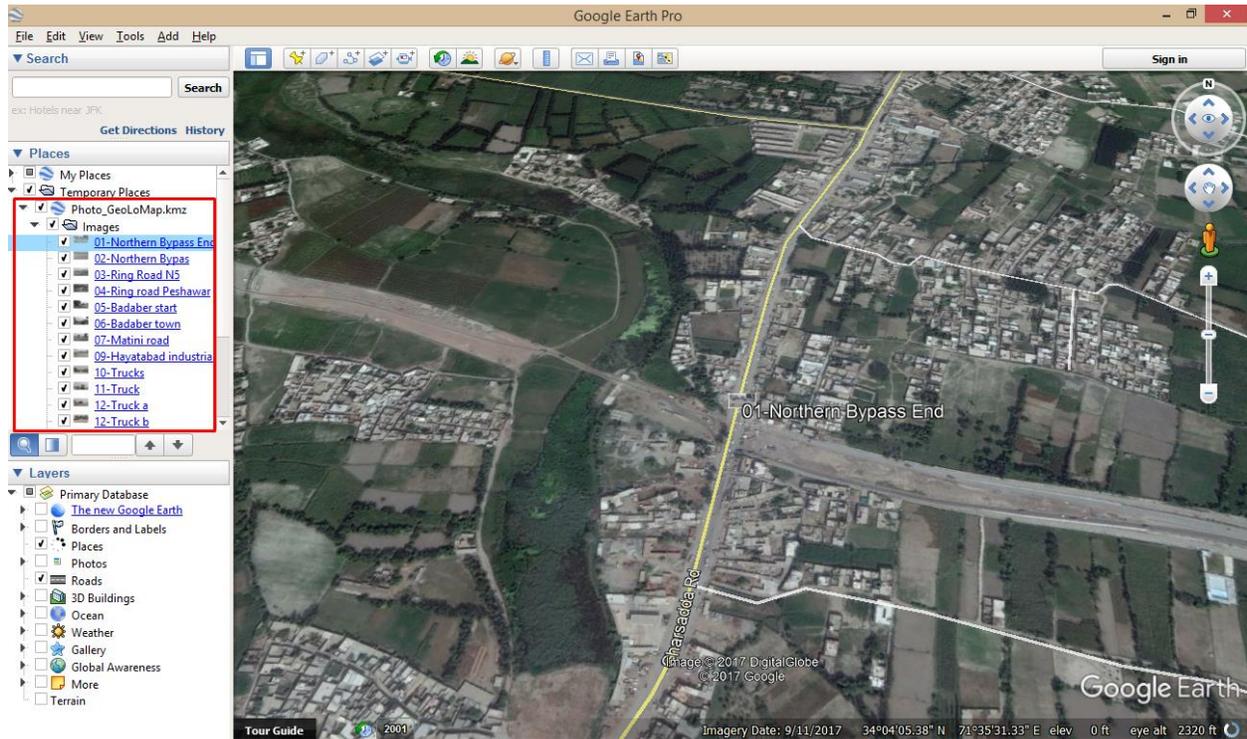
Select the desired File



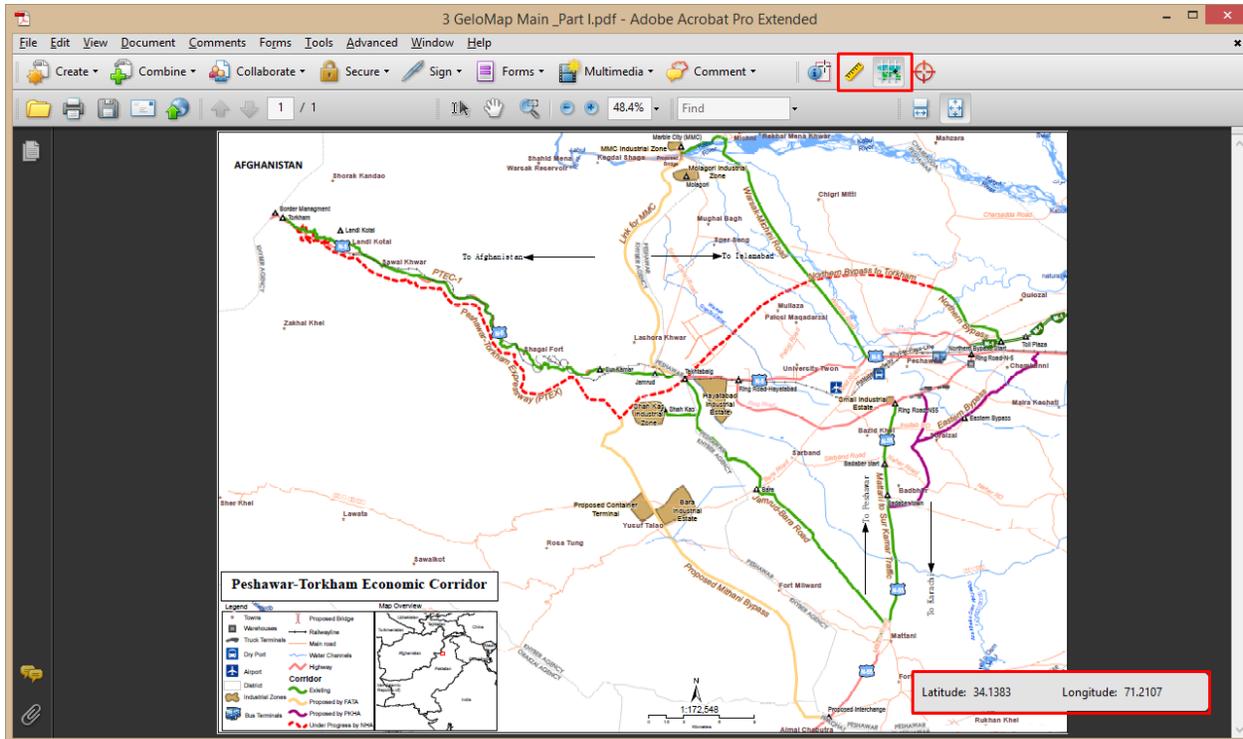


The desired file opens in Google Earth. Zoom In/Out capability can be used to view information.

Also Photo_GeoLoMap.Kmz file can be added in Google Earth to view the geotagged pictures. Double Click on desired picture will take to the actual location on the map



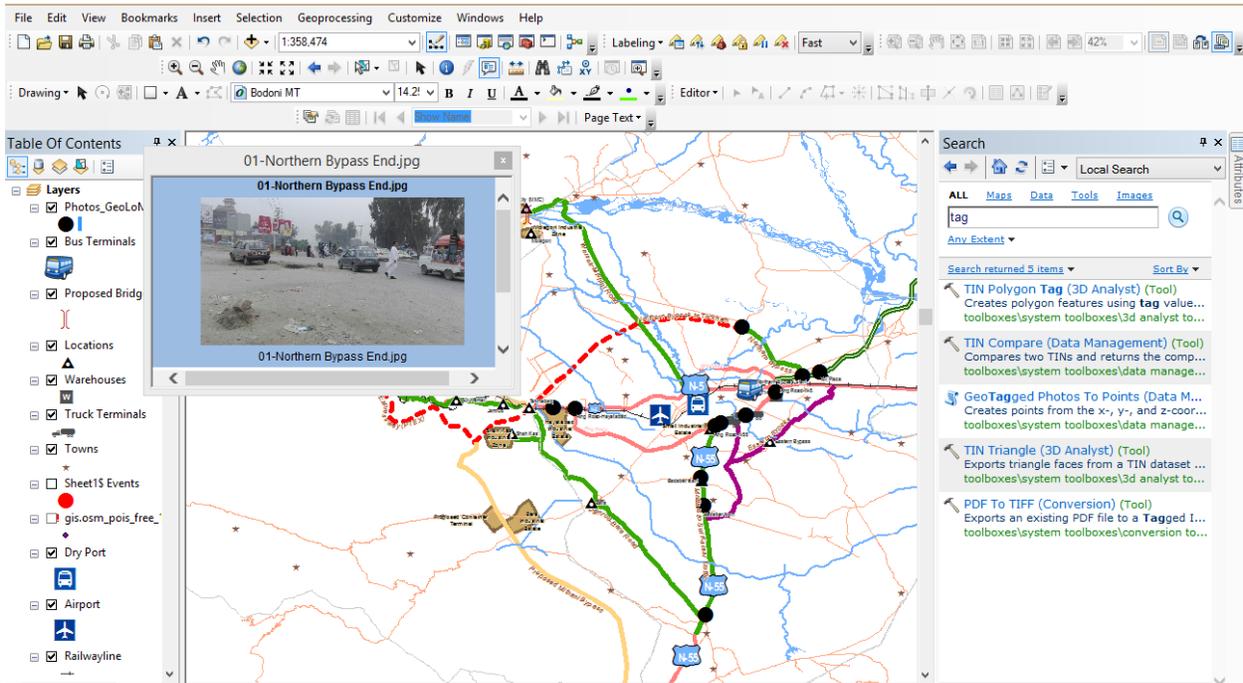
The Geo reference information is enabled on PDF maps and can be seen using PDF professional version. Analysis Tool in Adobe professional version allows to see Latitude and Longitude information as well as it allows to measure distance in PDF.



GeoTagged photos are in the point form stored in Geo-database. Add the layer Photos_GeoLoMap from Geo-database in ArcGIS info/Explorer software. The photo can be seen by selecting following tool.



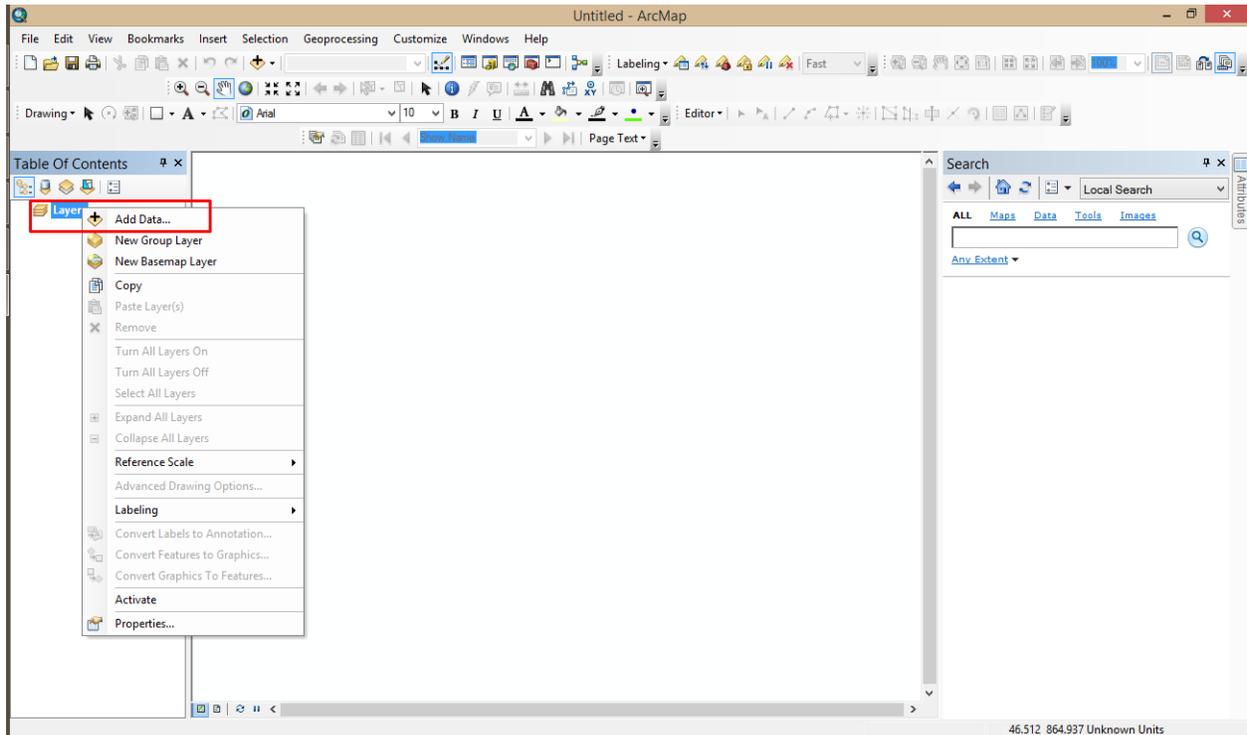
Then click on the desired point to see the Geotagged photo in ArcGIS Info and ArcGIS Explorer



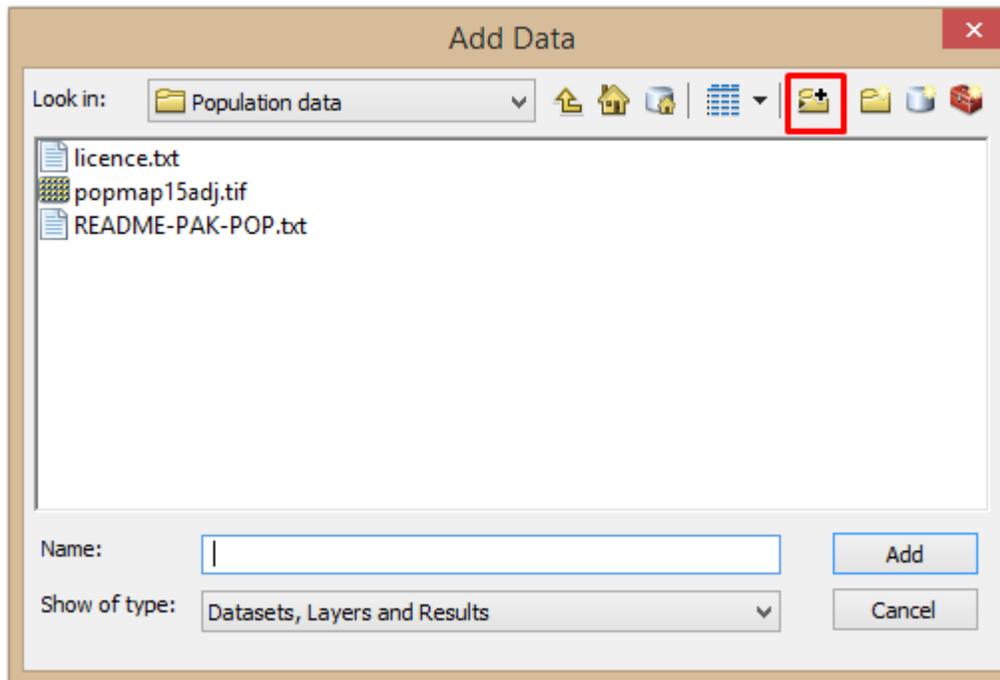
For the dynamic view of the geo reference data, the output contains ArcGIS map package. It retains symbology of features and its portable form to carry geospatial data and mapping layouts together.

Also Geodatabase contains goe reference information in separate layer form and it will allow to be viewed almost in all GIS software. [ArcGIS explorer](#) is free software to view geodatabase and ArcGIS Map package

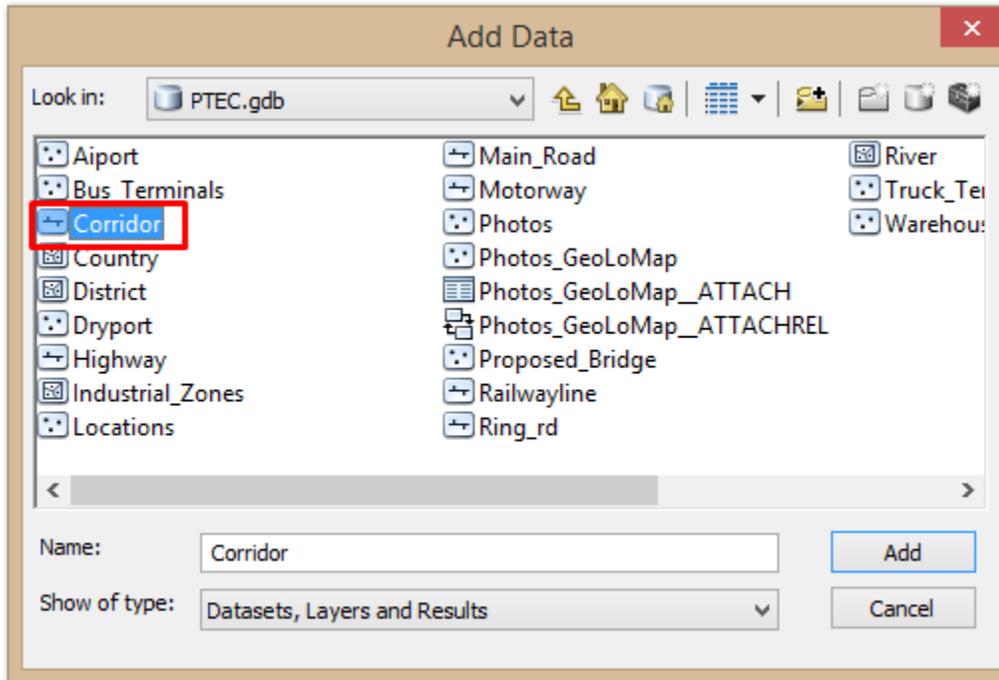
Open ArcGIS Info Right Click Layer > Add Data



Connect with folder containd Geodatabase layers



Double Click PTEC.gdb A box will open which contains all the geo referenced layers to be viewed dynamically.



Similarly, A map package can be opened by double click on it



Appendix IV: Dams and Irrigation information

The construction of Jabba dam has been planned by the provincial government for provision of clean drinking water facility to residents of Peshawar and Khyber Agency besides eradicating fatal waterborne diseases and controlling of flood water during monsoon season.

The government has announced construction of Jabba dam by including it in the Annual Development Program 2016-17 under its Peshawar Greater Water Supply Scheme (PGWS) with an objective to provide clean drinking water facilities to people Peshawar, Hayatabad and Khyber Agency.

The feasibility study of Jabba dam has been already completed and is found feasible in engineering point of view, the official said, adding this dam will serve as a principal source of water supply to Khyber Agency and Peshawar. If funds were available on regular basis, Jabba dam located in Jamrud tehsil of Khyber Agency, is expected to be completed by end of 2017.

Upon completion, this dam will cultivate an estimated 20,000 acres of land besides protecting Peshawar and Khyber Agency from floods water during monsoon as rainy water from Khyber Agency's streams would be stored in this water reservoir.

The dam is projected to provide about one million people with clean drinking water facility and store up to 38,000 gallons of water by providing enormous agri-culture benefits to local populations.

In addition to Jabba dam, the feasibility study of Bara dam has been also prepared with an estimated capacity of irrigating 50,000 acres area in Khyber Agency's tehsil Bara and settled areas of Peshawar.

The Bara dam will also serve as a source of drinking water for nearby areas and about two million cusecs potable water can be provided to the Bara Bazaar and about eight million cusecs to Hayatabad in Peshawar.

“Bara dam is very important for Peshawar as its life span is estimated between 80 and 100 years besides its storage capacity of about 88,000 acres feet water,” the official said, adding this dam has the potential to produce several megawatts electricity for domestic and agriculture consumption.



Irrigation System Geo- Referencing sheet

Peshawar district is roughly flat surface terrain where canal system is being used as irrigation source. The main source for the canal is irrigation is Kabul River which also gets contribution form BARA River and Khyber River. The main canals originating from Warsak Dam are mainly:

- Warsak Left Feder Canal
- Kabul River Canal
- Warsak Gravity Canal
- Wazidund Canal

FATA area comprises of mountainous formations where small channel drains coincide to format a river formation. The location of two important proposed dams are ;

- Proposed Jabba Dam
- 33.97, 71.322

Proposed Sapara Dam

- 33.834, 71.32

Irrigation System has been identified in GIS based format using following data sources.

- Topographic Sheets
- Google Earth
- ESRI Imagery Services
- Google Maps
- [Irrigation Department KPK](#)
- [Irrigation Department FATA](#)
- [Pakistan Council for Research in Water Resources](#)
- Open Street Map Vector Data

The digitization and management of the irrigation system is done using Arc Map software. The main categories of irrigation data produced in master plan are as follows;

- River, Canal, Drain

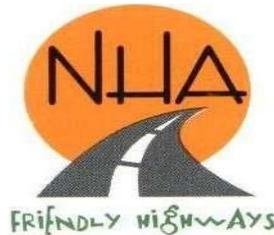


Appendix V: Study Operational Plan

Work Plan for the Development of GeLoMAP for the PTEC and Surrounds													
Tasks	Weeks												
	1	2	3	4	5	6	7	8	9	10	11	12	
1	Contract sign off	X											
2	Application for NOC	x											
3	Inception Meeting	X											
4	Preparation of Data Collection Tools	Xxxx	xxxxx										
5	Development of GIS based Information system		xxxxx	xxxxx									
6	Preparation and Organization for Stakeholder Workshop	Xxx											
7	Stakeholder Workshop												
8	Submission of Final Inception Report						X						
9	KII			xxxxx	xxxxx	xxxxx	xxxxx	xxxxx					
10	Field Data Collection			xxxxx	xxxxx	xxxxx	xxxxx	xxxxx					
11	Compilation and preparation of GIS based Maps						xxxxx	xxxxx	xxxxx	xxxxx			
12	Preparation of DRAFT report								xxxxx	xxxxx			
13	Submission of Draft Report										x		
14	Submission of Final Report												x



Annex 4: Traffic and Economic Report (PTECP)



NATIONAL HIGHWAY AUTHORITY
MINISTRY OF COMMUNICATIONS
GOVERNMENT OF PAKISTAN

TRAFFIC AND ECONOMIC ANALYSIS REPORT



Peshawar - Torkham Economic Corridor Project March 2018





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Chapter – 1: Traffic Study

1.0 Background

NHA has planned to construct the Peshawar - Torkham section of N-5 as Motorway and has requested World Bank for the financing of the project. The original scope of work of the Consultants involves preliminary design of the Peshawar - Kabul Motorway Project. Section between Peshawar and Torkham was initially taken up for preliminary design. The subject section is now proposed to be financed by the World Bank as the "PeshawarTorkham Economic Corridor Project" (PTECP). This will be an important trade route between Pakistan and Afghanistan and onwards to central Asian States. Pakistan is an important trade partner of Afghanistan with annual trade of about 2.5 billion US\$. Preliminary design of the motorway between Peshawar and Torkham has been completed by the Consultants, however for the approval of the loan few additional activities are required to be carried out.

As per requirement of the World Bank, supplementary traffic and OD Surveys, Route Alignment Reviews and Economic analysis as per the World Bank Guidelines have been identified to be carried out. Additional works/tasks as per the revised Terms of Reference required to be carried out are as follows:

- (i) Traffic and Origin-Destination (O/D) Surveys
- (ii) Condition Surveys and Roughness Surveys
- (iii) Review of Road Alignment and Preliminary Engineering
- (iv) Revised Economic Analysis

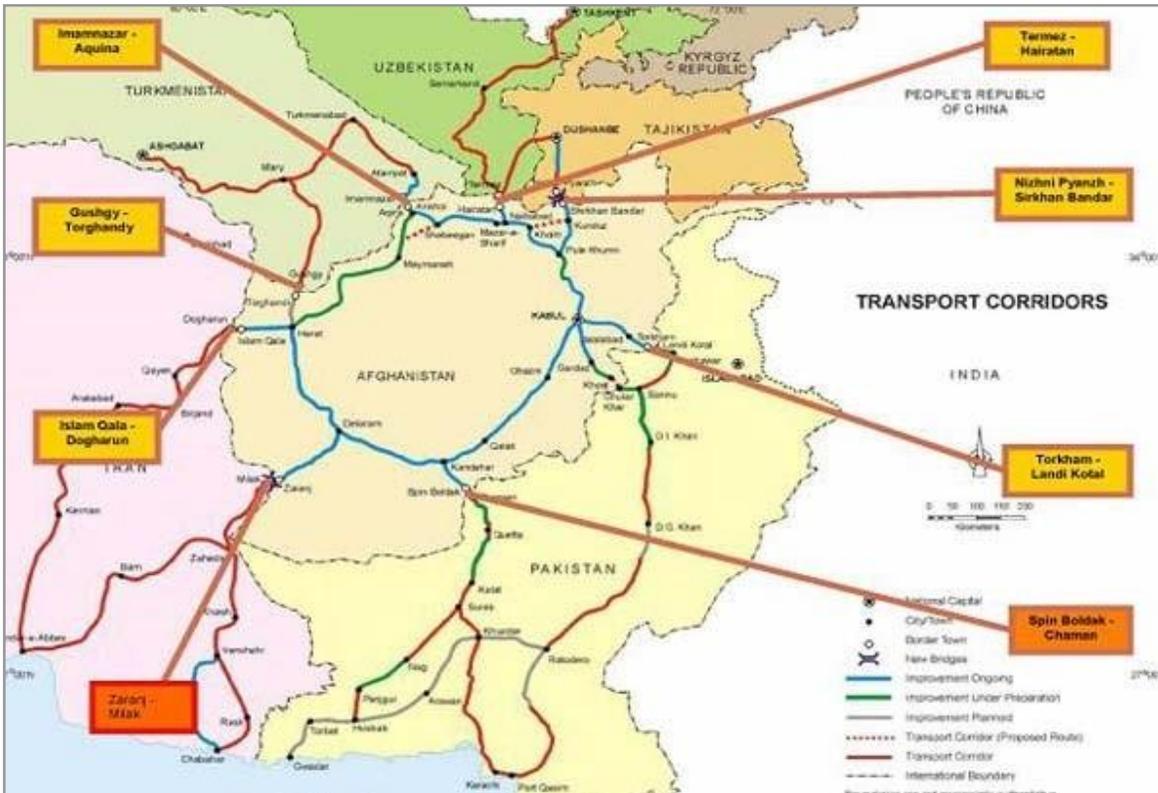
The overall transportation sector contributes around 10% of the total GDP of Pakistan, consuming 35% of the total energy and engages over 6% of total employment. The highway system has a total road length of 263,942 km. This total includes 185,063 km of paved highways (70%) and 708 km (0.3%) of motorway/expressway. The highway network of Pakistan includes 12,131 km of motorways and national highways, with another 93,000 km of provincial highways with the remainder classified as either district or urban roads.

The present NHA network comprises of 39 national highways, motorways, expressways and strategic roads. Current length of this network is 12,131 Kms. NHA existing portfolio consists of 26 on-going projects costing Rs. 393.4 billion with an allocation for PSDP 2015-16 of Rs. 159,600 million out of which Rs. 63,950 million as FEC and Rs. 95,650 million as local component. There are also 35 new schemes in PSDP 2015-16 with total cost of Rs. 1,213.5 billion¹.

¹ Economic Survey of Pakistan 2016.



Following map shows the major trade corridors for Afghanistan and other neighbouring countries. One of the major route is through Torkham and using N-5 to Karachi as most of the trade of Afghanistan is being carried out through this route.



1.1 Pak Afghan Trade

Pakistan and Afghanistan have a long history of being trade partners. Pakistan represents Afghanistan’s main access to a seaport for its foreign trade. Afghanistan, at the same time, has a potential for becoming a land linked country providing Pakistan with direct routes to the Central Asia. Transit to Afghanistan through Pakistan is governed by the Afghanistan Pakistan Transit Trade Agreement (APTTA) which specifies the port route transport modes and customs transit procedures.

Afghanistan continues to face challenges in its development, despite its potential of becoming a focal point for north-south trade from and to the other Central Asian States through Pakistan; owing to the geography and the geo-political dynamics of the neighborhood within which it is located. Due to the long distances—often as excessive as 2000 km or more—difficult terrain, poor road conditions, inappropriate national trade and transport policies, poor governance of transit systems, inefficiency and unreliability of transit transport service, rent-seeking activities,



inefficient bureaucratic procedures, inadequate provision of private sector services, long procedures and delays at border crossings, the transit time costs for Afghan goods is very long.



A comparison of Pak Afghan trade is given in the following Table:-

Pakistan Afghanistan Bilateral Trade (Value in Million US \$)				
Year	Exports	Imports	Total	Balance
2000-01	140	29.5	170	110.9
2001-02	169.2	22.9	192.1	146.4
2002-03	315.7	34.8	350.5	280.8
2003-04	492.9	47.4	540.3	445.4
2004-05	747.722	38.9	786.7	708.7
2005-06	1063.4	47.5	1110.9	1015.9
2006-07	753.9	76.2	830.2	677.7
2007-08	1143.6	91.3	1235	1052.3
2008-09	1398	93	1491	1305
2009-10	1572	139	1711	1433
2010-11	2336.7	172	2508.7	2164.7

1.2 Objective of the Peshawar – Torkham Economic Corridor Project (PTECP)

The subject motorway is connecting Peshawar with Torkham. Peshawar is the capital of Khyber Pakhtunkhwa and the administrative centre and economic hub for the Federally Administered Tribal Areas of Pakistan. Peshawar is situated in a large valley near the eastern end of the Khyber Pass, close to the Pak Afghan border. Known as “City on the Frontier”, Peshawar’s strategic location on the cross roads of Central Asia and South Asia has made it one of the most culturally vibrant and lively cities in the greater region. Peshawar is connected to Motorway system of Pakistan through Motorway M-1. The proposed motorway projects starts from Peshawar Northern Bypass and terminates at Torkham which is the border town between Pakistan and Afghanistan. Peshawar northern bypass is linked with M-1. The objective of constructing the Peshawar – Torkham Motorway to provide a faster and comfortable travel facility between two countries. By providing safe, reliable, effective, efficient, affordable, accessible, sustainable and fully integrated transport system will best meet the needs of freight & passenger access and mobility requirements. The subject report is prepared for the Motorway Section between Peshawar and Torkham. The total length of the section is over 40 Kms. Figure-1 shows the alignment of Peshawar – Torkham Motorway.

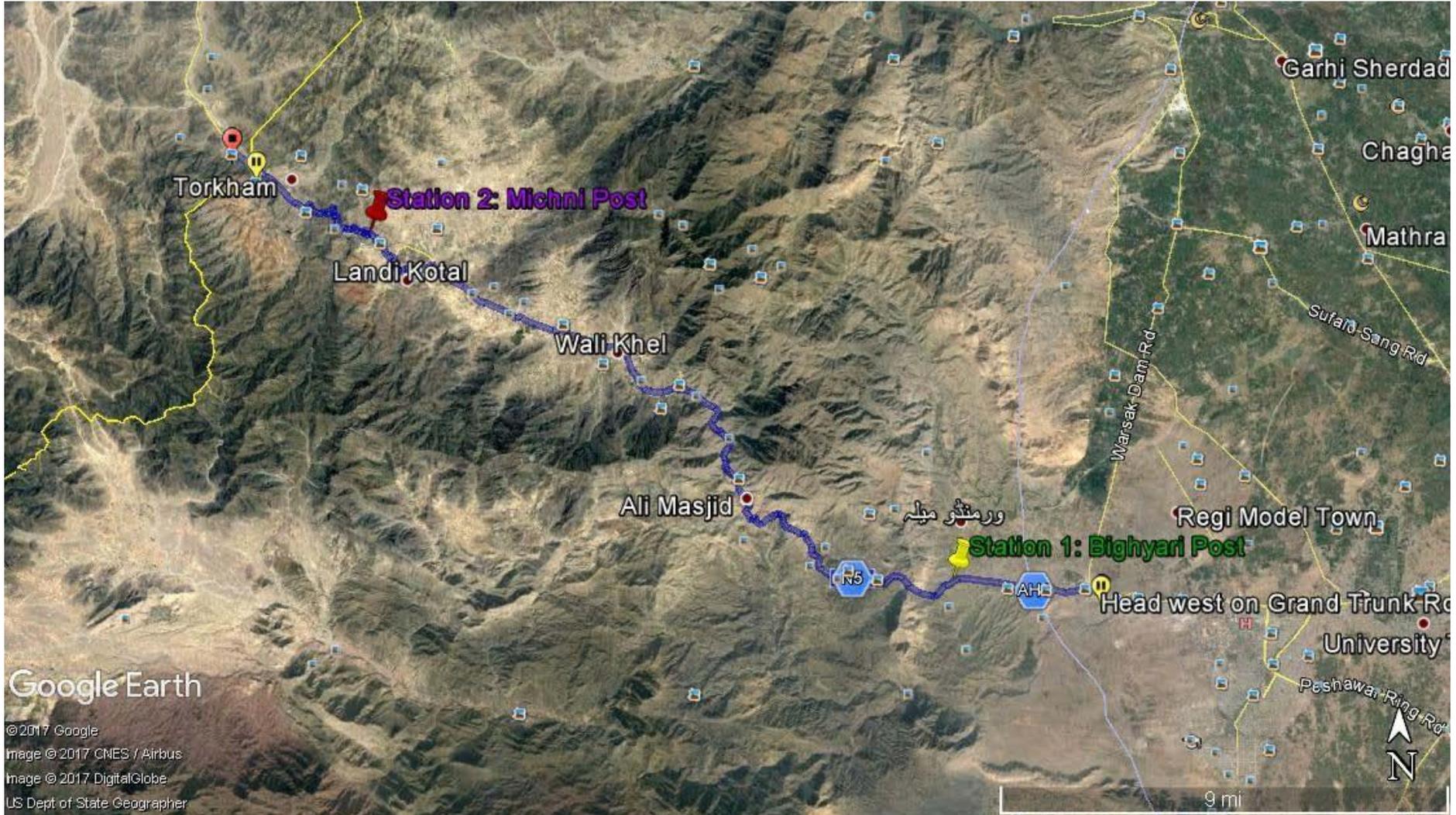


Figure 1: Alignment of Peshawar - Torkham Motorway





1.3 Objectives of Study

The primary objective for this traffic study is to determine the current traffic plying at different sections of N-5 between Peshawar and Torkham along the project alignment, to evaluate the existing traffic pattern, and an estimate of future traffic statistics.

1.4 Scope of Study

The traffic study comprises of following main tasks:

- i. Traffic Count Surveys
- ii. OD Surveys for Goods and Passenger Vehicles
- iii. Passenger Surveys
- iv. Travel Time Surveys
- v. Spot Speed Surveys
- vi. Condition Surveys
- vii. Roughness Surveys
- viii. Revised Economic Analysis

Detailed methodology of above mentioned tasks is described in the next Chapters.



Chapter – 2: Traffic Count / Traffic Survey

2.1 Classified Traffic Counts

Traffic Data Collection and projections thereof of traffic volumes are basic requirements for planning of road development and management schemes. Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data can help identify critical flow time periods, determine the influence of large vehicles on vehicular traffic flow, vehicle hourly patterns, document traffic volume trends and annual traffic estimates. The length of the sampling period depends on the type of count being taken and the intended use of the data recorded.

Traffic count surveys on Peshawar Torkham section have been conducted on an outer cordon i.e. major entry/exit points and on locations where important activity locations are situated. The surveys have been conducted over 8 consecutive days, 12 hours (due to security constraints) each at three locations. The location and timing have coincided with roadside interviews to facilitate adjustment for sampling. The information has been obtained by trained enumerators and experienced supervisors and includes all motorized and non-motorized traffic. Traffic surveys included the following:

1. 12-hour traffic counts (due to security Constraints), spread over one week plus one consecutive day (total 8 days) at each selected location.
2. All traffic counts been conducted simultaneously at the selected locations (i.e. the same 8 days).
3. Following three locations were selected for traffic surveys:

11.1.1 Table 1 : List of Sections of Peshawar - Torkham Motorway

Locations of Traffic Count	
Sr #	Location



1	Near Killa Jamrud
2	Before Landi Kotal
3	Between Landi Kotal & Torkham Border



The locations are on a straight road section with clear line of sight, outside of built-up areas and with no side obstructions or parking. Locations of the traffic stations are provided in **Figure below:**

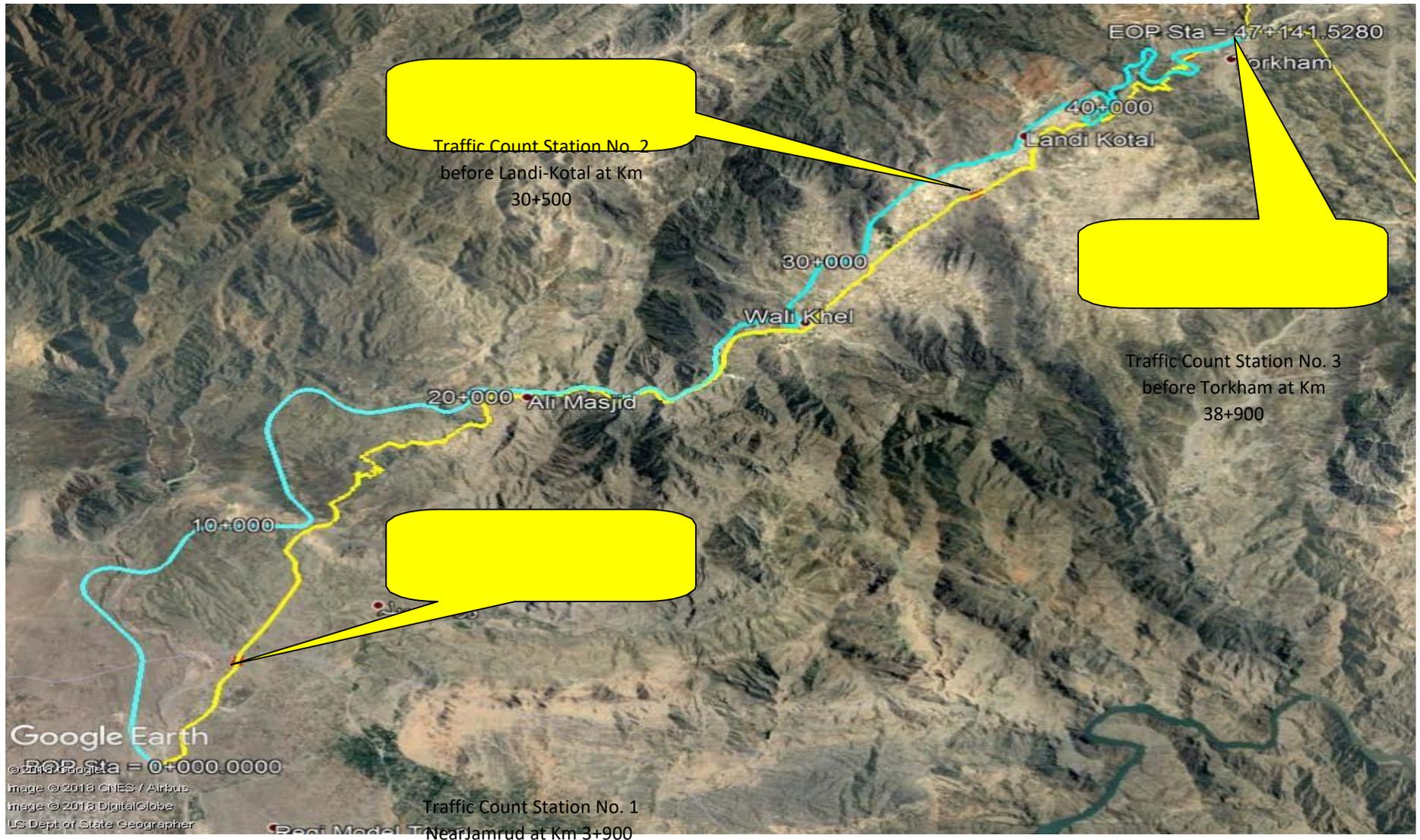




Figure 2: Locations of Traffic Count on Peshawar – Torkham



11.1.2 Table 2:Traffic Survey Vehicle Type

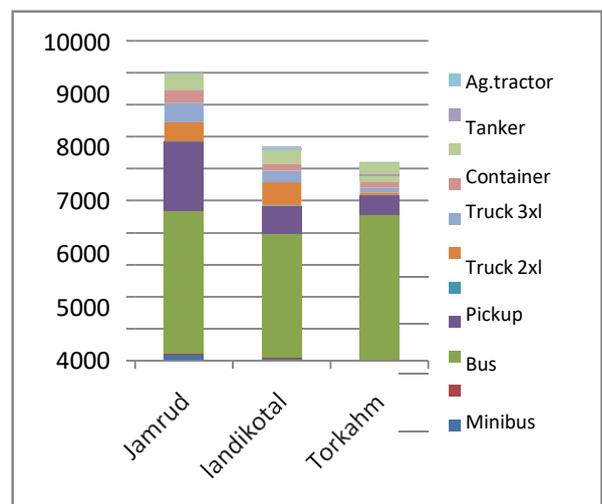
Vehicle Category	Vehicle Type
Motor Cycle	1) Motor Cycle, Rickshaw (traffic count only)
Car	2) Car (Passenger car, van, pickup, and taxi and 4WD)
Bus	3) Minibus (up to 12 seats), Medium bus (12 to 40 seats) 4) Large bus (40 and above seats)
Truck	5) Pick-up truck (open back with single or twin cabin) 6) 2-axle truck 7) 3 or more -axle truck/Dump/Trailer 8) Container truck/Container trailer 9) Tanker 10) Agriculture tractor with or without trolley or Trailer

Manually classified traffic counts and origin destination survey by road side interview were carried out at three locations on the project road, continuously for 8 days from February 10-17, 2018, for 12 hours, 6 AM to 6 PM, each. This section provides analysis of 12 hour survey data only. Raising of traffic volume to Average Daily (24 hour) level and forecasting over project life for design and economic analysis are given elsewhere in respective sections. The average 12 hour traffic observed during the survey is summarized in the table below and accompanying chart 1.

Table 3 – Average Daily Traffic (12 hrs)

Chart 1 – Daily Traffic

Location	Jamrud	Landikotal	Torkham
<i>M/cycle</i>	184	56	8
<i>Ricksha</i>	39	36	0
<i>Car*</i>	4441	3882	4549
<i>Minibus</i>	2186	852	605
<i>Bus</i>	6	23	6
<i>Pickup</i>	588	727	90
<i>Truck 2xl</i>	599	350	138
<i>Truck 3xl</i>	419	219	200
<i>Container</i>	506	501	610
<i>Tanker</i>	24	46	10
<i>Ag.tractor</i>	6	2	0
<i>Total</i>	8997	6693	6215



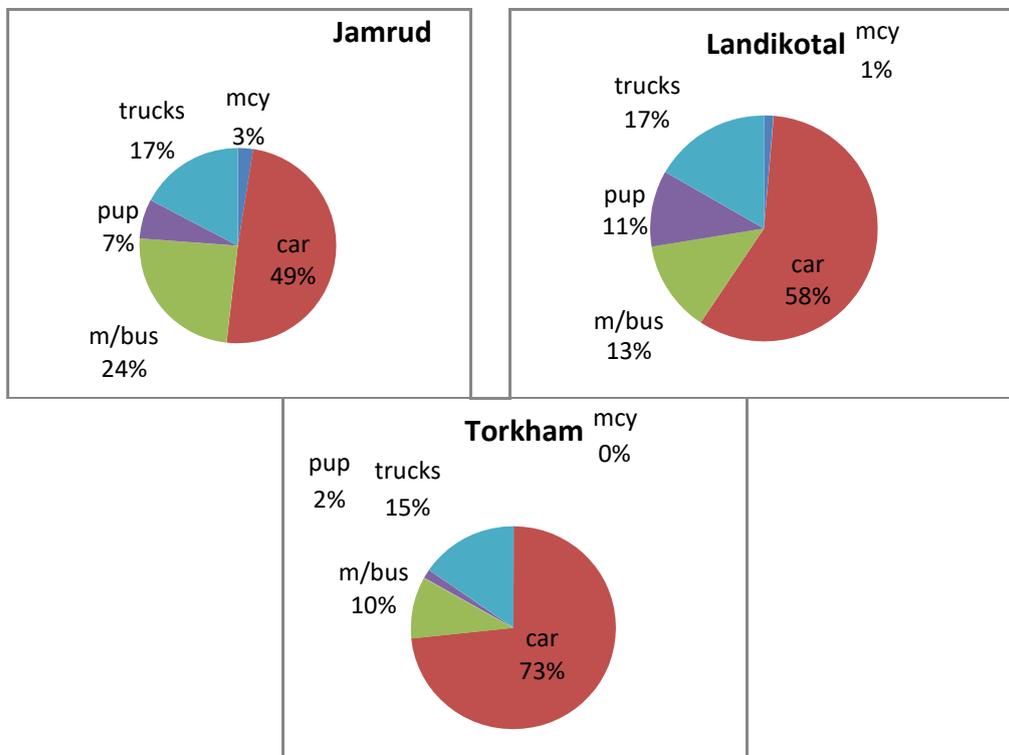


* includes taxis, jeeps and lcvs.

The volume of traffic is higher at Jamrud (Peshawar) than at other two places. It tapers off from provincial metropolis by 25 percent from 8997 vehicles at Jamrud to 6693 vehicles at Landikotal and by another 7 percent to 6215 vehicles at Torkham. The main difference is due to cars and micro-buses.

Unlike other locations in plain areas, motor cycles and rickshaws and agriculture tractor trollies are far and few on this road. Their volume is insignificant. Cars and mini-buses constitute largest proportion of traffic at Jamrud. The proportion of cars is relatively higher at Landikotal and Torkham. The composition of traffic is shown in the following graphs.

Chart 2- Composition of Traffic



11.1.3 Directional flows

The difference in two way flow traffic appears larger at Jamrud where 33,296 vehicles moved in up direction (Peshawar-Torkham) and 38,681 in down direction (Torkham-Peshawar). The difference is mainly due to mini-buses, pickups and 2axle trucks. At Landikotal and Torkham, significant differences are in mini buses and containers respectively. However, statistically, variations between directional flows are not significant. The coefficient of correlation $R = .99$ at each place. Details are shown below.



Table 4 – Directional flow

location	dir	mcy	rksh	car	m/bus	bus	pup	2xl	3xl	cont	tnkr	ag/tr	total
Jamrud	up	693	148	17531	7598	18	2124	1689	1227	2162	85	21	33296
	down	778	160	17997	9890	29	2577	3101	2128	1888	110	23	38681
Landikoal	up	223	113	16520	3737	67	2069	1510	969	2302	335	6	27851
	down	222	177	14537	3076	115	3746	1290	781	1706	32	7	25689
Torkham	up	24	0	19313	2314	2	281	466	575	2871	36	1	25883
	down	40	0	17077	2529	42	440	640	1021	2009	40	0	23838

11.1.4 Daily variations

There is no clear pattern of variations according to day of the week or difference in traffic on weekend, Friday or Saturday. If traffic at Jamrud was lowest, 8 percent below average on first Saturday, it was 8 percent above average on the next Saturday. Variations in between were less than 4 percent of average. Highest traffic was 17 percent above average on Friday which is business holiday elsewhere. At Torkham, the lowest volume was 9 percent below average on Tuesday and highest was 14 percent above average on Wednesday. The variations appear to be random. Standard deviations of week day variations range from 6 to 11 percent of average. Details may be seen in the table below and accompanying graphs.

11.1.5 Chart 3 – Daily Variations in Traffic

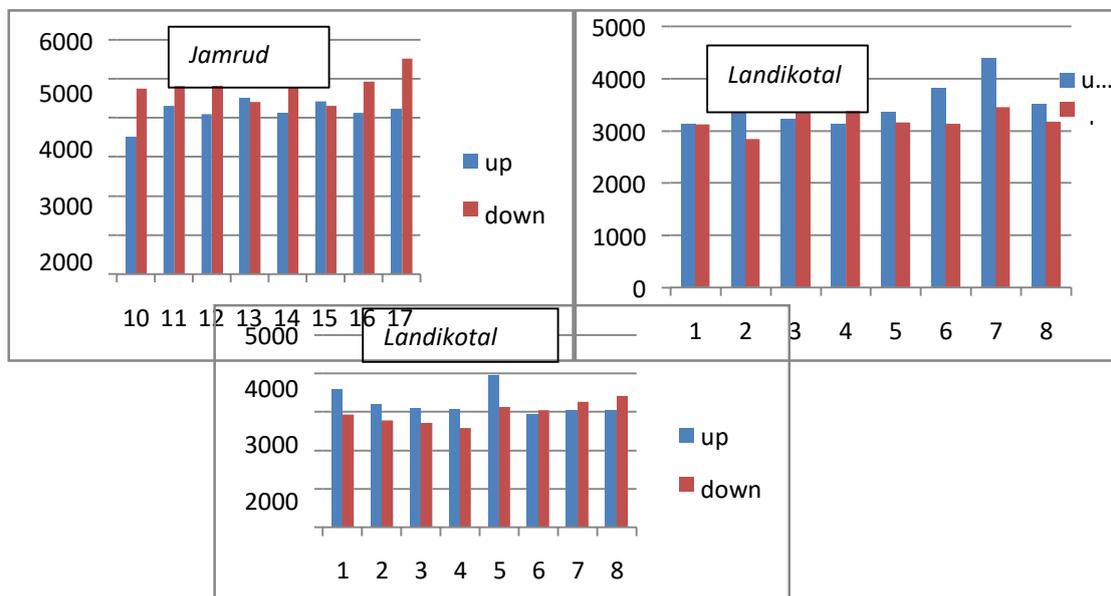






Table 5 - Daily variations by direction (8 days average)

Date	Feb.	10	11	12	13	14	15	16	17	avg	std	%
day		sat	sun	mon	tue	wed	thu	fri	sat			
Jamrud	up	3509	4302	4087	4503	4120	4413	4121	4241	4162	283	6.8
	down	4748	4800	4799	4403	5200	4307	4917	5507	4835	365	7.6
	both	8257	9102	8886	8906	9320	8720	9038	9748	8997	407	4.5
	Var/avg%	-8.2	1.2	-1.2	-1.0	3.6	-3.1	0.5	8.3	-8.2		
Landikotal	up	3114	3344	3214	3134	3348	3810	4376	3511	3481	399	11.5
	down	3123	2831	3472	3369	3148	3129	3451	3166	3211	199	6.2
	both	6237	6175	6686	6503	6496	6939	7827	6677	6693	487	7.3
	Var/avg%	-6.8	-7.7	-0.1	-2.8	-2.9	3.7	17.0	-0.2	-6.8		
Torkham	up	3570	3201	3076	3066	3944	2930	3052	3044	3235	323	10.0
	down	2928	2777	2711	2588	3133	3052	3259	3390	2980	261	8.8
	both	6498	5978	5787	5654	7077	5982	6311	6434	6215	431	6.9
	Var/avg%	4.6	-3.8	-6.9	-9.0	13.9	-3.8	1.5	3.5	4.6		

11.1.6 Hourly variations

Hourly variations during the day indicate that traffic is built up in the first one to two hours from 6 to 8 am and then continues with little variations up to 6 pm when it starts to taper down. The peak hour was found at Jamrud between 10-11 hours in up direction and 9-10 hours in down direction with 10.2 and 10 percent of 12 hour traffic. At Landikotal, peak load was 10.5 percent in up direction at 8-9 hours and 9.8 percent in down direction at 11-12 hours. At Torkham, peak in up direction was highest at 14.8 percent at 8-9 hours and 10 percent at 11-12 hours. Details are shown in table below and accompanying graphs.

11.1.7 Table 6 – Hourly variations (% of 12 hour total)

hour	6	7	8	9	10	11	12	13	14	15	16	17	
Jamrud	up	6.0	7.9	9.3	8.7	10.2	8.1	9.2	8.2	9.1	8.1	8.7	6.5
	down	3.2	6.1	9.7	10.0	9.7	8.6	9.3	8.9	8.8	8.9	8.1	8.7
Landikotal	up	3.9	7.1	10.5	9.7	9.6	8.2	8.5	7.6	8.1	8.9	9.1	8.7

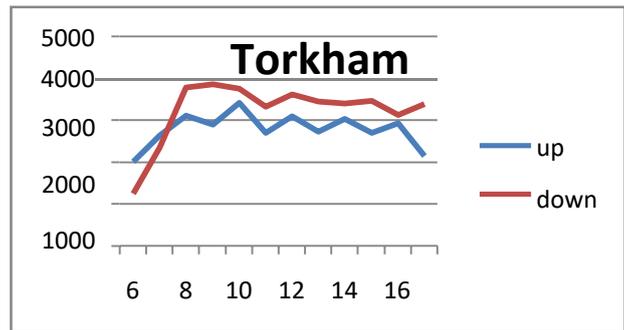
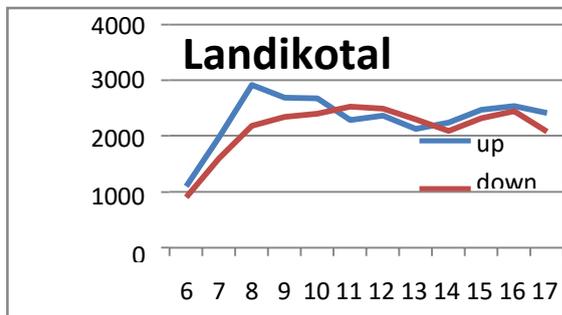
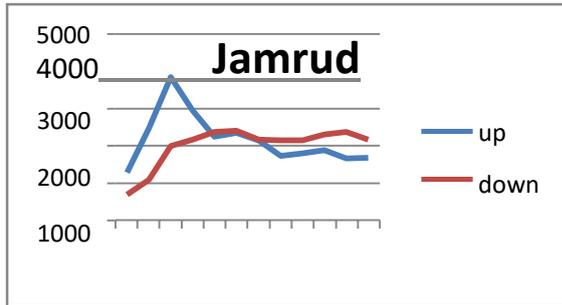


down	3.5	6.2	8.5	9.1	9.3	9.8	9.7	9.0	8.1	9.0	9.5	8.1
------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----



	hour	6	7	8	9	10	11	12	13	14	15	16	17
Torkham	up	4.9	9.5	14.8	11.3	8.6	9.0	8.3	6.7	6.9	7.2	6.4	6.4
	down	2.8	4.5	8.3	9.0	9.9	10.0	9.0	9.0	8.9	9.6	9.9	9.0
All	up	5.0	8.1	11.3	9.8	9.6	8.4	8.7	7.5	8.1	8.1	8.2	7.2
	down	3.2	5.7	9.0	9.5	9.6	9.3	9.4	8.9	8.6	9.1	9.0	8.6

Chart 4 – Hourly Variations in traffic



11.1.8 Calculation of ADT at 3 Locations

The traffic counts were conducted direction wise in the field, while they were combined for the calculation of Average Daily Traffic (ADT). Following tables provide the ADT for February

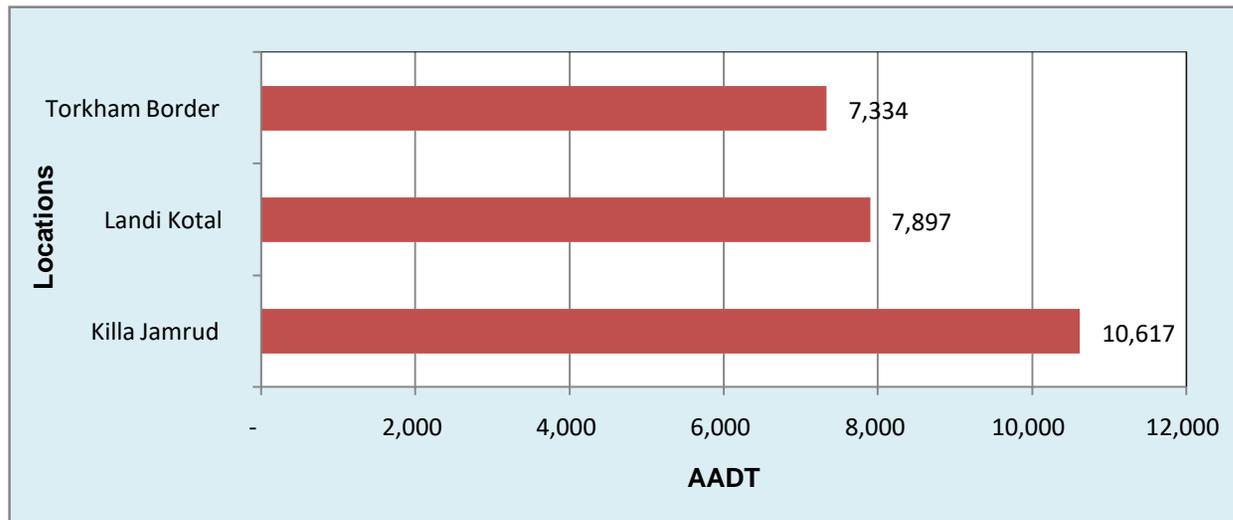


2018. 12 hours counts are converted to Average Daily Traffic (ADT) by using a factor of 18% as recommended by NTRC Report of Traffic Factors of Pakistan - III.



11.1.9 Table 7: Summary of Average Daily Traffic (ADT) at 3 Locations of N-5

Sr. #	Location	Truck / Trailers						Car/ Taxi / jeep / Van	Mini / Medium Bus	Large Bus	Motor Cycle	Rickshaw
		2-Axle Truck	3-Axle Truck	Container	Tanker	Agriculture Tractor	Pickup Truck					
1	At Killa Jamrud	707	495	597	29	6	693	5,240	2,579	7	217	45
2	At Landi Kotal	413	258	591	54	2	858	4,581	1,005	27	66	43
3	At Torkham Border	163	235	720	11	0	106	5,368	714	6	9	-







Calculation of AADT at 3 Locations

Traffic counts were conducted for different categories of traffic at N-5 at 3 locations. The traffic counts were conducted direction wise in the field, while they were combined for the calculation of Average Annual Daily Traffic (AADT).

We have obtained old data from NTRC annual traffic counts recorded at representative permanent traffic counting station to develop daily, weekly, and monthly adjustment factors to estimate the Average Annual Daily Traffic. In case of non availability of the traffic data from NHA/NTRC seasonal factors from NTRC old reports have been used.

11.1.10 Adjustments for Seasonal Effect

NTRC (National Transport Research Council) has established seasonal and daily factors which are compiled in "Traffic Factors for Pakistan-II (1992)".

Daily Factors: Traffic counts were conducted for 8 days (from Saturday to Saturday). Therefore we take average of seven days traffic.

Seasonal Factor: Seasonal Factor from NTRC Report has been used for the month of February for following closest station:

Sr. #	Station	February
1	Attock	0.95

11.1.11 * *SVF = Seasonal Variation Factor

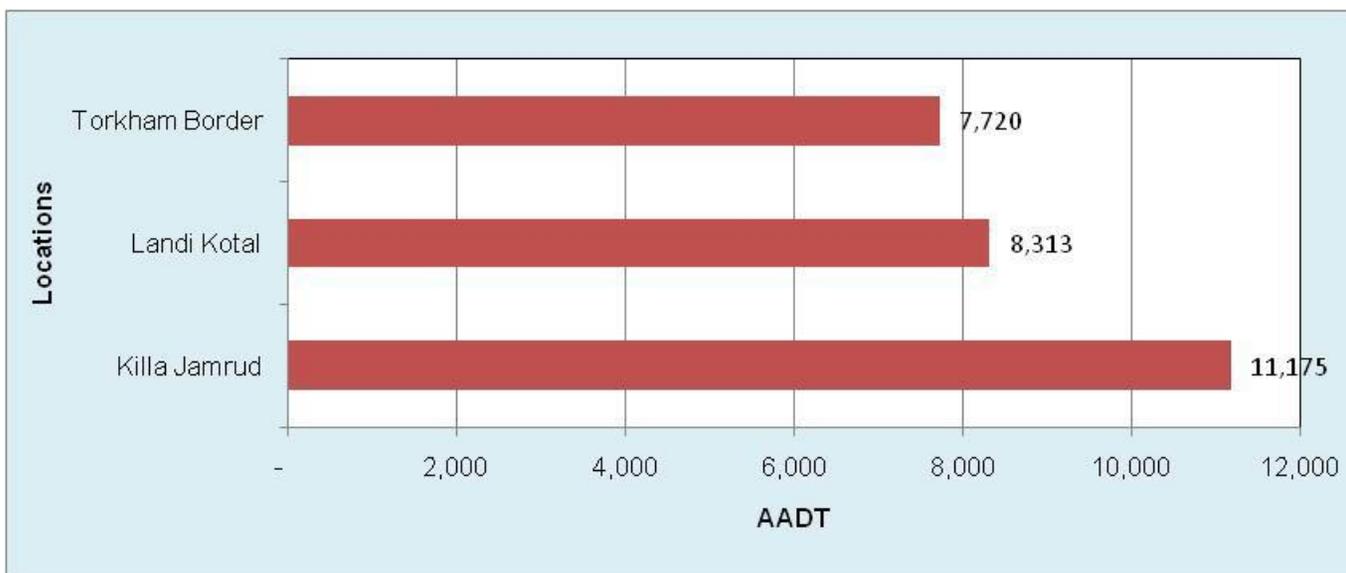
Following table provide the Average Annual Daily Traffic.





11.1.12 Table 8: Summary of Average Annual Daily Traffic (AADT) at 3 Locations of N-5

Sr. #	Location	Truck / Trailers						Car/ Taxi / jeep / Van	Mini / Medium Bus	Large Bus	Motor Cycle	Rickshaw
		2-Axle Truck	3-Axle Truck	Container	Tanker	Agriculture Tractor	Pickup Truck					
1	Killa Jamrud	744	521	629	30	7	730	5,516	2,715	7	228	48
2	Landi Kotal	435	272	622	57	2	903	4,822	1,058	28	69	45
3	Torkham Border	172	248	758	12	0	112	5,650	752	7	10	-



Details of AADT for each station are described in the next paras:

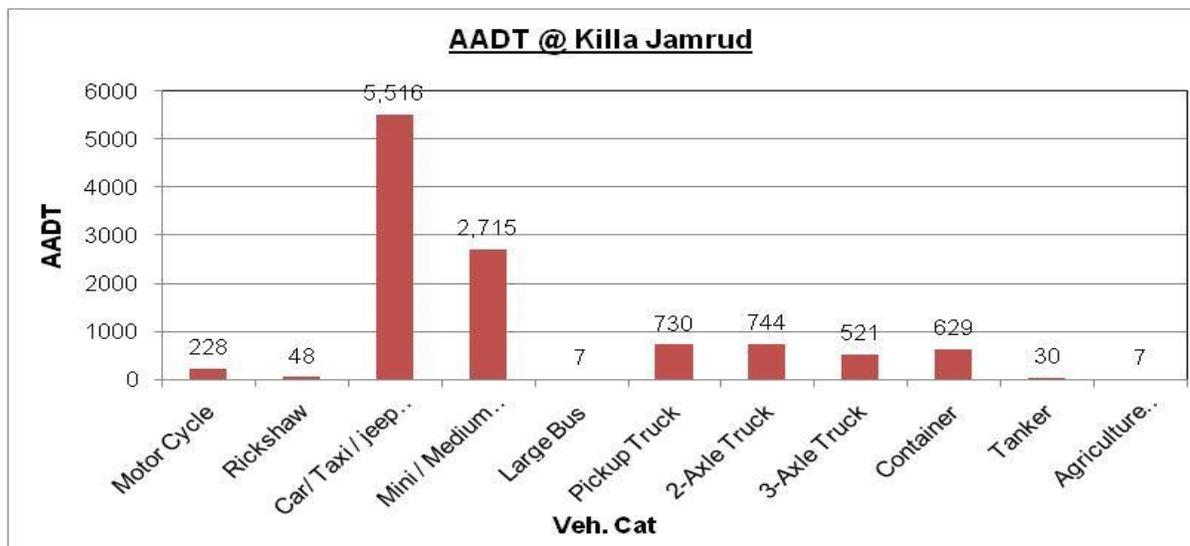




2.2 Detail of Traffic Count @ PTECP

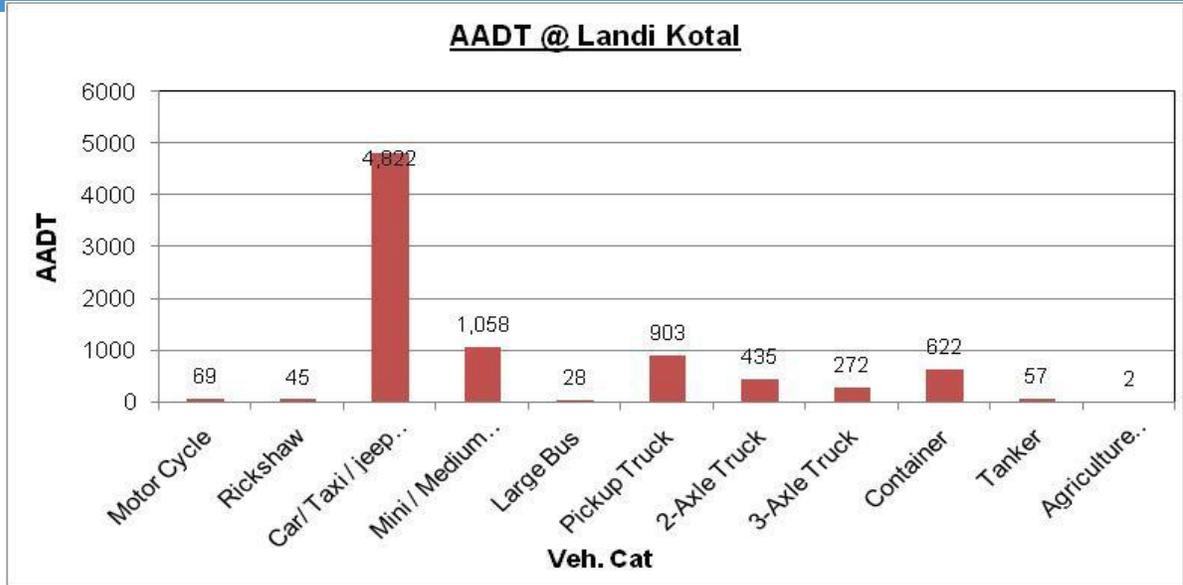
i. Average Annual Daily Traffic (AADT) At Killa Jamrud

The traffic counts were carried out in the month of February 2018 for eight days (8x12 hrs) in order to check the volume of traffic for **N-5 near Killa Jamrud**. Types of Vehicle surveyed include car, jeep, passenger buses and multi axle trucks. The traffic counts were conducted direction wise in the field, while they were combined for the calculation of Average Annual Daily Traffic (AADT). **The value of AADT for Tolling Traffic at N-5 near Killa Jamrud is 11,175.**



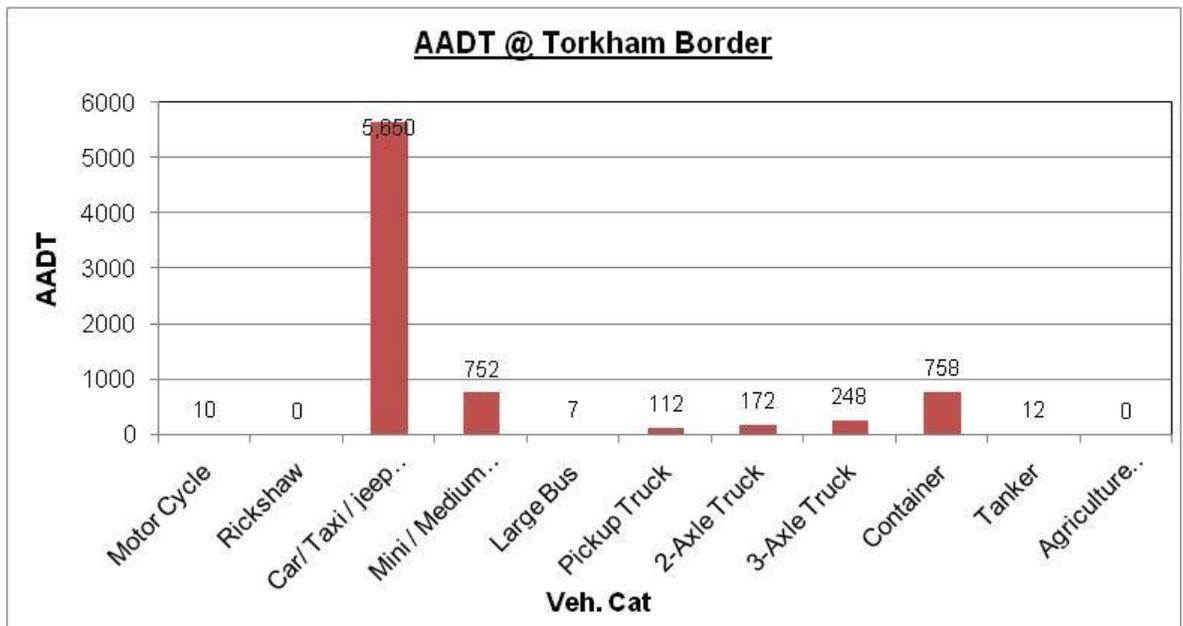
ii. Average Annual Daily Traffic (AADT) At Landi Kotal

The traffic counts were carried out in the month of February 2018 for eight days (8x12 hrs) in order to check the volume of traffic for **N-5 near Landi Kotal**. Types of Vehicle surveyed include car, jeep, passenger buses and multi axle trucks. The traffic counts were conducted direction wise in the field, while they were combined for the calculation of Average Annual Daily Traffic (AADT). **The value of AADT for Tolling Traffic at N-5 near Landi Kotal is 8,313.**



iii. Average Annual Daily Traffic (AADT) At Torkham Border

The traffic counts were carried out in the month of February 2018 for eight days (8x12 hrs) in order to check the volume of traffic at **Torkham Border**. Types of Vehicle surveyed include car, jeep, passenger buses and multi axle trucks. The traffic counts were conducted direction wise in the field, while they were combined for the calculation of Average Annual Daily Traffic (AADT). **The value of AADT for Tolling Traffic at Torkham Border is 7,720.**





The above figures shows that the maximum of the traffic constitutes of the cars and other light vehicles followed by the Mini buses, vans, pickups and Trucks.

2.3 Estimation of Growth Rate

For estimating the traffic forecasts, a growth rate is to be established. For establishing a growth rate historical growth in the country and on the existing road is discussed in the following paras.

2.3.1 Historical Data

Growth Rates established are based on the previous traffic data and historic counts. Furthermore various alternative growth rates from JICA reports and studies by other departments and agencies or based on historical increase in GDP, vehicle registration, traffic data etc have been studied in detail. Based upon the demand elasticity, induced and generated traffic have also been estimated.

The historical growth rates provide an insight for estimating the future projection of traffic. The utility of the historic data is that over a period of 5 to 10 years, irregular effects tend to cancel each other. On the contrary, in a single year, these effects may be too large and cannot be filtered out. Despite abundant historical data and studies, it must be acknowledged that growth projections are not an exact science and various project specific considerations must be taken into account to arrive at any project growth rates. Expected growth rates have been estimated for possible scenario covering worst case, expected and an optimistic estimate.

Data from various sources have been studied and following indicators have been identified which can be used to establish the historical growth factors for various categories of traffic:

- Vehicles on Road in Pakistan
- Registered Vehicles in Pakistan
- Gross Domestic Product
- Historical Growth in “Vehicles on Road” in Pakistan

Following graph shows the growth of total number of Vehicles on Road by category for the past 24 years in Pakistan from 1991 to 2015. The ACGR (Annual Compound Growth Rate) from this data is shown for each category of vehicle²:





Figure 2: Growth of Vehicles on Road in Pakistan (1991-2015)

11.1.13 Growth in Registered Vehicles in Pakistan

Following graph shows the growth of total number of Registered Vehicles in Pakistan by category for the past 24 years from 1990 to 2014. The ACGR (Annual Compound Growth Rate) from this data is also reflected in the table provided below for each category of vehicle: Following chart gives the growth of registered vehicles in Pakistan:

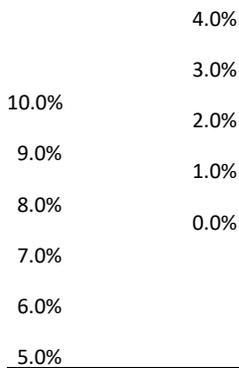
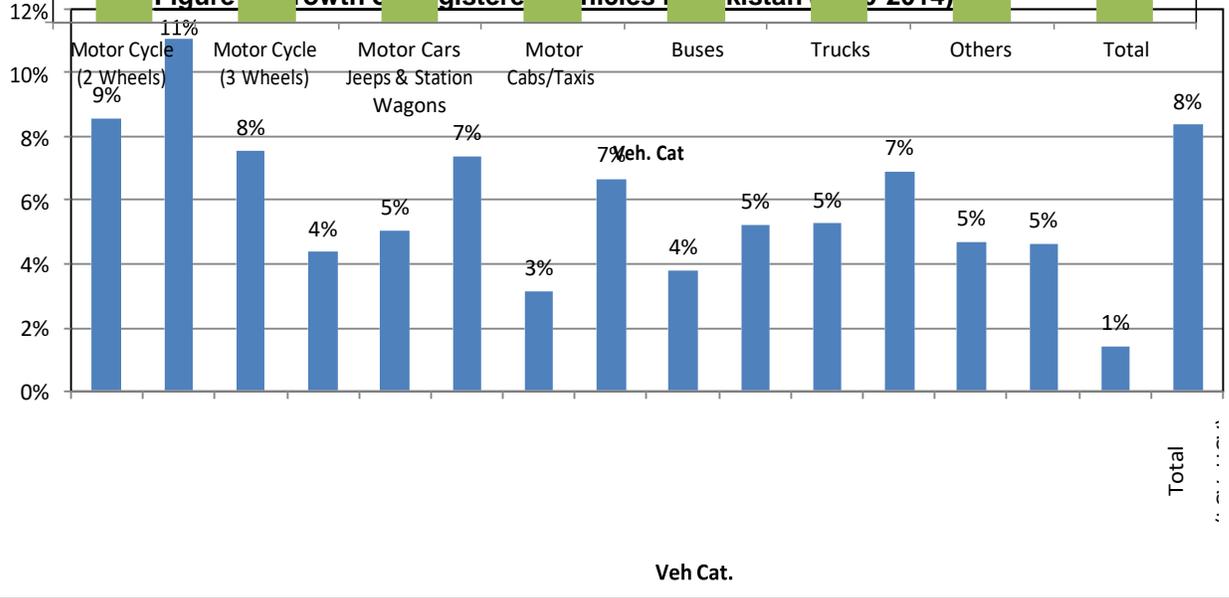




Figure 1: Growth of Registered Vehicles in Pakistan (2010-2014)





JICA did a study of traffic growth rates in 1981-83³. Their projections, based on historical data, were a growth rate of 6.8% for passenger vehicles and 9.5% for cargo vehicles. Over the period from 1971-83, GDP increased by 5.5% per annum. The elasticity of passengers traffic with respect to GDP was determined to be 1.18 and for cargo road traffic 1.73. The coefficient of correlation (R²) was found to be 0.97. Data for GDP for the last 61 years (1951-2012) shows that on average the growth rate has been increasing at a rate of 4.98% per annum which would indicate a traffic growth rate of 5.5% and 8.6% for passengers and freight traffic respectively.

The elasticity of traffic growth with population and industrial production has also been studied. In a 1983 JICA study traffic growth was shown to have a direct elasticity of 2.25 with the growth in population. Thus with a historical growth rate of 2.1% in population, the overall traffic should have grown at a rate of 4.7% annually. The growth of goods traffic with industrial growth showed an elasticity of 1.09. Thus with a historical growth in production of approximately 6%, cargo traffic should increase at 6.54% annually. In 1995 JICA conducted another study, which recommended growth rates from 1997 to 2006 of 5.9% for passengers and 5.5% for goods.

11.1.14 Pakistan Transport Plan Study 2006⁴

JICA in collaboration with the NTRC carried out the Pakistan Transport Plan Study in March 2006. It suggests land transport demand for freight is assumed to grow at an average annual rate of 6.3% (10.0% for railway and 6.1% for road) for next five years. For the same period the study assumes a growth rate of 7.6% per year. This means that the elasticity of land freight traffic demand against GDP is more than 1.0.

In past the land freight traffic volume has increased at an average rate of 8.6% in terms of ton-km from 1990/91 to 2003/04. This is higher than the growth rate of GDP which was 5.2-7.3% during the same period. Following table gives the summary of projected traffic and estimated growth rates as estimated by the subject study:

11.1.15 Table 9: Future Estimated Increase in Vehicles

Year	Car	Truck	Bus	Total
2004	1,753	269	115	2,137
2005	1,902	293	126	2,321
2010	2,645	440	192	3,277

³ The Study on National Transport Plan in Islamic Republic of Pakistan, JICA, May, 1983 – second in March 1988, third in February 1995.

⁴ Pakistan Transport Plan Study by JICA 2006



2015	3,338	628	276	4,242
2020	3,978	865	382	5,225
2025	4,567	1,152	511	6,230
2030	5,104	1,490	662	7,256
Growth	4.4%	7.1%	7.3%	5.0%

Total estimated increase in overall traffic in Pakistan is 5.0% which has an elasticity of 1.0 with respect to the historical average of GDP growth of the country which is around 5.0% for last 60 years.

11.1.16 Gross Domestic Product (GDP)

Historical data for GDP shows that on the average GDP has grown at 4.98% per annum over sixty years. In the 1980’s the GDP of growth was at an average of 6.4% per annum and in the 1990’s at 4.6% per year.

It has been found that the historical trend in the number of vehicles in Pakistan fits well with the trend in GDP. Economic growth as measured by GDP, in the last 15 years averaged below 4.41% which is lower than the past decades. This has been due to many reasons including a low economic activities and external & internal political situation. Following tables gives the historic GDP for the last 15 years.

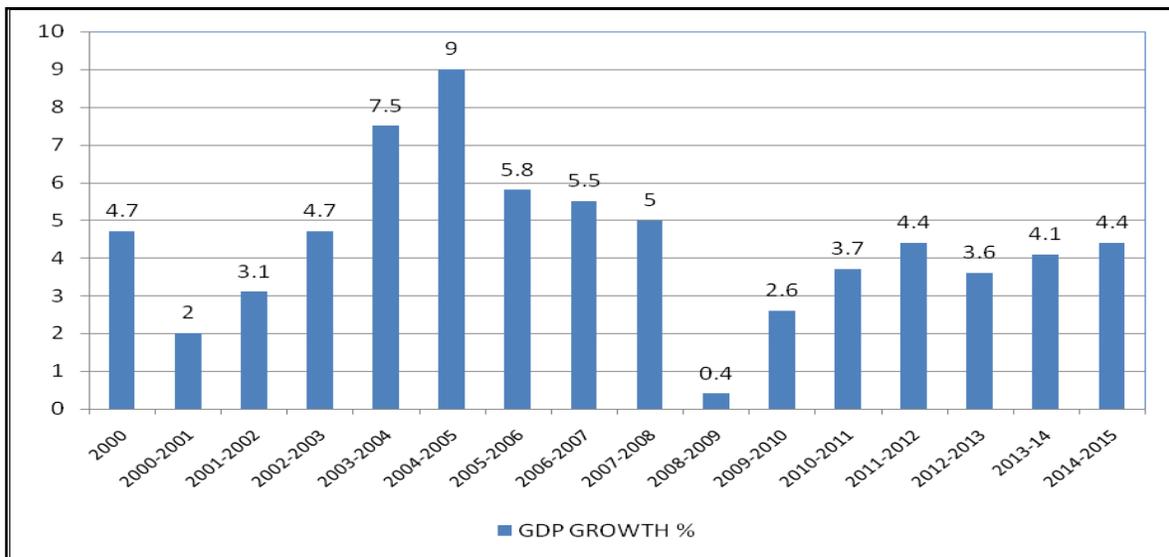




Figure 4: Historical Growth of GDP in Pakistan (2000-2015)



2.3.2 Adopted Growth Rates:

Historical growth of the GDP in last 15 years is remained around 4.41%. In particular, the future growth rates for the project have been based on the detailed analysis recommended in the study sponsored by the World Bank for NHA “Pre-feasibility Study for National Highway N-5, 1998”, Louis Berger Int’l Inc., USA.

For this study we have assumed a realistic estimated of elasticity of 1.0 with respect to historic GDP and have assumed an overall growth rate of 4.5%.

In relation to growth in passenger traffic, GDP has been found to have an elasticity of 1.015. Thus with a historical GDP growth of approximately 4.41%, the overall traffic should have grown at a rate of 4.5% annually.

11.1.17 Table 10: Growth Rate Adopted

Category	Future Traffic Growth Rates (%)
Car , Jeeps, Van	4.5
Mini Truck	4.5
Van/ Pickup	4.5
Truck / Trailer	4.5
Buses	4.5

2.3.3 Generated Traffic

Generated traffic is the growth in traffic along a roadway associated with the decrease / increase in user costs associated with utilizing that roadway and an elasticity factor. Generated traffic is the traffic generated by improving the project road including the development traffic. In practice it is difficult to distinguish between generated traffic and development traffic and the two are usually taken together and termed as generated traffic⁶.

For this study the percentage change (savings) in user costs by vehicle type with the proposed improvements are estimated. The user cost savings are factored by assumed demand elasticity values for cars and other vehicles to calculate the generated traffic levels. Each percentage reduction in vehicle operating and travel time costs will induce more traffic to use the improved facility. If the demand elasticity is assumed to be 0.50, then 10% reduction in user costs would result in a 5 percent increase in traffic.



5 JICA, Final Report, Pg 144, (Avg figure), 1983

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The price elasticity of demand for transport measures the responsiveness of traffic to a change in transport costs for instance following road investment. The price elasticity is defined as the ratio of the percentage change in travel demand to the percent change in travel costs. Evidence from studies in developing countries give a range of between 0.6 to 2.0 for the price elasticity of demand for transport with an average of about 1.0. This means that 1% decrease in transport costs leads to a 1% increase in traffic⁷. In this casewe have assumed a demand elasticity of 1 which means that 10% generated traffic will start using this road due to reduction in VOCs by 10%.

Following table provides the details of the VOC savings (from Fair to Very Good Condition) and percentage change in the VOC savings. Since the demand elasticity is taken as 1 therefore percentage savings in VOC are assumed as the generated trafficon Motorway.

11.1.18 Table 11: Calculation of Generated Traffic⁸ _

Vehicle Type	Financial VOC Cost					%age savings in VOC from Fair to Very Good Condition
	Road Condition (Roughness)					
	Very Good (r-2500)	Good (r-3000)	Fair (r-3500)	Poor (r-5000)	Very Poor (r-7000)	
Car	6.95	7.06	7.16	7.86	8.78	3%
Wagon	12.46	12.96	13.48	15.41	18.47	8%
Bus	24.09	25.35	26.58	32.09	38.73	10%
Truck (2-axle)	18.93	19.38	19.81	22.72	26.01	5%
Truck (3-axle)	22.27	22.88	23.45	26.51	30.08	5%
Truck (Trailer)	27.81	28.47	29.1	33.11	37.6	5%

Based upon the generated traffic from N-5, traffic forecasts have been prepared for Normal traffic and with generated traffic as well for 20 years on the three locations. The same is provided in the next tables.



7 Planning Methods from Highway and Traffic Engineering in Developing Countries edited by Bent Thagesen
8 Pakistan Transport Sector Plan Study



11.1.19 Table 12: Traffic Forecasts at Jamrud

DESIGN YEAR	YEAR / VEHICLE TYPE	TRUCKS			TRUCK		Pickup Truck	Large Bus	Car/ Taxi / jeep / Van	Mini / Medium Bus	Motor Cycle	Rickshaw	Agriculture Tractor	GRAND TOTAL (AADT)
		2-Axle	3-Axle	Container	Tanker									
Generated Traffic		5.00	5.00	5.00	5.00	5.00	10.00	3.00	8.00	3.00	3.00	3.00		
AADT	2018	744	521	629	30	730	7	5516	2715	228	48	7	11175	
Const. Period	2019	777	544	657	32	763	8	5764	2837	239	50	7	11678	
	2020	812	569	687	33	797	8	6024	2965	249	52	7	12204	
1	2021	889	623	752	36	873	9	6476	3336	268	56	8	13326	
2	2022	929	651	786	38	912	10	6767	3486	280	59	8	13926	
3	2023	971	680	821	40	953	10	7072	3643	293	61	9	14552	
4	2024	1015	711	858	41	996	10	7390	3807	306	64	9	15207	
5	2025	1061	743	897	43	1041	11	7722	3978	320	67	10	15891	
6	2026	1108	776	937	45	1088	11	8070	4157	334	70	10	16606	
7	2027	1158	811	979	47	1137	12	8433	4344	349	73	10	17354	
8	2028	1210	848	1023	49	1188	12	8812	4539	365	76	11	18135	
9	2029	1265	886	1069	51	1241	13	9209	4744	381	80	11	18951	
10	2030	1322	926	1117	54	1297	14	9623	4957	398	83	12	19803	
11	2031	1381	967	1168	56	1355	14	10056	5180	416	87	12	20695	
12	2032	1443	1011	1220	59	1416	15	10509	5413	435	91	13	21626	
13	2033	1508	1056	1275	61	1480	15	10982	5657	455	95	14	22599	
14	2034	1576	1104	1333	64	1547	16	11476	5912	475	99	14	23616	
15	2035	1647	1154	1393	67	1616	17	11992	6178	497	104	15	24679	
16	2036	1721	1205	1455	70	1689	18	12532	6456	519	109	16	25789	
17	2037	1799	1260	1521	73	1765	18	13096	6746	542	114	16	26950	
18	2038	1879	1316	1589	77	1845	19	13685	7050	567	119	17	28163	
19	2039	1964	1376	1661	80	1928	20	14301	7367	592	124	18	29430	
20	2040	2052	1438	1735	84	2014	21	14945	7698	619	130	19	30754	



Table 13: Traffic Forecasts at Landi Kotal

DESIGN YEAR	YEAR / VEHICLE TYPE	TRUCKS		TRUCK		Pickup Truck	Large Bus	Car/ Taxi / jeep / Van	Mini / Medium Bus	Motor Cycle	Rickshaw	Agriculture Tractor	GRAND TOTAL (AADT)
		2-Axle	3-Axle	Container	Tanker								
Generated Traffic		5.00	5.00	5.00	5.00	5.00	10.00	3.00	8.00	3.00	3.00	3.00	
AADT	2018	435	272	622	57	903	28	4822	1058	69	45	2	8313
Const. Period	2019	454	284	650	60	943	30	5039	1105	72	47	2	8687
	2020	475	297	680	62	986	31	5266	1155	75	49	2	9078
1	2021	520	325	744	68	1080	35	5661	1300	81	53	2	9869
2	2022	543	340	778	71	1128	37	5915	1358	85	55	2	10313
3	2023	568	355	813	74	1179	39	6182	1419	89	58	3	10777
4	2024	593	371	849	78	1232	40	6460	1483	93	60	3	11262
5	2025	620	387	887	81	1287	42	6750	1550	97	63	3	11768
6	2026	648	405	927	85	1345	44	7054	1619	101	66	3	12298
7	2027	677	423	969	89	1406	46	7372	1692	106	69	3	12851
8	2028	707	442	1013	93	1469	48	7703	1769	110	72	3	13430
9	2029	739	462	1058	97	1535	50	8050	1848	115	75	3	14034
10	2030	773	483	1106	101	1604	53	8412	1931	121	79	4	14666
11	2031	807	505	1156	106	1677	55	8791	2018	126	82	4	15325
12	2032	844	527	1208	111	1752	57	9186	2109	132	86	4	16015
13	2033	882	551	1262	116	1831	60	9600	2204	138	90	4	16736
14	2034	921	576	1319	121	1913	63	10032	2303	144	94	4	17489
15	2035	963	602	1378	126	1999	65	10483	2407	150	98	4	18276
16	2036	1006	629	1440	132	2089	68	10955	2515	157	102	5	19098
17	2037	1051	657	1505	138	2183	71	11448	2628	164	107	5	19958
18	2038	1099	687	1573	144	2282	75	11963	2746	171	112	5	20856
19	2039	1148	718	1643	150	2384	78	12502	2870	179	117	5	21794
20	2040	1200	750	1717	157	2492	82	13064	2999	187	122	5	22775



11.1.20 [Table 14: Traffic Forecasts at Torkham](#)

DESIGN YEAR	YEAR / VEHICLE TYPE	TRUCKS			TRUCK		Pickup Truck	Large Bus	Car/ Taxi / jeep / Van	Mini / Medium Bus	Motor Cycle	Rickshaw	Agriculture Tractor	GRAND TOTAL (AADT)
		2-Axle	3-Axle	Container	Tanker									
Generated Traffic		5.00	5.00	5.00	5.00	5.00	10.00	3.00	8.00	3.00	3.00	3.00		
AADT	2018	172	248	758	12	112	7	5650	752	10	0	0	7720	
Const. Period	2019	179	259	792	12	117	7	5904	786	10	0	0	8067	
	2020	188	271	827	13	122	7	6170	821	11	0	0	8430	
1	2021	205	296	906	14	134	9	6633	924	12	0	0	9133	
2	2022	215	310	947	15	140	9	6931	965	12	0	0	9543	
3	2023	224	324	989	15	146	9	7243	1009	13	0	0	9973	
4	2024	234	338	1034	16	153	10	7569	1054	13	0	0	10422	
5	2025	245	353	1080	17	160	10	7910	1102	14	0	0	10891	
6	2026	256	369	1129	18	167	11	8266	1151	15	0	0	11381	
7	2027	267	386	1180	18	174	11	8638	1203	15	0	0	11893	
8	2028	279	403	1233	19	182	12	9026	1257	16	0	0	12428	
9	2029	292	421	1288	20	190	12	9432	1314	17	0	0	12987	
10	2030	305	440	1346	21	199	13	9857	1373	17	0	0	13572	
11	2031	319	460	1407	22	208	13	10300	1435	18	0	0	14183	
12	2032	333	481	1470	23	217	14	10764	1499	19	0	0	14821	
13	2033	348	503	1536	24	227	14	11248	1567	20	0	0	15488	
14	2034	364	525	1606	25	237	15	11754	1637	21	0	0	16185	
15	2035	380	549	1678	26	248	16	12283	1711	22	0	0	16913	
16	2036	397	573	1753	27	259	17	12836	1788	23	0	0	17674	
17	2037	415	599	1832	29	271	17	13414	1868	24	0	0	18469	
18	2038	434	626	1915	30	283	18	14017	1952	25	0	0	19300	
19	2039	453	654	2001	31	296	19	14648	2040	26	0	0	20169	
20	2040	474	684	2091	33	309	20	15307	2132	27	0	0	21077	



Chapter – 3: Origin – Destination Survey

3.0 OD Surveys

Origin Destination Survey was carried out at three locations along with the traffic counts. Origin-Destination (O-D) survey plays important role in determination / estimation of anticipated traffic on a new transportation facility. This survey is carried out on sample based. Stations are setup at major key arterial locations close to the stations setup for 12 hours arterial count.

Traffic counts alone cannot give a good indication of the volumes of traffic that could potentially transfer the traffic load to the new facility. A reliable traffic model generally requires a matrix of trips (showing various origin and destination, and number of trips between each unique pair of origin and destination). This matrix is derived from surveys.

The vehicles were stopped and their drivers were interviewed by the surveyor. The questions asked include the origin and destination of their trip, vehicle type, commodity carried, route followed etc.

Origin-destination surveys have been conducted through roadside interviews on an outer cordon i.e. major entry/exit points and on locations where important activity locations are situated. The location and timing of the road side interviews were coincide with that of traffic counts to facilitate adjustment for sampling. Therefore OD surveys have been carried out at three locations for consecutive 8 days. The information, including both freight and passengers, is obtained by trained enumerators and experienced supervisors and include:

- type of vehicle,
- number of passengers in both passenger and freight vehicles
- type of commodity carried and loaded volume, truck capacity, travel time
- place and time of origin and destination
- route
- trip purpose

Separate OD Proforma prepared for passenger and freight traffic has been utilized. As per the TOR, O/D zones to include Jamrud, Landikotal, Torkham (Pakistan) and Bara as distinct and separate origins/destinations. Also, Port Qasim, Karachi Port and Gwadar have been treated as independent zones (separate from the hinterland). The cross-border zones will include Jalalabad, Kabul, rest of Afghanistan, and Central Asia as separate origins/destinations. Following table provides the list of zones prepared for the study:

11.1.21

Table 15: Zone for OD Survey Study

No	Nodes / Zones	Areas Included
1	Peshawar	All areas of Peshawar
2	Bara	Bara Area only
3	Jamrud	Jamrud and adjacent areas



No	Nodes / Zones	Areas Included
4	Landikotal	Landikotal and adjacent areas
5	Torkham (Pakistan)	Border Point of Torkham Pakistan
6	Torkham (Afghanistan)	Border Point of Torkham Afghanistan
7	Port Qasim	Only from the Port
8	Karachi Port	Only from the Port
9	Gwadar Port	Only from the Port
10	KPK	All areas of KPK & Fata except defined above
11	Punjab	All areas of Punjab
12	Sindh	All areas of Sindh except Ports
13	Balochistan	All areas of Balochistan
14	AJK	All areas of AJK
15	GB	All areas of Gilgit Baltistan
16	Islamabad	All areas of Islamabad and adjacent areas
17	Jalalabad	All areas of Jalalabad
18	Kabul	All areas of Kabul
19	Rest of Afghanistan	All areas of Afghanistan except Jalalabad and Kabul
20	Central Asia	All central Asian States and others

For analysis purpose, vehicles were also coded and the vehicle codes are provided in the following table:

11.1.22 Table 16: Vehicles Code used for OD Survey

Vehicle Type	Vehicle Code	Vehicle Type	Vehicle Code
Motor cycle/3 wheeler	1	Mini Truck	6
Car, Jeep, Taxi	2	Truck 2 Axle	7
Pickup	3	Truck Multi Axle	8
Wagon, Mini Bus	4	Tractor Trolleys	9
Bus	5	Other Vehicles	10



3.1 Analysis of OD Survey Data

The data obtained from field have been coded and entered in the computer. For the purpose of analysis O-D matrices developed for the vehicles surveyed. Data coding have been carried out according to a set of predefined codes set out in a coding. The coded data was then transfer to the data sorting model prepared in EXCEL worksheet software.

For analysis purpose, vehicles were also coded and the vehicle codes are provided in the table above. The model used for the analysis is capable of grouping trips of same origin and destination together, identifying any obvious errors (for example variable range and logical error checks) and presenting the results in the form of a trip matrix.

Along with traffic counts, origin-destination survey of passenger and goods vehicles was also carried out by interviewing vehicles on the road side consecutively for 8 days from February 10-17, 2018, for 12 hours from 6 am to 6 pm daily.

O&D data was brought to office for further processing. Data coding was carried out according to a set of predefined codes set out in a coding. Different cities were grouped together to form 20 different zones as described above and these zones were numbered from 1 to 20. Zoning of the project area was done so as to facilitate collected data processing and interpretation. The coded data was then transferred to the data sorting model prepared in EXCEL worksheet software. The model used for the analysis is capable of grouping trips of same origin and destination together, identifying any obvious errors (for example variable range and logical error checks) and presenting the results in the form of a trip matrix.

11.1.23 Interviews by Location

In all, 6,899 vehicles were interviewed of which 1260 (18.3%) were interviewed at Jamrud, 1293 (18.7%) and Landikotal and 4346 (63%) at Torkham border. Less than half the vehicles were passenger vehicles and a little more than goods vehicles.

11.1.24 Table 17 – Vehicles interviewed by location

Location	pass veh	goods veh	total	%
Jamrud	593	667	1260	18.3
Landikotl	607	686	1293	18.7
Torkham	2070	2276	4346	63.0
total	3270	3629	6899	100
percent	47.4	52.6	100	



Composition of vehicles interviewed

The largest number of interviews was of passenger cars which constituted 27.3 percent of the total and smallest number of interviews is of buses which were only 1.3 percent of total. There was no Agriculture Tractor Trolley in interviews. The proportion of other categories of vehicles is shown in the table below.

11.1.25 Table 18 – No. of vehicles interviewed by type of vehicle

veh type	Mcy*	Car#	m/bus	Bus	pup	2xl	3xl	cont	tnkr	total
Interviews	305	1883	992	90	116	377	606	1263	1267	6899
%	4.4	27.3	14.4	1.3	1.7	5.5	8.8	18.3	18.4	100.0

Coverage of O/D Survey

The coverage of Origin-Destination survey, as a proportion of traffic volume, significantly varied between locations and vehicle categories. The number of vehicles interviewed at Jamrud and Landikotal were 1.8 and 2.4 percent of traffic at these locations respectively. At Torkham, where parked vehicles were available, the coverage was quite significant, 8.7 percent of vehicles were interviewed. The low coverage at Jamrud and Landikotal is mainly due to cars and mini buses and security issues. The coverage of goods vehicles is better than passenger vehicles at all locations. The coverage of containers, tankers and articulated vehicles is 9.9 percent at Jamrud, 10.2 percent at Landikotal and 33.6 percent at Torkham. In the passenger category, coverage of cars is less than 1 percent at Jamrud and Landikotal and 3.9 percent at Torkham. For all locations combined, the overall coverage amounts to less than 4 percent of total traffic, comprising of 18.6 percent containers and articulated vehicles and 9 percent 3 axle vehicles. Further details of coverage by location and type of vehicle are given in the table below which is self explanatory.



11.1.26 Table 19 – Coverage of O/D survey by location and type of vehicle

Location	mcy	rksh	car	m/bus	bus	pup	2xl	3xl	cont	tnkr	ag/tr	total
jamrud	1471	308	35528	17488	47	4701	4790	3355	4050	195	44	71977
landiktl	445	290	31057	6813	182	5815	2800	1750	4008	367	13	53540
torkham	64	0	36390	4843	44	721	1106	1596	4880	76	1	49721
total	1980	598	102975	29144	273	11237	8696	6701	12938	638	58	175238
interviews												
jamrud	71	37	276	180	29	29	87	131	264	156	0	1260
landiktl	129	1	175	264	38	42	52	147	372	73	0	1293
torkham	62	5	1432	548	23	45	238	328	627	1038	0	4346
total	262	43	1883	992	90	116	377	606	1263	1267	0	6899
Interviews % of traffic volume												
jamrud	6.1	*	0.8	1.0	61.7	0.6	1.8	3.9	9.9	#	0	1.8
landiktl	17.7	*	0.6	3.9	20.9	0.7	1.9	8.4	10.2	#	0	2.4
torkham	104.7	*	3.9	11.3	52.3	6.2	21.5	20.6	33.6	#	0	8.7
total	11.8	*	1.8	3.4	33.0	1.0	4.3	9.0	18.6	#	0	3.9

* included in mcyles

combined with containers

The following paragraphs provide brief analysis and results of Origin Destination survey of passenger and goods traffic separately.

3.1.1 PASSENGER TRAFFIC

In all 3231 passenger vehicles were interviewed at three locations in 8 days. About two third of vehicles were interviewed at Torkham border and one third at Jamrud and Landikotal together. The daily interviews of passenger vehicles varied between 40 and 115 at Jamrud and Landikotal and between 146 and 365 at Torkham. Interviews were lowest on Sunday at Jamrud and Friday at Torkham. On average there were 6 interviews an hour at Jamrud and Landikotal and more than 21 at Torkham out of traffic volume of 550 passenger vehicles at Jamrud and 400 and Landikotal and Torkham. Details are shown in the table below.



11.1.27 Table 20 – Vehicles Interviewed by location and date

Date	Day	Jamrud	Landikotl	Torkham	Total	%
10	Sat	42	44	290	376	11.6
11	Sun	40	70	337	447	13.8
12	Mon	42	60	365	467	14.5
13	Tue	79	76	205	360	11.1
14	Wed	100	75	350	525	16.2
15	Thu	99	80	156	335	10.4
16	Fri	87	98	146	331	10.2
17	Sat	83	115	192	390	12.1
total		572	618	2041	3231	100.0
%		17.7	19.1	63.2	100.0	

11.1.27.1 Vehicle Composition

Proportionately and absolutely the largest number of vehicles interviewed were cars and wagons which constituted 57 and 25 percent of all interviews. Of the remaining 13 percent, 8 percent were motor cycles, 4.4 percent buses, 2.8 percent mini-buses and 1.6 and 1.3 percent LCVs and rickshaws respectively. Although the number of buses and their proportion in all interviews is small, their proportion in their own category is the highest.

11.1.28 Table 21 – Vehicles interviewed by location and type

Code	vey type	Jamrud	Landikotal	Torkham	Total	%
1	Mcycle	71	129	62	262	8.1
2	Ricksh	37	1	5	43	1.3
3	Car	229	172	1428	1829	56.6
4	LCV	47	3	3	53	1.6
5	Wagon	122	188	501	811	25.1
6	M.Bus	29	38	23	90	2.8
7	Bus	37	87	17	141	4.4
Total		572	618	2039	3229	100.0



%	17.7	19.1	63.1	100.0
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Trip purpose

Analysis of trip purpose by type of place of origin and destination indicated that nearly half the trips at Jamrud were to and from home and work, more than 26 percent for business and about 12 percent for shopping. At Landikotal the pattern was spread evenly. There 28 percent trips were to and from home and work, 13 percent home-business 19 percent home-shopping and 16 percent were to/from work and shopping. At Torkham 36 percent trips were to/from home and work, 15 percent home-business and 12 percent for shopping. Further details are contained in the table below.

11.1.29 Table 22 - Trips by purpose/place of origin/destination

place from	home	work	busns	shop	recre	other	all
Jamrud							
Home	7	156	118	52	6	20	359
Work	125	6	3	1	1	5	141
Busns	33	1	0	0	0	0	34
Shop	15	1	0	0	0	1	17
Recre	4	0	0	0	0	0	4
Other	11	1	0	1	0	3	16
Total	195	165	121	54	7	29	571
Landikotal							
Home	2	103	22	61	0	1	189
Work	70	14	29	19	0	0	132
Busns	58	34	1	13	0	0	106
Shop	57	79	29	4	0	4	173
Recre	5	5	3	0	0	0	13
Other	3	1	0	1	0	0	5
Total	195	236	84	98	0	5	618
Torkham							
Home	112	363	129	110	65	31	810
Work	377	27	13	6	4	13	440
Busns	176	10	12	5	0	4	207
Shop	124	27	11	0	0	3	165



Table 22 - Trips by purpose/place of origin/destination

place from	home	work	busns	shop	recre	other	all
Recre	92	3	0	0	0	1	96
Other	212	41	18	16	7	29	323
Total	1093	471	183	137	76	81	2041

11.1.30 Passenger Load

Average passenger load is an important statistic as it is used for estimating value of time in cost benefit analysis. Calculations of survey data indicate average passenger load of motor cycle 1.8, rickshaw 3.5, car/taxi/jeep 3.7, LCV 4.0, wagon 11.5, minibus 15 and large bus 20. Average passenger load of LCV is 5 times higher than at Jamrud and Torkham. However, this has not affected overall average much due to its smaller weight. Average load of micro buses and buses is significantly higher at Jamrud as compared to Landikotal and Torkham. Motor cycles, cars and wagons have similar load at all locations. Details may be seen in the table below.

11.1.31 Table 23 – Average Passenger Load

	Jamrud	Landiktl	Torkhm	All
M/cycle	1.7	1.9	1.6	1.8
Ricksha	3.6	1.0	3.6	3.5
Car	3.7	4.6	3.5	3.7
LCV	3.2	16.3	3.3	4.0
Wagon	11.1	12.5	11.2	11.5
M.Bus	22.6	10.7	12.3	15.0
Bus	29.2	16.1	19.1	19.9

Origin destinations

As survey sites are located on the extreme north west of the country close to Pak-Afghan border, traffic to/from other parts of the country and frontier areas in the north west and Afghanistan was likely to be intercepted. Vehicles to/from all zones were intercepted with one exception, Central Asian States. Besides, no vehicle from AJK and Gilgit and Baltistan was intercepted at Jamrud, although there were many at Landikotal and Torkham. About 11 percent of vehicles at Jamrud, 14 percent at Landikotal and more than 20 percent at Torkham were with these zones. The main origin and



destinations at Jamrud were Peshawar, Landikotal, Torkham and Bara which accounted for 88 percent of origins and



more than 90 percent destinations. At Landikotal, the main origin-destinations were Jalalabad, Torkham(Afghanistan), Torkham (Pakistan), Karachi and Qasim ports. At Torkham, origin and destinations are more widely spread, main ones being Torkham (Afghanistan), Landikotal, Peshawar, Jalalabad, Jamrud, Karachi and Qasim ports. The summary of origin/destinations at the three locations is given in the table below. Detailed origin-destination tables are given in the appendix.

11.1.32 Table 24 – Summary of Origin/Destinations

zone	No. of vehicles						percent of total					
	Jamrud		landikotal		Torkham		Jamrud		landikotal		Torkham	
	orig	dest	orig	dest	orig	dest	orig	dest	orig	dest	orig	dest
1 pesh	169	218	32	59	138	199	29.5	38.1	5.2	9.5	6.8	9.8
2 bara	49	15	14	15	149	122	8.6	2.6	2.3	2.4	7.3	6.0
3 jmrld	46	78	52	54	109	115	8.0	13.6	8.4	8.7	5.3	5.6
4 lndklt	109	98	73	96	196	199	19.1	17.1	11.8	15.5	9.6	9.8
5 trkmp	75	94	56	50	451	397	13.1	16.4	9.1	8.1	22.1	19.5
6 trkmaf	54	22	68	45	245	183	9.4	3.8	11.0	7.3	12.0	9.0
7 pqa	3	0	52	34	54	95	0.5	0.0	8.4	5.5	2.6	4.7
8 kpt	5	4	40	28	73	143	0.9	0.7	6.5	4.5	3.6	7.0
9 gwd	3	0	12	6	52	91	0.5	0.0	1.9	1.0	2.5	4.5
10 kpk	11	5	15	38	32	24	1.9	0.9	2.4	6.1	1.6	1.2
11 pnjb	15	22	0	1	30	32	2.6	3.8	0.0	0.2	1.5	1.6
12 sind	1	2	14	14	54	56	0.2	0.3	2.3	2.3	2.6	2.7
13 bal	1	0	13	11	37	30	0.2	0.0	2.1	1.8	1.8	1.5
14 ajk	0	0	21	16	30	26	0.0	0.0	3.4	2.6	1.5	1.3
15 gb	0	0	21	16	35	24	0.0	0.0	3.4	2.6	1.7	1.2
16 isbd	17	11	1	1	42	82	3.0	1.9	0.2	0.2	2.1	4.0
17 jlabd	11	1	70	33	134	67	1.9	0.2	11.3	5.3	6.6	3.3
18 kabul	3	1	59	69	144	98	0.5	0.2	9.5	11.2	7.1	4.8
19 afgh	0	1	5	32	36	58	0.0	0.2	0.8	5.2	1.8	2.8
20 casia	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	572	572	618	618	2041	2041	100.0	100.0	100.0	100.0	100.0	100.0



3.1.2 GOODS TRAFFIC

The number of goods vehicles interviewed were more than passenger vehicles, although. The proportion of goods vehicles interviewed is far higher than passenger traffic. In all 3636 goods vehicles were interviewed at three locations in 8 days. Of these, about 63 percent were interviewed at Torkham and 18 and 19 percent at Jamrud and Torkham respectively. Average daily interviews worked out to 84, 86 and 284 at Jamrud, Landikotal and Torkham respectively. Unlike passenger traffic, variations by days of the week are prominent in goods traffic. Interviews on two Saturdays on 10th and 17th February were lowest. Friday and Thursday were also low. Numbers on Sunday to Wednesday were high. Details are shown in the table below.

11.1.33 Table 25 – No. of Goods Vehicles Interviewed

Date	Day	Jamrud	Landikotal	Torkham	Total
10	Sat	77	55	129	261
11	Sun	83	100	446	629
12	Mon	85	111	442	638
13	Tue	88	34	359	481
14	Wed	85	85	423	593
15	Thu	108	93	159	360
16	Fri	76	96	170	342
17	Sat	69	116	147	332
total		671	690	2275	3636

Composition

Heavy goods vehicles including containers and articulated vehicles dominated the composition and constituted 70 percent of total – 35 percent each. Of the remaining 30 percent, 17 percent are three axle vehicles, 10 percent two axle vehicles and 3 percent pickup and small trucks. Details are shown in the table below.



11.1.34 Table 26 – Composition of Goods Vehicles Interviewed

location	Pickup small trk	2 axle truck	3axle truck	articulated	container	Total
Jamrud	29	89	131	156	266	671
landiktl	42	52	147	73	372	686
torkham	45	238	328	1038	627	2276
Total	116	379	606	1267	1265	3633
Percent of total						
Jamrud	4.3	13.0	19.6	23.4	39.6	100.0
landiktl	6.1	7.6	21.4	10.6	54.2	100.0
torkham	2.0	10.5	14.4	45.6	27.5	100.0
Total	3.2	10.4	16.7	34.9	34.8	100.0

Load condition

Fully loaded vehicles varied from 53 percent at Landikotal to 62 percent at Jamrud and 76 percent at Torkham. Empty vehicles were 18 and 19 percent at Jamrud and Torkham and

7 percent at Landikotal where partly loaded vehicles were highest at 40 percent as compared to about 20 percent at Jamrud and less than 6 percent at Torkham. On the average 69 percent vehicles were fully loaded, 15 percent partly loaded and 16 percent empty.

11.1.35 Table 27 – Load Condition

	Jamrud		Landikotal		Torkham		Total	
	Nos	%	Nos	%	No	%	Nos	%
fully loaded	417	62.1	365	52.9	1720	75.6	2502	68.8
partly loaded	131	19.5	276	40.0	130	5.7	537	14.8
empty	123	18.3	49	7.1	425	18.7	597	16.4
All	671	100.0	690	100	2275	100	3636	

Commodities carried



The largest number of vehicles was found carrying Agriculture, food, forest and live stock products. There proportion was 50 percent at Jamrud, 36 percent at Landikotal and 29 percent at Torkham. The other major groups were Basic Manufactures, Bulk Manufactures



Jamrud and Landikotal. Besides, raw materials were also significant at Torkham. Summary of Commodities carried by major group is given in the table below.

11.1.36 Table 28 – Summary of Commodities carried by major groups

Commodity group	Code	Jamrud	Landikotal	Torkham	All
Agr. Food, forest, l/stock	100	271	235	630	1136
Raw materials	200	2	19	245	266
Bulk manufactures	300	73	75	231	379
Basic manufactures	400	88	136	204	428
Misc. Manufactures	500	15	39	508	562
Mining & Quarrying	600	39	15	131	185
Fuel and Lubricants	700	56	124	214	394
Miscellaneous	800	0	0	2	2
n.e.c.	900	3	3	2	8
Total	900	547	646	2167	3360
percent distribution					
Agr. Food, forest, l/stock	100	49.5	36.4	29.1	33.8
Raw materials	200	0.4	2.9	11.3	7.9
Bulk manufactures	300	13.3	11.6	10.7	11.3
Basic manufactures	400	16.1	21.1	9.4	12.7
Misc. Manufactures	500	2.7	6.0	23.4	16.7
Mining & Quarrying	600	7.1	2.3	6.0	5.5
Fuel and Lubricants	700	10.2	19.2	9.9	11.7
Miscellaneous	800	0.0	0.0	0.1	0.1
n.e.c.	900	0.5	0.5	0.1	0.2
Total		100.0	100.0	100.0	100.0

Origin Destinations

Vehicles from all over the country were intercepted at the three survey locations without exception. However, there was no vehicle from AJK at Jamrud, although there were many at Landikotal and Torkham. One vehicle was also intercepted at Torkham for Central Asian States. Peshawar zone accounted for the largest number of origin and destinations. It was



followed by Landikotal, Torkham, Kabul and Jalalabad on the border side. Karachi and Qasim ports, Punjab and Islamabad are important destinations upcountry. They account for 65 to 70 percent of origin and destinations. Trips within the survey zone were 4-5 percent at Jamrud, 13-14 percent at Landikota and 12 percent at Torkham. Summary of origin destinations is given in the table below. Detailed origin destination tables are given in the Appendix.

11.1.37 Table 29 - Summary of Origin Destinations

zone	code	Jamrud		Landikotal		Torkham		All	
		orig	dest	orig	dest	orig	dest	orig	dest
peshawar	1	107	152	54	57	211	259	372	468
bara	2	29	18	31	22	128	91	188	131
jamrud	3	26	35	43	38	96	73	165	146
landiktl	4	67	36	91	97	148	169	306	302
torkhm-p	5	42	35	72	56	282	264	396	355
torkhm-af	6	62	65	65	59	197	256	324	380
pqa	7	2	1	38	35	81	78	121	114
kpt	8	57	54	53	43	194	216	304	313
gwadar	9	5	0	20	24	99	70	124	94
kpk	10	13	17	21	23	4	12	38	52
punjab	11	87	53	3	5	64	53	154	111
sind	12	8	1	26	33	84	96	118	130
baloch	13	1	1	15	16	61	39	77	56
ajk	14	1	0	15	17	36	41	52	58
gb	15	0	0	12	12	67	36	79	48
islamabad	16	26	0	8	7	43	38	77	45
jalalabad	17	53	59	49	53	221	240	323	352
kabul	18	68	90	66	79	196	221	330	390
afghnstn	19	17	54	8	14	62	22	87	90
centasia	20	0	0	0	0	0	1	0	1
total		671	671	690	690	2274	2275	3635	3636
		Percent of total							



Table 29 - Summary of Origin Destinations

zone	code	Jamrud		Landikotal		Torkham		All	
		orig	dest	orig	dest	orig	dest	orig	dest
peshawar	1	15.9	22.7	7.8	8.3	9.3	11.4	10.2	12.9
bara	2	4.3	2.7	4.5	3.2	5.6	4.0	5.2	3.6
jamrud	3	3.9	5.2	6.2	5.5	4.2	3.2	4.5	4.0
landiktl	4	10.0	5.4	13.2	14.1	6.5	7.4	8.4	8.3
torkhm-p	5	6.3	5.2	10.4	8.1	12.4	11.6	10.9	9.8
torkhm-af	6	9.2	9.7	9.4	8.6	8.7	11.3	8.9	10.5
pqa	7	0.3	0.1	5.5	5.1	3.6	3.4	3.3	3.1
kpt	8	8.5	8.0	7.7	6.2	8.5	9.5	8.4	8.6
gwadar	9	0.7	0.0	2.9	3.5	4.4	3.1	3.4	2.6
kpk	10	1.9	2.5	3.0	3.3	0.2	0.5	1.0	1.4
punjab	11	13.0	7.9	0.4	0.7	2.8	2.3	4.2	3.1
sind	12	1.2	0.1	3.8	4.8	3.7	4.2	3.2	3.6
baloch	13	0.1	0.1	2.2	2.3	2.7	1.7	2.1	1.5
ajk	14	0.1	0.0	2.2	2.5	1.6	1.8	1.4	1.6
gb	15	0.0	0.0	1.7	1.7	2.9	1.6	2.2	1.3
islamabad	16	3.9	0.0	1.2	1.0	1.9	1.7	2.1	1.2
jalalabad	17	7.9	8.8	7.1	7.7	9.7	10.5	8.9	9.7
kabul	18	10.1	13.4	9.6	11.4	8.6	9.7	9.1	10.7
afghnstn	19	2.5	8.0	1.2	2.0	2.7	1.0	2.4	2.5
centasia	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total		100	100	100	100	100	100	100	100



3.1.3 Passengers Surveys

A survey of bus passengers was carried out at Torkham Border, continuously for 8 days, Feb. 10-17, 2018. Arriving and leaving passengers at the bus terminal were interviewed. Questions were asked about occupation, income level, place of origin/destination, trip purpose/type of place at origin or destination, fare paid etc.

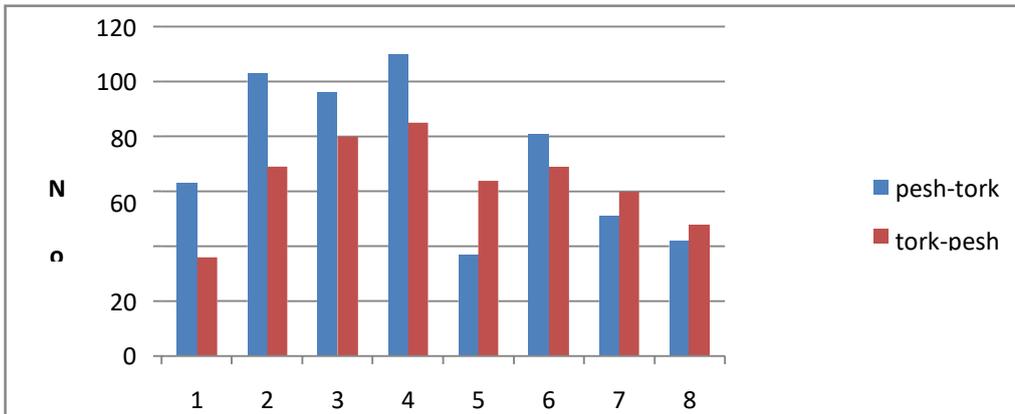
In all 1094 passengers were interviewed. 583 (53%) were arriving passengers (Peshawar- Torkham direction) and 511 were leaving passenger (Torkham-Peshawar direction). Daily number of interviews varied between 90 and 195. Interviews on both starting and ending Saturdays were the lowest with 90 and 99 interviews. Tuesday recorded highest number of interviews of 195. Details are shown in the following table and accompanying chart.

11.1.38 Table 30 - No. of Passengers Interviewed

Day	Date: Feb.2018	Peshawar-Torkham	Torkham-Peshawar	Total
Saturday	10	63	36	99
Sunday	11	103	69	172
Monday	12	96	80	176
Tuesday	13	110	85	195
Wednesday	14	37	64	- P101
Thursdy	15	81	69	150
Friday	16	51	60	111
Saturday	17	42	48	90
Total	583	511	1094	
Percent	53	47	100	



Chart 5 – Passengers Interviewed



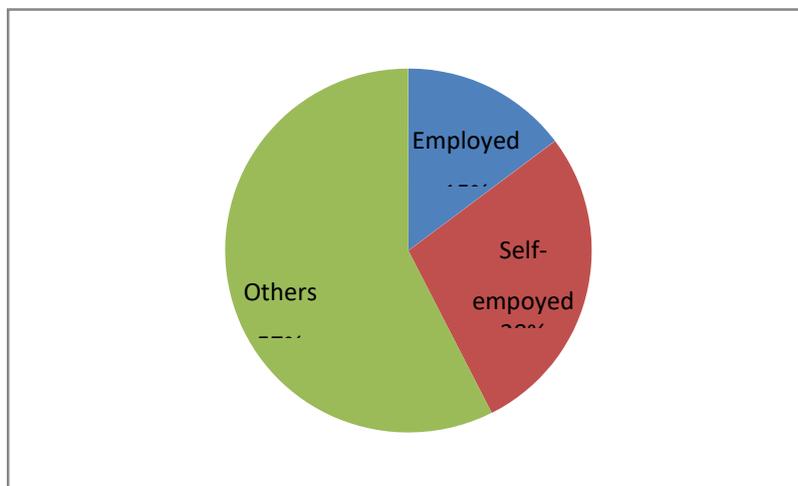
Most of the passengers were male. There were only 28 females and 2 others who were interviewed only one day on 13th February on Torkham-Peshawar direction. They constitute less than 3 percent of the total (separate data not shown).

Occupation classified people into three categories, namely, employed, self-employed/ business and all others. Less than 15 percent of passengers were employed, about 28 percent of self-employed and remaining 57 percent were in others category.

11.1.39 Table 31 - Distribution of Passengers by Occupation

Description	Employed	Self-employed/ Business	Others	Total
No. of Passengers	161	304	629	1094
percent	14.7	27.8	57.5	100.0

Chart 6 – Passenger occupations







11.1.40 Mode of Travel

Transport mode to/from terminal was recorded for origins and destinations of each passenger interviewed and also information on fare/cost of travel was obtained. The largest proportion of passengers traveled by taxis/rickshaw, which accounted for 59 and 47 percent passengers on origin and destination sides respectively. Private transport followed with more than a quarter passengers on both origin and destination sides. Walk/cycle were far and few and accounted for 4 percent of passengers only.

11.1.41 Table 32 - Mode of travel to terminal

Code	mode	No. of pass		Percent	
		Origin	destination	Origin	Destination
1	Bus	120	215	11.0	19.7
2	taxi/ricksh	647	514	59.1	47.0
3	Private transport	278	301	25.4	27.5
4	walk/cy	46	40	4.2	3.7
5	Other	3	22	0.3	2.0
	Total	1094	1092	100	100

Cost of travel to terminal

All passengers interviewed did not report fare or cost. A total of 789 (72%) passengers reported fares at place of origin and 746 (68%) at place of destination. Fares varied mostly from a minimum of Rs. 10 to Rs. 1000 at origin and Rs. 40 to Rs.1000, except for 2 odd values of Rs. 1500 and Rs. 3000 at origin and 5 odd values of more than Rs. 4000, 4 values of Rs. 2000 at destination. At origin, average bus and taxi fare was Rs. 218 and Rs. 268 respectively. Private transport showed highest average cost Rs. 525. On the destination side, average bus fare and cost of private transport was similar (Rs.202 and Rs. 213 respectively). Taxi fare was highest at Rs.

345. This is due to odd observations indicated above. If extreme values are excluded, average cost will come down to less than Rs. 300.



11.1.42 Table 33 - Fare/cost of travel to terminal by mode (Amount in Rs.)

Code	Mode	Passengers	Amount	Minimum	Maximum	Average
Origins						
1	Bus	119	25940	10	1000	218
2	Taxi/ricksha	646	172860	20	1500	268
3	Private trnspt	19	9980	50	3000	525
4	Walk/cycle	2	800	300	500	400
5	Other	3	850	200	350	283
Total		789	210430	10	3000	267
Destination						
1	Bus	77	15530	50	500	202
2	Taxi	521	179600	40	7000	345
3	Private	116	24740	40	1000	213
4	Walk/cyc	29	5240	40	500	181
5	Other	3	590	110	280	197
Total		746	225700	40	7000	302

Income Level

Determining income of individuals in a road side interview is extremely difficult. Eventax authorities find it difficult to get right information. There are several reasons for that. Normally, people don't want to disclose their income to unknown people. Besides, people in an informal and undocumented economy do not keep account and cannot indicate their right income level. At times, people exaggerate and suppress their income. Even many employed persons who get bonus and commission may also not know their income. Farmers and others who receive their reward in kind may not have an idea of their income level in monetary terms. Besides, incomes fluctuate and there are uncertainties about yield and price of agriculture produce where more than half of our population is engaged. These limitations should be kept in view while considering information on income level described in the following paragraphs.



In our survey of bus passengers, five levels of income were identified with minimum of Rs.3000 and maximum above 50,000 per month. Nearly half the passengers (47.2%) reported 10-20 thousand income, about 28 percent reported 3-10 thousand



and 13 percent reported 20-50. Only 2 percent passengers reported less than 3000 while 10 percent reported more than 50,000.

11.1.43 Table 34 - Distribution of Passengers by Income Level

SNo.	Income Rs/month	Passengers	Percent
1	Upto 3,000	23	2.1
2	3,000-10,000	303	27.7
3	10,000-20,000	516	47.2
4	20,000-50,000	141	12.9
5	> 50,000	111	10.1
	Total	1094	100

Relationship between income level and mode of travel has been examined by distribution according to mode of travel and income level. Surprisingly, average income of all modes is similar, more than Rs. 9,000 per month except for passengers of private transport whose income is below Rs.8,000 per month. There appears to be no relationship between income and mode of travel. Maximum number of passengers of all modes is in Rs. 10,000-20,000 range. Percentage distribution of passengers of different income levels is not dissimilar.



11.1.44 Table 35 - Distribution of Passengers by Income Level & Mode

Code	Mode	Income Level, 000 Rs						Rupees
		uptp3	3-10	10-20	20-50	>50	Total	Average
1	Bus	6	27	58	20	9	120	9246
2	Taxi	11	184	330	58	64	647	9668
3	Private	5	76	107	59	31	278	7916
4	Walk/cyc	1	16	19	4	6	46	9341
5	Other	0	0	2	0	1	3	22500
	Total	23	303	516	141	111	1094	9068
		percent						
1	Bus	5.0	22.5	48.3	16.7	7.5	11.0	
2	Taxi	1.7	28.4	51.0	9.0	9.9	59.1	
3	Private	1.8	27.3	38.5	21.2	11.2	25.4	
4	Walk/cyc	2.2	34.8	41.3	8.7	13.0	4.2	
5	Other	0.0	0.0	66.7	0.0	33.3	0.3	

Trip Purpose/location type

Every trip has an origin, a destination and purpose. Place of origin and destination are geographical locations with functional characteristics, such as home, work, business, business, market (shopping) or social visit to another home. Our survey classified trip origin and destinations into 7 categories, namely, home, work, business, education, shopping, social visit and residual category.

Trips among the above referred categories are given in matrix in the table that follows. It would be seen that more than 70 percent trips originate from, 19 percent from work and 6 percent from business. They account for 95 percent of origins. Trip origins for education, shopping, social visits are insignificant, less than 1 percent each.

On the reverse side, home is destination of 41 percent trips, business 31 percent, work 6 percent, education 3 percent and shopping about 2 percent. They account for about 83 percent of total trip destinations. The remaining 17 percent are in the residual category of others.



Normally, trips in two directions should balance ultimately. For example trips from home to work, business, shopping etc. should tally with trips from work, business and shopping to home. Similarly, trips origins and destinations among all purposes should balance. Minor differences due to sampling or time lag do not matter. The trip matrix below indicates significant differences in trip origin and destinations in every form of location. For example, 793 (73%) trips originate from home to other places (row total) whereas only 445 (43%) return from other places to home (column total). Between locations, there are 304 trips from home to work, but 124 from work to home; 41 trips from home to business and 28 from business to home; 26 trips from home to education but only 6 trips from education to home. The difference may be due to inadequate coverage and small size of sample. Nevertheless, the data gives broad indication of pattern of trip origin and destination.

It may also be noted that 277(>25%) trips are from home to home, 28(2.5%) are work to work and 7(<1%) are from business to business.

11.1.45 Table 36 - Origin-Destinations by purpose and location type

Origins	Destinations									
	home	work	busns	eductn	Shop	recreatn	visit	other	total	%
1. Home	277	304	41	26	12	1	7	125	793	72.6
2. Work	124	28	13	7	3	0	1	33	209	19.1
3. Business	28	5	7	0	1	0	0	24	65	5.9
4. Education	6	3	0	0	0	0	0	4	13	1.2
5. Shopping	1	0	0	0	0	1	0	0	2	0.2
6. Recreation	0	0	0	0	0	0	0	0	0	0.0
7. Social Visit	1	2	0	0	0	0	0	0	3	0.3
8. Other	8	0	0	0	0	0	0	0	8	0.7
Total	445	342	61	33	16	2	8	186	1093	100
percent	40.7	31.3	5.6	3.0	1.5	0.2	0.7	17.0	100	



Chapter – 4: Travel Time Survey

4.0 TRAVEL TIME SURVEYS

In conjunction with the classified traffic counts, we have carried out the travel time surveys in both directions during peak and off-peak hours, using appropriate survey methods, for a set of representative vehicles.

Travel time study determines the amount of time required to travel from one point to another point on a given route. The purpose of a Travel Time and Delay Study is to evaluate the quality of traffic movement along a route and determine the locations, types, and extent of traffic delays. The obtained data gives a good indication of the level of service on the study section. The data also aid traffic engineers to identify problem locations which may require special attention in order to improve the overall flow of traffic on the route. The obtained data can be used in any one of the following traffic engineering tasks:

1. Determination of the efficiency of a route with respect to its ability to carry traffic.
2. Identification of locations with high delays and the cause of those delays.
3. Performance of before and after studies to evaluate the effectiveness of traffic operation improvements.
4. Determination of relative efficiency of a route by developing sufficiency ratings or congestion indices.
5. Determination of travel times on specific links for use in trip assignment models.
6. Performance of economic studies in the evaluation of traffic operation alternatives that reduce travel time.

Test vehicle, vehicle observation, and probe vehicle are among the most common methods to conduct a Travel Time and Delay Study. The selection of the study method depends on the purpose of the study, roadway characteristics, and length of segment, study period of interest, personnel, equipment and resources available.

To conduct a Travel Time and Delay Study, study area is defined by selecting all control points before beginning the study. The time periods recommended for studies are A.M. and P.M. peak hours as well as off peak hours in the direction of heaviest traffic movements.

These studies have been made during reasonably good weather so that unusual conditions do not influence the study. Also, since crashes or other unusual delays have produced erroneous results, any runs made during such an occurrence should be terminated and another run conducted. These studies have been conducted during average or typical weekday traffic conditions.

4.1 Study through Test Vehicle



When conducting a Travel Time and Delay Study using the test vehicle method, there are following techniques that can be used:



1. Average-Car Technique: The speed of travel is determined by the driver’s judgment of the average speed of the traffic stream.
2. Maximum-Car Technique: the speed of travel is the posted speed limit unless impeded by safety considerations or actual traffic conditions.
3. Car Chasing Technique: This method only requires a test car with a driver and an observer to observe travel time for the study location. For this method, the test car will be driven at another driver-desired speed. In order to get representative journey time data, the driver will have to drive at the speed of a randomly chosen car in front.
4. Floating-Car Technique: In this method the driver tries to float in the traffic stream passing as many vehicles as pass the test car. If the test vehicle overtakes as many vehicles as the test vehicle is passed by, the test vehicles should, with sufficient number of runs, approach the median speed of the traffic movement on the route. In such a test vehicle, one passenger acts as observer while another records duration of delays and the actual elapsed time of passing control points along the route from start to finish of the run. The idea is to emulate an average driver for each section of roadway.
5. Moving-Car Technique: In this method observer makes a round trip on a test section starting from section (X-X) to (Y-Y) (East direction) then returns back from (Y-Y) to (X-X) West direction.

The observer records during the round trip the following:

- i. The time it takes to travel from (X-X) to (Y-Y) East in minutes (T_e).
- ii. The time it takes to travel from (Y-Y) to (X-X) West in minutes (T_w)
- iii. The number of vehicles travelling in the opposite direction while the test vehicle is travelling from (X-X) to (Y-Y) east (N_e)
- iv. The number of vehicles that over take the test car while it is travelling from (Y-Y) to (X-X) West (O_w)
- v. The number of vehicles that the test car passes while it is travelling from (Y-Y) to (X-X) West (P_w)

The volume in the (Y-Y) to (X-X) Westbound direction (V_w) & volume in the (X-X) to (Y-Y) Eastbound direction can be obtained by:

$$V_{ww} = \frac{(N_e + O_{ww} + P_{ww}) \times 6666}{T_e + T_{ww}} \qquad V_e = \frac{(N_{ww} + O_e + P_e) \times 6666}{T_e + T_{ww}}$$

The average travel time in the west direction & east direction can be obtained by:

$$T_{ww} = \frac{6666 \times (O_{ww} - P_{ww})}{V_{ww}} \qquad T_e = \frac{6666 \times (O_e - P_e)}{V_e}$$

4.2 Study through Vehicle Observation

There are following techniques that can be used to study Travel Time & Delay from vehicle observation:

1. License Plate Method
2. Interview Method



3. Cellular Telephone Observation Method



4.3 Study through Probe Vehicle

There are following techniques that can be used to study Travel Time & Delay from probe vehicle:

1. Signpost-based Transponders
2. Automatic Vehicle Identification (AVI) Transponders
3. Ground-based Radio Navigation
4. Cellular Telephone or GPS receivers

4.4 Methodology Adopted

Due to the ease and requirement of single observer we have selected the "Car Chasing Technique" to carry out the travel time and delay study on existing Peshawar – Torkham Highway (N-5).

The observer has fixed/located the start and end points on N-5 before conducting the study. Two stop watches were utilized to observe total travel time and delay time for the preceding vehicle. This study has been done in both directions because at two locations i.e., Ali Masjid and Torkham the existing highway splits into two ways/directions and directional traffic moves at different grades/levels. Further, to observe the travel time in peak and off peak hours separate trips is made. Data sheet to conduct the travel time and delay study is attached as Annexure.

Using the difference in minimum and maximum running speeds (\bar{R}) and the desired permitted error (ϵ), the number of sample runs can be calculated. A sample size has to be determined for each direction of travel and for each set of traffic and/or environmental conditions of interest. Following table shows the suggested ranges of acceptable error:

11.1.45.1 *Table 37: Suggested Ranges of Permitted Errors in the Estimate of the Mean Travel Speed Related to Study Purpose*

Study Purpose	Permitted Errors (ϵ)
Transportation planning and highway needs studies	± 3.0 to ± 5.0 mph
Traffic operation, trend analysis and economic evaluations	± 2.0 to ± 4.0 mph
Before-and-after studies *	± 1.0 to ± 3.0 mph

Source: ITE Manual of Transportation Engineering Studies, 2nd Edition, Exhibit 9-1.

* ± 3.0 mph for studies predominately involving efficiency, ± 2.0 mph for studies predominately concerned with safety

Following Table can be used to estimate the sample runs:



Table 38: Approximate Minimum Sample Size Requirements for Travel Time and Delay Studies

R̄ (mph)	Minimum Sample Size n for Specified Permitted Error ε									
	Confidence level: 99.73%					Confidence level: 95%				
	1 mph	2 mph	3 mph	4 mph	5 mph	1 mph	2 mph	3 mph	4 mph	5 mph
1	6	5	4	4	4	4	3	3	3	3
2	9	6	5	5	4	6	4	3	3	3
3	13	8	6	5	5	8	5	4	4	3
4	17	9	7	6	6	10	6	5	4	4
5	21	11	8	7	6	12	7	5	4	4
6	26	13	9	8	7	15	8	6	5	4
7	32	15	10	8	7	18	9	6	5	5
8	37	17	12	9	8	21	10	7	6	5
9	43	19	13	10	9	24	11	8	6	5
10	50	21	14	11	9	27	12	8	7	6
11	57	24	15	12	10	31	13	9	7	6
12	64	26	17	13	11	34	15	10	8	6
13	72	29	18	14	11	38	16	11	8	7
14	80	32	20	15	12	43	18	11	9	7
15	89	34	21	16	13	47	19	12	9	8
20	-	50	30	21	17	71	27	17	12	10
25	-	68	39	27	21	99	36	22	15	12
30	-	89	50	34	26	-	47	27	19	15

Source: ITE Manual of Transportation Engineering Studies, 2nd Edition, Exhibit 9-1

The approximate minimum sample size can be selected from above Table for the calculated difference in minimum and maximum running speeds and the desired permitted error.

Minimum and Maximum speeds can be obtained from spot speed study for each direction of travel and for each set of traffic condition (i.e., Peak/Off Peak). By using the calculated difference in minimum and maximum running speeds in mph, confidence level of 95% and 4.0 mph permitted value of error number of sample runs shall be obtained before conducting the travel time and delay study. Travel time summary is as follows:



11.1.47 Table 39: Summary of Travel Time

TRAVEL TIME SUMMARY TABLE							
Sr. No.	Type of Vehicle	Direction	Total Time	Distance Travel	Total Delay	Actual Time	Average Speed
			(00:00:00)	(km)	(00:00:00)	(00:00:00)	(km/hr)
1	Car	Peshawar - Torkham	00:54:48	40.00	-	00:54:48	43.80
2	Car	Torkham - Peshawar	01:01:38	40.00	00:02:50	00:58:48	41.17
3	Car	Peshawar - Torkham	00:58:55	40.00	00:00:45	00:58:10	41.26
4	Car	Torkham - Peshawar	00:50:58	40.00	00:00:42	00:50:16	47.75
5	Wagon	Torkham - Peshawar	01:09:55	40.00	00:06:58	01:02:57	38.13
6	Wagon	Peshawar - Torkham	01:07:07	40.00	00:04:50	01:02:17	38.53
7	Wagon	Torkham - Peshawar	01:05:01	40.00	00:02:55	01:02:06	38.65
8	Wagon	Peshawar - Torkham	00:55:40	40.00	00:01:09	00:54:31	44.02
9	Truck	Torkham - Peshawar	02:43:35	40.00	00:24:24	02:19:11	17.24
10	Truck	Torkham - Peshawar	02:46:20	40.00	00:22:10	02:24:10	16.65
11	Truck	Peshawar - Torkham	02:19:40	40.00	00:20:25	01:59:15	20.13
12	Trailer	Peshawar - Torkham	02:15:00	40.00	00:14:20	02:00:40	19.89
13	Trailer	Torkham - Peshawar	01:53:50	40.00	00:10:07	01:43:43	23.14
14	Trailer	Torkham - Peshawar	02:23:46	40.00	00:04:37	02:19:09	17.25
15	Trailer	Torkham - Peshawar	02:20:15	40.00	00:05:25	02:14:50	17.80
16	Trailer	Peshawar - Torkham	02:27:00	40.00	00:24:19	02:02:41	19.56



Chapter – 5: Spot Speed Survey

5.0 SPOT SPEED SURVEYS

The travel time surveys are supplemented by spot speed measurements at critical locations. The free speed is observed and impact of the prevailing traffic on running speed during peak and off-peak hours are established for homogeneous road sections to indicate the level of congestion. These surveys are established for trip duration, average vehicle speed and extent of congestion on key sections during peak and off-peak periods.

Speed is an important transportation consideration because it relates to safety, time, comfort, convenience, and economics. Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location. The data gathered in spot speed studies are used to determine vehicle speed percentiles, which are useful in making many speed-related decisions. Spot speed data have a number of safety applications, including the following (Robertson 1994):

1. Determining existing traffic operations and evaluation of traffic control devices.
2. Establishing roadway design elements.
3. Assessing roadway safety questions.
4. Monitoring traffic speed trends by systematic ongoing speed studies.
5. Measuring effectiveness of traffic control devices or traffic programs, including signs and markings, traffic operational changes, and speed enforcement programs.

For a spot speed study at a selected location, a sample size of at least 50 and preferably 100 vehicles is usually obtained (Ewing 1999). Data for the weekly speed should not be collected on Mondays and Fridays because of potential differences in traffic patterns on those days (unless, of course, an agency wants to conduct a spot speed study during a special event or other activity occurring on either Monday or Friday).

Peak period may show exceptionally high volumes and are not normally used in the analysis; therefore, counts are usually conducted on a Tuesday, Wednesday, and Thursday.

Spot speed data can be gathered using one of three methods:

1. Stopwatch method;
2. Radar meter method; or
3. Pneumatic road tube method

The stopwatch method can be used to successfully complete a spot speed study using a small sample size taken over a relatively short period of time. Hence, stopwatch method is adopted to complete a spot speed study at three different locations of Peshawar-Torkham Existing Alignment (N-5). The stopwatch method is the least expensive of the methods. But accuracy can be achieved through



vigilance/care and large sample size. A stopwatch spot speed study includes five keystone steps:

1. Appropriate study length
2. Selection of proper location and layout
3. Record observations on stopwatch spot speed study data form
4. Calculate vehicle speeds
5. Generate frequency distribution table and determine speed percentiles

5.1 Appropriate study length

The study length is important because it is used in the calculation of vehicle speeds. Following Table provides recommended study lengths, which are based on the average speed of the traffic stream. Using these recommended study lengths makes speed calculations straightforward and less confusing. If these lengths are not appropriate, another length can be used assuming it is long enough for reliable observer reaction times.

11.1.48 Table 40: Recommended Spot Speed Study Lengths

Traffic Stream Average Speed	Recommended Study Length (m)
Below 40 km/hr	30
40 – 64 km/hr	55
Above 65 km/hr	80

Three different straight sections with minimum vertical gradient on Peshawar- Torkham Existing Highway (N-5) were selected to carry out stopwatch spot speed study. For each section 80 meter study length is used to observe the spot speed of vehicles.

5.2 Selection of Proper Location and Layout

Following Figure illustrates a typical layout for conducting a spot speed study using a stopwatch. When selecting a location and layout, care must be exercised so that the observer can clearly see any vertical reference posts. The observer should be positioned higher than the study area and be looking down. The position could be on a bridge or a roadway back slope. The observer should use reference points to aid in collecting the elapsed time it takes a vehicle to travel through the study area. The reference point to start timing may be a brightly colored vertical post. The reference point to end timing may be a tree or a signpost in the observer’s sight line. An accurate sketch of the site should be documented, including number of lanes, position of observer, and description of reference points.

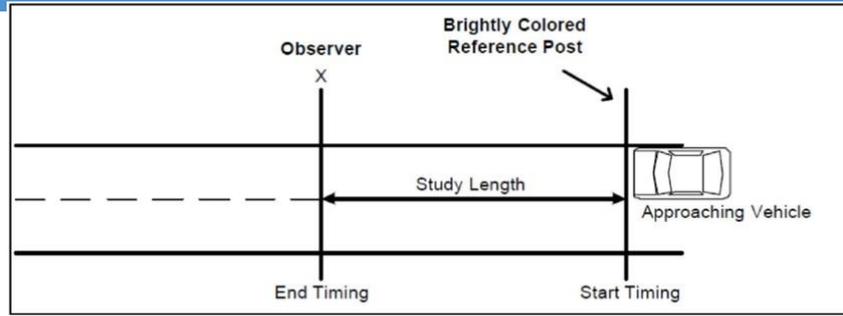


Figure -5: Typical Layout for Conducting a Spot Speed Study Using a Stopwatch

5.3 Record Observations on Stopwatch Spot Speed Data Form

On the stopwatch spot speed data form; the observer records the date, location, posted speed limit, weather conditions, start time, end time, and down time. As the front wheels of a vehicle cross a reference mark at the beginning of the predetermined study length, the observer starts the stopwatch. The watch is stopped when the vehicle’s front wheels pass a reference line in front of the observer. A slash is recorded on the data form corresponding to the elapsed time observed.

5.4 Calculate Vehicle Speeds

To calculate vehicle speed, use the predetermined study length and the elapsed time it took the vehicle to move through the course (as recorded on the stopwatch data form) in the following formula (Robertson 1994):

$$V = \frac{D}{0.278 \times T}$$

Where V = spot speed (km/hr), D = length (m), and T = elapsed time (seconds). In the equation, 0.278 is a constant that converts units of meter per second into kilometer per hour.

5.5 Generate Frequency Distribution Table and Determine Speed Percentiles

Determine the 50th and 85th speed percentiles using a frequency distribution table and calculations as described earlier.

5.6 Speed Percentiles

Speed percentiles are tools used to determine effective and adequate speed limits. The two speed percentiles are most important to understand the 50th and the 85th percentiles. The 50th percentile is the median speed of the observed data set. This percentile represents the speed at which half of the observed vehicles are below and half of the observed vehicles are above. The 50th percentile of speed represents the average speed of the traffic stream. The 85th percentile is the speed at which 85% of the observed vehicles are travelling at or below.

This percentile is used in evaluating/recommending posted speed limits based on the assumption that 85% of the drivers are travelling at a speed they perceive to be safe (Homburger et al. 1996). In other words, the 85th percentile of speed is normally



assumed to be the highest safe speed for a roadway section. Weather conditions may affect speed percentiles. For example, observed speeds may be slower in rainy or snowy conditions.

A frequency distribution table is a convenient way to determine speed percentiles. The frequency of vehicles is the number of vehicles recorded at each speed. The cumulative frequency is the total of each of the numbers (frequencies) added together from lower to higher speed. The cumulative percent frequency can be calculated from cumulative frequencies and total number of observed vehicles.

The 50th and 85th speed percentiles are determined from the cumulative percent frequency. The exact 50% and 85% (50th and 85th percentiles) may not be found from the cumulative percent frequency. To reach these exact percentages, following equation shall be used for calculating speed percentiles:

$$S_D = \frac{P_D - P_{min}}{P_{max} - P_{min}} \times (S_{max} - S_{min}) + S_{min}$$

Where S_D = speed at P_D , P_D = percentile desired, P_{max} = higher cumulative percent, P_{min} = lower cumulative percent, S_{max} = higher speed, and S_{min} = lower speed.

5.7 Sample Size

Two different locations on National Highway (N-5) were studied before conducting stopwatch spot speed study. At each survey location stop speed of 50 vehicles was observed in each direction to witness spot speed of total 100 vehicles. To utilize all vehicle classification in the spot speed study data, 50 vehicles on each direction are comprise of 15 cars/jeeps, 10 vans/pickups, 05 buses/mini trucks, 10 trucks, 10 trailers. Average vehicle speed and 85th percentile speed is calculated from the data. Data sheet to conduct the spot speed study is attached as **Annexure**.

5.8 Spot Speed using Radar Method

Spot speed using the Radar Method has also been measured at three locations. Speed Radar was hired from the police department and was used to measure the spot speeds of vehicles. It has been noticed that the spot speed measured using the Radar is comparatively less than the Manual Spot Speed method due to becoming conscious by the commuter.

Following table provides the summary of the spot speed calculations at different locations.



11.1.49 Table 41: Spot Speed for Goods Traffic

SUMMARY OF SPOT SPEED STUDY FOR GOODS VEHICLES								
Location		@km 5+700		@km 30+100		@km 33+000		Average Speed (km/hr.)
Method	Percentile	Location 1-NB	Location 1 SB	Location 2-NB	Location 2 SB	Location 3-NB	Location 3 SB	
Stop Watch	15th	28.07	42.58	23.69	35.69	-	-	32.5
	50th	42.35	52.38	30.00	46.45	-	-	42.8
	85th	52.67	62.30	52.00	52.71	-	-	54.9
	Mean	43.42	54.34	36.04	46.47	-	-	45.1
	Median	42.99	53.33	30.32	47.23	-	-	43.5
	Mode	42.35	53.33	55.38	51.43	-	-	50.6
Speed Gun	15th	16.55	35.00	26.43	24.35	25.50	30.35	26.4
	50th	36.50	41.00	34.25	34.50	34.00	32.17	35.4
	85th	42.45	51.55	46.15	38.33	45.50	34.65	43.1
	Mean	33.12	42.54	36.05	32.56	35.90	34.00	35.7
	Median	37.00	41.50	35.00	35.00	34.50	33.00	36.0
	Mode	38.00	40.00	35.00	30.00	-	-	35.8

11.1.50 Table 42: Spot Speed for Passenger Traffic

SUMMARY OF SPOT SPEED STUDY FOR PASSENGERS VEHICLES								
Location		@km 5+700		@km 30+100		@km 33+000		Average (km/hr.)
Method	Percentile	Location 1-NB	Location 1 SB	Location 2-NB	Location 2 SB	Location 3-NB	Location 3 SB	
Stop Watch	15th	44.25	52.17	46.80	45.44	-	-	47.2
	50th	58.50	66.92	62.38	60.60	-	-	62.1
	85th	71.44	83.31	73.47	77.00	-	-	76.3
	Mean	59.67	68.82	62.39	62.45	-	-	63.3
	Median	60.00	68.57	62.61	62.61	-	-	63.4
	Mode	62.61	75.79	68.57	75.79	-	-	70.7
Speed Gun	15th	41.65	49.38	43.00	37.18	36.19	39.23	41.1
	50th	56.50	61.00	60.67	51.83	47.00	54.75	55.3
	85th	70.00	73.45	74.78	66.20	60.00	65.00	68.2
	Mean	56.58	61.33	59.39	52.22	48.10	53.36	55.2
	Median	57.00	61.00	61.00	52.00	48.00	55.00	55.7
	Mode	59.00	57.00	75.00	38.00	41.00	57.00	54.5

11.1.51 Table 43: Spot Speed for Passenger and Goods Traffic

SUMMARY OF SPOT SPEED STUDY FOR PASSENGERS AND GOODS VEHICLES								
Location		@km 5+700		@km 30+100		@km 33+000		Average Speed (km/hr.)
Method	Percentile	Location 1-NB	Location 1 SB	Location 2-NB	Location 2 SB	Location 3-NB	Location 3 SB	
Stop Watch	15th	42.35	49.05	40.00	43.36	-	-	43.7
	50th	55.75	62.61	58.80	56.02	-	-	58.3
	85th	70.71	81.56	72.00	75.53	-	-	75.0
	Mean	57.42	65.84	57.76	59.85	-	-	60.2
	Median	57.60	62.61	60.00	57.60	-	-	59.5
	Mode	62.61	75.79	68.57	53.33	-	-	65.1
Speed Gun	15th	36.28	43.51	36.00	36.33	34.75	37.35	37.4
	50th	54.38	58.00	56.00	51.00	45.70	53.63	53.1
	85th	67.72	72.00	74.21	65.50	59.69	64.74	67.3
	Mean	53.71	58.57	55.47	51.30	47.03	51.98	53.0
	Median	55.00	58.00	56.00	52.00	46.00	54.00	53.5
	Mode	59.00	52.00	75.00	38.00	41.00	57.00	53.7



Distress types, quantities and severity levels (Low, Moderate and High) must be used to obtain an accurate PCI value. There are many types of distresses which can be observed on the flexible pavement as well as rigid pavement surfaces.

11.1.53 Table 44: Flexible Pavement Distress Types

1. Alligator Cracking	6. Depression	11. Patching & Utility Cut Patch	16. Shoving
2. Bleeding	7. Edge Cracking	12. Polished Aggregate	17. Potholes
3. Block Cracking	8. Jt. Reflection Cracking	13. Railroad Crossing	18. Rutting
4. Bumps and Sags	9. Lane/Shoulder Drop Off	14. Slippage Cracking	19. Swell
5. Corrugation	10. Long & Trans Cracking	15. Weathering/ Raveling	

6.4. Survey Procedure

Following are the main steps to calculate the PCI for Asphalt Concrete (AC) Pavement:

1. Divide the whole pavement into sections based on the pavement design, construction history, traffic and condition and the divide each section into sample units.
2. Select the sample units to be inspected. The number of sample units to be inspected may vary from the following: all of the sample units in the section, a number of sample units that provides a 95% confidence level, or a lesser number.
3. Add up the total quantity of each distress type at each severity level for each sample unit and record them. The units for the quantities may be either in square feet (square meters), linear feet (linear meters), or number of occurrences, depending on the distress type.
4. Determine the deduct value (DV) for each distress type and severity level combination from the distress deduct value curves given in Appendix X3 of ASTM D 6433.
5. Determine the maximum corrected deduct value (CDV). The procedure for determining maximum CDV from individual DVs is given in ASTM D 6433.
6. Calculate PCI by subtracting the maximum CDV from 100: $PCI = 100 - \text{max CDV}$.

For Peshawar – Torkham Highway (N-5); similar procedure has been adopted out to obtain PCI values of samples. The existing highway has been divided into sections based upon the construction/maintenance history. Each section has been divided into sample units and for each 1 kilometer length of road 2 sample unit has been observed. Sections, where existing highway splits into two ways/directions (i.e., Ali Masjid and Torkham) and directional traffic moves at different grades/levels, for each

1 kilometer length of road 2 sample unit has been observed in each direction. Approximate area of each sample unit is 700 to 750 square meters. Following graph shows the pavement condition index for the project road section:



11.1.54 Figure 7: Pavement Condition Index for Peshawar - Torkham (NB)

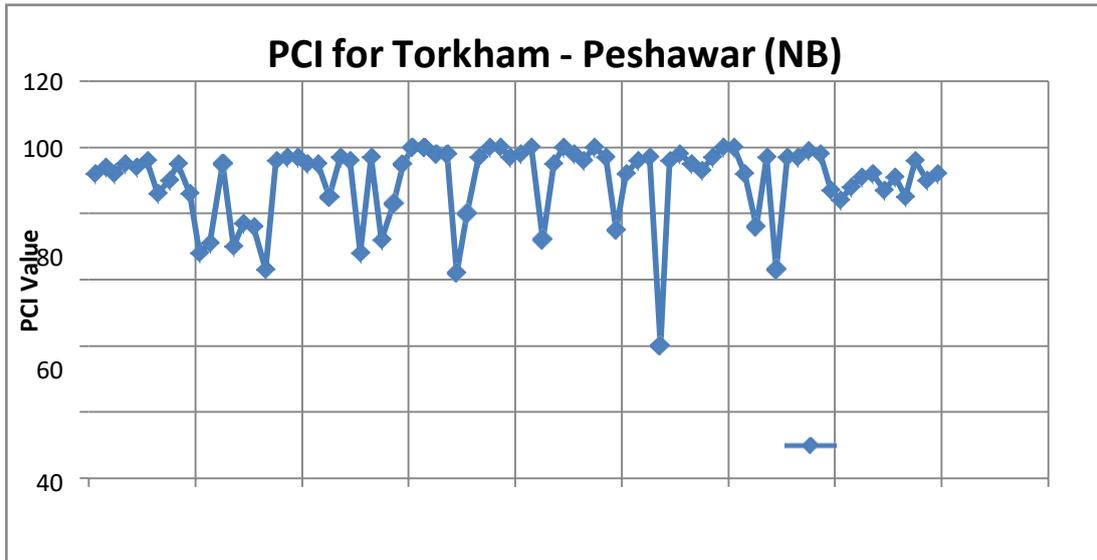
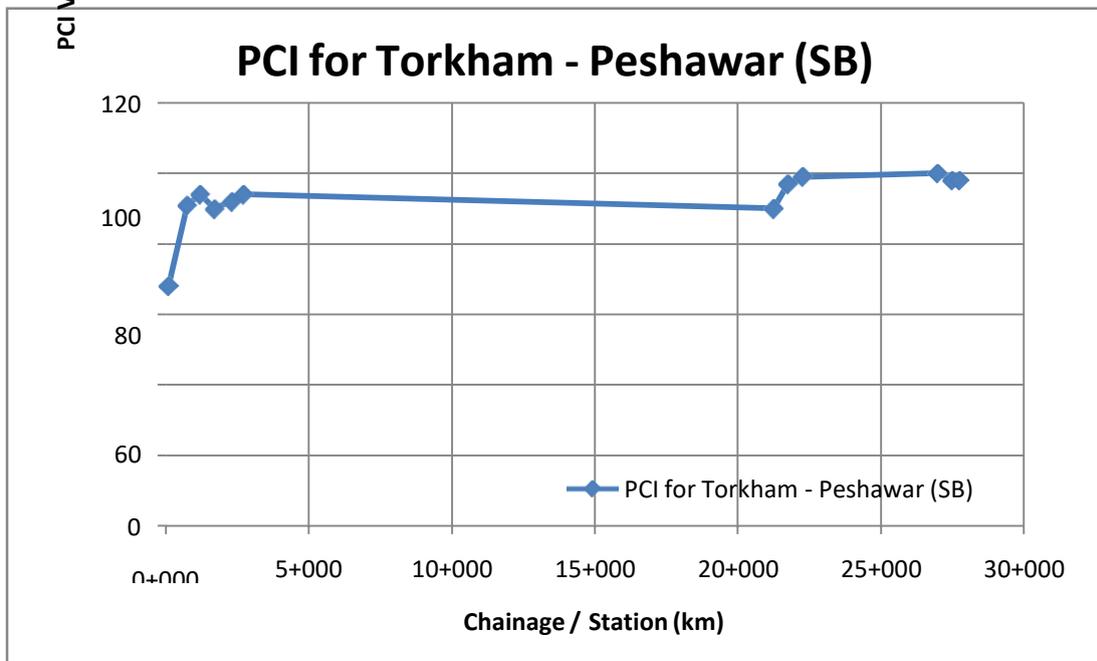


Figure 8: Pavement Condition Index for Peshawar - Torkham (SB)





6.2 Pavement Roughness Survey

Pavement roughness is an expression of the irregularities in a pavement surface that adversely affect the ride quality of a vehicle. Roughness also affects vehicle delay costs, fuel consumption, tires, and maintenance costs. Roughness is predominantly characterized by the international roughness index (IRI), which is often measured with inertial profilers. Inertial profilers are equipped with sensitive accelerometers, a height-measuring laser, and a distance-measuring instrument for measuring vehicle vertical acceleration data and the pavement profile. Modern smart phones are equipped with several sensors including a three-axis accelerometer, which can be



used in this project to collect vehicle acceleration data with an Android-based application.

As per our TOR, "Road Lab Pro" Android-based application has been utilized to measure international roughness index of existing Peshawar-Torkham Highway (N- 5). Road Lab Pro is designed as a data collection tool for engineers by the World Bank in collaboration with Beldor Center, Softteco and Progress Analytics LLC. With accelerometers in smartphones, this app evaluates road conditions, map road networks, detects major road bumps, and reports road safety hazards. One can even upload a picture of potholes, black spots, or road accidents, etc. with a simple tag. The app runs on all Android devices, such as Android smartphones or tablets.

The roughness measurement criteria of this application areas under:

1. IRI < 2: Excellent
2. 2 < IRI < 4: Good
3. 4 < IRI < 6: Fair
4. IRI > 6: Poor

Road Lab Pro application estimates the road roughness based on kinematic and GPS sensors in smartphones. This application provides the roughness of each 100 meter road section along with record of bumps. Application also provides the geo- tagging of road section and bumps on Google Map.

11.1.55 Table 45: Roughness Survey Results of Peshawar Torkham

Name	Links	Distance	Average Speed	Avg IRI	Max IRI	Min IRI	Mode IRI
Torkham Peshawar SB	2	41669.55	48.82	3.28	9.88	1.06	1.97
Torkham Peshawar NB	1	40707.98	48.18	3.15	8.03	1	1.75

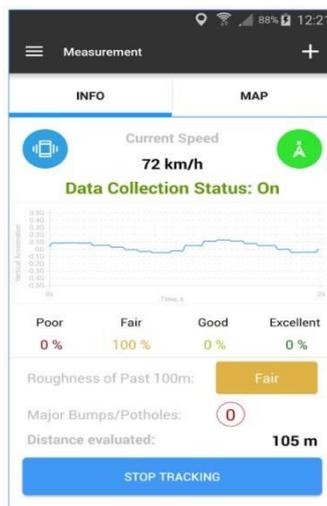


Figure 9: Measurement Screen of Road Lab Pro



Chapter – 7: Economic Analysis

The subject road section between Peshawar and Kabul is connecting Peshawar with Kabul through Torkham and Jalalabad. Peshawar is the capital of Khyber Pakhtunkhwa and the administrative centre and economic hub for the Federally Administered Tribal Areas of Pakistan. Peshawar is situated in a large valley near the eastern end of the Khyber Pass, close to the Pak Afghan border. Known as “City on the Frontier”, Peshawar’s strategic location on the cross roads of Central Asia and South Asia has made it one of the most culturally vibrant and lively cities in the greater region. Peshawar is connected to Motorway system of Pakistan through Motorway M-1.

The scheme provides for the construction of Peshawar - Torkham Motorway through a new alignment with 4 lanes carriageway. The overall objective of the project is to provide a good travel facility between Peshawar and Kabul through improved travelling conditions and reduction in the travel time and operating cost at the most economical and financially sustainable level. Most part of the alignment lies in FATA (Federally Administered Tribal Area). The Federally Administered Tribal Areas is a semi-autonomous tribal region in northwestern Pakistan, consisting of seven tribal agencies (districts) and six frontier regions, and are directly governed by Pakistan's federal government through a special set of laws called the Frontier Crimes Regulations (FCR). It borders Pakistan's provinces of Khyber Pakhtunkhwa and Balochistan to the east and south, and Afghanistan's provinces of Kunar, Nangarhar, Paktia, Khost and Paktika to the west and north. Peshawar - Torkham Motorway project falls in Khyber agency. Khyber is a tribal area in the Federally Administered Tribal Areas region of Pakistan. It is one of the eight tribal areas, better known as agencies in Pakistan. It ranges from the Tirah valley down to Peshawar. It borders Nangarhar Province to the west, Orakzai Agency to the south, Kurram Agency to south west and Peshawar to the east where it connects with the subject motorway project under discussion.

In depth analysis of the study indicates that the desired and optimal objectives of this project can be achieved by the construction of Motorway to National Highway Standards. Keeping in view, all the aspects of Design, Cost, Hydrology, Traffic and Future requirements etc., the construction of Motorway between Peshawar and Torkham has been proposed.

The methodology used follows standard practice of comparing life cycle road agency and user costs with and without project, using Net Present Value (NPV) and EIRR at 10% discount rate as decision criteria. The Highway Development and Management Model of the World Bank, HDM-4 has been used for analysis. The main assumptions about maintenance and improvement strategies “with” and “without” project are discussed below.



The existing road section from Peshawar and Torkham (total length = 40 km) under discussion is a two lane carriageway. The project road lies in a rolling to Hilly terrain. For the existing road, the current roughness level of existing road is taken as 3.2 IRI⁹ as per actual survey carried out in the field, only routine and periodic maintenance is provided for without project case. In recognition of the prevailing maintenance standards of NHA, roughness levels are allowed to deteriorate with provision of maintenance strategy on the roadway.

For improvement strategy (with project case), one treatment has been tested with construction of a new carriageway on the new alignment between Peshawar and Torkham. Preliminary design has been carried out by the Consultants and the alignment has been finalized with detailed topographic survey. Total length of the new alignment is 47.55 km. Periodic maintenance based on road condition in terms of roughness level has been assumed. The initial treatment will give IRI levels of 1.5 with Asphalt wearing Course. For this section of Motorway the "scheduled" maintenance strategy has been assumed that after every 10 years, a 50 millimeters (mm) overlay will be added with Asphaltic Concrete to reduce the IRI back to 1.5. It is further assumed that after improvement and overlay, routine maintenance will also be carried out and will include potholes being completely patched, ditch cleaning will be carried out on regular basis, any safety measures disturbed will be refurbished, and grading of shoulders will be carried out at regular intervals especially after the monsoon. The condition of existing road has been taken from the field surveys done by the Consultants. Following General Road Condition data is given in Table below:

11.1.56 Table 46: Existing Road Condition Data Summary

Road Section	Road Class	Length Km	Terrain	Condition	Proposed Width, m	Roughness (IRI) m/km
Peshawar - Torkham	Major Road	40	Rolling/Hilly	Paved, High Gradients upto 12%	Carriageway with 7.3m width	3.22

Traffic surveys have been carried by design consultants on the existing road section for 8 days. Following table shows the existing Traffic Counts at National Highway N-5 near Torkham. Based upon the travel time savings and distance ratio, diverted traffic has been calculated. Time savings are provided in Table. Average speed without project case is taken from Travel Time Survey and with project, the speed has been taken from HDM-4 results.

⁹ As per actual Roughness Survey



11.1.57

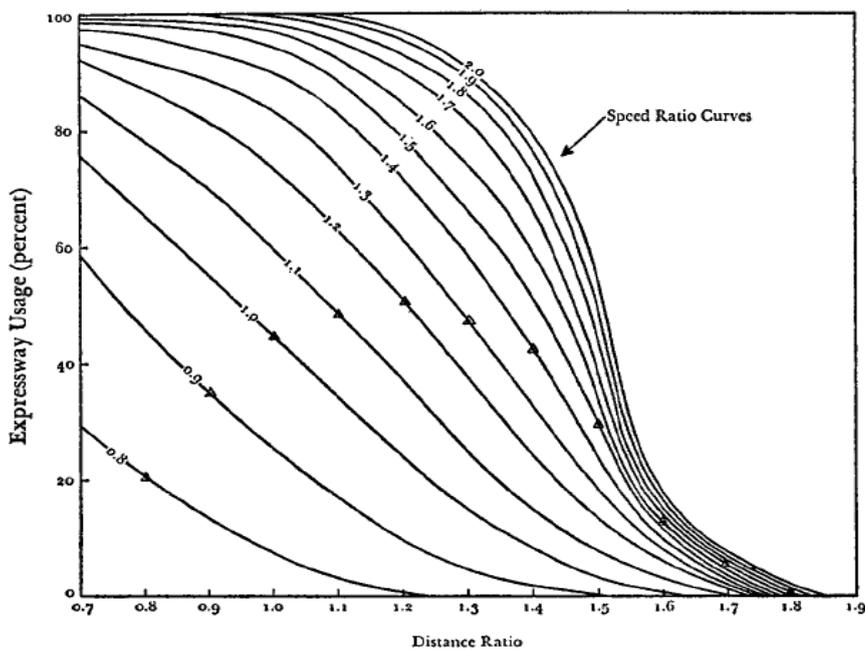
Table 47: Current Traffic Data 2018

Description	Car, Jeep	Van	Buses	Mini Truck	2 Axle Trk	Multi Axle	Sum
Traffic Torkham	5,650	752	7	112	172	1,018	7711

Table 48: Travel Time Savings 2018¹⁰

S. No.	Vehicle Type	Location	Avg Speed km/hr on N-5 (Actual Travel Time Survey)	Avg Speed on Motorway km/hr	Motorway Travelling Hr (48 km)	Speed Ratio	Percent of Diverted Traffic
1	Bus	N-5	39.83	56.00	0.86	1.41	70
2	Car	N-5	43.49	70.00	0.69	1.61	85
3	Mini Truck	N-5	18.01	48.00	1.00	2.67	95
4	OIL TANKER	N-5	19.53	48.00	1.00	2.46	95
6	Truck 2 Axle	N-5	18.01	48.00	1.00	2.67	95
7	Truck 3 Axle	N-5	18.01	48.00	1.00	2.67	95
8	Truck Multi Axle	N-5	18.01	48.00	1.00	2.67	95
9	Van	N-5	39.83	70.00	0.69	1.76	90

Following graph is used for the calculation of the diverted traffic which is based upon the speed ratio curve. Speed ratio and distance ratio is calculated separately and estimated diverted traffic is calculated from this graph.





11.1.58 Figure 10: Motorway Usage with respect to Speed and Distance Ratio¹¹

10 Speeds calculated from the HMD IV data



Based upon the distance ratio of 1.2, different speed ratios are calculated and provided in table 41. Based upon the speed ratios and distance ratio estimated percentage of diverted traffic to Motorway is calculated

11.1.59 Table 49: Estimated Diverted Traffic to Motorway

Description	Car, Jeep	Pickup	Van	Buses	Mini Truck	2 Axle Trk	Multi Axle	Sum
Torkham	5,650	-	752	7	112	172	1,018	7711
Diversion Factor %	85.00		90.00	70.00	95.00	95.00	95.00	
Total diverted Traffic	4,803	-	677	5	106	163	967	6,721

As explained in above chapters, the adopted growth rates are as under:

11.1.60 Table 50: Adopted Growth Rates

Category	Future Traffic Growth Rates (%)
Car , Jeeps, Van	4.5
Mini Truck	4.5
Van/ Pickup	4.5
Truck / Trailer	4.5
Buses	4.5

The vehicle operation costs depend upon road conditions on the one hand and on the other vehicle characteristics, utilization and prices. The road conditions with and without project have been described in section above. For vehicle characteristics, default values of HDM model have been used. The other input data, namely, prices of vehicles and other inputs, and utilization of vehicles are given below.

The economic costs of representative vehicles, tires, fuel have been computed by deducting taxes and duties from market prices. To have a realistic estimate of utilization of vehicles, the data available from World Bank studies was reviewed by the Consultants the subsequent values assumed for this study are shown in Table.



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11.1.61 Table 51: Vehicle Utilization

Item/unit	M/cycle	Car	Wagon	Bus	Trucks		
					2 axle	3 axle	> 3 axle
Basic Characteristics							
Gross Vehicle Weight (tons)	0.25	1.23	2.7	13.7	15.2	23.5	26
ESA factor per veh	0	0	0	0.5	4.67	8.84	10.84
No. of Axles	2	2	2	2	2	3	4
No. of Tires	2	4	4	6	6	10	14
No. Passengers	1	3	12	40	0	0	0
Vehicle Utilization							
Service Life years	10	12	10	10	10	12	12
Hours driven per year	400	500	2500	2500	2920	2920	2920
Economic Unit Costs							
New Vehicle price	42,316	982,692	5,500,000	9,550,000	8,554,000	9,390,000	9,390,000
New Tire price	2500	6330	10,970	41,320	43,688	46,688	46,688
Maintenance labour per hour	100	100	100	100	100	100	100
Crew cost per hour	0	0	120	130	130	130	130

The construction costs of the project have been estimated based upon preliminary design using NHA CSR for Peshawar 2014. Cost includes the Resettlement and Land Acquisition Costs. Residual value of the asset at the end of the operation and maintenance period has been taken for analysis is 10%. Detailed Cost breakup is given in Annexure. Cost per km is as follows:

11.1.62 Table 52: Construction Costs of New Motorway (Million Rs. / km)

Road Section	Financial	Economic
Peshawar - Torkham	757.700	644.045

The maintenance costs based on the unit rates for various maintenance operations are given in following Table.



11.1.63 Table 53: Unit Maintenance and Operations Costs

Work	Economic	Financial ¹²
Patching	52.16	61.37
Edge Repair	19.29	22.69
Reseal	64.00	75.30
DST	388.02	456.49
TST	464.68	546.69
AC 50mm	809.78	952.69
Rehabilitation / Overlay (Per KM)	12,750,000	15,000,000

The above costs are financial costs. They are inclusive of taxes and duties which are transfer payments. Price escalation, contingencies and interest during construction were excluded. They are converted in to economic cost using the factor of 0.85. The conversion factor is calculated based upon the Tradable and Non Tradable goods other than skilled and unskilled labour component. The estimated cost composition and adjustment factor is given in the following table:

Table 54: Conversion Factor for Civil Works (inclusive of tax in financial costs)

	Conversion	Cost Composition	Adjustment
	Factor	(%)	Factor
Materials			
Tradable	SERF	15	1.1
Non-tradable		20	1
Equipment (non-tradable)		25	1
Labour			
Skilled	Skilled SWR	10	0.9
Unskilled	Unskilled SWR	20	0.75
Tax		10	0
		100	0.855

It is assumed that the project duration is 4 years (2018-2022) plus 25 years of operation and maintenance.



12 A factor of 0.85 has been used to convert the Financial Costs to Economic Costs



6.1 Benefits

The main quantifiable benefits of the investment are (i) the savings in VOCs for existing and diverted traffic after construction of motorway; (ii) VOC savings to generated traffic where applicable and (iii) the savings in the travel time and (iv) reduction in accidents and improvement in traffic safety. For the subject road benefitsfor first three components have been considered. In absence of historical accident data on the project road, analysis with savings in accident costs cannot be carried out. However due to improve road travelling facilities, number of accidents will be reduced.

Time savings are an important element justifying investment in transport infrastructure improvements. It is more important for passengers and perishable commodities that for non-perishable commodities which can be stored without significant costs.

The value of time has been estimated on the basis of per capita GNI of \$ 1,560.7 in 2015-16¹³. Per capita GNI is based on overall population including infants, children and senior citizens. It is, however, produced by the working population only. The labour force participation rate being 32.3 percent¹⁴, GNI per employed person works out to \$ 4832. This gives value of working time of \$ 2.00 per hour on the basis of 300 working days and 8 hours a day. The values are converted to Pak Rs. for analysis purpose¹⁵. This has been taken as value of working time of a bus passenger. Value of working time of wagon and motor cycle passenger is taken at 1.5 times of time thatof a bus passenger and of car passenger at twice the time of a bus passenger. Non- working time is valued at 1/3rd of working time. The resulting value of time is given in the following table.

11.1.64 Table 55: Value of Time (Rs. per hour)

Passenger Category	Working	Non Working (1/3)
Bus Passenger	221	74
Wagon passenger	332	111
Motor cycle passengers	332	111
Car Passengers	443	148

Time savings have been taken for the passenger vehicles and the details of other various parameters taken into the HDM are as follows¹⁶:

13 Pakistan Economic Surveys 2015-16, Statistical Appendix Table 1.5.5

14 Pakistan Economic Surveys 2015-16, Statistical Appendix Table 12.1



15 1 Re/ = \$110

16 Actual values from OD Survey Data Results



Bus

Total Number of Passengers – 20 Work
related passenger trips – 70%Car

Number of Passengers -3.7

Work related passenger trips – 70%
Van

Number of passengers – 11.5

Work related passenger trips – 70%

A minor component will be savings in periodic maintenance cost to be incurred by theNHA. The savings in VOC are generated though better road surface conditions. As the access to markets, which reflects agricultural benefits, becomes better, it is expected that there will be more economic activities resulting in the generated traffic. In this case generated traffic has been estimated by assuming that half the saving in transportation costs will be devoted to additional travel and benefits to generated traffic are at half the rate for normal traffic.

Generated traffic is the growth in traffic along a roadway associated with the decrease / increase in user costs associated with utilizing that roadway and an elasticity factor. Generated traffic is the traffic generated by improving the project road including the development traffic. In practice it is difficult to distinguish between generated traffic and development traffic and the two are usually taken together and termed as generated traffic¹⁷.

For this study the percentage change (savings) in user costs by vehicle type with the proposed improvements are estimated. The user cost savings are factored by assumed demand elasticity values for cars and other vehicles to calculate the generated traffic levels. Each percentage reduction in vehicle operating and travel time costs will induce more traffic to use the improved facility. If the demand elasticity is assumed to be 0.50, then 10% reduction in user costs would result in a 5 percent increase in traffic.

The price elasticity of demand for transport measures the responsiveness of traffic to a change in transport costs for instance following road investment. The price elasticity is defined as the ratio of the percentage change in travel demand to the percent change in travel costs. Evidence from studies in developing countries give a range of between 0.6 to 2.0 for the price elasticity of demand for transport with an average of about 1.0. This means that 1% decrease in transport costs leads to a 1% increase in traffic¹⁸. In general the elasticity of demand for goods transport is much lower (0.1-0.5). In this case we have assumed an elasticity of 0.5 and considering

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18 Planning Methods from Highway and Traffic Engineering in Developing Countries edited by Bent





20% decrease in the user costs, overall 10% generated traffic has been added in the analysis.

Economic Analysis using the savings obtained from the use of the existing road instead of diversion has been calculated. The major assumptions taken are the VOC savings due to not constructing diversion instead using the existing road. Results are attached in the Annexure.

6.2 Results of Economic Evaluation and Sensitivity Analysis

The economic internal rates of return (EIRRs) have been computed using Highway Development and Management Model of the World Bank (HDM-4) computed values of VOCs. One improvement strategy (with Asphalt) has been evaluated.

The sensitivity of results has also been tested with respect to 15 percent increase in costs, decrease in benefits, both together and one year’s delay in implementation. Sensitivity analysis with respect to reduction in existing roughness and decrease in time costs has been calculated. In addition, switching values have also been calculated for costs and benefits. They indicate extent of variation in costs or benefits that will turn EIRR below 10%. The summary of the results is shown in tables 56 and 57.

11.1.65 Table 56: Summary of EIRRs with Sensitivity Analysis

Road Section	EIRR Proposed Strategy	15% Reduction on VoC	15% Increase in Capital Cost	15% Increase in Capital Cost and 15% reduction of VoC	Reduction in growth to 5%	One year Delay in Construction
Peshawar - Torkham	12.5%	11.0%	11.2%	9.8%	12.0%	12.1%

11.1.66 Table 57: Switching values

	Increase in Costs	Decrease in Benefits
Peshawar - Torkham	1.25	0.80

Switching Value – factor that will reduce the EIRR to 10%

Net Present Value = Rs. 8,196 million, Benefit Cost Ratio = 1.31



Conclusion and Recommendation

Based on results and analysis in the report, following conclusion is drawn and recommendations presented as below:

1. It is estimated that the proposed motorway will take about 6,721 vehicles per day currently and 8015 vehicles per day after its completion in 2022.
2. For the next 20 years it is expected there would be no capacity constraint on the Motorway and Level of Service C would be achieved.
3. The investment would result in IRR of 12.5% with an NPV of Rs. 8196 million for period of 25 years at a discount rate of 10%.
4. Overloading to be controlled on Motorway Section.



ANNEXURES



The World Bank

Khyber Pass Economic Corridor Project (P159577)

ANNEX A: RESULTS OF TRAFFIC SURVEY



The World Bank

Khyber Pass Economic Corridor Project (P159577)

Traffic Study Report for Peshawar Torkham Economic Corridor Project (PTECP)



TABLE: AVERAGE ANNUAL DAILY TRAFFIC AT N-5 NEAR KILLA JAMRUD

STATION	At Killa Jamrud									Average ADT	AADT after Divide with SVF**
	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8			
	10-Feb-18	11-Feb-18	12-Feb-18	13-Feb-18	14-Feb-18	15-Feb-18	16-Feb-18	17-Feb-18			
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday			
Both Direction	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction				
Motor Cycle	245	326	74	329	178	159	195	229	217	228	
Rickshaw	24	57	14	126	24	52	30	38	45	48	
Car/ Taxi / jeep / Van	4,938	5,113	5,547	5,257	5,402	5,050	5,282	5,334	5,240	5,516	
Mini / Medium Bus	2,165	2,681	2,793	2,202	2,450	2,847	2,591	2,906	2,579	2,715	
Large Bus	-	1	6	37	1	-	9	1	7	7	
Pickup Truck	898	746	452	686	752	609	582	824	693	730	
2-Axle Truck	671	749	473	578	890	686	585	1,020	707	744	
3-Axle Truck	289	471	548	607	582	558	473	432	495	521	
Container	505	565	573	591	687	273	894	690	597	629	
Tanker	6	18	4	91	26	46	14	26	29	30	
Agriculture Tractor	1	14	1	6	7	9	9	4	6	7	
Total	9,743	10,740	10,485	10,509	10,998	10,290	10,665	11,503	10,617	11,175	





TABLE : AVERAGE ANNUAL DAILY TRAFFIC AT N-5 LANDI KOTAL

At Landi Kotal										
STATION	At Landi Kotal								Average ADT	AADT after Divide with SVF**
TYPE OF VEHICLES	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8		
	10-Feb-18	11-Feb-18	12-Feb-18	13-Feb-18	14-Feb-18	15-Feb-18	16-Feb-18	17-Feb-18		
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
	Both Direction									
Motor Cycle	24	113	11	37	66	85	98	92	66	69
Rickshaw	2	329	-	-	-	1	4	6	43	45
Car/ Taxi / jeep / Van	4,200	3,658	4,819	4,539	4,641	5,001	5,367	4,423	4,581	4,822
Mini / Medium Bus	988	1,022	1,049	929	863	969	1,097	1,123	1,005	1,058
Large Bus	9	135	21	4	6	21	12	7	27	28
Pickup Truck	767	775	720	871	785	984	1,015	945	858	903
2-Axle Truck	427	460	358	335	431	395	516	382	413	435
3-Axle Truck	262	302	316	264	173	237	251	258	258	272
Container	662	432	563	629	621	490	768	565	591	622
Tanker	15	55	32	66	80	4	106	74	54	57
Agriculture Tractor	4	5	1	-	-	1	2	2	2	2
Total	7,360	7,287	7,889	7,674	7,665	8,188	9,236	7,879		8,313



TABLE : AVERAGE ANNUAL DAILY TRAFFIC AT N-5 AT TORKHAM BORDER										
STATION	At Torkham Border								Average ADT	AADT after Divide with SVF**
TYPE OF VEHICLES	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8		
	10-Feb-18	11-Feb-18	12-Feb-18	13-Feb-18	14-Feb-18	15-Feb-18	16-Feb-18	17-Feb-18		
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction	Both Direction		
Motor Cycle	6	7	-	4	14	9	22	13	9	10
Rickshaw	-	-	-	-	-	-	-	-	-	-
Car/ Taxi / jeep / Van	4,845	5,111	5,291	5,043	6,188	5,705	5,244	5,513	5,368	5,650
Mini / Medium Bus	789	664	576	603	788	681	778	835	714	752
Large Bus	-	-	-	-	50	2	-	-	6	7
Pickup Truck	142	104	81	114	96	76	83	156	106	112
2-Axle Truck	260	211	94	114	208	79	166	172	163	172
3-Axle Truck	622	256	159	225	194	127	166	133	235	248
Container	976	701	627	553	767	378	988	769	720	758
Tanker	28	-	-	14	47	-	-	-	11	12
Agriculture Tractor	-	-	-	-	-	1	-	-	0	0
Total	7,668	7,054	6,829	6,672	8,351	7,059	7,447	7,592		7,720



ANNEX B: Travel Time Survey Data

TRAVEL TIME AND DELAY STUDY FIELD SUMMARY TABLE FOR CARS																					
Road Name:		National Highway (N-5)				Posted Speed Limit:				30 - 60 Km/hr.											
City:		Peshawar - Landi Kotal - Torkham				Company				ACC											
Observer Name:		Muhammad Zeeshan																			
Direction:		Peshawar - Torkham	Peshawar - Torkham	Torkham - Peshawar	Torkham - Peshawar							Average Travel Time (ATT)	Average Travel Speed (ATS)	Average Delay (AD)	Average Running Time (ART)	Average Running Speed (ARS)					
Date:		13/2/2018	16/2/2018	13/2/2018	17/2/2018																
Day:		Tuesday	Friday	Tuesday	Saturday																
Time:		1345 Hrs.	1445 Hrs.	0830 Hrs.	0930 Hrs.	1720 Hrs.	1830 Hrs.	1620 Hrs.	1715 Hrs.												
Weather:		Partially Cloudy		Sunny		Cloudy		Sunny													
Period		After Noon		Morning		Evening		Evening													
Control Points	Trip Length	Travel Time and Delay in Seconds																			
			1		2		3		4		5										
	(kms)	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay										
0	10	850	-	776	-	1421	132	887	5	-	-	983.5	36.6	68.5	915.0	39.3					
1																					
1	10	786	-	848	-	735	38	727	32	-	-	774.0	46.5	35.0	739.0	48.7					
2																					
2	10	683	-	740	-	748	-	692	-	-	-	715.8	50.3	0.0	715.8	50.3					
3																					
3	10	969	-	1171	45	794	-	752	5	-	-	921.5	39.1	25.0	896.5	40.2					
4																					
Total Trip Length	40	Sum of Travel Time and Delay per Run										Total Averages									
			3288	0	3535	45	3698	170	3058	42	-	-	(ATTT)	(ATTS)	(ATTD)	(ARTT)	(ATRS)				
Running Time Per Run		3288		3490		3528		3016		-		3394.8	42.4	64.3	3330.5	43.2					



TRAVEL TIME AND DELAY STUDY FIELD SUMMARY TABLE FOR WAGONS/VANS

TRAVEL TIME AND DELAY STUDY FIELD SUMMARY TABLE FOR WAGONS/VANS																	
Road Name:		National Highway (N-5)				Posted Speed Limit:				30 - 60 Km/hr.							
City:		Peshawar - Landi Kotal - Torkham				Company				ACC							
Observer Name:		Muhammad Zeeshan															
Direction:		Peshawar - Torkham		Peshawar - Torkham		Torkham - Peshawar		Torkham - Peshawar									
Date:		12/2/2018		18/2/2018		12/2/2018		16/2/2018									
Day:		Monday		Sunday		Monday		Friday									
Time:		1200 Hrs.	1315 Hrs.	0800 Hrs.	0900 Hrs.	1030 Hrs.	1140 Hrs.	1045 Hrs.	1200 Hrs.								
Weather:		Rainy		Sunny		Rainy		Rainy									
Period		Noon		Morning		Morning		Morning - Noon									
Control Points	Trip Length	Travel Time and Delay in Seconds										Average Travel Time (ATT)	Average Travel Speed (ATS)	Average Delay (AD)	Average Running Time (ART)	Average Running Speed (ARS)	
		1		2		3		4		5							
	(kms)	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay						
0	10	924	50	730	5	1683	205	1310	95	-	-	1161.8	31.0	88.8	1073.0	33.6	
1																	
1	10	896	32	823	-	822	85	772	10	-	-	828.3	43.5	42.3	785.9	45.8	
2																	
2	10	905	47	657	-	758	-	783	-	-	-	775.8	46.4	47.0	728.8	49.4	
3																	
3	10	1302	161	1130	64	932	128	1036	70	-	-	1100.0	32.7	105.8	994.3	36.2	
4																	
Total Trip Length	40	Sum of Travel Time and Delay per Run										Total Averages					
		4027	290	3340	69	4195	418	3901	175	-	-	(ATTT)	(ATTS)	(ATTD)	(ARTT)	(ATRS)	
Running Time Per Run		3737		3271		3777		3726		-		3865.8	37.3	238.0	3627.8	39.7	



TRAVEL TIME AND DELAY STUDY FIELD SUMMARY TABLE FOR 3-AXLE RIGID TRUCKS																		
Road Name:		National Highway (N-5)				Posted Speed Limit:				30 - 60 Km/hr.								
City:		Peshawar - Landi Kotal - Torkham				Company				ACC								
Observer Name:		Muhammad Zeeshan																
Direction:		Peshawar - Torkham		Peshawar - Torkham		Torkham - Peshawar		Torkham - Peshawar										
Date:		16/2/2018				16/2/2018				16/2/2018				Average Travel Time (ATT)	Average Travel Speed (ATS)	Average Delay (AD)	Average Running Time (ART)	Average Running Speed (ARS)
Day:		Friday				Friday				Friday								
Time:		1330 Hrs. 1600 Hrs.				1600 Hrs. 1900 Hrs.		1600 Hrs. 1900 Hrs.										
Weather:		Sunny				Sunny - Clear				Sunny - Clear								
Period		After Noon				Evening				Evening								
Control Points	Trip Length	Travel Time and Delay in Seconds																
		1		2		3		4		5								
	(kms)	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay							
0	10	2629	1127	-	-	3694	690	3665	602	-	-	3329.3	10.81	806.3	2523.0	14.3		
1																		
1	10	1936	-	-	-	1996	280	2120	273	-	-	2017.3	17.85	276.5	1740.8	20.7		
2																		
2	10	1536	46	-	-	2421	332	2405	315	-	-	2120.7	16.98	231.0	1889.7	19.1		
3																		
3	10	2279	52	-	-	1704	162	1790	140	-	-	1924.3	18.71	118.0	1806.3	19.9		
4																		
Total Trip Length	40	Sum of Travel Time and Delay per Run										Total Averages						
		8380	1225	-	-	9815	1464	9980	1330	-	-	(ATTT)	(ATTS)	(ATTD)	(ARTT)	(ATRS)		
Running Time Per Run		7155		-		8351		8650		-		9391.7	15.3	1339.7	8052.0	17.9		



TRAVEL TIME AND DELAY STUDY FIELD SUMMARY TABLE FOR 6-AXLE TRAILERS

TRAVEL TIME AND DELAY STUDY FIELD SUMMARY TABLE FOR 6-AXLE TRAILERS																					
Road Name:		National Highway (N-5)				Posted Speed Limit:				30 - 60 Km/hr.											
City:		Peshawar - Landi Kotal - Torkham				Company				ACC											
Observer Name:		Muhammad Zeeshan																			
Direction:		Peshawar - Torkham		Peshawar - Torkham		Torkham - Peshawar		Torkham - Peshawar		Torkham - Peshawar		Average Travel Time (ATT)	Average Travel Speed (ATS)	Average Delay (AD)	Average Running Time (ART)	Average Running Speed (ARS)					
Date:		12/2/2018		13/2/2018		12/2/2018		13/2/2018		13/2/2018											
Day:		Monday		Tuesday		Monday		Tuesday		Tuesday											
Time:		0800 Hrs. - 1020 Hrs.		0800 Hrs. - 1030 Hrs.		1430 Hrs. - 1630 Hrs.		1030 Hrs. - 1300 Hrs.		1030 Hrs. - 1300 Hrs.											
Weather:		Rainy		Cloudy		Rainy		Partially Cloudy		Partially Cloudy											
Period		Morning		Morning		After Noon		Morning - Noon		Morning - Noon											
Control Points	Trip Length	Travel Time and Delay in Seconds																			
		1		2		3		4		5											
	(kms)	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay	Travel Time	Delay										
0	10	2040	536	2780	1054	2925	224	2930	117	2905	97						2716.0	13.3	405.6	2310.4	15.6
1																					
1	10	1740	74	1835	-	1515	260	1642	87	1663	59	1679.0	21.4	120.0	1559.0	23.1					
2																					
2	10	1467	71	1425	64	1053	-	2568	-	2564	-	1815.4	19.8	67.5	1747.9	20.6					
3																					
3	10	2853	179	2780	341	1337	123	1275	121	1494	121	1947.8	18.5	177.0	1770.8	20.3					
4																					
Total Trip Length	40	Sum of Travel Time and Delay per Run										Total Averages									
		8100	860	8820	1459	6830	607	8415	325	8626	277	(ATTT)	(ATTS)	(ATTD)	(ARTT)	(ATRS)					
Running Time Per Run		7240		7361		6223		8090		8349		8158.2	17.7	705.6	7452.6	19.3					



ANNEX C: OD Survey Data

Table A2 - Origin Destination of Passenger Vehicles at Jamrud

destinations	pes h	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total	
origins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
pes h	1	13	7	39	56	43	10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	169
bara	2	11	0	3	14	17	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	49
jmrd	3	22	0	0	14	3	4	0	0	0	0	1	0	0	0	0	1	1	0	0	0	46
lndktl	4	66	3	18	1	7	3	0	2	0	3	4	0	0	0	0	2	0	0	0	0	109
trkmp	5	51	0	6	0	0	0	0	0	0	0	13	2	0	0	0	3	0	0	0	0	75
trkmaf	6	43	2	3	0	0	0	0	1	0	1	3	0	0	0	0	1	0	0	0	0	54
pqa	7	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
kpt	8	1	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
gwd	9	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
kpk	10	0	3	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
pnjb	11	0	0	3	3	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
sind	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
bal	13	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ajk	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gb	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
isbd	16	2	0	1	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
jlabd	17	5	0	1	0	2	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	11
kabul	18	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
afgh	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		218	15	78	98	94	22	0	4	0	5	22	2	0	0	0	11	1	1	1	0	572



Table A3 - Origin Destinations of Passenger Cars at Jamrud

destinations \ origins	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total	
pesh	1	0	2	14	27	27	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	75
bara	2	9	0	2	2	14	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	28
jmrđ	3	3	0	0	2	2	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	10
lndktl	4	16	1	2	1	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	23
trkmp	5	33	0	3	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	40
trkmaf	6	24	0	3	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	29
pqa	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
kpt	8	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
gwd	9	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
kpk	10	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
pnjb	11	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
sind	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bal	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ajk	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gb	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
isbd	16	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
jlabd	17	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4
kabul	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
afgh	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	89	5	25	34	56	6	0	1	0	1	7	0	0	0	0	4	0	0	1	0	229	



Table A4 - Origin Destinations of Wagons at Jamrud																					
destinations \ origins	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total
pesh	1	4	9	11	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38
bara	2	1	0	6	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	11
jmrđ	3	4	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
lndktl	4	14	1	5	0	2	0	2	0	1	0	0	0	0	0	0	1	0	0	0	26
trkmp	5	10	0	2	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	16
trkmaf	6	5	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8
pqa	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
kpt	8	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
gwd	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
kpk	10	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pnjb	11	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
sind	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bal	13	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ajk	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gb	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
isbd	16	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
jlabd	17	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
kabul	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
afgh	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	38	7	18	27	16	5	0	2	0	3	3	0	0	0	0	3	0	0	0	0	122



Table A5 - Origin Destinations of passenger vehicles at Landikotal

destinations \ origins	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total	
pesh	1	0	0	0	12	4	3	0	0	0	0	0	0	0	0	0	0	2	11	0	0	32
bara	2	0	0	0	5	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	14
jmrđ	3	0	0	0	2	30	9	0	0	0	0	0	0	0	0	0	0	1	10	0	0	52
lndktl	4	5	12	13	0	0	0	1	2	5	1	0	9	0	14	0	0	0	0	11	0	73
trkmp	5	27	0	15	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	56
trkmaf	6	1	0	3	0	0	0	17	18	0	0	1	1	8	1	15	0	3	0	0	0	68
pqa	7	0	0	0	19	4	4	0	0	0	0	0	0	0	0	0	0	0	25	0	0	52
kpt	8	0	0	0	9	2	13	0	0	0	0	0	1	0	0	0	0	11	4	0	0	40
gwd	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	1	0	12
kpk	10	0	0	0	4	2	4	0	0	0	0	0	0	0	0	0	0	5	0	0	0	15
pnjb	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sind	12	0	0	0	11	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
bal	13	0	0	0	9	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
ajk	14	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
gb	15	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	17	0	0	21
isbd	16	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
jlabd	17	23	0	5	0	0	0	2	1	0	37	0	0	2	0	0	0	0	0	0	0	70
kabul	18	3	3	18	0	0	0	0	7	1	0	0	3	1	1	1	1	0	0	20	0	59
afgh	19	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	59	15	54	96	50	45	34	28	6	38	1	14	11	16	16	1	33	69	32	0	618	



Table A6 -Origin Destinations ofCars at Landikotal

destinations	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total	
origins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
pesh	1	0	0	0	7	1	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	11
bara	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
jmrđ	3	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	11
lndktl	4	0	2	3	0	0	0	1	0	1	0	0	4	0	7	0	0	0	0	5	0	23
trkmp	5	9	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	15
trkmaf	6	0	0	1	0	0	0	3	10	0	0	0	0	3	1	1	0	2	0	0	0	21
pqa	7	0	0	0	7	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	14
kpt	8	0	0	0	5	0	6	0	0	0	0	0	0	0	0	0	0	2	1	0	0	14
gwd	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
kpk	10	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
pnjb	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sind	12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
bal	13	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
ajk	14	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
gb	15	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	0	0	9
isbd	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jlabd	17	6	0	3	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	21
kabul	18	3	1	1	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	7	0	18
afgh	19	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	18	3	11	26	6	17	7	13	1	12	0	7	3	8	1	0	7	20	12	0	172	



destinations	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total	
origins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
pesh	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
bara	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
jmrđ	3	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	7
lndktl	4	1	4	1	0	0	0	0	2	2	0	0	2	0	6	0	0	0	0	2	0	20
trkmp	5	7	0	10	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	21
trkmaf	6	1	0	2	0	0	0	3	4	0	0	0	0	5	0	2	0	0	0	0	0	17
pqa	7	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	21
kpt	8	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	7	1	0	0	14
gwd	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5
kpk	10	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	8
pnjb	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sind	12	0	0	0	9	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
bal	13	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
ajk	14	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
gb	15	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	6
isbd	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jlabd	17	6	0	1	0	0	0	2	0	0	10	0	0	1	0	0	0	0	0	0	0	20
kabul	18	0	1	4	0	0	0	0	3	0	0	0	0	0	0	1	1	0	0	6	0	16
afgh	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	5	18	30	14	13	9	9	2	10	0	2	6	6	3	1	16	21	8	0	188	



destinations	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	Total	
origins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
pesh	1	0	2	0	33	50	31	0	0	0	0	0	0	0	0	0	0	5	11	6	0	138
bara	2	4	0	0	35	66	28	0	0	0	0	0	0	0	0	0	0	3	11	2	0	149
jmrđ	3	2	0	0	15	50	27	0	0	0	0	0	0	0	0	0	0	3	11	1	0	109
lndktl	4	20	17	15	1	17	6	22	31	12	0	7	11	4	6	5	8	3	3	8	0	196
trkmp	5	63	46	44	22	83	1	32	48	39	2	9	16	10	9	6	20	1	0	0	0	451
trkmaf	6	36	27	23	8	0	2	23	42	25	1	4	16	9	3	7	18	0	1	0	0	245
pqa	7	0	0	0	14	13	11	0	0	0	0	0	0	0	0	0	0	5	8	3	0	54
kpt	8	0	0	0	7	30	14	0	0	0	0	0	0	0	0	0	0	9	8	5	0	73
gwd	9	0	0	0	7	17	15	0	0	0	0	0	0	0	0	0	0	6	5	2	0	52
kpk	10	0	0	0	2	6	7	0	0	0	0	0	0	0	0	0	0	4	4	9	0	32
pnjb	11	0	0	0	3	11	3	0	0	0	0	0	0	0	0	1	0	2	7	3	0	30
sind	12	0	0	0	19	15	6	0	0	0	0	0	0	0	0	0	0	6	5	3	0	54
bal	13	0	0	0	7	7	9	0	0	0	0	0	0	0	0	0	0	5	5	4	0	37
ajk	14	0	0	0	6	11	5	0	0	0	0	0	0	0	0	0	0	2	6	0	0	30
gb	15	0	0	0	4	9	10	0	0	0	0	0	0	0	0	0	0	7	5	0	0	35
isbd	16	0	0	0	6	12	8	0	0	0	0	0	0	0	0	0	0	6	8	2	0	42
jlabd	17	31	16	10	2	0	0	7	13	6	21	1	6	3	2	2	14	0	0	0	0	134
kabul	18	30	10	20	3	0	0	9	9	9	0	8	7	4	5	3	17	0	0	10	0	144
afgh	19	13	4	3	5	0	0	2	0	0	0	3	0	0	1	0	5	0	0	0	0	36
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	199	122	115	199	397	183	95	143	91	24	32	56	30	26	24	82	67	98	58	0	2041	



destinations	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
origins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
pesh	1	0	2	0	23	32	20	0	0	0	0	0	0	0	0	0	0	4	7	4	0	92
bara	2	0	0	0	25	50	23	0	0	0	0	0	0	0	0	0	0	3	9	1	0	111
jmrđ	3	0	0	0	12	27	21	0	0	0	0	0	0	0	0	0	0	3	8	1	0	72
lndktl	4	17	17	10	1	10	5	18	24	11	0	7	8	4	2	3	7	0	2	4	0	150
trkmp	5	40	37	31	16	60	1	24	41	26	2	5	12	5	7	6	13	1	0	0	0	327
trkmaf	6	23	20	20	7	0	2	14	34	21	1	3	12	7	2	1	12	0	1	0	0	180
pqa	7	0	0	0	9	8	8	0	0	0	0	0	0	0	0	0	0	3	3	2	0	33
kpt	8	0	0	0	5	17	10	0	0	0	0	0	0	0	0	0	0	4	6	5	0	47
gwd	9	0	0	0	6	9	9	0	0	0	0	0	0	0	0	0	0	5	2	1	0	32
kpk	10	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	4	2	5	0	17
pnjb	11	0	0	0	2	6	2	0	0	0	0	0	0	0	0	1	0	0	6	1	0	18
sind	12	0	0	0	12	13	5	0	0	0	0	0	0	0	0	0	0	6	2	3	0	41
bal	13	0	0	0	2	4	6	0	0	0	0	0	0	0	0	0	0	4	3	2	0	21
ajk	14	0	0	0	3	5	4	0	0	0	0	0	0	0	0	0	0	2	5	0	0	19
gb	15	0	0	0	3	4	8	0	0	0	0	0	0	0	0	0	0	1	4	0	0	20
isbd	16	0	0	0	6	9	7	0	0	0	0	0	0	0	0	0	0	1	7	2	0	32
jlabd	17	18	16	8	0	0	0	6	12	4	6	1	6	3	1	2	10	0	0	0	0	93
kabul	18	19	9	9	1	0	0	6	8	7	0	7	5	3	4	3	14	0	0	8	0	103
afgh	19	7	4	1	3	0	0	1	0	0	0	2	0	0	1	0	2	0	0	0	0	21
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		124	105	79	136	256	135	69	119	69	9	25	43	22	17	16	58	41	67	39	0	1429



	pesh	bara	jmrđ	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
destinations	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
origins	0	0	0	7	16	10	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	37
bara	2	4	0	0	9	16	5	0	0	0	0	0	0	0	0	0	0	0	2	1	0	37
jmrđ	3	2	0	0	3	16	6	0	0	0	0	0	0	0	0	0	0	0	3	0	0	30
lndktl	4	3	0	3	0	5	0	4	6	1	0	0	3	0	4	2	1	3	1	1	0	37
trkmp	5	19	8	13	5	3	0	5	7	13	0	4	4	4	2	0	6	0	0	0	0	93
trkmaf	6	13	6	3	1	0	0	7	6	3	0	1	4	2	1	0	6	0	0	0	0	53
pqa	7	0	0	0	5	5	3	0	0	0	0	0	0	0	0	0	0	2	5	1	0	21
kpt	8	0	0	0	1	11	4	0	0	0	0	0	0	0	0	0	0	5	2	0	0	23
gwd	9	0	0	0	1	6	5	0	0	0	0	0	0	0	0	0	0	1	2	1	0	16
kpk	10	0	0	0	2	3	3	0	0	0	0	0	0	0	0	0	0	0	2	4	0	14
pnjb	11	0	0	0	1	5	1	0	0	0	0	0	0	0	0	0	0	2	1	2	0	12
sind	12	0	0	0	7	1	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	12
bal	13	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	1	2	2	0	10
ajk	14	0	0	0	3	6	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	11
gb	15	0	0	0	1	5	2	0	0	0	0	0	0	0	0	0	0	5	1	0	0	14
isbd	16	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	5	1	0	0	9
jlabd	17	6	0	2	2	0	0	1	1	2	5	0	0	0	1	0	4	0	0	0	0	24
kabul	18	11	1	6	2	0	0	2	1	2	0	1	2	1	1	0	3	0	0	1	0	34
afgh	19	6	0	2	2	0	0	1	0	0	0	1	0	0	0	0	3	0	0	0	0	15
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	64	15	29	52	102	45	20	21	21	5	7	13	7	9	2	23	25	27	15	0	502	



Table A 11 - origin destination of goods vehicles at Jamrud

origins	671	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
pesh	1	0	1	0	10	12	21	1	1	0	0	0	0	0	0	0	0	0	24	22	15	0	107
bara	2	1	0	0	0	3	10	0	0	0	0	0	0	0	0	0	0	0	2	7	6	0	29
jmrd	3	6	5	1	10	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	26
lndktl	4	41	2	12	1	3	3	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	67
trkmp	5	24	4	4	0	0	0	0	5	0	1	4	0	0	0	0	0	0	0	0	0	0	42
trkmaf	6	28	0	8	0	0	0	0	8	0	6	11	1	0	0	0	0	0	0	0	0	0	62
pqa	7	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
kpt	8	1	1	1	2	2	9	0	0	0	0	0	0	1	0	0	0	0	12	21	7	0	57
gwd	9	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5
kpk	10	0	0	2	1	2	6	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	13
pnjb	11	1	2	0	3	8	10	0	0	0	0	0	0	0	0	0	0	0	17	28	18	0	87
sind	12	0	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8
bal	13	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
ajk	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
gb	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
isbd	16	2	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	2	9	7	0	26
jlabd	17	22	1	1	2	0	0	0	5	0	8	14	0	0	0	0	0	0	0	0	0	0	53
kabul	18	21	1	4	0	1	0	0	26	0	1	14	0	0	0	0	0	0	0	0	0	0	68
afgh	19	3	0	0	0	0	0	0	9	0	1	4	0	0	0	0	0	0	0	0	0	0	17
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		152	18	35	36	35	65	1	54	0	17	53	1	1	0	0	0	59	90	54	0	671	



Table A12 - Origin Destination of Goods Vehicles at Landikotal

orogins	690	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
pesh	1	0	0	0	19	5	9	0	0	0	0	0	0	0	0	0	0	0	6	15	0	0	54
bara	2	0	0	0	14	5	0	0	0	0	0	0	0	0	0	0	0	0	3	9	0	0	31
jmrd	3	0	0	0	2	14	8	0	0	0	0	0	0	0	0	0	0	0	5	14	0	0	43
lndktl	4	17	14	9	0	0	0	7	5	9	5	0	10	6	6	1	1	0	0	1	0	0	91
trkmp	5	16	4	7	0	0	0	9	5	7	2	4	8	0	5	0	3	0	0	0	2	0	72
trkmaf	6	5	0	8	0	0	0	7	15	1	3	1	1	5	2	10	0	7	0	0	0	0	65
pqa	7	0	0	0	24	4	0	0	0	0	0	0	0	0	0	0	0	0	3	7	0	0	38
kpt	8	0	0	0	9	6	14	0	0	0	0	0	1	0	0	0	0	0	10	13	0	0	53
gwd	9	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	9	0	7	0	20
kpk	10	0	0	0	7	7	5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	21
pnjb	11	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
sind	12	0	0	0	4	6	4	0	0	0	0	0	0	0	0	0	0	0	4	8	0	0	26
bal	13	0	0	0	4	0	9	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	15
ajk	14	0	0	0	7	2	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	15
gb	15	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	2	6	0	0	12
isbd	16	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	8
jlabd	17	11	0	5	0	0	0	4	1	2	10	0	8	3	3	0	2	0	0	0	0	0	49
kabul	18	8	4	8	0	0	0	8	17	5	2	0	5	2	1	1	1	0	0	4	0	0	66
afgh	19	0	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	8
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		57	22	38	97	56	59	35	43	24	23	5	33	16	17	12	7	53	79	14	0	690	



Table A13 - Origin Destination of Containers at Landikotal

origins	376	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total		
pesh	1	0	0	0	10	4	5	0	0	0	0	0	0	0	0	0	0	0	6	10	0	0	35	
bara	2	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	10	
jmrd	3	0	0	0	1	12	3	0	0	0	0	0	0	0	0	0	0	0	3	12	0	0	31	
lndktl	4	9	8	4	0	0	0	4	4	8	2	0	7	0	5	0	1	0	0	0	0	0	52	
trkmp	5	11	0	5	0	0	0	4	0	1	2	3	1	0	4	0	0	0	0	0	1	0	32	
trkmaf	6	2	0	3	0	0	0	7	3	0	3	1	0	4	1	6	0	4	0	0	0	0	34	
pqa	7	0	0	0	12	2	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	19	
kpt	8	0	0	0	9	0	8	0	0	0	0	0	0	0	0	0	0	0	7	9	0	0	33	
gwd	9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5	0	7	0	0	13	
kpk	10	0	0	0	3	7	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	15	
pnjb	11	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	
sind	12	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6	
bal	13	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	10	
ajk	14	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6	
gb	15	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4	
isbd	16	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	7	
jlabd	17	8	0	4	0	0	0	1	1	1	7	0	3	0	0	0	0	0	0	0	0	0	0	25
kabul	18	7	4	5	0	0	0	0	7	2	1	0	4	2	1	1	1	0	0	3	0	0	38	
afgh	19	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
total		37	12	22	47	33	32	16	15	12	16	4	15	6	11	7	2	33	45	11	0	0	376	



Table A14 - Origin Destination of Goods Vehicles at Torkham

origins	2273	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total
pesh	1	3	0	0	17	30	46	0	0	0	0	0	0	0	0	1	1	62	42	8	1	211
bara	2	3	0	0	26	40	27	1	0	0	0	1	1	0	0	0	0	10	19	0	0	128
jmrd	3	0	0	0	18	24	22	0	1	0	0	0	0	0	0	0	0	16	15	0	0	96
lndktl	4	15	19	11	0	0	1	13	23	13	1	2	8	7	16	13	5	1	0	0	0	148
trkmp	5	65	31	21	5	1	0	21	41	23	0	9	25	9	12	5	13	0	0	0	0	281
trkmaf	6	24	18	24	0	0	2	22	28	11	4	8	28	14	5	5	3	1	0	0	0	197
pqa	7	0	0	0	7	22	20	0	0	0	0	0	0	0	0	0	0	16	14	2	0	81
kpt	8	2	0	0	25	40	40	0	0	0	0	0	0	0	0	0	0	46	40	1	0	194
gwd	9	0	0	0	23	26	16	0	0	0	0	0	0	0	0	0	0	16	16	2	0	99
kpk	10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4
pnjb	11	0	0	0	3	10	6	0	0	0	1	0	0	0	0	0	0	17	20	7	0	64
sind	12	0	0	0	9	25	21	0	0	0	0	0	0	0	0	0	0	14	15	0	0	84
bal	13	0	0	0	14	13	16	0	0	0	0	0	0	0	0	0	0	10	8	0	0	61
ajk	14	0	0	0	5	9	10	0	0	0	0	0	0	0	0	0	0	4	8	0	0	36
gb	15	0	0	0	10	12	22	0	0	0	0	0	0	0	0	0	0	15	7	1	0	67
isbd	16	0	0	0	5	9	6	0	0	0	0	0	0	0	0	0	0	9	14	0	0	43
jlabd	17	51	14	5	1	0	0	9	64	9	4	24	19	4	2	6	9	0	0	0	0	221
kabul	18	48	8	9	1	0	0	12	56	13	2	8	15	5	6	5	7	0	0	1	0	196
afgh	19	48	1	3	0	3	0	0	3	0	0	1	0	0	0	0	0	0	3	0	0	62
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		259	91	73	169	264	256	78	216	69	12	53	96	39	41	35	38	240	221	22	1	2273



Table A14 - Origin Destination of Goods Vehicles at Torkham

origins	2273	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total
pesh	1	3	0	0	17	30	46	0	0	0	0	0	0	0	0	1	1	62	42	8	1	211
bara	2	3	0	0	26	40	27	1	0	0	0	1	1	0	0	0	0	10	19	0	0	128
jmrd	3	0	0	0	18	24	22	0	1	0	0	0	0	0	0	0	0	16	15	0	0	96
lndktl	4	15	19	11	0	0	1	13	23	13	1	2	8	7	16	13	5	1	0	0	0	148
trkmp	5	65	31	21	5	1	0	21	41	23	0	9	25	9	12	5	13	0	0	0	0	281
trkmaf	6	24	18	24	0	0	2	22	28	11	4	8	28	14	5	5	3	1	0	0	0	197
pqa	7	0	0	0	7	22	20	0	0	0	0	0	0	0	0	0	0	16	14	2	0	81
kpt	8	2	0	0	25	40	40	0	0	0	0	0	0	0	0	0	0	46	40	1	0	194
gwd	9	0	0	0	23	26	16	0	0	0	0	0	0	0	0	0	0	16	16	2	0	99
kpk	10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4
pnjb	11	0	0	0	3	10	6	0	0	0	1	0	0	0	0	0	0	17	20	7	0	64
sind	12	0	0	0	9	25	21	0	0	0	0	0	0	0	0	0	0	14	15	0	0	84
bal	13	0	0	0	14	13	16	0	0	0	0	0	0	0	0	0	0	10	8	0	0	61
ajk	14	0	0	0	5	9	10	0	0	0	0	0	0	0	0	0	0	4	8	0	0	36
gb	15	0	0	0	10	12	22	0	0	0	0	0	0	0	0	0	0	15	7	1	0	67
isbd	16	0	0	0	5	9	6	0	0	0	0	0	0	0	0	0	0	9	14	0	0	43
jlabd	17	51	14	5	1	0	0	9	64	9	4	24	19	4	2	6	9	0	0	0	0	221
kabul	18	48	8	9	1	0	0	12	56	13	2	8	15	5	6	5	7	0	0	1	0	196
afgh	19	48	1	3	0	3	0	0	3	0	0	1	0	0	0	0	0	0	3	0	0	62
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		259	91	73	169	264	256	78	216	69	12	53	96	39	41	35	38	240	221	22	1	2273



Table A15 = Origin Destination of Articulated vehicles at Torkham

origins	1038	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
pesh	1	1	0	0	7	11	21	0	0	0	0	0	0	0	0	0	0	0	27	26	7	0	100
bara	2	2	0	0	8	26	9	0	0	0	0	1	1	0	0	0	0	0	6	6	0	0	59
jmrd	3	0	0	0	10	6	13	0	1	0	0	0	0	0	0	0	0	0	5	5	0	0	40
lndktl	4	7	7	5	0	0	1	7	13	7	0	0	0	2	2	11	7	3	0	0	0	0	72
trkmp	5	17	15	11	1	0	0	13	13	8	0	4	12	3	3	4	5	0	0	0	0	0	109
trkmaf	6	5	9	12	0	0	0	10	11	4	2	4	15	8	2	2	3	0	0	0	0	0	87
pqa	7	0	0	0	3	9	8	0	0	0	0	0	0	0	0	0	0	0	6	9	1	0	36
kpt	8	1	0	0	11	18	16	0	0	0	0	0	0	0	0	0	0	0	12	14	1	0	73
gwd	9	0	0	0	8	14	4	0	0	0	0	0	0	0	0	0	0	0	5	8	0	0	39
kpk	10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
pnjb	11	0	0	0	2	6	2	0	0	0	0	0	0	0	0	0	0	0	11	19	7	0	47
sind	12	0	0	0	4	13	10	0	0	0	0	0	0	0	0	0	0	0	10	2	0	0	39
bal	13	0	0	0	3	5	10	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0	27
ajk	14	0	0	0	1	5	6	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	18
gb	15	0	0	0	8	8	6	0	0	0	0	0	0	0	0	0	0	0	11	2	1	0	36
isbd	16	0	0	0	4	5	4	0	0	0	0	0	0	0	0	0	0	0	5	10	0	0	28
jlabd	17	31	7	1	0	0	0	3	20	4	2	13	12	2	1	2	6	0	0	0	0	0	104
kabul	18	36	4	6	0	0	0	8	12	11	1	5	7	4	3	3	3	0	0	1	0	0	104
afgh	19	17	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		117	43	36	70	126	111	41	70	34	5	27	49	19	20	18	20	106	108	18	0	0	1038



Table A16 - Origin Destination of containers at Torkham

origins	624	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
pesh	1	0	0	0	7	9	1	0	0	0	0	0	0	0	0	0	0	1	11	9	0	1	39
bara	2	1	0	0	7	4	7	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	25
jmrd	3	0	0	0	3	8	6	0	0	0	0	0	0	0	0	0	0	0	6	7	0	0	30
lndktl	4	6	8	2	0	0	0	5	5	3	0	1	5	3	2	5	2	0	0	0	0	0	47
trkmp	5	12	8	8	0	0	0	5	15	5	0	2	5	5	4	0	7	0	0	0	0	0	76
trkmaf	6	7	3	5	0	0	1	6	8	3	2	2	6	2	1	1	0	0	0	0	0	0	47
pqa	7	0	0	0	2	7	8	0	0	0	0	0	0	0	0	0	0	0	5	3	1	0	26
kpt	8	0	0	0	5	12	9	0	0	0	0	0	0	0	0	0	0	0	31	18	0	0	75
gwd	9	0	0	0	8	6	5	0	0	0	0	0	0	0	0	0	0	0	5	4	1	0	29
kpk	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
pnjb	11	0	0	0	1	1	2	0	0	0	1	0	0	0	0	0	0	0	3	1	0	0	9
sind	12	0	0	0	3	6	4	0	0	0	0	0	0	0	0	0	0	0	4	8	0	0	25
bal	13	0	0	0	2	3	4	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	15
ajk	14	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	8
gb	15	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	12
isbd	16	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	6
jlabd	17	12	3	1	0	0	0	3	38	2	2	4	3	1	0	1	1	0	0	0	0	0	71
kabul	18	8	2	1	1	0	0	0	38	0	0	1	4	0	1	0	3	0	0	0	0	0	59
afgh	19	10	0	2	0	3	0	0	3	0	0	1	0	0	0	0	0	0	0	3	0	0	22
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		56	24	19	41	62	56	19	107	13	5	11	23	11	8	7	14	78	67	2	1	624	



Table 17 - Origin Destination of 3 axle trucks at Torkham

		pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia		
origins	328	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	total	
pesh	1	1	0	0	1	6	14	0	0	0	0	0	0	0	0	0	0	0	16	1	0	0	39
bara	2	0	0	0	7	5	7	1	0	0	0	0	0	0	0	0	0	0	1	4	0	0	25
jmrd	3	0	0	0	4	4	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	11
lndktl	4	2	1	3	0	0	0	1	1	1	0	0	1	0	2	1	0	1	0	0	0	0	14
trkmp	5	17	4	2	1	0	0	0	7	6	0	2	4	0	1	1	0	0	0	0	0	0	45
trkmaf	6	6	4	4	0	0	1	3	6	2	0	1	3	3	1	2	0	1	0	0	0	0	37
pqa	7	0	0	0	2	4	4	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0	16
kpt	8	1	0	0	7	7	5	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	27
gwd	9	0	0	0	4	3	3	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	16
kpk	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pnjb	11	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
sind	12	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	10
bal	13	0	0	0	5	3	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10
ajk	14	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3
gb	15	0	0	0	1	2	6	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	12
isbd	16	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	5
jlabd	17	5	1	2	1	0	0	2	4	3	0	4	3	0	1	2	0	0	0	0	0	0	28
kabul	18	3	0	1	0	0	0	2	3	0	1	1	1	1	0	1	0	0	0	0	0	0	14
afgh	19	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	total	49	10	12	36	37	46	9	21	12	1	8	12	4	5	7	0	31	28	0	0	0	328



Table A18 - Origin Destination of 2 Axle Trucks at torkham

origins	2273	pesh	bara	jmrd	lndktl	trkmp	trkmaf	pqa	kpt	gwd	kpk	pnjb	sind	bal	ajk	gb	isbd	jlabd	kabul	afgh	casia	total	
pesh	1	1	0	0	2	1	4	0	0	0	0	0	0	0	0	0	0	0	3	4	1	0	16
bara	2	0	0	0	4	3	4	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	17
jmrd	3	0	0	0	1	6	2	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	15
lndktl	4	0	3	1	0	0	0	0	3	1	1	1	0	2	1	0	0	0	0	0	0	0	13
trkmp	5	14	4	0	2	1	0	3	5	2	0	0	4	1	3	0	1	0	0	0	0	0	40
trkmaf	6	6	2	2	0	0	0	3	3	2	0	1	3	1	1	0	0	0	0	0	0	0	24
pqa	7	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
kpt	8	0	0	0	2	3	6	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	15
gwd	9	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	14
kpk	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pnjb	11	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	6
sind	12	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
bal	13	0	0	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	9
ajk	14	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	6
gb	15	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7
isbd	16	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4
jlabd	17	3	3	1	0	0	0	1	2	0	0	3	1	1	0	0	2	0	0	0	0	0	17
kabul	18	1	2	0	0	0	0	2	3	2	0	1	2	0	1	1	1	0	0	0	0	0	16
afgh	19	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
casia	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total		32	14	4	21	34	30	9	16	7	1	6	10	5	6	1	4	20	16	2	0	238	



ANNEX D: Economic Analysis Data



H D M - 4

HIGHWAY DEVELOPMENT & MANAGEMENT

Economic Analysis Summary

Study Name: Peshawar - Torkham

Run Date: 14-03-2018

This report shows total economic benefits using the following:

Currency: Rupees (millions).

Discount rate: 10.00%.

Analysis Mode: Analysis-by-Section

Section: Peshawar - Torkham Motorway
Alternative: Improvement Torkham vs Base Alternative

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	28,879.01	671.43	0.00	63,083.72	117,450.08	0.00	0.00	0.00	150,983.36
Discounted	25,410.01	227.92	0.00	12,591.73	21,242.51	0.00	0.00	0.00	8,196.32

Economic Internal Rate of Return (EIRR) = 12.5% (No. of solutions = 1)



HDM - 4

ROADWAY DEVELOPMENT & MANAGEMENT

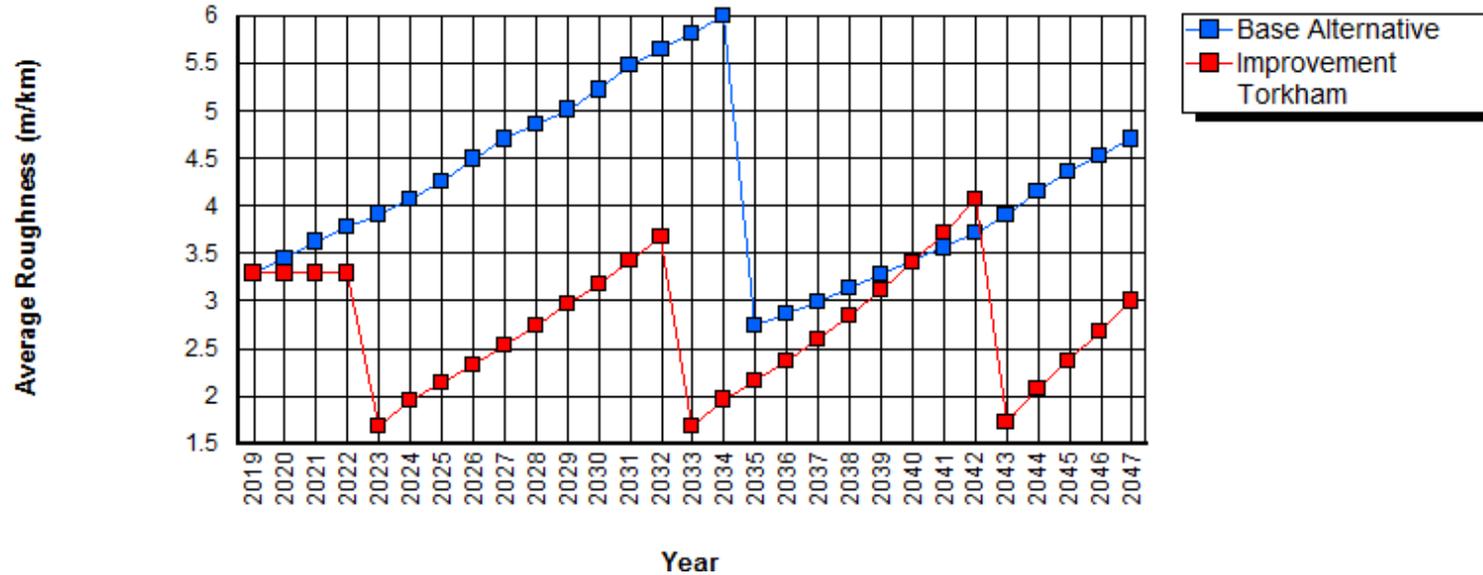
Average Roughness by Section (Graph)

Study Name: Peshawar - Torkham

Run Date: 14-03-2018

Section Details:

ID: Torkham	Road Class: Primary or Trunk	Length: 40.00km	Rise + Fall: 120.00m/km
Description: Peshawar - Torkham Motorway	Width: 7.30m	Curvature: 38.00deg/km	





Annual Discounted Net Benefit Streams

Year	Capital Works	Recurrent Works	Special Works	Normal (+ Diverted) Traffic			Generated Traffic			Accident Cost Reduction	Net Exogenous Benefits	Total Net Benefits
				MT VOC	MT Time	NMT Time & Operation	MT VOC	MT Time	NMT Time & Operation			
				2019	3,060.50	17.00	0.00	0.00	0.00			
2020	5,564.55	15.45	0.00	18.05	0.21	0.00	0.00	0.00	0.00	0.00	-5,561.74	
2021	7,572.58	14.05	0.00	38.13	0.45	0.00	0.00	0.00	0.00	0.00	-7,548.04	
2022	9,197.60	19.10	0.00	52.82	0.70	0.00	0.00	0.00	0.00	0.00	-9,163.19	
2023	0.00	16.26	0.00	644.35	909.53	0.00	0.00	0.00	0.00	0.00	1,537.63	
2024	0.00	14.78	0.00	635.83	899.73	0.00	0.00	0.00	0.00	0.00	1,520.78	
2025	0.00	13.43	0.00	631.52	891.92	0.00	0.00	0.00	0.00	0.00	1,510.01	
2026	-9.59	12.21	0.00	631.95	886.07	0.00	0.00	0.00	0.00	0.00	1,515.40	
2027	0.00	11.10	0.00	629.57	882.34	0.00	0.00	0.00	0.00	0.00	1,500.80	
2028	0.00	10.09	0.00	619.96	880.18	0.00	0.00	0.00	0.00	0.00	1,490.04	
2029	0.00	9.18	0.00	610.35	880.41	0.00	0.00	0.00	0.00	0.00	1,481.58	
2030	0.00	8.34	0.00	599.65	883.20	0.00	0.00	0.00	0.00	0.00	1,474.50	
2031	-5.95	7.58	0.00	585.96	888.57	0.00	0.00	0.00	0.00	0.00	1,472.90	
2032	354.53	6.89	0.00	564.79	892.09	0.00	0.00	0.00	0.00	0.00	1,095.45	
2033	0.00	6.27	0.00	614.01	900.13	0.00	0.00	0.00	0.00	0.00	1,507.87	
2034	-244.17	5.70	0.00	606.63	891.62	0.00	0.00	0.00	0.00	0.00	1,736.71	
2035	0.00	5.18	0.00	413.94	880.63	0.00	0.00	0.00	0.00	0.00	1,289.38	
2036	0.00	4.71	0.00	411.16	875.84	0.00	0.00	0.00	0.00	0.00	1,282.30	
2037	0.00	4.28	0.00	411.64	872.98	0.00	0.00	0.00	0.00	0.00	1,280.34	
2038	0.00	3.89	0.00	406.29	852.72	0.00	0.00	0.00	0.00	0.00	1,255.12	
2039	-2.78	3.54	0.00	396.05	831.36	0.00	0.00	0.00	0.00	0.00	1,226.65	
2040	0.00	3.22	0.00	384.42	813.20	0.00	0.00	0.00	0.00	0.00	1,194.40	
2041	0.00	2.92	0.00	373.72	798.30	0.00	0.00	0.00	0.00	0.00	1,169.09	
2042	136.69	2.66	0.00	359.63	795.00	0.00	0.00	0.00	0.00	0.00	1,015.28	
2043	0.00	2.42	0.00	407.30	803.36	0.00	0.00	0.00	0.00	0.00	1,208.25	
2044	-1.72	2.20	0.00	402.70	802.03	0.00	0.00	0.00	0.00	0.00	1,204.26	
2045	0.00	2.00	0.00	395.71	790.24	0.00	0.00	0.00	0.00	0.00	1,183.95	
2046	0.00	1.82	0.00	380.54	742.64	0.00	0.00	0.00	0.00	0.00	1,121.37	
2047	-212.23	1.65	0.00	365.06	697.07	0.00	0.00	0.00	0.00	0.00	1,272.70	
Total:	25,410.01	227.92	0.00	12,591.73	21,242.51	0.00	0.00	0.00	0.00	0.00	0.00	8,196.31



Average Costs per Vehicle Km

Section:	Peshawar - Torkham Motorway						
Alternative:	Base Alternative						
Sect ID:	Torkham			Road Class:	Primary or Trunk		
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average		Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip	
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User Cost	VOC	Travel Time	Road User Cost
Bus							
2019	30.63	72.97	115.82	188.79	2,918.83	4,632.84	7,551.67
2020	30.43	73.47	116.61	190.08	2,938.92	4,664.42	7,603.34
2021	30.23	74.06	117.44	191.50	2,962.41	4,697.56	7,659.97
2022	30.02	74.60	118.31	192.91	2,983.91	4,732.41	7,716.32
2023	29.81	75.10	119.18	194.28	3,003.91	4,767.12	7,771.03
2024	29.60	75.66	120.08	195.74	3,026.35	4,803.34	7,829.69
2025	29.37	76.33	121.05	197.38	3,053.05	4,842.07	7,895.12
2026	29.14	77.16	122.09	199.25	3,086.28	4,883.56	7,969.84
2027	28.91	77.95	123.09	201.04	3,117.93	4,923.54	8,041.47
2028	28.67	78.59	124.17	202.76	3,143.78	4,966.76	8,110.54
2029	28.43	79.32	125.30	204.62	3,172.72	5,012.19	8,184.91
2030	28.18	80.20	126.48	206.68	3,207.94	5,059.12	8,267.06
2031	27.94	81.26	127.62	208.88	3,250.32	5,104.97	8,355.29
2032	27.71	82.06	128.70	210.76	3,282.32	5,148.04	8,430.36
2033	27.46	82.88	129.88	212.77	3,315.33	5,195.39	8,510.72
2034	27.21	83.82	131.14	214.96	3,352.79	5,245.50	8,598.29
2035	26.98	76.90	132.28	209.18	3,076.17	5,291.16	8,367.33
2036	26.85	77.49	132.93	210.42	3,099.48	5,317.16	8,416.64
2037	26.72	78.27	133.62	211.89	3,130.69	5,344.83	8,475.52
2038	26.57	78.97	134.37	213.34	3,158.81	5,374.82	8,533.63



Section:	Peshawar - Torkham Motorway								
Alternative:	Base Alternative								
Sect ID:	Torkham			Road Class:	Primary or Trunk				
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km		
	Average		Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip			
	Speed								
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User		
				Cost			Cost		
2039	26.42	79.59	135.16	214.75	3,183.75	5,406.39	8,590.14		
2040	26.25	80.54	136.07	216.61	3,221.63	5,442.62	8,664.25		
2041	26.07	81.66	137.09	218.75	3,266.49	5,483.67	8,750.16		
2042	25.82	82.51	138.50	221.01	3,300.52	5,539.89	8,840.41		
2043	25.74	83.11	138.99	222.11	3,324.59	5,559.76	8,884.35		
2044	25.74	83.76	138.96	222.72	3,350.31	5,558.57	8,908.88		
2045	25.74	84.40	138.94	223.34	3,376.01	5,557.55	8,933.56		
2046	25.75	84.90	138.92	223.82	3,396.11	5,556.63	8,952.74		
2047	25.75	85.50	138.90	224.39	3,419.82	5,555.89	8,975.71		
Car									
2019	48.52	15.07	27.27	42.34	602.66	1,090.78	1,693.44		
2020	47.96	15.16	27.62	42.77	606.21	1,104.70	1,710.91		
2021	47.38	15.26	27.99	43.25	610.27	1,119.75	1,730.02		
2022	46.78	15.36	28.40	43.76	614.20	1,136.04	1,750.24		
2023	46.15	15.45	28.84	44.29	618.01	1,153.56	1,771.57		
2024	45.49	15.56	29.32	44.88	622.31	1,172.71	1,795.02		
2025	44.80	15.68	29.84	45.52	627.29	1,193.63	1,820.92		
2026	44.08	15.83	30.42	46.25	633.20	1,216.61	1,849.81		
2027	43.32	15.98	31.05	47.03	639.33	1,242.01	1,881.34		
2028	42.53	16.12	31.74	47.86	644.88	1,269.68	1,914.56		
2029	41.71	16.28	32.51	48.79	651.20	1,300.46	1,951.66		
2030	40.85	16.47	33.37	49.84	658.82	1,334.86	1,993.68		
2031	39.94	16.69	34.33	51.03	667.79	1,373.37	2,041.16		



Section:	Peshawar - Torkham Motorway						
Alternative:	Base Alternative						
Sect ID:	Torkham		Road Class:		Primary or Trunk		
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average		Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip	
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
2032	39.04	16.90	35.32	52.22	675.90	1,412.92	2,088.82
2033	38.14	17.10	36.36	53.47	684.14	1,454.55	2,138.69
2034	37.35	17.29	37.19	54.48	691.52	1,487.54	2,179.06
2035	36.65	16.56	38.00	54.56	662.44	1,520.14	2,182.58
2036	35.80	16.74	39.02	55.76	669.53	1,560.77	2,230.30
2037	34.94	16.94	40.14	57.08	677.78	1,605.60	2,283.38
2038	34.28	17.09	40.85	57.94	683.61	1,634.15	2,317.76
2039	33.65	17.24	41.56	58.80	689.60	1,662.51	2,352.11
2040	32.99	17.42	42.38	59.80	696.94	1,695.25	2,392.19
2041	32.28	17.63	43.33	60.96	705.32	1,733.22	2,438.54
2042	31.34	17.89	44.71	62.61	715.70	1,788.59	2,504.29
2043	30.31	18.20	46.43	64.63	728.03	1,857.03	2,585.06
2044	29.46	18.51	48.04	66.55	740.45	1,921.41	2,661.86
2045	28.84	18.77	49.34	68.11	750.87	1,973.44	2,724.31
2046	28.85	18.82	49.30	68.12	752.64	1,972.10	2,724.74
2047	28.87	18.87	49.27	68.14	754.77	1,970.86	2,725.63
Truck 2xl							
2019	24.55	101.16	0.00	101.16	4,046.36	0.00	4,046.36
2020	24.55	101.77	0.00	101.77	4,070.67	0.00	4,070.67
2021	24.55	102.49	0.00	102.49	4,099.50	0.00	4,099.50
2022	24.55	103.11	0.00	103.11	4,124.51	0.00	4,124.51
2023	24.55	103.67	0.00	103.67	4,146.83	0.00	4,146.83
2024	24.55	104.30	0.00	104.30	4,172.00	0.00	4,172.00



Section:	Peshawar - Torkham Motorway								
Alternative:	Base Alternative								
Sect ID:	Torkham			Road Class:	Primary or Trunk				
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km		
	Average		Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip			
	Speed								
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User	Cost	
				Cost			Cost		
2025	24.55	105.05	0.00	105.05	4,202.11	0.00	4,202.11		
2026	24.55	105.99	0.00	105.99	4,239.60	0.00	4,239.60		
2027	24.55	106.86	0.00	106.86	4,274.40	0.00	4,274.40		
2028	24.55	107.51	0.00	107.51	4,300.28	0.00	4,300.28		
2029	24.55	108.23	0.00	108.23	4,329.22	0.00	4,329.22		
2030	24.55	109.10	0.00	109.10	4,363.92	0.00	4,363.92		
2031	24.55	110.16	0.00	110.16	4,406.21	0.00	4,406.21		
2032	24.55	110.94	0.00	110.94	4,437.60	0.00	4,437.60		
2033	24.55	111.72	0.00	111.72	4,468.73	0.00	4,468.73		
2034	24.55	112.62	0.00	112.62	4,504.73	0.00	4,504.73		
2035	24.55	103.61	0.00	103.61	4,144.53	0.00	4,144.53		
2036	24.55	104.40	0.00	104.40	4,175.82	0.00	4,175.82		
2037	24.55	105.49	0.00	105.49	4,219.48	0.00	4,219.48		
2038	24.55	106.44	0.00	106.44	4,257.41	0.00	4,257.41		
2039	24.55	107.24	0.00	107.24	4,289.46	0.00	4,289.46		
2040	24.55	108.53	0.00	108.53	4,341.18	0.00	4,341.18		
2041	24.55	110.07	0.00	110.07	4,402.89	0.00	4,402.89		
2042	24.55	111.07	0.00	111.07	4,442.67	0.00	4,442.67		
2043	24.55	111.86	0.00	111.86	4,474.34	0.00	4,474.34		
2044	24.55	112.80	0.00	112.80	4,511.91	0.00	4,511.91		
2045	24.55	113.71	0.00	113.71	4,548.48	0.00	4,548.48		
2046	24.55	114.42	0.00	114.42	4,576.76	0.00	4,576.76		
2047	24.55	115.24	0.00	115.24	4,609.47	0.00	4,609.47		



Section:	Peshawar - Torkham Motorway										
Alternative:	Base Alternative										
Sect ID:	Torkham				Road Class:	Primary or Trunk					
Length:	40.00 km	Width:	7.30 m			Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km		
	Average		Annual Average Cost per Vehicle-kilometre				Annual Average Cost per Vehicle-trip				
	Speed										
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User	Cost	Cost	Cost	
Truck mxl				Cost							
2019	36.52	127.31	0.00	127.31	5,092.42	0.00	5,092.42				
2020	36.20	128.38	0.00	128.38	5,135.34	0.00	5,135.34				
2021	35.86	129.64	0.00	129.64	5,185.65	0.00	5,185.65				
2022	35.51	130.76	0.00	130.76	5,230.56	0.00	5,230.56				
2023	35.15	131.80	0.00	131.80	5,271.87	0.00	5,271.87				
2024	34.77	132.95	0.00	132.95	5,318.16	0.00	5,318.16				
2025	34.38	134.32	0.00	134.32	5,372.66	0.00	5,372.66				
2026	33.96	135.98	0.00	135.98	5,439.11	0.00	5,439.11				
2027	33.52	137.56	0.00	137.56	5,502.27	0.00	5,502.27				
2028	33.07	138.82	0.00	138.82	5,552.77	0.00	5,552.77				
2029	32.61	140.22	0.00	140.22	5,608.67	0.00	5,608.67				
2030	32.14	141.84	0.00	141.84	5,673.49	0.00	5,673.49				
2031	31.69	143.73	0.00	143.73	5,749.04	0.00	5,749.04				
2032	31.25	145.20	0.00	145.20	5,808.04	0.00	5,808.04				
2033	30.82	146.67	0.00	146.67	5,866.79	0.00	5,866.79				
2034	30.38	148.36	0.00	148.36	5,934.33	0.00	5,934.33				
2035	29.99	134.50	0.00	134.50	5,379.93	0.00	5,379.93				
2036	29.61	136.03	0.00	136.03	5,441.02	0.00	5,441.02				
2037	29.25	138.00	0.00	138.00	5,519.89	0.00	5,519.89				
2038	28.89	139.78	0.00	139.78	5,591.09	0.00	5,591.09				
2039	28.52	141.33	0.00	141.33	5,653.33	0.00	5,653.33				
2040	28.13	143.65	0.00	143.65	5,745.88	0.00	5,745.88				



Section:	Peshawar - Torkham Motorway						
Alternative:	Base Alternative						
Sect ID:	Torkham			Road Class:	Primary or Trunk		
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average		Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip	
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
2041	27.71	146.39	0.00	146.39	5,855.40	0.00	5,855.40
2042	27.16	148.46	0.00	148.46	5,938.41	0.00	5,938.41
2043	26.78	150.13	0.00	150.13	6,005.14	0.00	6,005.14
2044	26.76	151.66	0.00	151.66	6,066.45	0.00	6,066.45
2045	26.77	153.12	0.00	153.12	6,124.69	0.00	6,124.69
2046	26.78	154.24	0.00	154.24	6,169.70	0.00	6,169.70
2047	26.78	155.54	0.00	155.54	6,221.78	0.00	6,221.78
wgn/mbus							
2019	48.14	51.32	64.01	115.33	2,052.74	2,560.54	4,613.28
2020	47.60	51.69	64.82	116.52	2,067.69	2,592.99	4,660.68
2021	47.02	52.14	65.70	117.84	2,085.41	2,628.06	4,713.47
2022	46.43	52.56	66.65	119.21	2,102.22	2,666.00	4,768.22
2023	45.81	52.97	67.67	120.64	2,118.77	2,706.84	4,825.61
2024	45.16	53.44	68.79	122.23	2,137.67	2,751.42	4,889.09
2025	44.48	54.01	70.00	124.01	2,160.44	2,800.14	4,960.58
2026	43.77	54.73	71.34	126.07	2,189.20	2,853.61	5,042.81
2027	43.01	55.45	72.82	128.27	2,218.03	2,912.66	5,130.69
2028	42.24	56.09	74.43	130.51	2,243.51	2,977.03	5,220.54
2029	41.43	56.82	76.21	133.03	2,272.72	3,048.58	5,321.30
2030	40.58	57.74	78.21	135.95	2,309.41	3,128.47	5,437.88
2031	39.69	58.87	80.44	139.31	2,354.75	3,217.53	5,572.28
2032	38.80	59.78	82.73	142.51	2,391.21	3,309.31	5,700.52
2033	37.92	60.73	85.12	145.85	2,429.33	3,404.69	5,834.02



Section:	Peshawar - Torkham Motorway						
Alternative:	Base Alternative						
Sect ID:	Torkham			Road Class:	Primary or Trunk		
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average		Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip	
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
2034	37.14	61.66	87.03	148.69	2,466.22	3,481.27	5,947.49
2035	36.44	56.08	88.93	145.01	2,243.21	3,557.27	5,800.48
2036	35.60	56.63	91.29	147.92	2,265.23	3,651.56	5,916.79
2037	34.76	57.26	93.84	151.10	2,290.38	3,753.72	6,044.10
2038	34.12	57.73	95.50	153.23	2,309.24	3,820.02	6,129.26
2039	33.50	58.27	97.15	155.41	2,330.64	3,885.94	6,216.58
2040	32.84	58.90	99.05	157.95	2,356.15	3,962.00	6,318.15
2041	32.14	59.61	101.25	160.86	2,384.39	4,050.14	6,434.53
2042	31.21	60.52	104.46	164.99	2,420.98	4,178.53	6,599.51
2043	30.20	61.65	108.43	170.07	2,465.85	4,337.11	6,802.96
2044	29.36	62.84	112.15	174.99	2,513.56	4,486.10	6,999.66
2045	28.77	63.84	114.99	178.83	2,553.53	4,599.74	7,153.27
2046	28.79	64.14	114.92	179.05	2,565.44	4,596.67	7,162.11
2047	28.80	64.49	114.85	179.34	2,579.67	4,593.82	7,173.49
Section:	Peshawar - Torkham Motorway						



Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
Bus							
2019	30.63	72.97	115.82	188.79	2,918.83	4,632.84	7,551.67
2020	30.43	73.16	116.61	189.77	2,926.38	4,664.37	7,590.75
2021	30.23	73.36	117.44	190.80	2,934.36	4,697.52	7,631.88
2022	30.02	73.57	118.31	191.88	2,942.77	4,732.37	7,675.14
2023	64.17	47.19	55.13	102.32	2,265.23	2,646.33	4,911.56
2024	64.13	47.21	55.17	102.38	2,266.14	2,648.20	4,914.34
2025	64.09	47.23	55.20	102.43	2,266.86	2,649.61	4,916.47
2026	64.06	47.24	55.23	102.48	2,267.76	2,651.17	4,918.93
2027	64.01	47.27	55.27	102.54	2,269.10	2,652.90	4,922.00
2028	63.97	47.32	55.31	102.63	2,271.58	2,654.86	4,926.44
2029	63.91	47.43	55.36	102.79	2,276.88	2,657.13	4,934.01
2030	63.85	47.69	55.41	103.10	2,289.21	2,659.80	4,949.01
2031	63.77	48.18	55.48	103.66	2,312.65	2,663.02	4,975.67
2032	63.67	48.72	55.57	104.29	2,338.76	2,667.19	5,005.95
2033	64.15	47.20	55.15	102.35	2,265.42	2,647.21	4,912.63
2034	64.09	47.22	55.21	102.42	2,266.50	2,649.84	4,916.34
2035	64.00	47.24	55.28	102.53	2,267.72	2,653.56	4,921.28
2036	63.89	47.28	55.38	102.66	2,269.38	2,658.41	4,927.79
2037	63.76	47.33	55.50	102.82	2,271.81	2,663.79	4,935.60
2038	63.57	47.43	55.67	103.10	2,276.83	2,671.98	4,948.81
2039	63.34	47.68	55.88	103.57	2,288.84	2,682.46	4,971.30



Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
2040	63.07	48.28	56.13	104.41	2,317.26	2,694.35	5,011.61
2041	62.77	49.01	56.42	105.43	2,352.49	2,708.09	5,060.58
2042	62.42	49.85	56.76	106.60	2,392.57	2,724.33	5,116.90
2043	62.86	47.46	56.39	103.85	2,277.86	2,706.89	4,984.75
2044	62.59	47.53	56.68	104.21	2,281.41	2,720.43	5,001.84
2045	62.32	47.61	56.97	104.58	2,285.25	2,734.70	5,019.95
2046	61.74	47.77	57.55	105.32	2,293.03	2,762.28	5,055.31
2047	61.12	48.05	58.18	106.24	2,306.63	2,792.65	5,099.28
Car							
2019	48.52	15.07	27.27	42.34	602.66	1,090.78	1,693.44
2020	47.97	15.11	27.62	42.73	604.56	1,104.61	1,709.17
2021	47.39	15.17	27.99	43.15	606.63	1,119.54	1,726.17
2022	46.79	15.22	28.39	43.61	608.88	1,135.69	1,744.57
2023	89.14	12.25	14.71	26.96	587.86	706.26	1,294.12
2024	89.11	12.26	14.72	26.98	588.34	706.50	1,294.84
2025	89.09	12.26	14.72	26.99	588.69	706.69	1,295.38
2026	89.06	12.27	14.73	27.00	589.07	706.89	1,295.96
2027	89.03	12.28	14.73	27.01	589.51	707.13	1,296.64
2028	89.00	12.29	14.74	27.03	590.08	707.41	1,297.49
2029	88.96	12.31	14.75	27.06	591.00	707.76	1,298.76
2030	88.90	12.35	14.75	27.10	592.74	708.20	1,300.94
2031	88.83	12.41	14.77	27.18	595.75	708.80	1,304.55



Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User Cost	VOC	Travel Time	Road User Cost
2032	88.71	12.48	14.79	27.26	598.98	709.71	1,308.69
2033	89.10	12.25	14.72	26.97	587.84	706.63	1,294.47
2034	89.03	12.26	14.73	26.99	588.32	707.18	1,295.50
2035	88.89	12.26	14.76	27.02	588.61	708.32	1,296.93
2036	88.71	12.27	14.79	27.06	588.94	709.90	1,298.84
2037	88.50	12.28	14.83	27.10	589.39	711.65	1,301.04
2038	88.17	12.29	14.89	27.18	590.05	714.52	1,304.57
2039	87.75	12.32	14.96	27.29	591.49	718.28	1,309.77
2040	87.28	12.39	15.05	27.45	594.87	722.55	1,317.42
2041	86.76	12.48	15.16	27.64	598.97	727.53	1,326.50
2042	86.14	12.57	15.28	27.85	603.45	733.51	1,336.96
2043	86.31	12.24	15.27	27.51	587.33	733.20	1,320.53
2044	85.82	12.25	15.39	27.64	588.12	738.78	1,326.90
2045	85.30	12.27	15.52	27.79	588.94	744.94	1,333.88
2046	84.14	12.28	15.77	28.05	589.64	756.84	1,346.48
2047	82.92	12.32	16.04	28.36	591.18	770.15	1,361.33
Truck 2xl							
2019	24.55	101.16	0.00	101.16	4,046.36	0.00	4,046.36
2020	24.55	101.28	0.00	101.28	4,051.17	0.00	4,051.17
2021	24.55	101.41	0.00	101.41	4,056.26	0.00	4,056.26
2022	24.55	101.54	0.00	101.54	4,061.65	0.00	4,061.65
2023	48.72	62.52	0.00	62.52	3,001.12	0.00	3,001.12



Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User Cost	VOC	Travel Time	Road User Cost
2024	48.74	62.54	0.00	62.54	3,001.71	0.00	3,001.71
2025	48.76	62.55	0.00	62.55	3,002.22	0.00	3,002.22
2026	48.78	62.56	0.00	62.56	3,002.98	0.00	3,002.98
2027	48.79	62.59	0.00	62.59	3,004.38	0.00	3,004.38
2028	48.81	62.66	0.00	62.66	3,007.49	0.00	3,007.49
2029	48.83	62.81	0.00	62.81	3,015.00	0.00	3,015.00
2030	48.85	63.20	0.00	63.20	3,033.48	0.00	3,033.48
2031	48.86	63.94	0.00	63.94	3,068.94	0.00	3,068.94
2032	48.88	64.74	0.00	64.74	3,107.36	0.00	3,107.36
2033	48.72	62.53	0.00	62.53	3,001.27	0.00	3,001.27
2034	48.73	62.54	0.00	62.54	3,002.01	0.00	3,002.01
2035	48.73	62.56	0.00	62.56	3,002.94	0.00	3,002.94
2036	48.72	62.59	0.00	62.59	3,004.35	0.00	3,004.35
2037	48.72	62.64	0.00	62.64	3,006.82	0.00	3,006.82
2038	48.69	62.77	0.00	62.77	3,012.92	0.00	3,012.92
2039	48.66	63.12	0.00	63.12	3,029.60	0.00	3,029.60
2040	48.62	63.99	0.00	63.99	3,071.46	0.00	3,071.46
2041	48.58	65.04	0.00	65.04	3,122.04	0.00	3,122.04
2042	48.54	66.18	0.00	66.18	3,176.73	0.00	3,176.73
2043	48.29	62.73	0.00	62.73	3,011.23	0.00	3,011.23
2044	48.25	62.79	0.00	62.79	3,013.84	0.00	3,013.84
2045	48.20	62.85	0.00	62.85	3,016.83	0.00	3,016.83



Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
2046	48.06	63.00	0.00	63.00	3,023.88	0.00	3,023.88
2047	47.92	63.32	0.00	63.32	3,039.53	0.00	3,039.53
Truck mxl							
2019	36.52	127.31	0.00	127.31	5,092.42	0.00	5,092.42
2020	36.20	127.63	0.00	127.63	5,105.31	0.00	5,105.31
2021	35.87	127.98	0.00	127.98	5,119.06	0.00	5,119.06
2022	35.52	128.34	0.00	128.34	5,133.75	0.00	5,133.75
2023	76.19	77.63	0.00	77.63	3,726.36	0.00	3,726.36
2024	76.15	77.73	0.00	77.73	3,730.96	0.00	3,730.96
2025	76.13	77.80	0.00	77.80	3,734.31	0.00	3,734.31
2026	76.10	77.88	0.00	77.88	3,738.10	0.00	3,738.10
2027	76.07	77.98	0.00	77.98	3,742.83	0.00	3,742.83
2028	76.04	78.12	0.00	78.12	3,749.84	0.00	3,749.84
2029	76.01	78.39	0.00	78.39	3,762.53	0.00	3,762.53
2030	75.98	78.94	0.00	78.94	3,789.12	0.00	3,789.12
2031	75.94	79.94	0.00	79.94	3,837.06	0.00	3,837.06
2032	75.88	81.02	0.00	81.02	3,888.73	0.00	3,888.73
2033	76.15	77.64	0.00	77.64	3,726.55	0.00	3,726.55
2034	76.09	77.74	0.00	77.74	3,731.42	0.00	3,731.42
2035	75.98	77.82	0.00	77.82	3,735.32	0.00	3,735.32
2036	75.84	77.92	0.00	77.92	3,740.01	0.00	3,740.01
2037	75.68	78.05	0.00	78.05	3,746.35	0.00	3,746.35



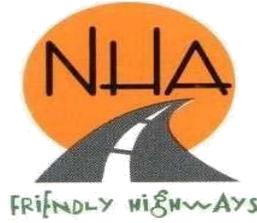
Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38.00 deg/km
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	Road User
				Cost			Cost
2038	75.44	78.28	0.00	78.28	3,757.47	0.00	3,757.47
2039	75.13	78.80	0.00	78.80	3,782.23	0.00	3,782.23
2040	74.81	79.98	0.00	79.98	3,838.95	0.00	3,838.95
2041	74.46	81.39	0.00	81.39	3,906.83	0.00	3,906.83
2042	74.07	82.92	0.00	82.92	3,979.95	0.00	3,979.95
2043	74.12	77.89	0.00	77.89	3,738.62	0.00	3,738.62
2044	73.74	78.07	0.00	78.07	3,747.43	0.00	3,747.43
2045	73.36	78.25	0.00	78.25	3,756.07	0.00	3,756.07
2046	72.50	78.54	0.00	78.54	3,769.71	0.00	3,769.71
2047	71.61	79.06	0.00	79.06	3,795.03	0.00	3,795.03
wgn/mbus							
2019	48.14	51.32	64.01	115.33	2,052.74	2,560.54	4,613.28
2020	47.60	51.48	64.82	116.30	2,059.16	2,592.79	4,651.95
2021	47.03	51.65	65.69	117.34	2,066.12	2,627.59	4,693.71
2022	46.44	51.84	66.63	118.47	2,073.67	2,665.24	4,738.91
2023	86.57	43.63	35.29	78.93	2,094.31	1,694.11	3,788.42
2024	86.55	43.65	35.30	78.95	2,094.99	1,694.59	3,789.58
2025	86.53	43.66	35.31	78.97	2,095.51	1,694.95	3,790.46
2026	86.51	43.67	35.32	78.99	2,096.14	1,695.36	3,791.50
2027	86.49	43.69	35.33	79.02	2,097.05	1,695.83	3,792.88
2028	86.46	43.72	35.34	79.06	2,098.68	1,696.40	3,795.08
2029	86.42	43.79	35.36	79.15	2,102.13	1,697.09	3,799.22



Section:	Peshawar - Torkham Motorway						
Alternative:	Improvement Torkham						
Sect ID:	Torkham		Road Class:	Primary or Trunk			
Length:	40.00 km	Width:	7.30 m	Rise+Fall:	120.00 m/km	Curvature:	38
	Average	Annual Average Cost per Vehicle-kilometre			Annual Average Cost per Vehicle-trip		
	Speed						
Year	(km/hr)	VOC	Travel Time	Road User	VOC	Travel Time	F
				Cost			
2030	86.38	43.96	35.37	79.34	2,110.17	1,697.99	
2031	86.32	44.28	35.40	79.68	2,125.65	1,699.19	
2032	86.22	44.65	35.44	80.09	2,143.26	1,701.05	
2033	86.53	43.63	35.31	78.94	2,094.35	1,694.97	
2034	86.47	43.65	35.34	78.98	2,095.07	1,696.16	
2035	86.34	43.66	35.39	79.05	2,095.69	1,698.76	
2036	86.17	43.68	35.47	79.14	2,096.53	1,702.38	
2037	85.99	43.71	35.55	79.25	2,097.87	1,706.36	
2038	85.68	43.76	35.69	79.45	2,100.67	1,712.92	
2039	85.28	43.91	35.87	79.78	2,107.91	1,721.54	
2040	84.85	44.29	36.07	80.36	2,126.13	1,731.27	
2041	84.37	44.78	36.30	81.08	2,149.52	1,742.52	
2042	83.81	45.36	36.58	81.94	2,177.37	1,755.93	
2043	83.89	43.73	36.60	80.33	2,099.11	1,756.78	
2044	83.43	43.78	36.87	80.65	2,101.49	1,769.60	
2045	82.95	43.84	37.16	81.00	2,104.16	1,783.70	
2046	81.86	43.92	37.73	81.66	2,108.31	1,811.17	
2047	80.70	44.10	38.37	82.47	2,116.59	1,841.81	



Annex 3: Traffic Study Report Peshawar Torkham Motorway-DFA-3-7-2017



**GOVERNMENT OF
PAKISTAN MINISTRY OF
COMMUNICATIONS**

NATIONAL HIGHWAY AUTHORITY ISLAMABAD

Traffic Study Report

For

(Peshawar –Torkham Section)

Of

**FEASIBILITY STUDY AND PRELIMINARY DESIGN OF
PESHAWAR-KABUL MOTORWAY PROJECT**

July 2017



Associated Consultancy Centre (Pvt.) Ltd. (ACC)

in association with

SAMBO Engineering Co. Ltd. (South Korea),

ACE-TES Lahore & Assign International





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EXECUTIVE SUMMARY

The Transport sector has greater impact on the development and welfare of the people. Efficient transport systems provide economic and social opportunities that have a multiplier effect in the form of better accessibility to markets, improved employment levels, and additional investments.

Pakistan is taking benefits of its strategic location and has focused on to develop efficient and well integrated transport and communication system by connecting remote regions of the country into one road one Asia chain. With the help of China Pakistan Economic Corridor, roads and railways infrastructure will integrate Pakistan with the regional countries which will result in generating economic boom by integrating Pakistani markets with Central Asia, Middle East and other parts of the world. The Corridor will be a strategic game changer in the region and would go a long way in making Pakistan a richer and stronger entity. The investment on the corridor will transform Pakistan into a regional economic hub and it will be confidence booster for investors and attract investment not only from China but also from other parts of the world. Other than transportation infrastructure, the economic corridor will provide Pakistan with modern telecommunication and energy infrastructure, also.

National Highway Authority has envisaged Peshawar – Torkham Motorway project to provide direct access to capital of Afghanistan. It will attract the “through” traffic from all over Pakistan. The other targeted benefits include: Provision of a standardized access/exit controlled road with good ride quality to reduce the vehicle operating costs (VOC’s) with direct impact on country’s micro economics, easy access to ports and markets. Promotion of interprovincial harmony, social and economic uplift of the Khyber Pakhtunkhwa province. Proposed motorway in the larger context is the development of an economic corridor connecting Central Asian States through Afghanistan by providing direct access to the Arabian Sea.

The proposed Peshawar – Torkham motorway starts from Peshawar falling in Khyber Agency and terminates at Torkham. The total length of proposed motorway is approximately 50 Kms.

With a view to assess the existing and future traffic attracted and generated by the proposed Motorway project, an in-depth traffic study was conducted. The purpose of the study was to evaluate the financial / commercial feasibility of the proposed scheme. The study is based on traffic surveys comprising volume counts and origin – destination surveys at selected sections.

*Traffic Study Report for (Peshawar-Torkham Section) of
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Two road sections were selected where surveys were carried out; Questionnaires were designed for the collection of data. The surveys included traffic count, and origin-destination surveys. Regions of influence were divided into zones to carry out Origin-Destination Surveys. Summary of results of traffic count survey is given in table below:

Daily Traffic Counts

Station	Car Jeep	Wagon Pickup	Coaster Mini Bus	Bus	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axle	3-Axle	3-Axle	4-Axle	5-Axle	6-Axle	
Bighyari Post	5004	1399	1768	6	50	443	174	84	164	92	467	9651
Michni Post	4107	431	557	6	54	213	72	33	80	33	392	5978

ADT for Peshawar Torkham

Car Jeep	Wagon Pickup	Coaster Mini Bus	Bus	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
					2-Axle	3-Axle	3-Axle	4-Axle	5-Axle	6-Axle	
4556	915	1163	6	52	328	123	59	122	63	430	7817

The sample rate for O-D survey ranged from 9% to 41%. O-D tables were developed for eight zones in the catchment area of proposed facility. The analysis of these O-D matrices produced estimated volume of traffic attracted by Peshawar - Torkham motorway presented in table below:

Generated/ Diverted Traffic for Peshawar Torkham Motorway

Vehicle Type	Cars/ Jeep	Wagons / Coasters	Bus	Mini Truck	Truck 2 axle	Truck 3 axle	Trucks	Truck	Truck	Truck	Total
							3 axle	4 axle	5 axle	6 axle	
ADT	1027	248	2	14	54	18	Articulated				1499
							9	20	9	98	

The projected traffic suggests that the proposed facility will generate significant traffic to attain economic sustainability.

CHAPTER 1

INTRODUCTION

1.1 Transport Sector

The traditional definition of 'Transport Sector' is not confined to physical infrastructure such as rails, roads, road transport, sea trade and related freight alone, but it also includes services such as packing, delivery and storage as well as trade logistics. The factors like high freight, insurance, longer delivery times and renewal costs are considered as important additional costs. The aggregate transport and logistics costs - including opportunity cost, device standards and trade facilitation – ultimately determine the efficiency of the Transport & Logistics Sector and also represent the cost of doing business.

Sustainable economic development is dependent on a robust and low cost Transport & Logistics Sector. Enhanced export competitiveness is also contingent upon the efficient performance of the sector.

The Transport & Logistics Sector plays an important role in economic development and in improving the competitiveness in export. The Transport & Logistics Sector claims 20 to 25% share of the Annual Public Sector Development Program (PSDP), but this level of investment is not enough to meet the growing needs. Approximately two to three times more investment is required to enable the sector to perform in harmony with the needs arising from the expansion of economic activities.

1.2 Transport Sector Status

The population of Pakistan is estimated over 180 million with an area of 796,095 Sq. Km. The density of population is 226 persons per Sq. Km. The rural urban ratio stands at 67:33. The dominant occupation of the people is agriculture and urbanization is growing fast in the country, while industrialization is now picking-up pace. Pakistan has five provinces namely Punjab, Sindh, Khyber Pakhtunkhwa (KPK), Baluchistan and upgraded GilgitBaltistan. The population of Punjab Province is 96.55 million, Sindh 42.28 million, Khyber Pakhtunkhwa 23.77 million and

Baluchistan is 9.07 million people. Capital Territory Islamabad constitutes 1.33 million while Federally Administered Tribal Area has 4.20 million population.

The transport and logistics sector is the fourth largest sector in Pakistan. Transport sector accounts for 12 percent of GDP, 21 percent of capital formation and 25 percent of the PSDP; transport generates around 3 million jobs in Pakistan. Viewed as a whole the transport and logistics sector generates substantial revenue for the government exchequer (*in form of taxes and duties*). The sector comprises of a number of distinct modes and services, notably railways, roads, road transport, ports, shipping, aviation and the logistics network. Railways and roads dominate the sector.

The total inland traffic by road and rail transport is currently estimated at 239 billion passenger-km of passenger traffic and 153 billion ton-km of freight traffic. Freight and passenger traffic has been growing at 3% and 4.5% annum respectively. Road transport accounts for 95% of passenger traffic and 97% of freight traffic. The de-regulation of the road transport services has resulted in development of a competitive and vibrant Private Sector for goods and passenger transport.

1.2.1 National Road Network

Pakistan's National Road Network (*National & Provincial Roads*) comprises 260,000 km of roads, of which 68.4% is of high-type. Network expansion has been rather modest; at a rate of about 2,211 km / year (1996 – 2009). The focus had been on consolidation of the existing network and up-gradation of low-type roads to high-type. The road spread – which facilitates economic activity in many ways – is rather low; at 0.33 km of road length per sq km of land area. It is relatively high in Punjab (0.51) and Sindh (0.57), but, low in Baluchistan (0.12) and Khyber Pakhtunkhwa (0.30). In neighboring countries road spread ranges from 2.1 km/km² in Bangladesh and 1.1 km/km² in India. In order to upgrade the road density to 0.50 km/km² it is estimated that approximately 138,000 km roads length (*based on surface area of 796,096 sq km*) will have to be added to the network, which appear unattainable through the Public Investment alone so a concerted effort would be required to leverage Private Sector funding to achieve the target within proposed Plan period. The National Highway Authority (NHA) looks after the construction and maintenance of the National Highways system linking the centers of population

and economic activity to ports and neighboring countries. The highways system extends over 12,000 km and cater 80% of inter provincial passenger and freight traffic in the country. The remaining road network is maintained by provincial and local Governments.

The present on-road vehicles stand at about 10.5 million. The National Highway Authority (NHA) maintains the National Highway Network while the Provincial Communications & Works Departments are responsible for the Provincial Road Network, Urban Road Network is managed by respective City District Governments. Following the implementation of the devolution plan, a majority of the intra-district Provincial Networks have been devolved to the districts. The road transport services are regulated by the Provincial Governments through the Provincial Transport Departments. The Provincial Transport Authorities (PTAs) and Regional Transport Authorities (RTAs) plan, allocate routes, regulate, enforce and assert day-to-day control over inter- and intra-city passenger transport services, which are dominated by the Private Sector.

1.3 Vision – 2025: Modernizing Transportation Infrastructure & Greater Regional Connectivity

Pakistan Vision-2025 seeks to establish an efficient and integrated transportation system that will facilitate the development of a competitive economy. Key related targets are to ensure reduction in transportation costs, safety in mobility, effective connectivity between rural areas and markets

/ urban centers, inter-provincial high-speed connectivity, integrated road / rail networks between economic hubs (*including air, sea and dry ports*) and also high-capacity transportation corridors connecting major regional trading partners. Some of the specific targets include:

1.3.1 Roads

Raise road-density to a level of 0.45 km / Sq.Km by 2018, which will increase the existing road National Network from around 260,000 km to 358,000 km.

1.3.2 Railways

Major upgrade of the railway system includes increasing speed from 95 km/h to 120 / 140 km/h; doubling tracks of the mainline sections; increasing line capacity with a modern signaling system; establishing North-South and East-West corridors and developing linkages through road

and rail to Central Asian States, China, and other neighboring countries and development of a separate freight corridor on railway tracks. Pakistan Railways will be made more profitable and will be the quality service provider for passengers and freight.

1.3.3 Aviation

A key objective related to the Aviation Sector, will be the enhancement of the cargo, passenger, infrastructure and handling capacity at important airports to meet the delivery needs of a modern global supply chain. Further, a revised Civil Aviation Policy will be formulated. National Flag Carrier will become a leading airline.

1.3.4 Ports & Shipping

Pakistan's seaports will require significant additional investments to upgrade their facilities and infrastructure to meet global efficiency and cargo-handling standards and shipping services shall be made competitive.

A strategic program of regional connectivity is envisaged to connect Pakistan through enhanced physical infrastructure development (*Physical Connectivity*), effective institutional arrangements (*institutional connectivity*) and business and individual contact (*people connectivity*). Building enhanced regional connectivity requires not only the development of new strategies and institutions, but, also investment in more effective implementation of existing and future initiative (*Source – Pakistan Vision – 2025*).

1.4 National Highway Authority -Integrated Development Strategy for KhyberPakhtunkhwa (KPK)

National Highway Authority strategy for Khyber Pakhtunkhwa, contains following broad parameters:

- Improved access for the people of Khyber Pakhtunkhwa;
- Enhanced road infrastructure;
- Well maintained and safer roads;
- Research and institutional development for better asset management;

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- Better working environment for the Khyber Pakhtunkhwa employees;
- Construction and maintenance of the Government Buildings;
- Improved Governance;
- Improved systems and processes established based on public private partnership models for procurement of goods and services;
- Improved policy, planning, budgeting and monitoring.

Despite historical significance of connectivity in Khyber Pakhtunkhwa economy, growth in road transport and related infrastructure is less than optimal. Road transport is the main mode of inter-provincial travel and is considered an easy and affordable means of transportation. Roads account for 91% of passenger transport and 96% of freight transport. About 44% of provincially maintained and 78% of district-maintained roads are in dilapidated condition. A total of only 606km of roads were added to the road network in Khyber Pakhtunkhwa between the years 2009 – 2010 and 2011 – 2012.

Road connectivity plays a critical role in the formation of industrial clusters, which in turn result in agglomeration of economies attracting more firms. Firms choose for location in areas of high connectivity. Industrial density in KPK is highest in the central districts. Both the degree of road density and proximity to the motorway and main highways are important factors behind increased industrial activity in KPK.

1.5 Challenges Faced by the Province in Transport Sector

- The province has a low level of accessibility due to its location, which is far away from the seaport. This results in a higher cost of production for many goods;
- Higher costs inhibit the competitiveness of the products produced in the region;
- The poor condition of roads in addition to low levels of funding is mainly due to the non-existent enforcement of axle load limits. Funding for road maintenance and repairs is inadequate and unpredictable.

To have a good quality integrated road network that stimulates economic activity and eases the logistical issues and transportation-related burden on prospective entrepreneurs, the following initiatives are being taken:

- The provision of access roads in areas housing industrial estates;

- The provision of access to areas with natural resources, especially oil, gas and minerals;
- Increased access for rural communities through the development of access and farm-to-market roads;
- A complete asset record of roads and priority funding for repairs and maintenance;
- Integrated approach to infrastructure development. Power generation and supply, roads and rail as well as support services will be developed in a coordinated way among the various departments of KPK;
- National Highway Authority (NHA) will strive to use Public Private Partnerships (PPP) in the construction of infrastructure;
- NHA is moving towards a well-defined and integrated approach to transport policy formulation, planning and implementation.

1.6 Spatial Clustering

If we compare the road network of Khyber Pakhtunkhwa and Punjab, it is evident that the road network of Punjab is much more widespread, dispersed geographically and has multiple clusters (*Faisalabad, Islamabad, Sialkot, Multan etc.*). These road network clusters overlap with the main industrial clusters in the Punjab, suggesting the presence of 'locational economies' which allow industry to benefit from increased connectivity to factor and product markets. The dispersion of road densities in Khyber Pakhtunkhwa is markedly different from Punjab. There is a sizeable cluster of roads concentrated in the west-central region of the province covering Peshawar-Mardan-Nowshera. The road network thins out considerably as we move away from this central region.

1.7 Existing State of Transport Sector of Khyber Pakhtunkhwa

The Transport sector has greater impact on the development and welfare of the people. Efficient transport systems provide economic and social opportunities that have a multiplier effect in the form of better accessibility to markets, improved employment levels, and additional investments. An efficient transport system reduces costs in many other economic sectors. Currently, 40% of Khyber Pakhtunkhwa people do not have access to any form of transport, compared to 30% for Pakistan as a whole.

In Khyber Pakhtunkhwa, the transport sector provides about 11% of economic activity. The provincial labor force engaged in transport sector accounted for a sizeable 7.50% of the total labor force during the year 2012 – 2013.

In view of the deficient transportation networks, the economic impact of transport investments will be significant. Developing the sector as an efficient logistic and urban transportation network presents enormous potential for establishing a service economy.

1.8 A Report by International Growth Center, Pakistan Program

The International Growth Centre (IGC) aims to promote sustainable growth in developing countries by providing demand-led policy advice informed by frontier research. Based at the London School of Economics and in partnership with Oxford University, the IGC is initiated and funded by DFID. The IGC has 15 country programs.

This report has been prepared under the overall supervision of the management team of the IGC Pakistan program.

1.8.1 Opportunities from Infrastructure Development

This section discusses the major foreseeable benefits in industrial agglomeration, labor market linkages and poverty reduction that can accrue from investing in infrastructure development and increased transport connectivity in the province.

Firms in Pakistan chose to locate in areas of high connectivity or road density because of better access to raw materials, factor and product markets (*Burki and Mushtaq 2010*). Road connectivity plays a critical role in the formation of industrial clusters, which in turn results in agglomeration economics attracting more firms. This creates a virtuous cycle of industrial agglomeration benefiting the whole sector in the three ways: pooling of labour with the required skill-sets, reduction in the cost of transportation and technological diffusion due to the exchange of idea.

This pattern of industrial clustering is evident in KPK; industrial density is highest in the central districts and Swat. Moreover, districts with comparable road density, but which are proximate to the Motorway (M-1) or are connected by a National Highway have significantly more industrial units than the districts that do not enjoy the same proximity. Therefore, both the degree of road density and proximity with the Motorway and main Highway are important factors behind increased industrial activity in Khyber Pakhtunkhwa.

The top three districts (*by number of operating industrial units*) for the five largest industries of the province indicate that Peshawar and Swat have the highest number of industrial units. Furthermore, Mansehra, Nowshera and Buner host the highest number of production units for marble & chips. Also, Nowshera is a very important logistical node as it connects Peshawar with Haripur and Buner through Swabi. It is interesting to note that Swat is the only district in northern KPK which has high industrial clustering. The regions of Kohistan, Battagram, Shangla, Hangu, Karak and Tank are the least industrialized districts and also have relatively low road density and lack of access to the Motorway or major highways

The industrial and economic disparity between different districts in KPK may also be a consequence of geographical features such as elevation and terrain, which can potentially impede infrastructure development. Despite these geographical constraints, the medium to long-term benefits of infrastructure development in linking remote areas to economic hubs would far exceed the initial costs associated with it.

The link between labor supply / migration, demand for goods and services and investment is essentially bi-directional. The availability of labor supply and more importantly, the demand of goods and services generated by cities with higher population is an incentive for business and industries to locate nearby.

An efficient and well-planned road network can widen the geographical perimeter of an area's labor market and also facilitate inter-provincial labor migration. KPK has 38% of its population below the poverty line and most of them look for employment opportunities either in the more developed central region or outside the province. The link between transport infrastructure and poverty alleviation in Pakistan is supported by empirical evidence, which shows that an increase on one standard deviation in a districts road density is correlated to approximately a 4.4% reduction in poverty (*LUMS, 2011*).

Although better transport infrastructure helps alleviate poverty and spurs economic growth it can potentially lead to unregulated urban sprawl, congestion costs, environmental and social externalities. Therefore increased migration, population growth and urbanization place tremendous pressure on the infrastructure of the provincial Capital and the Central Regional of KPK. To mitigate the negative impact of rapid urbanization it is imperative that major investments in new transport projects are made along with an emphasis on the maintenance of the existing transport infrastructure.

1.8.2 Priority Areas for the Khyber Pakhtunkhwa Government in Transport Sector

Given the present situation and potential from investment, the following are identified as the priority areas for the Khyber Pakhtunkhwa Government in the transport sector:

Connecting Relatively Poor Areas to Economic Hubs: It is evident from the analysis of spatial distribution of industry and road infrastructure that most of the economic activity is concentrated in the central region of KPK. Thus the broader aim of the transport infrastructure policy should be to improve the connectivity of the industrial clusters in the center with the less developed regions of the province. Such a policy would eventually lead to increased economic activity, facilitate the inter-provincial flow of goods, services and labor and create employment and income across Khyber Pakhtunkhwa, reducing inter-district socioeconomic disparities. In particular investments in highways and road networks is required in Kohistan, Battagram, Karakand Tank in order to better connect these regions to the rest of the province and the country. NHA should employ the public-private partnership model for these new investments and leverage private sector investment to reduce the burden on public finance

1.8.3 Continued Maintenance of the Existing Road Infrastructure

As stated before, there is high concentration of population and congestion in the central areas of KPK. In the absence of an extensive, well connected and properly functioning railway service, roads and highways are heavily used for both passenger and freight traffic. To mitigate the resultant deterioration of road and transport infrastructure, the existing road and highway networks need to be improved with special emphasis on transport infrastructure up gradation and maintenance.

1.8.4 Multimodal Transport Network to Boost International Trade and Domestic Commerce

The current transport system in the country in general and KPK in particular is essentially uni-modal there is an excessive reliance on road networks for both passenger and freight traffic (*trucking*). KPK being a landlocked province can utilize the potential of the railways sector in conjunction with the road network connectivity of Pakistan with China, Afghanistan and Central Asia. This would significantly boost trade and commercial activity within the province.

Like the road network, the railway service needs to extend to the northern parts of the province in order to galvanize economic activity in the relatively low-income area. Moreover, there is a need to improve road connectivity to the railway stations to facilitate both passengers and freight traffic. As stated above, the main deficiency in railways is the lack of freight traffic and inadequate locomotives. A multi-modal transport policy is required which connects roads and railways optimally to best utilize both the trucking and railway freight system. Road and railway networks are complementary because railways freight is the most efficient long distance carrier of bulk freight, while trucking is more cost effective for smaller loads and shorter distances. Thus railway freight can bring goods, raw material etc. from longer distances to outskirts of cities where it is loaded onto trucks for transport within the city.

1.9 Peshawar Kabul Motorway Project

National Highway Authority intends to undertake the detailed design for Peshawar-Kabul motorway project, which is to build a motorway from Peshawar city to the Afghan capital Kabul. The four-lane road via Jalalabad and Torkham would cover about 281 kilometers in which the Peshawar-Torkham (50km) will be constructed from scratch meanwhile the existing structure of Torkham-Jalalabad (76km) and Jalalabad-Kabul (155km) will be upgraded.

The project, upon completion, will become part of the Pakistan motorway network up to Torkham and will be linked with Peshawar-Islamabad motorway. Location map of the project is attached as Map-1. The project road has been divided into following sections for uniformity and ease in construction:

Table 1: Peshawar Kabul Motorway Sections

S.No	Section	From - To	Length
1	Section I	Peshawar - Torkham	50 km
2	Section II	Torkham - Jalalabad	76 km
3	Section III	Jalalabad - Kabul	155 km

1.10 Scope of Work

Scope of this study is to examine the existing road network between Peshawar and Torkham and to ascertain future traffic volume (with considerable accuracy) for the proposed motorway. For this purpose classified traffic counts has been obtained at the existing road network. The obtained data is then utilized in estimation of Growth Factors, Estimation of Projected volumes, estimation of Design Traffic and lastly the Capacity Analysis. This report outlines the traffic study carried out to evaluate the frequency of traffic along the existing sectional length. Following activities have been carried out to evaluate the intensity of traffic:

- Traffic forecast and working of growth rates through use of justifiable inputs;
- Evaluation of the existing traffic i.e., predicted future traffic (10 year design life);
- Computation of Equivalent Single Axle Loads (EASL's) based on the data obtained;
- Capacity Analysis for Level of Service (LOS) determination.

1.11 Traffic Count Stations

The sectional length considered for the purpose of this report is from Peshawar to Torkham. This route is on west side of Peshawar City. The area is urbanized and populated predominantly with medium sized community clusters. Keeping in view the scope and objective of the project, two locations were determined for traffic counts and the counts were obtained for three consecutive days at these locations.

Since the proposed motorway is intended to smooth out the traffic between Pakistan and Afghanistan, so in this connection, it has been observed that majority of the Afghanistan bound passenger car traffic originates at Peshawar. The cargo traffic from different sea-ports In

Pakistan also joins the main traffic to Afghanistan at Peshawar. Therefore a traffic count station was judiciously set-up at **Bighyari-post Jamrud**, a town abutting district Peshawar. The next station was located near Torkham border at **Michni-post Landikotal**. The counts were obtained for traffic in both direction and for three consecutive days so that a complete picture of the traffic pattern may be obtained. The identified traffic count stations are as follows:

- Station 1: Bighyari Post Jamrud
- Station 2: Michni Post Landikotal

The plan showing the location of traffic stations attached at Annexure A of this report.

1.12 Background and Objective

The primary objective for this traffic study is to determine traffic statistics for the motorway between Peshawar and Kabul and an estimate of the future expected traffic after completion of the said motorway project. This has been accomplished by establishing current traffic conditions of existing Peshawar-Torkham road.

The main objectives of the project are to:

- Boost bilateral trade between Pakistan and Afghanistan and to facilitate Pakistan's export to Afghanistan.
- Improve connectivity between the two neighbors and with other Central Asian States.
- Provide commercial link between south and central Asian nations.
- Improve the connection of provincial and national highways to the Central Asian States.
- Provide access to income and employment opportunities.
- The completion of the project would contribute to Asia's infrastructure development and will spur economic growth, reduce poverty, and improve people's lives.

Type, Volume, Pattern and Growth of Traffic on any road are the most important factors to be considered in roadway design, structural design and pavement structure determination. These studies encompass:

- Highway Traffic and its Growth
- Classified Traffic Count Surveys
- Origin Destination Survey
- Estimation of Annual Average Daily Traffic
- Traffic Projections
- Capacity Analysis

The economic viability of a project is also a function of the traffic likely to use it during the period of analysis.

1.13 Methodology

In order to meet the objective of the study, following methodology was adopted, which is presented here in descriptive as well as in framework form.

- **Existing scenario:** in this step the existing road alignment were studied through available maps and potential locations which are able to generate considerable traffic volume especially of heavy vehicles were determined.
- **Data collection:** in data collection step, both the type of data as well as its methodology of collection were determined. The collected data will then be analyzed according to standard procedure for future traffic volumes on the proposed motorway.
- **Traffic data analysis:** this is a vital stage of traffic study since it provides a complete picture with respect to traffic pattern. it is at this stage that traffic volumes are estimated and analyzed operationally as well as volumetrically.
- **Traffic report preparation:** this steps involves the preparation and assemblage of collected data and analysis results in a presentable form in accordance with standard operation procedures.

CHAPTER 2

TRAFFIC SURVEYS

2.1 General

Traffic flow data is important in planning of a particular section of the road network and for its subsequent maintenance. Traffic flow pattern appears to be random in distribution, as it reflects people's motivation in terms of different composition of vehicles on different types of roads under varying environmental conditions. Therefore the data being collected is a methodological statistics, because traffic flow pattern follows a random distribution. Despite such complexities, it does follow fairly and clearly defined patterns that are possible to classify and analyze. Thus, traffic data collection and analysis follows varying trends and plays an important role in the evaluation and management of road network schemes.

The traffic analysis for the prospective traffic on project road requires that comprehensive traffic data be collected on ground and then analyzed. Questionnaires were designed for the collection of data. The survey stations were set up to conduct traffic count, and origin-destination, surveys. Zones were developed for Origin-Destination Surveys

24 Hours traffic count was carried out at 2 locations while origin-destination data was collected for both stations. Both the surveys were conducted simultaneously. Traffic data was then entered / punched manually by the enumerators and quality checks performed. Finally a simple data analysis was carried out with the refined numbers.

All details related to methodology to conduct surveys are described below. Final results are summarized based on the spreadsheet analysis and shown accordingly.

2.2 Methodology Applied for Traffic Surveys

2.2.1 Survey Procedure

The survey was carried out at two locations. The Manual Classified Traffic Counts survey at each location was carried out for 24 hours from 08:00 to 08:00 (conducted by 3 teams), while Origin Destination survey

was done for 12 hours from 08:00 to 20:00 (conducted by 2 teams); working on an 4-hourly basis. The survey schedule for all the teams was devised and provided to supervisors. Off duty staff remained at survey site to assist during rush hours.

Besides consultant staff, local police assistance was available for guiding and handling traffic at the survey sites.

2.1.1 Location of Survey Sites

Although road sections where surveys were to be carried out had been selected by experts and consultant and approximate locations of survey points had been marked, yet the exact location of survey site was determined by the supervisors according to availability of suitable place. It was preferably on a straight stretch of road, visible from distance, with sufficient shoulder space to make an interview bay.

2.1.2 Survey Equipment's

Each survey team was provided with traffic cones to be placed on the road to guide vehicles for interviews. Surveyors were provided with reflective jackets for each team to ensure visibility for oncoming traffic. The supervisors managed proper flagging of the survey points. Supervisors were also provided with stationery, electric torches, gas cylinders, water coolers, glasses, tables, chairs, storage box, floor mat etc to conduct their 24 hrs activities in a smooth and professional way.

2.1.3 Deployment of Staff

Survey team of each shift had a supervisor, enumerators and a helper. Few enumerators undertook classified volume counts while others conducted the origin-destination survey. The enumerators interviewed as many vehicles as possible during survey hours without causing traffic to hold up. While a group of vehicles were being interviewed, others were allowed to pass by. Volume Counts were made for away moving traffic and not approaching traffic.

The police officers on duty with the survey staff managed the traffic at the survey site. They directed vehicles for interviews and helped in managing the traffic.

2.1.4 Compilation of Survey Forms

(Forms Attached at Annex-B & C)

2.1.4.1 Manual Classified Traffic Counts

It is self-explanatory. Volume counts were carried out for two directions separately. Each group of enumerators did traffic count in one direction. The number of enumerators in each direction depended on the traffic volume. A new form was used in the beginning of each hour. For 24- hour traffic in two directions, there were 24 forms for each location in each direction.

General information on top of the form was provided on all forms beforehand. This included:

- (i) Survey site location – give brief description of road section and site location as provided by the supervisor;
- (ii) Survey Direction – As traffic in two directions was counted separately, the direction of traffic was indicated on each form by indicated traffic From and To
- (iii) Date and Day - record date in 6 digits as dd-mm-yy and note day of the week;
- (iv) Time Hour Beginning – Give exact starting time in hours and minutes e.g. 0800. Use new form at the beginning of each hour.

2.1.4.2 Classified Volume Counts

The form contained 10 vehicle categories of which 3 were for passenger vehicles and 7 for goods vehicles as follows:

- i. Cars/Jeeps
- ii. Wagon/Coaster/ Hiace
- iii. Bus/Coach
- iv. Mini trucks
- v. 2-axle trucks

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- vi. 3-axle trucks
- vii. 3-axle trucks (Articulated)
- viii. 4-axle trucks
- ix. 5-axle trucks
- x. 6-axle trucks

Space for each vehicle category was approximately according to their proportion in traffic. At the end of the survey shift, forms were reviewed and volume of traffic of the given hour was recorded. It was also ensured that top of each form had been properly filled in and was then handed over to the supervisor.

2.1.5 Origin Destination Survey

Various terms used in description of results of this survey are as elaborated below:

2.1.5.1 Origin

It is the location where a trip begins. It is described in terms of a well-known locality, a city district. All survey origins have been geo-coded for precision. Each origin has also been assigned a zone number to support the application of the survey data for travel demand modelling and forecasting.

2.1.5.2 Destination

It is the location where a trip ends. It has similar attributes as the trip origin.

2.1.5.3 Origin-Destination

Describes both 'ends' of a single trip. This term is commonly abbreviated to 'O-D.'

2.1.5.4 Zone

It is a small-area geography that divides the area of interest i.e. Khyber Pakhtunkhwa spatially. The zones, also known as transportation analysis zones (TAZs) are used for modelling. There are currently 8 TAZs, including one external zone outside the KPK boundary.

2.1.5.5 O-D Forms

There was one form for all vehicles categories excluding motorcycles and tractors. Forms were numbered and bound in books. Each enumerator kept one book with him and used for the vehicle

that was directed to him. Information on top of the form, concerning location, date, time, etc. was the same for all forms, as follows:

- i. Survey site location – give code number of site location provided by the supervisor;
- ii. Survey Direction – Give name of place against:
- iii. From (place at start) To (place at the end);
- iv. Date and Day - record date in 6 digits as dd-mm-yy and note day of the week;
- v. Time Hour Beginning – Give exact starting time in hours and minutes as 0800;
- vi. Weather – Note down the weather as fair, poor, rainy & foggy;
- vii. Name of Interviewer – Write your name clearly and legibly;
- viii. The details concerning 'Coded by and Checked by' will be filled in the office.

The above information was filled in before hand in the beginning and at the end of the shift. Details of specific information for the form are given below:

- i. Write 'vehicle code' in the space for vehicle type;
- ii. Note down the vehicle occupants including driver;
- iii. Ask, "Where do you come from?" City/Town? i.e. Origin?
- iv. Ask, "Where are you going to?" City/Town? i.e. Destination?
- v. Fill in the 'purpose code' for what kind of work you are going?
- vi. Note down the kind of goods being transported and the condition of load in the carrying vehicle as full, partial full or empty etc;
- vii. Ask the approximate journey time from the drivers.

Chapter 3

SURVEY RESULTS

Below is a brief synopsis of results for both types of surveys that have been undertaken.

3.1 Manual Classified Traffic Counts

Present traffic on the project is always base point for traffic study for any up gradation/rehabilitation project. Therefore, 3-day twenty-four hour traffic count survey was conducted in the month of April 2017 to assess the traffic volume and vehicular configurations. Locations of the traffic count station were selected with due consideration to the existing road network with the aim to cover maximum traffic for determining the best representation of traffic plying on the road. Twenty-four hour traffic counts at two locations are given in **Table 2** and their respective average daily traffic is presented in **Table 3** below:

Table 2: Daily Traffic Counts

Station	Car	Wagon	Coaster	Bus	Mini Truck	Trucks (Rigid)		Trucks (Articulated)			Total	
	Jeep	Pickup	Mini Bus			2-Axle	3-Axle	3-Axle	4-Axle	5-Axle		6-Axle
Bighyari Post	5004	1399	1768	6	50	443	174	84	164	92	467	9651
Michni Post	4107	431	557	6	54	213	72	33	80	33	392	5978

Table 3: Average Daily traffic (ADT)

Car Jeep	Wagon Pickup	Coaster Mini Bus	Bus	Mini Truck	Trucks (Rigid)		Trucks (Articulated)			Total	
					2-Axle	3-Axle	3-Axle	4-Axle	5-Axle		6-Axle
4556	915	1163	6	52	328	123	59	122	63	430	7817

3.2 Daily Volumes and Peak Hour Volumes

The traffic count survey was conducted for all 10-vehicle categories. It was found that the lowest average per day traffic count in both directions was "5843 VPD" at Michni Post

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Landikotal(station 2) while the highest per day traffic count in both directions was “10556VPD”Bighyari Post Jamrud (station 1).

The summary of traffic counts at both stations is given in table 4below:

Table 4: Peak Hour Traffic and Daily Traffic at Stations

Sr. No.	Survey Station	Peak Hour Time	Peak Hour Traffic		24 Hour Traffic	
			No. of Veh.	PCU	No. of Veh.	PCU
1	Bighyari Post Jamrud	0800-0900	2073	2795	9651	13920
2	Michni Post Landikotal	0800-0900	1684	2322	5978	8513

Graphical presentation for hourly variations at both stations with peak hour traffic has been shown in Figures 1 to 2below:

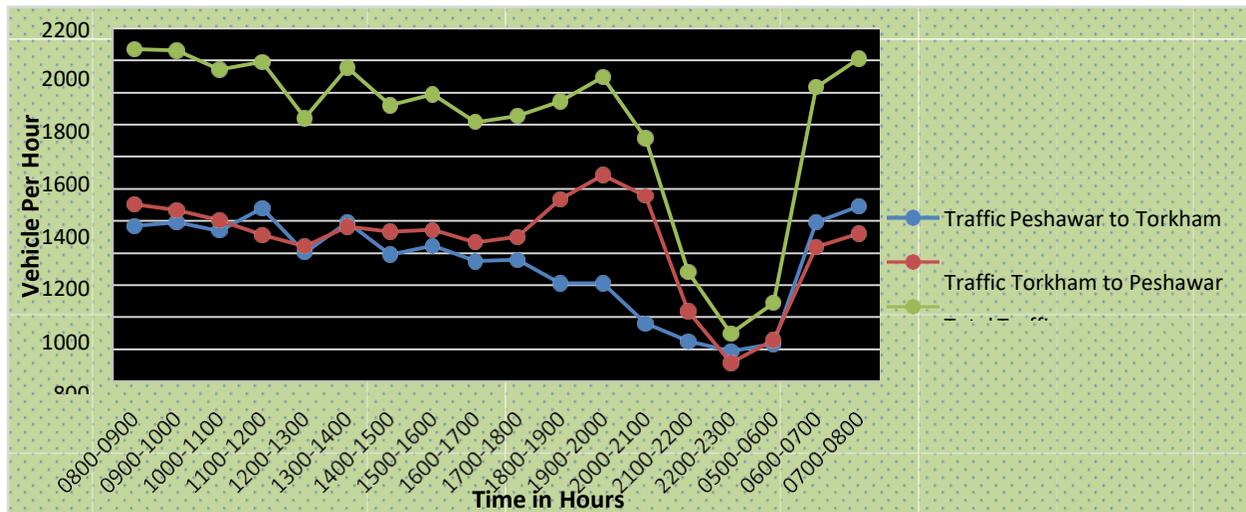


Figure 1: Hourly Variations in Traffic Volume (Bighyari Post Jamrud)

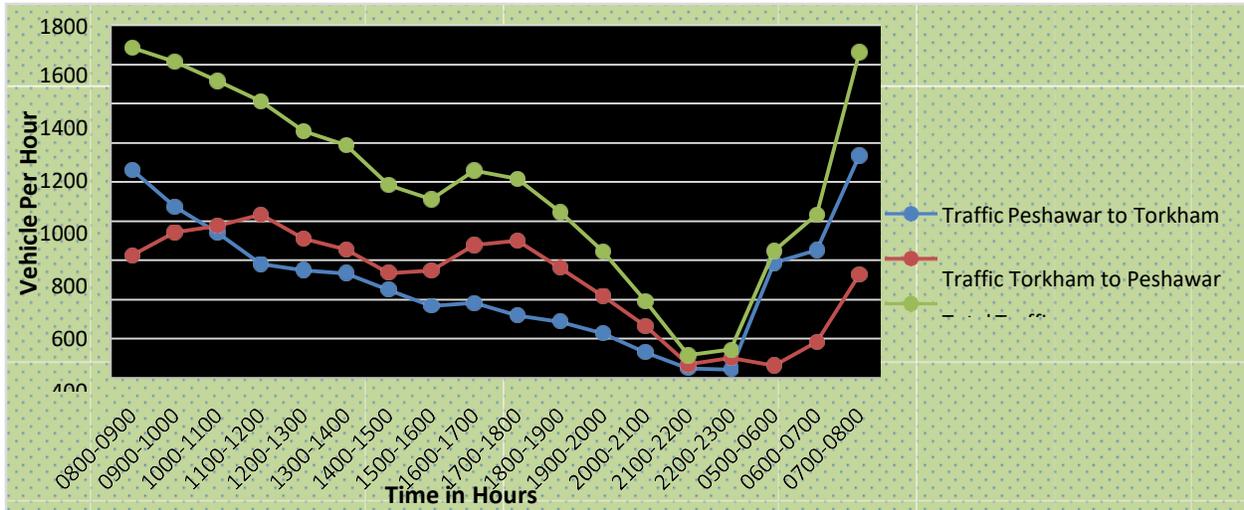


Figure 2: Hourly Variations in Traffic Volume (Michni Post Landikotal)

3.3 Percentage Composition

The survey results reveal that the car is the dominant mode of travel making 60.3% of vehicle streams on both stations. These percentages are the aggregates of vehicles for 24 hour traffic at a station and don't give the true picture of vehicle composition variations during different hours of the day. The percentage composition of traffic at respective sections of roads are given in the table 5 and shown in figure 3 and 4 below:

Table 5: Traffic percentage composition

Sr. No.	Survey Station Ref.	Car/ Jeep	Wagon/ Coaster/ Mini Bus	Bus/ Coach	Mini Truck	Truck (2 Axles)	Truck (3 Axles)	Trucks (3 Axle Articulated)	Truck (4 Axles)	Truck (5 Axles)	Truck (6 Axles)	total %age

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1	Stn. No. 1	51.8	32.8	0.1	0.5	4.6	1.8	0.9	1.7	1.0	4.8	100.0
2	Stn. No. 2	68.7	16.5	0.1	0.9	3.6	1.2	0.6	1.3	0.6	6.6	100.0
Overall		60.3	24.7	0.1	0.7	4.1	1.5	0.7	1.5	0.8	5.7	100.0

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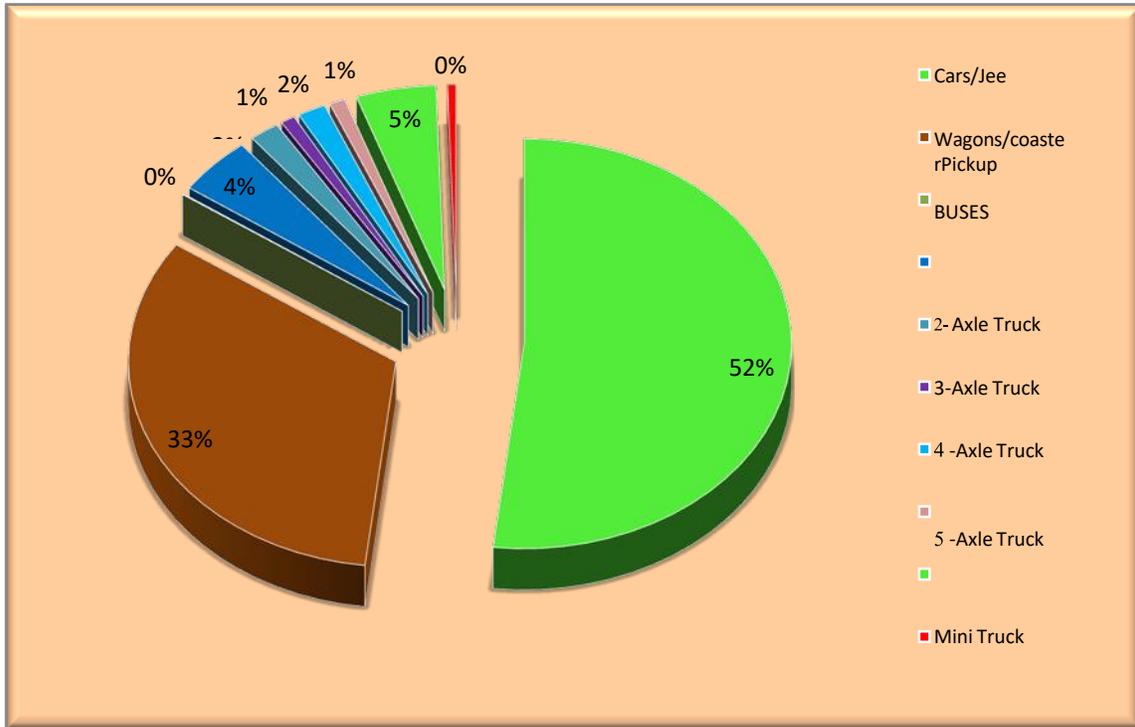


Figure 3: Percentage composition at Bighyari Post Jamrud

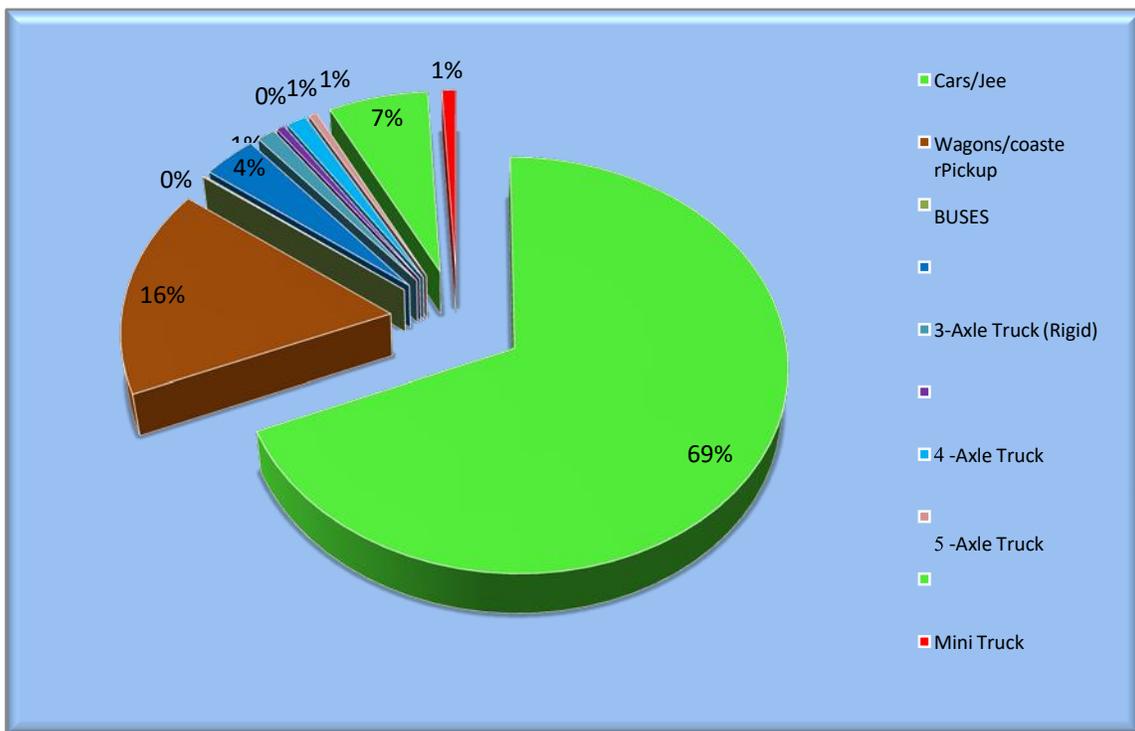


Figure 4: Percentage composition at Michni Post Landikotal

3.4 Traffic Zones for Current O-D Survey

For the purpose of analysis of the survey data of this study, following zones were constituted:

- Zone -I:** Torkham, Jalalabad, Kabul and other areas of Afghanistan;
- Zone -II:** Jamrud, Landikotal, Nasir Bagh, Sufaid Sang, Mathra, upto Swat;
- Zone-III:** Peshawar, Hayatabad, Charsadda, Shabqadar and other nearby town;
- Zone-IV:** Nowshera, Mardan, Swabi, Abbotabad, Mansehra, Northern Areas and China etc;
- Zone-V:** Matanni, Dara Adam Khel, Kohat, Hanju, Sherkot, Sourthern KPK;
- Zone-VI:** This zone comprised of cities in the south and west like Hassan Abdal, Taxila, Rawalpindi, Islamabad and whole Punjab;
- Zone-VII:** Karachi and whole Sindh province;
- Zone-VIII:** Gawadar and whole Balochistan province

The O-D survey was conducted for all vehicle categories except motorcycles and tractors. Survey included major information as origin and destination of the traveling vehicle, purpose of visit, the kinds of goods it was transporting and the approximate journey time. Survey was done randomly and that may be the reason for different no. of surveys for a certain vehicle category at different stations.

The data obtained from field was coded and entered in the computer. For the purpose of analysis O-D matrices were developed for following categories of vehicles:

- Cars/Jeep;
- Wagons/Coasters;
- Buses;

- Mini Trucks;
- Trucks 2, 3, 4, 5 and 6 Axle Vehicles.

3.5 Sample Size

As elaborated in one of the previous sections, the sample size depends upon overall traffic volume at a road section, the composition of traffic stream and approach of a driver. Stratified random sampling technique was used for the survey. Various categories of vehicles were interviewed randomly. However, the stratification was among various categories of vehicles. The details of size of sample for OD survey at both survey stations is described in table 6 below:

Table 6: Sample size for OD survey

Station	No. of Vehicles interviewed					
	Cars/ Jeeps	Wagons/ Pickups	Bus	Mini Truck	Truck 2,3,4,5,6 Axle	Total
Station 1	472	341	3	19	305	1140
sample rate %	9.4	10.8	50.0	38.0	21.4	11.8
Station 2	392	286	2	12	252	944
sample rate %	9.5	28.9	33.3	22.2	30.6	15.8
overall	864	627	5	31	557	2084
sample rate %	9.5	15.1	41.7	29.8	24.8	13.3

3.6 O-D Matrices

The sample OD matrices developed from field data obtained were extrapolated using the Manual Classified Traffic Count Survey Results to obtain Estimated OD matrices for current travel pattern at various road sections. These OD matrices for individual sections were statistically treated to combine into unified matrices for entire network range.

Detailed OD matrices for various categories of vehicles are given at Annex-D.

3.7 Traffic Generated/Diverted By Proposed Motorway

Diverted traffic is the traffic which is attracted from an alternative route to the project. For the subject road section diverted traffic has been taken for the traffic which is currently using N-50 for reaching to Kabul. Generated traffic is the growth in traffic along a roadway associated with the decrease / increase in user costs associated with utilizing that roadway and an elasticity factor. Generated traffic is the traffic generated by improving the project road including the development traffic.

Choice of route for a trip depends upon a number of factors. However the most significant ones are the travel time which mainly depends on quality of road, fuel economy which is a function of a number of variables including road condition, speed of vehicle, engine technology etc and

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accessibility of an express road facility which depends on the connecting road network within a geographical region.

On the basis of location of the project road, quality of facility it is going to offer and the level of service, it is anticipated that the trips between following pairs of zones will be using part or whole length of the project road:

Zone 1-zone 2, Zone 1-zone 3, Zone 1-zone 4, Zone 1-zone 5, Zone 1-zone 6, Zone 1-zone 7, Zone 1-zone 8.

It is also assumed that 50 % of following OD trips will be made using the proposed Motorway: Zone 2-zone 3, Zone 2-zone 4, Zone 2-zone 5, Zone 2-zone 7 and Zone 2-zone 8

Based on these assumptions, the anticipated traffic that is likely to be diverted /generated for the proposed Motorway is given in table 7 below:

Table 7: Generated/ Diverted Traffic for Peshawar Torkham Motorway

Vehicle Type	Cars/ Jeep	Wagons / Coasters	Bus	Mini Truck	Truck 2 axle	Truck 3 axle	Trucks 3 axle	Truck 4 axle	Truck 5 axle	Truck 6 axle	Total
							Articulated				
ADT	1027	248	2	14	54	18	9	20	9	98	1499

Historical traffic count data was not available for the project road. Therefore, for estimation of future traffic growth factors, following traffic influencing parameters have been used:

- Sectoral Growth Rates
- Population Growth
- Growth of Registered Vehicles in Khyber Pakhtunkhwa
- Growth of Registered Vehicles in Project Area
- Growth in Fuel Consumption in Transport Sector

4.1 Sectoral Growth Rates

Traffic volume and its growth are directly related to the socio-economic parameters like population, agriculture, mineral and industrial growth. It is actually a prerequisite for estimation of future traffic growth and its pattern. The socio-economic study regarding immediate and expanded zone of influence of the project area is intended to provide an understanding of the dynamics regarding various sectors of regional economy contributing towards economic growth of the area.

Development in Khyber Pakhtunkhwa has direct influence on the economy of the project area. Therefore, whole of the Khyber Pakhtunkhwa has been considered as expanded zone of influence. Based on past growth rates and future target growth rates as planned and with the application of statistical technique of best fit equation to time series data regarding Agriculture, Horticulture and Mineral growth, average sector growth rates have been computed as given in Table 8 below:

Table 8: Average Growth Rates

	2010 – 15	2015 – 20	2020 – 25	2025 – 30	2030 – 35
*AGR (%)	5.35	5.06	4.54	4.11	3.85

*AGR is the Average Growth Rate.

4.2 Population Growth

Passenger traffic is the function of population growth. Population grew at 2.61 percent per annum. During last ten years registered passenger vehicular traffic showed an annual growth of

5.2 percent. It implies that passenger vehicles increased by 1.99 time that of population growth. According to “Ten Year Perspective Development Plan 2001-11” it is expected that population of the Pakhtunkhwa will grow at 1.98 percent per annum from 2004 to 2011. Therefore, it has been assumed that passenger traffic will grow at 3.30 percent per annum in future.

Table 9: Population of Various Districts in KPK

District	Area in Sq.Kms	Population		Growth rate 1981-1998 (Percent)	Estimated Population 2015	Population Density per Sq.Km
		1981 (Census)	1998 (Census)			
NWFP	74,521	11,061,328	17,735,912	2.82	28,455,926	382
Abbottabad	1,967	647,635	880,666	1.82	1,196,668	608
Bannu	1,227	422,027	675,667	2.81	1,082,265	882
Battagram	1,301	339,119	307,278	-0.58	278,346	214
Buner	1,865	265,517	506,048	3.86	963,414	517
Charsadda	996	630,811	1,022,364	2.88	1,656,654	1663
Chitral	14,850	208,560	318,689	2.52	486,534	33
D.I.Khan	7,326	494,432	852,995	3.26	1,471,609	201
Hangu	1,097	182,474	314,529	3.25	541,741	494
Haripur	1,725	479,031	692,228	2.19	1,000,442	580
Karak	3,372	249,681	430,796	3.26	743,221	220
Kohat	2,545	326,617	562,644	3.25	969,091	381
Kohistan	7,492	465,237	472,570	0.09	479,853	64
Lakki	3,164	288,759	490,025	3.16	831,593	263
Lower Dir	1,583	404,844	717,649	3.42	1,271,128	803
Malakand	952	257,797	452,291	3.36	793,251	833
Mansehra	4,579	770,235	1,152,839	2.4	1,725,313	377

Mardan	1,632	881,465	1,460,100	3.01	2,417,309	1481
Nowshera	1,748	537,638	874,373	2.9	1,421,537	813
Peshawar	1,257	1,113,303	2,019,118	3.56	3,659,539	2911
Shangla	1,586	251,546	434,563	3.27	750,955	473
Swabi	1,543	625,035	1,026,804	2.96	1,685,981	1093
Swat	5,337	715,938	1,257,602	3.37	2,209,276	414
Tank	1,679	141,062	238,216	3.13	402,269	240
Upper Dir	3,699	362,565	575,858	2.76	914,798	247

4.3 Growth of Registered Vehicles in Khyber Pakhtunkhwa

Data regarding various types of vehicles registered in Pakhtunkhwa was available from year 2001 to 2009 showed that growth in case of buses is highest (5.95 percent per annum) followed by cars/jeeps (5.28 percent per annum). Growth in case of trucks was 3.4 percent per annum. Overall registered vehicles have been growing at 5.41 percent per annum.

For the purpose of estimation of future growth trend in respect of various types of vehicle registered in Pakhtunkhwa, statistical technique of regression analysis for best-fit line / curve has been used. Various equations tried are as follow:

- Linear
- Polynomial
- Exponential
- Power
- Log

Best-fit equations for number of vehicles registered in Pakhtunkhwa have been developed and are given below:

$$\text{Passenger Traffic} = 48.24 x + 652.78 \text{ Freight}$$

$$\text{Traffic} = 787773 e^{0.0584 x}$$

x is the consecutive year of the period. Based on above equations future growth rates have been calculated and are shown Table 10 below:

Table 10: Future Growth Rates Passenger Traffic vs. Freight Traffic

Vehicle Type		2010 – 15	2015 – 20	2020 – 25	2025 – 30	2030 – 35
Passenger Traffic	*AGR (%)	5.27	4.93	4.68	4.48	4.17
Freight Traffic		7.19	6.68	6.25	5.83	5.52

*AGR is the Average Growth Rate

4.4 Growth of Registered Vehicles in Project Area

Best-fit equations for registered vehicles in Project area have been developed and are given below:

$$\text{Passenger Traffic} = 402.35 e^{0.053 x}$$

$$\text{Freight Traffic} = -0.0531 x^2 + 5.2709 x + 37.041$$

Based on above equations future growth rates have been calculated and are shown below Table 11 below:

Table 11: Future Growth Rates – Best Fits

Vehicle Type		2010 – 15	2015 – 20	2020 – 25	2025 – 30	2030 – 35
Passenger Traffic	AGR (%)	5.84	5.09	4.23	4.23	4.23
Freight Traffic		4.89	4.40	4.21	3.91	3.45

4.5 Growth in Fuel Consumption in Transport Sector

Fuel consumption in Transport Sector is also an important indicator of traffic growth behavior. It has been observed that fuel consumption has increased from 4841 tons in year 2001 to 8158 tons in year 2008 – 09 showing a growth rate of 5.3 percent per annum vehicles have been growing at

5.41 percent per annum.

4.6 Pakistan Transport Plan Study 2006

JICA in collaboration with the NTRC carried out the Pakistan Transport Plan Study in March 2006. It suggests land transport demand for freight is assumed to grow at an average annual rate of 6.3% (10.0% for railway and 6.1% for road) for next five years.

For the same period the study assumes a growth rate of 7.6% per year. This means that the elasticity of land freight traffic demand against GDP is more than 1.0.

In past the land freight traffic volume has increased at an average rate of 8.6% in terms of ton-km from 1990/91 to 2003/04. This is higher than the growth rate of GDP which was 5.2-7.3% during the same period. Following table gives the summary of projected traffic and estimated growth rates as estimated by the subject study:

Table 12: Future Estimated Increase in Vehicles

Year	Car	Truck	Bus	Total
2004	1,753	269	115	2,137
2005	1,902	293	126	2,321
2010	2,645	440	192	3,277
2015	3,338	628	276	4,242
2020	3,978	865	382	5,225
2025	4,567	1,152	511	6,230
2030	5,104	1,490	662	7,256
Growth	4.4%	7.1%	7.3%	5.0%

4.7 Adopted Future Traffic Growth Rates

On the basis of parameters discussed above future traffic growth rates in respect of various types of vehicles have been calculated and summarized in Table 13 below:

Table 13: Future Growth Rates

Vehicle Type		2010 – 15	2015 – 20	2020 – 25	2025 – 30	2030 – 35
Passenger Traffic	ARG (%)	5.36	4.74	4.48	4.37	4.24
Freight Traffic		7.04	6.78	6.55	6.32	6.12

Chapter 5 FUTURE TRAFFIC PROJECTIONS

5.1 Average Annual Daily Traffic (AADT)

The traffic counts were carried out in the month of April 2017 for three day in order to check the volume of traffic from Peshawar to Torkham. Types of Vehicle surveyed include car, jeep, wagon, coasters, passenger buses, mini trucks and multi axle trucks.

Adjustments for Seasonal Effect

NTRC (National Transport Research Council) has established seasonal factors which are compiled in "Traffic Factors for Pakistan-II (1991)". The daily factors vary by only +/- 2% for all types of vehicles. Weekdays being 1.02 and weekends at 0.98. The average monthly factors range from 0.91 to 1.07.

For estimating the traffic forecasts, growth rates are used as described in above paras and traffic has been forecasted for next 20 year. Following factors has been used:

* WDMF = Week Day Multiplying Factor

For Saturday =	1.00	For Wednesday =	0.98
For Sunday =	0.99	For Thursday =	1.02
For Monday =	1.00	For Friday =	1.02
For Tuesday =	0.99		

**** SVF = Seasonal Variation Factor**

For March: 0.91

The traffic counts were conducted direction wise in the field i.e from Peshawar to Torkham and Torkham to Peshawar, while they were combined for the calculation of Average Annual Daily Traffic (AADT). Table 14 presents the AADT for the project road.

Table 14: Average Annual Daily Traffic (AADT)

Year	Vehicle Type	Car Jeep	Wagons Coaster Pickup	Buses	Mini Truck	Trucks(Rigid)		Trucks(Articulated)				ADT	AADT
	AGR (%)	4.74	4.74	4.74	4.74	2-Axle	3-Axle	3-Axle	4-Axle	5 -Axle	6 -Axle		
		6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78		
Base Year	2017	5019	2280	7	57	361	136	65	135	70	474	8,604	3,140,460
Const. Period	2018	5288	2402	7	61	386	146	70	145	75	507	9,087	3,316,748
	2019	5539	2516	8	65	413	155	74	154	80	542	9,546	3,484,307
1	2020	6828	2883	10	122	486	181	87	182	93	665	11,538	4,211,198
2	2021	7134	3013	11	130	518	193	93	194	99	709	12,092	4,413,580
3	2022	7454	3147	11	139	552	205	99	206	105	755	12,674	4,625,927
4	2023	7788	3288	12	148	588	219	105	220	112	805	13,284	4,848,745
5	2024	8137	3436	12	158	627	233	112	234	120	858	13,925	5,082,565
6	2025	8501	3590	13	168	668	248	119	249	127	914	14,597	5,327,948
7	2026	8873	3747	13	178	710	264	127	265	135	972	15,284	5,578,528
8	2027	9260	3910	14	190	755	281	135	282	144	1033	16,003	5,841,181
9	2028	9665	4081	14	202	802	298	143	300	153	1098	16,758	6,116,505
10	2029	10087	4260	15	215	853	317	152	319	163	1168	17,548	6,405,128
11	2030	10528	4446	16	228	907	337	162	339	173	1242	18,377	6,707,713
12	2031	10975	4634	16	242	963	358	172	360	184	1318	19,220	7,015,368
13	2032	11440	4831	17	257	1021	380	182	382	195	1398	20,103	7,337,490
14	2033	11925	5035	18	273	1084	403	194	405	207	1484	21,027	7,674,780
15	2034	12430	5249	18	289	1150	428	205	430	220	1575	21,994	8,027,974
16	2035	12958	5472	19	307	1221	454	218	456	233	1671	23,008	8,397,843
17	2036	13507	5704	20	326	1295	482	231	484	247	1773	24,069	8,785,199
18	2037	14080	5945	21	346	1375	511	245	514	262	1882	25,181	9,190,894
19	2038	14677	6197	22	367	1459	543	261	545	278	1997	26,345	9,615,822
20	2039	15299	6460	23	389	1548	576	276	578	296	2119	27,564	10,060,923

5.2 Loaded/Unloaded, Directional and Lane Distribution Factors

Loaded and Unloaded ratio of 80:20 is taken for calculation of ESALs. Directional distribution factor is taken as 0.50 for two directional traffic flows. Lane distribution factor is adopted 0.9 according to the number of lanes as follows:

Table 15: Lane Distribution Factors (AASHTO Design Guide 1993)

No. of Lanes in each Direction	Percentage of 18 kips EASLs in Design Lane
1	100
2	80 – 100
3	60 – 80

5.3 Equivalent Axle Load Factor (EALF)

An equivalent axle load factor (EALF) defines the damage per pass to a pavement by the axle in question relative to the damage per pass of a standard axle load usually 18-kip single axle load. According to AASHTO method, EALF is based on type of pavement, type of axle, SN of pavement, terminal serviceability index (P_t) of pavement. Under heavy axle loads with an equivalent factor much greater than unity, the EALF increases as P_t or SN decreases. This is expected because heavy axle loads are more destructive to poor and weaker pavements than to good and stronger ones. Practically, EALF is not very sensitive to pavement thickness and a SN of 5 may be used for most cases. Most of the major highway designs have structural number of 5, therefore, it was considered appropriate to assume SN as 5. EALF's of different trucks carrying maximum allowed load and actual loads have been taken from *NTRC Axle load study 1995*, presented in Table 16.

Table 16: EALF's by AASHTO method

Equivalent Standard Axle Factor			
Description	Loaded	Unloaded	
Mini Truck	2.52	0.042	
2-Axle	4.67	0.052	
3-Axle	8.84	0.075	
Articulated	3-Axle	9.6	0.272
	4-Axle	10.35	0.385
	5-Axle	10.35	0.495
	6-Axle	10.84	0.505

5.4 Equivalent Single Axle Loads (ESAL's)

The EALF's are used in the calculation of Cumulative Equivalent Single Axle Loads (CESAL's) in one direction on projected traffic for 10 and 20 year design period. Average daily traffic (ADT) count has been multiplied by National Transport Research Centre (NTRC) weekday factor and coefficient of seasonal variation to convert ADT into Average annual daily traffic (AADT). Detailed working is presented as table 17 below:

Table 17: Cumulative ESAL's

Year	Vehicle Type	Cars/ Jeep	Wagons/ coaster Pickup	Buses	Mini Truck	TRUCKS (Rigid)		TRUCKS(Articulated)				Annual	Cumulative	Design
						2-Axle	3-Axle	3-Axle	4-Axle	5-Axle	6-Axle			
	AGR (%)	4.74	4.74	4.74	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78		
Damaging Factor	Loaded			0.767	2.52	4.67	8.84	9.26	10.35	10.35	10.84	ESALs	ESALs	ESALs
	Empty				0.042	0.052	0.075	0.092	0.385	0.495	0.505			
2017	Base Year	5019	2280	7	57	361	136	65	135	70	474	3,210,040	3,210,040	1,444,518
2018	Const. Period	5257	2402	7	61	386	146	70	145	75	507	3,435,984	6,646,024	2,990,711
2019		5506	2516	8	65	413	155	74	154	80	542	3,668,889	10,314,913	4,125,965
2020	1	6794	2883	10	124	495	184	88	185	94	677	4,505,392	14,820,305	5,928,122
2021	2	7098	3013	11	132	527	196	94	197	101	721	4,800,419	19,620,724	7,848,290
2022	3	7416	3147	11	140	562	209	100	210	107	768	5,114,767	24,735,491	9,894,197
2023	4	7749	3288	12	149	598	223	107	223	114	818	5,449,701	30,185,193	12,074,077
2024	5	8096	3436	12	159	637	237	114	238	122	872	5,806,570	35,991,762	14,396,705
2025	6	8459	3590	13	170	679	253	121	254	130	929	6,186,809	42,178,571	16,871,429
2026	7	8828	3747	13	180	722	269	129	270	138	988	6,577,726	48,756,297	19,502,519
2027	8	9214	3910	14	192	768	286	137	287	147	1050	6,993,345	55,749,642	22,299,857
2028	9	9617	4081	14	204	816	304	146	305	156	1117	7,435,227	63,184,869	25,273,948
2029	10	10037	4260	15	217	868	323	155	324	166	1187	7,905,032	71,089,901	28,435,960
2030	11	10475	4446	16	231	923	343	165	345	176	1262	8,404,524	79,494,425	31,797,770
2031	12	10920	4634	16	245	979	364	175	366	187	1339	8,918,774	88,413,198	35,365,279
2032	13	11383	4831	17	260	1039	387	186	388	198	1421	9,464,491	97,877,689	39,151,076
2033	14	11865	5035	18	276	1103	410	197	412	211	1508	10,043,602	107,921,292	43,168,517
2034	15	12368	5249	18	292	1170	435	209	437	223	1601	10,658,150	118,579,441	47,431,776
2035	16	12893	5472	19	310	1242	462	222	464	237	1699	11,310,302	129,889,744	51,955,897
2036	17	13439	5704	20	329	1318	490	235	492	252	1803	12,002,361	141,892,105	56,756,842
2037	18	14009	5945	21	349	1399	520	250	522	267	1913	12,736,769	154,628,874	61,851,550
2038	19	14603	6197	22	371	1482	552	265	554	283	2030	13,516,116	168,144,991	67,257,996
2039	20	15222	6460	23	393	1576	586	281	588	301	2154	14,343,154	182,488,145	72,995,258

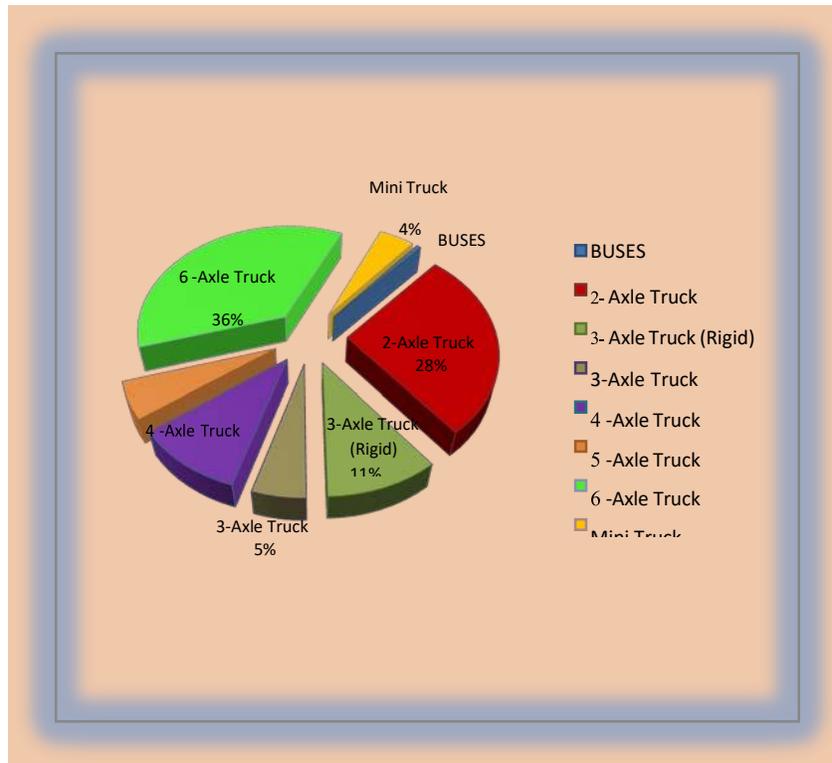


Figure 5: ESAL's Contribution

5.5 Determination of Average annual PCU

Traffic is the basic input for capacity analysis of highway facility. For capacity analysis / Level of Service determination, traffic is taken in terms of Passenger Car Units (PCU). In case of mix traffic phenomenon, conversion factors are used to convert mix traffic into Passenger Car Units (PCU). The traffic in terms of Passenger Car Units(PCU) is obtained by multiplying these factors with traffic volumes of individual vehicles. Traffic factors for different categories of vehicles were taken from *Highway Capacity Manual (HCM 2000)*. Table 18 gives the average annual PCU for different classes of vehicles up to 20 years after construction of facility.

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Table 18: Average Annual Passenger Car Unit's (PCU)

Year	Vehicle Type	Car Jeep	Wagons Coaster Pickup	Buses	Mini Truck	Trucks(Rigid)		Trucks(Articulated)				Avg. Daily PCU's	Average Annual PCU's
	AGR (%)	4.74	4.74	4.74	4.74	2-Axle	3-Axle	3-Axle	4-Axle	5 -Axle	6 -Axle		
	PCU Factor	1	1.5	2.5	1.5	1.5	2.5	2.5	3.5	4	4.5		
AADT	2017	5019	2280	7	57	361	136	65	135	70	474	8,604	
PCU		5019	3420	18	143	542	340	163	473	280	2133	12,531	4,573,815
Const. Period	2018	5257	3582	19	153	579	363	174	505	299	2278	13,208	4,820,949
	2019	5506	3752	20	163	618	388	186	539	319	2432	13,923	5,081,854
1	2020	6794	4302	26	306	728	451	217	635	370	2988	16,817	6,138,326
2	2021	7098	4494	27	326	776	481	231	676	395	3184	17,689	6,456,358
3	2022	7416	4696	28	347	827	512	247	721	420	3393	18,607	6,791,456
4	2023	7749	4906	29	370	881	546	263	768	448	3615	19,574	7,144,571
5	2024	8096	5126	31	394	939	581	280	818	477	3852	20,594	7,516,705
6	2025	8459	5356	32	420	1000	619	298	872	509	4104	21,668	7,908,920
7	2026	8828	5590	33	446	1063	659	317	927	541	4363	22,768	8,310,214
8	2027	9214	5834	35	475	1131	700	337	986	575	4639	23,925	8,732,563
9	2028	9617	6089	36	505	1202	744	358	1048	611	4932	25,143	9,177,110
10	2029	10037	6355	38	537	1278	791	381	1114	650	5244	26,425	9,645,060
11	2030	10475	6633	40	570	1359	842	405	1184	691	5575	27,774	10,137,689
12	2031	10920	6914	41	605	1442	893	430	1257	733	5917	29,152	10,640,448
13	2032	11383	7207	43	642	1530	948	456	1334	778	6279	30,600	11,168,987
14	2033	11865	7513	45	682	1624	1006	484	1416	826	6663	32,122	11,724,671
15	2034	12368	7831	47	723	1723	1067	514	1502	876	7071	33,723	12,308,942
16	2035	12893	8163	49	768	1829	1133	545	1594	930	7503	35,406	12,923,319
17	2036	13439	8509	51	815	1941	1202	579	1692	987	7963	37,176	13,569,406
18	2037	14009	8870	53	865	2059	1275	614	1795	1047	8450	39,038	14,248,893
19	2038	14603	9246	55	918	2185	1353	652	1905	1111	8967	40,996	14,963,564
20	2039	15222	9638	58	974	2319	1436	692	2022	1179	9516	43,056	15,715,300

CHAPTER 6

CAPACITY AND LEVEL-OF-SERVICE ANALYSIS

The level of service denotes the level of facility one can drive from a road under different operating characteristics and traffic volumes. The following are used to evaluate the level of service:

1. Speed and travel time, including the operating speed and overall travel time consumed in traveling over a section of roadway;
2. Traffic interruptions or restrictions, with due consideration to the number of stops per unit length, delays involved and the speed changes necessary to maintain pace in the traffic stream;
3. Freedom to maneuver to maintain the desired operating speeds;
4. Driving comfort and convenience reflecting the roadway and traffic conditions in-so-far as they affect driving comfort and convenience of the driver;
5. Economy, with due consideration of the operating cost of the vehicle;

Even though it is desirable to consider all the above factors in identifying a particular level of service, it is difficult to incorporate all these in the absence of accurate data. The Highway Capacity Manual (HCM), therefore utilizes (i) travel speed and (ii) the volume / capacity (v/c) ratio depending upon the particular problem. As regards the travel speed, the Manual recommends the use of operating speeds on those types of highway carrying generally uninterrupted flow, such as in rural areas. For urban locations, the Manual recommends the use of average overall travel speed.

6.1 Categories of Level of Service

The operating conditions for the six levels of service selected by the Manual are given below level A representing the highest and level F representing the lowest level:

Level of Service A: Free flow, with low volumes and high speeds. Traffic density low, with speeds controlled by driver's desires, speed limits and physical roadway conditions. Little or no

restriction in maneuverability due to presence of other vehicles and drivers can maintain their desired speed with little or no delay.

Level of Service B: Zone of stable flow, operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed and lane of operations. Reduction in speed is not unreasonable. The lower limit of (*lowest speed, highest volume*) of this level of service has been associated with service volumes used in the design of rural highways.

Level of Service C: Still in the zone of stable flow, but speeds and maneuverability are more closely controlled by higher volumes. Most of the drivers restricted in their freedom to select their own speed, lane changing or overtaking maneuvers. A relatively satisfactory operating speed is still obtained, with service volumes perhaps suitable for urban design practice.

Level of Service D: Approaches unstable flow, with tolerable operating speed being maintained though considerably affected by changes in operating conditions. Fluctuation in volume and temporary restrictions to flow may cause substantial drops in operating speeds. Drivers have little freedom to maneuver; comfort and convenience are low, but conditions can be tolerated for short periods of time.

Level of Service E: Cannot be described by speed alone, but represents operations at even lower operating speeds than level D, with volumes at or near the capacity. At capacity, speeds are typically but not always in the neighborhood of 50 K.P.H. Flow is unstable, and there may be stoppages of momentary duration.

Level of Service F: Forced flow operations at low speeds, where volumes are below capacity. Conditions result from queues of vehicles backing up from a restriction downstream. The section under study will be serving as a storage area during parts of the peak hour. Speeds are reduced substantially and stoppages may occur for short or long periods of time, because of downstream congestion. In the extreme, both speed and volume can drop to zero.

The factors which affect, the capacity and level of service can be considered under the following two main categories:

- (i) Roadway Factors.
- (ii) Traffic Factors

Roadway Factors:

- (A) Roadway factors pertain to restrictive physical features of a road such as lane width, lateral clearance, shoulders, auxiliary lanes, surface conditions, alignment and grades.

Traffic Factors:

- (B) Traffic factors that affect capacity are the composition of different types of vehicles in the traffic stream, lane distribution, variations in traffic flow and traffic interruption.

6.2 Level of Service (LOS) Operational Analysis

The most common form of analysis is *operational analysis*. In this form of analysis, all traffic, roadway, and control conditions are defined for an existing or projected highway section, and the expected level of service and operating parameters are determined. The basic approach is to convert the existing or forecast demand volumes to an equivalent flow rate under ideal conditions:

$$v_p = \frac{V}{PHF * N * f_{HV} * f_p}$$

Where,

v_p = demand flow rate under equivalent ideal conditions, pc/h/ln

PHF = peak-hour factor

N = number of lanes (in one direction) on the facility

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f_{HV} = adjustment factor for presence of heavy vehicles

f_p = adjustment factor for presence of occasional or non-familiar users of a facility

6.3 Heavy-Vehicle Factor (f_{HV})

The principal adjustment to demand volume is the heavy-vehicle factor, which adjusts for the presence of heavy vehicles in the traffic stream. By definition, the heavy-vehicle adjustment factor, f_{HV} , converts veh/h to pc/h when divided into the flow rate in veh/h. The heavy-vehicle adjustment factor is based upon the concept of passenger-car equivalents. A *passenger-car equivalent* is the number of passenger cars displaced by one truck, bus, or RV in a given traffic stream under prevailing conditions. Given that two categories of heavy vehicle are used, two passenger car equivalent values are defined:

E_T = passenger car equivalent for trucks and buses in the traffic stream under prevailing conditions

E_R = passenger car equivalent for RV's in the traffic stream under prevailing conditions

The formula for heavy vehicle factor is as follows:

$$f_{HV} = \frac{1}{1 + P_T (E_T - 1) + P_R (E_R - 1)}$$

6.4 Driver Population Factor (f_p)

The base procedures for freeways and multilane highways assume a driver population of commuters or drivers familiar with the roadway and its characteristics. On some recreational routes, the majority of drivers may not be familiar with the route. This can have a significant impact on operations. In general, the factor ranges between values of 1.00 (for commuter traffic streams) to 0.85 as a lower limit for other driver populations. Unless specific evidence for a lower value is available, a value of 1.00 is generally used in analysis. Where a future situation is being analyzed, and recreational users dominate the driver population, a value of 0.85 is suggested as it represents a "worst-case" scenario.

6.5 Free Flow Speed (FFS)

The free-flow speed for a multilane highway may be estimated as:

$$FFS = BFFS - f_{LL} - f_{LC} - f_M - f_A$$

Where,

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FFS= free-flow speed of the multilane highway, mi/h

BFFS= base free-flow speed

f_{LW} = adjustment for lane width, mi/h

f_{LC} = adjustment for lateral clearance, mi/h f_M =

adjustment for type of median, mi/h f_A =

adjustment for access points, mi/h

Abase free-flow speed of 60 mi/h may be used for rural and suburban multilane highways, if no field data is available. It may also be estimated using the posted speed limit. The base free-flow speed is approximately 7 mi/h higher than the posted speed limit, for speed limits of 40 and 45 mi/h. For speed limits of 50 and 55 mi/h, the base free-flow speed is approximately 5 mi/h higher than the limit.

Table 19: Data for Level of Service

Description	Symbol	Unit	Value
Volume	V	vpd	12457
Proportion of trucks	P_T	%	0.33
Proportion of recreational vehicle	P_R	%	0
Passenger car equivalents (trucks buses)	E_T	C*	4.5
Passenger car equivalents (recreational v)	E_R	C	0
Heavy vehicle factor	f_{HV}	C	0.467
Directional Design Hourly Volume	DDHV	veh/hr	641
Peak hour factor	PHF	C	0.88
Factor for occasional users	f_p	C	1
No of lanes	N	No.	2
Demand flow rate	v_p	veh/hr	928
Basic free flow speed	BFFS	km/hr	85
Adjustment for lane width	F_{LW}	km/hr	2.1
Adjustment for lateral clearance	F_{LC}	km/hr	2.1
Adjustment for type of median	F_M	km/hr	2.6
Adjustment for access points	F_A	km/hr	4
Free flow speed	FFS	km/hr	74.2

*=Constant

The results are used to enter the standard speed-flow curves of figure 6(multilane highways). Using the appropriate free-flow speed, the curves may be entered on the x-axis with the demand flow rate, v_p to determine the level of service and the expected average speed.

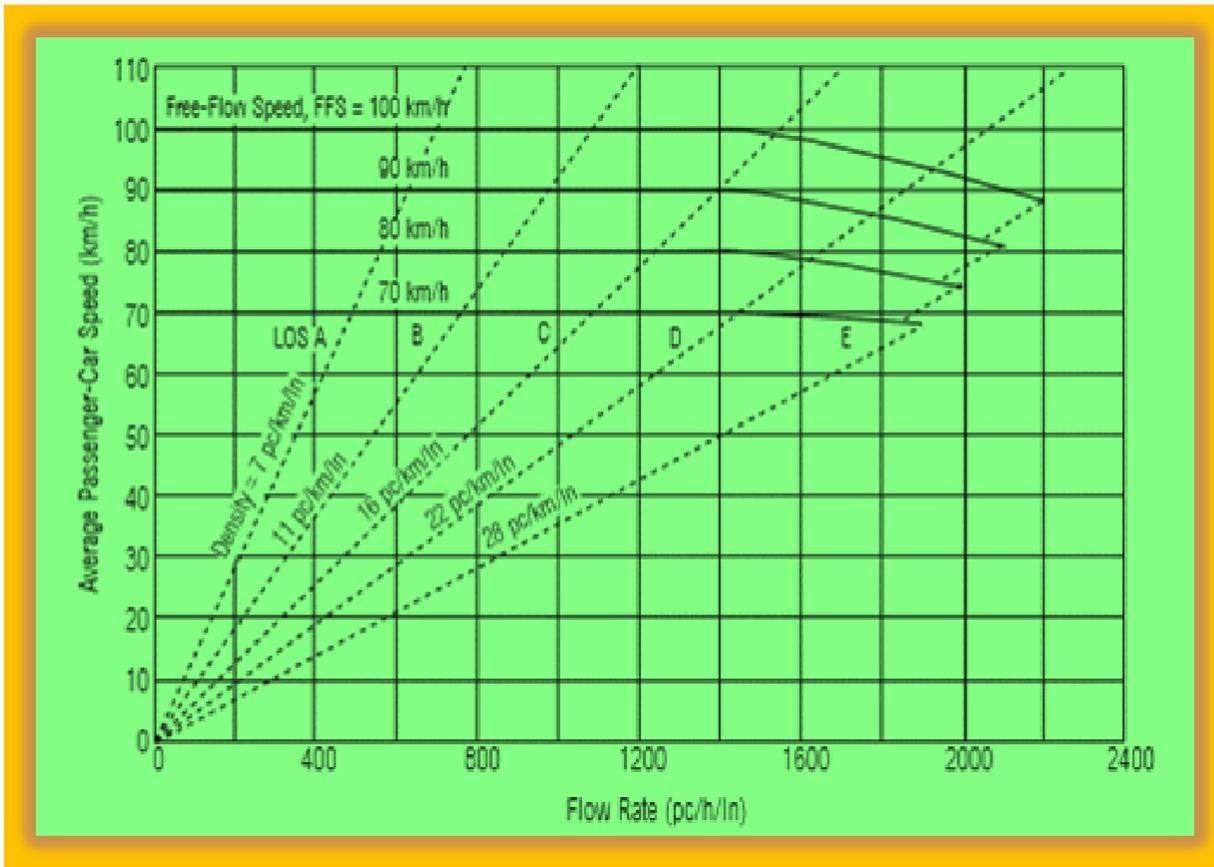


Figure 6: HCM Standard Speed-Flow Curve

Table 20: Level of Service (For Four Lanes)

Description	Level of Service
Existing Two Lanes (2017)	B
Existing Peak Hour (2017)	E
First Year After Construction	B
Expected After 10 Years	C
Expected After 20 Years	E

CHAPTER 7

IMPACT OF PROJECT ON ENVIRONMENT

Environment is a matter of serious concern all over the globe. It has been estimated that transport is the leading contributor of air pollutants. It is therefore important that the transport projects are devised in such a way that they have minimum adverse on environment.

7.1 Environment Conditions in Urban Pakistan

In spite of the recently well directed initiatives of the Government of Pakistan, the state of environment in most of the urban centers of Pakistan has been dismal. The pollution levels have been much higher than the international/ national standards. Most of these pollutants have been contributed by the vehicular mobility. Table 21 below shows the results of survey carried out by Pak EPI in 2010 for determination of suspended particulate levels at selected locations in various cities of Pakistan:

Table 21: Average Suspended Particulate Matter (PM_{2.5})

S. N	City	Level ug/m ³
1.	Islamabad	73.0
2.	Lahore	121.8
3.	Karachi	53.2
4.	Peshawar	70.2
5.	Quetta	47.1
	Safe Limit	35.0

Similar results can be drawn for almost all other pollution indicators such as NO_x, SO_x, Hydro Carbons, radiation levels etc, from the annual data of 2010 obtained through mobile pollution estimation units of (Central Laboratory for Environmental Analysis and Networking. (CLEAN)

7.2 National Environment Quality Standards

Ministry of Environment, prepared national environment quality Standards for motor vehicle exhausts and noise. These standards were incorporated in Pakistan Environment protection Act 1997. These are presented in table 22 below:

Table 22: National Environment Quality Standards for in use vehicles

S. No.	Parameter	Standards (Maximum permissible limit)	Measuring Method	Applicability
1	Smoke	40% or 2 on Ringlemann Scale during Engine acceleration mode.	To be compared with Ringlemann Chart at a distance of 6 m or more	Immediat eeffect
2	Carbon Monoxide	6%	Under idling condition: non-dispersive infra-red detection through gas analyzer	
3	Noise	85 db (A)	Sound meter at 9.5 m from source	

7.3 Impact of project road on environment

The proposed Peshawar – Torkham Motorway will be a high class road facility having multiple positive impacts on environment of the area. Firstly, it will bypass various towns and thus will help in reducing congestion by diverting external traffic which in turn will be helpful in reducing concentrations of pollutants within the project area. Secondly, being an expressway facility, it will reduce travel time.

ANNEXURES

Annexure A: Location Map



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Annexure C: Hourly Traffic Counts

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Bighyari Post (P-K)				Surveyed By:	Raza Khan						
Date:	23-04-2017				Day:	Sunday						
Time:	From: 0800 hrs To: 0800 hrs				Weather:	Sunny						
Time	Cars/Jeeps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	180	34	75		9	14		1	7		14	334
0900-1000	188	23	79	1		10		2	3	3	8	317
1000-1100	176	38	68			2	4	3			6	297
1100-1200	210	56	68			13	3		2		4	356
1200-1300	159	66	53			4	5	2			5	294
1300-1400	180	54	39		1	14	8		4	3	16	319
1400-1500	113	39	31			9	8	1	1		7	209
1500-1600	120	31	33			14	11	3	3	1	11	227
1600-1700	107	34	34		1	10	6		7		7	206
1700-1800	93	29	39			7	3	2			9	182
1800-1900	114	17	31		1	4	4		2		13	186
1900-2000	74	12	23			2	4	4		1	4	124
2000-2100	46	10	10			1	2					69
2100-2200	26	2	3			5					2	38
2200-2300	7	2	2			4					3	18
0500-0600	47	3	5			7	1	1	2		6	72
0600-0700	299	12	27			21	4	1	11	2	57	434
0700-0800	271	34	81		8	11	3	2	7	3	42	462
Total	2410	496	701	1	20	152	66	22	49	13	214	4144

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Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Bighyari Post (K-P)				Surveyed By:			Mujahid Ali				
Date:	23-04-2017				Day:			Sunday				
Time:	From: 0800 hrs To: 0800 hrs				Weather:			Sunny				
Time	Cars/Jee p	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	138	55	90		4	8	3	2	1			301
0900-1000	181	38	68	2	4	7		1	2		5	308
1000-1100	175	33	67		1	12	2	1			1	292
1100-1200	171	47	59			12	2	3			4	298
1200-1300	170	37	74	1		5	4	3	4		3	301
1300-1400	159	35	54			12	4					264
1400-1500	148	35	56			7	3	4				253
1500-1600	199	47	81			6			1	2	2	338
1600-1700	148	28	54			2	1	1				234
1700-1800	144	21	45			4	1		2		1	218
1800-1900	138	27	33			2	7		1	1		209
1900-2000	117	29	39			3	4	1				193
2000-2100	61	14	11			14	3	2		1	2	108
2100-2200	13	8	3			10	2				2	38
2200-2300	9	5	4			3					4	25
0500-0600	17	4	3			5	3				3	35
0600-0700	84	29	52		7	6	8	1	7	4	7	205
0700-0800	84	45	61		4	8	5	1	5			213
Total	2156	537	854	3	20	126	52	20	23	8	34	3833

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Bighyari Post (P-K)				Surveyed By:	Raza Khan						
Date:	24-04-2017				Day:	Monday						
Time:	From: 0800 hrs To: 0800 hrs				Weather:	Sunny						
Time	Cars/Jeeps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	189	28	36		3	14	4	3	3		6	286
0900-1000	182	31	46			8	2	1	3	1	2	276
1000-1100	184	30	59		3	10	2	1	1		4	294
1100-1200	178	72	73		2	14	3	2	2		4	350
1200-1300	117	43	53			18	2		1		5	239
1300-1400	186	60	55		1	14	5	2			2	325
1400-1500	140	38	32		3	22	6		1	2	4	248
1500-1600	170	61	56		2	9	6	3	5	1	9	322
1600-1700	170	60	51		2	5	4		2		1	295
1700-1800	165	87	70			19	2	4	1		10	358
1800-1900	120	29	29			10	5	2	15	1	2	213
1900-2000	148	20	12			20	7	2	3	12	21	245
2000-2100	90	28	32		2	12	7	1			7	179
2100-2200	91	3	4		2	13	4		2		11	130
2200-2300	74	7	9			16	4	1		3	17	131
0500-0600	43	4	9			7					5	68
0600-0700	161	18	38			26	4	2	12	3	50	314
0700-0800	179	2	34			11	3	4	4	5	27	269
Total	2587	621	698	0	20	248	70	28	55	28	187	4542

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project													
Station Name:	Bighyari Post (K-P)				Surveyed By:	Mujahid Ali							
Date:	24-04-2017				Day:	Monday							
Time:	From: 0800 hrs To: 0800 hrs				Weather:	Sunny							
Time	Cars/Jee p	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total	
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles		
0800-0900	211	62	94		2	2	2	3	1		1	378	
0900-1000	220	35	92		4	8	2	4			1	366	
1000-1100	201	29	69			4	7	4	2		3	319	
1100-1200	152	30	49	2	1	14		5	3	2	3	261	
1200-1300	144	21	38			3	2	8	5	3	6	230	
1300-1400	205	36	53			8	5	7	8	8	19	349	
1400-1500	154	55	71			10	6	6	7	4	9	322	
1500-1600	163	43	62			4	6	3	8	2	6	297	
1600-1700	150	59	72			6	3	2	9	1	6	308	
1700-1800	174	58	89		2	11	9	5	9	12	18	387	
1800-1900	179	73	53		1	26	12	8	28	24	42	446	
1900-2000	202	104	107			43	18	4	27	37	107	649	
2000-2100	187	68	122			64	26		31	18	60	576	
2100-2200	97	12	4			7			11	5	24	160	
2200-2300	23	7	6			7	3	3			5	54	
0500-0600	67	22	13			3	2	6		2	7	122	
0600-0700	120	40	92		5	20	9	4	12	10	12	324	
0700-0800	152	61	92		5	1	3	2			2	318	
Total	2801	815	1178	2	20	241	115	74	161	128	331	5866	

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Bighyari Post (P-K)			Surveyed By:			Raza Khan					
Date:	25-04-2017			Day:			Tuesday					
Time:	From: 0800 hrs To: 0800 hrs			Weather:			Sunny					
Time	Cars/Jeeps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	196	48	73		2	12	7	4	2		6	350
0900-1000	240	50	73		7	21	1	2	3	1	4	402
1000-1100	220	54	63		1	4	1	2	1	2		348
1100-1200	192	84	65	1	1	20	4	3			5	375
1200-1300	152	42	37	2	5	26	1		3	1	2	271
1300-1400	154	52	59		7	34	11	4	7	7	14	349
1400-1500	161	57	45		7	37	10		5		10	332
1500-1600	187	37	38			14	7	5	4		4	296
1600-1700	162	37	34			10	3				4	250
1700-1800	109	24	49			10	5	2	2	2	14	217
1800-1900	130	19	33			11	2	2			15	212
1900-2000	104	39	41			19	5	1	5	2	27	243
2000-2100	74	9	12				6				11	112
2100-2200	54	8	4			1	2	1			11	81
2200-2300	21	2	3			2	1	2			5	36
0500-0600	55	9	11			4	3	6			4	92
0600-0700	151	11	20			18	7	4	8	2	26	247
0700-0800	176	31	78	1	6	24	4	2	16	11	13	362
Total	2538	613	738	4	36	267	80	40	56	28	175	4575

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Bighyari Post (K-P)				Surveyed By:			Mujahid Ali				
Date:	25-04-2017				Day:			Tuesday				
Time:	From: 0800 hrs To: 0800 hrs				Weather:			Sunny				
Time	Cars/Jee p	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	178	103	104			6	4	3	12		14	424
0900-1000	197	82	84		2	15	5	2	5		3	395
1000-1100	166	94	88	2		18	7	5	2	1	11	394
1100-1200	169	80	55	1		14	5	6	5	2	15	352
1200-1300	161	54	65			6	1	4	3		16	310
1300-1400	152	59	70	2		18	12	4	5	6	22	350
1400-1500	145	65	88	1	4	13	11	3	7	2	19	358
1500-1600	157	66	61			6	3	2	5	2	8	310
1600-1700	147	68	78		3	8	2	1	3		15	325
1700-1800	144	32	49		16	14	7		5		28	295
1800-1900	192	71	97	2		18	12	7	16	12	55	482
1900-2000	158	65	34			22	17	9	22	36	82	445
2000-2100	119	92	75			75	15	8	22	2	65	473
2100-2200	47	29	21			26	18	6	17	7	66	237
2200-2300	11	2				8		1			12	34
0500-0600	45	26	11		2	6			3		6	99
0600-0700	177	37	54		5	11	10	3	7		5	309
0700-0800	153	88	101			10	9	4	7	1	16	389
Total	2518	1113	1135	8	32	294	138	68	146	71	458	5981

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Michni Post (P-K)				Surveyed By:			Raza Khan				
Date:	20-04-2017				Day:			Thursday				
Time:	From: 0800 hrs To: 0800 hrs				Weather:			Sunny				
Time	Cars/Jeeps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	186	23	25		2	12	4	2	2	1	10	267
0900-1000	148	19	17			3	5	1			8	201
1000-1100	143	18	22			9	1	2			7	202
1100-1200	111	15	8			14	4	1			6	159
1200-1300	119	21	11	1	2	14	1				5	174
1300-1400	141	25	9			21	2	2		3	10	213
1400-1500	106	17	14			3	4				17	161
1500-1600	83	6	4		1	8	5				14	121
1600-1700	64	7	2				1			1	16	91
1700-1800	23	3	3			4				1	11	45
1800-1900	15	4	1		1	3	1		1		15	41
1900-2000	11	2	2			5			2	1	9	32
2000-2100	5					2					3	10
2100-2200												0
2200-2300												0
0500-0600	315	15	61	2	3	6	6	2	5	1	5	421
0600-0700	224	15	43		2	9	4	3	2	1	17	320
0700-0800	191	10	27			5	4	2		1	16	256
Total	1885	200	249	3	11	118	42	15	12	10	169	2714

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Michni Post (K-P)				Surveyed By:			Mujahid Ali				
Date:	20-04-2017				Day:			Thursday				
Time:	From: 0800 hrs To: 0800 hrs				Weather:			Sunny				
Time	Cars/Jee ps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	186	13	23			6	3	2			8	241
0900-1000	218	9	40	1	1	8	1		2		4	284
1000-1100	176	9	26		2	7	1		5	5	10	241
1100-1200	225	12	22			2			14	4	4	283
1200-1300	180	20	27	1		5	1		12	3	9	258
1300-1400	141	12	25	1		1					3	183
1400-1500	169	19	22			18	1	1	2		11	234
1500-1600	159	18	18		4	8	2	1	1	2	12	225
1600-1700	178	21	24		3	7	4	1	2	2	28	270
1700-1800	166	27	18		4	7	5			3	43	273
1800-1900	104	15	8		3	17	4	2		1	22	176
1900-2000	79	14	6			68	7	2			12	134
2000-2100	22	7	4			78	6	2	4			60
2100-2200	2					15						8
2200-2300	17	1	2			2	3				16	41
0500-0600												0
0600-0700												0
0700-0800	161	6	27		2	7	2	1			12	218
Total	2183	203	292	3	36	104	40	12	42	20	194	3129

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project													
Station Name:	Michni Post (P-K)				Surveyed By:	Raza Khan							
Date:	21-04-2017				Day:	Friday							
Time:	From: 0800 hrs To: 0800 hrs				Weather:	Sunny							
Time	Cars/Jeeps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total	
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles		
0800-0900	251	20	41		1	4	5	2	6	1	38	369	
0900-1000	232	20	42			9	4	1	3	1	27	339	
1000-1100	194	8	34			9	2		1		9	257	
1100-1200	170	5	28			10	3	1	1	7	8	233	
1200-1300	132	14	13		1	6	2		3	2	9	182	
1300-1400	82	16	11			13		2	1		13	138	
1400-1500	108	18	8			7	2	1	3		4	151	
1500-1600	113	26	10			8	1		3		9	170	
1600-1700	110	18	9	1		15	5		1	1	5	165	
1700-1800	102	10	3		6	3	9	3	4		4	144	
1800-1900	70	1	1		1	2	4	3	1		5	88	
1900-2000	27	1				7	8	4		1	15	63	
2000-2100	23		1			6		1	1		8	40	
2100-2200	2	1	1			1	1				8	14	
2200-2300	6	2				3	4				11	26	
0500-0600	38	5	14		2	11	4	2	3		9	88	
0600-0700	99	12	14			5	2	1	6		19	158	
0700-0800	291	17	52	5		13	2	2	8	1	26	417	
Total	2050	194	282	8	12	133	54	23	45	14	227	3042	

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

HourlyTraffic Count Survey Form For Peshawar Torkham Motorway Project													
Station Name:	Michni Post (K-P)				Surveyed By:	Mujahid Ali							
Date:	21-04-2017				Day:	Friday							
Time:	From: 0800 hrs To: 0800 hrs				Weather:	Sunny							
Time	Cars/Jee p	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total	
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles		
0800-0900	174	9	25		2	3	2	1			3	219	
0900-1000	174	8	31		3	7	1	1				225	
1000-1100	173	23	40		1	4	1	2	4		8	256	
1100-1200	187	19	33		3				4	6	13	265	
1200-1300	170	21	31		3	5	2	2	7	3	5	249	
1300-1400	153	2	24		1	3			5	3	9	200	
1400-1500	110	14	21		1	3	1	1	7	1	10	169	
1500-1600	115	14	18		2	1	1		5	1	6	163	
1600-1700	130	19	14		9		2	1	2		23	200	
1700-1800	139	34	10		6	3	5	2			34	233	
1800-1900	120	33	8		8	4			5	1	26	205	
1900-2000	83	3	5		5	7	2	3	4		21	133	
2000-2100	47	7	3		4	4	6	3			28	102	
2100-2200	5		1								3	9	
2200-2300	13		3		1		1		1	3	11	33	
0500-0600	30	2	3									35	
0600-0700	52	7	4		1	2	1	1				68	
0700-0800	114	4	20		5	7		1			1	152	
Total	1989	219	294	0	55	53	25	18	44	18	201	2916	

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project													
Station Name:	Michni Post (P-K)				Surveyed By:	Raza Khan							
Date:	22-04-2017				Day:	Saturday							
Time:	From: 0800 hrs To: 0800 hrs				Weather:	Sunny							
Time	Cars/Jeeps	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total	
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles		
0800-0900	280	23	54	1	3	12	6	2	7	4	32	424	
0900-1000	234	24	30			11	1	1	14	3	15	333	
1000-1100	206	20	28			8	2	1	7	2	6	280	
1100-1200	159	10	12			3					3	187	
1200-1300	146	21	11			2	3	1	2		7	193	
1300-1400	131	11	10		2	10	2	2			13	181	
1400-1500	96	19	7			8					5	135	
1500-1600	47	8	3			4	2	1			9	74	
1600-1700	94	15	4			8	1	1			2	125	
1700-1800	82	12	5			11	3	2		2	10	127	
1800-1900	110	13	4		1	3	2	3			21	157	
1900-2000	74	11	6		1	13	2	1			24	132	
2000-2100	54	5	3		3	6			2		6	79	
2100-2200	11	2	3		4	3	2		2	3	3	33	
2200-2300	7	2				4	1		1			15	
0500-0600	46	6	10			4			2	1	7	76	
0600-0700	106	7	13			11	1	2	4	4	25	173	
0700-0800	308	28	48	1	1	14	3	2	9	4	44	462	
Total	2191	237	251	2	15	135	31	19	50	23	232	3186	

*Traffic Study Report for (Peshawar-Torkham Section) of
Preliminary Design of Peshawar Kabul Motorway Project*

Hourly Traffic Count Survey Form For Peshawar Torkham Motorway Project												
Station Name:	Michni Post (K-P)			Surveyed By:			Mujahid Ali					
Date:	22-04-2017			Day:			Saturday					
Time:	From: 0800 hrs To: 0800 hrs			Weather:			Sunny					
Time	Cars/Jee p	Wagons/ Pick ups	Coasters/ Mini	Buses	Mini Truck	Trucks (Rigid)		Trucks (Articulated)				Total
						2-Axles	3-Axles	3-Axles	4-Axles	5-Axles	6-Axles	
0800-0900	125	9	15		4	5		1			5	164
0900-1000	177	9	37			3	3				3	232
1000-1100	201	14	33		3	7	1	1	6	1	11	278
1100-1200	197	27	34		5	4	2	2	5	1	7	284
1200-1300	142	16	13		2	8	3		5	2	12	203
1300-1400	161	24	41		3	7	2		6	2	25	271
1400-1500	79	12	11		3	4	2	1	5		15	132
1500-1600	108	13	15		2	1	1		3	2	13	158
1600-1700	150	20	13		2	2		1	9	3	6	206
1700-1800	133	28	18			4	3		3		5	194
1800-1900	114	30	17		2	12	1		1	1	2	180
1900-2000	108	15	9		2	11		1			3	149
2000-2100	71	8	4			7	2		1		8	101
2100-2200	20	2	3		2	3					21	51
2200-2300	9	3	1			6					9	28
0500-0600	23	2	3									28
0600-0700	87	3	12			5	2	1			4	114
0700-0800	117	4	23		2	5		2	1		3	157
Total	2022	239	302	0	32	94	22	10	45	12	152	2930

Annexure D: Origin-Destination Matrices

Origin Destination Matrix for Cars/Jeeps
Destination Zone

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
Zone 1	100	53	348	64	53	100	22	53	793
Zone 2	79	58	116	37	32	43	32	27	424
Zone 3	484	106	432	48	43	100	43	37	1293
Zone 4	164	11	95	43	22	64	100	11	510
Zone 5	100	48	79	53	79	64	69	90	582
Zone 6	106	43	58	37	37	0	37	27	345
Zone 7	64	11	79	22	22	43	48	64	353
Zone 8	53	16	43	27	27	37	43	32	278
Total	1150	346	1250	331	315	451	394	341	4578

Origin Destination Matrix for
Wagons/Coasters Destination Zone

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
Zone 1	0	14	70	47	40	24	20	14	229
Zone 2	37	20	57	37	30	34	20	17	252
Zone 3	116	37	50	27	17	34	30	14	325
Zone 4	50	44	40	50	20	27	20	17	268
Zone 5	63	27	47	47	70	50	40	24	368
Zone 6	50	47	40	34	20	30	37	24	282
Zone 7	47	34	30	50	40	44	0	20	265
Zone 8	24	0	27	20	24	14	7	0	116
Total	387	223	361	312	261	257	174	130	2105

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Origin Destination Matrix for Buses
Destination Zone

Origin Zone		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total	
	Zone 1	0	0	2	0	0	0	0	0	0	2
	Zone 2	0	0	0	0	0	0	0	0	0	0
	Zone 3	2	0	0	0	0	0	0	0	2	
	Zone 4	0	0	0	0	0	0	0	0	0	
	Zone 5	0	0	0	0	0	0	0	0	0	
	Zone 6	1	0		0	0	0	0	0	1	
	Zone 7	0	0	0	0	0	0	0	0	0	
	Zone 8	0	0	0	0	0	0	0	0	0	
	Total	3	0	2	0	0	0	0	0	0	5

Origin Destination Matrix for Mini Trucks

Destination Zone

Origin Zone		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total	
	Zone 1	0	2	6	2	0	4	2	0	0	16
	Zone 2	2	0	2	0	0	2	0	0	0	6
	Zone 3	7	0	4	0	0	0	0	0	0	11
	Zone 4	0	0	0	0	0	2	2	0	0	4
	Zone 5	4	0	4	0	0	0	0	0	0	8
	Zone 6	2	0	2	0	0	0	0	0	0	4
	Zone 7	2	0	2	0	0	0	0	0	0	4
	Zone 8	4	0	2	0	0	2	0	0	0	8
	Total	21	2	22	2	0	10	4	0	0	61

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Origin Destination Matrix for 2-Axle Trucks
Destination Zone

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
Zone 1	4	2	21	3	2	3	4	2	41
Zone 2	2	0	3	1	0	1	0	0	7
Zone 3	22	4	9	3	2	1	4	2	47
Zone 4	3	2	5	1	1	2	2	0	16
Zone 5	5	1	6	2	2	3	2	3	24
Zone 6	4	0	3	0	2	0	2	0	11
Zone 7	3	0	4	0	0	4	0	0	11
Zone 8	2	0	2	0	0	1	0	0	5
Total	45	9	53	10	9	15	14	7	162

Origin Zone

Origin Destination Matrix for 3-Axle
Trucks Rigid Destination Zone

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
Zone 1	2	0	11	4	2	1	0	0	20
Zone 2	0	0	0	0	0	0	0	0	0
Zone 3	13	0	0	0	0	4	0	0	17
Zone 4	3	0	0	0	0	0	0	0	3
Zone 5	1	0	2	0	0	0	0	0	3
Zone 6	2	0	2	0	0	0	0	0	4
Zone 7	2	0	3	0	0	2	0	0	7
Zone 8	1	0	2	0	0	3	0	0	6
Total	24	0	20	4	2	10	0	0	60

Origin Zone

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**Origin Destination Matrix for 3-Axle Trucks Articulated
Destination Zone**

Origin Zone		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
	Zone 1	0	0	3	0	0	2	1	1	7
	Zone 2	0	0	0	0	0	0	0	0	0
	Zone 3	4	0	2	1	0	2	1	1	11
	Zone 4	0	0	0	0	0	0	0	0	0
	Zone 5	0	0	0	0	0	0	0	0	0
	Zone 6	2	0	2	0	0	1	1	0	6
	Zone 7	2	0	0	0	0	1	0	0	3
	Zone 8	1	0	1	0	0	0	0	0	2
	Total	9	0	8	1	0	6	3	2	29

Origin Destination Matrix for 4-Axle

Trucks Destination Zone

Origin Zone		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
	Zone 1	2	0	14	1	1	2	1	0	21
	Zone 2	1	0	2	0	0	0	0	0	3
	Zone 3	17	2	0	1	0	0	1	1	22
	Zone 4	0	0	2	0	0	0	0	0	2
	Zone 5	1	0	2	0	0	0	0	0	3
	Zone 6	1	0	1	0	0	0	0	0	2
	Zone 7	2	0	2	0	0	0	0	0	4
	Zone 8	1	0	1	0	0	0	0	0	2
	Total	25	2	24	2	1	2	2	1	34

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Origin Destination Matrix for 5-Axle Trucks
Destination Zone

Origin Zone		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
	Zone 1	0	1	7	0	0	1	2	1	12
	Zone 2	0	0	0	0	0	0	0	0	0
	Zone 3	8	0	2	0	0	0	2	0	12
	Zone 4	0	0	0	0	0	0	0	0	0
	Zone 5	0	0	0	0	0	0	0	0	0
	Zone 6	1	0	2	0	0	0	0	0	3
	Zone 7	1	0	1	0	0	0	0	0	2
	Zone 8	1	0	1	0	0	0	0	0	2
	Total	11	1	13	0	0	1	4	1	31

Origin Destination Matrix for 6-Axle

Trucks Destination Zone

Origin Zone		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Total
	Zone 1	0	2	48	4	7	6	5	3	75
	Zone 2	0	0	4	0	0	0	0	0	4
	Zone 3	52	4	5	0	0	1	0	0	62
	Zone 4	11	1	5	2	1	2	0	0	22
	Zone 5	10	0	7	0	0	0	0	0	17
	Zone 6	9	0	8	0	0	0	0	0	17
	Zone 7	5	0	6	0	0	0	0	0	11
	Zone 8	2	0	2	0	0	0	0	0	4
	Total	89	7	85	6	8	9	5	3	212

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Annexure E: Traffic Survey Pictures



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