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PLANNING & DEVELOPMENT DEPARTMENT
GOVERNMENT OF KHYBER PAKHTUNKHWA

DRAFT LAND USE PLAN

DISTRICT BAJAUR

January, 2026

District Land Use plans of 8 newly Merged Districts of Khyber Pakhtunkhwa

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LIST OF ACRONYMS

ADP	Annual Development Plan
KP	Kyber Pakhtunkhwa
LUBCA	Land Use and Building Contral Act
MDs	Merged Districts
NWFP	North-Western Frontier Province
P&DD	Planning and Development Department
PLUP	Provincial Land Use Plan
UPPU	Urban Planning and Policy Unit
MCDA	Multi Criteria Decision Analysis

1 CHAPTER I: INTRODUCTION OF THE PROJECT

1.1 Project Overview and Background

The concept of scarcity is a fundamental principle in economics, and Land is considered a fundamental factor of production and a scarce resource. This means that its availability is limited in relation to the demand for it. With urbanization, the universal phenomena take place and the population expands rapidly, the demand for land increases, while the total supply remains fixed. Keeping in view the fixed supply of land and its diminishing rate the NWFP Housing Authority Act 2005, Under Section 4, Sub-Section 2 (xv), established NWFP Housing Authority (PHA) and was tasked with creating a provincial land use plan or policy. As a result, the PHA's Housing Department's Project Management Unit was established on April 1, 2010. The Provincial Land Use Plan was initiated in this regard. In 2013, on the instruction of the Honorable Chief Minister of Bajaur Pakhtunkhwa, the Project Management Unit of the Land Use Plan was transferred to the Urban Policy Unit. Later, the Provincial Land Use Plan was used instead of the Project Management Unit for the Land Use Plans.

The land, which is in limited supply, must be used to meet the fundamental necessities of food, water, fuel, clothes, and shelter. The demand for resources increases as the population grows. The available Land must be utilized to satisfy the new needs brought on by the population growth. The amount of land that is accessible for farming and agriculture is dwindling daily because of additional housing projects.

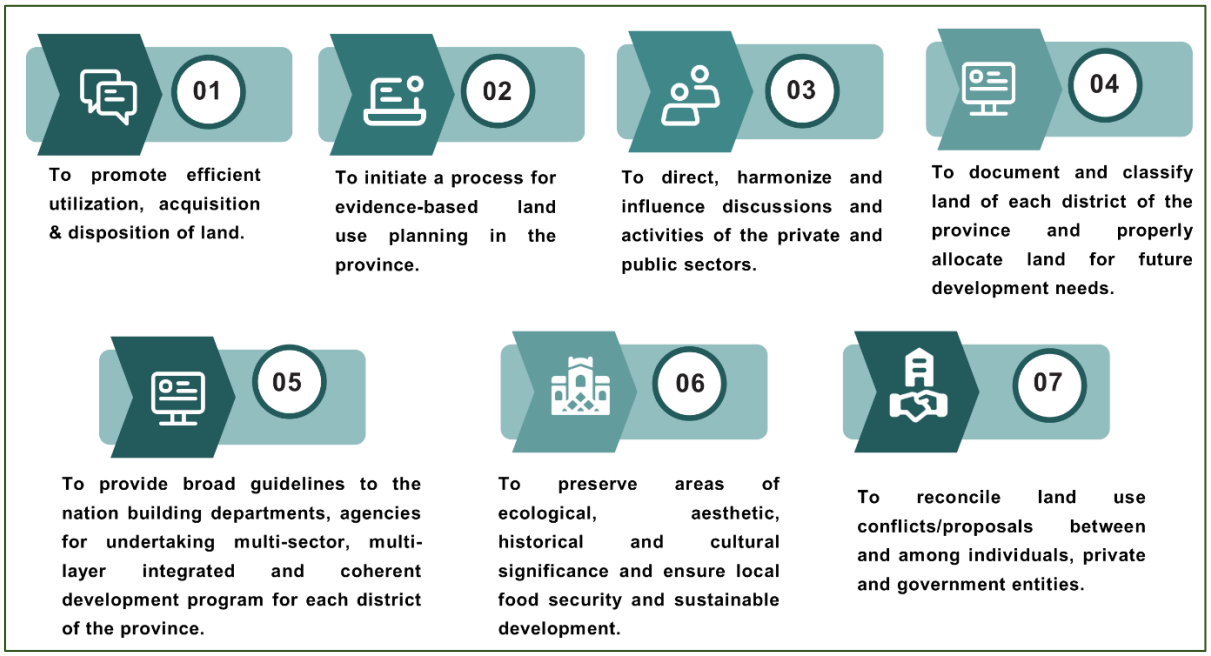
The uncontrolled Urban sprawl over the agricultural land is putting great pressure on the available resources of the province and because of these resources shall be equally distributed among the population of the province. Planned towns & villages will be developed and in the result of these planning, resources shall be equally distributed among the population of the province. The guided land use distribution will also result in a healthy living environment, better human resource utilization. Proper sanitation, drinking water supply and forestation will make the environment clean and healthy. It will also minimize the chances of epidemic and other man mad disasters and will contribute to upgrading the living standards of the area.

To develop an integrated land use plan for the province of KP the Urban Policy Unit of P&D Department organized consultative conferences for the development of Terms of Reference for the District Land Use Plan on May 29th, 2014, with various stakeholders including district administration, government officials, policy planners, academia, and civil society organizations. A Provincial land use plan is a planning and policy document for integrated, coordinated, evidence based and systematic planning. This successful completion of Land Use Plans will increase developmental activities, generate employment for the urban and rural areas. It aims at establishing hierarchy of settlements and developments of satellite, intermediate, Secondary, and existing towns/settlements as focal points for future

development. This will help in increasing the life standards of the people and optimum utilization of the natural resources.

1.1.1 Project Objectives

The project aims to develop a comprehensive and enduring planning vision through a cooperative effort known as a "Land Use Plan." In shaping the future physical manifestation of Urban Centers, this framework will play a critical role. The objectives of the project include



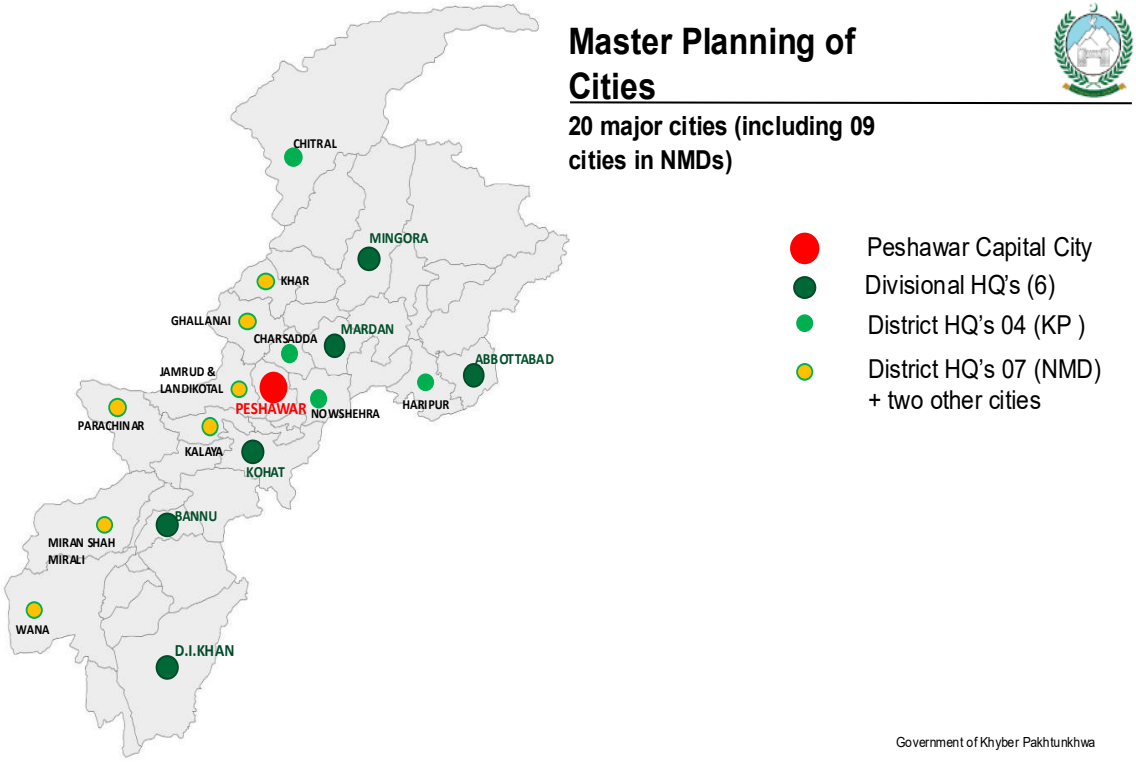
1.1.2 Status of the Land Use and Master Plan Project in Bajaur Pakhtunkhwa

Urban Policy and Planning unit, of the planning and development department Bajaur-Pakhtunkhwa, is in the process of preparing district land use plans of all the districts including MDs. Six (06) District Land Use Plans (Peshawar, Nowshera, Charsadda, Mardan, Swabi and Abbottabad) were completed in December 2018 and were handed over to LGE&RDD in December 2019 for further approval of the competent authority/forum. Later, in July 2022, all these six completed DLUPs were handed over to DG-LU&BCA for further processing and approval of the Provincial Land Use and Building Control Council. The Provincial Land Use and Building Control Council approved these six plans under Section 4 (f) of the Land Use and Building Control Authority Act, 2021. The approved district land use plans have been handed over to the concerned district administration for execution/implementation. For implementation/execution at district level, district land use planning and management committees have been notified under section-14 of the land use and Building Control Act 2021, under the chairmanship of the concerned Deputy Commissioners. Status of Master plans

The urban centers in the Province of Bajaur Pakhtunkhwa have been neglected in the past. This has resulted in unregulated urban growth, with less-than-optimal infrastructure, inefficient institutions and poor quality and outreach of civic services, which has led to low

quality of life. Instantaneously, to the District Land Use Plan (DLUP) project, the Urban Policy Unit is also preparing long term Master Plans for all the divisional and district headquarter cities of Bajaur Pakhtunkhwa including the provincial capital Peshawar, Divisional HQs Mardan, Abbottabad, Kohat, Mingora, Bannu and DI Khan and other major cities of KPK including NMDs. The map below shows the detail of master plan.

Map 1: Current Status of the Cities Master Plan in KP



Three (03) cities Master plan Plans (Mardan, Mir Ali/Miran Shah, District North Waziristan and Wana, District south Waziristan) were completed and approved from the Land Use and Building Control Council. Further the said plans were handed over to DG-LU&BCA and concerned DCs for implementation/Execution.

1.1.2.1 Status of Khar Master Plan

To ensure sustainable urban development, the Urban Policy, and Planning Unit (UPPU) of KP has initiated the preparation of a Master Plan for the Khar urban center District Bajaur. The Master Plan aims to regulate and align existing infrastructure and provide a comprehensive and integrated guideline for the future development of the area. The Master Plan covers the period from 2022 to 2042.

The existing population of the project area is 42,336, while the additional population of 124,763 will be accommodated within these neighborhoods. The overall population of these neighborhoods will be 167,099, while the remaining population of 92,463 will be adjusted

outside the planned neighborhoods in the form of mixed-use development in blue area of the city.

The Linear Napoli's and aims to encourage commercial, civic, administrative, and mixed-use development in the blue area along the main road of Khar and Inayat Kali. The plan proposes the development of Self-Sustained Neighborhoods to provide housing for the existing and future population of Khar. The neighborhoods will have all basic amenities such as schools, parks, shopping centers, community centers, dispensaries, police posts, post offices, mosques, and libraries located at a five to ten minutes walking distance. The plan also includes infilling, intensification, and redevelopment strategies to ensure that existing land is used efficiently and sustainably, reducing urban sprawl, and promoting a compact and walkable city. The Multiple Criteria Analysis (MCA) technique was used to identify suitable land uses for different purposes such as residential, commercial, and industrial, through a vector-based overlay analysis. The available land for future development in Khar Urban Centre is 4263 acres, after removing areas restricted due to factors such as agriculture, steep slopes, buildings, water table, and roads ROW. The land suitability criteria are categorized into three classes: most suitable, moderate, and least suitable. The proposed neighborhoods are numbered from NH 1 to NH 13, and the proposed residential area is significantly larger than the existing residential area in all neighborhoods, reflecting the need to accommodate a larger population in the future.

The proposed land use plan for Khar Urban Centre includes increasing the population density in planned neighborhoods from 21 to 77 persons per acre, requiring the construction of multistory walk-up apartment buildings.

The proposed housing plan aims to accommodate low-middle and high-income groups in the city, requiring 651 acres for housing and 279 acres for infrastructure. The proposed neighborhoods cover 32% of the total urban center area, with 930 acres for residential purposes and infill development. The proposed blue area in Khar Urban Centre is 1066.82 acres, which will be used for administrative, commercial, civic, and mixed-use purposes, separate from the bypass road.

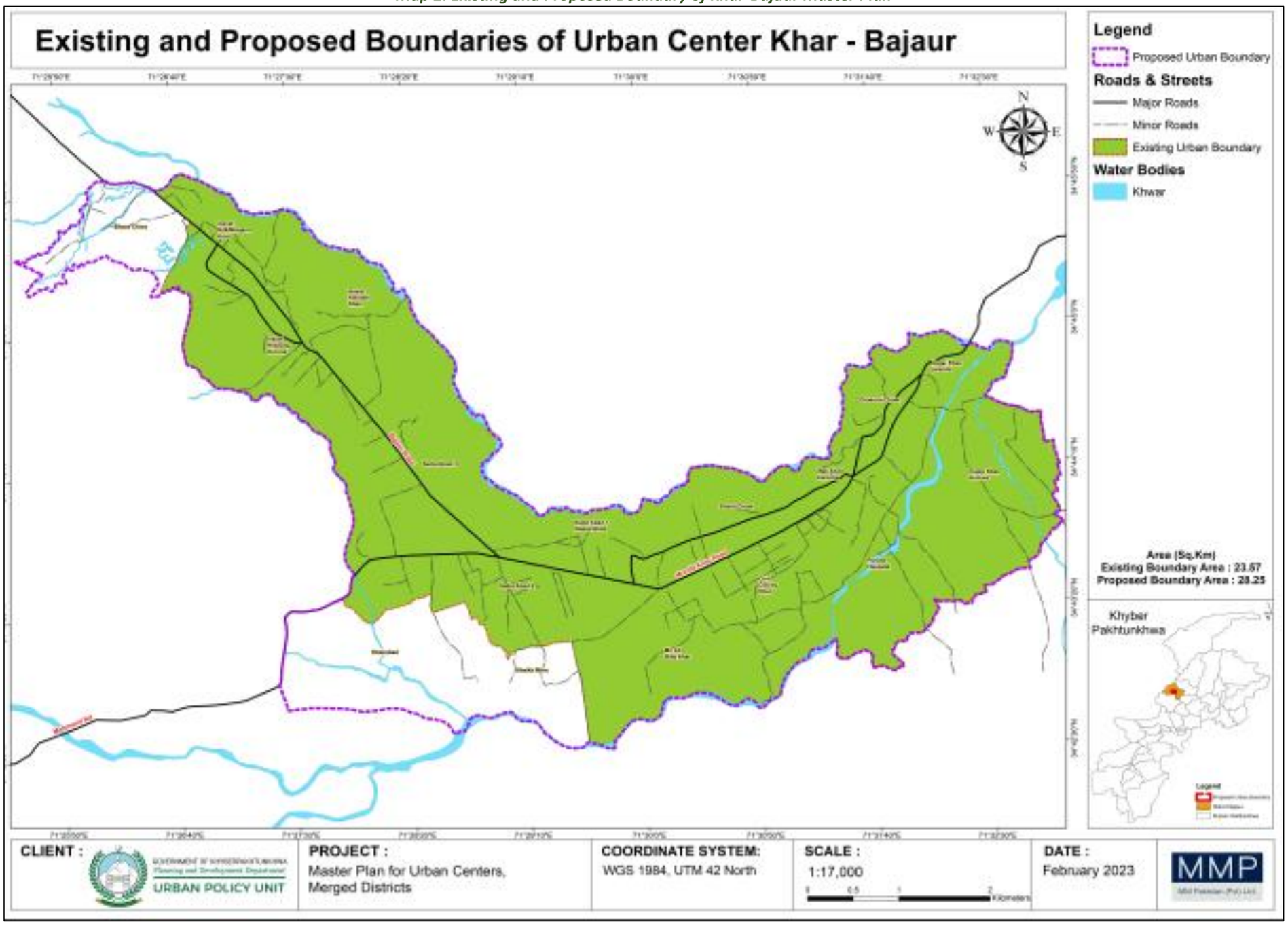
The Khar Urban Centre Master Plan proposes a 97.1-acre industrial estate with amenities and infrastructure to support businesses and workers. The site selection is based on multi-Criteria analysis, prioritizing economic and environmental aspects, and creating new jobs, expanding businesses, attracting new investments, and stimulating economic growth.
Khar city needs more educational facilities to accommodate the growing population. Land has been allocated for primary and middle schools, and multiple schools and colleges are proposed in the draft master plan. Private education facilities will also be encouraged to meet the remaining needs.

Current health facilities in Khar Urban Centre are adequate, with a 403-bed DHQ hospital. However, an additional 116 beds will be required, and an extension to the existing DHQ hospital is proposed. Dispensaries for basic medical care and first aid will be established in neighborhood centers for easy access by residents in Khar Urban Centre.
The proposed Khar Urban Centre Master Plan aims to address the shortage of post offices in the city. The plan proposes the construction of eight new post offices, including one post-mall, and one letterbox in each neighborhood center to cater to the needs of the growing population. This would help ensure adequate postal services for both the present and future residents of the city.

The Khar city Master Plan reserves 30.6% of the total area for agriculture and 2.2% for livestock and fish farms. The CBD covers 21.4% of the total area, while 18.1% is for residential areas divided into 13 neighborhoods. The plan includes provisions for educational institutions, commercial activities, recreational facilities, public buildings, and facilities. Additionally, land is allocated for urban forestation, managed forest, and green belts, which will cover 3% and 2.1% of the total area, respectively. The plan reserves 9.2% of the total area for primary, secondary, and tertiary roads.

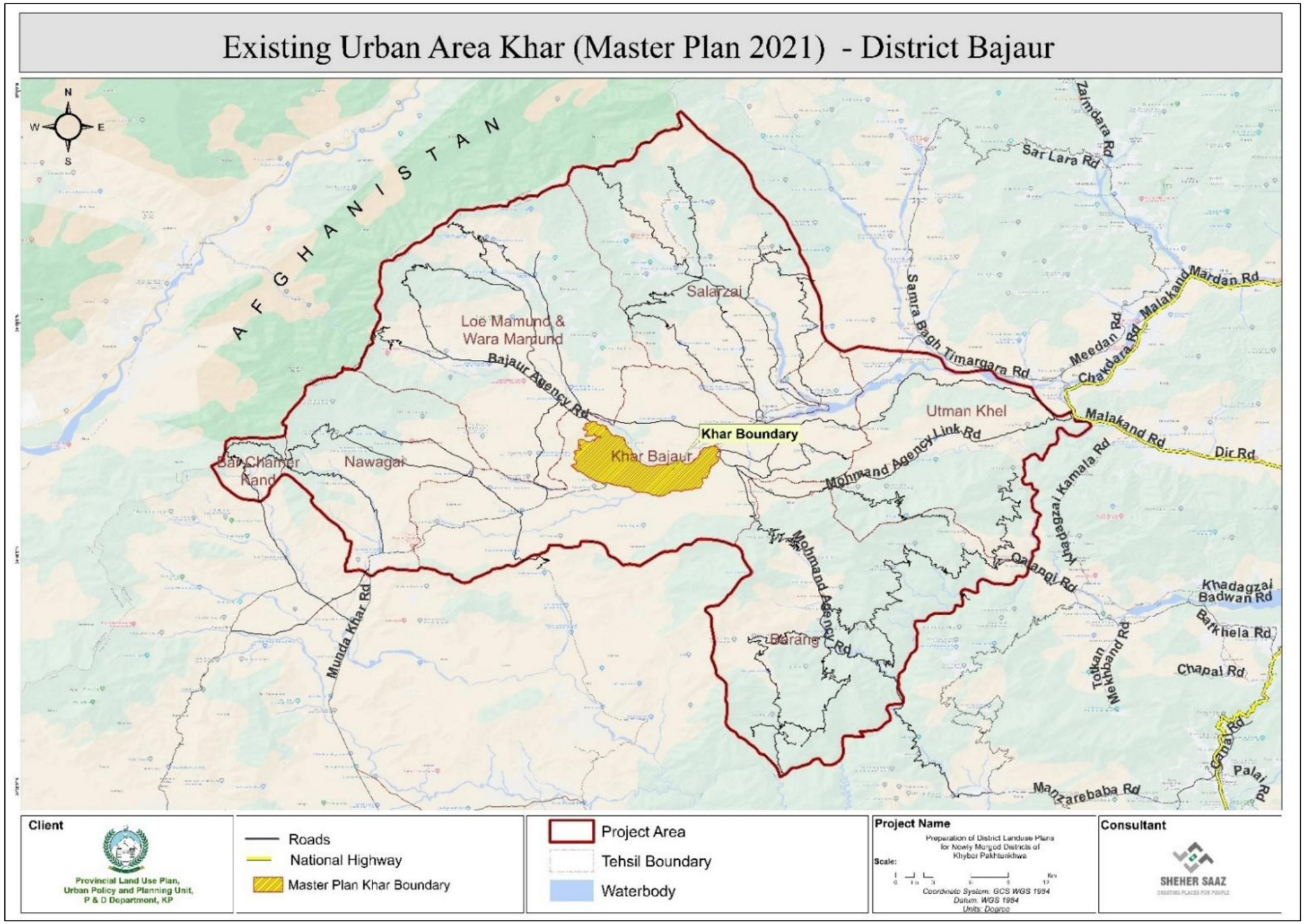
In the district land use plan Bajaur will be prepared in line of the master plan and their proposals. The location and extent of the existing urban boundary and proposed urban boundary for the plan period of 2040 of the project area is shown in below;

Map 2: Existing and Proposed Boundary of Khar-Bajaur Master Plan



Source: Consultants, 2024

Map 3: Boundary of Urban Centers Khar



Source: Consultants, 2024

1.2 Introduction of the Region

1.2.1 Background

Malakand Division is a vast region in northern Bajaur Pakhtunkhwa, Pakistan, comprising nine districts: Swat, Shangla, Buner, Malakand, Upper and Lower Dir, Upper and Lower Chitral, and Bajaur. Covering an area of 32,007 square kilometers and home to 8.7 million people, it was formerly constituted by the princely states of Swat, Dir, Chitral, and the Malakand Protected Area, unified into a single administrative unit in 1969. Known for its majestic mountains, sparkling rivers, abundant orchards, and verdant meadows, Malakand is a popular tourist destination. Sharing borders with the Karakoram Highway, Afghanistan, and the Wakhan Corridor, the region boasts a deep-rooted history.

A cradle of Aryan and Gandhara civilizations, Malakand has witnessed the incursions of Alexander the Great, Sakas, Kushans, and White Huns. It also thrived under the patronage of Ashoka, with over 1400 monasteries and 18000 monks during the Buddhist era. This rich historical heritage, combined with its stunning natural beauty, makes Malakand a compelling place to explore.

1.3 Study Area Profile

District Bajaur is a region situated in the northwestern part and bordered by Afghanistan to the west. The district covers an area known for its diverse landscapes, including mountains, valleys, and fertile plains. Bajaur has historically been a significant area due to its strategic location along ancient trade routes.

The district is predominantly inhabited by the Pashtun ethnic group, who follows their rich cultural traditions and speaks the Pashto language. Agriculture is the primary economic activity in Bajaur, with crops like wheat, maize, and fruits being cultivated in the fertile lands.

Bajaur has faced its share of challenges, including security concerns due to its proximity to the Afghan border. The region has been affected by conflicts and unrest in the past. However, in recent years, efforts have been made to bring stability and development to the area. Despite its challenges, District Bajaur remains a culturally vibrant region, and its people are known for their hospitality and resilience. The district's unique blend of natural beauty and cultural heritage makes it an intriguing destination for both travelers and researchers interested in exploring this part of Pakistan.

1.3.1 Regional History

The history of Bajaur dates back to ancient times, and the region has been inhabited by various civilizations and tribes over the centuries. Due to its strategic location, it has been a significant crossroads for trade, culture, and invasions, shaping its rich historical background.

Ancient Period: During the ancient period, Bajaur was part of the Gandhara region, an important center of Buddhist culture and learning. It was a part of the Mauryan and Kushan empires and

witnessed the spread of Buddhism throughout the area. Many archaeological sites and Buddhist stupas can be found in the region, attesting to its historical importance.

Medieval Period: In the medieval period, Bajaur came under the control of various empires, including the Ghaznavids, Delhi Sultanate, and the Mughals. It also saw the influence of different Central Asian and Persian dynasties.

Pashtun Tribes and British Rule: In the 16th century, the region began to be dominated by Pashtun tribes, particularly the Tarkani tribe. Over time, various Pashtun tribes established their influence and control over Bajaur.

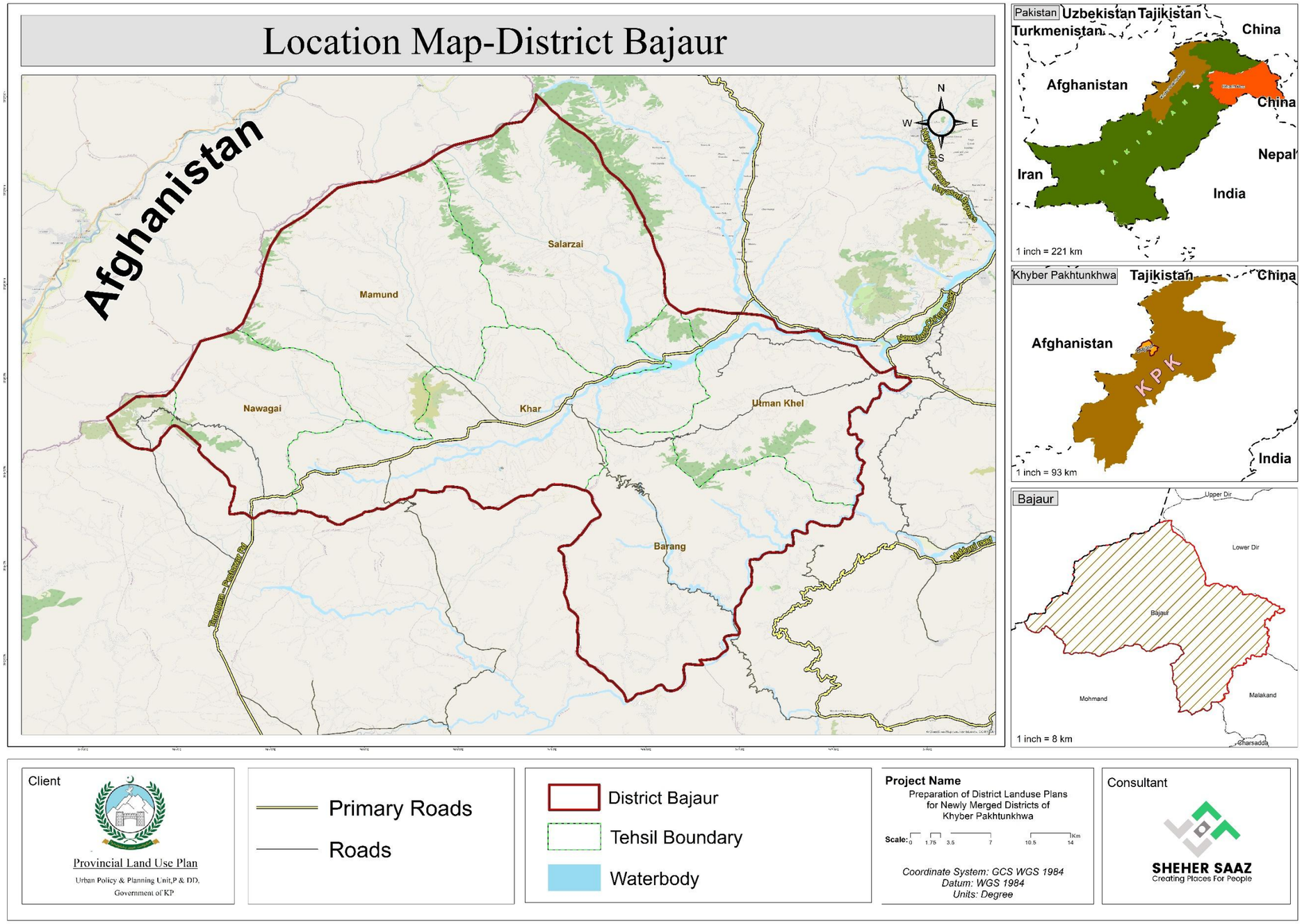
During the 19th century, the British colonial rule extended into the region, and Bajaur became part of the larger British Indian Empire. The British established administrative control but faced resistance from local Pashtun tribes in various campaigns. The area was considered a challenging frontier for the British, and maintaining stability and control was difficult.

Post-Independence and Modern Era: After the partition of British India in 1947, Bajaur became part of Pakistan. It was integrated into the North-West Frontier Province (now Bajaur Pakhtunkhwa) and later became a separate tribal agency within Pakistan's administrative setup. In 2018, with the 25th Constitutional Amendment, the merger of the tribal areas with Bajaur Pakhtunkhwa was initiated, and the Bajaur Agency was restructured into a regular district, officially known as District Bajaur.

1.3.2 Geographic Location

Bajaur district is situated near Bajaur district, Charsadda, Mardan and Peshawar which makes its location ideal for trade within the country. Bajaur is the smallest of previous FATA agencies having an area of 1290 km^2. The geography of Bajaur is characterized by diverse landscapes, ranging from mountainous regions to fertile valleys and plains.

Map 4: Location Map of the Project Area



Source: Consultant, 2024

1.3.3 Topographic Overview

Hindu Kush Mountains: Bajaur is situated in the Hindu Kush Mountain range, which is an extension of the larger Himalayas. The mountainous terrain dominates the landscape of the district, with peaks and valleys forming intricate patterns across the region.

Valleys: The district is home to several valleys, the most notable of which is the Panjkora Valley. The Panjkora River flows through this valley, providing water for agriculture and serving as a lifeline for local communities.

Plains: While much of Bajaur is mountainous, there are also fertile plains and agricultural lands in the lower elevations. These plains provide suitable conditions for cultivating crops, and agriculture is one of the primary economic activities in the district.

Panjkora River: The Panjkora River is a significant waterway that originates in the Hindu Kush mountains and flows through Bajaur. It eventually joins the Kabul River in Afghanistan. The river's water is crucial for irrigation and supports the local ecosystem.

Bajaur National Park: The district is home to Bajaur National Park, which was established to preserve the natural beauty and biodiversity of the area. The park provides sanctuary for various wildlife species, including ibex, urial, markhor, and various bird species.

Cultural Significance: Bajaur has historical importance as part of the Gandhara region, which was a significant center of Buddhist culture and learning in ancient times. The area contains numerous archaeological sites, including Buddhist stupas and monasteries, adding to its cultural significance.

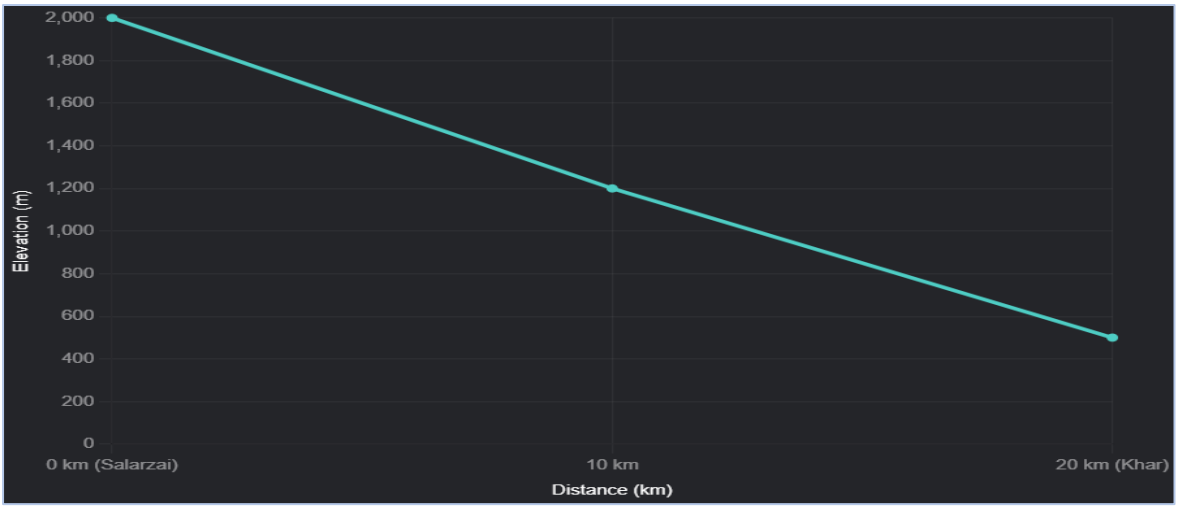
1.3.4 Physiography and Geology

Bajaur District, formerly a part of the Federally Administered Tribal Areas (FATA), is situated in the northwestern part of Pakistan, adjacent to Afghanistan. The district spans approximately ***45 miles*** (72 km) in length and ***20 miles*** (32 km) in width, making it the smallest district in the region.

The Bajaur District is mountainous and is probably most famous for its rugged elevations, which range from 500 meters in the Panjkora Valley to peaks, such as Koh-i-Mor, reaching up to 2,000 meters. The tehsils in the northern parts of the district, such as Salarzai, have steep slopes, whereas the southern part, for example, Khar, is flatter. Bajaur has some regional characteristics because it shares geology with the Kohistan Arc, within which sedimentary and metamorphic rocks dominate; significant deposits of marble are spread in areas like Nawagai. The Panjkora River runs through the valley, creating very fertile alluvial plains but also accompanying flood hazard risks during the monsoon.

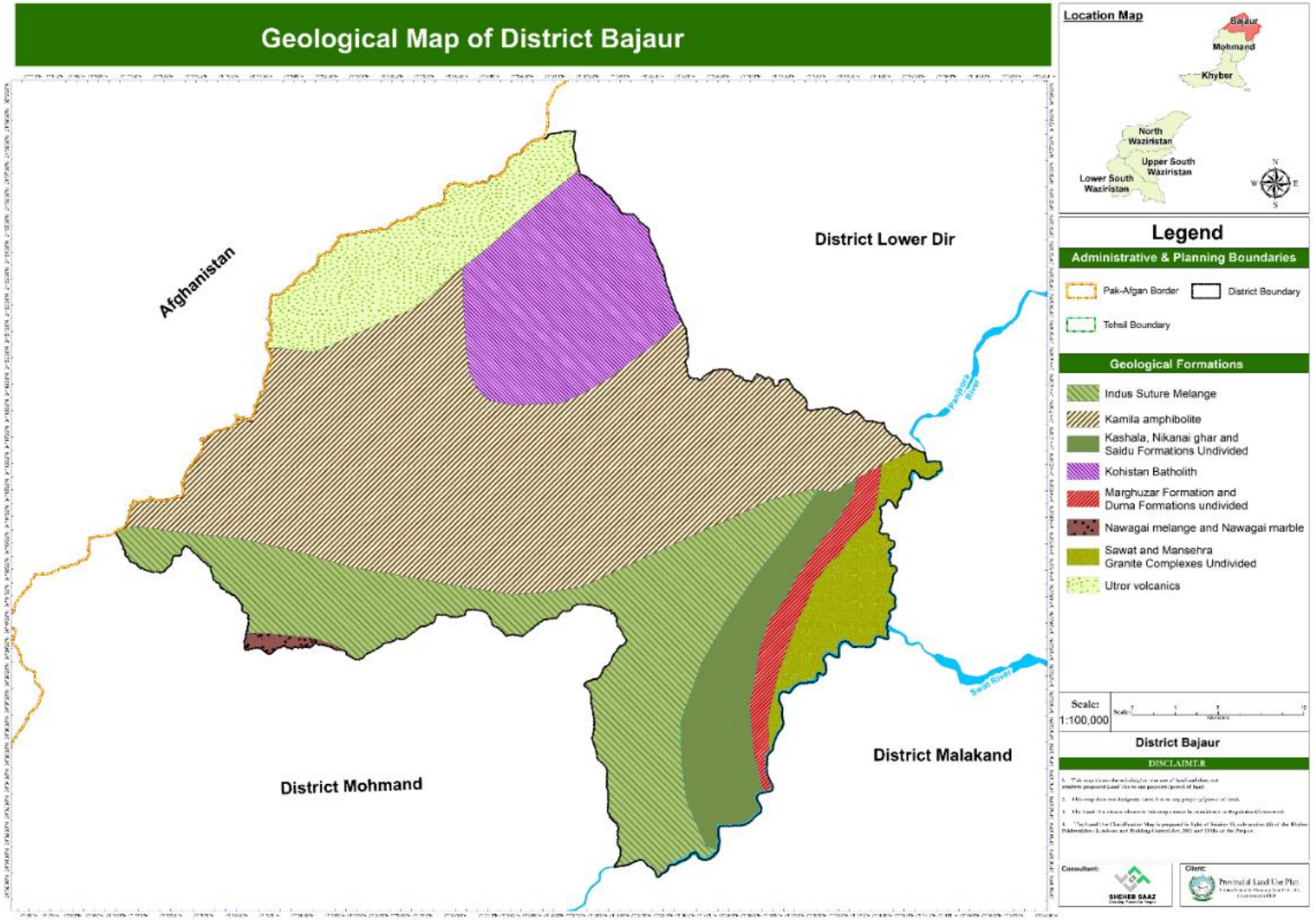
To better depict the district in a delineated form, an extensive map showing the topography of the district would be included in the form of a topographic map with elevation contours at 100-meter intervals across Bajaur's 1,290 km² area. Such a map would portray major features, including the 2,000-meter Koh-i-Mor peak in Salarzai, the 500-meter lowlands near Khar, and the path of the Panjkora River. Likewise, a cross-sectional diagram below, showing elevation changes from north (Salarzai) to south (Khar), would help visualize the steep gradients, where

slopes average 15% in the north versus 2% in the south. For simplicity transmission, the chart below illustrates the variation of elevation along a 20 km north-south transect through Bajaur:

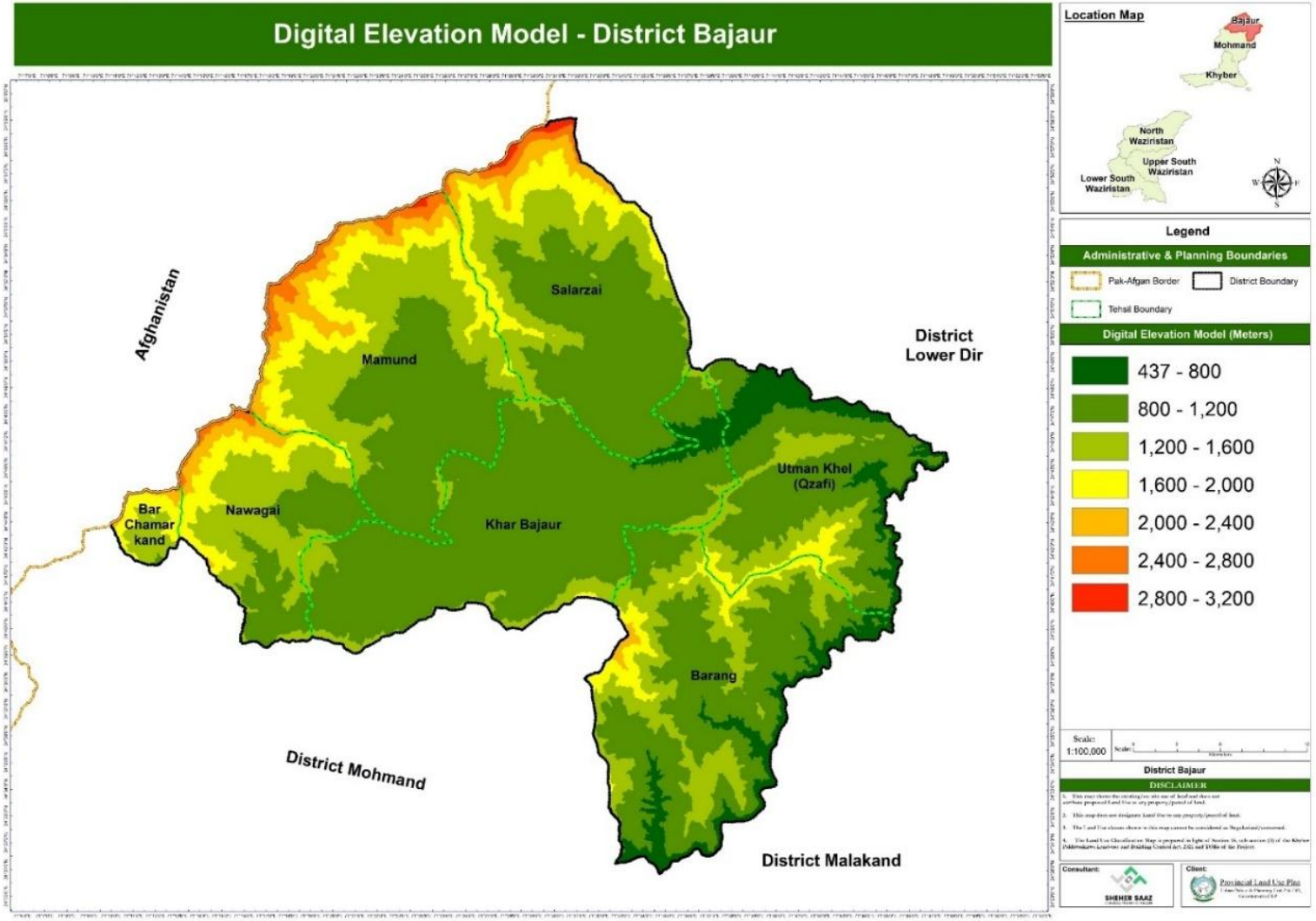


The geological framework of Bajaur is significantly influenced by its location within the Hindu Kush Mountain range. The region's geology is complex, comprising a range of rock types that reflect its dynamic tectonic history. The mountains in Bajaur are primarily composed of metamorphic and sedimentary rocks, including schists, gneisses, and limestone. These geological formations are indicative of the area's ancient geological processes, including the collision and uplift associated with the Indian and Eurasian tectonic plates. The Panjkora River and its tributaries have played a crucial role in shaping the district's geology. Over time, these rivers have carved out deep valleys and transported sediments, contributing to the development of fertile alluvial plains in certain areas.

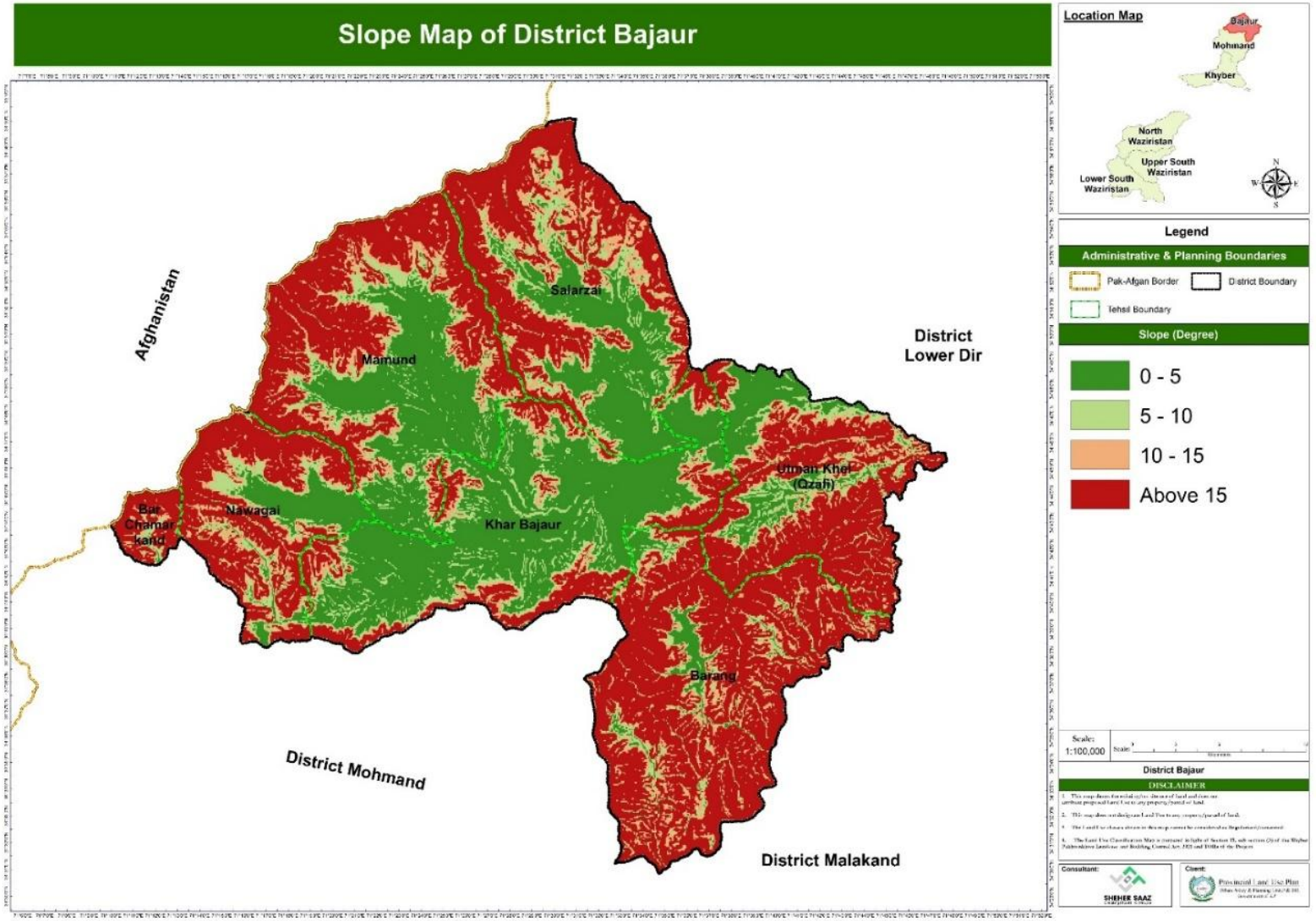
Map 5: Geological Map - District Bajaur



Map 6: Digital Elevation Map (District Bajaur)



Map 7: Slope Map of District Bajaur



1.3.5 Hydrology and Water Resources

Bajaur District's hydrology and water resources play a crucial role in the daily lives and economic activities of its residents. The region's water sources are diverse, including surface water, groundwater, and rainwater harvesting systems. The availability and quality of water are influenced by the district's geographical and climatic conditions, making water management a vital aspect of local governance.

In the major towns of Bajaur, the Public Health Engineering Department has established a piped water supply system, which serves about 19% of households. However, a significant proportion of the population still relies on more traditional water sources. Open wells are the primary source of drinking water for approximately 38% of households, particularly in rural and less urbanized areas. These wells are a crucial resource, providing a reliable supply of water despite potential concerns about water quality.

Ponds serve as a source of drinking water for about 5% of households. These ponds, which collect rainwater, are especially important during dry periods when other sources may be scarce. Additionally, hand pumps, which tap into shallow groundwater, are used by 3% of households. However, the installation and maintenance of hand pumps can be challenging, limiting their widespread use.

A significant 35% of households rely on other sources, including streams and rainwater harvesting. Streams, fed by the district's river systems and seasonal rainfall, provide a convenient water source for many communities. Rainwater harvesting, an adaptive response to the region's climate, enables households to collect and store rainwater for later use, ensuring water availability during dry spells.

Despite these diverse sources, Bajaur District faces several challenges in water resource management. Seasonal variability significantly affects water availability, with fluctuations in both quantity and quality throughout the year. This variability can pose challenges for both domestic consumption and agricultural activities. The limited reach of piped water infrastructure highlights the need for further investment in expanding access to clean and reliable water sources, which is critical for public health and economic stability.

Water quality remains a concern, particularly for those relying on open wells, ponds, and streams. Contamination from natural and human activities can compromise the safety of these water sources. Thus, there is a pressing need for regular monitoring and proactive management to ensure that water remains safe for consumption.

1.4 The Administrative Structure of the Region

Khyber Pakhtunkhwa (KP) Province operates under a hierarchical administrative structure, subordinate to the federal government. At the apex of provincial governance is the Chief Minister, elected by the Provincial Assembly. The Chief Minister heads the executive branch and is assisted by a cabinet of ministers overseeing various departments.

The bureaucratic machinery is led by the Chief Secretary, who coordinates and supervises departmental activities. The Additional Chief Secretary heads the Planning & Development Department, reporting directly to the Chief Secretary. A tiered structure of Additional

Secretaries, Deputy Secretaries, Section Officers, and other staff supports the departments. Additionally, various attached departments and autonomous bodies operate under the provincial government.

The province is divided into 38 districts, each with its administrative hierarchy. Local government is overseen by the Secretary of the Local Council Board, under the purview of the Local Government Establishment and Rural Development Department. This department is responsible for administration, planning, and development at the local level. Its structure includes five key sections: Planning & Development, Estate, Administration/Establishment, Finance, and Local Governance. An Additional Secretary heads the Litigation, Monitoring & Evaluation, and Smart City wings. The Deputy Secretary for Administration and Establishment oversee municipal administration across KP, including 7 Regional Municipal Officers (RMOs) and 93 Tehsil Municipal Officers (TMOs).

The land use regulations governing development in Pakistan, including national and provincial laws, acts, and policies, are implemented by the local government department and development authorities.

1.5 Legal & Policy Framework (Federal, Provincial, Local)

1.5.1 Existing Legal Framework

1.5.1.1 The North-West Frontier Province Urban Planning Ordinance, 1978

The North-West Frontier Province Urban Planning Ordinance of 1978 was enacted to establish a comprehensive urban planning system for the province. Its primary goals are to integrate physical planning with economic and social planning at all levels of government and to establish an institutional framework for the effective implementation of these plans. Ordinance makes the Provincial Urban Development Board (Board) as the primary governing body. The Board is responsible for formulating and implementing urban development policies, coordinating with federal and local planning agencies, and ensuring proper consideration of economic and social planning factors.

Established by the Board with government approval, detailed planning and implementation are mandated in specific local areas under Section 15. The Board defines the boundaries of these local areas as per Section 15(2). Additionally, the Board has the authority to delegate all or any of its functions related to the local area to the Local Area Authority (LAA), as specified in Section 16.

The functions of LAAs are comprehensive and include engaging in a continuous planning process that outlines land development, public facilities, housing, open spaces, and more. They are also responsible for conducting studies, making projections, and analyzing existing conditions under Section 17(3). Furthermore, LAAs are tasked with implementing approved plans, which require the necessary resources and powers, as stated in Section 17(4). They must prepare documents like Local Area Plans (LAPs) and others as needed, according to Section 17(5), and follow directions from the Board under Section 17(6).

Local Area Plans (LAPs) are defined by the LAA with titles approved by the Board, as outlined in Section 18(1). These plans include written summaries of findings, recommendations, and proposed plans. They also specify territorial and time dimensions, subject matter, and the level of detail required. Moreover, LAPs identify provisions to be included in Land Development Regulations or adhered to by government agencies, as noted in Section 18(4).
Land Development Regulations (LDRs) can be adopted by LAAs if authorized by the Board, as outlined in Section 21. These regulations govern various aspects of land development within the local area, as specified in Sections 31(1) and (2).

The implementation of the approved plans is a key responsibility of LAAs, who must carry out this task directly or through other government agencies, as stated in Section 22. The Board has the authority to modify delegation terms, dissolve LAAs, or merge them with other planning agencies, according to Section 23. Once local area development is complete, the Board can dissolve the LAA and transfer the area to a local council, as outlined in Section 24.
The ordinance outlines the procedures for land acquisition for urban planning purposes. The process begins with the identification of required land, where the Board identifies the necessary land and publishes a notification in the official gazette. Authorized officers are then allowed to survey, mark boundaries, and assess land suitability, with compensation provided for any damage caused during this process. Compensation is determined based on factors such as market value, damages, and relocation expenses, while excluding factors like urgency or potential land value increases due to the project.

1.5.1.2 North-West Frontier Province Local Government Ordinance, 2001

In line with the objectives of decentralization and devolution of power, the *North-West Frontier Province Local Government Ordinance, 2001* (the "NWFP LGO 2001") was promulgated under the Devolution Plan 2001 to restructure the local government system in the then North-West Frontier Province, now Khyber Pakhtunkhwa. The Ordinance aimed to devolve political, administrative, and financial authority to the district, tehsil, and union levels, thereby strengthening grassroots governance and improving service delivery.
The NWFP LGO 2001 applied to the entire province, excluding cantonment areas and any other areas notified by the government. The Ordinance defined key institutional terms such as district, tehsil, union, local government, and local council, and established a **three-tier local government structure** comprising District Governments, Tehsil Municipal Administrations (TMAs), and Union Administrations. Each tier was assigned specific functions and responsibilities to ensure administrative decentralization and local participation in governance.
Under the Ordinance, a **District Government** was established in each district, headed by a directly elected *Nazim*, with executive authority supported by the District Coordination Officer and district line departments. The District Government was responsible for overall district-level planning, coordination, and management of devolved sectors, including education, health, infrastructure, and spatial planning. The District Nazim provided leadership for district development, approved development strategies, and coordinated with provincial departments.
At the tehsil level, the Ordinance established **Tehsil Municipal Administrations (TMAs)**, headed by a Tehsil Nazim. TMAs were assigned municipal and regulatory functions, including

land use control, building regulations, water supply, sanitation, solid waste management, local roads, markets, and spatial planning. The TMAs were responsible for preparing tehsil-level development plans and managing municipal services in both urban and rural settlements within their jurisdiction, subject to provincial policies.

The **Union Administration**, headed by a Union Nazim, functioned as the lowest tier of local government. Union Councils were responsible for identifying local development needs, maintaining communal infrastructure, assisting in data collection, monitoring service delivery, and facilitating community participation. They also played a role in dispute resolution, registration of vital events, and implementation of small-scale development schemes.

The NWFP LGO 2001 also established **elected councils** at each tier—District Council, Tehsil Council, and Union Council—which exercised legislative and oversight functions. These councils approved budgets, development plans, local taxes, fees, and bylaws, and held the respective Nazims accountable for administrative and financial performance through committees and council proceedings.

Although the NWFP LGO 2001 introduced an extensive framework for devolution and local-level planning, its implementation faced challenges related to administrative capacity, fiscal dependence on the province, and limited continuity. The Ordinance remained in force until it was repealed and replaced by subsequent local government legislation, including the *Khyber Pakhtunkhwa Local Government Act, 2012* and later the *Khyber Pakhtunkhwa Local Government Act, 2013*. Nevertheless, the NWFP LGO 2001 remains a foundational legal instrument that shaped the evolution of local governance and planning institutions in Khyber Pakhtunkhwa.

1.5.1.3 The Khyber Pakhtunkhwa Establishment of District Development Advisory Committees Act, 1989

With a District Development Advisory Committee for each district, the KP Establishment of District Development Advisory Committees Act, 1989 was established to provide appropriate planning and oversight of local-level development operations throughout the province. The heads of any district-level Attached Departments, the District Nazim, the City District Nazim, the Tehsil Nazim/Town Nazim, and any other elected representatives that the Government may designate as co-opted members comprise the Committees, in addition to all the members of the Provincial Assembly from that District. Voting rights are not granted to co-opted members.

1.5.1.4 The Khyber Pakhtunkhwa Local Government Act, 2013

In accordance with Article 140A of the Constitution of the Islamic Republic of Pakistan, 1973 (the "Constitution"), which mandates the establishment of local government systems (in all provinces) and the devolution of political, administrative, and financial responsibility authority to the elected representatives of such local governments, the province's local government system has been reorganized and consolidated thanks to the Khyber Pakhtunkhwa Local Government Act, 2013 (the "LGA").

The Khyber Pakhtunkhwa Local Government Act, 2013, applies throughout the entire Khyber Pakhtunkhwa Province, excluding designated cantonments and any other areas excluded by official government notification. The Act defines key terms like district, local government,

local council (including Tehsil, Village, and Neighborhood Councils), and tehsil. It establishes local areas for the formation of local governments, including villages, neighborhoods, and later additions like tehsils. Finally, the Act outlines the structure of local governments, which will consist of City Local Governments, Tehsil Local Governments, Village Councils, and Neighborhood Councils.

The Khyber Pakhtunkhwa Local Government Act, 2013 establishes a Tehsil Local Government (TLG) in each tehsil. Each TLG has a directly elected Chairman with executive authority and a Tehsil Local Administration for support. The Chairman is responsible for ensuring the TLG functions according to the Act and oversees a range of duties. These include providing vision and leadership for the tehsil's development, formulating development strategies, and coordinating with the District Administration. The TLG itself manages devolved government departments within the tehsil, following general government policies. They are accountable to both the public and the provincial government for improving governance and service delivery within their devolved authority. The Chairman has a wide range of powers to fulfill these responsibilities. They can propose budgets and development plans, oversee implementation of devolved functions, and regulate markets and services within the tehsil. Additionally, the Chairman monitors government officials, coordinates with village and neighborhood councils, and represents the TLG in official capacities.

The Khyber Pakhtunkhwa Local Government Act, 2013 also establishes a Tehsil Council in each tehsil. The council's composition is detailed in Part-I of the Eleventh Schedule of the Act. This council plays an important oversight role by approving taxes, fines, and bylaws proposed by the Chairman. Additionally, they have final say on the annual budget and development plans for the Tehsil Local Government. To ensure an effective delivery service, the council elects Standing Committees to oversee various aspects of TLG's operations. These committees cover areas like municipal offices, devolved functions, finances, accounts, and ensuring smooth council proceedings and ethical conduct amongst members. Finally, the Tehsil Council reviews report from the Accounts Committee and performance reports from the Chairman, holding them accountable for their actions.

The Khyber Pakhtunkhwa Local Government Act, 2013 establishes Village Councils in rural areas and Neighborhood Councils in urban areas. After their boundaries are finalized by the Election Commission, the government officially forms these councils. Both types of councils play a crucial role in local development and service delivery.

Their shared responsibilities include implementing and monitoring village-level development projects (for Village Councils), handling village sanitation (Village Councils only), identifying local development needs, registering vital events, approving annual budgets and development plans, organizing local sports and cultural events, and overseeing watch and ward programs. Village Councils additionally organize cattle fairs and shows.

Furthermore, both councils play a vital role in monitoring service providers like education, health, agriculture, and sanitation. They achieve this through a dedicated Monitoring Committee that reports to the Tehsil Local Government. Data collection on social indicators is another important function. The councils also collaborate with the Tehsil Local Government by assisting with surveys, data collection, and selecting locations for public facilities. Finally, they can be assigned additional tasks by the government or the Tehsil Local Government. The

Khyber Pakhtunkhwa Local Government Act, 2013, outlines the process for delimiting village and neighborhood councils within the province.

- **Number of Councils:** The total number of councils per district is specified in the Ninth Schedule of the Act.
- **Delimitation Authority:** The Election Commission of Pakistan is responsible for delimiting village and neighborhood councils.
- **Village Council Areas:** A village council covers one or more muaziaat (land revenue units) or census villages.
- **Neighborhood Council Areas:** In urban areas, a neighborhood council covers whole census blocks or a combination of blocks and muaziaat.
- **Delimitation Considerations:** Delimitation considers factors like population distribution, geographic compactness, existing administrative boundaries, communication facilities, public convenience, and ensuring homogeneity in council creation.
- **Population Range:** The population range for councils within a district is 5,000 to 15,000 based on the latest official census data. If the official census results are not available, provisional results from the 2017 national population census can be used for delimitation.

1.5.1.5 Khyber Pakhtunkhwa Planning and Development Guidelines for Local Governments 2015

The Planning and Development (P&D) Guidelines 2015 for the devolved tiers of local governments in Khyber Pakhtunkhwa (KP) were developed to operationalize the provisions of the Local Government Act (LGA) 2013. These guidelines provide a structured approach for the planning, execution, and monitoring of development projects at the district, tehsil, and village/neighborhood levels. The guidelines underscore the importance of decentralized and participatory planning to ensure that development initiatives are responsive to the specific needs of local communities. It advocates for a decentralized planning system where local governments have the authority and responsibility to plan and execute development projects. This approach aims to bring decision-making closer to the community level, promoting more effective and context-sensitive interventions.

Local governments are required to prepare a Medium-Term District Development Plan (DDP) and an Annual Development Program (ADP). The DDP outlines the strategic development priorities for a multi-year period, while the ADP details the specific projects and budget allocations for each fiscal year. The planning cycle is designed to ensure alignment between the medium-term and annual plans, facilitating continuity and coherence in development efforts.

A key feature of the guidelines is the emphasis on inclusive and evidence-based planning. Local governments must conduct thorough needs assessments, involving extensive data collection and stakeholder consultations to identify service delivery gaps and prioritize projects. Special attention is given to engaging marginalized groups, including women,

minorities, and the disabled, to ensure that development interventions are equitable and address the needs of all community members.

The guidelines specify the allocation of development funds across various sectors, such as education, health, infrastructure, and water supply. There are also earmarked funds for gender-responsive projects, youth, and marginalized groups. This structured allocation is intended to ensure that critical areas receive adequate funding and that development efforts are balanced and comprehensive.

The guidelines outline clear procedures for project identification, approval, and implementation, with an emphasis on transparency and accountability. Various committees at the district, tehsil, and village/neighborhood levels are responsible for overseeing these processes. Furthermore, monitoring and evaluation mechanisms are established to track project progress, assess outcomes, and ensure the proper utilization of funds. Recognizing the need for effective implementation, the guidelines highlight the importance of capacity building for local government officials. This includes training on technical aspects of project planning, financial management, and community engagement.

The P&D Guidelines 2015 for devolved local governments in KP represent a significant step towards achieving a decentralized and participatory development planning framework. The guidelines are comprehensive, detailing every aspect of the planning, execution, and monitoring process. The Khyber Pakhtunkhwa Urban Areas Development Authorities Act, 2020.

The Khyber Pakhtunkhwa Urban Areas Development Authorities Act of 2020 represents a significant step towards the regulated and sustainable development of urban centers within the province. The legislation establishes a framework for the creation and operation of Urban Areas Development Authorities, empowering them to play a pivotal role in shaping the future of the province's cities.

The primary objective of the Act is to enhance the quality of life for urban residents. It seeks to achieve this by promoting planned and sustainable urban growth. To this end, the Act grants Urban Development Authorities broad powers to formulate and implement comprehensive land use plans and zoning regulations. These authorities are also entrusted with the responsibility of developing and maintaining essential urban infrastructure, including transportation networks, water supply, and sanitation systems.

One of the notable features of the Act is its provision for granting autonomous status to specific development authorities. This decentralization approach empowers local authorities to make decisions tailored to the unique needs and challenges of their respective areas. The Kohat Development Authority is a prime example of this, serving as a model for other potential autonomous development authorities.

To ensure alignment with broader development objectives, the Act establishes an Urban Development Authority's Board. This body oversees the approval of development schemes and can initiate modifications as needed.

While the Act presents a promising framework for urban development, its successful implementation hinges on several factors. Effective coordination and monitoring mechanisms are essential to ensure that the authorities operate efficiently and harmoniously. Moreover, fostering meaningful public participation in decision-making is crucial for creating inclusive

and responsive urban environments. Adequate financial resources are also indispensable for the development and maintenance of necessary infrastructure.

The Khyber Pakhtunkhwa Urban Areas Development Authorities Act of 2020 offers a solid foundation for urban transformation. By empowering local authorities, promoting sustainable practices, and emphasizing the importance of public engagement, the Act has the potential to significantly improve the lives of urban residents in the province. However, its full potential can only be realized through effective implementation, ongoing evaluation, and adaptation to emerging challenges and opportunities.

1.5.1.6 Khyber Pakhtunkhwa Land Use and Building Control Act, 2019

The *Khyber Pakhtunkhwa Land Use and Building Control Act, 2019* provides the legal framework for regulating land use, urban development, and building construction across the province. Its primary objective is to ensure planned, safe, and sustainable urban growth, while controlling unauthorized construction and unplanned settlement expansion.

The Act applies throughout the province in **notified urban areas, towns, and cities**, excluding cantonments unless specifically notified by the government. It defines key terms such as land use, development, building, zoning, planning authority, and local authority. The Act also establishes the legal basis for preparation, approval, and enforcement of land use plans, zoning schemes, and building regulations at provincial and local levels.

Under the Act, designated **Local Authorities**, including City Local Governments, Tehsil Local Governments, Development Authorities, and other notified agencies, are empowered to regulate land use and building activities within their jurisdiction. Their responsibilities include approving land use plans, granting building permissions, regulating changes in land use, enforcing zoning compliance, and overseeing all construction activity to ensure conformity with approved plans.

The Act mandates the preparation of **zoning and land use plans**, classifying areas into residential, commercial, industrial, institutional, mixed-use, and other designated zones. Any land subdivision, change of land use, or building construction requires prior approval from the relevant authority according to the rules and standards set forth in the Act.

It also outlines **building control provisions**, including plot coverage, building height, structural safety, setbacks, parking, access, and provision of essential services. Local Authorities are authorized to inspect buildings, issue notices, impose penalties, seal unauthorized constructions, and order demolition of structures violating approved plans.

To ensure effective implementation, the Act provides mechanisms for appeals, penalties, and enforcement, ensuring accountability of developers and landowners. The provincial government is empowered to issue detailed rules, regulations, and guidelines to operationalize the Act and adapt it to local needs.

The *Khyber Pakhtunkhwa Land Use and Building Control Act, 2019* thus serves as a **key legal instrument** for guiding orderly urban development, promoting efficient land utilization, regulating housing density and vertical expansion, and supporting sustainable urban planning across the province.

1.5.1.7 Khyber Pakhtunkhwa Land Acquisition Rules, 2020

The KP Land Acquisition Rules, 2020 are a comprehensive framework governing land acquisition in Khyber Pakhtunkhwa, Pakistan, published by the Board of Revenue and

available on their official website. These rules outline the procedures for land acquisition, including the determination and payment of compensation. Their primary objective is to establish a clear and transparent process that ensures fairness and equity for all parties involved, particularly by providing adequate compensation to landowners whose properties are acquired for public purposes. The rules detail a step-by-step procedure for land acquisition, clarify the criteria and methodology for determining compensation, and establish a mechanism for timely payment to eligible landowners. Additionally, they designate the role of a Land Acquisition Collector, responsible for the effective implementation of these regulations. However, the enforcement and monitoring of these rules can present challenges, necessitating robust mechanisms to address non-compliance. Ensuring local compliance and raising awareness among stakeholders may also be difficult, especially when resources for monitoring and corrective actions are limited. Furthermore, the policy may require periodic updates to remain aligned with evolving local development needs and changing circumstances.

1.5.1.8 Khyber Pakhtunkhwa Local Government (Private Housing Schemes Management and Regulation) Rules 2021

The KP Local Government (Private Housing Schemes Management and Regulation) Rules 2021 are designed to oversee the management and regulation of private housing schemes in Khyber Pakhtunkhwa, Pakistan. Promulgated by the Government of Khyber Pakhtunkhwa under Section 112 of the Khyber Pakhtunkhwa Local Government Act, 2013, these rules establish a regulatory framework aimed at ensuring that private housing schemes are developed in a sustainable and planned manner while protecting the rights of all stakeholders involved. They promote transparency and accountability in the management of these schemes. The rules provide a structured mechanism for overseeing private housing projects, ensuring compliance with established guidelines and standards in planning, execution, and ongoing management.

They also prioritize community interests by encouraging the development of inclusive and safe housing schemes with well-planned infrastructure. Additionally, the rules establish transparent processes for the approval, monitoring, and management of private housing schemes, thereby enhancing accountability and trust among stakeholders while promoting the integration of environmental considerations and sustainable practices. However, the enforcement of these rules presents challenges, including the complexity of effective monitoring and the need for robust mechanisms to address non-compliance. Ensuring local-level compliance and raising awareness among stakeholders can be difficult, especially given the limited resources available for monitoring and corrective actions. Furthermore, the policy may require periodic updates to adapt to evolving local development needs and changing circumstances.

1.5.1.9 Khyber Pakhtunkhwa Urban Policy 2022-2030

The Khyber Pakhtunkhwa (KP) Urban Policy (2022-2030) is a comprehensive blueprint designed to steer the growth and management of the province's urban areas. It acknowledges the province's diverse urban landscape by categorizing cities based on population and administrative factors, recognizing the unique challenges and opportunities presented by the

Northern, Central, and Southern regions. This zonal differentiation allows for flexible and tailored strategies while maintaining a unified policy framework.

At its core, the policy envisions cities as engines of social and economic progress, aiming to create inclusive and prosperous urban spaces. It emphasizes adaptability, inclusivity, and collaboration as guiding principles. The policy seeks to create cities that are responsive to changing needs, where all residents feel valued and empowered, and where government, the private sector, and civil society work together towards shared goals.

To achieve this vision, the policy outlines three primary objectives: fostering sustainable cities, promoting social mobility and livability, and driving youth-focused economic development. Sustainable cities are envisioned as balanced ecosystems where economic growth coexists with environmental protection and social well-being. The policy emphasizes green spaces, clean air, and efficient resource management as crucial elements of this vision.

Social mobility and livability are central to creating inclusive and equitable cities. The policy aims to improve the quality of life for all residents, particularly vulnerable groups such as women, children, and people with disabilities. By enhancing access to essential services, creating inclusive public spaces, and fostering a sense of community, the policy seeks to build vibrant and resilient urban environments.

Recognizing the potential of young people, the policy places a strong emphasis on youth-focused economic development. By creating an environment that supports entrepreneurship, job creation, and skill development, the policy aims to empower young people to contribute to the province's economic growth and innovation.

Beyond these primary objectives, the policy integrates gender equality, technology, and sustainability into all aspects of urban development. By mainstreaming these cross-cutting themes, the policy aims to create cities that are just, efficient, and resilient.

A significant aspect of the policy is the introduction of Strategic City Management Plans (SCMPs). These plans are to be developed for each city on a rolling three-year basis, prioritizing local interventions and sustainable solutions in various sectors including urban governance, land use, mobility, urban design, local economic development, environmental sustainability, financial stability, and communication. The development of SCMPs involves a participatory process of public engagement, ensuring that the plans are user-friendly and reflect the community's needs. Additionally, the SCMPs include a disaster risk management response and coordination mechanism.

The policy also includes several annexures providing additional guidelines and frameworks. Annexure 1 lists the cities and tehsils by zone, while Annexure 2 details the implementation framework for the policy, emphasizing the need for periodic reviews and updates. Annexure 3 presents a linkages matrix that connects the goals, indicators, and policy clauses. Annexure 4 provides guidelines for the preparation of SCMPs, and Annexures 5 and 6 offer public space design and community participation guidelines, respectively. Finally, Annexure 7 includes an urban sector diagnostic to inform policy decisions.

The KP Urban Policy (2022-2030) aims to create a balanced and inclusive urban development framework that addresses the diverse needs of the province. It seeks to promote sustainability, enhance social mobility, and drive economic development through comprehensive planning, public participation, and the use of technology. The policy's success

will depend on effective implementation, continuous adaptation, and genuine engagement with the communities it serves.

1.5.1.10Merged District's Annual Development Plan 2022-23

The Merged Areas Development Plan 2022-23 for Khyber Pakhtunkhwa is a detailed and comprehensive framework aimed at integrating the formerly Federally Administered Tribal Areas (FATA), and now Merged Districts, into the province. The document addresses various sectors, including agriculture, education, health, infrastructure, governance, and social welfare, each with specific projects, financial allocations, and expected impacts. The agricultural sector is a significant focus, with projects aimed at enhancing productivity through modern farming techniques, establishing soil and water testing labs, promoting indigenous crops, and developing fisheries. These initiatives aim to create a sustainable agricultural framework that supports local economies and food security.

In education, the plan includes scholarships to encourage higher education and numerous projects for constructing and rehabilitating schools in remote areas, addressing the literacy gap, and promoting education accessibility. The health sector focuses on improving healthcare infrastructure, expanding essential medical services, and combating prevalent diseases such as tuberculosis and hepatitis. Key initiatives include constructing new hospitals, upgrading existing facilities, and enhancing maternal and child health services, which are critical for improving the overall health standards of the population.

Infrastructure development is a cornerstone of the plan, with significant projects aimed at improving road connectivity, water supply, and energy infrastructure. This includes the construction and upgrading of roads to enhance connectivity within the merged areas and with the rest of KP, and the implementation of new water supply schemes to ensure access to clean drinking water. These projects are designed to facilitate economic activities, improve living standards, and create a robust infrastructure framework that supports sustainable urban development.

Governance and social welfare projects within the plan focus on strengthening local governance institutions and providing social safety nets for vulnerable populations. Initiatives for capacity building aim to improve service delivery, while social welfare programs provide financial assistance and skill development opportunities, fostering social cohesion and supporting economic mobility. The urban planning components emphasize creating sustainable and resilient urban environments by integrating economic, social, and environmental considerations. Projects aim to develop urban areas through infrastructure improvements, enhanced public services, and the promotion of economic activities, while sustainable practices such as efficient water management and renewable energy projects are highlighted.

The document also stresses the importance of community engagement in the planning process, ensuring that development meets local needs and preferences. Financial allocations are detailed, highlighting the investment required for each sector and the sources of funding, which include a mix of local and foreign resources. Effective implementation mechanisms are crucial, and the plan discusses coordination among various government departments and stakeholders to ensure smooth execution.

However, potential challenges and issues may affect the successful implementation of the plan. These include the capacity for effective implementation, requiring robust administrative

capabilities, resource allocation, and coordination. Establishing strong monitoring and evaluation mechanisms is essential to track progress and address bottlenecks promptly. Ensuring the long-term sustainability of projects, especially in infrastructure and agriculture, requires continuous support and maintenance. Security concerns, given the region's history of conflict, could also pose significant challenges to implementing development projects.

1.6 Context & Rationale for Land Use Planning

Historical planning of Master Plans of Cities/Towns in Bajaur Pakhtunkhwa involved drawing plans in isolation from their hinterland, which was a piecemeal and isolated procedure, and consequently did not yield results. Recognizing the situation, the Provincial Government has rightly opted to adopt an integrated and holistic Land Use Planning approach for the development of all parts of the province. The Land Use Plan will serve as a policy document meant for the integrated, coordinated, systematic planning and uniform spread of development activities. It also aims to generate employment for the rural and suburban populations, thereby reducing rural-urban migration. It would help establish a hierarchy of settlements and the development of satellite, intermediate, secondary, and industrial towns as focal points for the future, catering to rural areas and small towns.

The plan will focus on creating, inducing, and facilitating sustainable development, optimizing land and other physical resource use, enhancing provincial income, increasing overall activity, and ensuring a balanced distribution of infrastructure and services. The Land Use Plan must serve as a guide for all the Provincial Government, Urban Policy Unit, District Governments, and TMAs to run integrated as well as coherent development programs.

2 CHAPTER II: POPULATION

2.1 Population Distribution

Bajaur District is divided into seven tehsils, each with its own importance. However, only Khar Tehsil, the district headquarters, has a developed urban center. Tehsils like Mamund, Salarzai, and Utman Khel have significant populations and require proper urban centers to support administration and provide essential facilities.

The population in the remaining tehsils is scattered and generally below the 100,000 benchmarks. In these areas, facilities like education and healthcare may be needed in some locations but not all. While Khar Tehsil is progressing well, establishing proper urban centers in Mamund, Salarzai, and Utman Khel is essential to improve administration and access to services.

Table 1: Percentage of Division Population

Area	Pop 2023	Percentage of Division Population
Bar Chamar Kand Tehsil	3,574	0.3
Barang Tehsil	90,082	7.0
Khar Bajaur Tehsil	301,778	23.4
Mamund Tehsil	358,190	27.8
Nawagai Tehsil	93,850	7.3
Salar Zai Tehsil	316,767	24.6
Utman Khel Tehsil	123,719	9.6
Bajaur District	1,287,960	100%

Source: Pakistan Bureau of Statistics (PBS) Census 2023

2.2 Migration

Migration from Bajaur District is primarily driven by the search for better opportunities, including jobs, marriage prospects, education, healthcare, and security. Understanding these factors highlights the need for a structured development plan in Bajaur.

While very few people migrate abroad, a significant number move within Khyber Pakhtunkhwa (KPK) province. This shows that residents of Bajaur are relocating to other districts in KPK that offer better opportunities and facilities.

Table 2: Indicator and Reason for Migration in Bajaur

Indicators	Total	Rural	Urban
Population 2023	1,283,113	1,283,113	-
Migration	3,662	3,662	-
Intra Provisional Migration	3,442	3,442	-
Inter-Provincial Migration	130	130	-
Migration from Abroad	90	90	-

Reason for Migration			
Job/ Business	498	498	-
Education	6	6	-
Marriage	672	672	-
With Family	1461	1461	-
Back to Home	69	69	-
Other	956	956	-

Source: Pakistan Bureau of Statistics (PBS) Census 2023

2.3 Density Pattern

Density patterns are vital for understanding how people, resources, and infrastructure are spread across a city. It reveals where populations are concentrated, guiding the efficient placement of essential services like schools, hospitals, and transit hubs to ensure they're accessible without overloading certain areas.

Table 3: Density Pattern – District Bajaur

District/ Tehsil	Area (Sq.km)	Density 2017	Density 2023	Density 2025	Density 2030	Density 2035	Density 2040	Density 2045
Bajaur District	1290	846	998	1052	1194	1348	1515	1698
Bar Chamar Kand Tehsil	13	221	275	295	349	410	478	556
Barang Tehsil	159	481	567	598	680	769	867	974
Khar Bajaur Tehsil	238	1037	1268	1353	1579	1831	2111	2426
Mamund Tehsil	250	1245	1433	1501	1679	1871	2076	2299
Nawagai Tehsil	216	363	434	460	529	605	688	780
Salarzai Tehsil	220	1217	1440	1515	1711	1921	2146	2388
Utman Khel Tehsil	194	553	638	669	750	837	930	1032

Source: Calculated by the Consultant 2025

2.4 Growth Rate

The population growth rates for Bajaur District and its tehsils from 2017 to 2023 reveal varied trends. Bajaur District itself saw a slight decline in growth from 3.23% to 2.81%, indicating a modest slowdown. Bar Chamar Kand Tehsil experienced a remarkable turnaround, shifting from a negative growth rate of -0.65% in 2017 to a robust 3.75% in 2023, suggesting a significant population increase, possibly due to migration or policy changes. Barang Tehsil showed a slight increase from 2.24% to 2.77%, maintaining steady growth. Khar Bajaur Tehsil, despite a decrease from 4.04% to 3.41%, remained one of the higher-growth areas. Mamund

Tehsil's growth rate dropped notably from 3.29% to 2.37%, while Nawagai Tehsil saw a substantial rise from 1.67% to 3.03%. Salarzai Tehsil experienced a modest decline from 3.4% to 2.86%, and Utman Khel Tehsil's growth slowed from 3.25% to 2.42%. Overall, most areas experienced slower growth in 2023 compared to 2017, with Bar Chamar Kand and Nawagai as notable exceptions, reflecting diverse demographic dynamics across the region.

Table 4: Growth Rate Comparison of 2017 and 2023- District Bajaur

Area	Growth Rate 2017	Growth Rate 2023
Bajaur District	3.23	2.81
Bar Chamar Kand Tehsil	-0.65	3.75
Barang Tehsil	2.24	2.77
Khar Bajaur Tehsil	4.04	3.41
Mamund Tehsil	3.29	2.37
Nawagai Tehsil	1.67	3.03
Salarzai Tehsil	3.4	2.86
Utman Khel Tehsil	3.25	2.42

Source: Pakistan Bureau of Statistics (PBS) Census 2023

2.5 Population Projection

2.5.1 District Bajaur

Population projections are a big deal for city planning because they give a heads-up on how many people will be living in a place, how fast it's growing, and what kind of folks are moving in. Knowing this helps make sure there's enough housing, roads, buses, schools, and hospitals to keep everyone happy and comfortable. Taking a place like Bajaur District, seeing how its population is shifting, helps figure out where to put resources so the area can grow without falling apart. Accurate projections also inform policy decisions, ensuring cities remain resilient, equitable, and capable of supporting residents' quality of life over time.

Table 5: Population Projection of Tehsil and District- District Bajaur

Area	*Method*	*2025*	*2030*	*2035*	*2040*	*2045*
Bajaur District						
Bajaur District	Arithmetic	1353618	1517762	1681906	1846050	2010194
	Geometric	1361360	1563687	1796084	2063020	2369629
	Average	1357489	1540725	1738995	1954535	2189911
Bajaur District (Tehsils)						

Area	*Method*	*2025*	*2030*	*2035*	*2040*	*2045*
Bar Chamar Kand Tehsil	Arithmetic	3809	4398	4986	5574	6163
	Geometric	3860	4677	5664	6857	8298
	Average	3835	4537	5325	6216	7230
Barang Tehsil	Arithmetic	94612	105936	117260	128584	139908
	Geometric	95457	110304	127403	147085	169729
	Average	95034	108120	122331	137835	154819
Khar Bajaur Tehsil	Arithmetic	320079	365832	411584	457337	503089
	Geometric	323778	385934	459814	547587	651812
	Average	321929	375883	435699	502462	577450
Mamund Tehsil	Arithmetic	373796	412810	451824	490838	529852
	Geometric	376612	426786	483426	547333	619401
	Average	375204	419798	467625	519086	574626
Nawagai Tehsil	Arithmetic	98969	111765	124562	137359	150155
	Geometric	99953	116968	136818	159963	186937
	Average	99461	114367	130690	148661	168546
Salarzai Tehsil	Arithmetic	333144	374087	415029	455972	496914
	Geometric	333384	378722	430033	488072	553686
	Average	333264	376404	422531	472022	525300
Utman Khel Tehsil	Arithmetic	129209	142935	156661	170387	184113
	Geometric	130209	147917	167957	190625	216252
	Average	129709	145426	162309	180506	200182

Source: Calculated by the Consultant 2025

2.5.2 Urban Centers, Potential Urban Centers and Settlements

The table presents projected population growth for existing and potential urban settlements across the tehsils of Bajaur District from 2017 to 2045. Khar Bajaur Tehsil, designated as the primary urban centre, shows the most significant growth, with the population of Khar Urban Area increasing from 93,273 in 2017 to 265,713 by 2045, reinforcing its role as the district's administrative, commercial, and service hub.

Mamund Tehsil, identified as a potential urban centre, is projected to grow steadily from 21,158 in 2017 to 47,120 in 2045, indicating increasing urbanization pressures and the need for planned infrastructure and services.

In Utman Khel Tehsil, the combined settlements of Gardai, Marano Shah, and Swal Qilla are expected to expand from 26,584 to 59,196 over the same period, reflecting gradual consolidation of these settlements into a growing urban cluster.

Salarzai Tehsil includes both an emerging urban settlement (Lara Dandokaii) and potential urban areas (Salarzai), with projected populations rising from 17,820 to 42,930 and 16,546 to 39,861, respectively. This dual growth pattern highlights the need for phased urban development and service provision.

Barang Tehsil shows comparatively moderate growth, with the population of Barang increasing from 13,667 in 2017 to 27,636 by 2045, while Nawagai Tehsil is projected to grow from 20,206 to 39,726, indicating a steady transition towards urban characteristics.

Overall, the projections indicate sustained urban population growth across all tehsils, underscoring the importance of proactive land use planning, infrastructure expansion, and service delivery to accommodate future urban demand in Bajaur District.

Figure 1: Projected population for Urban areas and Settlements

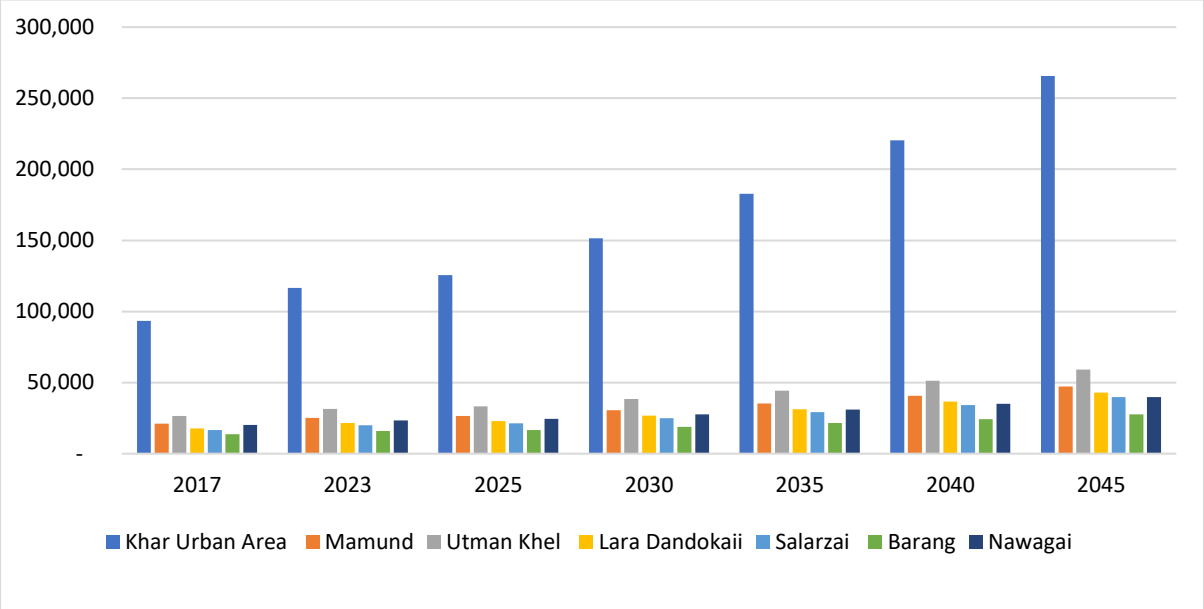
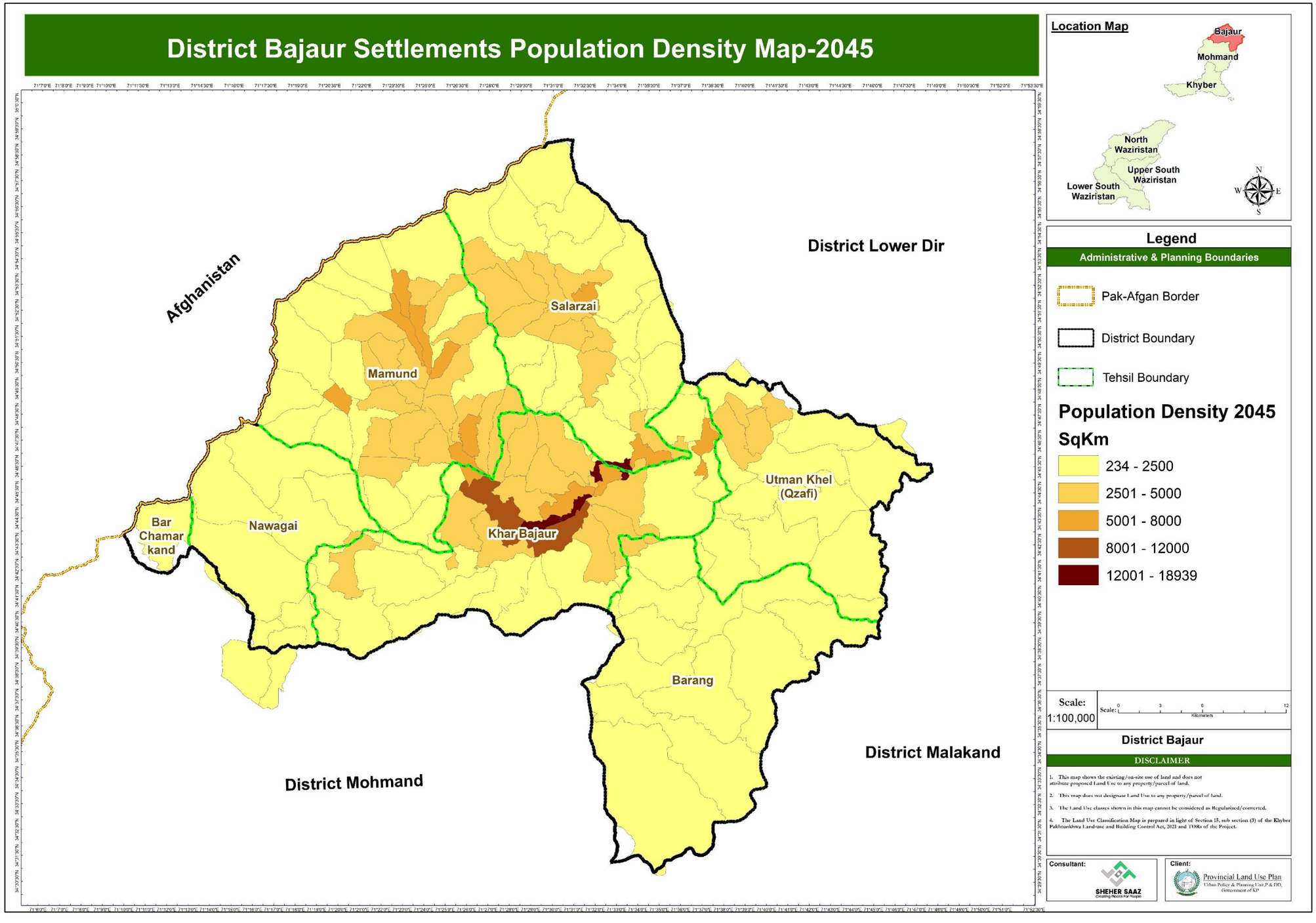


Table 6: Projected population for Urban areas and Settlements

Tehsil	Urban Settlements/Areas	Urban Settlements/Areas	2017	2023	2025	2030	2035	2040	2045
Khar Bajaur Tehsil	Urban Centre	Khar Urban Area	93,273	116,654	125,694	151,505	182,662	220,281	265,713
Mamund Tehsil	Potential Urban Centre	Mamund	21,158	25,083	26,552	30,622	35,334	40,793	47,120
Utman Khel Tehsil		Utman Khel (Gardai, Marano Shah, Swal Qilla)	26,584	31,523	33,370	38,487	44,407	51,260	59,196
Salarzai Tehsil		Lara Dandokaii	17,820	21,504	22,896	26,785	31,340	36,677	42,930
	Potential Settlements	Salarzai	16,546	19,967	21,259	24,870	29,100	34,055	39,861
Barang Tehsil		Barang	13,667	15,886	16,703	18,939	21,478	24,361	27,636
Nawagai Tehsil		Nawagai	20,206	23,285	24,421	27,533	31,076	35,116	39,726

Map 8: Population Projection 2045



3 CHAPTER III: ANALYSIS OF EXISITING LAND USE DISTRIBUTION

3.1 District Bajaur

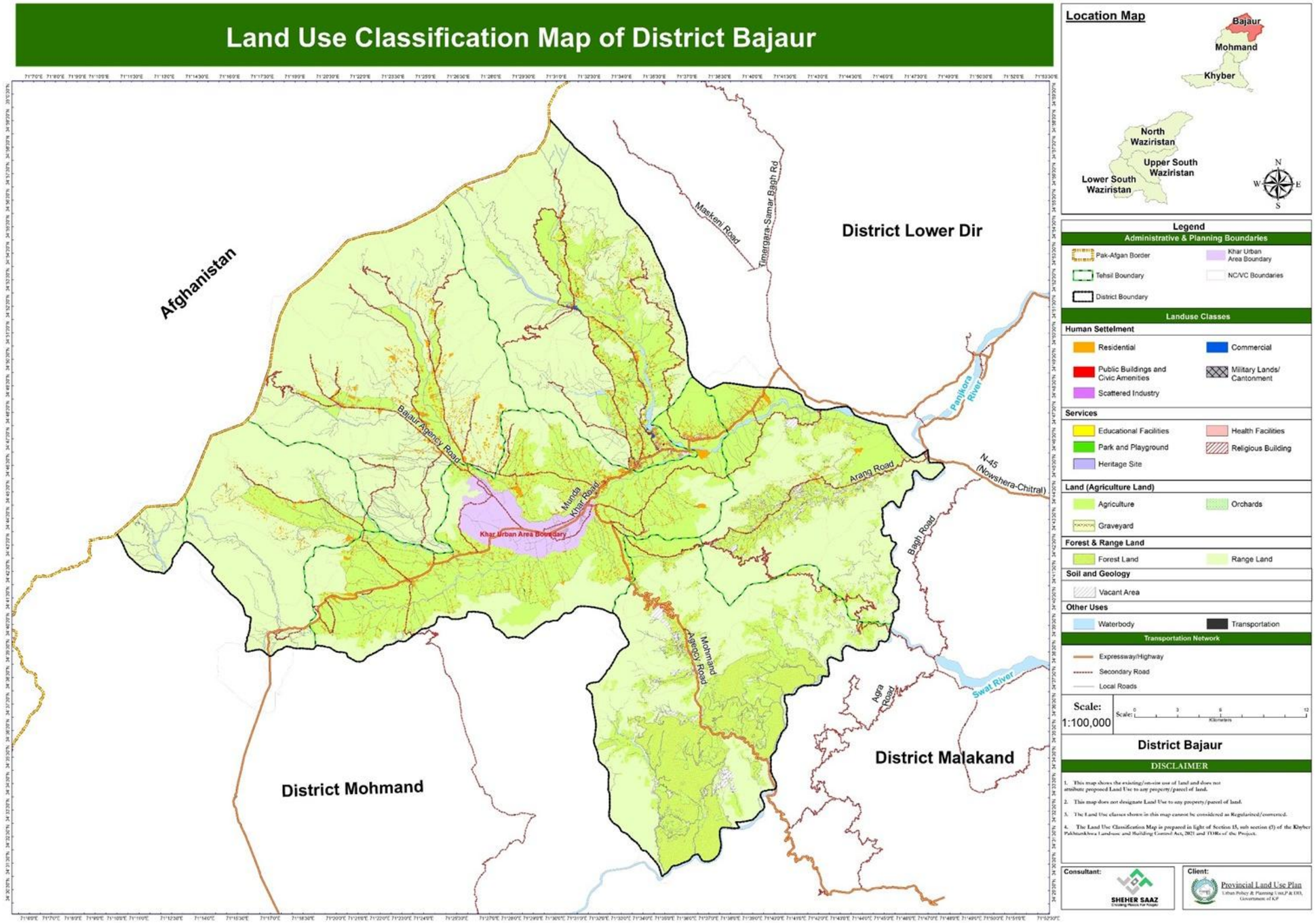
The existing land use profile indicates that the majority of the area is dominated by range land (42.7%) and agricultural land (40.8%), reflecting a predominantly rural and natural landscape with significant open and cultivable land. Forest land accounts for 7.3%, contributing to the ecological and environmental stability of the region. Urban and built-up uses such as residential (4.88%), commercial (0.17%), scattered industry (0.04%), and public and civic amenities (0.03%) occupy only a small fraction of the total area, highlighting limited urbanization. Facilities for education (0.07%), health (0.03%), and religious buildings (0.03%), along with parks and playgrounds (0.03%), are minimal, indicating limited public service infrastructure relative to the land area.

Other land uses, including graveyards (0.19%), transportation (1.06%), military lands (0.05%), mining areas (0.01%), and vacant areas (0.63%), collectively form a small portion of the land. Waterbodies, covering 1.84%, provide essential natural resources and contribute to the ecological balance. Overall, the distribution highlights that the area remains largely rural, with extensive agricultural and natural landscapes and limited urban or infrastructural development.

Table 7: Existing Land use Division of District

Existing Land Uses	Area (Acres)	Percentage %
Residential	16682.95	4.88%
Commercial	573.36	0.17%
Scattered Industry	129.87	0.04%
Public Buildings and Civic Amenities	103.25	0.03%
Religious Building	94.58	0.03%
Education Facilities	250.25	0.07%
Health Facilities	88.55	0.03%
Park and Playground	107.80	0.03%
Graveyard	642.09	0.19%
Range Land	146034.01	42.71%
Forest Land	25046.39	7.32%
Agriculture	139567.07	40.82%
Orchard	315.50	0.09%
Transportation	3634.88	1.06%
Military Lands/Cantonment	186.80	0.05%
Mining Area	47.54	0.01%
Vacant Area	2165.45	0.63%
Waterbody	6279.54	1.84%
Total	**341949.90**	100.00%

Map 9: District Bajaur Existing Land Uses Classification



3.2 Tehsil-wise

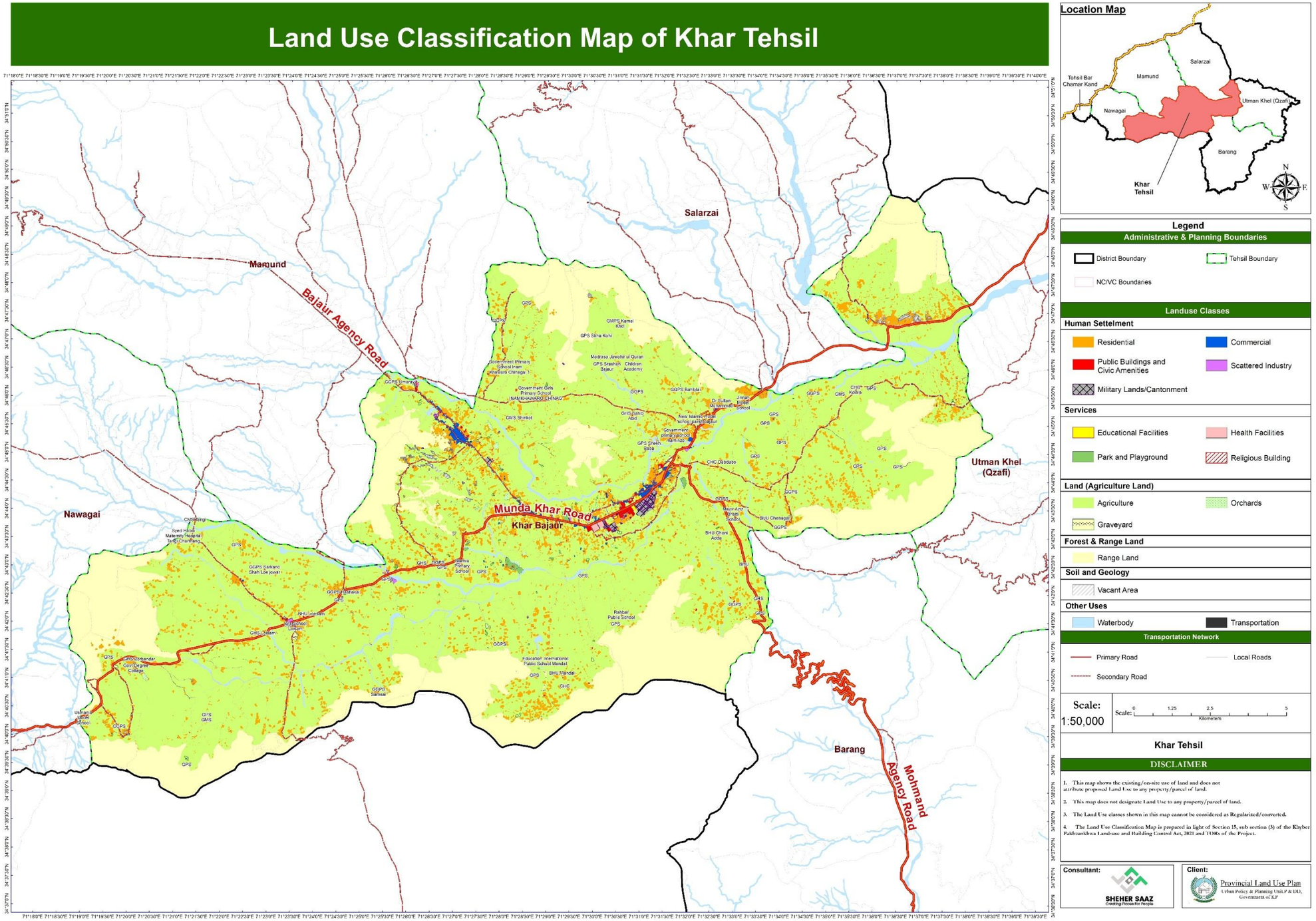
3.2.1 Tehsil Khar

The land use distribution shows that agriculture dominates the area, covering 62.2% (42,498.76 acres), followed by range land at 25.9% (17,692.15 acres), indicating that the region is largely rural and devoted to farming and grazing. Residential areas occupy 7.34% (5,012.24 acres), reflecting moderate settlement concentration relative to the total area. Other built-up uses, including commercial (0.44%), scattered industry (0.10%), public and civic buildings (0.10%), religious buildings (0.05%), education facilities (0.18%), health facilities (0.06%), and parks/playgrounds (0.10%), occupy a very small share, showing limited urban and public infrastructure. Graveyards (0.21%), orchards (0.13%), military lands (0.19%), and vacant areas (0.23%) are minor components, while transportation infrastructure (1.3%) and waterbodies (1.48%) provide essential connectivity and natural resources. Overall, the data reflects a region with a predominantly agricultural and rural character, supported by limited urban development and public amenities.

Table 8: Land use Classification of Khar Bajaur

Landuse	Area (Acres)	Percentage %
Residential	5012.24	7.34%
Commercial	298.53	0.44%
Scattered Industry	65.54	0.10%
Public Buildings and Civic Amenities	71.02	0.10%
Religious Building	32.90	0.05%
Education Facilities	123.47	0.18%
Health Facilities	41.99	0.06%
Park and Playground	68.05	0.10%
Graveyard	143.93	0.21%
Range Land	17692.15	25.90%
Agriculture	42498.76	62.20%
Orchard	85.90	0.13%
Transportation	885.96	1.30%
Military Lands/Cantonment	131.94	0.19%
Vacant Area	157.00	0.23%
Waterbody	1012.23	1.48%
Total	68321.62	100.00%

Map 10: Land use Map of Tehsil Khar Bajaur



3.2.2 Tehsil Salarzai

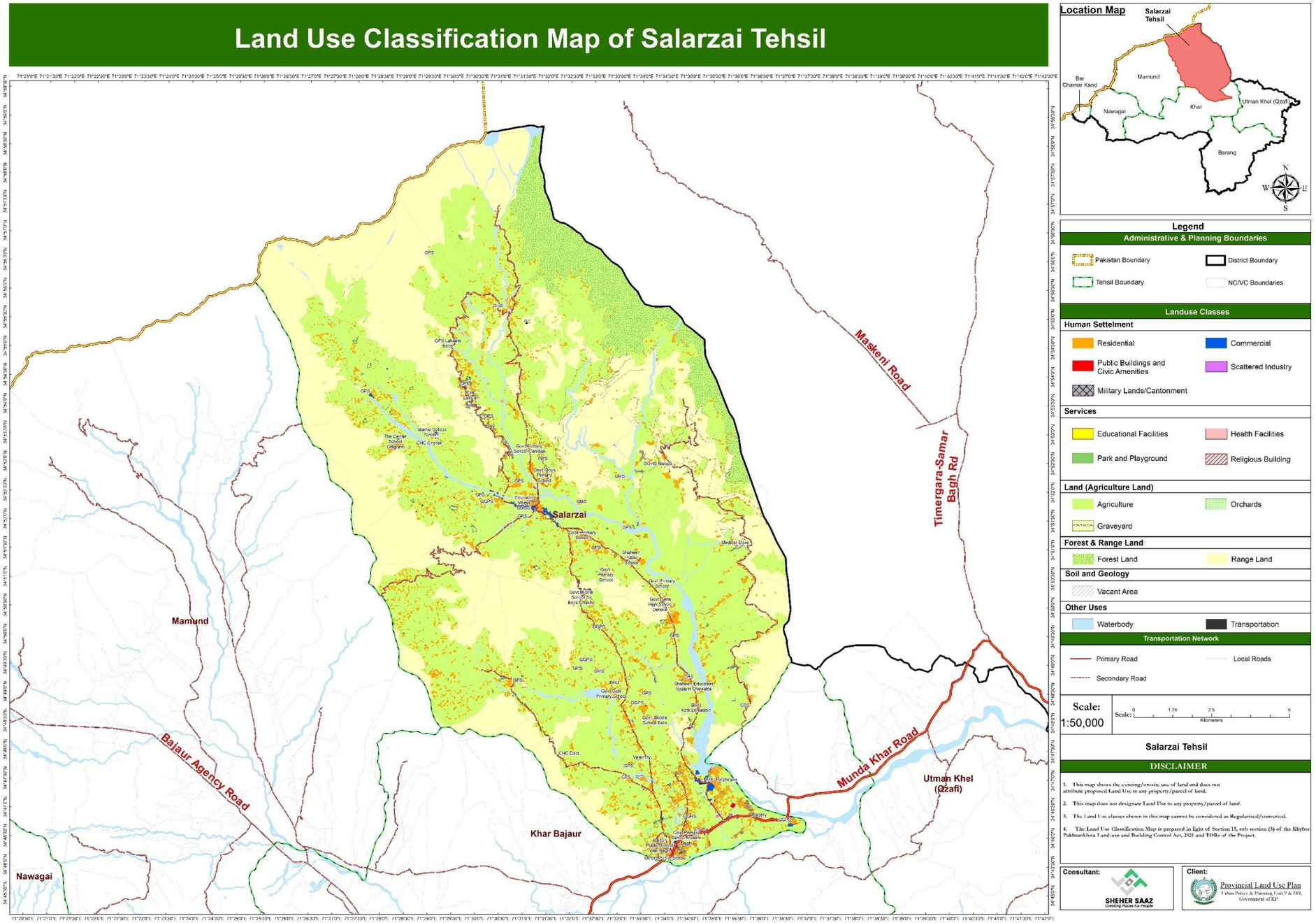
Salarzai covers a total area of 59,100.31 acres, with rangelands (21,297.74 acres, 36.04%) forming the largest share, reflecting the region's strong natural and grazing potential. Agricultural land (27,691.14 acres, 46.85%) and orchards (161.22 acres, 0.27%) indicate significant farming activity, making agriculture a key land use. Residential areas (3,503.79 acres, 5.93%) are limited, while commercial zones (147.01 acres, 0.25%) and scattered industry (24.18 acres, 0.04%) provide basic economic functions.

Waterbodies (1,607 acres, 2.72%) are crucial for local water resources and ecosystem balance. Public and civic infrastructure, including education facilities (42.83 acres, 0.07%), health services (11.48 acres, 0.02%), and public buildings (12.55 acres, 0.02%), supports essential community services. Social and cultural land uses, such as religious buildings (16.20 acres, 0.03%), graveyards (220.57 acres, 0.37%), and parks/playgrounds (7.80 acres, 0.01%), contribute to the area's societal framework. With vacant land (212.98 acres, 0.36%) and transportation networks (724.31 acres, 1.23%), Salarzai offers potential for planned development while maintaining its predominantly natural and rural character.

Table 9: Land use Classification of Salarzai

Landuse	Area (**Acres**)	Percentage %
Residential	3503.79	5.93%
Commercial	147.01	0.25%
Scattered Industry	24.18	0.04%
Public Buildings and Civic Amenities	12.55	0.02%
Religious Building	16.20	0.03%
Education Facilities	42.83	0.07%
Health Facilities	11.48	0.02%
Park and Playground	7.80	0.01%
Graveyard	220.57	0.37%
Range Land	21297.74	36.04%
Forest Land	3407.54	5.77%
Agriculture	27691.14	46.85%
Orchard	161.22	0.27%
Transportation	724.31	1.23%
Military Lands/Cantonment	11.96	0.02%
Vacant Area	212.98	0.36%
Waterbody	1607.00	2.72%
Total	59100.31	100.00%

Map 11: Land use Map of Tehsil Salarzai



3.2.3 Tehsil Bar Chamar Kand

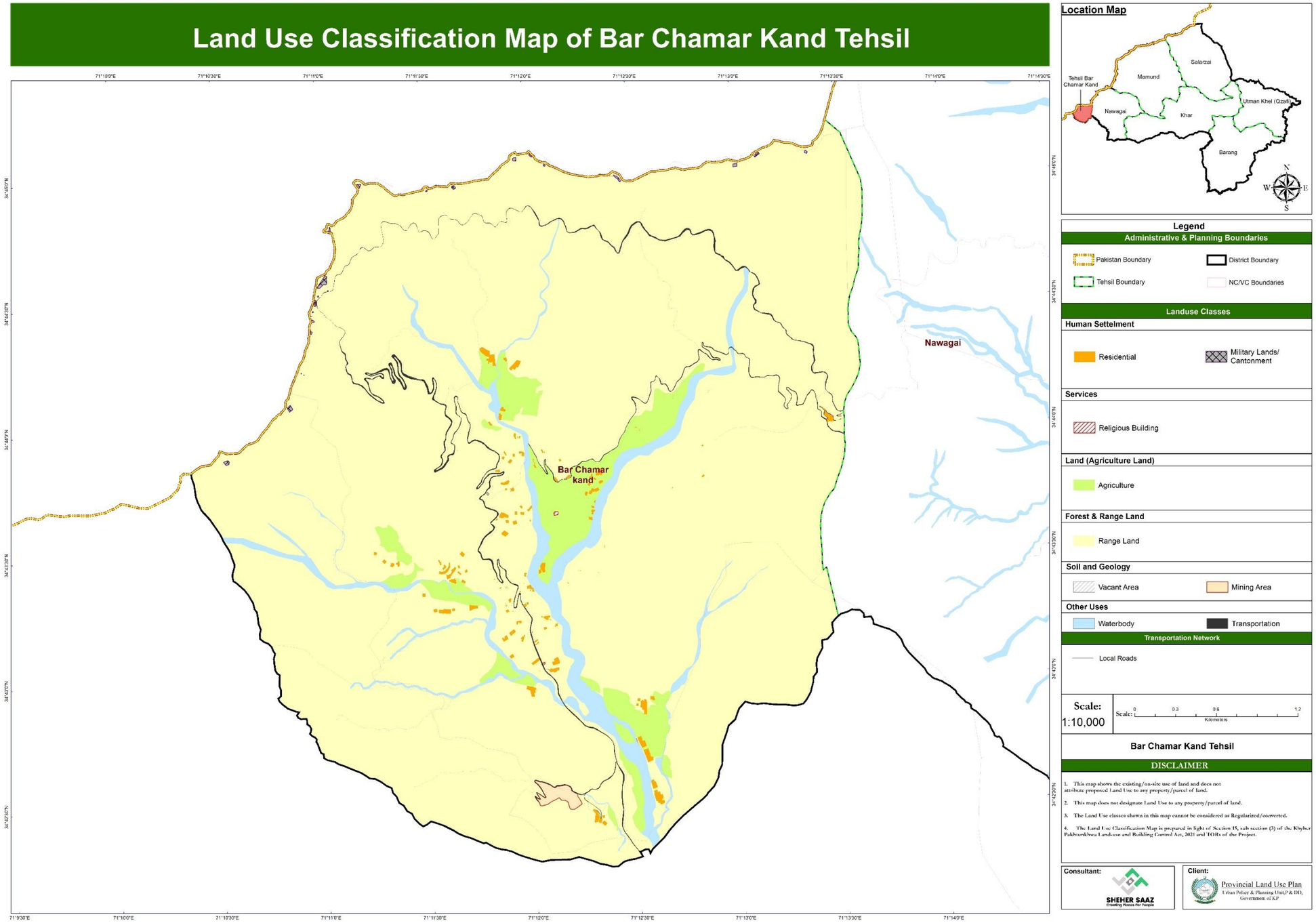
The area covers a total of 4,712.93 acres, with rangelands dominating at 4,243.50 acres (90.04%), highlighting the region's natural landscape and grazing potential. Agricultural land (210.91 acres, 4.48%) supports limited farming activities, while waterbodies (181.92 acres, 3.86%) provide essential ecosystem and water resources.

Residential areas (24.59 acres, 0.52%) and religious buildings (0.22 acres, negligible) occupy a very small portion, indicating sparse settlement. Other land uses, including transportation networks (39.99 acres, 0.85%), mining areas (8.97 acres, 0.19%), military lands (2.70 acres, 0.06%), and vacant areas (0.13 acres, negligible), form a minor part of the landscape. Overall, the land use pattern reflects a predominantly natural and rural environment, with very limited urban or infrastructural development.

Table 10: Land use Classification of Bar Chamar Kand Tehsil

Landuse	Area (Acres)	Percentage %
Residential	24.59	0.52%
Religious Building	0.22	0.00%
Agriculture	210.91	4.48%
Mining Area	8.97	0.19%
Range Land	4243.50	90.04%
Transportation	39.99	0.85%
Military Lands/Cantonment	2.70	0.06%
Vacant Area	0.13	0.00%
Waterbody	181.92	3.86%
Total	4712.93	100.00%

Map 12: Land use Map of Bar Chamar Kand Tehsil



3.2.4 Tehsil Barang

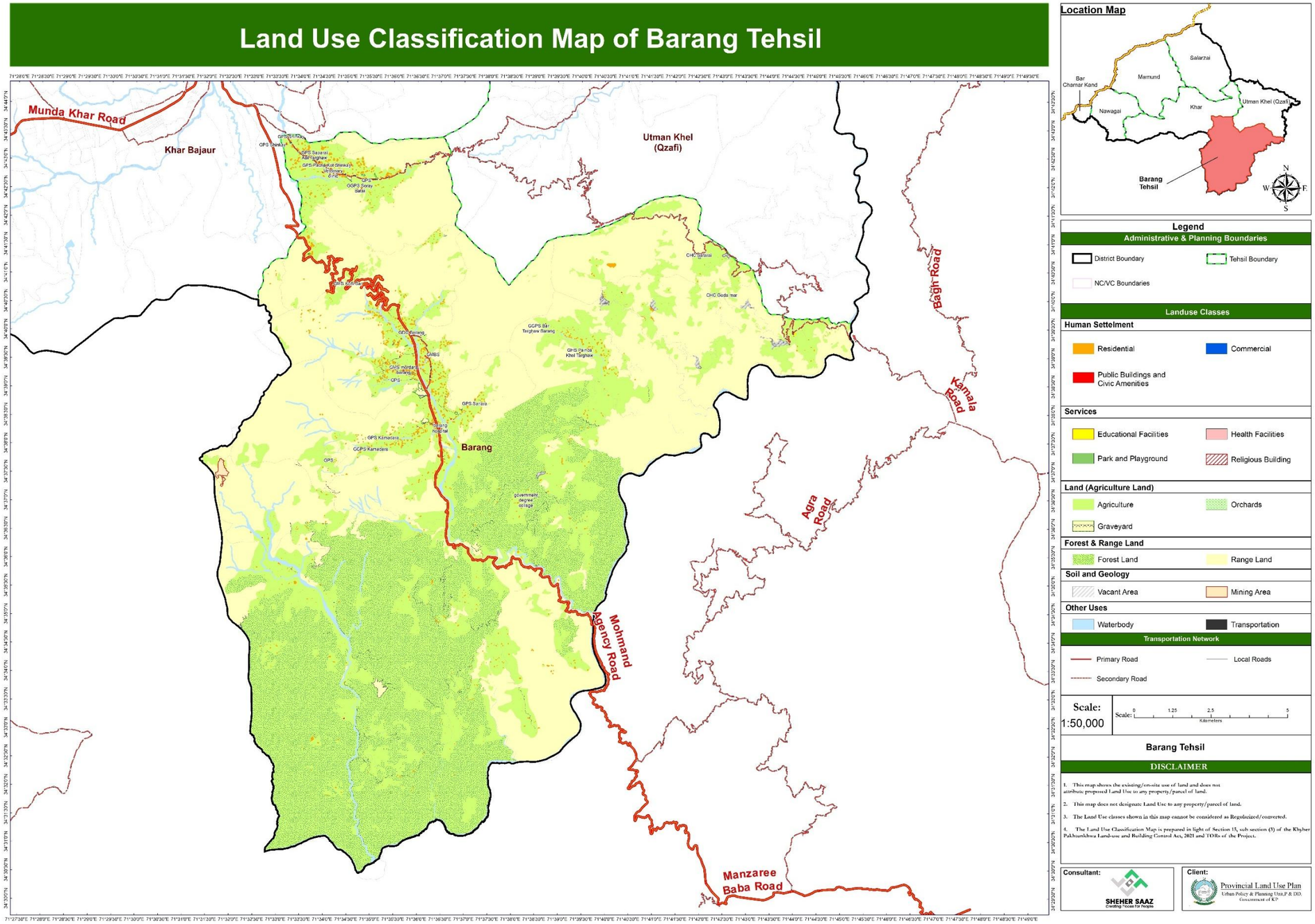
Barang Tehsil covers a total area of 66,919.16 acres, with range land (30,312.81 acres, 45.3%) forming the largest share, reflecting the region's extensive natural and grazing areas. Agricultural land (13,997.46 acres, 20.92%) and forest land (19,894.78 acres, 29.73%) highlight the importance of farming and forestry in the local economy and ecological balance. Residential areas (976.63 acres, 1.46%) are limited, while commercial zones (5.58 acres, 0.01%), public and civic buildings (1.20 acres, 0.00%), education facilities (15.81 acres, 0.02%), health services (6.09 acres, 0.01%), and religious buildings (1.42 acres, 0.00%) occupy very small portions, indicating minimal urban infrastructure.

Graveyards (53.73 acres, 0.08%), orchards (0.61 acres, 0.00%), and vacant land (118.21 acres, 0.18%) contribute minor components, while transportation networks (472.47 acres, 0.71%), mining areas (38.57 acres, 0.06%), and waterbodies (1,023.79 acres, 1.53%) provide essential connectivity and natural resources. Overall, Barang Tehsil exhibits a predominantly rural and natural landscape, with agriculture, forestry, and rangelands forming the backbone of land use, and limited urban or civic development.

Table 11: Land use Classification of Barang Tehsil

Landuse	Area (Acres)	Percentage %
Residential	976.63	1.46%
Commercial	5.58	0.01%
Public Buildings and Civic Amenities	1.20	0.00%
Religious Building	1.42	0.00%
Education Facilities	15.81	0.02%
Health Facilities	6.09	0.01%
Graveyard	53.73	0.08%
Orchard	0.61	0.00%
Agriculture	13997.46	20.92%
Range Land	30312.81	45.30%
Forest Land	19894.78	29.73%
Transportation	472.47	0.71%
Mining Area	38.57	0.06%
Vacant Area	118.21	0.18%
Waterbody	1023.79	1.53%
Total	66919.16	100.00%

Map 13: Land use Map of Barang Tehsil



3.2.5 Tehsil Mamund

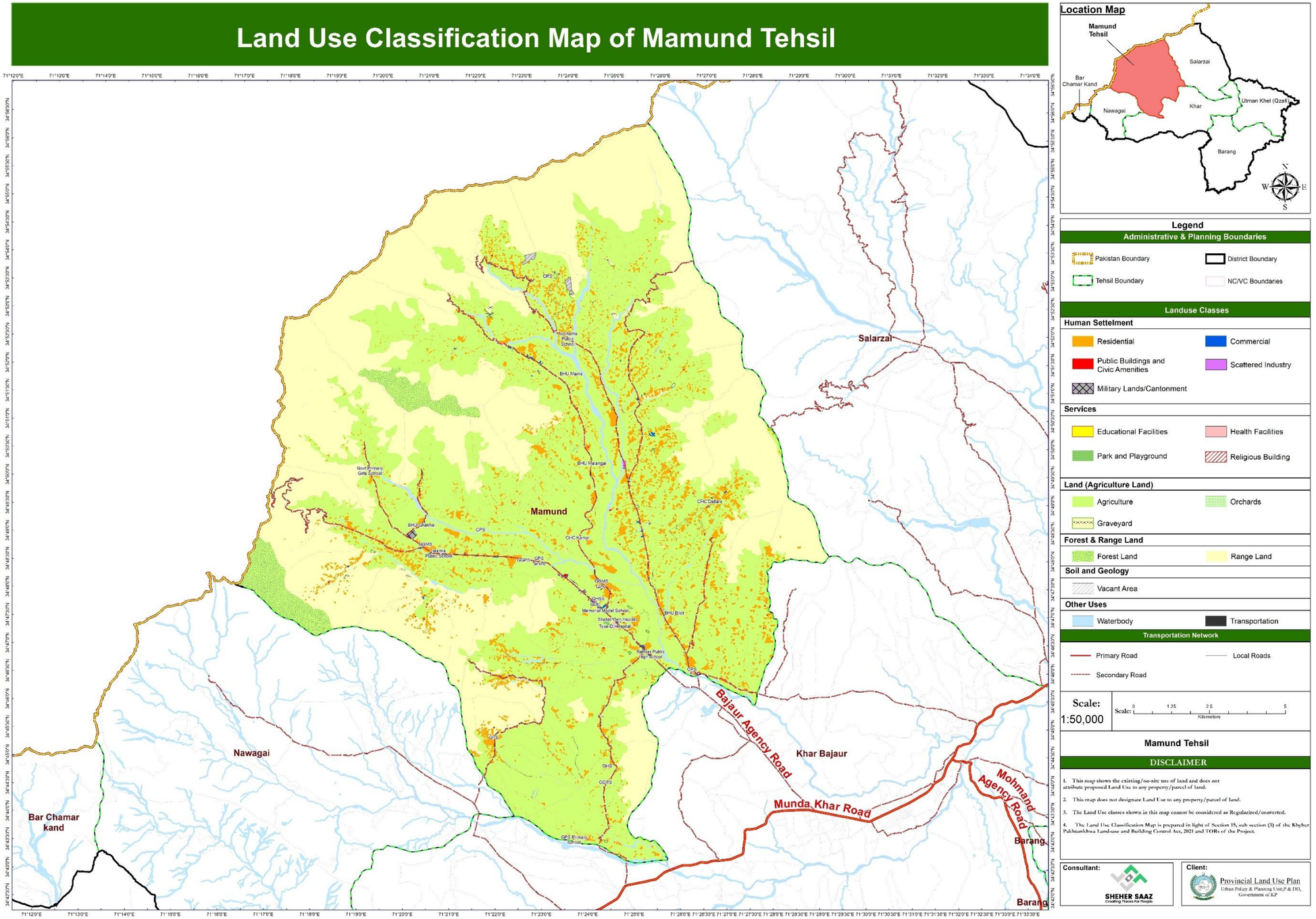
Mamund Tehsil covers a total area of 67,272.79 acres, with agriculture (31,777.08 acres, 47.24%) and range land (27,580.88 acres, 41%) dominating the landscape, highlighting the region's dual focus on farming and grazing. Residential areas (4,790.22 acres, 7.12%) form a modest portion, while commercial zones (52.83 acres, 0.08%), scattered industry (12.02 acres, 0.02%), public buildings (2.47 acres, 0.00%), education facilities (35.04 acres, 0.05%), health services (20.58 acres, 0.03%), and religious buildings (18.51 acres, 0.03%) occupy minimal land, reflecting limited urban and civic infrastructure.

Forest land (1,445.38 acres, 2.15%), orchards (39.58 acres, 0.06%), parks/playgrounds (8.52 acres, 0.01%), and graveyards (117.51 acres, 0.17%) provide minor ecological and social components. Waterbodies (819.14 acres, 1.22%), transportation networks (496.92 acres, 0.74%), military lands (18.15 acres, 0.03%), and vacant areas (37.95 acres, 0.06%) support connectivity, security, and future development. Overall, Mamund is a predominantly agricultural and rural tehsil, with extensive rangelands and limited urban development.

Table 12: Land use Classification of Mamund

Landuse	Area (Acres)	Percentage %
Residential	4790.22	7.12%
Commercial	52.83	0.08%
Scattered Industry	12.02	0.02%
Public Buildings and Civic Amenities	2.47	0.00%
Religious Building	18.51	0.03%
Education Facilities	35.04	0.05%
Health Facilities	20.58	0.03%
Park and Playground	8.52	0.01%
Graveyard	117.51	0.17%
Agriculture	31777.08	47.24%
Range Land	27580.88	41.00%
Forest Land	1445.38	2.15%
Orchard	39.58	0.06%
Transportation	496.92	0.74%
Military Lands/Cantonment	18.15	0.03%
Vacant Area	37.95	0.06%
Waterbody	819.14	1.22%
Total	67272.79	100.00%

Map 14: Land use Map of Tehsil Mamund



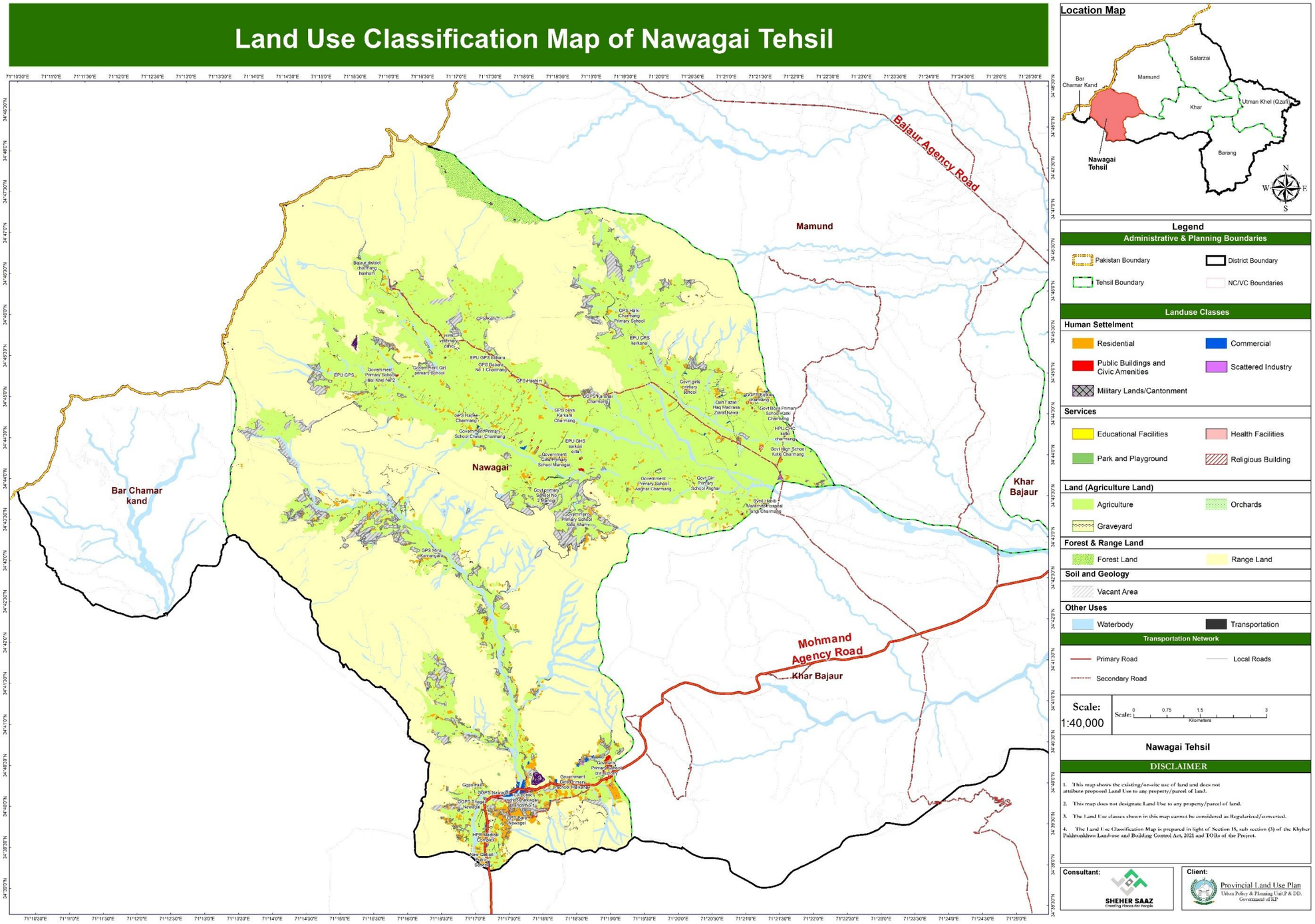
3.2.6 Tehsil Nawagai

Nawagai Tehsil covers a total area of 32,343.35 acres, with range land (18,844.03 acres, 58.26%) and agricultural land (9,224.94 acres, 28.52%) dominating the landscape, indicating the region's strong natural grazing potential alongside significant farming activities. Residential areas (844.92 acres, 2.61%) are limited, while commercial zones (57.31 acres, 0.18%), scattered industry (26.37 acres, 0.08%), public buildings (16.01 acres, 0.05%), education facilities (24.61 acres, 0.08%), health services (6.02 acres, 0.02%), and religious buildings (21.13 acres, 0.07%) occupy very small portions, reflecting minimal urban infrastructure. Forest land (298.69 acres, 0.92%) and orchards (20.56 acres, 0.06%) contribute minor ecological resources, while parks and playgrounds (7.97 acres, 0.02%) and graveyards (75.90 acres, 0.23%) serve social and cultural functions. Waterbodies (1,043.04 acres, 3.22%), transportation networks (575.18 acres, 1.78%), military lands (22.05 acres, 0.07%), and vacant areas (1,234.63 acres, 3.82%) provide essential connectivity, natural resources, and development potential. Overall, Nawagai exhibits a predominantly rural and natural landscape, with agriculture and rangelands forming the backbone of land use and limited urban development.

Table 13: Land use Classification of Nawagai

Landuse	Area (Acres)	Percentage %
Residential	844.92	2.61%
Commercial	57.31	0.18%
Scattered Industry	26.37	0.08%
Public Buildings and Civic Amenities	16.01	0.05%
Religious Building	21.13	0.07%
Education Facilities	24.61	0.08%
Health Facilities	6.02	0.02%
Park and Playground	7.97	0.02%
Graveyard	75.90	0.23%
Agriculture	9224.94	28.52%
Range Land	18844.03	58.26%
Forest Land	298.69	0.92%
Orchard	20.56	0.06%
Transportation	575.18	1.78%
Military Lands/Cantonment	22.05	0.07%
Vacant Area	1234.63	3.82%
Waterbody	1043.04	3.22%
Total	32343.35	100.00%

Map 15: Land use Map of Tehsil Nawagai



3.2.7 Tehsil Utman Khel

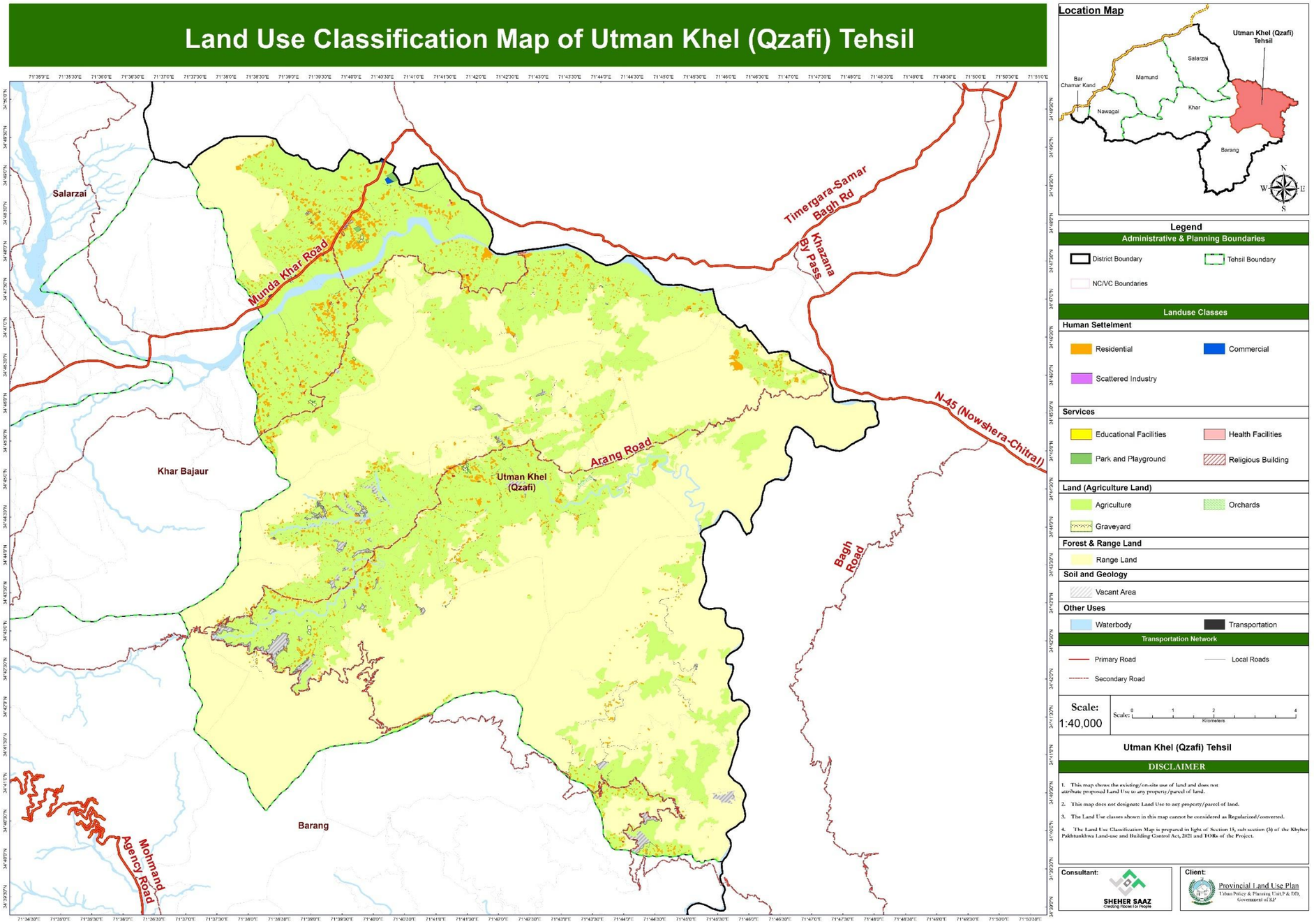
Utman Khel Tehsil covers a total area of 43,279.74 acres, with range land (26,062.91 acres, 60.22%) dominating the landscape, highlighting the region's natural grazing potential. Agricultural land (14,166.78 acres, 32.73%) represents a significant portion, indicating active farming in the area. Residential areas (1,530.55 acres, 3.54%) are relatively small, while commercial zones (12.10 acres, 0.03%), scattered industry (1.75 acres, negligible), religious buildings (4.21 acres, 0.01%), education facilities (8.50 acres, 0.02%), and health services (2.39 acres, 0.01%) occupy very minor shares, reflecting limited urban and civic infrastructure. Social and recreational land uses, including parks/playgrounds (15.46 acres, 0.04%) and graveyards (30.46 acres, 0.07%), form a small component.

Waterbodies (592.41 acres, 1.37%), transportation networks (440.05 acres, 1.02%), vacant areas (404.54 acres, 0.93%), and orchards (7.63 acres, 0.02%) contribute to connectivity, future development potential, and minor ecological resources. Overall, Utman Khel exhibits a predominantly rural and natural landscape, with agriculture and rangelands as the primary land uses and limited urban development.

Table 14: Land use Classification of Utman Khel

Landuse	Area (Acres)	Percentage %
Residential	1530.55	3.54%
Commercial	12.10	0.03%
Scattered Industry	1.75	0.00%
Religious Building	4.21	0.01%
Education Facilities	8.50	0.02%
Health Facilities	2.39	0.01%
Park and Playground	15.46	0.04%
Graveyard	30.46	0.07%
Agriculture	14166.78	32.73%
Range Land	26062.91	60.22%
Orchard	7.63	0.02%
Transportation	440.05	1.02%
Vacant Area	404.54	0.93%
Waterbody	592.41	1.37%
Total	43279.74	100.00%

Map 16: Land use Map - Tehsil Utman Khel



3.3 Urban Centers

3.3.1 Khar Bajaur

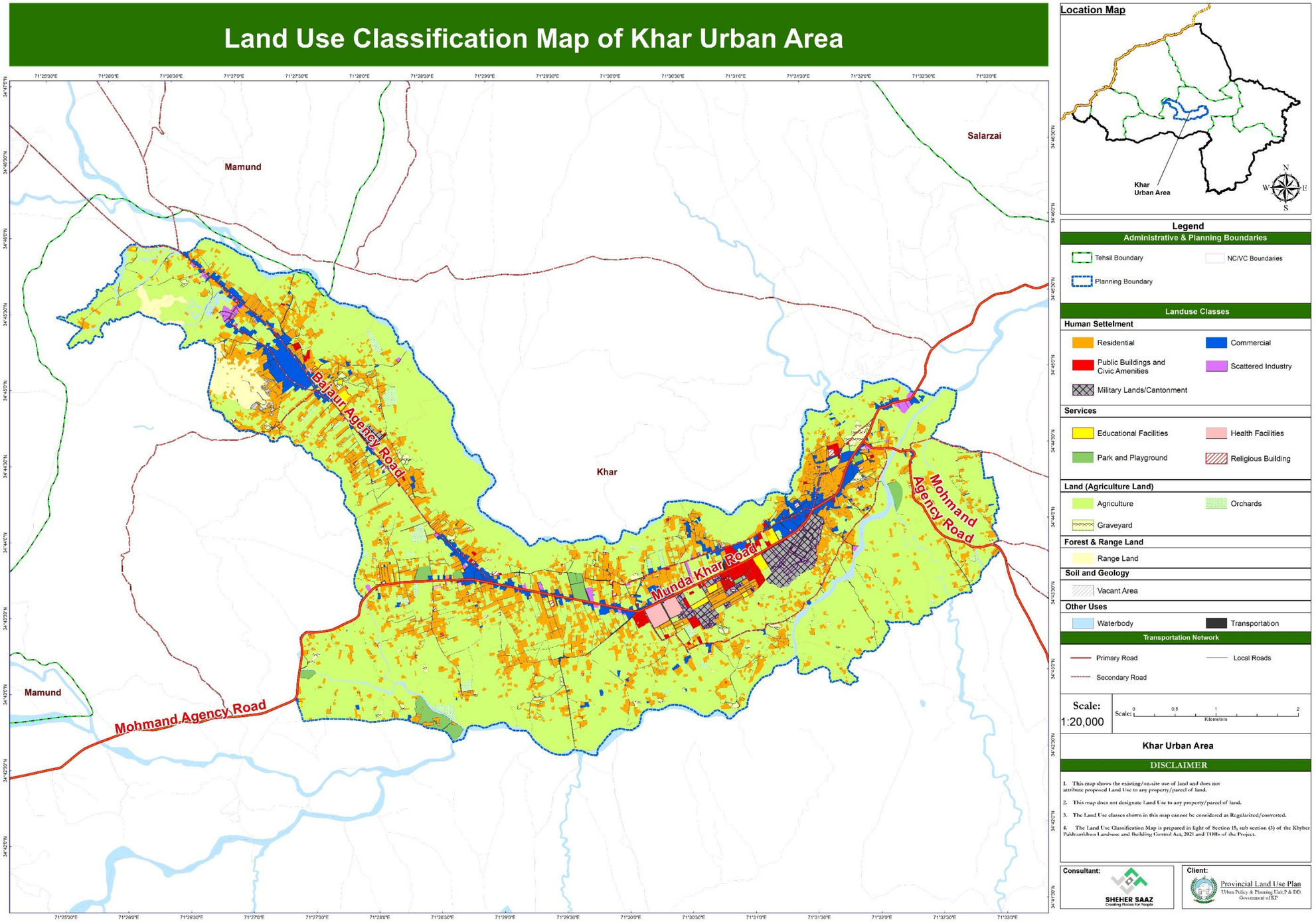
Khar, covering 6,939.23 acres, is primarily an urbanized area, with residential land (1,245.17 acres, 17.94%) forming a significant share alongside agriculture (4,312.09 acres, 62.14%), which mainly exists on the outskirts or peri-urban zones. Commercial areas (273.65 acres, 3.94%), transportation networks (295.53 acres, 4.26%), and public and civic buildings (65.19 acres, 0.94%) reflect the town's developed urban infrastructure, supporting economic and social activities. Other urban services, including education facilities (47.71 acres, 0.69%), health services (30.21 acres, 0.44%), religious buildings (26.04 acres, 0.38%), parks and playgrounds (67.66 acres, 0.98%), and graveyards (62.25 acres, 0.90%), ensure basic civic amenities and community services.

Range land (101.49 acres, 1.46%), orchards (63.46 acres, 0.91%), military lands (129.60 acres, 1.87%), and waterbodies (175.69 acres, 2.53%) occupy minor portions. Overall, Khar represents a densely settled urban center within Bajaur, where urban residential, commercial, and civic functions dominate, while agriculture and peri-urban open spaces support the surrounding hinterland.

Table 15: Existing Land use distribution of Khar Bajaur

Existing Land Use	Area (Acres)	Percentage %
Residential	1245.17	17.94%
Commercial	273.65	3.94%
Scattered Industry	33.91	0.49%
Public Buildings and Civic Amenities	65.19	0.94%
Religious Building	26.04	0.38%
Education Facilities	47.71	0.69%
Health Facilities	30.21	0.44%
Park and Playground	67.66	0.98%
Graveyard	62.25	0.90%
Range Land	101.49	1.46%
Orchard	63.46	0.91%
Agriculture	4312.09	62.14%
Transportation	295.53	4.26%
Military Lands/Cantonment	129.60	1.87%
Vacant Area	9.56	0.14%
Waterbody	175.69	2.53%
Total	6939.23	100.00%

Map 17: Land use Classification Khar Bajaur Urban Area



3.4 Potential Urban Centre

3.4.1 Mamund

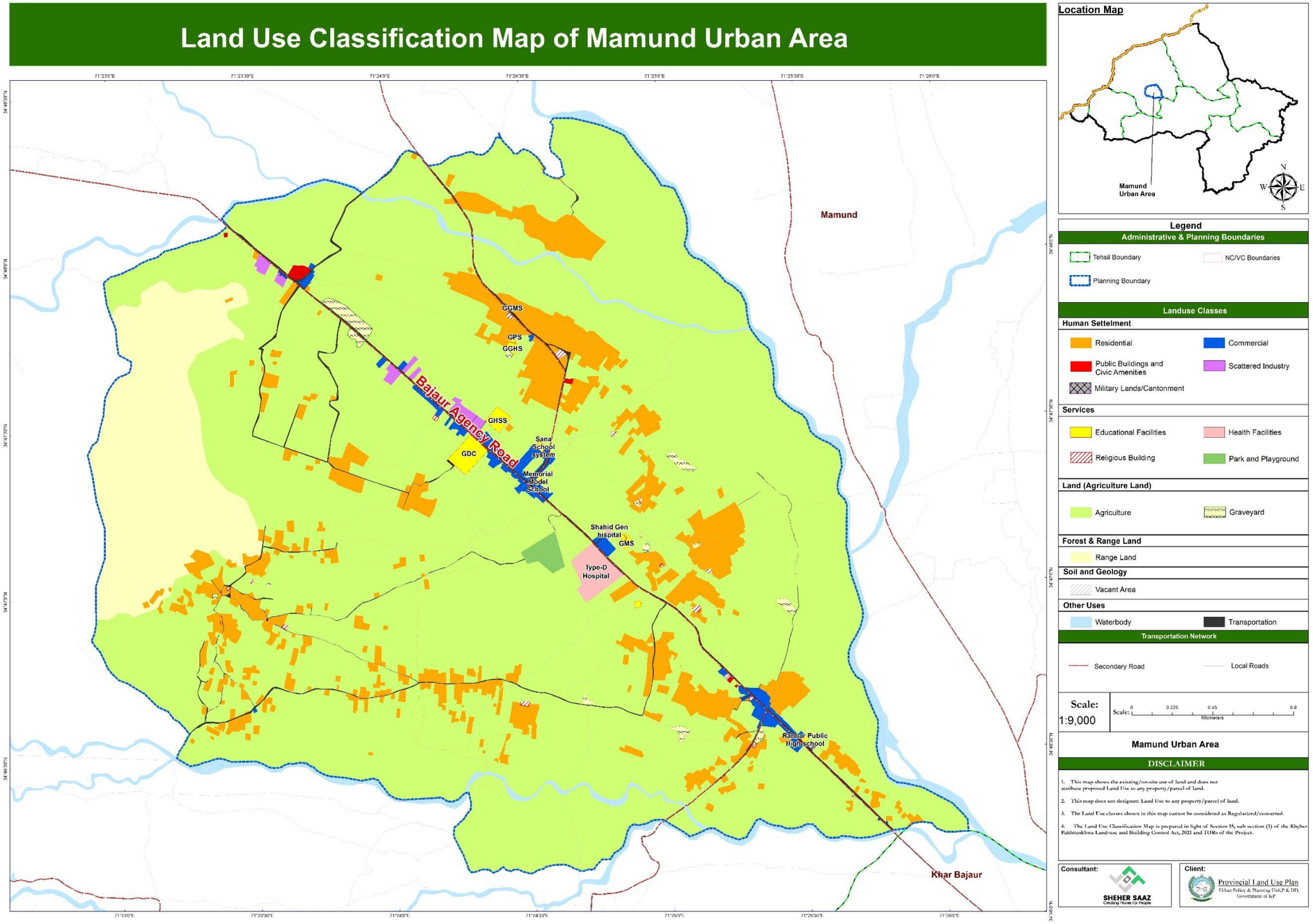
Mamund's potential urban center covers 3,357.88 acres, with agriculture (2,580.31 acres, 76.84%) still dominating the land, reflecting that the urban area is surrounded by farming land. Residential areas (394.31 acres, 11.74%) form the main built-up component, indicating a concentrated settlement base. Commercial land (3.78 acres, 0.11%), public and civic buildings (1.96 acres, 0.06%), education facilities (12.24 acres, 0.36%), health services (13.47 acres, 0.40%), religious buildings (1.01 acres, 0.03%), parks/playgrounds (7.54 acres, 0.22%), and graveyards (8.89 acres, 0.26%) provide basic urban infrastructure and civic amenities, though at a relatively small scale.

Range land (269.71 acres, 8.03%), transportation networks (43.46 acres, 1.29%), waterbodies (20.88 acres, 0.62%), and military lands (0.33 acres, 0.01%) occupy minor portions. Overall, this area shows the characteristics of a small but developing urban center, where residential settlement is growing, supported by essential civic and social infrastructure, yet still embedded within a largely agricultural and rural landscape.

Table 16: Existing Land use distribution of Mamund

Existing Land Use	Area (Acres)	Percentage %
Residential	394.31	11.74%
Commercial	3.78	0.11%
Public Buildings and Civic Amenities	1.96	0.06%
Religious Building	1.01	0.03%
Education Facilities	12.24	0.36%
Health Facilities	13.47	0.40%
Park and Playground	7.54	0.22%
Graveyard	8.89	0.26%
Agriculture	2580.31	76.84%
Range Land	269.71	8.03%
Military Lands/Cantonment	0.33	0.01%
Transportation	43.46	1.29%
Waterbody	20.88	0.62%
Total	3357.88	100.00%

Map 18: Land use Classification Map of Mamund



3.4.2 Nawagai

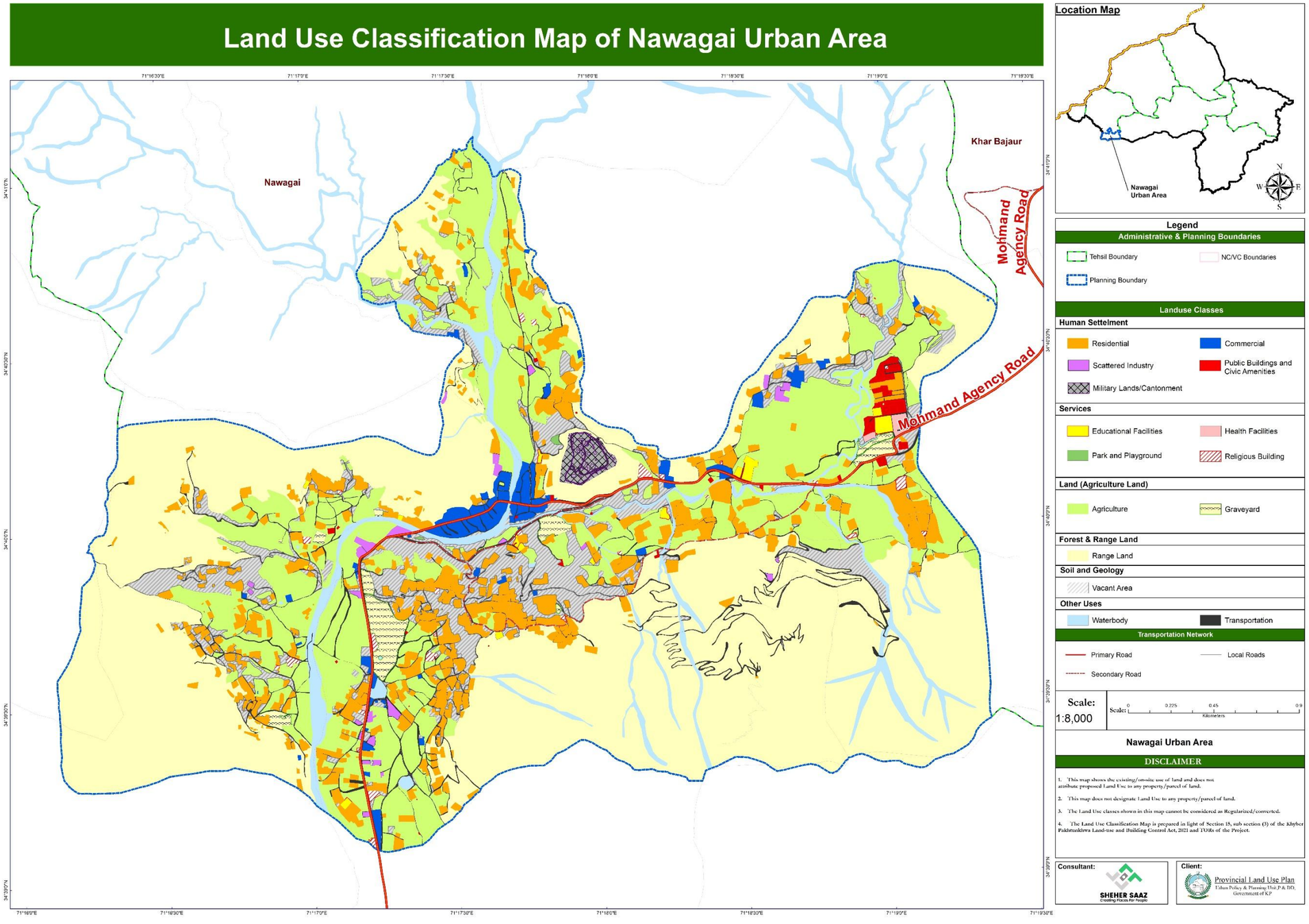
Nawagai's potential urban center covers 2,562.20 acres, with range land (1,217.41 acres, 47.51%) and agriculture (577.53 acres, 22.54%) still forming a significant portion of the area, reflecting its peri-urban and rural surroundings. Residential land (246.67 acres, 9.63%) represents the main built-up component, supported by commercial areas (37.54 acres, 1.46%) and scattered industry (11.25 acres, 0.44%), indicating the beginnings of urban economic activity. Essential civic infrastructure, including public buildings (10.32 acres, 0.40%), education facilities (7.87 acres, 0.31%), health services (2.76 acres, 0.11%), religious buildings (8.10 acres, 0.32%), parks/playgrounds (0.58 acres, 0.02%), and graveyards (28.17 acres, 1.10%), provides basic urban services.

Transportation networks (110.37 acres, 4.31%), vacant land (197.93 acres, 7.73%), waterbodies (93.34 acres, 3.64%), and military lands (12.34 acres, 0.48%) contribute to connectivity, development potential, and resource management. Overall, Nawagai exhibits the characteristics of a small but emerging urban center, where residential and commercial development is growing within a largely rural and agricultural landscape.

Table 17: Existing Land use distribution of Nawagai

Existing Land Use	Area (Acres)	Percentage %
Residential	246.67	9.63%
Commercial	37.54	1.46%
Scattered Industry	11.25	0.44%
Public Buildings and Civic Amenities	10.32	0.40%
Religious Building	8.10	0.32%
Education Facilities	7.87	0.31%
Health Facilities	2.76	0.11%
Park and Playground	0.58	0.02%
Graveyard	28.17	1.10%
Range Land	1217.41	47.51%
Agriculture	577.53	22.54%
Transportation	110.37	4.31%
Military Lands/Cantonment	12.34	0.48%
Vacant Area	197.93	7.73%
Waterbody	93.34	3.64%
Total	2562.20	100.00%

Map 19: Land use Classification Map of Nawagai



3.4.3 Lara Dandokaii

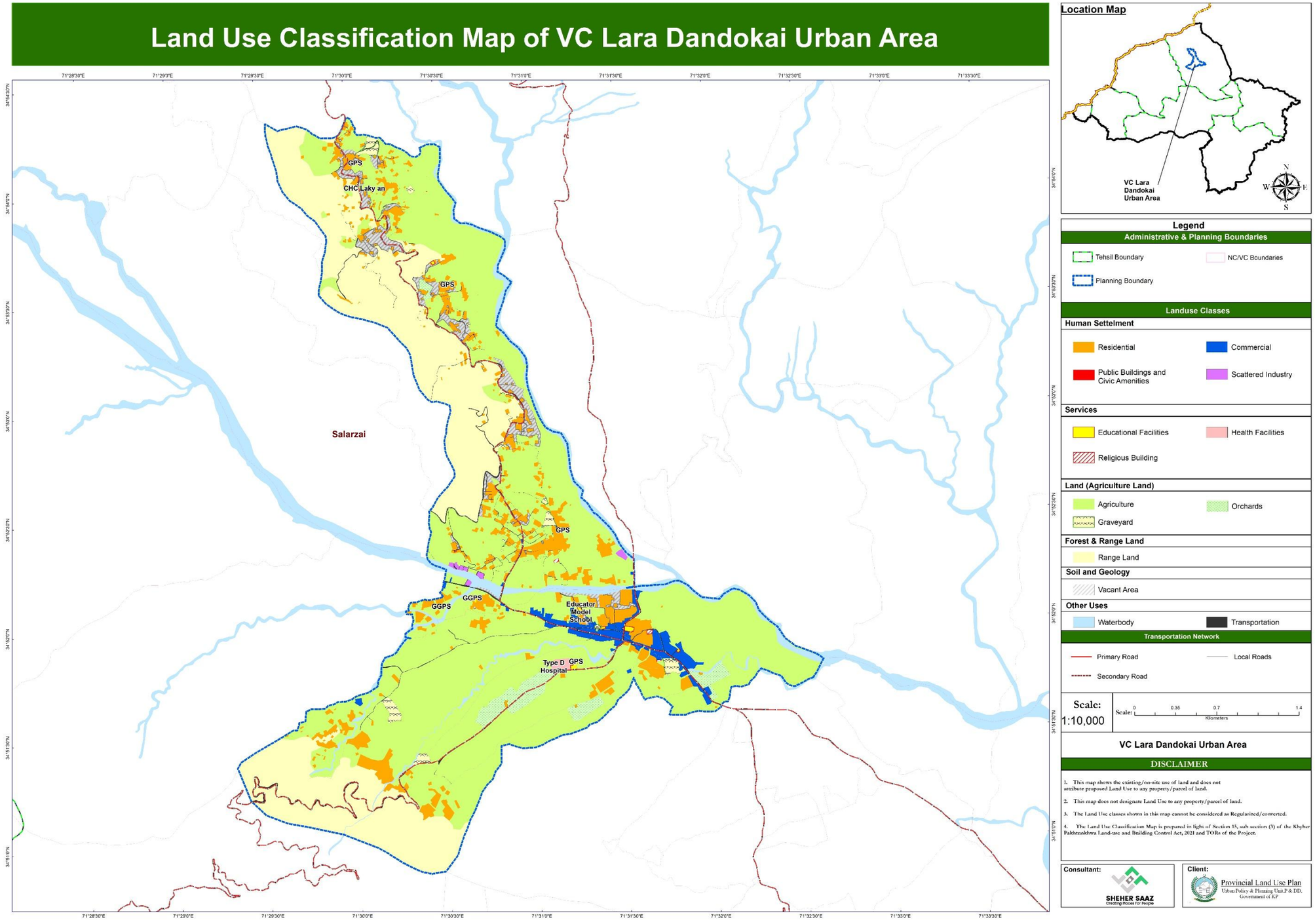
Lara Dandokaii covers a total area of 2,601.91 acres, with agriculture (1,388.72 acres, 53.37%) and range land (663.04 acres, 25.48%) forming the majority of land use, highlighting the area's strong rural and farming character. Residential areas (216.56 acres, 8.32%) and commercial zones (48.00 acres, 1.84%) indicate a modest level of urban settlement and economic activity. Scattered industry (4.33 acres, 0.17%), public buildings (0.03 acres, negligible), education facilities (3.64 acres, 0.14%), health services (4.52 acres, 0.17%), and religious buildings (1.29 acres, 0.05%) occupy minimal portions, reflecting limited civic infrastructure.

Graveyards (22.16 acres, 0.85%), orchards (48.22 acres, 1.85%), and vacant areas (61.82 acres, 2.38%) serve social, ecological, and development functions, while transportation networks (59.34 acres, 2.28%) and waterbodies (80.24 acres, 3.08%) provide connectivity and natural resource support. Overall, Lara Dandokaii exhibits a predominantly rural and agricultural landscape, with small clusters of residential and commercial development and potential for controlled growth.

Table 18: Existing Land use distribution of Lara Dandokaii

Existing Land Use	Area (Acres)	Percentage %
Residential	216.56	8.32%
Commercial	48.00	1.84%
Scattered Industry	4.33	0.17%
Public Buildings and Civic Amenities	0.03	0.00%
Religious Building	1.29	0.05%
Education Facilities	3.64	0.14%
Health Facilities	4.52	0.17%
Graveyard	22.16	0.85%
Range Land	663.04	25.48%
Agriculture	1388.72	53.37%
Orchard	48.22	1.85%
Transportation	59.34	2.28%
Vacant Area	61.82	2.38%
Waterbody	80.24	3.08%
Total	2601.91	100.00%

Map 20: Land use Classification Map of Lara Dandokaii



3.5 Potential Urban Settlements/Areas

3.5.1 Salarzai

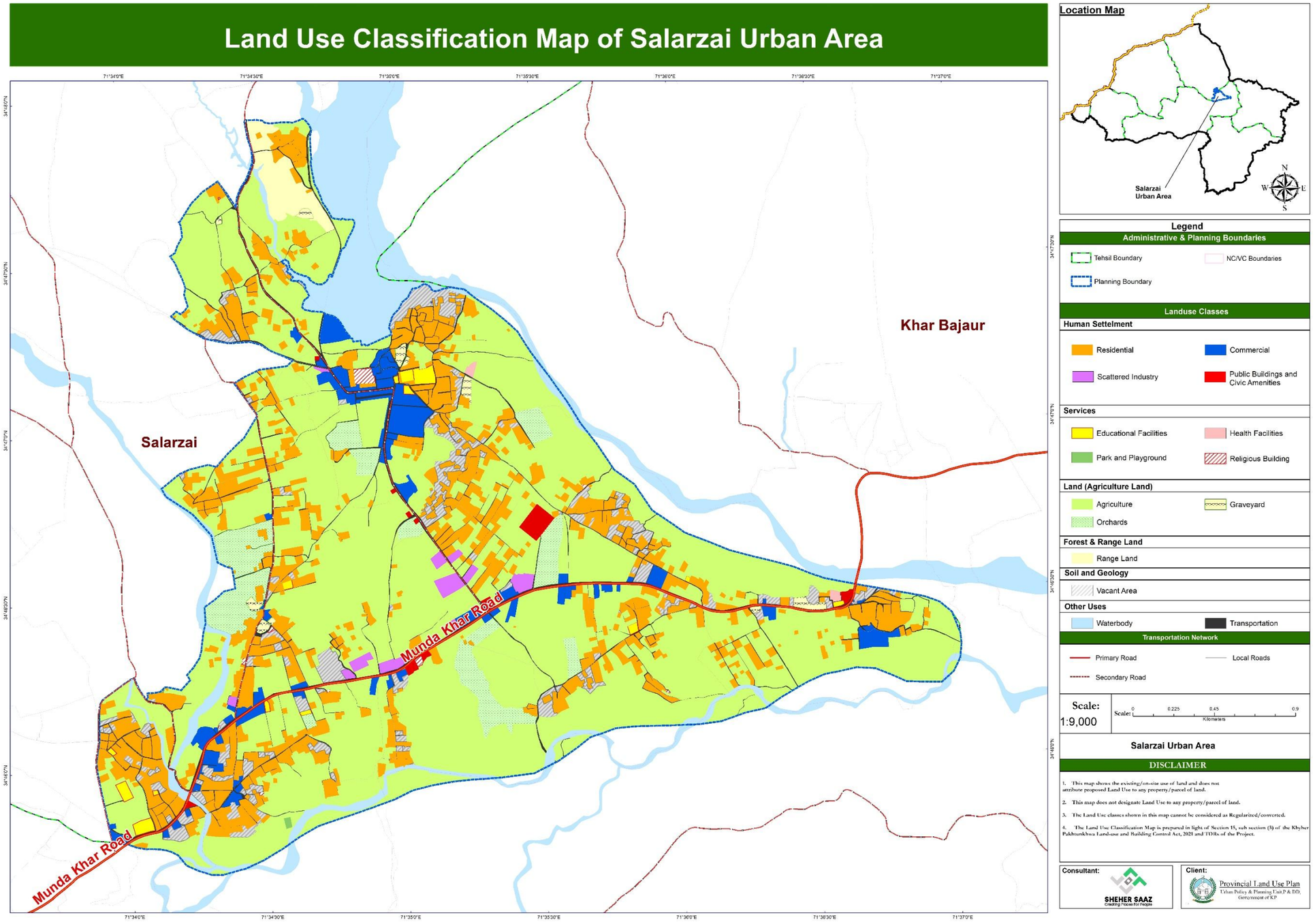
Salarzai's area covers 2,075.62 acres, with agriculture (1,243.70 acres, 59.92%) and residential areas (376.74 acres, 18.15%) dominating the land use, reflecting a mix of rural and emerging urban settlement patterns. Commercial zones (71.62 acres, 3.45%), transportation networks (95.20 acres, 4.59%), and orchards (88.90 acres, 4.28%) indicate economic activity and connectivity within the area. Essential civic infrastructure, including education facilities (10.91 acres, 0.53%), health services (1.80 acres, 0.09%), public buildings (9.02 acres, 0.43%), religious buildings (3.62 acres, 0.17%), and parks/playgrounds (0.55 acres, 0.03%), occupies a small share, supporting the community.

Scattered industry (15.68 acres, 0.76%), graveyards (9.86 acres, 0.47%), vacant land (82.80 acres, 3.99%), waterbodies (39.32 acres, 1.89%), and range land (25.90 acres, 1.25%) form minor components. Overall, Salarzai represents a predominantly agricultural landscape with a growing residential base, supported by modest commercial and civic infrastructure, showing potential for further urban development.

Table 19: Existing Land use distribution of Salarzai

Existing Land Use	Area (Acres)	Percentage %
Residential	376.74	18.15%
Commercial	71.62	3.45%
Scattered Industry	15.68	0.76%
Public Buildings and Civic Amenities	9.02	0.43%
Religious Building	3.62	0.17%
Education Facilities	10.91	0.53%
Health Facilities	1.80	0.09%
Park and Playground	0.55	0.03%
Graveyard	9.86	0.47%
Range Land	25.90	1.25%
Agriculture	1243.70	59.92%
Orchard	88.90	4.28%
Transportation	95.20	4.59%
Vacant Area	82.80	3.99%
Waterbody	39.32	1.89%
Total	2075.62	100.00%

Map 21: Land use Classification Map of Salarzai



3.5.2 Gardai Utman Khel

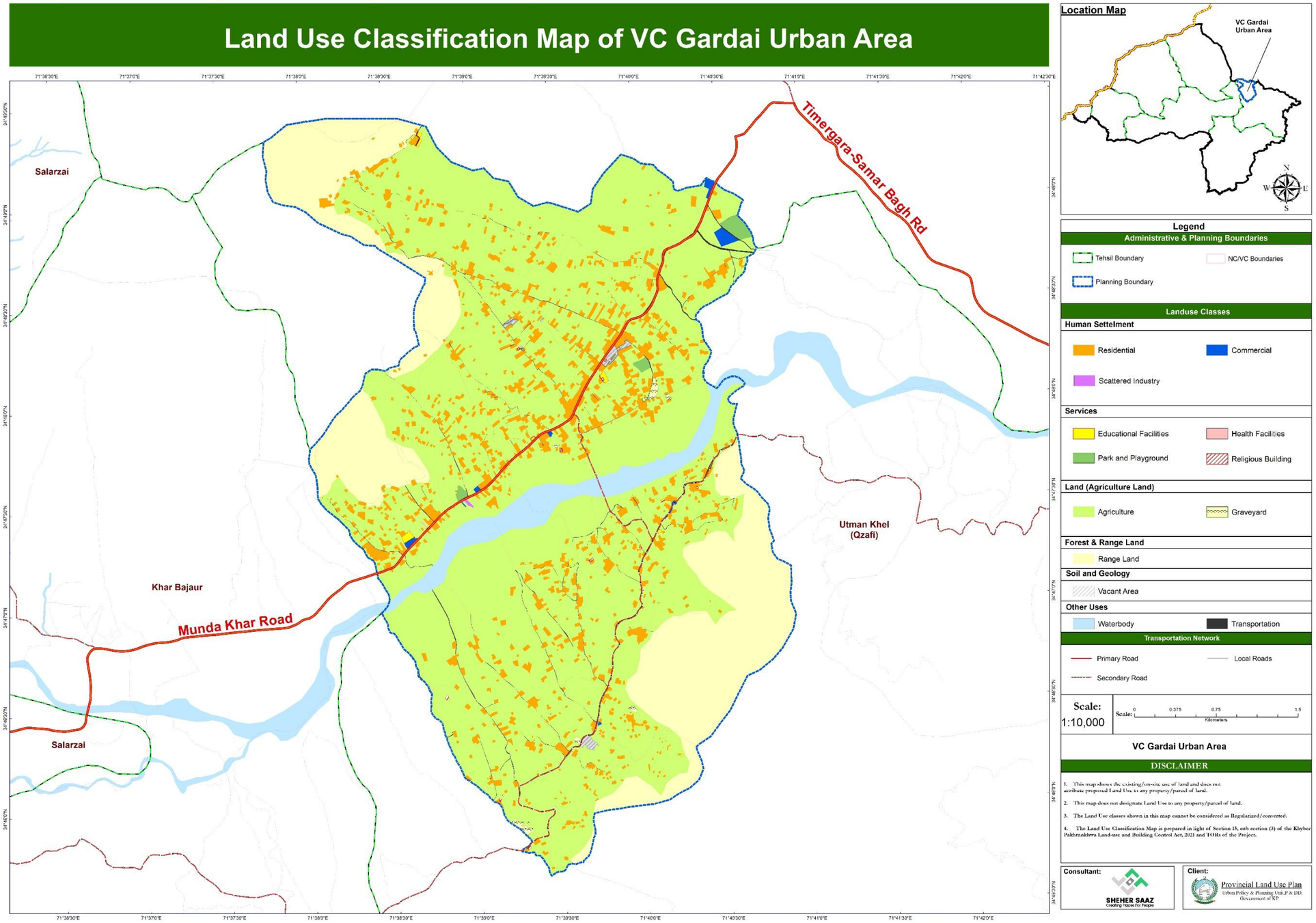
Gardai in Utman Khel covers a total area of 4,961.53 acres, with agriculture (3,225.11 acres, 65%) dominating the landscape, reflecting the area's strong farming base. Range land (985.12 acres, 19.86%) provides natural grazing and open space, while residential areas (452.86 acres, 9.13%) represent the primary built-up component. Commercial zones (10.89 acres, 0.22%), scattered industry (0.72 acres, 0.01%), public and civic amenities, including education facilities (5.36 acres, 0.11%), health services (0.40 acres, 0.01%), religious buildings (1.92 acres, 0.04%), and parks/playgrounds (15.14 acres, 0.31%), occupy minimal portions, providing basic urban and social services.

Transportation networks (82.05 acres, 1.65%), waterbodies (163.15 acres, 3.29%), graveyards (9.14 acres, 0.18%), and vacant land (9.66 acres, 0.19%) contribute to connectivity, ecosystem support, and potential for development. Overall, Gardai exhibits a predominantly agricultural and rural character, with residential clusters and minimal commercial and civic infrastructure, reflecting a small but growing rural settlement.

Table 20: Existing Land use distribution of Gardai Utman Khel

Existing Land Use	Area (Acres)	Percentage %
Residential	452.86	9.13%
Commercial	10.89	0.22%
Scattered Industry	0.72	0.01%
Religious Building	1.92	0.04%
Education Facilities	5.36	0.11%
Health Facilities	0.40	0.01%
Park and Playground	15.14	0.31%
Graveyard	9.14	0.18%
Agriculture	3225.11	65.00%
Range Land	985.12	19.86%
Transportation	82.05	1.65%
Vacant Area	9.66	0.19%
Waterbody	163.15	3.29%
Total	4961.53	100.00%

Map 22: Land use Classification Map of Gardai



3.5.3 Barang

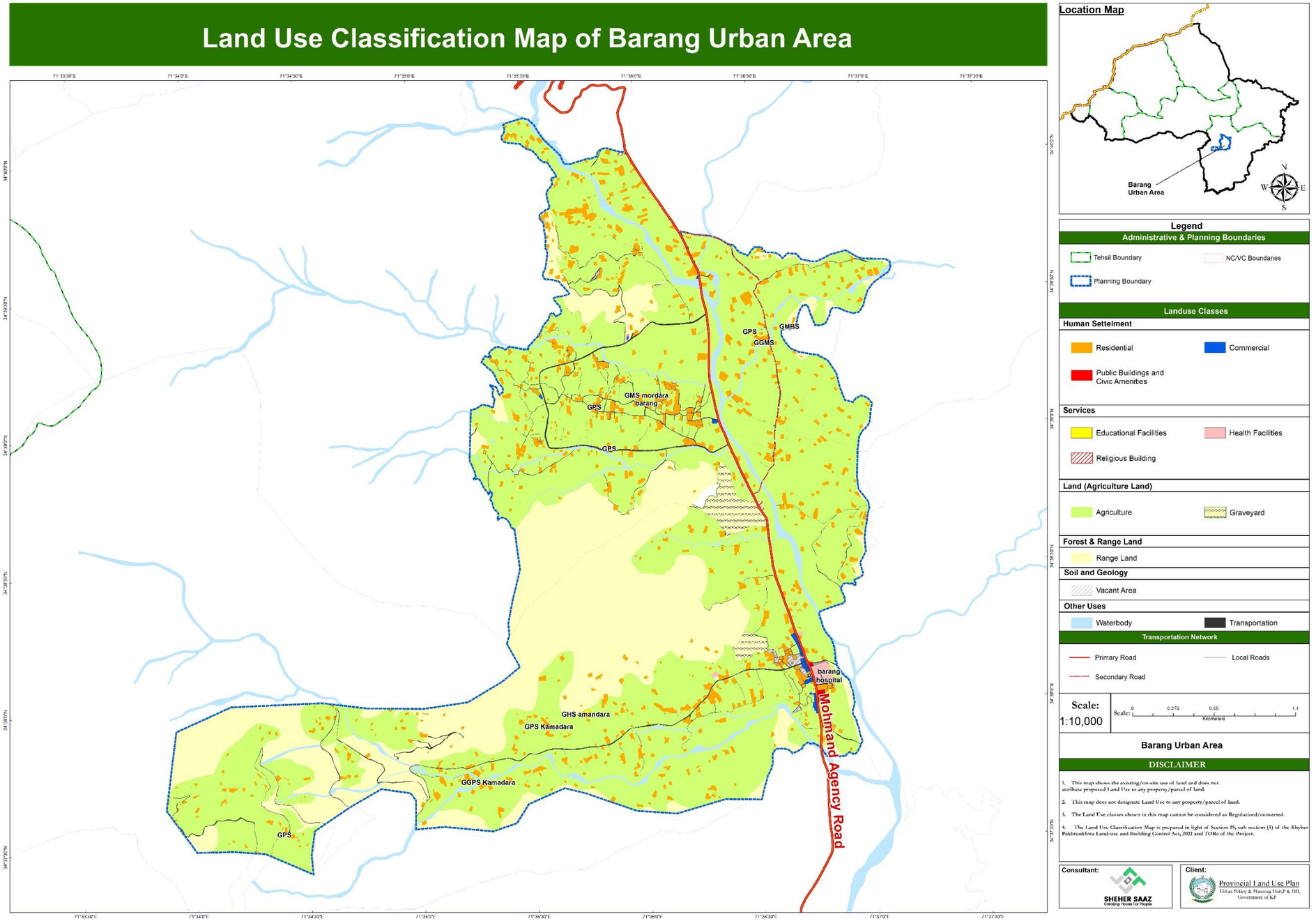
Barang covers a total area of 2,666.42 acres, with agriculture (1,626.38 acres, 60.99%) and range land (693.70 acres, 26.02%) dominating the landscape, reflecting the area's strong rural and farming character. Residential areas (172.26 acres, 6.46%) form the main built-up component, while commercial zones (3.98 acres, 0.15%), public buildings (1.20 acres, 0.05%), religious buildings (0.70 acres, 0.03%), education facilities (3.68 acres, 0.14%), and health services (4.93 acres, 0.19%) provide basic civic infrastructure.

Graveyards (32.27 acres, 1.21%), transportation networks (55.38 acres, 2.08%), waterbodies (65.19 acres, 2.44%), forest land (3.06 acres, 0.11%), and vacant areas (3.69 acres, 0.14%) support ecological functions, connectivity, and potential for controlled development. Overall, Barang exhibits a predominantly rural and agricultural landscape, with small residential clusters and limited commercial and civic infrastructure, providing scope for planned urban expansion while maintaining its rural character.

Table 21: Existing Land use distribution of Barang

Existing Land Use	Area (Acres)	Percentage %
Residential	172.26	6.46%
Commercial	3.98	0.15%
Public Buildings and Civic Amenities	1.20	0.05%
Religious Building	0.70	0.03%
Education Facilities	3.68	0.14%
Health Facilities	4.93	0.19%
Graveyard	32.27	1.21%
Range Land	693.70	26.02%
Forest Land	3.06	0.11%
Agriculture	1626.38	60.99%
Transportation	55.38	2.08%
Vacant Area	3.69	0.14%
Waterbody	65.19	2.44%
Total	2666.42	100.00%

Map 23: Land use Classification Map of Barang



4 CHAPTER IV: URBANIZATION AND HIERARCHY OF HUMAN SETTLEMENTS

4.1 Urbanization

Urbanization refers to the systematic transformation of rural areas into urbanized regions, driven by economic development and industrialization. Demographically, it refers to the shift of populations from rural to urban settings over time. This process predominantly leads to the formation and expansion of towns and cities as more people start living and working in central urban areas. Over the past fifty years, many developing countries have experienced rapid urbanization, resulting in a high concentration of urban populations in large cities. Urbanization is not just a modern occurrence but a significant and historical shift in human social structures on a global scale, where rural cultures are rapidly being replaced by urban ones.

Urbanization has both positive and negative impacts. On the positive side, it drives economic development and improves education. However, it also strains existing social services and infrastructure. For example, a sudden population increase can lead to housing shortages, resulting in the development of slums. To address urbanization, long-term planning for cities and towns is crucial. This planning should include considerations for housing, infrastructure, employment, and social services to manage urban growth effectively. Such planning is essential for creating attractive, affordable, sustainable, and well-serviced communities with access to job opportunities.

4.1.1 Urbanization of District Bajaur

Urbanization in Pakistan has accelerated in recent years, characterized by rapid population growth in urban centers due to rural-to-urban migration and high natural growth rates. The Pakistan Bureau of Statistics (PBS) 2017 Census and subsequent surveys confirm a marked rise in urban population, resulting in city and town expansions. This shift brings several challenges, such as strained infrastructure, housing shortages, and the proliferation of informal settlements. Bajaur Pakhtunkhwa (KP) aligns with these trends; cities like Peshawar have witnessed notable population increases and urban sprawl.

Bajaur District exhibits a comparable trajectory, with urbanization primarily driven by socio-economic factors including population growth, internal migration, and aspirations for improved living standards. While censuses in 2017 and 2023 did not officially classify Khar, Salarzai, and Nawagai as urban centers, Neighborhood Council assessments indicate these tehsils are evolving into urban settlements. These hubs attract populations from nearby rural areas due to their concentration of administrative services, access to basic amenities, and active economic sectors.

Complementing this, the development of local infrastructure, such as expanded roads and improved communication networks, facilitates the movement of goods and services and

further accelerates urban growth. Bajaur's landscape is thus transitioning as rural communities increasingly interact with urbanized environments.

Analysis of population data shows this transformation. Bajaur's population grew from 1,090,987 in 2017 to 1,287,960 in 2023, signifying an 18% increase and an annual growth rate of approximately 2.8%. This consistent growth validates the ongoing urbanization in the district.

- Rising population density is intensifying demand for infrastructure and public services, expanding urban zones.
- Population growth varies across tehsils, with established centers absorbing more residents due to superior facilities and opportunities.
- Increasing population highlights the necessity for robust urban planning, strategic infrastructure investments, and responsive policy measures.
- Urban settlements in Bajaur are becoming prominent centers for employment, administration, and education, reflecting their growing significance in the district's evolution.

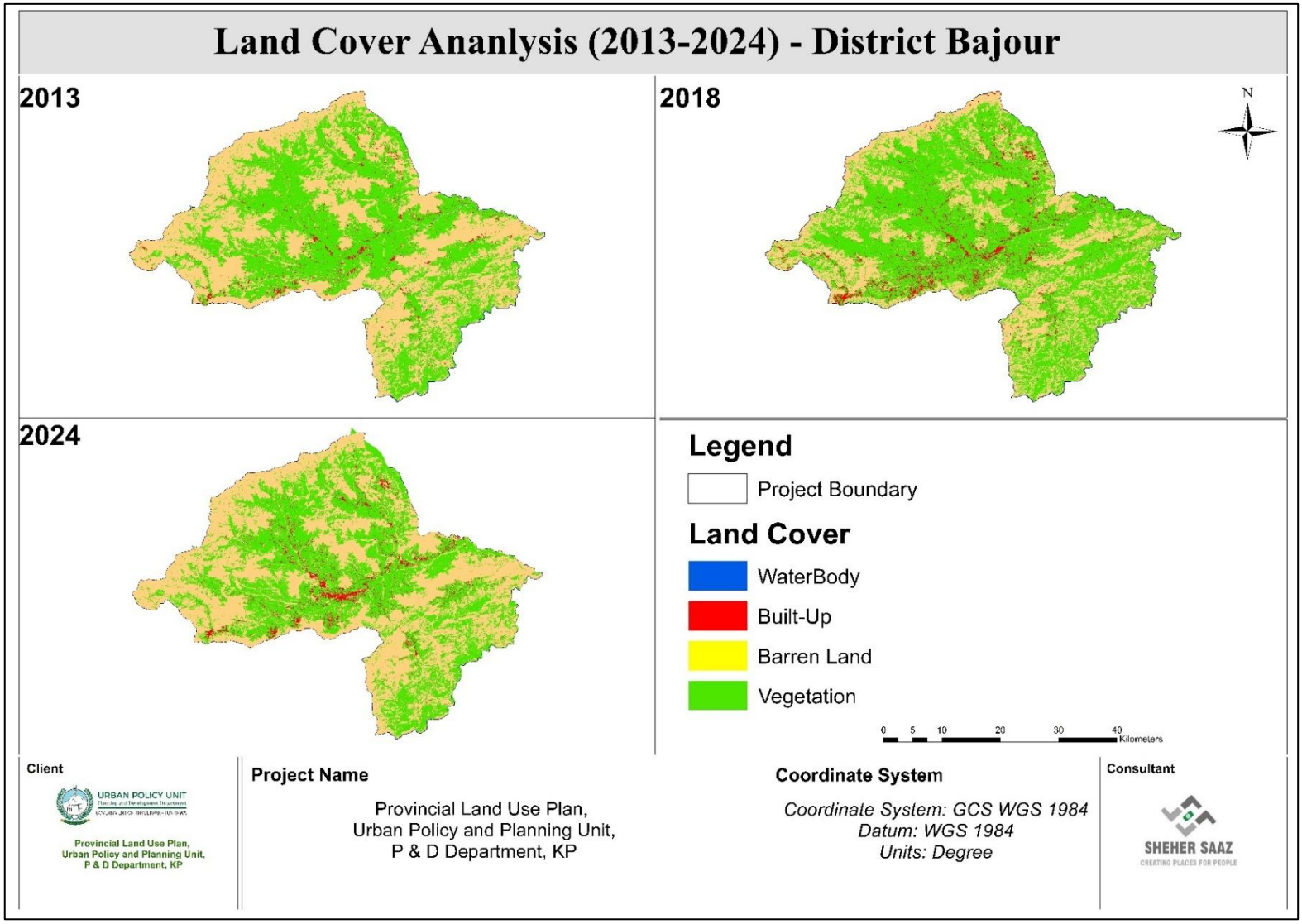
4.1.2 Growth Direction

The land cover analysis of District Bajour for the period 2013 to 2024 highlights a clear trend of spatial expansion and land transformation across the district. Based on the comparative satellite imagery, four main land cover classes Built-up, Vegetation, Barren land, and Water bodies were assessed to identify changes and directional patterns of growth.

Between 2013 and 2024, there has been a notable increase in built-up areas, with expansion primarily radiating from central Bajour towards the south and southeast, as well as along major road corridors leading to Khar and other nearby settlements. The growth pattern suggests linear and clustered development along transportation routes, reflecting infrastructure-driven urban expansion and settlement concentration near the district's central urban core. The vegetation cover remains predominant across the northern and eastern highlands, though slight reductions are visible along the southern peripheries due to ongoing construction and land conversion. Barren land shows a marginal increase, especially in the western upland zones, which may be attributed to deforestation, overgrazing, and soil erosion.

Water bodies remain consistent over time, but their spatial distribution remains limited and concentrated along the main drainage channels. Overall, the spatial dynamics of land cover change indicate a trend of southern and southeastern urban growth, accompanied by a gradual transformation of vegetated and agricultural lands into built-up and semi-barren zones.

Map 24: Growth Trend Map - District Bajaur



4.1.3 Drivers of Urbanization

Urbanization in Bajaur District is shaped by a complex interplay of socio-economic, infrastructural, and demographic factors. One of the primary drivers is the search for better economic opportunities. As traditional livelihoods such as agriculture face challenges like land fragmentation and limited productivity, people increasingly migrate to urban areas like Khar, Salarzai, and Nawagai in pursuit of jobs, trade, and other income-generating activities. These centers, though not officially recognized as urban in the 2017 and 2023 censuses, have developed urban characteristics due to the concentration of economic activities, services, and infrastructure. The growth of markets, small industries, and service sectors in these areas attracts a steady stream of people from rural regions, contributing to urbanization.

Infrastructural development also plays a significant role in driving urbanization in Bajaur. Improved transportation networks, including roads connecting these urban centers to rural areas and other districts, facilitate easier movement of people and goods. This connectivity not only supports economic activities but also enhances access to education, healthcare, and other essential services, making urban areas more attractive. Multiple effort, although not very fruitful, have been carried out to develop and rehabilitate the infrastructure.

The district's proximity to the Afghanistan border and its position along key trade routes further amplify its urbanization. These trade routes can be enabled to boost cross-border commerce, fostering economic exchange, and creating opportunities for local businesses to thrive. The presence of a trade route could not only boost the local economy but also attracts people seeking employment and business opportunities linked to cross-border trade. Demographically, natural population growth, coupled with migration from rural to urban areas, better infrastructure and employment opportunities, reinforcing the trend of urbanization in Bajaur District.

4.1.4 Settlements to be Urbanized by 2045

Given the potential of some settlements, some settlements can be categorized as urban settlements. Based on the projected population for 2045, several settlements within Bajaur District demonstrate clear potential for transitioning into urban centres over the next two decades. Presently classified as rural, these settlements are expected to reach population thresholds comparable to small cities (exceeding 20,000–30,000 residents), indicating the need for future reclassification and strategic urban planning interventions.

In Khar Bajaur Tehsil, settlements such as Sara Mina Alizai (42,355), Ali Jan Kallai (38,158), Tank Khatta (33,020) and Loi Sam/Khanano Kallai (32,904) show the strongest demographic momentum for urbanization. In Mamund Tehsil, Bar Kholozo Bar Cham (25,598), Jannat Shah/Babar Shah (24,292), and Agra-1 (23,688) are likewise projected to cross the urban population benchmark by 2045.

Similarly, within Salarzai Tehsil, V/C Haji Laung (29,463), Dabar-1 (26,727), Shah Narai (26,693) and Lara Dandokai (24,998) demonstrate both population potential and locational significance to justify their gradual shift up the settlement hierarchy. In Utman Khel Tehsil,

Gardai (26,519) and Bar Safarai (24,256) also emerge as priority locations that are likely to develop urban characteristics over the planning horizon.

These settlements exceed the typical rural-settlement size and thus, if supported with adequate physical and social infrastructure, can act as secondary urban centres to absorb demographic pressures currently concentrated in the main tehsil headquarters. Their strategic upgradation will help distribute urban growth, reduce pressure on existing urban nodes, and promote balanced regional development across Bajaur.

Table 22: Potential Urban Settlements to be urbanized by 2045

Sr. No.	Tehsil	Existing Hierarchy	Settlement Name	Settlement by Type	Population	Population
					2025	2045
1	Khar Bajaur Tehsil	Urban center	Khar Bajaur	Urban Centre	125,694	265,713
2	Mamund Tehsil	Rural	Mamund	Potential Urban Centre	26,552	47,120
3	Nawagai Tehsil	Rural	Nawagai	Potential Urban Centre	24,421	39,726
4	Salarzai Tehsil	Rural	Lara Dandokaii	Potential Urban Centre	22,896	42,930
5		Rural	Salarzai	Potential Settlements	21,259	39,861
6	Utman Khel Tehsil	Rural	Gardai Utman Khel	Potential Settlements	33,370	59,196
7	Barang Tehsil	Rural	Barang	Potential Settlements	16,703	27,636

4.2 Hierarchy of Settlements

4.2.1 Objectives of Hierarchy of Settlements

The purpose of establishing a hierarchy of settlements in Bajaur District is to analyze and organize the network of towns and villages. This approach helps guide policies and development projects by considering each area's role and function.

The main objectives are as follows:

- Improve infrastructure and connections among all settlements to support better access and delivery of essential services.
- Encourage responsible and sustainable development in each community through proper planning.
- Strengthen the role of settlements as centers for economic activity, social services, and cultural interaction for the district and nearby regions.
- Support balanced growth in smaller towns and villages, creating equitable opportunities across the district.
- Enhance connections between larger and smaller settlements, allowing resources and benefits to be distributed fairly throughout Bajaur.
- Develop each town and village as a vibrant hub for employment, high-quality services, and livable neighborhoods.
- This settlement hierarchy supports efficient urban management and aims to build a district that is well-planned, inclusive, and resilient.

4.2.2 Hierarchy of Human Settlements and Urban Planning

Although not declared but there are only three identified urban settlements in Bajaur District, there is a need to identify criteria by which rural settlements can be categrized by hierarchy. Since, there is no universally agreed-upon standard for these thresholds to establish a relevant settlement hierarchy, the consultant has developed criteria based on indicators of human settlements including population, density, administrative status, and infrastructure development as these indicators are essential for urban planning and resource allocation:

- Population & its Density
- Administrative Status of Settlement
- Education Facilities
- Health Facility
- Access Roads

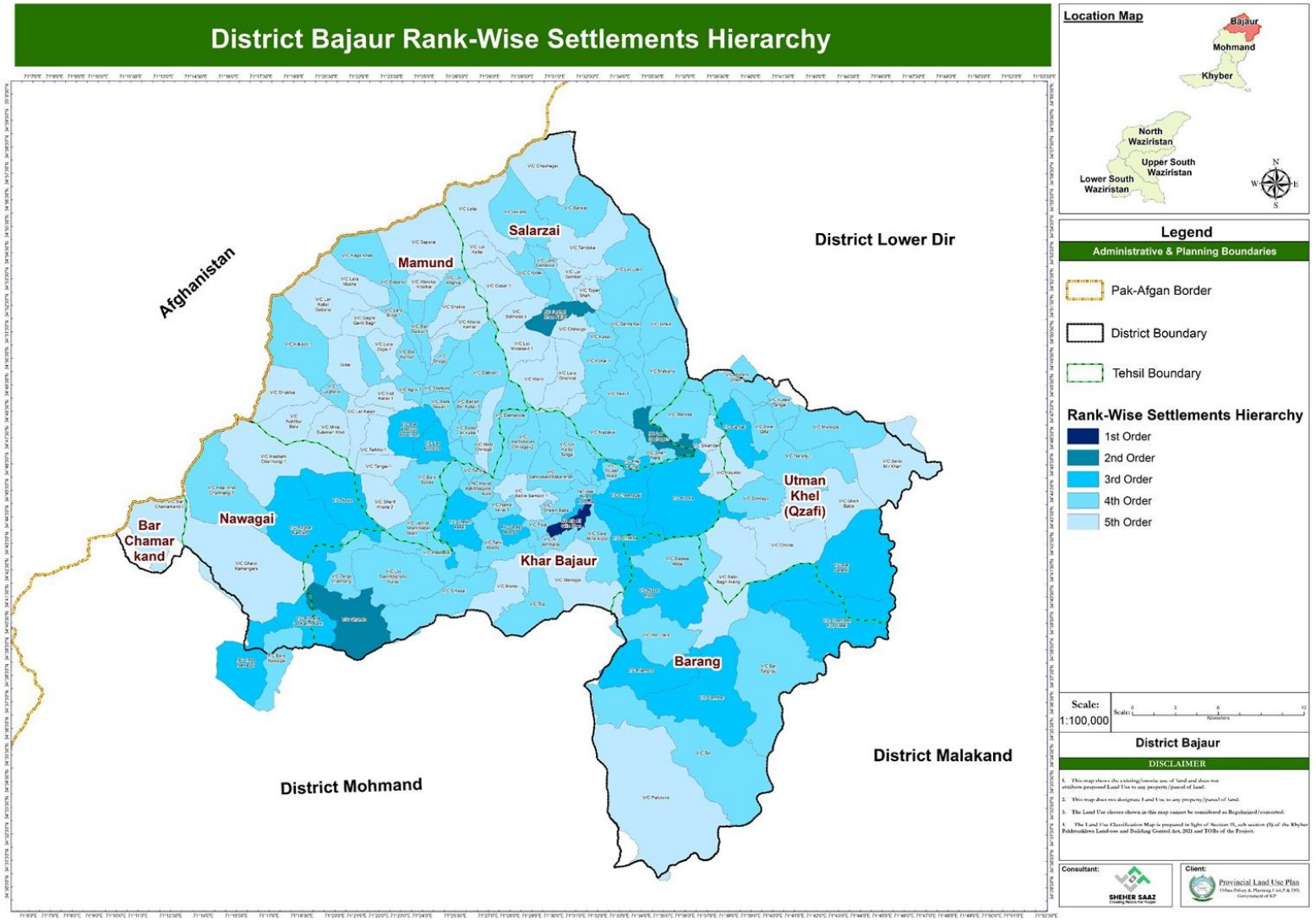
These indicators have been assigned weight based on the outcome of the analysis of spatial and non-spatial data, best practices, professional judgment, and the importance of the criteria identified. The criteria for the hierarchy of human settlements are shown below:

Table 23: Key Indicators of Human Settlements in Bajaur District

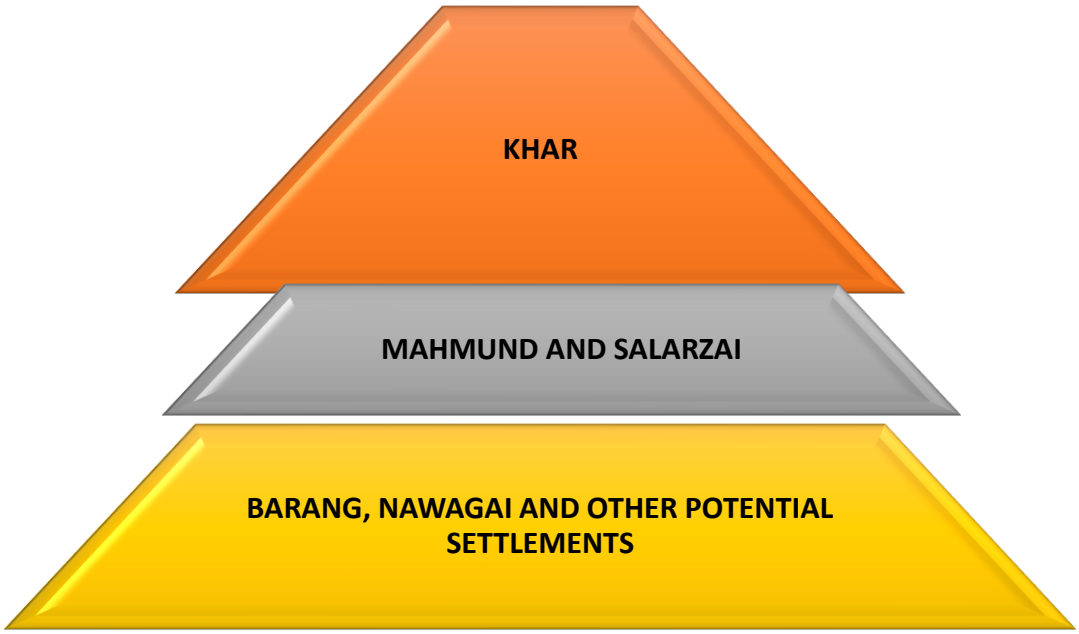
Indicator	Bajaur
Population	• Every 7,000 population = 1.0
Density	• 0-5000 = Low Density = 0.5 • 5001-10001 = Medium Density = 1.0 • 10002-15002= High Density = 1.5 • >15003 = Very High Density = 2.0
Administrative Status of Settlement	• District Headquarter = 2.0 • Tehsil Headquarter = 1.5 • Town Committee = 1.0 • Village Council = 0.5 • Cantonment = 0.0
Education Facilities	• No Education Facility = 0.0 • Every 1 Primary School = 0.15 • Every 1 Middle School = 0.25 • Every 1 High School = 0.5 • Every 1 Higher Secondary School/Inter College = 1.0 • Every 1 Degree College = 1.5 • Every 1 University = 2.0
Health Facility	• No Health Facility = 0.0 • Every 1 Dispensary = 0.25 • Every 1 Basic Health Unit = 0.5 • Every 1 Rural Health Center = 1.0 • Every 1 Other Health Center = 1.5 • Every 1 Hospital = 2.0
Access Roads	No connectivity (isolated, no transport or digital access) = 0.0 Basic connectivity (e.g., unmetalled road, no public transport, limited digital access) = 0.5 Moderate connectivity (e.g., metalled road, occasional public transport, 3G access) = 1.0 Good connectivity (e.g., metalled road, regular public transport, 4G access) = 1.5 Excellent connectivity (e.g., highway/trade route access, frequent public transport, 5G access) = 2.0
Economic Activity	No economic activity (e.g., no markets or businesses) = 0.0 Presence of 1–2 small markets or shops = 0.5 Presence of a main market or 3–5 businesses = 1.0 Presence of a large market or 6–10 businesses = 1.5 Major commercial hub or >10 businesses = 2.0

According to the availability of services and other factors mentioned above, the Bajaur district's settlement hierarchy is split into five categories: first order, second order, third order, fourth order, and fifth order.

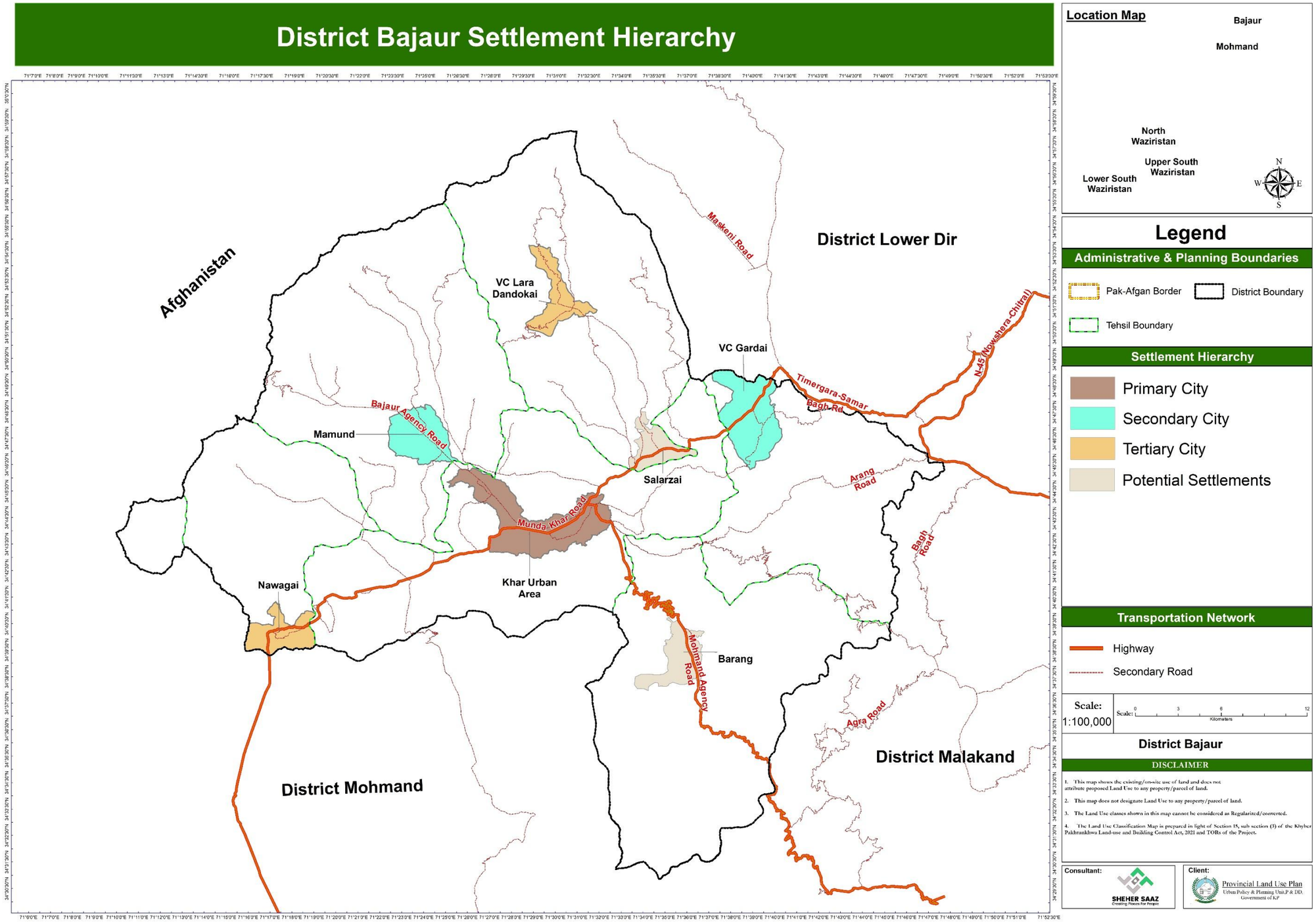
Map 25: Rank-Wise Settlements Hierarchy



The settlement hierarchy of Bajaur District reveals Khar as the most dominant urban center, followed by Mahmund, with Salarzai and Barang positioned at lower levels of the hierarchy.



Map 26: Hierarchical Structure of Settlements in Bajaur District



5 CHAPTER V: LAND SUITABILITY AND MULTI-CRITERIA ANALYSIS

5.1 Multi-Criteria Decision Analysis (MCDA)

Multi-criteria decision-making is one approach used to facilitate the consideration of multiple criteria by decision-makers. MCDA is used to logically evaluate and compare multiple, often conflicting, criteria in order to make the best possible decision. Especially useful when you have a wide range of stakeholders with conflicting interests, values and goals.

Though the multi-criteria analysis can be carried out in multiple ways, the consultant has pooled two criterion types into one i.e., land suitability classes and conditional suitability.

The general equation for multi-criteria analysis is as under:

$$Multi\ Criteria\ Analysis = w\ x\ C\ x\ r$$

Where;

w = specified weightage to the class.

C = Criteria or Factors involved in criteria. &

r = restrictions or constraints involved in the criteria.

Multi-criteria analysis can be performed using a variety of techniques, It can be performed using the raster calculator method or it can be used using the weighted overlay method. In either case, the basic essence remains the same. The core of multi-criteria analysis revolves around the equation stated above.

Land's suitability is the aptness of a given type of land for a defined use i.e., residential, or commercial. Suitability can consider land in its existing condition or after improvements. The process of land suitability classification is the appraisal and grouping of specific areas of land in terms of their suitability for defined uses. Multi-criteria analysis has been used to determine suitable land uses for existing land parcels.

The consultant has pooled two criterion types into one i.e., land suitability classes and conditional suitability.

Land suitability classes reflect degrees of suitability. The classes are numbered consecutively in sequence of decreasing degrees of suitability within the Order. The opted criterion provides following three suitability classes:

Figure 2: Classes of the LSA

Highly Suitable:

- Land having no significant limitations to sustained application of a given use, or only minor limitations that will not significantly reduce productivity or benefits and will not raise inputs above an acceptable level.

Moderately Suitable:

- Land having limitations which in aggregate are moderately severe for sustained application of a given use; the limitations will reduce productivity or benefits and increase required inputs to the extent that the overall advantage to be gained from the use, although still attractive, will be appreciably inferior to that expected on Class S1 land.

Least Suitable:

- Land having limitations which in aggregate are severe for sustained application of a given land use and will so reduce productivity or benefits will not be suitable.

Source: Developed by Consultant

5.2 Land Suitability Analysis (LSA) for Land uses

The criteria for the Land Suitability Assessment (LSA) of various land uses, residential, agricultural, commercial, and industrial, are developed based on extensive consultations with the client. These discussions help identify key factors such as land characteristics, environmental sustainability, infrastructure availability, and community needs, ensuring that each land use is appropriately allocated. The details of all land-uses are given below:

5.2.1 LSA Criteria for Residential

The residential criteria are made by using factors and constraints of planning development. The important factor is the proximal of land to primary and secondary roads, planned residential, water bodies and land cover. The table below shows the selected criteria for residential.

Table 24: Factors and Criteria of Residential

S. No	Parameters	Classes (Meters) (Degree)	Weights 1 = Not Suitable 2 = Moderate 3 = Most Suitable	Influence
1	Primary Roads	11 - 50	1	15
		51 - 1400	2	
		1401 - 2800	3	
		Above 2801	2	
2	Secondary Roads	11 - 50	1	20
		51 - 1500	3	
		1501 - 2900	3	
		Above 2901	2	
3	Planned Residential	0 - 400	3	15
		401 - 800	3	
		801 - 1600	2	
		Above 1601	1	
4	Waterbodies	0 - 50	1	20
		51 - 500	2	
		501 - 1200	3	
		Above 1201	3	
5	Land Cover	Built-Up	1	10
		Vacant	3	
		Agriculture	2	
6	Slope	0-9 Degree	3	20
		10-15	2	
		Above 15 degrees	1	

Source: Developed by Consultants, 2025

5.2.2 LSA Criteria for Commercial

The commercial criteria are made by using factors and constraints of planning development. The important factor is the proximal of land to Primary and Secondary Roads, Existing Commercial Bazaar and Land Cover.

Table 25: Factors and Criteria for Commercial

Criteria For Commercial				
S. No	Parameters	Classes (Meters) (Degree)	Weights 1 = Least Suitable 2 = Moderate 3 = Most Suitable	Influence
1	Primary Roads	11 - 70	3	20
		71 - 800	2	
		801 - 1600	1	

		Above 1600	1	
2	Secondary Roads	20 - 80	3	30
		81 - 900	2	
		901 - 1800	1	
		Above 1800	1	
3	Existing Commercial Bazar	0 - 600	3	20
		601 - 1200	2	
		1201 - 1800	2	
		Above 1800	1	
4	Land Cover	Built-Up	1	10
		Vacant	3	
		Agriculture	2	
5	Slope	0-9 Degree	3	
		10-15	2	
		Above 15 degree	1	

Source: Developed by Consultants, 2025

5.2.3 LSA Criteria for Industry

The Industrial criteria have been made by using factors of planning and development. The important factor is the proximal of land to road, community facilities and parks, and playgrounds. For the Land cover, the built-up area is the least suitable, vegetation is moderately suitable, and vacant is highly suitable.

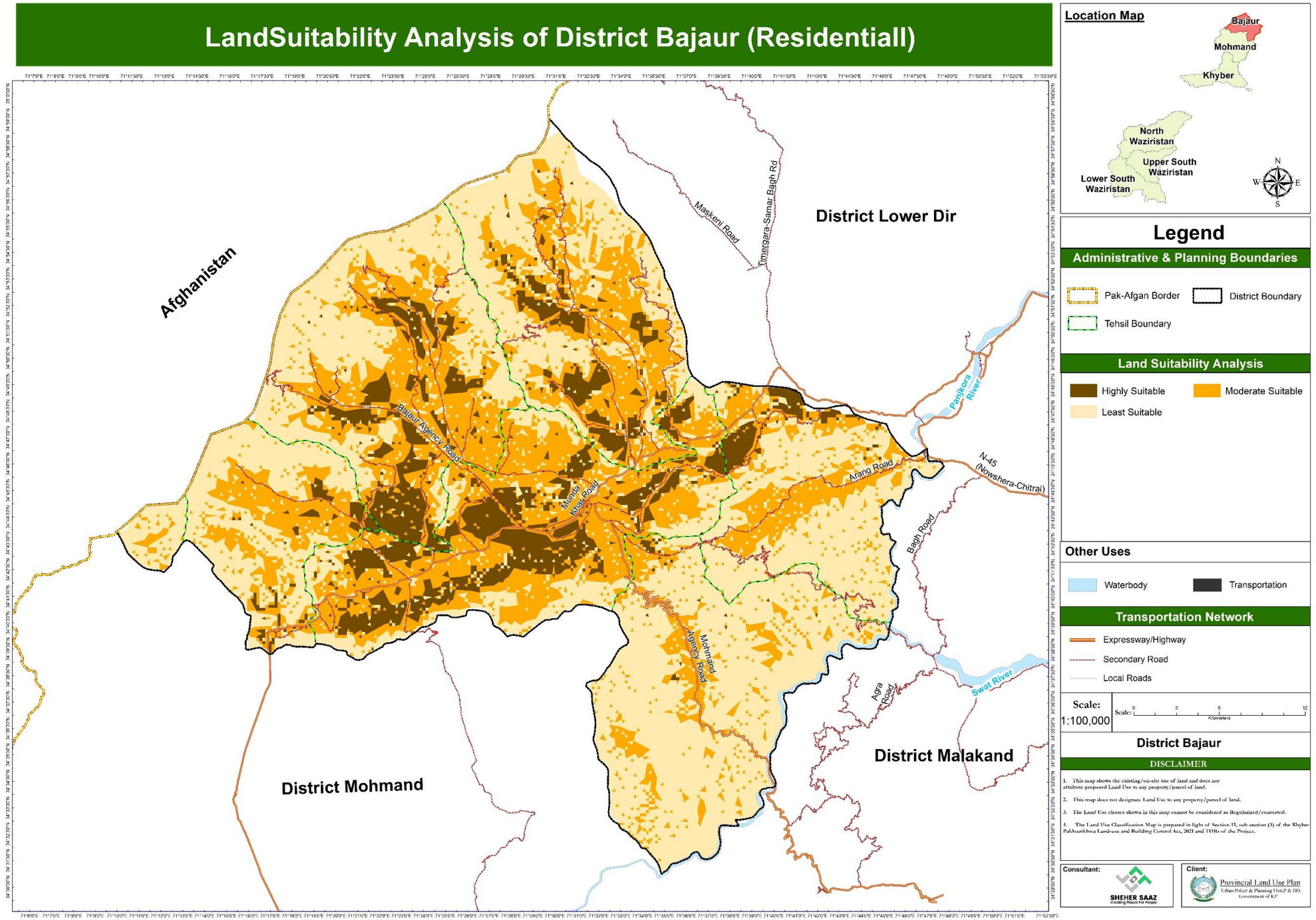
Table 26: LSA Criteria for Industry

Criteria For Industry				
S. No	Parameters	Classes (Meters) (Degree)	Weights 1 = Least Suitable 2 = Moderate 3 = Most Suitable	Influence
1	Primary Roads	11 - 700	3	10
		701 - 1400	2	
		1401 - 2100	1	
		Above 2100	1	
2	Secondary Roads	6 - 650	3	20
		551 - 1200	2	
		1201 - 1650	2	
		Above 1650	1	
3	Waterbodies	0 - 50	1	25

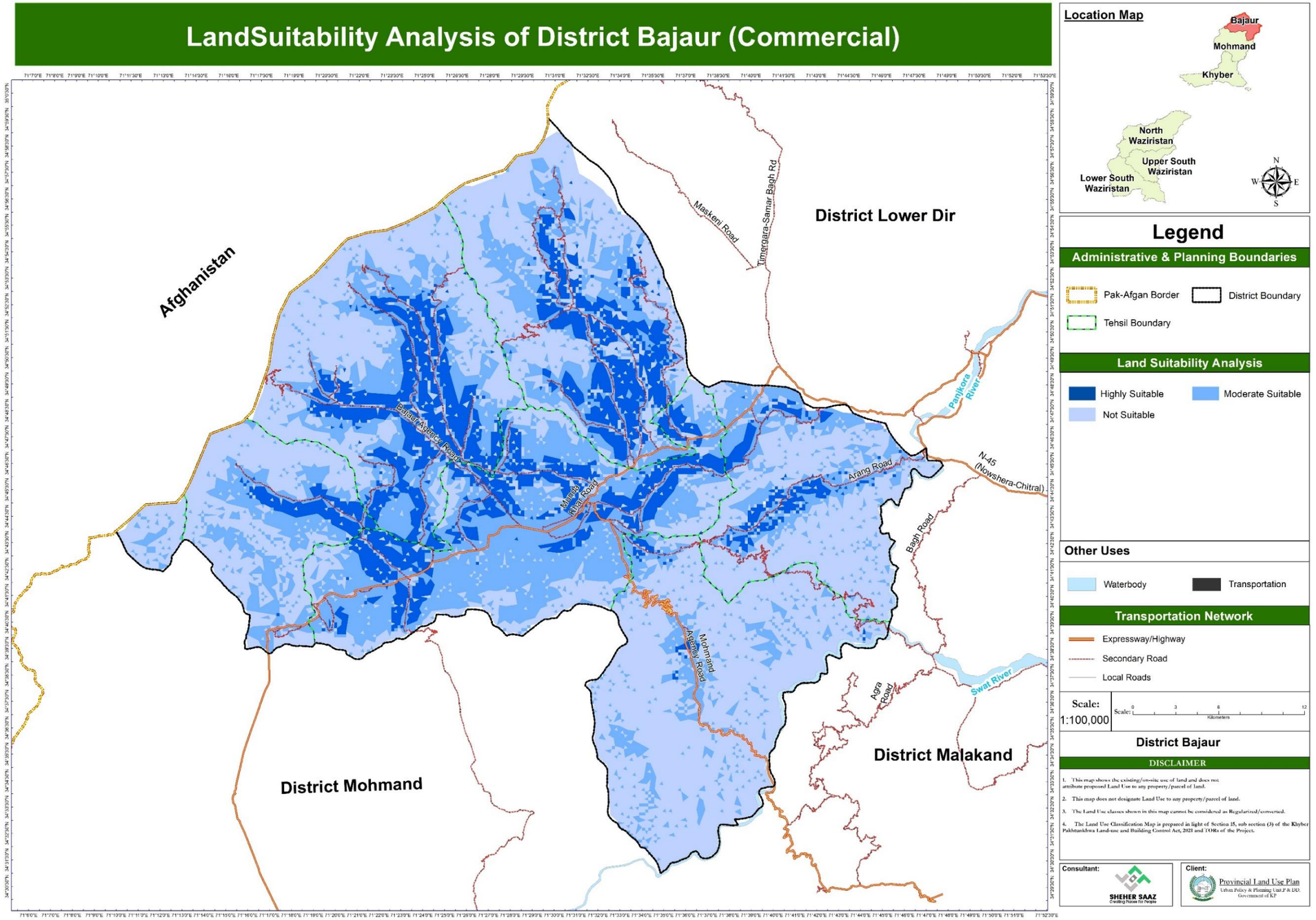
		51 - 500	2	
		501 - 1200	3	
		Above 1200	3	
4	Existing Industrial Block	0 - 500	1	20
		501 - 1000	2	
		1001 - 1500	3	
		Above 1500	3	
5	Land Cover	Built-Up	1	10
		Vacant	3	
		Agriculture	2	

Source: Developed by Consultants, 2025

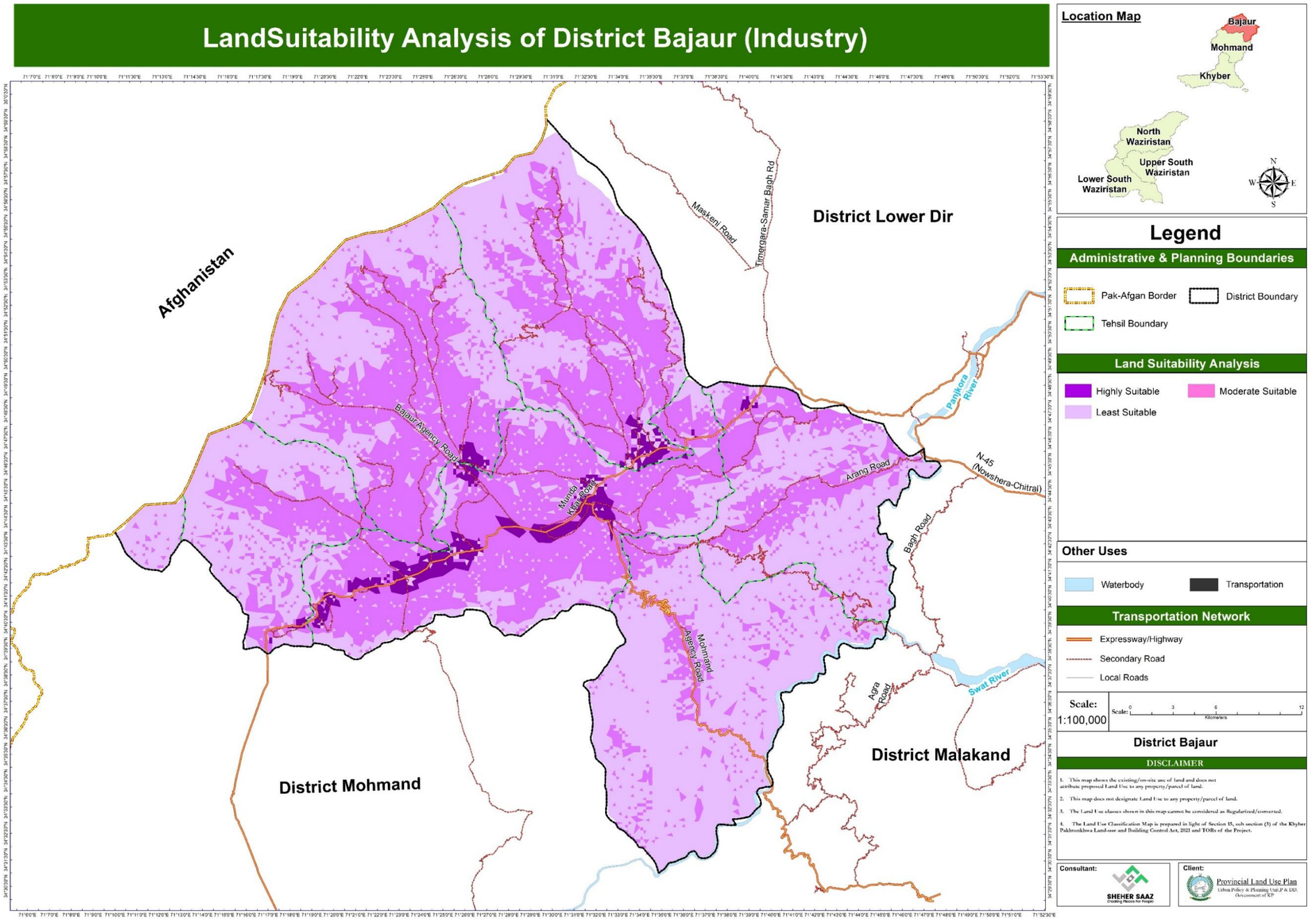
Map 27: Land Suitability Analysis of Residential Land Use



Map 28: Land Suitability Analysis Commercial



Map 29: Land Suitability Analysis for Industry



Source: Developed by Consultants

6 CHAPTER VI: SECTORAL STUDIES

6.1 RESIDENTIAL ZONES

6.1.1 Existing Housing Stock

As per the census report of 2017, the total population of 1,090,987 people in Bajaur District was accommodated in 121,487 housing units as against the population of 595,227 people enumerated in 65,439 housing units in year 1998. However, according to 7th census (2023), this population has increased to 1,287,960 people, which are housed in 181,699 units.
From 1998 to 2017, the total number of housing units in Bajaur district represents a growth of approximately 185.65%. However, this increase has further shown potential in intercensal period from 2017 to 2023. Within this period, the housing stock 149.65%. This substantial rise indicates significant development efforts and population growth in the region over the two decades. In parallel to district, the analysis overtime of the Bajaur tehsils has been carried out using intercensal period of 1998-2023. The following table depicts housing units by tehsil:

Table 27: Tehsil Wise Details of Housing Units – Bajaur District

Administrative Unit	Housing Units		
	1998	2017	2023
Bar Chamer Kand Tehsil	394	336	755
Barang Tehsil	7,307	10,602	14,016
Khar Bajaur Tehsil	11,310	27,389	41,817
Mamund Tehsil	17,423	35,488	48,697
Nawagai Tehsil	6,055	7,711	13,131
Salarzai Tehsil	16 ,562	29,119	47,565
Utman Khel Tehsil	6,388	10,842	15,718

Source: Census Report of 1998 & 2017, 2023, Pakistan Bureau of Statistics

For Bar Chamer Kand Tehsil, there was a decrease in housing units from 394 in 1998 to 336 in 2017, marking a reduction of 14.7%. However, in 2023, these housing units have increased to 755. This decline and then increase might indicate factors such as migration in and out of the area, or other socio-economic issues impacting housing availability. In contrast, Barang Tehsil experienced substantial growth, with housing units increasing from 7,307 to 14,016, representing nearly 50% rise. This growth suggests that the area has seen considerable development, possibly due to enhanced infrastructure or economic opportunities.

Khar Bajaur Tehsil depicts the most dramatic growth, with the number of housing units soaring from 11,310 to 41,817, an impressive increase of 370%. This sharp rise indicates rapid development and urban expansion, which may be driven by migration, economic improvements, or other significant factors. Similarly, Mamund Tehsil saw a considerable

increase in housing units from 17,423 to 48,697. Nawagai Tehsil's growth was more moderate, with an increase from 6,055 to 13,131 housing units, nevertheless more than double. This slower growth rate is like the more rapid expansions seen in other tehsils. Salarzai Tehsil also experienced significant growth, with housing units increasing from 16,562 to 47,565, marking a 287.19% rise.

In 1980, the predominant roofing material was cement or iron sheets, used by 99.8% of households. However, by 1998, this figure dropped to 93.9% (including both Cement/Iron Sheet and Wooden/Bamboo), and by 2017, it slightly increased to 89.15% (including both Cement/Iron Sheet, Wooden/Bamboo and Garder / T.Iron). The use of Garder/T. Iron roofing materials was not recorded in the earlier years but by 2017, it accounted for 13.45% of the roofs. This substantial adoption indicates the introduction and growing popularity of these materials, likely due to their cost-effectiveness, or availability for local conditions.
Apart from material of roof and out wall, the further analysis on administrative setup has been conducted to assess the construction of the building based on census categorisation of the buildings based on Kacha, Semi Pucca and Pucca status. The following table shows the trends observed in Kacha (temporary), Semi-Pucca (semi-permanent), and Pucca (permanent) housing based on 1998 and 2017 census.

Table 28: Tehsil-Wise Types of Housing Units – Bajaur District

Administrative Unit	1998			2017			2023		
	Kacha	Semi-Pucca	Pucca	Kacha	Semi-Pucca	Pucca	Kacha	Semi-Pucca	Pucca
Bajaur District	30,276	3,508	31,655	56,493	49,419	15,575	90,388	63,965	27,346
Bar Chamer Kand Tehsil	3	10	381	12	267	57	177	565	13
Barang Tehsil	538	676	6,093	4,456	5,942	204	2,288	11,374	354
Khar Bajaur Tehsil	9 ,245	609	1,456	16,333	5,266	5,790	24,532	8,043	9,242
Mamund Tehsil	8,154	1,249	8,020	15,534	17,018	2,936	27,187	17,210	4,300
Nawagai Tehsil	1,624	279	4,152	3,776	3,243	692	6,401	5,394	1,336
Salarzai Tehsil	7,686	528	8,348	10,894	13,946	4,279	21.668	17,271	8,626
Utman Khel Tehsil	3,026	157	3,205	5,488	3,737	1,617	8,135	4,108	3,475

Source: Census Report of 2017, 2023, Pakistan Bureau of Statistics

6.1.2 Household Size

In 1998, the average household size in Bajaur district was 9.1. By 2017, this number had decreased to 8.86, which had decreased to 7 people per household in 2023. This decline suggests a trend towards smaller family units, which may be attributed to socio-economic factors such as improved family planning, economic pressures, or cultural shifts.

In the light of different administrative units within Bajaur district, highest household size can be observed in Landi Kotal tehsil with 10.2 average household size, followed closely by Jamrud tehsil with 10.1 people per households in 1998. The trend within these tehsils followed non-traditional trend; settlements with higher urban proportion has higher households' size. However, a different trend has been observed based on 2017 census. The Jamrud tehsil has the highest urban proportion, but its household size is comparatively less than that of district average and other tehsils. The table below depicts different administrative units with respect to their urban proportion and average household size:

Table 29: Comparison of Average Household Size – Bajaur District

Administrative Unit	Census 1998	Census 2017	Census 2023
Bajaur District	9.1	8.86	7.0
Bar Chamer Kand Tehsil	8.2	8.43	4.7
Barang Tehsil	6.9	7.49	6.4
Khar Bajaur Tehsil	10.2	8.85	7.2
Mamund Tehsil	9.6	8.66	7.3
Nawagai Tehsil	9.4	10.03	7.1
Salarzai Tehsil	8.6	9.12	6.6
Utman Khel Tehsil	9.1	9.71	7.8

Source: Census Report of 2017, Pakistan Bureau of Statistics

The decreasing trend in average household size in several areas could indicate a move towards smaller family units, possibly influenced by factors such as better access to education, family planning, and the starting impacts of security situation.

6.1.3 Housing Shortage/Backlog

The assessment of housing backlog in Bajaur District is based on three key parameters — total population, average household size, and existing housing stock. Using the 2017 population of 1,090,987 and an average household size of 8.86, the required number of housing units was estimated at 123,136. With an existing stock of 121,487 units, this resulted in a backlog of 1,649 houses in 2017. By 2023, the population had increased to 1,287,960, while the average household size declined to 7.0. Consequently, the housing requirement rose to 183,994 units. Given that only 181,699 housing units existed in 2023, the backlog reached 2,295 units. This steady rise in demand clearly reflects the impact of growing population pressure and evolving household structures, reinforcing the need for a proactive approach in expanding the district's housing supply.

Table 30: Housing Backlog - Bajaur District

Year	Population	Household size	Required housing units	Existing housing units	Backlogs
2017	1,090,987	8.86	123,136	121,487	1,649
2023	1,287,960	7.00	183,994	181,699	2,295

Source: Census Report of 2017, Pakistan Bureau of Statistics

6.1.4 Additional Housing Demand (2025-2045)

6.1.4.1 Urban Centre

An assessment of additional housing demand has been carried out for Khar, a major urban center within the planning area, based on projected population growth for the years 2025 and 2045. The analysis applies an average household size of 7.2 persons per household, assumed to remain constant throughout the planning horizon, to estimate current and future housing requirements.

Khar's population is projected to increase from 125,694 persons in 2025 to 265,713 persons by 2045, reflecting rapid urbanization and its role as a key economic and administrative hub. Based on the household size, the current housing requirement is estimated at 17,457 units in 2025, which is projected to rise sharply to 36,905 units by 2045. This represents an additional demand of 19,448 housing units over the planning period, highlighting the need for planned residential development, infrastructure expansion, and efficient land use management to accommodate future population growth while ensuring sustainable urban living conditions.

Table 31: Additional Housing Demand in Urban centers (Current 2025 and Future 2045)

Khar urban area		
Projected Population	***2025***	***2045***
	125,694	265,713
Household Size from 2025 till 2045	7.20	
Future Requirements Housing Units for 2045	17,457	36,905

Source: Calculated by Consultants

6.1.4.2 Potential Urban Centre

An assessment of additional housing demand has been carried out for potential urban centers within the planning area, based on projected population growth for 2025 and 2045. The analysis applies the respective average household sizes for each center, assumed to remain constant throughout the planning horizon, to estimate current and future housing requirements.

In Mamund, the population is projected to increase from 26,552 in 2025 to 47,120 in 2045. With an average household size of 7.3 persons, the current housing requirement is estimated

at 17,218 units, rising to 36,399 units by 2045, resulting in an additional demand of 19,181 units.

In Lara Dandokaii, the population is projected to grow from 22,896 in 2025 to 42,930 in 2045. Based on an average household size of 6.6 persons, the housing requirement will increase from 3,469 units in 2025 to 6,505 units in 2045, creating an additional demand of 3,036 units over the planning period.

In Gardai, Utman Khel, the population is expected to rise from 33,370 in 2025 to 59,196 in 2045. Using an average household size of 7.8 persons, the housing demand will increase from 4,278 units in 2025 to 7,589 units by 2045, generating an additional requirement of 3,311 units.

Table 32: Additional Housing Demand in Potential urban centers (2025 and 2045)

Potential Urban Centre		
Mamund		
Projected Population	2025	2045
	26,552	47,120
Household Size from 2025 till 2045	7.30	
Future Requirements Housing Units for 2042	17,218	36,399
Lara Dandokaii		
Projected Population	2025	2045
	22,896	42,930
Household Size from 2025 till 2045	6.60	
Future Requirements Housing Units for 2042	3,469	6,505
Gardai Utman Khel		
Projected Population	2025	2045
	33,370	59,196
Household Size from 2025 till 2045	7.80	
Future Requirements Housing Units for 2042	4,278	7,589

Source: Calculated by Consultants

6.1.4.3 Potential Urban Settlements / Areas

An assessment of additional housing demand has been carried out for potential settlements and peri-urban areas within the planning region, based on projected population growth for 2025 and 2045. The analysis applies the respective average household sizes for each settlement, assumed to remain constant throughout the planning horizon, to estimate current and future housing requirements.

In Salarzai, the population is projected to grow from 21,259 in 2025 to 39,861 in 2045. With an average household size of 6.6 persons, the housing requirement will increase from 3,221

units in 2025 to 6,040 units by 2045, resulting in an additional demand of 2,819 units over the planning period.

In Nawagai, the population is expected to rise from 24,421 in 2025 to 39,726 in 2045. Based on an average household size of 7.1 persons, housing demand will increase from 3,440 units in 2025 to 5,595 units in 2045, generating an additional requirement of 2,155 units.

In Barang, the population is projected to grow from 16,703 in 2025 to 27,636 in 2045. Using an average household size of 6.4 persons, housing units will need to increase from 2,610 in 2025 to 4,318 by 2045, reflecting an additional demand of 1,708 units.

These projections indicate a moderate but significant growth in housing demand across potential settlements, highlighting the need for planned residential development, infrastructure provision, and efficient land use strategies to accommodate future population growth while maintaining livable conditions.

Table 33: Additional Housing Demand in Potential Settlements/areas (2025 and 2045)

Salarzai		
Projected Population	***2025***	***2045***
	21,259	39,861
Household Size from 2025 till 2045	6.60	
Future Requirements Housing Units for 2042	3,221	6,040
Nawagai		
Projected Population	***2025***	***2045***
	24,421	39,726
Household Size from 2025 till 2045	7.10	
Future Requirements Housing Units for 2042	3,440	5,595
Barang		
Projected Population	***2025***	***2045***
	16,703	27,636
Household Size from 2025 till 2045	6.40	
Future Requirements Housing Units for 2042	2,610	4,318

Source: Calculated by Consultants

6.1.5 Future Area Requirement

This section presents a comprehensive analysis of existing and projected housing needs across urban centers, potential urban centers, and potential settlements, assessing gaps, required land, and phased development strategies from 2025 to 2045. The assessment evaluates projected populations, required housing units, and backlogs, while factoring in proposed plot sizes, residential zones, and allied land uses to determine the total area necessary for sustainable settlement expansion.

For urban centers, such as Khar Bajaur, housing demand is analyzed across multiple residential zones, including Infill (0–10 Marla), Short Term (10–20 Marla), Medium Term (20–40 Marla), and Long Term (>40 Marla) zones. Each zone is designed to accommodate a proportion of the population, with land allocation and plot sizes reflecting settlement patterns, population density, and housing needs. The proposed plot sizes are based on detailed assessments of existing areas and are designed to meet both current and future housing demands.

In potential urban centers, including Mamund, Lara Dandokaii, and Gardai Utman Khel, housing needs are similarly distributed across Short, Medium, and Long Term Residential Zones, reflecting population proportions and proposed plot sizes. The phased approach ensures that residential expansion aligns with projected population growth, settlement patterns, and infrastructure capacity, while providing flexibility to adjust plot sizes to accommodate different income groups and resources.

For potential settlements, such as Salarzai, Nawagai, and Barang, housing demand is smaller but still significant. Planned residential zones are categorized as Short, Medium, and Long Term, based on population distribution and average plot sizes. The phased approach ensures that land allocation aligns with population growth, settlement patterns, and infrastructure capacity, while maintaining flexibility for alternative plot sizes when required.

Overall, this analysis highlights a structured, phased housing strategy across urban and peri-urban areas, ensuring adequate land provision, sustainable settlement expansion, and flexibility to respond to future demographic changes, infrastructure capacity, and community needs.

Table 34: Existing and Proposed Future requirement of housing/residential zones

Settlement	*Proposed Plot Size*	*Proposed Zones*	*Proposed Avg.Plot Size (Marla)*	Percentage	Population	Req. Housing Units	Area Required (Marla)	Area into Acres	Area Required for Allied Uses	Total Area Required Phase-Wise	Existing GAP (Acres)	Total Area Required (Acres) (2025-2045)
Urban Centre												
Khar Bajaur	***0-10 Marla***	Infill Residential Zone	**10**	**5%**	7001	673	6731.68	42.07	21.04	63.11	10.556	73.67
	10-20 Marla	Short Term Residential Zone	**15**	**20%**	28004	2693	40390.10	252.44	126.22	378.66	42.224	420.88
	20-40 Marla	Medium Term Residential Zone	**30**	**60%**	84011	8078	242340.58	1514.63	757.32	2271.95	126.672	2398.62
	More than 40 Marla	Long Term Residential Zone	**40**	**15%**	21003	2020	80780.19	504.88	252.44	757.32	31.668	788.98
	Total			**100%**	**140019**	**13463**	**370243**	**2314.02**	**1157.01**	**3471.03**	**211.12**	**3682.15**
Potential Urban Centre												
Mamund												
Mamund	**10-20 Marla**	Short Term Residential Zone	**15**	**70%**	14398	1972	29584.11	184.90	92.45	277.35	179.592	456.94
	20-40 *Marla*	Medium Term Residential Zone	**30**	**20%**	4114	564	16905.21	105.66	52.83	158.49	51.312	209.80
	More than 40 Marla	Long Term Residential Zone	**40**	**10%**	2057	282	11270.14	70.44	35.22	105.66	25.656	131.31
	Total			**100%**	**20568**	**2818**	**57759.45**	**361.00**	**180.50**	**541.50**	**256.56**	**798.06**
Lara Dandokaii												
Lara Dandokaii	**10-20 Marla**	Short Term Residential Zone	**10**	**65%**	13022	1973	19730.45	123.32	61.66	184.97	66.924	251.90
	20-40 *Marla*	Medium Term Residential Zone	**15**	**20%**	4007	607	9106.36	56.91	28.46	85.37	20.592	105.96
	More than 40 Marla	Long Term Residential Zone	**25**	**15%**	3005	455	11382.95	71.14	35.57	106.72	15.444	122.16
	Total			**100%**	**20034**	**3035**	**40220**	**251.37**	**125.69**	**377.06**	**102.96**	**480.02**
Gardai Utman Khel												
Gardai Utman Khel	**10-20 Marla**	Short Term Residential Zone	**15**	**20%**	6964	893	13391.92	83.70	41.85	125.55	136.352	261.90
	20-40 *Marla*	Medium Term Residential Zone	**30**	**35%**	12187	1562	46871.73	292.95	146.47	439.42	238.616	678.04
	More than 40 Marla	Long Term Residential Zone	**40**	**45%**	15669	2009	80351.54	502.20	251.10	753.30	306.792	1060.09
	Total			**100%**	**34819**	**4464**	**140615**	**878.85**	**439.42**	**1318.27**	**681.76**	**2000.03**
Potential Urban Settlement												
Salarzai												
Salarzai	**10-20 Marla**	Short Term Residential Zone	**15**	**55%**	10231	1550	23252.50	145.33	72.66	217.99	23.056	241.05
	20-40 *Marla*	Medium Term Residential Zone	**30**	**35%**	6511	986	29594.09	184.96	92.48	277.45	14.672	292.12
	More than 40 Marla	Long Term Residential Zone	**40**	**10%**	1860	282	11273.94	70.46	35.23	105.69	4.192	109.89
	Total			**100%**	**18602**	**2818**	**64121**	**400.75**	**200.38**	**601.13**	**41.92**	**643.05**
Nawagai												
Nawagai	**10-20 Marla**	Short Term Residential Zone	**15**	**40%**	6122	862	12932.96	80.83	40.42	121.25	142.624	263.87
	20-40 *Marla*	Medium Term Residential Zone	**30**	**40%**	6122	862	25865.92	161.66	80.83	242.49	142.624	385.12
	More than 40 Marla	Long Term Residential Zone	**40**	**20%**	3061	431	17243.94	107.77	53.89	161.66	71.312	232.97
	Total			**100%**	**15304**	**2155**	**56043**	**350.27**	**175.13**	**525.40**	**356.56**	**881.96**
Barang												
Barang	**Upto 10 Marla**	Infill Residential	**10**	10%	1093	171	1708.28	10.68	5.34	16.02	7.658	23.67
	10-20 Marla	Short Term Residential Zone	**15**	15%	1640	256	3843.63	24.02	12.01	36.03	11.487	47.52
	20-40 *Marla*	Medium Term Residential Zone	**30**	55%	6013	940	28186.64	176.17	88.08	264.25	42.119	306.37
	40 Marla & Above	Long Term Residential Zone	**40**	20%	2187	342	13666.25	85.41	42.71	128.12	15.316	143.44
	Total			**100%**	**10933**	**1708**	**47405**	**296.28**	**148.14**	**444.42**	**76.58**	**521.00**

- ***Urban Centre***

Khar Bajaur, as the primary urban center, has been planned with a phased residential development strategy based on proposed plot sizes and zones. The Infill Residential Zone with plots of 0–10 Marla accounts for 5% of the population, accommodating approximately 7,001 people, which requires 673 housing units. This translates into a land requirement of 42.07 acres for housing and an additional 21.04 acres for allied uses, totaling 63.11 acres.

The Short-Term Residential Zone (10–20 Marla plots) is designed for 20% of the population, or 28,004 people, requiring 2,693 housing units and a total area of 378.66 acres, including allied uses. The Medium-Term Residential Zone (20–40 Marla plots) covers the majority of Khar's population (60%), housing 84,011 people in 8,078 units, requiring 2,271.95 acres in total.

Finally, the Long-Term Residential Zone (>40 Marla) plans for 15% of the population (21,003 people), requiring 2,020 units and 757.32 acres including allied uses. Overall, Khar's total land requirement for residential development from 2025 to 2045 is 3,682.15 acres, considering existing gaps and phased expansion. This structured approach ensures short, medium, and long-term housing needs are met efficiently within the urban area.

- ***Potential Urban Centre***

Mamund is planned with Short Term Residential plots (10–20 Marla) accommodating 70% of the population (14,398 people), requiring 1,972 housing units and a total area of 277.35 acres, including allied uses. Medium Term plots (20–40 Marla) serve 20% of the population, requiring 564 units and 158.49 acres, while Long Term plots (>40 Marla) cater to the remaining 10%, needing 282 units and 105.66 acres. The total residential land requirement for Mamund is 798.06 acres, including gaps and future needs.

In Lara Dandokaii, Short Term plots (10–20 Marla) cover 65% of the population, needing 1,973 units on 184.97 acres, while Medium Term plots (20–40 Marla) serve 20%, requiring 607 units and 85.37 acres, and Long-Term plots (>40 Marla) cover 15%, requiring 455 units and 106.72 acres. The total land requirement is 480.02 acres, phased over 2025–2045.

Gardai Utman Khel adopts a larger scale plan, with Short Term plots (10–20 Marla) serving 20% of the population (6,964 people) and requiring 125.55 acres, Medium Term plots (20–40 Marla) for 35% of the population needing 439.42 acres, and Long-Term plots (>40 Marla) for 45% of the population requiring 753.30 acres, resulting in a total land requirement of 2,000.03 acres for phased development.

- ***Potential Urban Settlement***

In Salarzai, Short Term plots (10–20 Marla) cover 55% of the population, requiring 1,550 housing units and 217.99 acres including allied uses. Medium Term plots (20–40 Marla) serve 35% of the population, needing 986 units on 277.45 acres, while Long Term plots (>40 Marla) cover 10%, requiring 282 units and 105.69 acres. The total area required is 643.05 acres for phased housing development.

Nawagai is planned with Short Term plots (10–20 Marla) for 40% of the population, requiring 862 units on 121.25 acres, Medium Term plots (20–40 Marla) for another 40%, needing 862 units on 242.49 acres, and Long-Term plots (>40 Marla) for 20%, requiring 431 units on 161.66 acres. This results in a total residential land requirement of 881.96 acres.

In Barang, Infill Residential plots (up to 10 Marla) account for 10% of the population, needing 171 units on 16.02 acres, Short Term plots (10–20 Marla) for 15%, requiring 256 units on 36.03 acres, Medium Term plots (20–40 Marla) for 55%, needing 940 units on 264.25 acres, and Long Term plots (>40 Marla) for 20%, requiring 342 units on 128.12 acres, totaling 521.00 acres for phased development.

6.1.6 Proposed Locations and Area for New Housing Areas (Residential Zones)

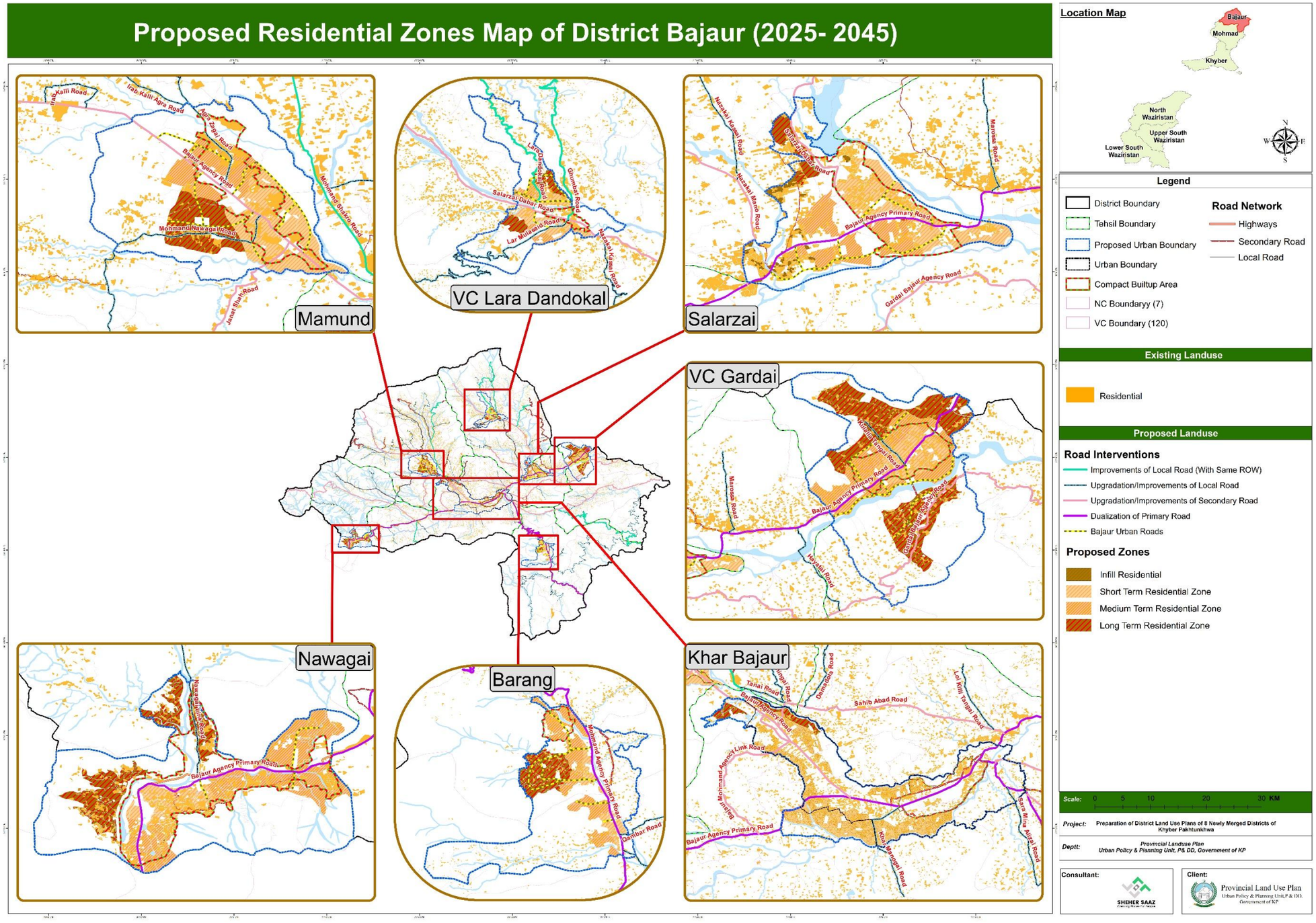
The future housing demand of District Bajaur cannot be absorbed solely through infill development. In addition to the identified infill parcels, new residential zones have been delineated across the district to accommodate population growth up to 2045. These areas are strategically located within established urban centers and in potential Village Councils earmarked for urbanization under the settlement hierarchy framework. The proposed zoning approach follows a phased development strategy short, medium, and long term to align land release with actual demand and infrastructure expansion.

Table 35: Proposed Residential Zones

Urban centre/Settlements	*Existing Residential (Acres)*	*Proposed Residential Zones*	*Proposed Areas (Acres)*	*Total Proposed Areas (Acres)*
Urban Centre				
Khar Urban Area	1245.17	Long Term Residential Zone	231.41	1648.68
		Proposed Residential Zone	1417.27	
Potential Urban Centre				
Mamund				
Mamund	394.31	Long Term Residential Zone	302.37	1065.79
		Medium Term Residential Zone	276.13	
		Short Term Residential Zone	487.29	
Gardai Utman Khel				
Gardai Utman Khel	452.86	Long Term Residential Zone	1090.68	2040.85
		Medium Term Residential Zone	684.42	
		Short Term Residential Zone	265.76	
Lara Dandokaii				
Lara Dandokaii	216.56	Long Term Residential Zone	153.89	575.84

		Medium Term Residential Zone	148.37	
		Short Term Residential Zone	273.58	
Potential Settlement				
Salarzai				
Salarzai	376.74	Long Term Residential Zone	94.69	703.20
		Medium Term Residential Zone	293.85	
		Short Term Residential Zone	272.20	
		Infill Residential	42.46	
Nawagai				
Nawagai	246.67	Long Term Residential Zone	221.15	695.39
		Medium Term Residential Zone	380.74	
		Short Term Residential Zone	92.73	
		Infill Residential	0.78	
Barang				
Barang	172.26	Long Term Residential Zone	213.97	643.79
		Medium Term Residential Zone	326.60	
		Short Term Residential Zone	103.22	

Map 30: Proposed Residential Development - District Bajaur



6.2 TRADE AND COMMERCE

6.2.1 Current Commercial Area Gap

The district's economy relies heavily on small-scale commerce, trade, mining (e.g., marble, granite), agriculture, and livestock, with potential for industrial growth (e.g., upcoming small industrial zone). However, unregulated development has led to congestion, pollution, and inefficiencies. Khar, as the district headquarters and sole major urban center, dominates commercial activities, exacerbating burdens on its infrastructure while underserved peripheral tehsils (e.g., Nawagai, Mamund) face accessibility challenges. This report analyzes these gaps based on the Khar Urban Centre Master Plan (2024-2042) and Draft Master Plan 2040, highlighting Khar's role and the risks of over-reliance on a single hub. Recommendations focus on decentralized development to ensure balanced growth by 2042, when the urban population is projected to reach 259,562.

Bajaur's commercial infrastructure is primarily concentrated in Khar Urban Centre, totaling 286-293 acres (4.13-14% of the city's 6,981-acre area), including retail (146.4 acres), warehouses (123.2 acres), and wholesale (18.7 acres). Key hubs include Khar Main Bazar, Inayat Kali Bazar, and mini centers like Phatak Bazar and Shande Morr Bazar, supporting retail, services, small-scale processing, and trade.

However, the gap lies in quality rather than quantity:

- **Unplanned and Haphazard Growth**: Commercial areas have developed linearly along main roads (e.g., Khar-Munda Road) without zoning, building controls, or bye-laws, leading to informal settlements, mixed incompatible uses (e.g., marble factories near retail causing pollution), and encroachment on footpaths/roads.
- **Infrastructure Deficiencies**: No systematic parking (peak-hour congestion: 573 cars/1,120 bikes in Khar Bazar), inadequate solid waste management (30-40% collection rate; 60% uncollected waste dumped in drains), poor sewerage (open drains clogged, untreated industrial effluent exceeding NEQS for COD/BOD), and lack of fire safety (no hydrants/extinguishers). Roads are narrow (12-30 feet), eroded, and non-metallic, with no public toilets, streetlights, or signage.
- **Environmental and Social Issues**: Over-commercialization contributes to air/noise pollution, health hazards, traffic accidents, and high land prices (70% of parcels >Rs. 400,000/marla), segregating low-income groups and limiting equitable access.

These gaps hinder economic efficiency, with commerce/trade as a major employment source (2.7% workforce in manufacturing, large male dependence on small-scale business), but constrained by poor connectivity and facilities.

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6.2.2 Proposed Locations for New Commercial Areas and Mixed Land Use Zones

Internationally, the allocation of commercial land is generally determined in terms of floor space per capita or as a percentage of total urban land use, rather than a fixed acreage per

population. For example, in the United States, commercial land typically accounts for 5–10% of total urban land, with retail floor space ranging between 20–40 square feet per person (around 2–3.7 m² per capita). In the United Kingdom, benchmarks usually fall between 2–3 m² per person, guided by a "town center first" policy that prioritizes compact, service-oriented growth. Similarly, UN-Habitat and World Bank guidelines suggest that commercial and business uses together should occupy 5–7% of urban land, which translates to about 1.5–2.5 m² per capita. In South Asia, India's URDPFI Guidelines (2015) recommend around 0.8–1.2 acres per 1,000 people, or 0.15–0.25 m² of commercial space per person at different planning levels, which aligns closely with international averages but adjusts for higher densities.

In contrast, Pakistan follows the planning standard of 1 acre per 1,000 people (≈4 m² per capita) as defined in the National Reference Manual (NRM) of Planning Standards. This ratio is relatively higher than international averages, but it reflects the low- to medium-density settlement pattern in Pakistan, where commercial activity is plot-based, spread across bazaars, and rarely concentrated in multi-story retail complexes. The higher allocation ensures sufficient land for wholesale markets, truck terminals, and service-related commercial activities that are spatially more land-intensive than in compact, high-rise urban models. It also provides flexibility for future expansion of economic activity, recognizing that Pakistan's urban centers often evolve organically with scattered, mixed-use growth rather than tightly zoned systems.

On this Basis, the commercial total area from the Bajaur district was calculated:

Table 36: Required Total Commercial of Bajaur District

Commercial Area Requirement (Till-2045) Using NRM Standard				
Name	***Total Population 2045***	***Existing Area/Acre***	***Area Required 2045/Acre***	***Standard***
Khar Urban Area	265,713	273.64	265.71	1-Acre for 1000 Population
Vc Lara Dandok	42,930	48	42.93	
Vc Gardai	58,880	10.88	58.88	
Nawagai	39,726	37.53	39.72	
Mamund	47,120	3.78	47.12	
Barang	27,636	3.97	27.63	

Salarzai	39,861	71.62	39.86	

Source: Developed by Consultant, 2025

6.2.2.1 Analysis of LSA of Commercial Area

After calculating the required total area, it is important to identify which land is suitable for the provision of a commercial area. To perform LSA, it is important to develop a set of criteria that help identify the area. (Refer to chapter 5, section 5.2.2.)

6.2.2.2 Proposed Commercial Areas

The following table explains the proposed commercial activity in each tehsil

Table 37: Total Proposed Commercial Area in Bajaur District

Settlements	Type of Commercial Activity	Total Area (Acres)
Khar Urban Centre	Proposed Commercial Zone	39.59
	Proposed Mixed Use Zone	937.32
Vc Lara Dandok	Proposed Commercial Zone	5.42
	Proposed Grain Market	4.96
Vc Gardai	CBD	13.22
	Proposed Commercial Zone	33.07
	Proposed Grain Market	4.19
Nawagai	Proposed Commercial Zone	2.36
Mamund	Proposed Commercial Zone	22.01
	Proposed Grain Market	3.40
Barang	Proposed Commercial Zone	27.20
	Proposed Grain Market	2.80
Salarzai	Proposed Commercial Zone	25.05

Source: Developed by Consultant, 2025

- ***Khar Urban Centre***

Khar Urban Centre, the district headquarters and primary administrative and urban centre of Bajaur District, has been allocated 9.59 acres within the proposed Commercial Zone and 937.32 acres within the proposed Mixed-Use Zone. All proposed Commercial and Mixed-Use allocations are in line with the approved Master Plan for Khar Urban Centre, ensuring consistency between district- and city-level planning frameworks. The allotment is intended to support both existing commercial activity and anticipated future demand for retail, office, institutional, and residential uses. The mixed-use zoning also provides capacity for housing development, ensuring accommodation for a growing urban population and workforce as urbanisation progresses.

The zoning focuses commercial and mixed-use growth within the district's primary urban node, emphasising efficient land use, accessibility, functional integration, and agglomeration benefits. By allowing residential uses alongside commercial and service functions, the mixed-use framework promotes a compact urban form, reduces travel demand, and supports walkable, integrated neighbourhoods while limiting uncontrolled outward expansion.
The proposed land-use allocation strengthens Khar's role as the principal economic, administrative, and service hub of the district, as reflected in centrality and accessibility considerations, and ensures the long-term viability, resilience, and sustainability of the district's economic base.

- ***Salarzai Potential Settlement***

Salarzai, identified as a potential settlement within Bajaur District, has been allocated 25.05 acres within the proposed Commercial Zone. The allocation is intended to support the development of commercial activities as the settlement grows and to accommodate anticipated future demand for retail, office, and service-oriented uses.
The zoning focuses commercial growth in Salarzai to encourage planned development, efficient land use, and accessibility. Establishing commercial infrastructure in this emerging settlement will strengthen its role as a local service node, providing basic economic and service functions for surrounding rural areas. This allocation ensures that Salarzai can develop in an organised manner, supporting the district's broader objective of balanced and sustainable spatial development.

- ***Mamund Potential Urban Centre***

Mamund, identified as a potential urban centre within Bajaur District and planned for urbanisation by 2045, has been allocated 22.01 acres within the proposed Commercial Zone and 3.40 acres for a proposed Grain Market. These allotments are intended to support the development of commercial and agro-market activities, accommodating anticipated future demand for retail, services, and agricultural trade as the settlement evolves.
The zoning focuses on commercial and market growth in Mamund to guide planned urban development, efficient land use, and accessibility. Establishing these facilities will strengthen Mamund's role as a future sub-regional economic and service hub, providing commercial, market, and service functions for surrounding rural areas. This allocation ensures that Mamund can grow in an organised, phased, and sustainable manner, aligning with the district's long-term objective of balanced spatial development and polycentric urban growth.

- ***Barang Potential Urban Centre***

Barang, identified as a potential settlement within Bajaur District, has been allocated 27.20 acres within the proposed Commercial Zone and 2.80 acres for a proposed Grain Market. These allotments are intended to support the development of commercial and agro-market

activities, meeting current needs and anticipated future demand in retail, services, and agricultural trade.

The zoning focuses on commercial and market growth in Barang to encourage planned development, efficient land use, and accessibility. Establishing these facilities in the settlement will strengthen its role as a local economic and service node, providing commercial and market functions for surrounding rural areas. This allocation ensures that Barang can develop in an organised and sustainable manner, contributing to the district's broader objective of balanced spatial development.

- ***Nawagai Potential Urban Centre***

Nawagai, identified as a potential urban centre within Bajaur District, has been allocated 2.36 acres within the proposed Commercial Zone. The allotment is intended to support the development of commercial activities, meeting anticipated future demand for retail, services, and local economic functions as the settlement evolves.

The zoning focuses commercial growth in Nawagai to guide planned urban development, efficient land use, and accessibility. Establishing commercial infrastructure in this emerging urban centre will strengthen its role as a future sub-regional service and economic hub, providing commercial and service functions for surrounding rural areas. This allocation ensures that Nawagai can grow in an organised, phased, and sustainable manner, aligning with the district's long-term objective of balanced spatial development and polycentric urban growth.

- ***VC Gardai Potential Urban Centre***

VC Gardai, identified as a potential urban centre within Bajaur District, has been allocated 13.22 acres for the Central Business District (CBD), 33.07 acres for the proposed Commercial Zone, and 4.19 acres for a proposed Grain Market. These allotments are intended to support the development of commercial, administrative, and agro-market activities, accommodating anticipated future demand as the settlement evolves into a fully functional urban centre.

The zoning focuses growth in VC Gardai to guide planned urban development, efficient land use, and accessibility. Establishing commercial, CBD, and market infrastructure will strengthen VC Gardai's role as a future sub-regional economic and service hub, providing employment, retail, and service functions for surrounding rural areas. This allocation ensures that VC Gardai can develop in an organised, phased, and sustainable manner, aligning with the district's long-term objective of balanced spatial development and polycentric urban growth.

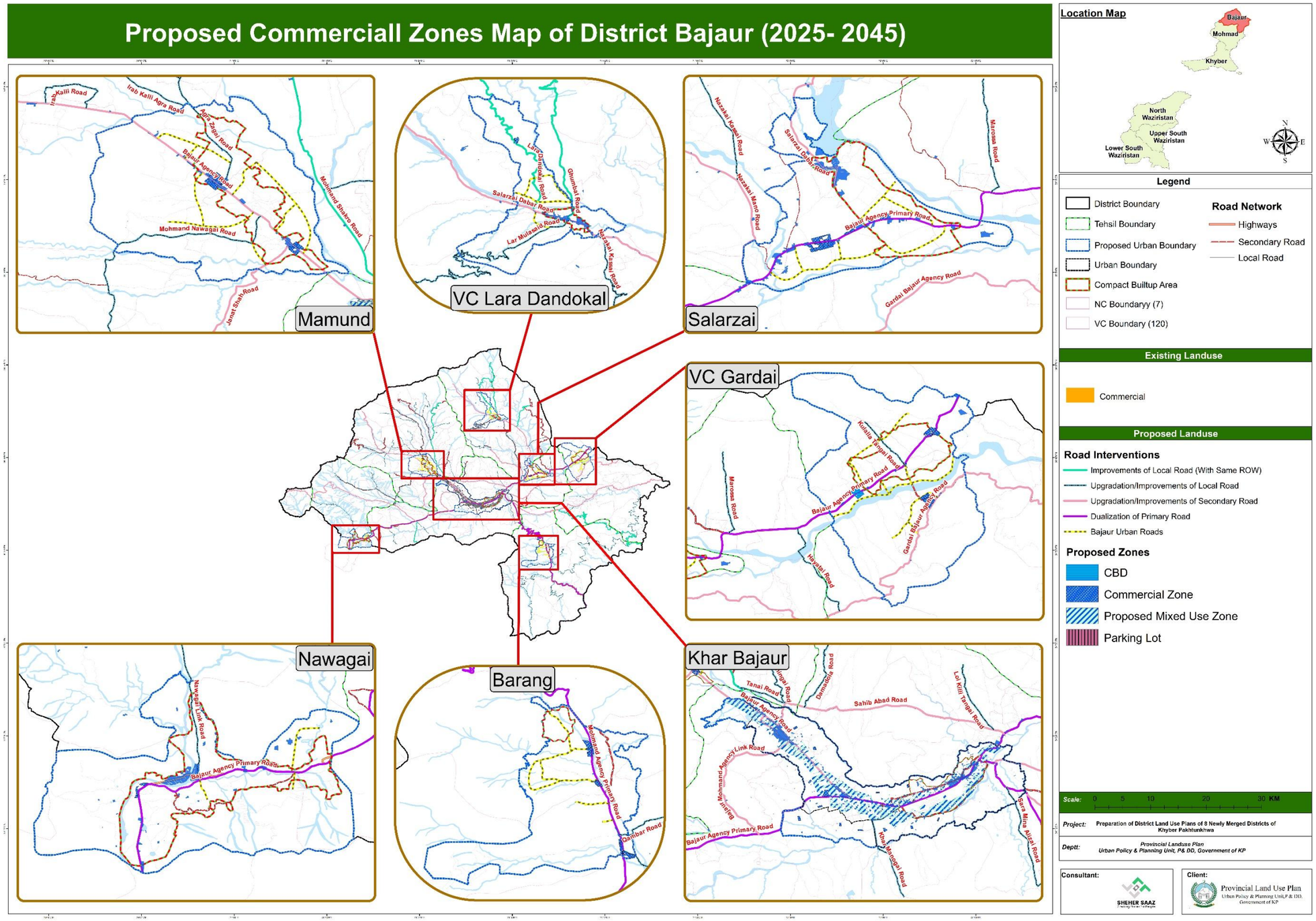
- ***VC Lara Dandok Potential Urban Centre***

VC Lara Dandok, identified as a potential urban centre within Bajaur District, has been allocated 5.42 acres within the proposed Commercial Zone and 4.96 acres for a proposed Grain Market. These allotments are intended to support the development of commercial and

agro-market activities, accommodating anticipated future demand as the settlement evolves into a fully functional urban centre.

The zoning focuses on commercial and market growth in VC Lara Dandok to guide planned urban development, efficient land use, and accessibility. Establishing these facilities will strengthen VC Lara Dandok's role as a future sub-regional service and economic hub, providing commercial and market functions for surrounding rural areas. This allocation ensures that VC Lara Dandok can develop in an organised, phased, and sustainable manner, aligning with the district's long-term objective of balanced spatial development and polycentric urban growth.

Map 31: Proposed Commercial Map of District



6.2.3 Future Strategies, Constraints, and Recommendations

The future development is divided into three phases so that development can be controlled and refined.

6.2.3.1 Short Term

The building by laws of KPK needs to be put in immediate action according to which certain road width will be standardized and will help in traffic inflow and is one of the major Short Term Development Project.

Table 38: Commercial Regularizations for the major road Short Term

S.No	Types	Name of Road	Setback and Height building	Commercial Buffer	TOD Buffer
1	Type A	Ring road	Setback=50 feet (Mandatory) Height of building = 100 feet OR The setback=60 feet (Optional) Height of building = 160 feet	Approx. 250 Feet	----
2	Type-B	Major Arterial Roads	Setback=25 feet (Mandatory) Height of building=80 feet OR The setback = 30 feet (Optional) Height of building = 120 feet	Approx. 250 Feet	Approx. 650 Feet
3	Type-C	All canals, patrolling, and other roads,	(ROW + Setback) *1.5		

- ***Type A Roads (e.g., Bajaur Agency Road)***

- Commercial Development Buffer:250 feet on both sides
- Mandatory Setback: 50 feet
- Maximum Building Height: 100 feet
- Incentive for Increased Setback: If the setback is increased to 60 feet (optional), the building height can be extended to 160 feet.
- Objective: Encourages greater setbacks to promote vertical development while maintaining urban aesthetics and smooth traffic flow.

- ***Type B Roads (e.g., GT Arang Road)***

- Commercial Development Buffer: 250 feet on both sides
- Mandatory Setback: 25 feet
- Maximum Building Height: 80 feet

- Incentive for Increased Setback: If the setback is increased to 30 feet (optional), the building height can go up to 120 feet.
- Objective: Ensures a balance between urban density and road functionality by maintaining clear sightlines and preventing congestion along these major corridors.

➢ ***Type C Roads (e.g., Canal Patrolling Roads and Other Roads)***

- Building Height Formula: (Right of Way (ROW) + Setback) * 1.5

Objective: Links permissible building height directly to ROW and setback, ensuring proportional vertical development. This regulation accommodates the unique characteristics of canal-side roads, maintaining a balance between commercial activity, environmental considerations, and spatial planning. Adhering to the Jamrud Master Plan is essential, as it will facilitate the establishment of the district's first major linear commercial development while significantly enhancing local GDP growth.

6.2.3.2 Medium Term

Table 39: Medium Term Proposals

Settlement	Status	Type of Commercial Activity	Area (Acres)	Medium-Term Justification / Function
Khar Urban Centre	Existing Urban Centre	Proposed Commercial Zone	39.59	Strengthens Khar's established role as the district's primary commercial and service hub; accommodates expanding retail, offices, and mixed commercial uses driven by population growth and administrative functions.
		Proposed Mixed-Use Zone	937.32	Promotes compact and efficient urban expansion by integrating commercial, residential, and institutional uses; supports densification, reduces travel demand, and maximizes infrastructure efficiency in the existing urban core.

VC Lara Dandok	Potential Urban Centre	Proposed Commercial Zone	5.42	Supports transition from rural settlement to an emerging urban node; meets growing daily retail and service needs; reduces dependency on Khar for basic commerce.
		Proposed Grain Market	4.96	Strengthens agro-trade and marketing facilities; supports farmers and local producers; enhances rural–urban economic linkages during urban transition.
VC Gardai	Potential Urban Centre	CBD	13.22	Develops a secondary commercial core with higher-order trade and services; supports administrative, business, and service functions at the tehsil level.
		Proposed Commercial Zone	33.07	Accommodates expanding retail and service demand; supports population growth and urban consolidation in Gardai.
		Proposed Grain Market	4.19	Preserves agricultural trade functions while urbanization occurs; strengthens agro-based livelihoods and market access.
Nawagai	Potential Urban Centre	Proposed Commercial Zone	2.36	Provides essential commercial services for surrounding settlements; supports compact urban growth and gradual upgrading to urban centre status.
Mamund	Potential Urban Centre	Proposed Commercial Zone	22.01	Facilitates emergence of Mamund as a tehsil-level service centre; supports retail, services, and local employment generation.
		Proposed Grain Market	3.40	Anchors agro-economic activity; improves storage, trading efficiency, and farmer incomes during urban transition.

6.2.3.3 Long Term

Table 40: Long Term proposals

Settlement	Status	Type of Commercial Activity	Area (Acres)	Long-Term Justification / Function
Barang	Potential Settlement	Proposed Commercial Zone	27.20	Activated in the long term as settlement population and connectivity increase; supports corridor-based trade along regional routes; contributes to balanced spatial growth across the district.
		Proposed Grain Market	2.80	Establishes a structured agricultural trade facility; supports long-term agro-economic development and rural livelihood sustainability.
Salarzai	Potential Settlement	Proposed Commercial Zone	25.05	Planned for gradual commercial development in response to future population growth; supports decentralized service provision and reduces long-term pressure on Khar Urban Centre.

The staging of commercial development in the District Land Use Plan has been designed to respond to the district's urban hierarchy, demographic trends, infrastructure capacity, and projected economic demand. The distinction between Medium-Term and Long-Term commercial allocations ensures that development occurs in a phased, demand-responsive, and spatially balanced manner, while avoiding premature land conversion and inefficient use of public investment.

In the **Medium Term**, commercial development is prioritized within the **Existing Urban Centre of Khar** and the identified **Potential Urban Centres**, namely **VC Lara Dandok, VC Gardai, Nawagai, and Mamund**. Khar functions as the district's principal administrative, commercial, and service centre, with an established market base, higher population concentration, and comparatively developed infrastructure. Medium-term commercial and mixed-use allocations in Khar are therefore justified to consolidate its economic role, support urban densification, and promote integrated land-use patterns that maximize the efficiency of existing infrastructure networks.

The inclusion of **Potential Urban Centres** in the medium-term staging reflects their strategic locations, emerging population growth, and increasing functional importance within the district's settlement system. Commercial allocations in VC Lara Dandok, VC Gardai, Nawagai, and Mamund are intended to facilitate their gradual transformation into secondary urban nodes capable of serving surrounding rural catchments. These allocations address daily retail and service requirements, while designated Central Business District (CBD) functions in VC Gardai support higher-order commercial and administrative activities. The provision of grain markets within selected centres ensures the continuation of agro-based economic functions, strengthens rural–urban economic linkages, and supports local livelihoods during the transition from rural to urban character. This medium-term strategy promotes a **polycentric development pattern**, reduces excessive dependence on Khar, and improves spatial equity in access to employment and services.

In contrast, **Long-Term commercial development** is reserved for **Potential Settlements**, specifically **Barang and Salarzai**, where existing population thresholds, market activity, and infrastructure availability do not yet justify significant commercial intensification. Deferring commercial development in these settlements ensures that growth remains demand-driven and infrastructure-led, thereby minimizing the risk of underutilized commercial land, scattered development, and inefficient service provision. Long-term commercial allocations in Barang and Salarzai are intended to respond to future population growth, enhanced regional connectivity, and emerging economic opportunities, particularly along transport corridors and regional development axes.

Overall, the medium- and long-term staging framework supports orderly urban expansion, protects agricultural land from premature conversion, and aligns commercial development with realistic demand and service capacity. By consolidating Khar as the primary urban centre, strengthening potential urban centres in the medium term, and activating potential settlements in the long term, the plan establishes a balanced, resilient, and sustainable commercial development structure for the district.

6.3 INDUSTRIAL ZONES

6.3.1 Existing Industrial Profile of the District

As per the development statistics of 2022, there were 42 total units in Bajaur district in 2019-20, out which 36 were running, however, in 2020-21, the total number of industrial units increased to 71 and all are functional. The district does not have any formal industrial sector but its industries range from woodworks and mills to marble production and cement industry, each contributing uniquely to the region's development.

Table 41: Total Running Industry in Bajaur District

District	2021-2022			2022-2023			2023-2024		
Bajaur	Total	Running Unit	Closed Unit	Total	Running Unit	Closed Unit	Total	Running Unit	Closed Unit
	73	65	8	73	65	8	71	67	4

Source: KPK Statistics 2025

6.3.1.1 By Size (Small, Medium, Large)

Industries can be categorized into three primary types based on scale, capital investment, and technological intensity: small, medium, and large. Small industries employ fewer than 50 people and have lower investment levels. Medium industries employ between 50 and 250 people and require moderate investment. Large industries, on the other hand, employ over 250 people and necessitate significant capital.

According to the Bajaur Chamber of Commerce and Industry, there are approximately 200-250 small and large-scale industries in Bara, providing jobs to thousands of people in Bara Tehsil. Additionally, at least 39 silk power looms (light industry) operate in Bara, employing about 6,000 workers, classifying them as medium industries due to the average number of employees per loom being 153 persons.

BajaurAgency has a limited industrial base, with only three significant large industrial units: Bara Ghee Mills and two cigarette factories, One More Cigarette Factory and Tatara Cigarette Factory, employing an estimated total of 800 people. Other small silk processing units, considered cottage industries, are in Alam Gudar Bara.

6.3.1.2 Classification of Industries by Type

The industries are divided into three primary types based on their scale, capital investment, and technological intensity: light, medium, and heavy industries.

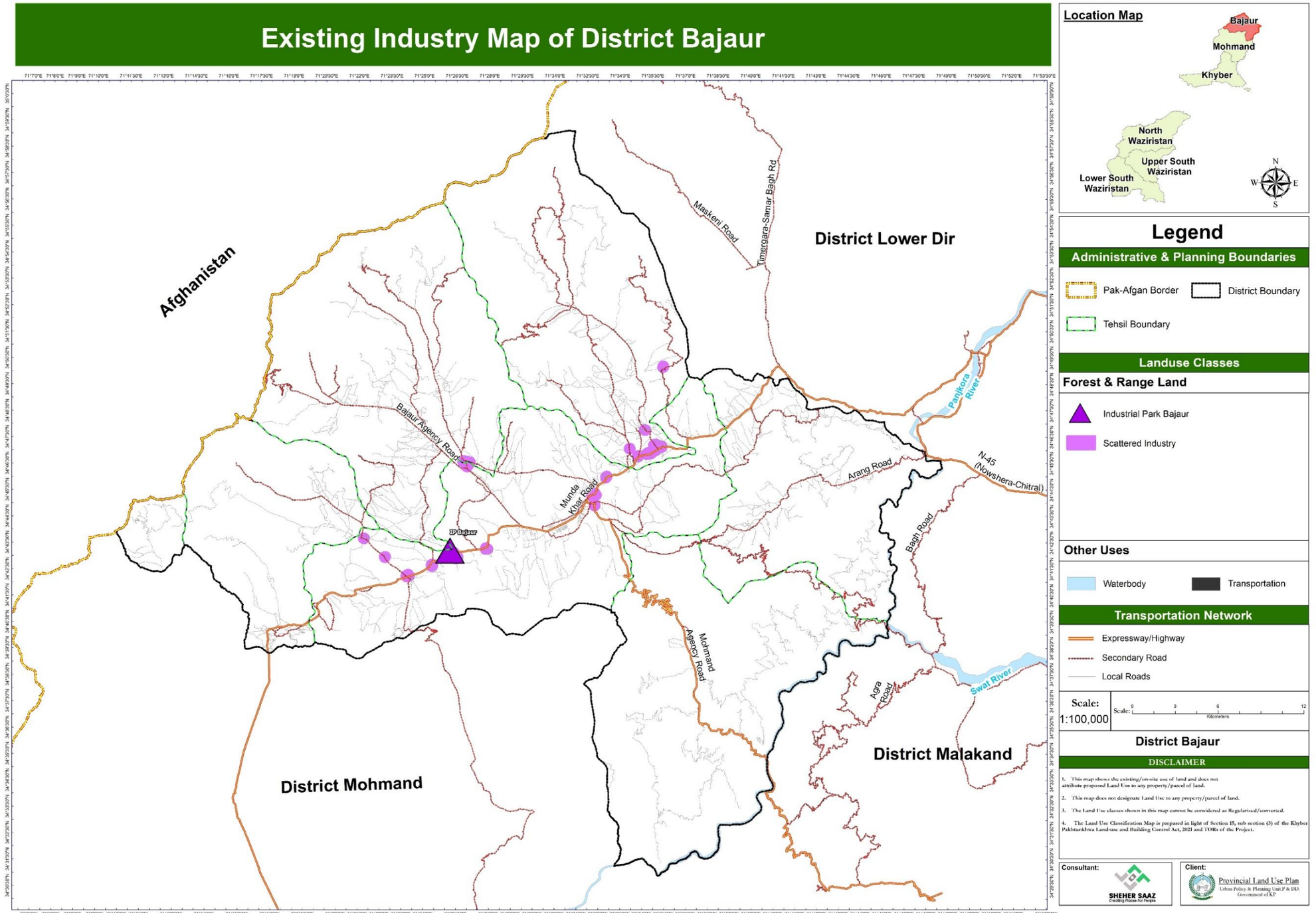
- **Light Industries:** Characterized by relatively small-scale operations, lower capital investment, and a focus on consumer goods, light industries typically employ labor-intensive processes.

- **Medium Industries:** These industries require a moderate level of capital investment and technology. They often produce intermediate goods used by other industries or consumer durables.
- **Heavy Industries:** Characterized by large-scale operations, substantial capital investment, and complex technological processes, heavy industries primarily focus on basic industrial goods. These industries are often resource-intensive and play a crucial role in supporting the broader economy.

Most of the industries are located in Khar as there are 46 different types of industries and factory units, serving as a source of livelihood. Major types of industrial units that exist are woodworking/furniture, metal works (steel and iron related industry, making gates, doors, windows), cement industry-making construction materials (block maker, brick maker), marble factories, and mills. The major types of industrial units that exist in Khar are:

- **Woodworking and Furniture**: This sector is significant in Khar, producing a wide range of wooden products, including furniture, which supports local craftsmanship and trade.
- **Metalworks**: This includes industries related to steel and iron, focusing on the manufacturing of gates, doors, and windows. These products are essential for both residential and commercial construction, making metalworks a crucial component of the local economy.
- **Cement Industry**: The production of construction materials, such as blocks and bricks, is a major industrial activity. The cement industry can support infrastructure development and is vital for the region's growth.
- **Marble Factories**: Marble production is another key industry, involving the extraction and processing of marble. These factories can contribute significantly to the construction and export sectors, providing high-quality materials for various uses.
- **Mills**: Various types of mills operate in Khar, processing different raw materials into finished products. These mills can support local agriculture and other industries by providing necessary processing services.

Map 32: Existing Industry - District Bajaur



6.3.2 Existing and Future Industrial Plans

Bajaur District is undergoing a period of development with several initiatives aimed at boosting its economy, vocational education and training and improving the livelihood of its residents.

- ***Establishment of Vocational Training Centers/Institutes in Bajaur Agency, NWA and FR Kohat***

The establishment of vocational training centers in Bajaur Agency, North Waziristan (NWA), and FR Kohat represent a significant step toward enhancing the employability of the local workforce. The Board of Directors approved this project on September 15, 2017, with a total estimated cost of 156.6 million rupees. For the fiscal year 2022-23, an allocation of 16.06 million rupees was made to support the development and operationalization of these centers. The initiative aims to provide specialized training in various trades, thus fostering skill development and improving job prospects in the region.

- ***Introduction of B.Tech Program at Govt. College of Technology Khar***

The Govt. College of Technology in Khar District, Bajaur, is set to introduce a B.Tech program, a move aimed at advancing technical education in the area. With a projected cost of 199.9 million rupees, this program is expected to enhance the academic and professional opportunities available to students. For the fiscal year 2022-23, 46.3 million rupees have been allocated to kickstart the program. This initiative underscores the commitment to fostering higher education and technical expertise among the youth in Bajaur.

- ***Accelerated Skill Development Program for Merged Areas***

To address the skill gap and boost local employment, the Accelerated Skill Development Program for Merged Areas has been launched with a comprehensive budget of 700 million rupees. The program is designed to accelerate skill acquisition and improve the employability of the local population. For the fiscal year 2024-25, a substantial allocation of 50 million rupees has been earmarked to support this initiative. The program's focus will be on equipping individuals with relevant skills to meet the demands of various industries and promote sustainable economic growth in the region.

- ***Improvement of Technical Institutes Infrastructure***

Recognizing the critical role of technical education, the government plans to enhance the infrastructure of existing technical institutes in the merged areas. This project, with an estimated cost of 210 million rupees, aims to upgrade facilities and improve the quality of technical education. For the fiscal year 2024-25, 100 million rupees have been allocated to initiate the necessary improvements. This investment reflects a strategic approach to strengthening the educational framework and supporting the development of a skilled workforce.

- ***Establishment of Small Industrial Estate at Bajaur***

The creation of a Small Industrial Estate in Bajaur is an important industrial development initiative, with the Project Concept-II (PC-II) already approved. The project has a total cost of 401 million rupees, with 86.5 million rupees allocated for the fiscal year 2023-24. The industrial estate aims to provide a conducive environment for small and medium-sized enterprises (SMEs), fostering industrial growth and creating job opportunities in the region. This development is expected to stimulate economic activity and contribute to the overall industrial landscape of Bajaur.

While these initiatives demonstrate a commitment to advancing Bajaur's development, the distribution of funding reveals varying priorities. The establishment of vocational training centers and the introduction of a B.Tech program signify a strong focus on enhancing technical education and skill development. However, the comparatively modest allocation for the Small Industrial Estate project suggests that industrial development may not be receiving equal attention. The substantial investment in skill development programs and the improvement of technical institute infrastructure highlight an emphasis on building human capital, which is crucial for long-term economic growth and job creation in the region.

6.3.3 Employment in the Industrial Sector

The employment situation in Bajaur District provides a comprehensive view of labor dynamics in a predominantly rural setting, as there is no urban population. The district's labor force participation rate is significant, with 279,400 individuals actively participating in the labor market out of a total adult population of 464,822. Of these, 263,700 are employed, resulting in a relatively low unemployment rate of 5.7%. However, a notable challenge is the high rate of informal employment, with 89.7% of the workforce engaged in informal economic activities. This heavy reliance on the informal sector suggests vulnerabilities to economic fluctuations and limited social protection for workers.

Despite this, the industrial sector remains a crucial component of the district's economy, employing 33.3% of the workforce. In contrast, the formal sector accounts for only 10.3% of employment, highlighting a significant gap in formal job opportunities and underscoring the need for strategies to increase formal employment. Addressing these issues requires concerted efforts to promote formal employment opportunities, particularly in the industrial sector, while simultaneously strengthening the informal economy through capacity building and skill development programs. Additionally, policies aimed at improving the business environment and attracting investments can play a pivotal role in fostering job creation and economic growth in the district.

This underscores the critical challenges faced by Bajaur District in terms of job creation, formalization, and poverty reduction. The heavy reliance on the informal sector implies vulnerabilities to economic shocks and limited social protection for workers. To address these issues, concerted efforts are required to promote formal employment opportunities, particularly in the industrial sector, while simultaneously strengthening the informal economy through capacity building and skill development programs. Additionally, policies aimed at

improving the business environment and attracting investments can play a pivotal role in fostering job creation and economic growth in the district.

Table 42: Employment Statistics by Industry Sector – Bajaur District

Indicator	Total	Urban	Rural
Population Over 18 Years of Age (person)	464,822	-	464,822
Labor Force (person)	279,400	-	279,400
Employed People (person)	263,700	-	263,700
Unemployment Rate (%)	5.7	-	5.7
Employment by Industry (%)	33.3	-	33.3
Activity Status (Formal) (%)	10.3	-	10.3
Activity Status (Informal) (%)	89.7	-	89.7

Source: Labor Force Statistics Survey, 2020-21

6.3.4 Current Industrial Area Gap

The current industrial area gap in District Bajaur has been calculated as follows:

Table 43: Current Industrial Area Gap – Bajaur District

Urban & Rural Population	**1,357,489**
Industrial Labor Force @5%	67874.45
Industrial Area Required (@40 Worker Per Acre)	1696.86
Current Area Under Industries	361.39
Industrial Area Deficiency	1335.47

Source: Calculated by Consultant, 2025

It is evident from the above calculations that the district is currently facing an industrial land deficit of 1335.7 acres. This significant shortfall highlights the urgent need for expansion through the establishment of new industrial estates and zones. Unless this deficiency is addressed alongside future industrial land requirements, the district will face increasing constraints on industrial growth, job creation, and economic diversification.

6.3.5 Future Industrial Area Requirement

The future industrial area requirement for District Bajaur has been projected on the basis of additional population growth and labor force participation. For the short-term plan period (2025–2030), the district is expected to add 183,236 people to its population. Applying a participation rate of 5 percent, this translates into an estimated 9,162 industrial workers, which would require an industrial area of about 229 acres.

In the long-term period (2031-2045), the additional population is projected at 649,187 persons, creating an industrial labor force of approximately 32,459 workers. Based on the standard of 50 workers per acre, the industrial area required for this phase comes to about 811 acres.

Overall, for the entire 2025-2045 plan period, the cumulative additional population is estimated at 832,422, generating an industrial labor force of 41,621 workers. To accommodate this, District Bajaur will require a total of nearly 1,041 acres of industrial land. This project clearly indicates a substantial demand for new industrial estates and planned zoning to ensure that industrial growth keeps pace with demographic and economic expansion in the district.

Table 44: Future Industrial Area Requirements – District

Parameters	Short-Term Plan (2025-2030)	Long Term-Term Plan (2031-2045)	Total (2025-2045)
Additional Population	183236	649187	832422
Industrial Labor Force	9161.78	32459.35	41621
Industrial Area Required	229.04	811.48	1041

Source: Calculated by Consultant, 2025

The future industrial area requirement for urban areas in District Bajaur has been projected on the basis of additional population growth and labor force participation. For the short-term plan period (2025–2030), the urban areas are expected to add 27,087 people to its population. Applying a participation rate of 5 percent, this translates into an estimated 1,354 industrial workers, which would require an industrial area of about 34 acres.

In the long-term period (2031-2045), the additional population is projected at 196,886 persons, creating an industrial labor force of approximately 9,844 workers. Based on the standard of 50 workers per acre, the industrial area required for this phase comes to about 246 acres.

Table 45: Future Industrial Area Requirement in Urban Settlements – Bajaur District

Area	Requirement (acres)
Khar Urban Area	332.14
Vc Lara Dandok	53.66
Vc Gardai	73.60
Nawagai	49.66
Mamund	58.90
Barang	34.55
Salarzai	49.83

Source: Calculated by Consultant, 2025

6.3.6 Proposed Industrial Area

To meet the projected demand for industrial land in urban areas of District Bajaur (estimated at 565.40 acres over 2026-2045), a comprehensive land suitability analysis was conducted. However, the analysis revealed very limited suitable land, as large-scale industrial development cannot be allocated in every potential settlement due to constraints like terrain, environmental sensitivity, and infrastructure access. As a result, highly suitable land was identified and designated strategically located near existing industries or active mining sites to leverage current economic activities, transportation networks, and workforce proximity. This allocation comfortably exceeds and meets the required 565.40 acres, ensuring efficient, sustainable industrial growth while minimizing new environmental impacts and supporting seamless integration with urban residential expansions.

Area	Requirement (acres)
Khar Urban Area	112.52
Vc Lara Dandok	39.32
Vc Gardai	61.03
Nawagai	39.94
Mamund	50.82
Barang	37.59
Salarzai	34.26

6.3.6.1 Location-Specific Planning

Table 46: Type of Industries Proposed in District Bajaur

Settlement / Area	Minerals Identified	Proposed Industrial Typology	Suitable Industries	Planning & Zoning Remarks
Khar Urban Area	Chromite, Marble, Granite	Medium & Light Industry (Value-Addition & Urban-Compatible)	Marble and granite cutting, polishing and tiles; chromite beneficiation (non-smelting); stone-based construction materials	Existing urban centre; heavy mineral processing to be restricted; emphasis on clean, value-addition industries; adequate buffers, traffic management, and environmental safeguards required.

VC Lara Dandok	Chromite, Granite, Copper	Medium Industry (Mineral Processing)	Chromite beneficiation, granite processing, copper concentration and semi-processing	Emerging urban centre; industries to be located outside residential areas with controlled access; suitable for planned industrial estate with shared infrastructure and environmental controls.
VC Gardai	Granite	Light to Medium Industry (Stone-Based)	Granite cutting, polishing, tiles, slabs, decorative stone products	Potential urban centre; compatible with stone-based SMEs; focus on low-impact processing; buffer zones to protect nearby settlements.
Nawagai	Chromite, Granite, Marble, Nephrite, Manganese	Medium Industry (Multi-Mineral & Stone Cluster)	Marble and granite processing, nephrite handicrafts, chromite and manganese beneficiation, stone products	Identified as a diversified mineral zone; suitable for cluster-based industrial development; strict environmental management and transport planning required due to multi-mineral activity.
Mamund	Granite	Light to Medium Industry (Stone Processing)	Granite cutting, polishing, tiles, paving stones, construction aggregates	Potential urban centre; SME-focused development; industries to be planned with controlled expansion and environmental safeguards.
Barang	Copper, Quartz, Chromite,	Medium to Heavy Industry (Multi-	Copper beneficiation, quartz processing, chromite	Long-term industrial node; corridor-based development recommended;

	Granite, Emerald	Mineral Processing)	beneficiation, granite products, gemstone cutting and polishing	gemstone units to be separated from heavy processing; robust environmental and logistics planning required.
Salarzai	Granite, Potash	Medium Industry (Industrial Minerals)	Granite processing, potash-based inputs, industrial mineral products	Long-term potential settlement; phased industrial development; industries to be linked with future infrastructure upgrades and regional connectivity.

6.3.6.2 Rationale for Industrial Zoning in District Bajaur

The industrial zoning strategy for District Bajaur has been formulated in accordance with the objectives of the **Khyber Pakhtunkhwa Industrial Policy** and the **KP Minerals Policy**, which emphasize value addition at source, cluster-based industrial development, employment generation, environmental sustainability, and balanced regional growth. The proposed industrial areas are aligned with the district's mineral endowment, settlement hierarchy, and infrastructure capacity to ensure orderly and economically viable industrialization.

Industrial activities in **Khar Urban Area**, the district's primary urban and administrative centre, are restricted to **light and medium, urban-compatible industries** in line with policy directives discouraging environmentally hazardous and heavy processing within urban limits. Emphasis is placed on stone cutting, polishing, and non-smelting beneficiation activities that support downstream value addition while minimizing environmental and social impacts. This approach supports industrial productivity without compromising urban livability.

The designation of **VC Lara Dandok, VC Gardai, Nawagai, and Mamund** as locations for **medium-scale and cluster-based mineral industries** reflects the KP Industrial Policy's focus on developing **specialized industrial clusters** near raw material sources. These areas possess significant deposits of chromite, granite, marble, nephrite, and manganese, making them suitable for stone processing, mineral beneficiation, and handicraft-based industries. Cluster-based development in these settlements promotes shared infrastructure, reduces production costs, formalizes artisanal mining activities, and enhances compliance with environmental regulations as envisaged under the KP Minerals Policy.

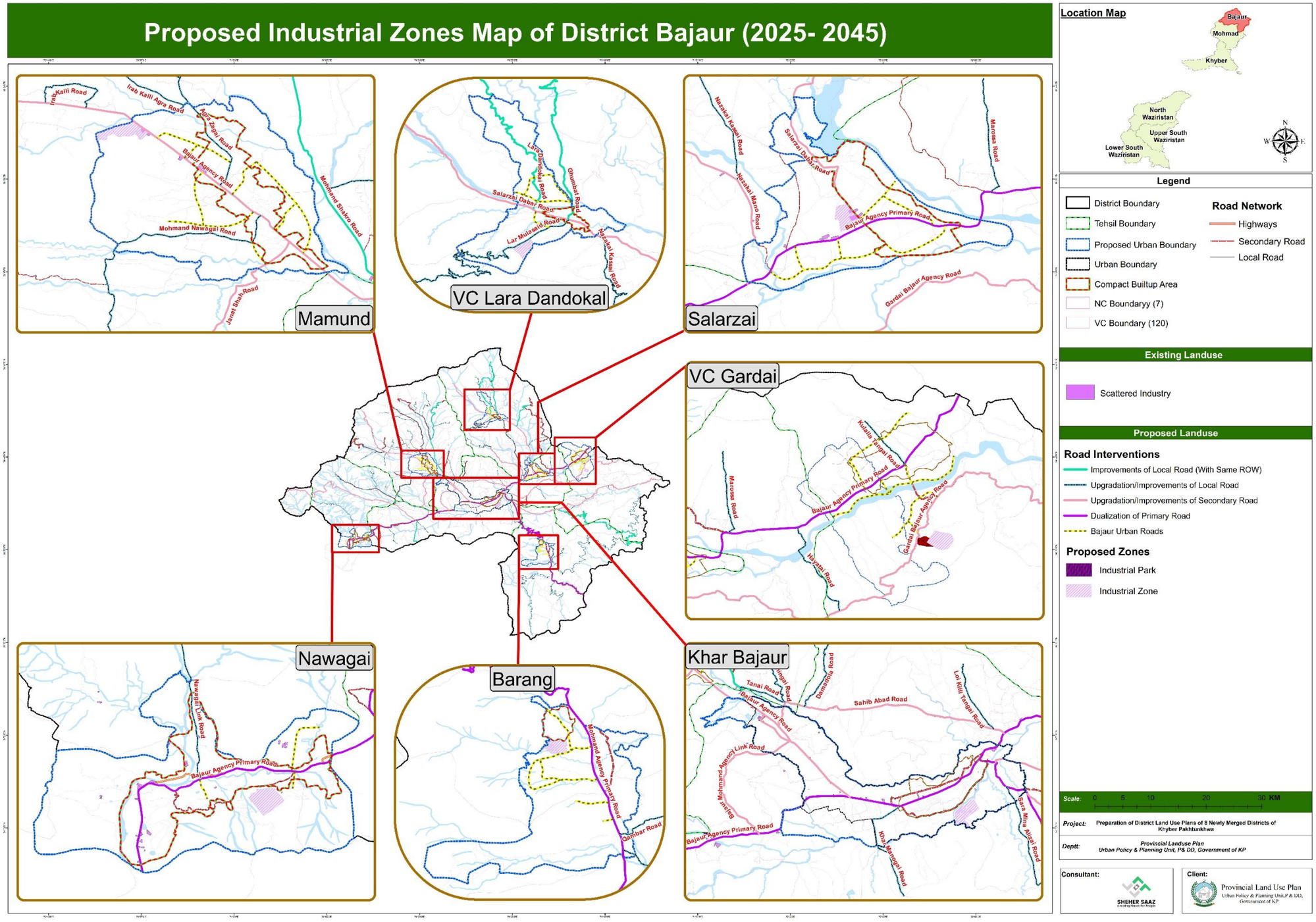
Nawagai has been identified as a diversified multi-mineral zone, justifying the development of a structured mineral processing cluster with strengthened environmental management

and transport planning. This aligns with policy objectives of regulating mineral extraction, improving recovery rates, and encouraging downstream processing rather than raw mineral export.

Barang and Salarzai, identified as long-term industrial locations, are aligned with the policy principle of **phased and infrastructure-led industrial expansion**. These areas possess significant multi-mineral potential, including copper, chromite, quartz, emerald, granite, and potash, but require improved connectivity, utilities, and environmental safeguards before large-scale industrialization. Long-term zoning in these areas prevents premature land conversion and ensures that future industrial growth is demand-driven, sustainable, and compliant with regulatory frameworks.

Overall, the proposed industrial zoning for District Bajaur supports the KP Government's strategic shift from extractive to **value-added, environmentally responsible, and employment-intensive industrial development**. By aligning industrial typologies with mineral resources, settlement capacity, and policy priorities, the plan establishes a resilient and sustainable framework for mineral-based industrial growth in the district.

Map 33: Proposed Industrial Zones



6.4 SOCIAL INFRASTRUCTURE

6.4.1 Educational Facilities

6.4.1.1 Existing Educational Institutions

The educational landscape of District Bajaur presents a multifaceted scenario characterized by a strong primary education network but notable attrition and limited infrastructure at higher levels of education. The district currently hosts 543 primary schools with a substantial enrollment of 124,181 students and 1,192 teachers, indicating a well-established foundation phase that caters to the basic educational needs of the majority of the population. However, this large student base begins to narrow significantly at the middle school level, where only 109 schools serve 21,434 students, supported by 424 teachers. This sharp decline highlights potential barriers related to student retention, access, or transition between educational stages.

At the high school tier, the number of schools reduces further to 44, with 7,633 students and 460 teachers, underscoring a continuing drop in student participation that may reflect socioeconomic challenges, infrastructure limitations, or cultural factors impacting educational continuity. The relatively low student population at this level signals the need for targeted interventions to improve accessibility and retention.

Higher education facilities in the district include seven colleges with 3,377 students and 155 teachers, as well as four government degree colleges serving 3,006 students with 71 teachers, offering both genders co-educational opportunities. Nonetheless, the existence of only one post-graduate college, which is male-only and accommodates 2,357 students with 35 teachers, reveals a constrained scope for advanced studies and gender imbalance at the postgraduate education level.

Vocational education is represented by a sole female-only institute with 512 students and 5 teachers, suggesting an emerging focus on skill development for women, albeit on a limited scale. This signals potential for growth in vocational training programs tailored to female learners to enhance their socio-economic empowerment.

6.4.1.2 Accessibility Analysis

Accessibility to educational institutions is assessed through two approaches: walkability distance and driving distance. For walkability, different speeds are considered based on age groups, since younger children and older students have varying mobility levels. For primary school students, a speed of 3.5 km/h is used, which corresponds to an effective walking range of 600–800 m. For secondary and high school students, a standard adult speed of 5.0 km/h is applied, giving a reasonable walking range of 800 m–1 km. These buffers represent the maximum distance students can realistically cover on foot without difficulty[1].

[1] Mansour, S. (2016). Spatial analysis of public health facilities in Riyadh Governorate, Saudi Arabia: A GIS-based study to assess geographic variations of service provision and accessibility. *Geo-spatial Information Science*, 19(1), 26-38.

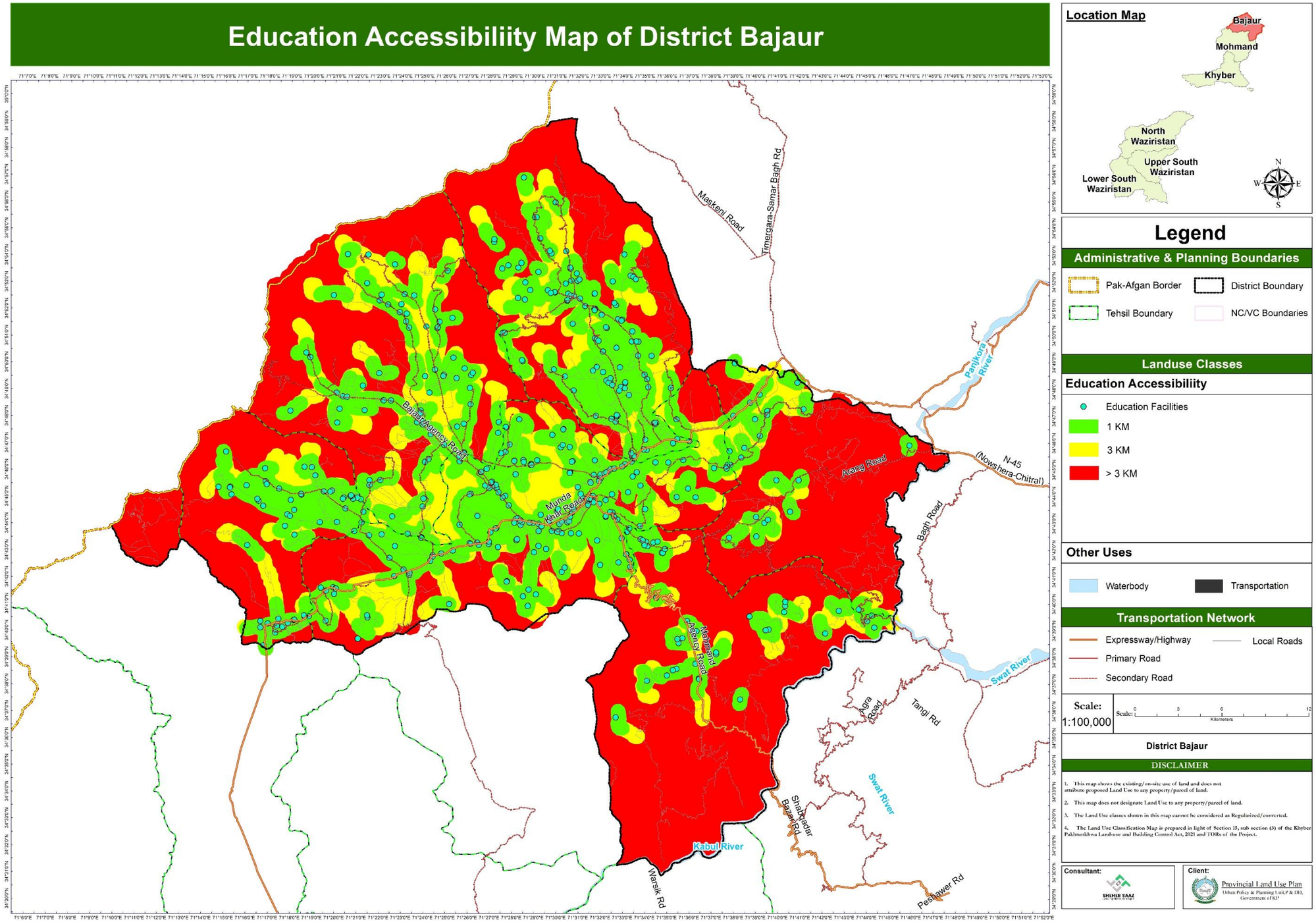
In contrast, for vehicular accessibility, a speed of 30 km/h is assumed to reflect the mixed road conditions common in urban and peri-urban areas of Bajaur District. At this speed, a 10-minute travel time translates to a service radius of approximately 6 km, which represents the effective catchment of schools when accessed by vehicles[2].

The walkable distance shows that many areas cannot access public educational institutes, however, if driving distance is used almost entire study area can access the available public educational institutes. This does not change the fact that with respect to the population, the number of schools are quite low, and more are required in the next twenty years. The following maps show accessibility of public educational institutions with respect to walkability and driving[3]. The analysis indicates that while the majority of settlements have access to educational facilities, certain areas remain underserved with limited accessibility. To address this imbalance, proposed educational zones have been designed to meet the calculated requirements and ensure that facilities are more equitably distributed and easily accessible to the community.

[2] Parvin, F., Ali, S.A., Hashmi, S.N.I., and Khatoon, A. (2020). Accessibility and site suitability for healthcare services using GIS-based hybrid decision-making approach: a study in Murshidabad, India. Spatial Information Research, 29(1), 1-18. https://doi.org/10.1007/s41324-020-00330-0

[3] Lawal, O., and Anyiam, F.E. (2019). Modelling geographic accessibility to Primary Health Care Facilities: combining open data and geospatial analysis. *Geo-spatial Information Science*, 23(1), 9-25. **https://doi.org/10.1080/10095020.2019.1645508**

Map 34: Existing Educational Facilities Accessibility – District Bajaur



6.4.1.3 National and International Education Policies and Planning Standards

6.4.1.3.1 National Standards

- ***National Reference Manual (NRM)***

According to the NRM standards, a primary school is required for a population of 7500. A middle school is required for a population of 17000, and a high school is required for a population of 74000. For a college, a population of 170,000-400,000 is required.

- ***Standards for Allocation of New Education Facilities***

According to the National Reference Manual for Planning and Infrastructure Standards, primary schools should be strategically positioned within existing or well-planned residential areas to ensure effective service to the community. Ideally, these schools should be within walking distance of homes but located away from busy roads to ensure safety. Secondary schools should be easily reachable by both vehicle and foot and should also be situated away from high-traffic roads to maintain security.

Both primary and secondary schools are considered essential residential amenities, and their locations should be carefully planned during the development of new housing schemes and areas. Colleges, universities, and other higher education institutions, which offer undergraduate and graduate programs, are best located in the Town Center to facilitate accessibility and integration into the community. The table below shows the location guidelines for establishing a new education institute.

Table 47: Location Guidelines for New Educational Institutes

Sr. No.	Educational Institution Type	Location Guidelines
1	Primary School	• Near existing and planned housing schemes • Located within walking distance from home • Commonly situated centrally within residential areas and away from busy roads • Catchment area for urban schools: 0.5-1 km • Catchment area for rural schools: up to 2.2 km
2	Secondary School	• Must have easy and good vehicular access and safe walking routes • Located away from schools of the opposite gender • Situated far from the main busy roads with fast and heavy traffic • Positioned on roads with favorable linkages to their catchment area • Catchment area for urban schools: 1.25-2 km • Catchment area for rural schools 5-10km
3	Intermediate College	• Catchment area for urban school - boys: 2.75-4 km • Catchment area for rural school - boys: 10-15 km • Catchment area for urban school - girls: 3.25-5 km
4	Degree College	Large City
5	University	Metropolitan City Area

Source: National Reference Manual of Planning and Infrastructure Standards (NRM)

- **Khyber Pakhtunkhwa Education Facility Planning Framework**

The planning, establishment, and upgradation of education facilities in Khyber Pakhtunkhwa are governed by provincial education policies, with specific provisions for backward and hilly areas. These policies define quantitative enrolment thresholds, population triggers, distance criteria, land requirements, and minimum infrastructure standards, ensuring equitable access to education while avoiding duplication of facilities.

Table 48: Education Planning Framework - KP Specific

Facility Type	Trigger / Eligibility Criteria	Distance / Catchment Criteria	Land Requirement	Key Infrastructure Requirements
Primary School (New)	Catchment population ≥ 800, ensuring minimum 80 students	No primary school within 1.5 km (waived if nearest school is overcrowded)	Urban: 1–2 Kanal Rural: 2 Kanal	6 classrooms, admin block, lavatories, water supply, electricity/solar, boundary wall (8 ft), play area
Primary School (Additional)	Village population > 5,000, existing school overcrowded and no expansion space	Distance condition waived	Same as above	Same as above
Secondary School (Grade VI–XII) ***(Backward & Hilly Areas)***	Feeder enrolment: • Class V: ≥50 boys / 40 girls • Class VIII: ≥25 boys / 20 girls • Class X: ≥100 boys / 80 girls • Minimum total: 175 boys / 140 girls	No secondary school within 5 km (waived if overcrowded); feeder schools within 2.5 km	Urban: 4 Kanal Rural: 8 Kanal	Academic blocks, labs, admin spaces; vertical construction (≤50% covered area)
Middle to High School Upgradation ***(Backward & Hilly Areas)***	Class VIII enrolment: • Proposed school: ≥10 boys / 8 girls • Feeder schools: ≥15 boys / 12 girls • Minimum Class IX intake: 25 boys / 20 girls	No high school within 3 km (waived if overcrowded); feeder schools within 2 km	9,000 sq ft available for expansion	3 classrooms, library, IT & science labs, exam hall, staff rooms
High to Higher Secondary Upgradation ***(Backward & Hilly Areas)***	• Class X enrolment (including feeder schools): ≥100 boys / 80 girls	No HSSC / college within 10 km (girls: 5 km); waived in urban areas	10,000 sq ft additional area	4 classrooms, Physics/Biology/Chemistry/IT labs; vertical construction

General Planning and Design Provisions

All education facilities must comply with general provisions relating to safety, accessibility, learning environment, and disaster resilience. These include solar power provision, emergency exits, accessibility for physically challenged students, ICT and multimedia facilities, boundary walls, play areas, and site selection based on school mapping and EMIS data. Furniture, fixtures, and equipment are to be provided in accordance with notified standards.

6.4.1.3.2 International Policies and Planning Frameworks

Internationally, education planning is increasingly based on evidence-driven, catchment-oriented frameworks rather than fixed "1 school per population" ratios. Countries such as Australia, the United States, New Zealand, and Qatar employ official policies and guidelines to ensure that new schools and expansions are aligned with projected enrolment, demographic trends, and community needs.

In Australia, the NSW Education Facilities Standards and Guidelines (EFSG) and Queensland's School Site Selection Guidelines determine school size and land requirements based on enrolment forecasts, with primary schools typically accommodating up to 1,000 students on 1.5–2 hectares and secondary schools up to 2,000 students on 2.5–4 hectares. The United States combines federal environmental siting guidelines (EPA) with state-level enrolment and land formulas, ensuring schools are sited safely with sufficient land area (e.g., primary schools 5–8 acres, secondary schools 10–25 acres) based on projected student numbers. New Zealand's network planning similarly forecasts school-age populations within defined catchments, with primary schools typically serving 400–500 students and secondary schools 800–1,200 students per catchment.

Qatar's National Master Plan (QNMP) integrates both population catchments and urban density to guide school provision. Primary school catchments range from 15,000–25,000 people, with walking distances of 750–1,500 meters, while secondary schools serve 30,000–60,000+ residents with access distances up to 2,250 meters. Across all four countries, planning emphasizes flexibility, catchment-based enrolment forecasting, land adequacy, accessibility, and safety, ensuring that schools are neither under- nor over-utilized. These international practices provide a robust framework for ensuring equitable access to education and can serve as benchmarks for comparing or aligning local policies, such as the KP education standards, with global best practices.

Table 49: International Education Policies and Planning standards[4][5][6]

Country / Policy	School Level	Planning Metric	Enrolment / Capacity Standard	Site / Land Requirement	Catchment / Distance
Australia – NSW (EFSG)	Primary	Classroom & facilities per student	1,000 students per school	1.5–2 ha	Catchment defined by local intake; adjustments for high-density urban areas
	Secondary	Classroom & facilities per student	2,000 students per school	2.5–4 ha	Catchment-based enrolment planning

[4] Qatar Education Master Plan https://www.sciencedirect.com/science/article/pii/S1195103624000156
[5] World Bank Guidelines for School https://documents.worldbank.org/en/publication/documents-reports/documentdetail/156591468333603141/guidelines-for-school-location-planning
[6] Internation education standard classification https://unesdoc.unesco.org/ark:/48223/pf0000098243?posInSet=8&queryId=31bdb56d-f010-4069-8db9-20ceeed2a618

Australia – Queensland	Primary	Forecast enrolment	80–100% utilization triggers new planning	1.5–2 ha	Defined local catchment
	Secondary	Forecast enrolment	80–100% utilization triggers new planning	2.5–4 ha	Catchment boundaries determine access
USA – Federal (EPA)	Primary / Secondary	Safety-based siting	N/A	N/A	Minimum distances from hazards: roads, fuel stations, high-voltage lines
USA – State (e.g., NYSED)	Primary	Land & enrolment sizing	100 students per 1 acre land + 5 acres base	5–8 acres	Feeder schools and local population
	Secondary	Land & enrolment sizing	1,500–2,000 students per school	10–25 acres	Feeder schools and projected enrolment
New Zealand – MoE Network Planning	Primary	Forecast enrolment	400–500 students per catchment	1–1.5 ha	Catchment-based enrolment planning
	Secondary	Forecast enrolment	800–1,200 students per catchment	2–3 ha	Catchment-based enrolment planning
Qatar – QNMP	Primary	Population-based catchment	15,000–25,000 per primary school (density dependent)	1–2 ha (urban)	Walking distance 750–1,500 m
	Secondary	Population-based catchment	30,000–60,000 per secondary school	4–5 ha	Walking distance 1,500–2,250 m

6.4.1.4 Future Requirement

6.4.1.4.1 Urban Centre, Potential Urban Centre and Potential Settlement

The assessment of education facilities across urban centres, potential urban centres, and potential settlements indicates that most areas currently have more institutions than the minimum population-based requirements, resulting in no existing gaps at any education level.

- ***Urban Centre***

The assessment of existing and future educational facilities for Khar Urban Centre has been carried out by comparing the available infrastructure with population-based requirements for the years 2025 and 2045, in accordance with NRM standards. In 2025, Khar Urban Area accommodates a population of 125,694, for which 17 primary schools are required. However,

the area currently has 42 primary schools, indicating that at the primary level, the existing provision is adequate and no immediate backlog exists. With the projected population increasing significantly to 265,713 by 2045, the future requirement rises to 35 primary schools. After accounting for existing facilities, an additional requirement of 10 primary schools emerges over the planning horizon. At the middle school level, only 4 facilities currently exist, whereas the 2025 population requires 7 middle schools, resulting in a current gap of 3 facilities. By 2045, the requirement increases to 16 middle schools, and when combined with the existing backlog, the total requirement rises to 19 middle schools, highlighting a substantial need for expansion in this category. For high schools, Khar Urban Area presently has 6 facilities, while the 2025 requirement is limited to 2 schools, indicating no current deficit. By 2045, the projected requirement increases modestly to 4 high schools, which can largely be accommodated within the existing stock; therefore, no significant future gap is identified at this level. At the higher secondary/college level, there are no existing institutions in Khar Urban Area. Based on the 2025 population, one facility is required, resulting in an immediate shortfall. With population growth by 2045, the requirement increases to two higher secondary or college-level institutions, leading to a total requirement of three facilities when both current and future needs are combined.

Table 50: Existing and Future Education Requirement for Khar - Urban Centre

Khar - Urban Centre							
Educational Facilities	***Existing facilities***	***Pop 2025***	***Existing Requirements***	**Current Gap Analysis**	***Pop 2045***	**Future Requirement as per NRM Standard**	**Total Requirement (Gap+Future)**
Khar Urban Area							
Primary	42	125694	17	N/A	265,713	35	10
Middle	4		7	3		16	19
High	6		2	N/A		4	N/A
Higher Secondary /College	0		1	1		2	3

- ***Potential Urban Centre***

The assessment of educational facilities for the potential urban centres of Mamund, Lara Dandokaii, and Gardai Utman Khel evaluates existing infrastructure against population-based requirements for 2025 and 2045, following NRM standards. The analysis identifies existing gaps and future needs to guide phased educational planning in line with projected urban growth.

- ***Mamund Urban Centre***

Mamund Urban Centre has a projected population of 26,552 in 2025, increasing to 47,120 by 2045. At the primary level, the centre currently has 6 schools, while the 2025 requirement stands at 4 schools, indicating adequate provision with no existing backlog. By 2045, the requirement increases to 6 primary schools; however, considering future demand and

distribution needs, an additional requirement of 4 primary schools has been identified over the planning period. At the middle school level, only one facility exists, whereas two schools are required in 2025, resulting in an existing gap of one middle school. With population growth, the requirement rises to three middle schools by 2045, leading to a total future requirement of four middle schools when the existing gap is included. For high schools, Mamund currently has one facility, while no requirement exists in 2025. By 2045, the requirement increases to one high school, which can be accommodated within the existing provision, resulting in no additional future requirement. There is no requirement for higher secondary or college-level institutions during the planning horizon, and therefore no gaps are identified at this level.

- ***Gardai Utman Khel***

Gardai Utman Khel is projected to grow from a population of 33,365 in 2025 to 58,880 by 2045. At the primary education level, the area currently has 26 schools, while the 2025 requirement is only 4 schools, indicating a strong surplus. By 2045, the requirement increases to 8 primary schools, which can be comfortably met through existing infrastructure; therefore, no additional future requirement is identified at this level.

For middle schools, two facilities currently exist, matching the 2025 requirement and resulting in no existing gap. By 2045, the requirement increases to three middle schools, leading to a total future requirement of three facilities, implying the need for one additional middle school over the planning period. At the high school level, Gardai Utman Khel has three existing facilities, while no requirement exists in 2025 and only one high school is required by 2045. This demand is fully met within the existing stock, and no future gap is identified. The centre already has one higher secondary institution, while no current or future requirement exists, indicating adequate provision at this level.

- ***Lara Dandokaii***

Lara Dandokaii has a population of 22,896 in 2025, projected to rise to 42,930 by 2045. At the primary level, 7 schools are currently available against a requirement of 3 schools in 2025, indicating sufficient existing capacity. By 2045, the requirement increases to 6 primary schools, resulting in a future additional requirement of 2 primary schools to accommodate population growth and spatial distribution.

At the middle school level, there are no existing facilities, while one school is required in 2025, creating an immediate gap of one middle school. By 2045, the requirement rises to three middle schools, resulting in a total future requirement of four middle schools over the planning period. For high schools, Lara Dandokaii currently has two facilities, with no requirement in 2025 and a requirement of one high school by 2045. Given the existing provision, no future gap is identified at this level. Similar to Mamund, there is no current or future requirement for higher secondary or college-level institutions within the planning horizon.

Table 51: Existing and Future Education Requirement for Potential Urban Centre

Educational Facilities	Existing facilities	Pop 2025	Current Requirements	Existing Gap	Pop 2045	Requirements 2045	Total Future Requirement
Mamund Urban Centre							
Primary	6	26552	4	N/A	47,120	6	4
Middle	1		2	1		3	4
High	1		0	N/A		1	0
Higher Secondary /College	0		0	0		0	0
Lara Dandokaii							
Primary	7	22896	3	N/A	42,930	6	2
Middle	0		1	1		3	4
High	2		0	N/A		1	N/A
Higher Secondary /College	0		0	0		0	0
Gardai Utman Khel							
Educational Facilities	**Existing facilities**	**Pop 2025**	**Current Requirements**	**Existing Gap**	**Pop 2045**	**Requirements 2045**	**Total Future Requirement**
Primary	26	33365	4	N/A	58,880	8	N/A
Middle	2		2	0		3	3
High	3		0	N/A		1	N/A
Higher Secondary /College	1		0	N/A		0	0

- ***Potential Settlements***

The assessment of educational facilities for the potential settlements of Nawagai, Barang, and Salarzai evaluates existing infrastructure against population-based requirements for 2025 and 2045, following NRM standards. The analysis identifies both surpluses and deficits to guide rational planning and avoid unnecessary over-provision while ensuring future needs are adequately met.

➢ *Nawagai*

Nawagai has a projected population of 24,421 in 2025, increasing to 39,726 by 2045. At the primary level, the settlement currently has 12 schools, whereas only 3 schools are required in 2025, indicating a surplus of 9 primary schools. By 2045, the requirement increases to 5 primary schools; however, the existing surplus largely absorbs future demand, resulting in an overall surplus of 3 primary schools even in the long term. At the middle school level, Nawagai has one existing facility, which matches the 2025 requirement and results in no current gap. By 2045, the requirement increases to two middle schools, and when future growth is considered, the total future requirement rises to three middle schools, indicating the need for additional middle-level provision over the planning horizon. For high schools, Nawagai

currently has two facilities, while no requirement exists in 2025, resulting in a surplus of two high schools. By 2045, the requirement increases to one high school, which is adequately met within existing capacity, leaving a remaining surplus of one high school. There is no current or future requirement for higher secondary or college-level institutions.

➢ *Barang*

Barang's population is projected to grow from 16,703 in 2025 to 27,636 by 2045. At the primary level, the settlement has 6 existing schools, compared to a requirement of 2 schools in 2025, reflecting a surplus of 4 schools. By 2045, the requirement increases to 4 primary schools, which can be fully accommodated by the existing stock, resulting in no future gap. At the middle school level, two facilities currently exist against a requirement of one school in 2025, creating a surplus of one middle school. By 2045, the requirement increases to two middle schools, and when future demand is accounted for, the total future requirement becomes one additional middle school, indicating a moderate future need. For high schools, Barang has two existing facilities, while no requirement exists in either 2025 or 2045. This results in a continued surplus, with no additional high school requirement identified over the planning period. As with other potential settlements, no higher secondary or college-level facilities are required during the planning horizon.

➢ *Salarzai*

Salarzai has a population of 21,259 in 2025, projected to rise to 39,861 by 2045. At the primary education level, 7 schools currently exist against a requirement of 3 schools in 2025, indicating a surplus of 4 primary schools. By 2045, the requirement increases to 5 primary schools, resulting in a net future requirement of one additional primary school to meet growing demand. At the middle school level, Salarzai has one existing facility, which meets the 2025 requirement and results in no current gap. By 2045, the requirement increases to two middle schools, and when cumulative demand is considered, the total future requirement rises to three middle schools, indicating the need for additional middle-level facilities. For high schools, three facilities currently exist, while no requirement exists in 2025 and only one high school is required by 2045. This demand is fully met within existing capacity, resulting in a continued surplus of two high schools. There is no requirement for higher secondary or college-level institutions during the planning period.

Table 52: Existing and Future Education Requirement of Potential Settlement

Educational Facilities	*Existing facilities*	*Pop 2025*	*Current Requirements*	*Existing Gap*	*Pop 2045*	*Requirements 2045*	*Total Future Requirement*
Nawagai							
Primary	12	24421	3	N/A	39,726	5	N/A
Middle	1		1	0		2	3
High	2		0	N/A		1	N/A

Educational Facilities	*Existing facilities*	*Pop 2025*	*Current Requirements*	*Existing Gap*	*Pop 2045*	*Requirements 2045*	*Total Future Requirement*
Higher Secondary /College	0		0	0		0	0
Barang							
Primary	6	16703	2	N/A	27,636	4	0
Middle	2		1	N/A		2	1
High	2		0	N/A		0	N/A
Higher Secondary /College	0		0	0		0	0
Salarzai							
Primary	7	21259	3	N/A	39,861	5	1
Middle	1		1	0		2	3
High	3		0	N/A		1	N/A
Higher Secondary /College	0		0	0		0	0

Source: Calculated by Consultant

6.4.1.4.2 Rural areas (Cluster-wise)

Bajaur District is predominantly rural in character, with dispersed settlements, limited accessibility, and an uneven distribution of educational facilities. Excluding urban centers and potential urban settlements, rural areas of the district require a context-specific planning approach to address existing deficiencies and future educational needs. Therefore, multiple planning criteria and officially recognized standards were applied to assess the education gap at the district and regional levels.

To address spatial inequities in service provision, both primary and high school requirements were assessed for current deficits and future population growth. Existing educational facilities were identified at the NC/VC level, and a ***cluster-based planning approach*** was adopted by grouping multiple VCs. These clusters were formed to ensure coverage of unserved and underserved rural populations across Bajaur District. The rationale and spatial logic of clustering are discussed in detail in the Rural Development Plan chapter.

- ***Primary Schools***

For primary schools, the current requirement was assessed using the KP Elementary and Secondary Education (KP-ESED) standard of ***1 primary school per 1,000 population***, which is considered appropriate for rural settlements in Khyber Pakhtunkhwa due to smaller catchment sizes and limited mobility. The existing number of schools within each VC and cluster was compared against this standard to identify the present gap. Future requirements were then calculated based on incremental population growth, following the same KP-ESED criterion. A minimum land requirement of ***1 acre per primary school*** was applied to ensure adequate space for classrooms, playgrounds, and basic facilities. The total requirement at the cluster level was derived by combining the existing gap with future demand, representing the actual need for primary schools in rural bajaur District.

Table 53: Existing and Future Education Requirement Cluster wise (Primary Schools)

Tehsil	Cluster	VC's	Population 2025	Existing Educational Facility (Primary School)	Requirement as per NRM Standard (1 per 1000)	Current Requirement	Population 2045	Future Requirement (Incremental Population) for primary school as per NRM Standard	Total Requirement (Gap+Future
Barang Tehsil	Cluster 1	V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	40918	30	41	11	69765	29	40
	Cluster 2	V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	39876	20	40	20	68436	29	48
	Cluster 3	V/C Panjkora, V/C Qambar, V/C Tar	30491	14	30	16	50372	20	36
Khar Bajaur Tehsil	Cluster 4	V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	37791	8	38	30	79684	42	72
	Cluster 5	V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	51448	25	51	26	104877	53	80
	Cluster 6	V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	40531	14	41	27	85461	45	71
	Cluster 7	V/C Hayatai, V/C Marosa, V/C Sikandaro	33618	9	34	25	70886	37	62
	Cluster 8	V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	35950	18	36	18	75802	40	58
	Cluster 9	V/C Manai, V/C Manogai, V/C Top	32773	6	33	27	69104	36	63
	Cluster 10	V/C Rashakai, V/C Sheikh kallai, V/C Smasai	33862	13	34	21	71400	38	58
	Cluster 11	V/C Sara Mina Alizai, V/C Shinkai	32577	20	33	13	68689	36	49
Mamund Tehsil	Cluster 12	V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	35371	3	35	32	62296	27	59
	Cluster 13	V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	42408	4	42	38	74689	32	71
	Cluster 14	V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	81015	10	81	71	142684	62	133
	Cluster 15	V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	26949	7	27	20	47463	21	40
	Cluster 17	V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	51210	8	51	43	90192	39	82
	Cluster 18	V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	37630	9	38	29	66274	29	57

	Cluster 19	V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	34592	9	35	26	60925	26	52
	Cluster 20	V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	43614	15	44	29	76814	33	62
Bar Chamarkand Tehsil	Cluster 21	V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	25574	17	26	9	40151	15	23
	Cluster 22	V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	31271	22	31	9	50034	19	28
Salarzai Tehsil	Cluster 23	V/C Batmalai-II, V/C Chorak, V/C Dabar 1	33304	9	33	24	62283	29	53
	Cluster 24	V/C Batwar, V/C Chachagai	22270	7	22	15	41648	19	35
	Cluster 25	V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	40916	17	41	24	76518	36	60
	Cluster 26	V/C lakiano, V/C Letai, V/C Loi Kallai	29686	3	30	27	55516	26	53
	Cluster 27	V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	41877	8	42	34	78315	36	70
	Cluster 28	V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	38442	18	38	20	71892	33	54
Utman Khel Tehsil	Cluster 29	V/C Malkana, V/C Nazakai, V/C Talai 1	33058	23	33	10	61822	29	39
	Cluster 30	V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	51808	23	52	29	91428	40	68

High Schools

For high schools, planning was carried out using the ***NRM average standard of one high school per 15,000 population for boys' and girls' schools*** in rural areas. This standard is appropriate for Bajaur District, where settlements are scattered, population densities are low, and higher-level educational facilities are typically accessed over larger catchment areas.

High schools were planned at the cluster level rather than at individual VC level to optimize land use, public investment, and accessibility while ensuring coverage of unserved and underserved rural populations. The clustering approach allows a single high school to serve multiple VCs within a reasonable service area, which is consistent with rural settlement patterns in Khyber Pakhtunkhwa.

The minimum land requirement for a high school was taken as 5 to 8 Kanals, extendable up to ***2 to 5 acres***, depending on enrollment capacity, availability of separate facilities for boys and girls, and future expansion needs. This land standard ensures adequate provision of academic blocks, playgrounds, circulation space, and supporting facilities.

In addition to population-based standards, qualitative planning factors were also considered, including the existing physical condition of school buildings, spatial distribution of facilities within clusters, accessibility through the road network, and overall service coverage. These factors were integrated to ensure that high school planning outcomes are realistic, equitable, and responsive to the socio-spatial context of rural Bajaur District.

Table 54: Existing and Future Education Requirement Cluster wise (High Schools)

Tehsil	Cluster	VC's	Population 2025	Existing Educational Facility (High School)	Requirement as per NRM Standard (1 per 15000)	Current Requirement	Population 2045	Future Requirement (Incremental Population) for high school as per NRM Standard	Total Requirement (Gap+Future
Barang Tehsil	Cluster 1	V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	40918	3	3	0	69765	2	2
	Cluster 2	V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	39876	1	3	2	68436	2	4
	Cluster 3	V/C Panjkora, V/C Qambar, V/C Tar	30491	0	2	2	50372	1	3
Khar Bajaur Tehsil	Cluster 4	V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	37791	1	3	2	79684	3	4
	Cluster 5	V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	51448	1	3	2	104877	4	6
	Cluster 6	V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	40531	3	3	0	85461	3	3
	Cluster 7	V/C Hayatai, V/C Marosa, V/C Sikandaro	33618	0	2	2	70886	2	5
	Cluster 8	V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	35950	1	2	1	75802	3	4
	Cluster 9	V/C Manai, V/C Manogai, V/C Top	32773	1	2	1	69104	2	4
	Cluster 10	V/C Rashakai, V/C Sheikh kallai, V/C Smasai	33862	0	2	2	71400	3	5
	Cluster 11	V/C Sara Mina Alizai, V/C Shinkai	32577	0	2	2	68689	2	5
Mamund Tehsil	Cluster 12	V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	35371	0	2	2	62296	2	4

Tehsil	Cluster	VC's	Population 2025	Existing Educational Facility (High School)	Requirement as per NRM Standard (1 per 15000)	Current Requirement	Population 2045	Future Requirement (Incremental Population) for high school as per NRM Standard	Total Requirement (Gap+Future
	Cluster 13	V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	42408	1	3	2	74689	2	4
	Cluster 14	V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	81015	1	5	4	142684	4	9
	Cluster 15	V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	26949	0	2	2	47463	1	3
	Cluster 17	V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	51210	0	3	3	90192	3	6
	Cluster 18	V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	37630	1	3	2	66274	2	3
	Cluster 19	V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	34592	0	2	2	60925	2	4
	Cluster 20	V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	43614	1	3	2	76814	2	4
Bar Chamarkand Tehsil	Cluster 21	V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	25574	0	2	2	40151	1	3
	Cluster 22	V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	31271	2	2	0	50034	1	1
Salarzai Tehsil	Cluster 23	V/C Batmalai-II, V/C Chorak, V/C Dabar 1	33304	1	2	1	62283	2	3
	Cluster 24	V/C Batwar, V/C Chachagai	22270	1	1	0	41648	1	2
	Cluster 25	V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	40916	1	3	2	76518	2	4
	Cluster 26	V/C lakiano, V/C Letai, V/C Loi Kallai	29686	0	2	2	55516	2	4

Tehsil	Cluster	VC's	Population 2025	Existing Educational Facility (High School)	Requirement as per NRM Standard (1 per 15000)	Current Requirement	Population 2045	Future Requirement (Incremental Population) for high school as per NRM Standard	Total Requirement (Gap+Future
	Cluster 27	V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	41877	1	3	2	78315	2	4
	Cluster 28	V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	38442	0	3	3	71892	2	5
Utman Khel Tehsil	Cluster 29	V/C Malkana, V/C Nazakai, V/C Talai 1	33058	0	2	2	61822	2	4
	Cluster 30	V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	51808	3	3	0	91428	3	3

6.4.1.5 Proposed Future Educational Zones

Educational facilities proposed under this Landuse plan are an integral part of the broader institutionalization and economic development strategies. These facilities are expected to significantly improve literacy rates, which in turn will contribute to enhanced economic growth and overall social development.

The rationale and reasons for proposing new educational facilities in District Bajaur are grounded in addressing the current educational disparities, meeting the growing population's needs, and fostering socio-economic development through improved access to quality education.

District Bajaur continues to face considerable educational challenges, including low literacy rates, significant gender gaps, and limited infrastructure, particularly for girls. The district's total literacy rate is substantially below the provincial average, with female literacy especially lagging due to socio-cultural barriers and economic constraints. These challenges are compounded by insufficient educational institutions and resources, resulting in unequal access to schooling.

The proposal for expanding educational facilities aims to bridge these gaps by increasing the availability and functionality of schools at all levels primary, middle, high, and higher secondary. Providing additional schools will accommodate the rising student population due to demographic growth, reducing overcrowding and improving student-teacher ratios. Special emphasis on girls' schools will promote gender parity by addressing cultural and infrastructural obstacles that currently limit female education.

Furthermore, enhancing educational infrastructure aligns with the strategic objectives of the District Education Office and government policies focused on community engagement, teacher development, and out-of-school children's inclusion. New facilities will support improved enrollment, retention, and learning outcomes, contributing to raising overall education standards.

Investments in education are also integral to broader socio-economic development goals, as education equips individuals with the skills and knowledge essential for employment, health, and civic participation. By establishing accessible, safe, and quality educational environments, the district can foster inclusive growth and empower its youth.

6.4.1.5.1 Urban Centre, Potential Urban Centre and Potential Settlement

The education infrastructure assessment for urban centres, potential urban centres, and potential settlements indicates a significant expansion of educational facilities planned between 2025 and 2045 to address service gaps, improve accessibility, and accommodate projected population growth.

In the urban centre of Khar, existing facilities cover 47.71 acres, with 146.63 acres proposed, resulting in a total of 194.35 acres. The expansion focuses on not only increasing capacity but also upgrading the quality of education. Proposed initiatives include:

- Smart classrooms and digital learning labs with internet connectivity and interactive whiteboards.
- STEM labs for science, robotics, and technology-based learning.
- Libraries with digital resources, e-books, and research facilities.
- Sports, arts, and multipurpose halls to encourage holistic education.
- Community outreach programs and adult education centers in urban zones.

For potential urban centres:

- Mamund (21.37 acres total): Proposals include establishing mixed-use educational hubs that integrate primary and secondary education with computer labs, vocational training units, and community libraries.
- Gardai Utman Khel (10.82 acres total): Suggested facilities include digital literacy centers and modular classrooms that can adapt to population growth.
- Lara Dandokaii (21.47 acres total): Plans include STEM-focused secondary schools and e-learning centers, modeled on successful regional initiatives in Gilgit-Baltistan and KP that combine classroom and remote digital learning.

In potential settlements:

- Salarzai (12.10 acres): Proposals include primary schools with integrated computer labs, solar-powered smart classrooms, and community engagement programs.
- Nawagai (12.31 acres): Suggested development includes science and technology labs, library/resource centers, and sports facilities to enhance overall learning experiences.
- Barang (7.24 acres): Plans focus on modular, expandable classrooms, ICT integration, and multipurpose spaces to serve as both education and community centers.

Successful examples to guide these proposals include:

- Gilgit-Baltistan's smart classroom initiative, which uses solar-powered digital labs to reach remote schools.
- KP's e-learning pilot programs, which combine virtual teaching with local mentorship to increase learning outcomes.
- Community school models in northern Pakistan, where multipurpose facilities provide education, vocational training, and adult literacy under one roof.

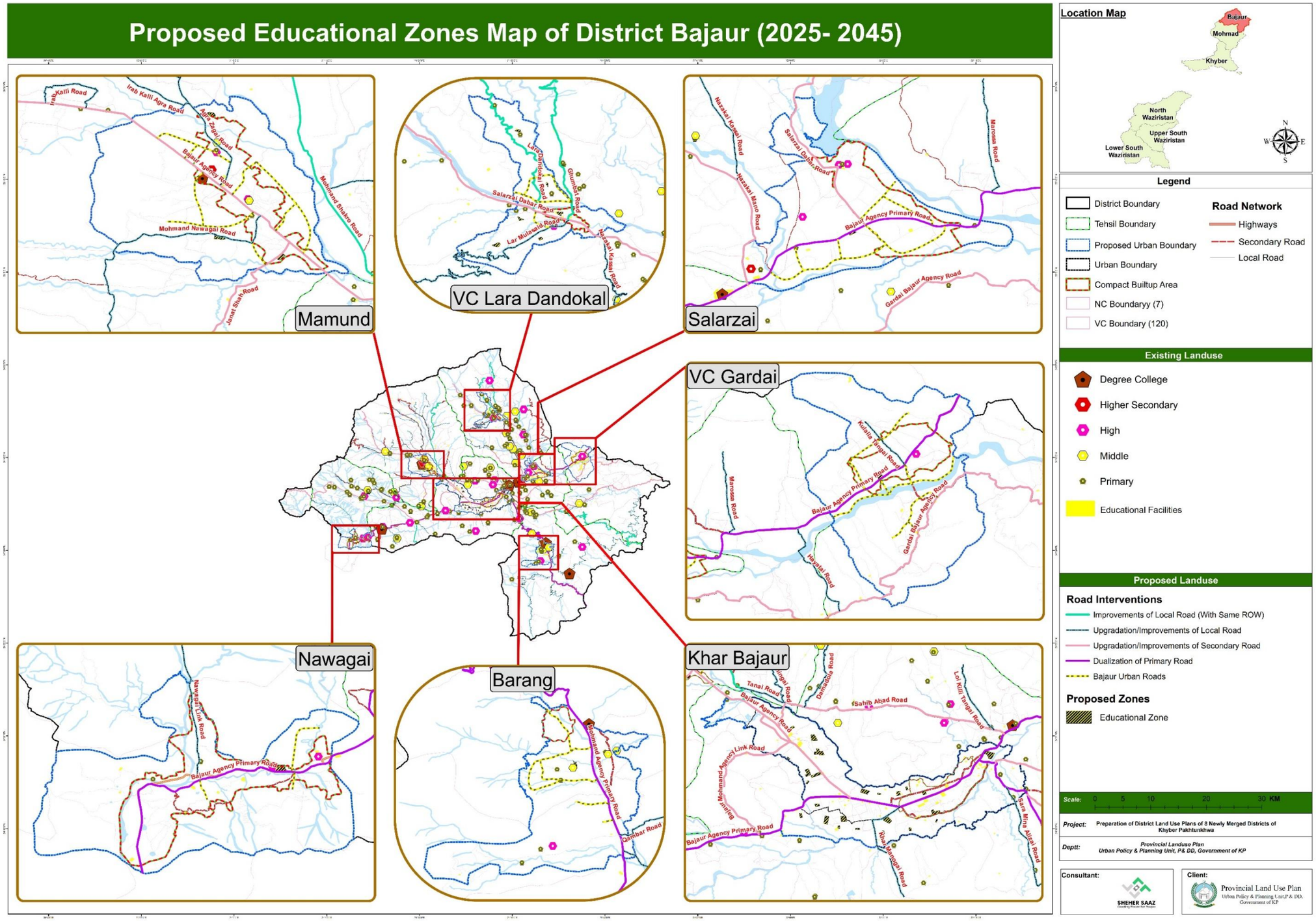
These proposals aim to modernize educational delivery, ensure equitable access across dispersed settlements, and prepare students for a rapidly evolving technological and economic landscape. The integration of advanced technology, STEM focus, and community-oriented infrastructure ensures that the proposed educational zones are not just larger in area but also higher in quality and future-ready.

Table 55: Proposed Zone for Educational Facilities – 2045

Urban centre/Settlements	*Existing Education*	*Proposed Educational Zones*	*Total Education (2025-2045)*
Urban Centre			
Khar Urban Area	47.71	146.63	194.35
Potential Urban Centre			
Mamund	12.24	9.13	21.37
Gardai Utman Khel	5.36	5.46	10.82
Lara Dandokaii	3.64	17.83	21.47
Potential Settlement			
Salarzai	10.91	1.19	12.10
Nawagai	7.87	4.44	12.31
Barang	3.68	3.56	7.24

Source: Developed by Consultant

Map 35: Proposed Educational Zones in District Bajaur



6.4.1.5.2 Rural areas (Cluster-wise)

Based on the assessment, educational zones were proposed at both cluster and Village Council (VC) levels to address existing service gaps and improve accessibility across rural Bajaur District. In several clusters, two or more educational zones were proposed due to spatial constraints, dispersed settlement patterns, and limited physical connectivity.

The zoning proposals were informed by a GIS-based analysis of existing land use, supported by an assessment of physical features such as water bodies, rangelands, and hilly terrain. In clusters where these constraints restricted movement or fragmented settlements, multiple educational zones were designated to ensure reasonable travel distances, equitable access, and balanced service coverage. This approach was particularly relevant in areas with natural barriers that limit direct accessibility.

An accessibility analysis using the existing road network was undertaken, prioritizing areas that were unserved or had a very low ratio of educational facilities. Proposed educational zones were generally aligned along existing main roads to maximize accessibility. In locations where only kacha roads or informal paths were present, road upgradation was proposed as part of the planning framework to ensure safe, reliable, and year-round access to educational facilities.

For remote and severely underserved clusters, a centralized educational zone was proposed at strategically located VCs to maximize catchment coverage and service efficiency. This strategy was applied in clusters characterized by widely dispersed settlements and limited infrastructure, where a central service location offers the most viable solution.

In terms of land allocation, zones of less than 2 acres are intended for lower-order educational facilities, primarily primary schools. Zones exceeding 4 acres are reserved for higher-order facilities, such as high schools and degree colleges, allowing space for future expansion and the provision of essential supporting infrastructure. These facilities include science and computer laboratories, libraries, multipurpose halls, administrative blocks, playgrounds and sports facilities, sanitation and drinking water infrastructure, staff accommodation (where required), and provision for renewable energy and boundary protection.

Detailed area-wise zoning proposals and corresponding educational facilities are presented in the table below.

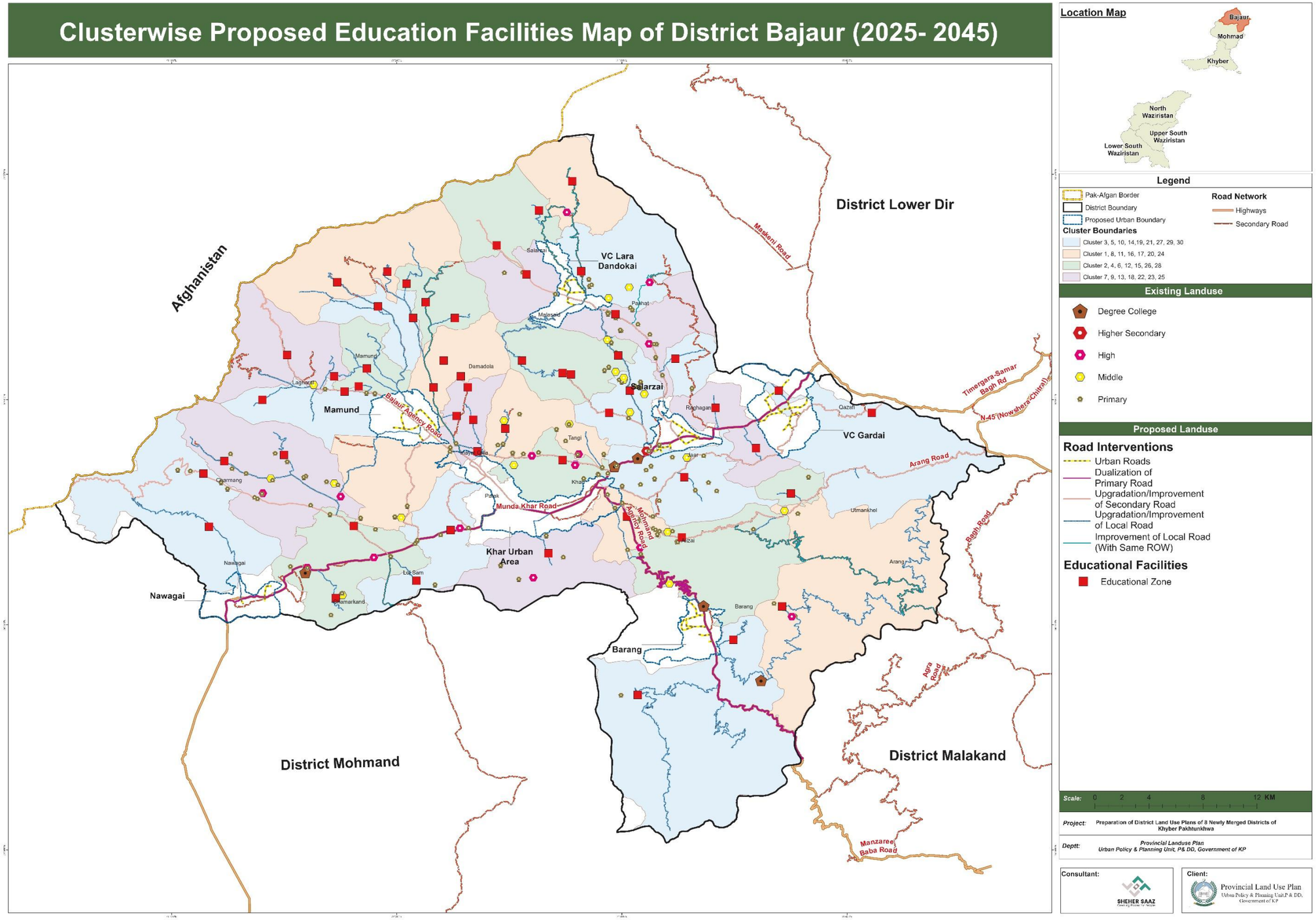
Table 56: Proposed Educational Zones (Cluster wise)

Tehsil	Clusters	VC's	Proposed Zones	Proposed Zones (Acres)
Barang Tehsil	Cluster 1	V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	Education Zone	1.65
	Cluster 2	V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	Education Zone 1	1.59
			Education Zone 2	1.23
	Cluster 3	V/C Panjkora, V/C Qambar, V/C Tar	Education Zone 1	1.75
			Education Zone 2	3.08
Khar Bajaur Tehsil	Cluster 4	V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	Education Zone	5.99
	Cluster 5	V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	Education Zone	4.61
	Cluster 6	V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	Education Zone 1	5.28
			Education Zone 2	5.68
	Cluster 7	V/C Hayatai, V/C Marosa, V/C Sikandaro	Education Zone 1	1.89
			Education Zone 2	1.06
	Cluster 8	V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	Education Facilities	2.43
	Cluster 9	V/C Manai, V/C Manogai, V/C Top	Education Facilities	2.46
	Cluster 10	V/C Rashakai, V/C Sheikh kallai, V/C Smasai	Education Zone 1	1.02
			Education Zone 2	1.92
	Cluster 11	V/C Sara Mina Alizai, V/C Shinkai	Education Facilities	2.16
Mamund Tehsil	Cluster 12	V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	Education Zone 1	1.64
			Education Zone 2	7.08
	Cluster 13	V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	Education Zone 1	1.94
			Education Zone 2	3.67
			Education Zone 3	3.29

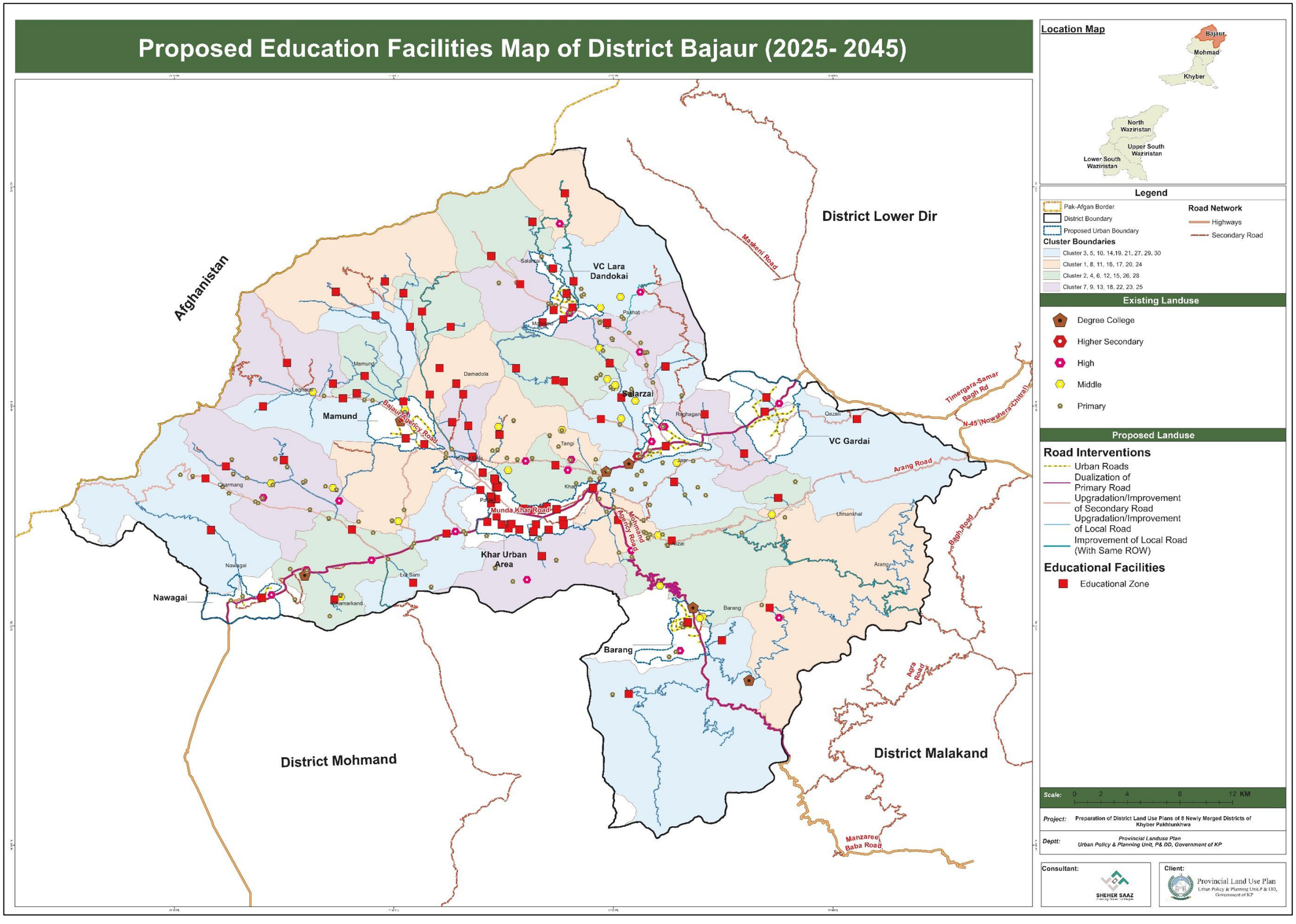
			Education Zone 4	1.34
	Cluster 14	V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	Education Zone 1	1.44
			Education Zone 2	1.42
	Cluster 15	V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	Education Zone 1	1.71
			Education Zone 2	1.71
			Education Zone 3	0.99
			Education Zone 4	1.05
	Cluster 17	V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	Education Zone	1.00
	Cluster 18	V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	Education Zone 1	1.74
			Education Zone 2	2.12
	Cluster 19	V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	Education Zone 1	1.66
			Education Zone 2	2.61
	Cluster 20	V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	Education Zone 1	2.72
			Education Zone 2	1.49
			Education Zone 3	2.27
Bar Chamarkand Tehsil	Cluster 21	V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	Education Zone 1	1.11
			Education Zone 2	3.93
	Cluster 22	V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	Education Zone 1	1.70
			Education Zone 2	2.12
Salarzai Tehsil	Cluster 23	V/C Batmalai-II, V/C Chorak, V/C Dabar 1	Education Zone	1.34
	Cluster 24	V/C Batwar, V/C Chachagai	Education Zone	1.14
	Cluster 25	V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	Education Zone	4.01
	Cluster 26	V/C lakiano, V/C Letai, V/C Loi Kallai	Education Zone 1	1.07
			Education Zone 2	1.14

	Cluster 27	V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	Education Zone	3.06
	Cluster 28	V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	Education Zone 1	1.52
			Education Zone 2	1.47
			Education Zone 3	2.30
			Education Zone 4	1.02
Utman Khel Tehsil	Cluster 29	V/C Malkana, V/C Nazakai, V/C Talai 1	Education Zone 1	1.75
			Education Zone 2	1.98
			Education Zone 3	1.33
	Cluster 30	V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	Education Zone 1	1.28
			Education Zone 2	2.61

Map 36: Proposed Educational Zones (Cluster-wise)



Map 37: Proposed Educational Facilities Map – Overall District Bajaur



6.4.1.6 Zoning Regulations for Educational Zone

Permitted Uses	*Permitted on appeal uses*
• Educational and Research Institutions • Offices of Social and Cultural Organizations • Public Utilities and Buildings • Taxi Stands, Bus Halts • Approved Parking Provisions • Day Cares • Research centers • Libraries	• Food courts • Religious Institutions • Petrol and gas filling Station • Parks, Memorials and Monuments

6.4.1.7 Recommendations

Based on the existing situation and challenges faced by the Bajaur district in education, here are realistic future recommendations at the district level:

- Expansion and Infrastructure Development: Accelerate the proposed education area increase to build more schools, particularly middle and high schools, in remote and backward areas where currently only primary schools exist. This includes constructing functional school buildings with basic facilities like classrooms, boundary walls, washrooms, and drinking water to create a conducive learning environment.
- Female Education Focus: Prioritize appointment and retention of female teachers to encourage girls' enrollment and attendance, especially in culturally conservative areas. Establish more girls' schools and implement community awareness campaigns promoting girls' education to overcome social resistance.
- Teacher Recruitment and Training: Close the significant gaps in teacher staffing by timely recruitment, particularly for female teachers, and provide ongoing professional development to improve teaching quality. Prevent arbitrary transfers that destabilize staff presence in remote schools.
- Access and Transportation: Address the issue of students traveling long distances on foot by exploring solutions such as transportation services or clustering new schools closer to population centers to reduce dropout rates due to accessibility challenges.
- Community Engagement: Involve local tribal leaders, Jirgas, and youth organizations in education planning and monitoring to ensure community support, reduce resistance to education, especially for girls, and foster ownership of education initiatives.

- Non-Formal and Distance Education: Complement formal education with non-formal education centers, distance learning, and adult education programs targeted especially at women and out-of-school children to widen access and literacy.
- Resource Provision: Ensure adequate supply of textbooks and learning materials to all schools to support academic progress. Improve monitoring mechanisms for accountability and transparency in resource allocation.
- Special Programs for Retention: Develop interventions aimed at reducing dropout rates, such as incentive schemes, remedial classes, and counseling services for students and parents to maintain continuity beyond the primary level.

These recommendations aim to build on the planned expansion of educational area (over 516 acres by 2045), addressing not only physical infrastructure but also social, cultural, and quality issues which are critical to meaningful education outcomes in Bajaur. Implementing them systematically will help fulfill the district's educational potential and socio-economic development goals.

6.4.2 Health Facilities

6.4.2.1 Existing Health Institutions

A comprehensive gap analysis of District Bajaur's healthcare facilities shows substantial deficiencies relative to both current and projected population needs, necessitating major infrastructural expansion by 2045.

Based on standardized facility-to-population norms and projected demographic growth, the most critical shortfall is evident in Basic Health Units (BHUs). The district presently operates only 19 BHUs against a requirement of 136, resulting in a current deficit of 117 units. To adequately serve the population anticipated by 2045, an additional 83 BHUs must be established, making this a top strategic priority for primary healthcare delivery.

Rural Health Centers (RHCs) and Maternal and Child Health (MCH) centers similarly exhibit acute service gaps. The district is short by 17 RHCs and requires at least 11 more by 2045 to ensure accessible, quality secondary healthcare services in both present and future scenarios. With the complete absence of MCH centers, an urgent requirement stands at 18 centers currently, rising by another 11 as the population expands, underlining a critical challenge in maternal and child health service provision.

The situation is comparable for dispensaries, where the district currently has none despite a need for 90. By 2045, a further 55 dispensaries will be required to provide reliable, decentralized primary care and first-contact health services. While public hospitals marginally exceed the present requirement, an additional two hospitals must be planned to match future inpatient and emergency needs created by a growing populace.

Bed capacity across all facilities stands at just 575, far below the present need for 4,072 and a total projected requirement that implies a further shortfall of nearly 2,500 beds by 2045. This marks a severe constraint on the district's ability to manage both routine admissions and public health emergencies.

6.4.2.2 Accessibility Analysis

Accessibility to health facilities was evaluated using a network-based spatial analysis in ArcGIS Pro to represent realistic travel conditions along the existing road network. A geodatabase network dataset was developed with road length (meters) as the impedance attribute, and topological errors were corrected to ensure accurate routing. All existing health facilities were mapped as point features and snapped to the nearest road segments to enable precise distance calculations.

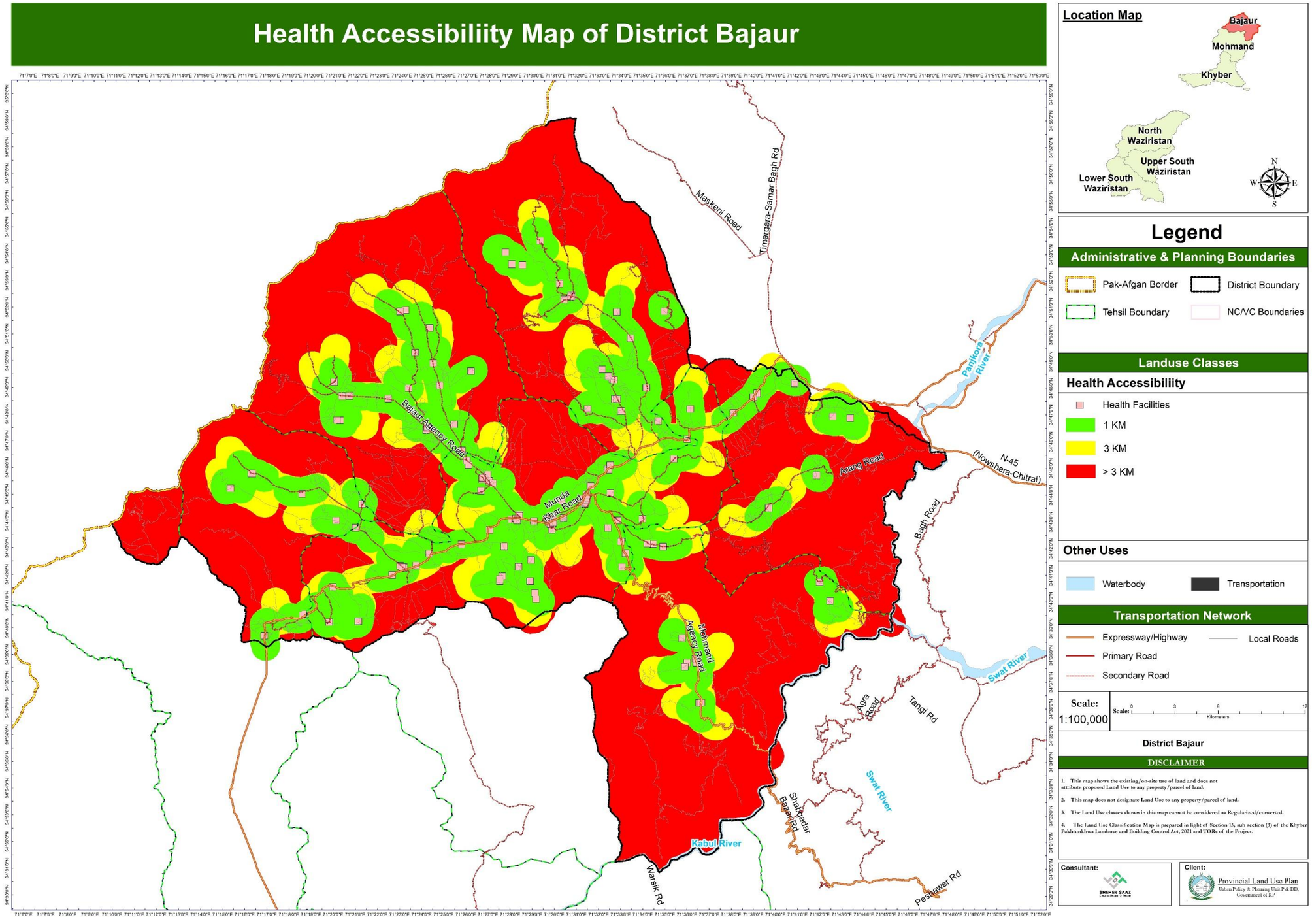
The analysis was conducted using the Service Area tool within the Network Analyst extension, applying a "toward facilities" travel direction. Two network distance thresholds 1 km and 3 km were used to define primary and extended service catchments. Service areas were generated as non-overlapping polygon rings, with overlapping catchments dissolved to

represent combined health service coverage. A 1,000-meter trim distance was applied to account for populations residing away from road centrelines.

Health facility accessibility was classified into three levels: **High Accessibility** (within 1 km), **Moderate Accessibility** (1–3 km), and **Low Accessibility** (beyond 3 km). These zones were intersected with administrative boundaries to quantify coverage and identify underserved areas. Locations outside all service areas were identified as accessibility gaps, highlighting priority zones for future health facility provision and infrastructure improvement.

The following maps show accessibility of public health facilities with respect to walkability and driving;

Map 38: Existing Health Facilities Accessibility – District Bajaur



6.4.2.3 National Standards

6.4.2.3.1 National reference manual (NRM)

Health facility standards in Pakistan are based on population thresholds to ensure equitable and efficient healthcare service delivery across all regions. A Basic Health Unit (BHU) is recommended for every 10,000 people, functioning as the primary level of care for outpatient treatment, maternal and child health services, and preventive care. For more comprehensive services, a Rural Health Centre (RHC) is required for every 73,000 people, offering minor surgical procedures, inpatient care, and diagnostic support. While dispensaries do not follow a defined population standard, they are typically established in remote or underserved areas to provide basic outpatient care. At the secondary level, one District Headquarters Hospital (DHQ) is required per district. At the same time, a Tehsil Headquarters Hospital (THQ) is established in each tehsil to serve as a referral point for BHUs and RHCs, delivering specialized care. General Hospitals are located in major urban areas, offering tertiary-level care and a broad range of specialist services. These standards serve as a guideline for identifying service delivery gaps and planning new health infrastructure to meet the needs of both rural and urban populations.

Table 57: Requirement for New Health Institute in the District

Type of Health Facility	Standard
Basic Health Unit (BHU)	1 BHU for 10,000 people
Rural Health Centre (RHC)	1 for 73,000 people
Dispensary	1 for 15,000
District Headquarters Hospital (DHQ)	1 per district
Tehsil Headquarters Hospital (THQ)	1 per tehsil (1 hospital for 0.5 to 1 million people)
General Hospital	In Large Cities
Hospital Beds	3 for 1000 people

Source: National Reference Manual of Planning and Infrastructure Standards (NRM)

6.4.2.3.2 Khyber Pakhtunkhwa Health Facility Planning Framework

As per the Kp policies, the establishment of a Basic Health Unit (BHU) is planned to serve a catchment population of 15,000–20,000 in urban areas and 10,000–15,000 in rural areas, within a 7–10 km service radius. Each BHU requires 10.75 kanals of land, along with basic infrastructure including road access, electricity, and water supply. The facility should be located 7–10 km away from another BHU or higher-level health facility, and the availability of basic educational facilities in the area is considered supportive.

For up-gradation of a BHU to a Rural Health Center (RHC), the proposed catchment population increases to 45,000–60,000, with a wider service area of 25–35 km. The up-gradation requires 10.75 kanals of additional adjacent land, a minimum OPD load of 50–60 patients per day, and access via a metallic road, along with reliable electricity and water supply. The presence of at least one college or higher secondary school and a post office is desirable, while the upgraded

RHC should be located 25–35 km from the nearest RHC or Civil Hospital to ensure balanced healthcare coverage.

Table 58: Proposed Criteria for Establishment of BHU and Up-gradation to RHC[7]

Sr. No.	Criteria	BHU Establishment Standards	BHU Up-gradation to RHC Standards
1	Catchment Population	Urban: **15,000 – 20,000** Rural: **10,000 – 15,000**	**45,000 – 60,000**
2	Catchment Area	**7 – 10 km** radius	**25 – 35 km** radius
3	Land Availability	**10.75 Kanals**	**10.75 Kanals** (adjacent to existing BHU)
4	Road Access	Road access required	**Metallic road** required
5	Electricity & Water	Required	Required
6	OPD Load	Not applicable	Minimum **50–60 patients/day per BHU**
7	Distance from Nearest Health Facility	**7 – 10 km** from another BHU or higher-level facility	**25 – 35 km** from nearest RHC or Civil Hospital

The proposal has been prepared using National Reference Manual (NRM) standards, given that a detailed assessment of existing health facilities was not feasible at this stage. It is therefore recommended that a comprehensive evaluation of current BHUs including population coverage, service demand, land availability, and infrastructure be undertaken. Based on this evaluation, BHU up-gradation to RHCs should follow the outlined criteria, ensuring that facilities meet the required population thresholds, service radius, OPD load, and access to utilities, thereby supporting effective and balanced healthcare service delivery.

- **Primary Healthcare Facilities in Khyber Pakhtunkhwa**

  Healthcare services in Khyber Pakhtunkhwa are delivered through a tiered system of facilities to ensure comprehensive coverage and accessibility. **Basic Health Units (BHUs) and dispensaries** serve as the first point of contact, primarily catering to populations of 15,000–20,000, offering essential primary healthcare including maternal and child care, immunization, and common ailment management. **24/7 BHUs and MCH centres** provide round-the-clock services, including delivery care, for a larger catchment of 30,000–40,000 people. **Rural Health Centres (RHCs)** serve 40,000–60,000 or more, offering a broader

[7] Source: Secondary Data collected from Department

range of services including emergency care, minor surgical procedures, inpatient care, and support to linked BHUs. At the higher level, **first level hospitals** provide specialist consultations, diagnostic services, and hospital admissions on referral from primary care, ensuring continuity and equity of healthcare delivery. This tiered system is structured to maintain service accessibility, operational efficiency, and effective referral linkages across the province.

Table 59: Healthcare Facility Types and Services – Khyber Pakhtunkhwa[8]

Facility Type	Population Served / Catchment	Operating Hours	Key Services & Functions	
Basic Health Unit (BHU) / Civil Dispensary / General Practitioner Clinic	~15,000–20,000 (per Union Council/Ward)	8 hours / 6 days a week	• Maternal & child care (static & outreach) • Immunization- Family planning- Management of diarrhoea, pneumonia, common ailments • Control of communicable diseases • Health education- Management & logistic support to LHWs & community-based providers	Dispensaries are older type facilities mainly in urban areas; BHUs are primarily rural; first formal point of contact for primary healthcare
24/7 BHU / MCH Centre / Medical Centre	30,000–40,000	24/7	• Expanded primary healthcare services- Round-the-clock delivery services- Maternal & child health- Requires adequate infrastructure, human resources, equipment & supplies	Upgradation of BHUs for 24/7 delivery care is being implemented in Khyber Pakhtunkhwa; MCH centres and private clinics also provide 24/7 services
Rural Health Centre (RHC) / Health Centre / Nursing Home	40,000–60,000 or more	24/7	• Comprehensive primary healthcare • Basic inpatient care (20 beds)- BEmONC services • Emergency management (injuries, accidents) • Selected minor surgical procedures (stitching, abscess drainage, circumcision) • First aid & referral services • Clinical, logistical, managerial support to linked BHUs, LHWs, MCH Centres, Dispensaries- Laboratory & X-ray services- Medico-legal, basic surgical, dental, ambulance services	Typically links 5–8 BHUs for referral; private sector equivalents exist in urban areas; ambulance services under Rescue 1122
First Level Hospital	Intermediate care on referral from primary care	24/7	• Specialist consultation- Hospital admissions- Technical, therapeutic, diagnostic services- Basic specialist services per standardized categories (A–D)	Previously known as DHQ/THQ hospitals; standardized since 2002 to ensure 1 bed per 2,500 population; infrastructure & equipment upgradation conducted through ADP

[8] Essential Package of Health Services with localized evidence/ UHC Benefit Package of Khyber Pakhtunkhwa, Health Department, Khyber Pakhtunkhwa, 2022

6.4.2.3.3 Comparative Analysis of NRM and KP Health Department Standards

The National Reference Manual (NRM) and the population-based standards of the Khyber Pakhtunkhwa Health Department differ primarily in their approach to healthcare planning and service provision. NRM standards are more conservative and planning-oriented, as they apply lower population thresholds per facility, resulting in higher facility and capacity requirements. In contrast, KP Health Department standards are designed around minimum service delivery needs, allowing higher population thresholds per facility and therefore indicating lower numerical requirements.

For primary healthcare facilities such as Basic Health Units, NRM prescribes one BHU per 10,000 population, while the KP Health Department allows one BHU per 17,500 population. This makes NRM more sensitive to population growth and spatial accessibility, whereas KP standards focus on maintaining essential service coverage. In the case of Rural Health Centres and Maternal and Child Health facilities, both standards broadly align, although KP Health Department standards typically adopt slightly lower population thresholds, emphasizing service delivery efficiency rather than long-term capacity expansion.

Dispensaries show minor variation between the two frameworks, with NRM generally recommending a higher number of facilities due to stricter population ratios, while KP standards permit fewer units without compromising basic outpatient coverage. At the hospital level, NRM defines clear population thresholds for major hospitals, whereas KP Health Department standards rely more on administrative and functional considerations rather than fixed population criteria.

A significant distinction is observed in hospital bed standards, where NRM recommends a substantially higher bed-to-population ratio, reflecting future demand, service intensity, and emergency preparedness. KP Health Department standards, on the other hand, prescribe lower bed ratios that represent minimum operational requirements. Overall, NRM standards are more suitable for long-term spatial planning and infrastructure forecasting, while KP Health Department standards are more appropriate for assessing immediate service adequacy and operational planning.

Table 60: Comparison of NRM and Khyber Pakhtunkhwa Health Department Standard

Health Facility Type	NRM Population Standard	Khyber Pakhtunkhwa Health Department Standard
Basic Health Unit (BHU)	1 BHU per 10,000 population	1 BHU per 17,500 population
Rural Health Centre (RHC)	1 RHC per 73,000 population	1 RHC per 50,000 population
Maternal & Child Health (MCH) Facility	1 MCH per 73,000 population	1 MCH per 50,000 population
Dispensary	1 Dispensary per 15,000 population	1 Dispensary per 17,500 population
DHQ / Public Hospital	1 Hospital per 0.5 – 1.0 million population	No fixed population-based standard
Hospital Beds	3 beds per 1,000 population	1 bed per 2,500 population

6.4.2.4 Future Requirement

A comprehensive gap analysis of District Bajaur's healthcare facilities reveals substantial deficiencies relative to both current and projected population needs, necessitating major infrastructural expansion by 2045.

Table 61: Future Requirement of Health Facilities in District Bajaur

Facility	Current Requirement (2025)				Future Requirement (2025-2045)		
	Existing Facilities (numbers)	Population 2025	Current requirement	Current Gap (2025)	Population (2045)	Increase in Population	Total Requirement (2025-2045)
BHU	19	1357489	136	117	2,189,911	832,422	83
RHC	2		19	17			11
MCH	11		18	7			11
Dispensary	8		90	82			55
Public Hospitals	4		3	-1			2
Bed in all Facilities	601		4072	3471			2497

Source: Calculated by Consultants

6.4.2.4.1 Urban Centers, Potential Urban Centers and Settlements

The assessment of health facilities in the *urban center* of District, *potential urban centre* and *potential settlements* highlights a mixed situation where limited infrastructure is in place, but future population growth will require proportional expansion. Despite being more accessible than rural regions, these urban areas still face significant gaps in primary and secondary healthcare facilities when measured against NRM Standards.

To ensure equitable access to primary and secondary healthcare services across Khyber District, the future healthcare requirements have been projected for both urban centers and potential urban settlements based on population growth from 2025 to 2045. The analysis includes Basic Health Units (BHUs), Rural Health Centers (RHCs), Maternal and Child Health (MCH) facilities, dispensaries/clinics, public hospitals, and bed capacity.

Urban Centers:

Khar Urban Area, the main urban centre of Bajaur District, currently has 1 Basic Health Unit (BHU), 1 dispensary, and 1 DHQ/Public Hospital, while Rural Health Centres (RHCs) and Maternal and Child Health (MCH) facilities are absent. The population of Khar is estimated at

125,694 in 2025, projected to increase to 265,713 by 2045, placing significant pressure on existing health infrastructure.

The health facilities in Khar have been assessed against both the National Reference Manual (NRM) and the Khyber Pakhtunkhwa Health Department standards to evaluate adequacy, existing gaps, and future requirements for 2025 and 2045. The assessment indicates that NRM standards are more stringent, as they apply lower population thresholds per facility and therefore identify substantially higher service gaps compared to KP standards, which represent minimum service provision benchmarks.

For Basic Health Units, NRM standards (1 BHU per 10,000 population) indicate a requirement of 13 BHUs in 2025, increasing to 27 BHUs by 2045, resulting in a major service gap given the presence of only one facility. Under KP Health Department standards (1 BHU per 17,500 population), the requirement is relatively lower, at 7 BHUs in 2025 and 15 BHUs in 2045, yet still reflects a substantial shortfall.

In the case of Rural Health Centres (RHCs) and Maternal and Child Health (MCH) facilities, no such facilities currently exist in Khar. Based on population thresholds, both NRM and KP standards identify a requirement of 2 facilities in 2025, increasing to 4–5 facilities by 2045, highlighting a critical gap in secondary and maternal healthcare services within the urban area.

For dispensaries, only one facility is currently available. NRM standards require 8 dispensaries in 2025 and 18 by 2045, while KP standards require 7 and 15 dispensaries, respectively. This indicates insufficient primary healthcare outreach, particularly considering the projected population growth.

At the hospital level, Khar currently has one DHQ/Public Hospital. According to NRM population thresholds (0.5–1 million population per DHQ), the existing facility is marginally adequate for current demand but will require capacity enhancement by 2045. KP Health Department standards do not specify population-based thresholds for DHQs, focusing instead on functional and administrative considerations, and therefore do not indicate a requirement for an additional hospital.

In terms of hospital bed capacity, the gap is particularly pronounced. Under NRM standards (3 beds per 1,000 population), Khar requires 377 beds in 2025 and 797 beds by 2045, whereas under KP standards (1 bed per 2,500 population), the requirement is 50 beds in 2025 and 106 beds by 2045. This wide variation reflects NRM's stronger emphasis on future service intensity and urban healthcare demand.

Table 62: Health Requirement of Urban Centre

Urban Centre											
Khar Urban Area											
Health facilities	Existing facilities	Pop 2025	Pop 2045	NRM Standards			Health Department Standards, Khyber Pakhtunkhwa			Population Based Standards	
				Existing Requirement 2025	Gap	Future Requirement 2045	Existing Requirement 2025	Gap	Future Requirement 2045	NRM	KP Health Standards
BHU	1	125 694	265,713	13	12	27	7	6	15	10,000	17,500
RHC	0			2	2	4	3	3	5	73,000	50,000
MCH	0			2	2	4	3	3	5	73,000	50,000
Dispensary	1			8	7	18	7	6	15	15,000	17,500
DHQ/Public Hospitals	1			0	-1	1	0	-1	1	0.5 to 1 million	N/A
Beds				377	377	797	50	50	106	3 for 1000 people	1 per 2,500

Potential Urban Centers:

The health infrastructure of the assessed settlements has been evaluated against both the National Reference Manual (NRM) and Khyber Pakhtunkhwa Health Department standards to determine existing adequacy, service gaps, and future requirements for 2025 and 2045, based on projected population growth. The assessment highlights consistent deficiencies in primary and secondary healthcare facilities across all areas, with gaps becoming more pronounced under NRM standards due to their stricter population thresholds.

In the first settlement, with a projected population increase from 26,552 in 2025 to 47,120 by 2045, there are no existing BHUs, RHCs, MCH centres, or dispensaries, while one DHQ/Public Hospital is present. Under NRM standards, the area requires 3 BHUs in 2025, increasing to 5 by 2045, along with 2 dispensaries in 2025 and 3 by 2045. KP Health standards indicate slightly lower requirements, yet still identify significant gaps in all primary healthcare categories. Although the DHQ hospital meets broader population thresholds, hospital bed capacity is critically inadequate, with a requirement of 80 beds in 2025 rising to 141 beds by 2045 under NRM, compared to 11 and 19 beds under KP standards, respectively.

The second settlement, with a population projected to grow from 33,370 in 2025 to 59,196 by 2045, has one existing BHU and one dispensary, but no RHCs, MCH facilities, or hospitals. NRM standards indicate a requirement of 3 BHUs in 2025 and 6 by 2045, resulting in a persistent service gap. Dispensary coverage is also insufficient, with requirements increasing from 2 to 4 facilities over the planning horizon. Secondary and maternal healthcare facilities remain entirely absent under both standards. Bed requirements show a sharp increase, from 100 beds in 2025 to 178 beds by 2045 under NRM, compared to 13 and 24 beds under KP standards, underscoring the need for facility expansion and service upgrading.

In the third settlement, the population is expected to increase from 22,896 in 2025 to 42,930 by 2045. No BHUs, RHCs, or MCH centres are currently available, while one dispensary and one DHQ/Public Hospital exist. NRM standards require 2 BHUs in 2025, increasing to 4 by 2045, along with 2–3 dispensaries over the same period. KP standards similarly indicate unmet needs, though at a lower threshold. While the presence of a DHQ hospital meets population-based norms, bed capacity remains insufficient, with requirements increasing from 69 beds in 2025 to 129 beds by 2045 under NRM, compared to 9 and 17 beds under KP standards.

Overall, the assessment demonstrates that NRM standards consistently identify larger gaps than KP Health Department standards, reflecting NRM's emphasis on higher service intensity and future demand. Across all settlements, primary healthcare facilities (BHUs and dispensaries) show the most critical shortages, while secondary (RHC) and maternal healthcare (MCH) facilities are almost entirely absent. Although DHQ hospitals are present in some locations, significant investment in hospital bed capacity and facility upgradation will be required to meet both current needs and long-term population growth.

Table 63: Health Requirement of Potential Urban Centre

Potential Urban Centers											
Mamund											
Health facilities	**Existing facilities**	**Pop 2025**	**Pop 2045**	**NRM Standards**			**Health Department Standards, Khyber Pakhtunkhwa**			**Population Based Standards**	
				Existing Requirement 2025	**Gap**	**Future Requirement 2045**	**Existing Requirement 2025**	**Gap**	**Future Requirement 2045**	**NRM**	**KP Health Standards**
BHU	0	26552	47,120	3	3	5	2	2	3	10,000	17,500
RHC	0			0	0	1	1	1	1	73,000	50,000
MCH	0			0	0	1	1	1	1	73,000	50,000
Dispensary	0			2	2	3	2	2	3	15,000	17,500
DHQ/Public Hospitals	1			0	N/A	0	0	N/A	0	0.5 to 1 million	N/A
Beds				80	80	141	11	11	19	3 for 1000 people	1 per 2,500 people
Gardai Utman Khel											
Health facilities	**Existing facilities**	**Pop 2025**	**Pop 2045**	**NRM Standards**			**Health Department Standards, Khyber Pakhtunkhwa**			**Population Based Standards**	
				Existing Requirement 2025	**Gap**	**Future Requirement 2045**	**Existing Requirement 2025**	**Gap**	**Future Requirement 2045**	**NRM**	**KP Health Sandards**
BHU	***1***	33370	59,196	3	2	6	2	1	3	10,000	17,500
RHC	***0***			0	0	1	1	1	1	73,000	50,000
MCH	***0***			0	0	1	1	1	1	73,000	50,000
Dispensary	***1***			2	1	4	2	1	3	15,000	17,500
DHQ/Public Hospitals	***0***			0	0	0	0	0	0	0.5 to 1 million	N/A
Beds				100	100	178	13	13	24	3 for 1000 people	1 per 2,500

Lara Dandokaii											
Health facilities	*Existing facilities*	*Pop 2025*	*Pop 2045*	*NRM Standards*			*Health Department Standards, Khyber Pakhtunkhwa*			*Population Based Standards*	
				Existing Requirement 2025	*Gap*	*Future Requirement 2045*	*Existing Requirement 2025*	*Gap*	*Future Requirement 2045*	*NRM*	*KP Health Sandards*
BHU	0	22896	42,930	2	2	4	1	1	2	10,000	17,500
RHC	0			0	0	1	0	0	1	73,000	50,000
MCH	0			0	0	1	0	0	1	73,000	50,000
Dispensary	1			2	1	3	1	0	2	15,000	17,500
DHQ/Public Hospitals	1			0	N/A	0	0	N/A	0	0.5 to 1 million	N/A
Beds				69	69	129	9	9	17	3 for 1000 people	1 per 2,500

Potential Urban Settlements:

The health infrastructure of potential settlements—Salarzai, Barang, and Nawagai—has been assessed against the National Reference Manual (NRM) and the Khyber Pakhtunkhwa Health Department standards to identify existing gaps and future requirements for 2025 and 2045. The evaluation highlights significant deficiencies in primary, secondary, and maternal healthcare facilities, with NRM standards consistently identifying higher needs due to stricter population thresholds.

Salarzai has an estimated population of 21,259 in 2025, projected to rise to 39,861 by 2045. Currently, the settlement has 1 BHU and 1 dispensary, with no RHCs, MCH centres, or DHQ/Public Hospitals. Under NRM standards, 2 BHUs and 2 dispensaries are required in 2025, increasing to 4 BHUs and 3 dispensaries by 2045, highlighting moderate gaps in primary care. Secondary and maternal healthcare facilities are absent and will require the establishment of RHCs and MCH centres to meet both NRM and KP thresholds. Hospital bed requirements are projected at 64 beds in 2025, rising to 120 beds by 2045 under NRM, compared to 9 and 16 beds under KP standards.

Barang, with a projected population of 16,703 in 2025, growing to 27,636 by 2045, currently has only 1 RHC. No BHUs, MCH facilities, dispensaries, or DHQs exist. NRM standards identify a need for 2 BHUs and 1 dispensary in 2025, increasing slightly by 2045, reflecting a significant gap in primary healthcare coverage. Secondary and maternal services are insufficient, and hospital bed requirements are 50 beds in 2025, rising to 83 beds by 2045 under NRM, compared to 7 and 11 beds under KP standards.

Nawagai is projected to have a population of 24,421 in 2025, reaching 39,726 by 2045, with 1 DHQ/Public Hospital but no BHUs, RHCs, MCH centres, or dispensaries. NRM standards indicate a need for 2 BHUs and 2 dispensaries in 2025, rising to 4 BHUs and 3 dispensaries by 2045, while KP standards identify smaller gaps. The absence of RHCs and MCH facilities highlights critical deficiencies in secondary and maternal healthcare. Hospital bed requirements are 73 beds in 2025, increasing to 119 beds by 2045 under NRM, compared to 10 and 16 beds under KP standards.

Table 64: Health Requirement of Potential Settlement

Potential Settlement											
Salarzai											
Health facilities	**Existing facilities**	**Pop 2025**	**Pop 2045**	**NRM Standards**			**Health Department Standards, Khyber Pakhtunkhwa**			**Population Based Standards**	
				Existing Requirement 2025	**Gap**	**Future Requirement 2045**	**Existing Requirement 2025**	**Gap**	**Future Requirement 2045**	**NRM**	**KP Health Standards**
BHU	***1***	21259	39,861	2	1	4	1	0	2	10,000	17,500
RHC	***0***			0	0	1	0	0	1	73,000	50,000
MCH	***0***			0	0	1	0	0	1	73,000	50,000
Dispensary	***1***			1	0	3	1	0	2	15,000	17,500
DHQ/Public Hospitals	***0***			0	0	0	0	0	0	0.5 to 1 million	N/A
Beds				64	64	120	9	9	16	3 for 1000 people	1 per 2,500
Barang											
Health facilities	**Existing facilities**	**Pop 2025**	**Pop 2045**	**NRM Standards**			**Health Department Standards, Khyber Pakhtunkhwa**			**Population Based Standards**	
				Existing Requirement 2025	**Gap**	**Future Requirement 2045**	**Existing Requirement 2025**	**Gap**	**Future Requirement 2045**	**NRM**	**KP Health Standards**
BHU	0	16703	27,636	2	2	3	1	1	2	10,000	17,500
RHC	1			0	N/A	0	0	-1	1	73,000	50,000
MCH	0			0	0	0	0	0	1	73,000	50,000
Dispensary	0			1	1	2	1	1	2	15,000	17,500
DHQ/Public Hospitals	0			0	0	0	0	0	0	0.5 to 1 million	N/A

Beds				50	50	83	7	7	11	3 for 1000 people	1 per 2,500
Nawagai											
Health facilities	***Existing facilities***	***Pop 2025***	***Pop 2045***	***NRM Standards***			***Health Department Standards, Khyber Pakhtunkhwa***			***Population Based Standards***	
				Existing Requirement 2025	***Gap***	***Future Requirement 2045***	***Existing Requirement 2025***	***Gap***	***Future Requirement 2045***	***NRM***	***KP Health Standards***
BHU	0	24421	39,726	2	2	4	1	1	2	10,000	17,500
RHC	0			0	0	1	0	0	1	73,000	50,000
MCH	0			0	0	1	0	0	1	73,000	50,000
Dispensary	0			2	2	3	1	1	2	15,000	17,500
DHQ/Public Hospitals	1			0	N/A	0	0	N/A	0	0.5 to 1 million	N/A
Beds				73	73	119	10	10	16	3 for 1000 people	1 per 2,500

6.4.2.4.2 Rural areas (Cluster-wise)

For the assessment of health facilities in rural areas of Bajaur District, excluding urban centers and potential urban settlements, a standards-based planning approach was adopted to identify existing gaps and future requirements at the district and cluster levels. Due to the predominantly rural character of the district, dispersed settlements, and limited accessibility, both current and future health facility requirements were evaluated using recognized national and provincial standards.

The current requirement of basic health facilities was assessed using two reference standards to ensure a balanced and realistic evaluation. The NRM standard of ***one health facility per 10,000 population*** was applied as a benchmark for optimal service provision in rural areas, while the ***Khyber Pakhtunkhwa Health Department standard of one facility per 17,500 population*** was used to reflect prevailing provincial practice and implementation capacity. Existing health facilities were identified at the NC/VC level, and clusters were formed to assess service coverage and accessibility across multiple VCs.

The gap analysis was carried out by comparing the existing number of facilities with the current requirement under both standards. This allowed identification of underserved and unserved areas within each cluster. For future requirements, projected incremental population was calculated and applied to the NRM standard, as it provides a more comprehensive planning threshold for long-term service delivery in rural districts.

The total health facility requirement for each cluster was determined by combining the existing gap and future demand, calculated in accordance with the NRM standard. This total requirement represents the actual need for health facilities to achieve adequate service coverage and equitable access across rural Bajaur District.

Table 65: Existing and Future Health Requirement (Cluster wise)

Tehsil	Cluster	VC's	Population 2025	Existing Health Facility (BHU/CD)	Requirement as per NRM Standard (1 per 10,000)	Requirement as per KPK health dpt(1 per 17,500)	Current Gap Analysis (as per NRM)	Population 2045	Future Requirement as per NRM Standard (1 Per 10000)	Future Requirement as per KPK Health Dpt (1 Per 17500)	Total Requirement (Current Gap+Future) as per NRM
Barang Tehsil	Cluster 1	V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	40918	0	4	2	4	69765	3	4	7
	Cluster 2	V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	39876	1	4	2	3	68436	3	4	6
	Cluster 3	V/C Panjkora, V/C Qambar, V/C Tar	30491	0	3	2	3	50372	2	3	5
Khar Bajaur Tehsil	Cluster 4	V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	37791	0	4	2	4	79684	4	5	8
	Cluster 5	V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	51448	1	5	3	4	104877	5	6	9
	Cluster 6	V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	40531	2	4	2	2	85461	4	5	7
	Cluster 7	V/C Hayatai, V/C Marosa, V/C Sikandaro	33618	0	3	2	3	70886	4	4	7
	Cluster 8	V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	35950	0	4	2	4	75802	4	4	8
	Cluster 9	V/C Manai, V/C Manogai, V/C Top	32773	1	3	2	2	69104	4	4	6
	Cluster 10	V/C Rashakai, V/C Sheikh kallai, V/C Smasai	33862	1	3	2	2	71400	4	4	6
	Cluster 11	V/C Sara Mina Alizai, V/C Shinkai	32577	1	3	2	2	68689	4	4	6
Mamund Tehsil	Cluster 12	V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	35371	0	4	2	4	62296	3	4	6
	Cluster 13	V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	42408	1	4	2	3	74689	3	4	6
	Cluster 14	V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	81015	2	8	5	6	142684	6	8	12
	Cluster 15	V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	26949	0	3	2	3	47463	2	3	5
	Cluster 16	V/C Bara Banda, V/C Jannat Shah/Babar Shah, V/C Sharif Khana 2, V/C Tangai-1	38588	0	4	2	4	67961	3	4	7
	Cluster 17	V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	51210	0	5	3	5	90192	4	5	9

Tehsil	Cluster	VC's	Population 2025	Existing Health Facility (BHU/CD)	Requirement as per NRM Standard (1 per 10,000)	Requirement as per KPK health dpt(1 per 17,500)	Current Gap Analysis (as per NRM)	Population 2045	Future Requirement as per NRM Standard (1 Per 10000)	Future Requirement as per KPK Health Dpt (1 Per 17500)	Total Requirement (Current Gap+Future) as per NRM
	Cluster 18	V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	37630	2	4	2	2	66274	3	4	5
	Cluster 19	V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	34592	0	3	2	3	60925	3	3	6
	Cluster 20	V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	43614	0	4	2	4	76814	3	4	8
Bar Chamarkand Tehsil	Cluster 21	V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	25574	1	3	1	2	40151	1	2	3
	Cluster 22	V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	31271	1	3	2	2	50034	2	3	4
Salarzai Tehsil	Cluster 23	V/C Batmalai-II, V/C Chorak, V/C Dabar 1	33304	0	3	2	3	62283	3	4	6
	Cluster 24	V/C Batwar, V/C Chachagai	22270	0	2	1	2	41648	2	2	4
	Cluster 25	V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	40916	2	4	2	2	76518	4	4	6
	Cluster 26	V/C lakiano, V/C Letai, V/C Loi Kallai	29686	0	3	2	3	55516	3	3	6
	Cluster 27	V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	41877	0	4	2	4	78315	4	4	8
	Cluster 28	V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	38442	0	4	2	4	71892	3	4	7
Utman Khel Tehsil	Cluster 29	V/C Malkana, V/C Nazakai, V/C Talai 1	33058	1	3	2	2	61822	3	4	5
	Cluster 30	V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	51808	0	5	3	5	91428	4	5	9

6.4.2.5 Proposed Future Health Zones

6.4.2.5.1 Urban Centers, Potential Urban Centers and Settlements

The health infrastructure assessment for urban centres, potential urban centres, and potential settlements shows a planned expansion of health facilities between 2025 and 2045 to meet growing population needs and service gaps. The assessment considers existing health infrastructure and proposes additional health zones to ensure equitable coverage, accessibility, and capacity for both primary and secondary healthcare services.

In the urban centre of Khar, existing health facilities cover 30.21 acres, with an additional 13.09 acres proposed for new health zones, resulting in a total health footprint of 43.30 acres. The expansion aims to improve primary healthcare coverage, add specialized clinics, and increase hospital capacity to accommodate the projected population growth.

For potential urban centres:

- Mamund: Existing health facilities cover 13.47 acres, with 8.02 acres proposed, totaling 21.49 acres. Proposals include additional BHUs, dispensaries, and community health centers.
- Gardai Utman Khel: Only 0.40 acres of existing health infrastructure exists, with 6.96 acres proposed, totaling 7.36 acres, indicating a high priority for new primary and secondary healthcare services.
- Lara Dandokaii: Current facilities cover 4.52 acres, with 8.41 acres proposed, for a total of 12.93 acres. Proposed facilities focus on BHUs, maternal and child health centers, and dispensaries.

For potential settlements:

- Salarzai: Existing facilities cover 1.80 acres, with 8.03 acres proposed, totaling 8.03 acres, emphasizing new primary healthcare services.
- Nawagai: Existing coverage of 2.76 acres is supplemented with 4.70 acres proposed, totaling 7.46 acres, focusing on BHUs and dispensaries.
- Barang: Existing health infrastructure of 4.93 acres is expanded by 4.20 acres, totaling 9.13 acres, addressing both primary and secondary care gaps.

Proposals for new health zones include:

- Modernized Basic Health Units (BHUs) with digital patient record systems.
- Maternal and Child Health (MCH) centers equipped with diagnostic labs and vaccination facilities.
- Community clinics and dispensaries to improve access in remote areas.
- Telemedicine-enabled facilities to connect underserved settlements with specialist doctors in urban centers.
- Emergency care and mobile health units to serve scattered or remote populations.

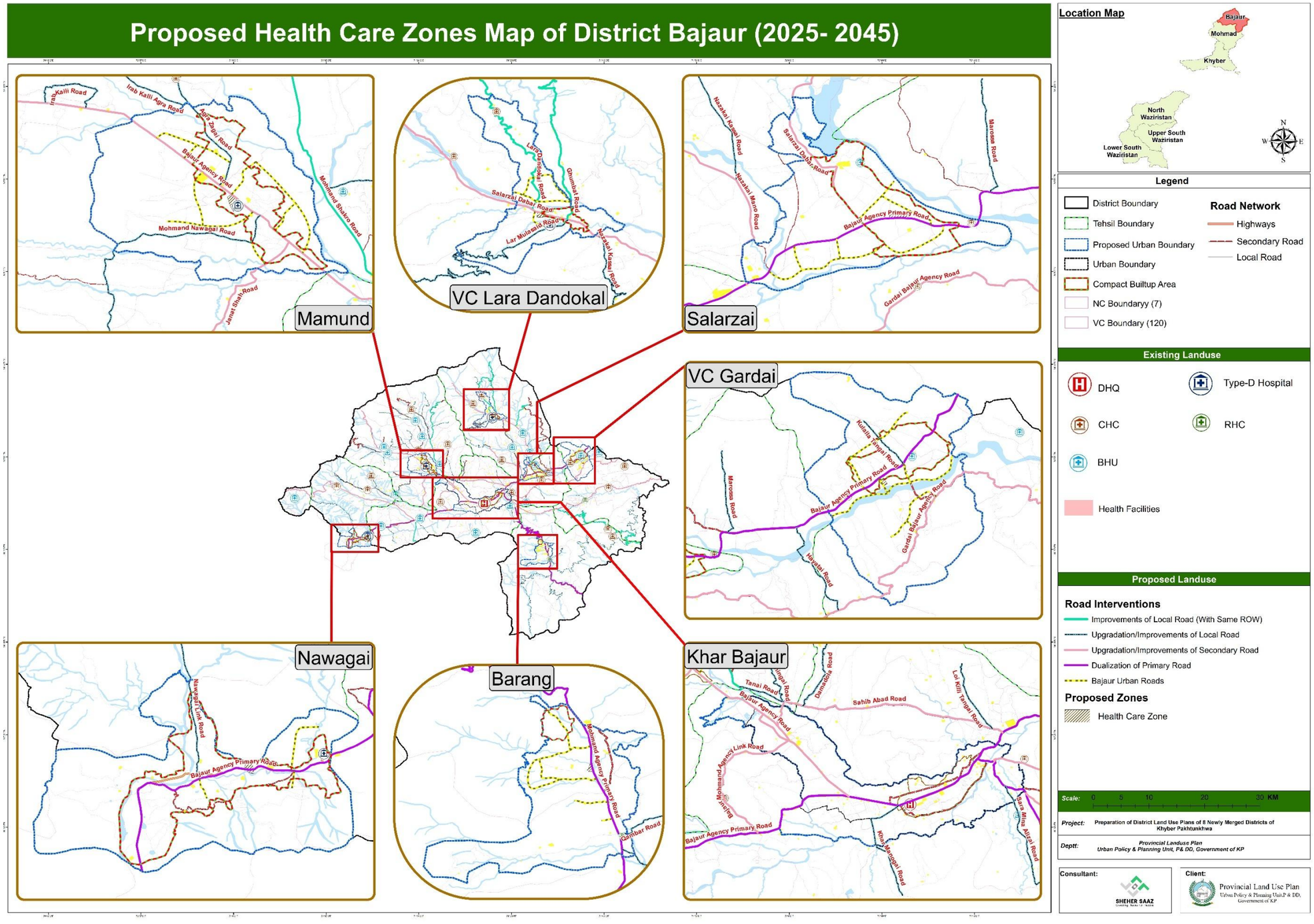
The planned health zone expansions aim to reduce gaps in primary and secondary healthcare, improve accessibility, and future-proof health infrastructure to accommodate the population growth between 2025 and 2045.

Table 66: Existing and Proposed Health facilities

Urban centre/Settlements	*Existing Health (Acres)*	*Proposed Health Zones (Acres)*	*Total Health (2025-2045) (Acres)*
Urban Centre			
Khar Urban Area	30.21	13.09	43.30
Potential Urban Centre			
Mamund	13.47	8.02	21.49
Gardai Utman Khel	0.40	6.96	7.36
Lara Dandokaii	4.52	8.41	12.93
Potential Settlement			
Salarzai	1.80	8.03	8.03
Nawagai	2.76	4.70	7.46
Barang	4.93	4.20	9.13

Source: Developed by Consultant

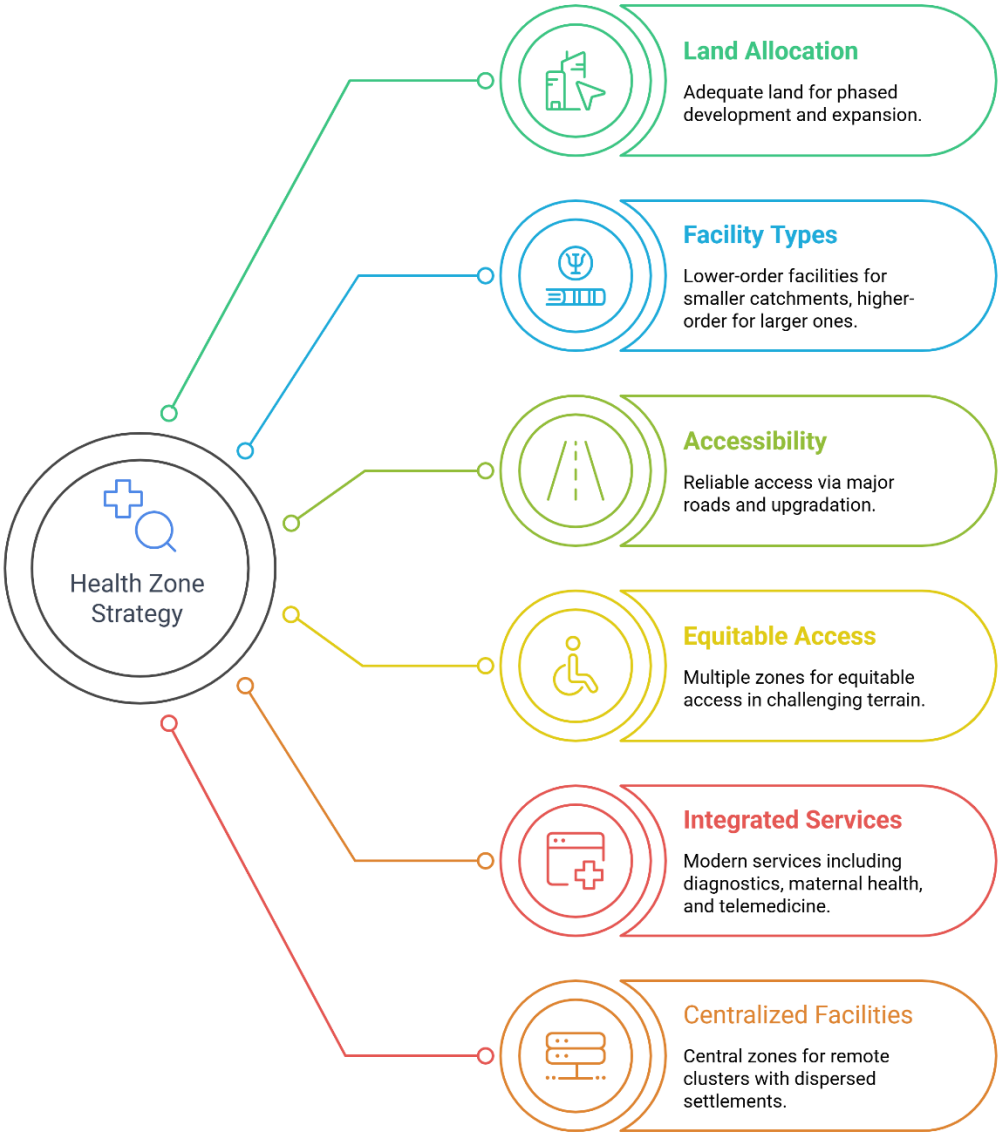
Map 39: Proposed Health Care Zones - District Bajaur



6.4.2.5.2 Rural areas (Cluster-wise)

Based on the health facility gap and accessibility assessment, health zones were proposed at cluster and VC levels to improve spatial coverage and reduce dependency on urban centers. The proposed average land allocation for health zones ranges between 2 to 3 acres, which is considered adequate for phased development, functional zoning, and future expansion in rural settings.

Figure 3: Proposed Health zone strategies for Rural areas



Zones with land areas of less than 1 acre to up to 2 acres are recommended for lower-order health facilities, primarily Basic Health Units (BHUs), as these facilities serve smaller catchments and focus on primary healthcare services. Zones exceeding 2 acres are proposed for higher-order health facilities, including Rural Health Centres (RHCs) and hospitals, which require larger footprints to accommodate inpatient services, diagnostics, staff housing, circulation space, and emergency access.

An accessibility analysis was conducted using the existing road network to identify unserved and underserved areas within each cluster. Health zones were accordingly proposed along major roads to ensure reliable and year-round access. In locations where access is currently through kacha roads or informal paths, road upgradation has been proposed as part of the health planning strategy to enhance service reach and emergency response capability.

In areas affected by physical barriers such as water bodies, rugged terrain, or hilly landscapes, multiple health zones were proposed within the same cluster to ensure equitable access for all settlements. This approach recognizes the mobility constraints of rural populations, particularly women, children, and elderly residents, and supports decentralized service provision where single-facility coverage is not feasible.

For clusters with remote locations or dispersed settlements, central health zones were proposed at strategically located focal points to serve multiple VCs efficiently. These central zones are intended to accommodate higher-order health facilities, allowing a concentration of services at one accessible location and reducing reliance on distant urban centres such as Khar. This strategy is particularly applicable in clusters where population thresholds do not justify multiple facilities under future projections but where accessibility remains a critical concern.

Accordingly, central health facilities were proposed in some Clusters. In these clusters, the central zone approach ensures that basic and secondary healthcare services remain accessible to all residents despite limited future demand at the individual VC level.

The proposed health zones are envisioned to support modern and scalable healthcare delivery, including basic diagnostic services, maternal and child health units, emergency response facilities, and tele-medicine capabilities. Coordination with the KP Health Department, Rescue 1122, and district administration is recommended to strengthen referral systems, staffing, and operational sustainability. This integrated approach aims to establish a resilient health service network for Bajaur District that is accessible, equitable, and responsive to local needs.

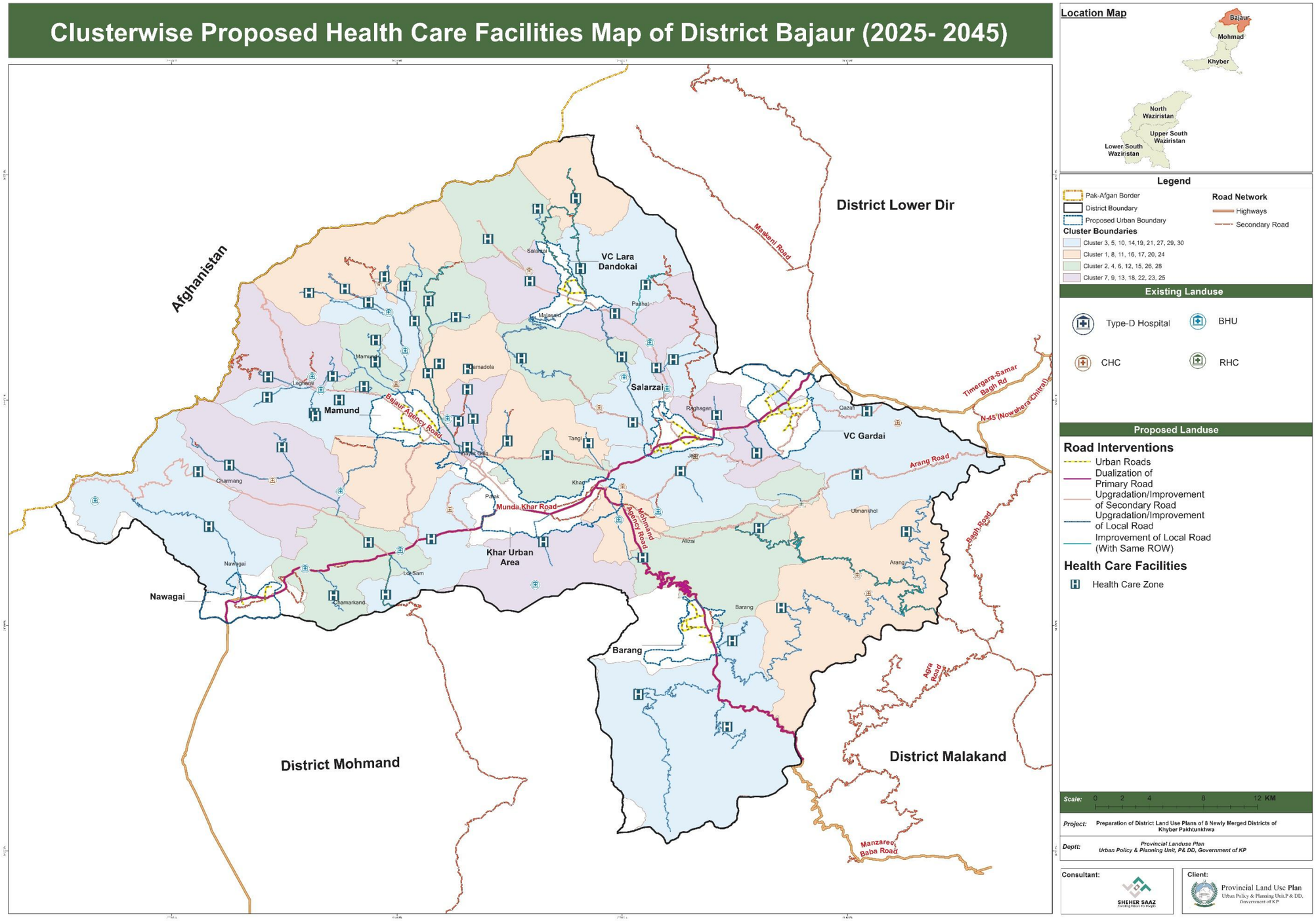
Table 67: Proposed Health Zones (Cluster wise)

Tehsil	Cluster	VC's	Proposed Zones	Proposed Zones (Acres)
Barang Tehsil	Cluster 1	V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	Health Zone 1	1.49
			Health Zone 2	1.14
	Cluster 2	V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	Health Zone 1	2.22
			Health Zone 2	2.15
	Cluster 3	V/C Panjkora, V/C Qambar, V/C Tar	Health Zone 1	1.10
			Health Zone 2	2.86
			Health Zone 3	1.19

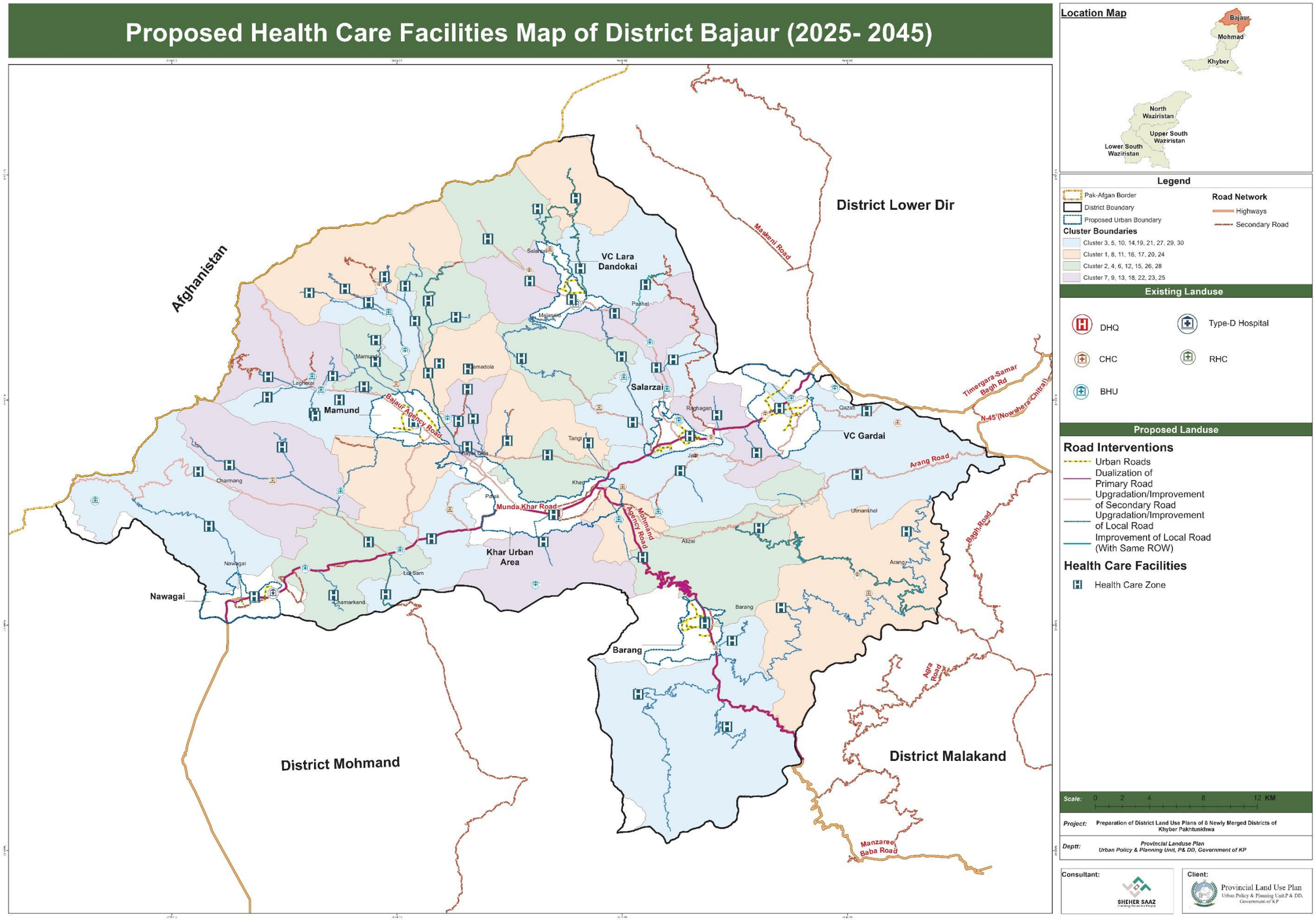
Tehsil	Cluster	VC's	Proposed Zones	Proposed Zones (Acres)
Khar Bajaur Tehsil	Cluster 4	V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	Health Zone	3.28
	Cluster 5	V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	Health Zone	1.69
	Cluster 6	V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	Health Zone 1	5.13
			Health Zone 2	2.87
	Cluster 7	V/C Hayatai, V/C Marosa, V/C Sikandaro	Health Zone 1	6.31
			Health Zone 2	1.48
	Cluster 8	V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	Health Zone 1	7.31
			Health Zone 2	3.13
	Cluster 9	V/C Manai, V/C Manogai, V/C Top	Health Zone	3.48
	Cluster 10	V/C Rashakai, V/C Sheikh kallai, V/C Smasai	Health Zone 1	2.86
			Health Zone 2	4.14
Mamund Tehsil	Cluster 12	V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	Health Zone 1	2.68
			Health Zone 2	2.26
			Health Zone 3	1.82
	Cluster 13	V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	Health Zone 1	5.85
			Health Zone 2	3.95
			Health Zone 3	1.27
			Health Zone 4	1.17
	Cluster 14	V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	Health Zone 1	3.79
			Health Zone 2	1.91
	Cluster 15	V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	Health Zone 1	2.31
			Health Zone 2	1.09
			Health Zone 3	1.18
	Cluster 17	V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	Health Zone 1	1.30
			Health Zone 2	1.25
			Health Zone 3	1.91
	Cluster 18	V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	Health Zone 1	1.07
			Health Zone 2	3.58
	Cluster 19	V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	Health Zone 1	1.11
			Health Zone 2	0.97
			Health Zone 3	0.97
			Health Zone 4	1.51
	Cluster 20	V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	Health Zone 1	2.63
			Health Zone 2	1.57
			Health Zone 3	0.99
	Cluster 21		Health Zone 1	0.93

Tehsil	Cluster	VC's	Proposed Zones	Proposed Zones (Acres)
Bar Chamarkand Tehsil		V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	Health Zone 2	1.69
	Cluster 22	V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	Health Zone 1	2.50
			Health Zone 2	1.00
Salarzai Tehsil	Cluster 23	V/C Batmalai-II, V/C Chorak, V/C Dabar 1	Health Zone 1	3.95
	Cluster 24	V/C Batwar, V/C Chachagai	Health Zone 2	1.19
	Cluster 25	V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	Health Zone	4.56
	Cluster 26	V/C lakiano, V/C Letai, V/C Loi Kallai	Health Zone 1	1.90
			Health Zone 2	1.06
	Cluster 27	V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	Health Zone 1	2.99
			Health Zone 2	1.23
	Cluster 28	V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	Health Zone 1	1.52
			Health Zone 2	2.52
Utman Khel Tehsil	Cluster 29	V/C Malkana, V/C Nazakai, V/C Talai 1	Health Zone 1	0.97
			Health Zone 2	2.20
	Cluster 30	V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	Health Zone 1	1.33
			Health Zone 2	1.61

Map 40: Proposed Health Care Facilities – District Bajaur (Cluster-wise)



Map 41: Proposed Health Facilities Map – Overall District Bajaur



6.4.2.6 Zoning Regulations for Health Zone

Permitted Uses	Permitted on appeal Uses
• Hospitals • Burn Units • Basic Health Units • Teaching Hospital • Medical Research Centres • Staff Residencies • Community facilities • Parking lots • Urban Forest • Religious Place • Veterinary Hospital • Clinical Laboratory • Day care centre or Pre schools • Support facilities (bus stops, parking lots, civil dispensaries and small green spaces)	• Playlands & Amusement Parks • Hostels • Hotels & Restaurants • Banks • Gymnasiums & Clubs • Cinema • Petrol Pumps • Banks

6.4.3 Public/Civic Amenities Zone

The provision of public amenities across the urban centres, potential urban centres, and emerging settlements has been assessed to evaluate existing capacity and future land requirements up to 2045. The analysis reflects both current availability and proposed additions, ensuring equitable access to civic, social, and community facilities in line with projected population growth.

The Urban Centre of Khar currently hosts the largest share of public amenities in District Bajaur, with an existing area of 91.23 acres. To accommodate future population growth and enhance service provision, an additional 24.25 acres of public amenities are proposed, increasing the total to 115.48 acres and reinforcing Khar's role as the district's primary hub for civic and community facilities. Among Potential Urban Centres, Mamund, Gardai Utman Khel, and Lara Dandokaii are identified for significant enhancement of public services. Mamund, with an existing 2.97 acres, is proposed to receive 12.72 acres of new public amenities, while Lara Dandokaii's existing 1.32 acres are expanded by 5.08 acres to reach a total of 6.40 acres, supporting their development into secondary service centres. Gardai Utman Khel, currently served by 1.92 acres, will see an increase of 3.45 acres to a total of 5.37 acres, addressing service gaps. In Potential Settlements, including Salarzai, Nawagai, and Barang, the proposed public amenities aim to ensure equitable access and planned growth. Salarzai's facilities are expanded to 10.08 acres, Nawagai from 18.41 to 27.37 acres, and Barang from 1.90 to 11.96 acres, providing sufficient infrastructure for civic, recreational, and community services and preventing future shortages as these settlements grow.

Table 68: Proposed Area for Public/Civic Amenities Zones - 2045

Urban centre/Settlements	*Existing Public Amenities (Acres)*	*Proposed Public Amenities (Acres)*	*Total Public Amenities (2025-2045) (Acres)*
Urban Centre			
Khar Urban Area	91.23	24.25	115.48
Potential Urban Centre			
Mamund	2.966	12.72	6.40
Gardai Utman Khel	1.92	3.45	5.37
Lara Dandokaii	1.32	5.08	6.40
Potential Settlement			
Salarzai	12.64	10.08	10.08
Nawagai	18.41	8.96	27.37
Barang	1.90	10.06	11.96

Source: Developed by Consultant

The zones will include government and semi-government offices such as the District Secretariat, Town Hall, Tehsil complexes, and local municipal offices, along with social welfare institutions, community centers, museums, and auditoriums. Supporting uses such as guest houses, athletic clubs, gyms, fitness centers, research and development facilities, and small hotels or motels may also be allowed to complement civic functions. Essential services such

as police stations, fire stations, post offices, shelter homes, panahgahs (public shelters), and convention centers will also form part of the civic fabric.

Overall, the proposed Civic and Public Amenities Zones in overall district Bajaur represents a forward-looking planning approach for District Bajaur promoting coordinated service delivery, integrated governance, and citizen-friendly accessibility while preparing the district to meet future administrative and social service demands.

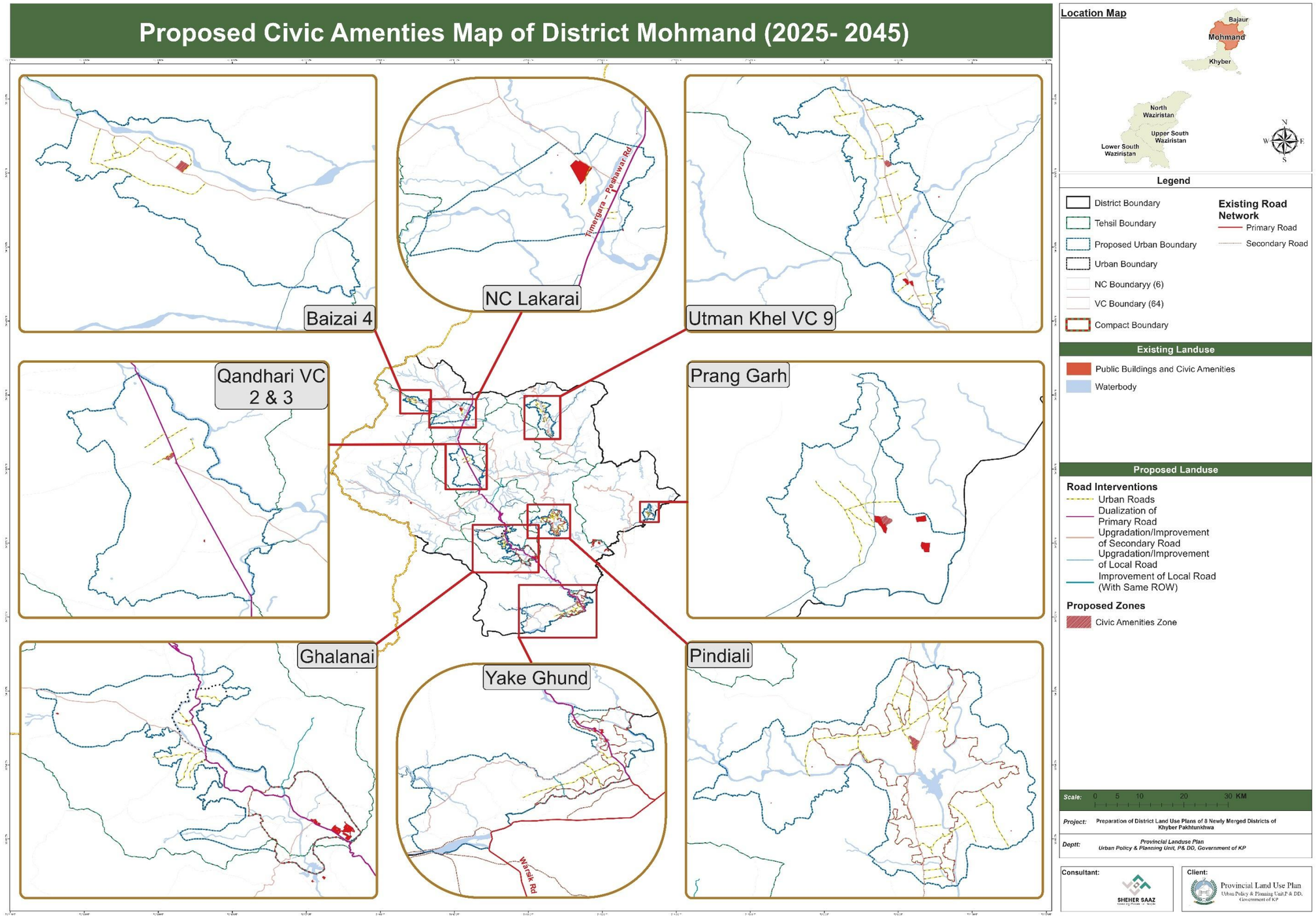
6.4.3.1 Zoning Regulations for Public/Civic Amenities Zone

The zoning regulations ensure that only allied and compatible functions are permitted within this zone, preventing uses that may conflict with the administrative and community-oriented nature of the area. This controlled land-use approach will enhance the efficiency of governance, improve accessibility for residents, and ensure proper utilization of urban land.

Table 69: Zoning Regulations for Public/Civic Amenities Zone

Permitted Uses	Allied Permissible Uses	Prohibited Uses
Government or semi-government offices (District Secretariat, Town Hall etc.)	Hotel or Motel	Other than permitted and permissible
Social welfare institution such as community center, art gallery, museum and auditorium	Guest house	
Local and zonal municipal office	Athletic club, gymnasium, fitness center or indoor sport facility	
Police station, fire station or post office	Research and development centers	
Shelter home		
Panahgahs		
Convention center		

Map 42: Proposed Public/Civic Amenities Zones



6.4.4 Graveyards

6.4.4.1 Existing Graveyards

The existing profile of graveyards in District Bajaur shows that a total of 349.09 acres of land is allocated across the district for burial purposes. These graveyards are spread throughout various localities, serving the community's burial needs. However, despite this sizable area, many graveyards face challenges in terms of condition and management. Common issues include lack of formal maintenance, inadequate boundary demarcations, and limited basic amenities such as pathways, lighting, and sanitation facilities. Overcrowding is often observed due to the increasing population and limited availability of new land designated for burial use. The condition of graveyards varies, with some older sites experiencing neglect and deterioration, while others are better preserved depending on local community involvement. There is a notable absence of designated graveyards for minority communities, which often leads to additional burdens on those populations.

Graveyards have been allocated by the locals on the basis of their respective villages and specific areas. Some famous Graveyards are ***Dosai, Jar, Kanaser, Pashat, Loesam, Ghazi Baba Arang, Batai Alizai, Chinagai Utmankhel, Hayati, Manodehrai, Bandagai, Kulala, Mandal, Tangi Charmang, Tangi Salarzai, Raghagan, Inayat Killi, Inzari, Haji Lawang, Tang Khatta, Chingazo, Shandai Morh, Rashakai, Zoorbandar.***

Currently, the district relies on traditional, community-run graveyards, primarily serving the majority Muslim population. Most villages and townships maintain their own communal burial spaces, which are managed locally without formal municipal oversight or systematic expansion plans. These graveyards face issues such as limited capacity, lack of proper boundary demarcations, and absence of essential amenities like pathways, lighting, or fencing, often leading to overcrowded conditions and encroachment over time.

For minority communities, especially Christians, there is a documented absence of designated graveyards. As a result, these families are compelled to transport their deceased over considerable distances to other cities, such as Nowshera, for burial. This causes significant social, emotional, and financial hardship while highlighting the exclusion of minorities from essential civic amenities in Bajaur[9].

Local government officials have acknowledged the lack of formal cemetery infrastructure for minorities but efforts to address the issue are still pending[10]. The situation underscores the urgent need for inclusive planning to ensure accessible, dignified burial space for all community segments in the district.

[9] https://thepenpk.com/no-land-for-cemetery-bajaur-christian-burying-the-beloveds-at-a-high-cost/
[10] https://www.dawn.com/news/1630181

6.4.4.2 National Standards and Future Requirements for New Graveyards

6.4.4.2.1 Grave Dimensions

As shown in the Table below, grave sizes vary by age category. An adult grave typically requires 7 feet by 4 feet (2.13 × 1.22 meters), while children and infants require proportionally smaller spaces. These standard dimensions facilitate the estimation of the total area required for each burial plot, including allowances for circulation paths and spacing between graves.

Table 70: Age-wise Grave Size Standards as per NRM

Category	*Dimensions (Feet)*	*Dimensions (Meters)*
Adults	7' × 4'	2.13 × 1.22
Children under 12	6' × 3'	1.83 × 0.91
Infants	4' × 3'	1.22 × 0.91

Source: National Reference Manual for Infrastructure and Planning

6.4.4.2.2 Land Requirement Estimation

Based on planning norms, a mortality rate of 12 deaths per 1,000 people per year and a grave rotation time of 40 years are assumed for urban graveyards. This results in 480 graves per 1,000 people over one rotation cycle. Each grave, including circulation and non-burial space, occupies an average of 54 square feet, leading to a total requirement of ***0.595 acres per 1,000 people.*** Using an urban density of 35 persons per acre, the required land for graveyards is calculated at 20.8 acres per 1,000 acres of urban space. This equates to 2.1% of the total urban area that should be reserved for graveyard use, as detailed in the Table below.

Table 71: Planning Standards for graveyard as per NRM

Parameter	Value / Calculation
Rotation time for graveyard	40 years
Graves required for one rotation	40 years × 12 deaths/year = 480 graves
Gross size of each grave	9 ft × 6 ft = 54 sq. ft. (includes circulation & other uses)
Total area required per 1000 persons	54 sq. ft × 480 graves = 25,920 sq. ft = 0.595 acres
Urban density	35 persons per acre
Area required for 1000 acres of urban space	0.595 acres × 35 = 20.8 acres
Percentage of urban area dedicated to graveyards	2.1%

Source: National Reference Manual for Infrastructure and Planning

6.4.4.3 Proposed Graveyards

The ***Urban Centre*** of Khar currently contains 62.25 acres of graveyards. To accommodate projected population growth and future burial requirements, an additional 98.67 acres are proposed, increasing the total graveyard area to 160.91 acres and ensuring sufficient capacity for long-term community needs.

Among ***Potential Urban Centres***, Mamund, Gardai Utman Khel, and Lara Dandokaii are prioritized for expansion of burial facilities. Mamund's existing 8.89 acres are proposed to be increased by 15.00 acres, bringing the total to 23.89 acres, while Gardai Utman Khel will expand from 9.14 to 33.02 acres through the addition of 23.88 acres, addressing current and future service gaps. Lara Dandokaii, with an existing 22.16 acres, is proposed to add 3.90 acres, resulting in a total of 26.06 acres.

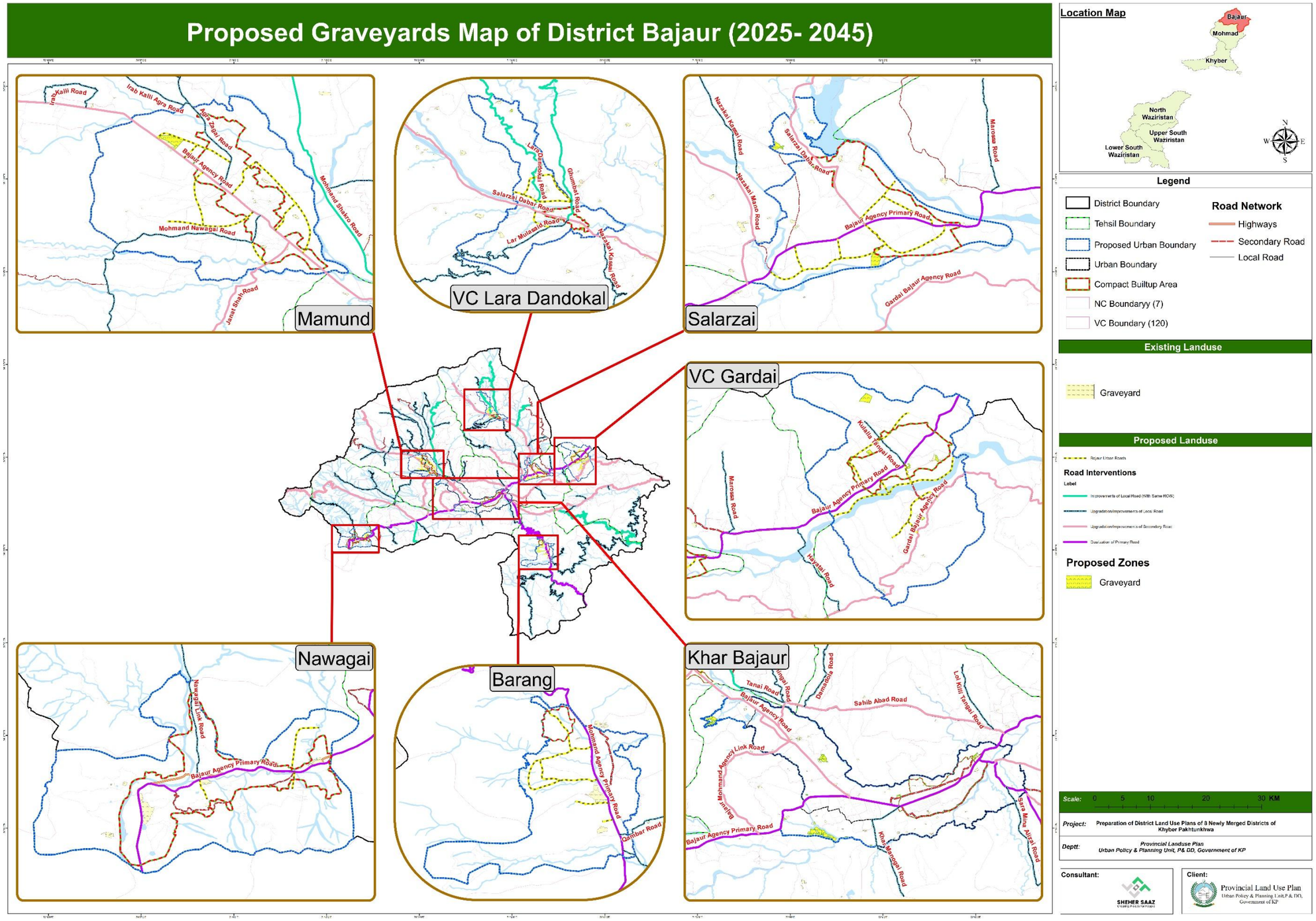
In ***Potential Settlements,*** Salarzai is planned for an increase from 9.86 to 24.19 acres to meet long-term needs, whereas Nawagai and Barang, with 28.17 and 32.27 acres respectively, have adequate existing graveyard land and no immediate expansion is proposed. These measures ensure equitable and sufficient burial provisions across the district while aligning with anticipated population growth up to 2045.

Table 72: Proposed Graveyards

Urban centre/Settlements	*Existing Graveyard (Acres)*	*Proposed Graveyard (Acres)*	*Total Graveyard (2025-2045) (Acres)*
Urban Centre			
Khar Urban Area	62.25	98.67	160.91
Potential Urban Centre			
Mamund	8.89	15.00	23.89
Gardai Utman Khel	9.14	23.88	33.02
Lara Dandokaii	22.16	3.90	26.06
Potential Settlement			
Salarzai	9.86	14.34	24.19
Nawagai	28.17	Extention of existing	28.17
Barang	32.27	Extention of existing	32.27

Source: Developed by Consultant

Map 43: Proposed Graveyards – District Bajaur



6.4.4.4 Guidelines for the Proposed Graveyards

According to the Khyber Pakhtunkhwa Urban Policy 2022–30, the responsibility of defining Land Use, Building Control, and Zoning Regulations lies with the Khyber Pakhtunkhwa Land Use and Building Control Authority. Under the Khyber Pakhtunkhwa Land Use and Building Control Act, 2021, the Authority specifies the concepts of permitted and permissible land uses. Permissible land uses may be granted approval by the District Planning and Design Committee, subject to the payment of the prescribed fee. However, detailed planning standards and development guidelines are yet to be formally established. In this context, the consultant has reviewed both national and international case studies and formulated development guidelines tailored to the study area. These guidelines shall remain applicable until the Building Control Authority officially notifies any Land Use Classification Rules enforceable across Khyber Pakhtunkhwa. The proposed development guidelines for graveyard sites are as follows:

Table 73: Rules and Guidelines for Proposed Graveyards

Permitted Uses	Allied Permissible Uses	Prohibited Uses
• Administration buildings • Religious buildings • Mosques • Clinics/dispensaries • Local shopping areas • Retail stores (e.g., flower shops, horticulture, convenience stores) • Petrol pumps, Gas filling stations • Parking facilities	• Residential for graveyard workers/caretakers • Shops • Zoological garden • Botanical garden • Bird sanctuary	• Heavy, large, and extensive industries (noxious, obnoxious) • Hazardous industries • Warehousing, storage godowns of perishables, hazardous, inflammable goods • Sewage treatment plant/disposal work • Water treatment plant • Solid waste dumping yards • Research laboratories treating contagious diseases

6.5 RECREATIONAL ZONES & TOURISM

6.5.1 Heritage and Archaeological Sites

6.5.1.1 Archaeological Profile

- ***Gandhara Buddhist Heritage***

Bajaur forms an integral part of the greater Gandhara region, which encompasses the Peshawar Valley, Mardan, Swabi, Swat, Dir, Buner, and extends to Taxila in the east and Kabul in Afghanistan to the west. The Gandhara civilization, which emerged around 500 BCE, is particularly renowned for its Buddhist art and architecture. The main Gandhara sites in the region are located in the valleys of Peshawar, Dir, Swat, Bajaur, Mohmand, Kabul, and Taxila. Archaeological discoveries in Bajaur include Buddhist stupas, monasteries, sculptures, coins, and inscriptions that illuminate the region's role as a center of Buddhist learning and religious practice.

- ***Buddhist Architectural Features***[11]

Buddhist architecture in Bajaur follows the classic Gandharan style, characterized by:

- ***Stupas***: Stone and earthen hemispherical structures with a cylinder-like base (drum) and dome. These sacred monuments contained relics of Buddhist monks and served as centers for meditation and circumambulation (pradakhshina). Bajaur stupas display both round Ashokan-style designs dating back 2,200 years and later square stupas introduced in the Kushan period.
- ***Monasteries***: Complex buildings featuring assembly halls, dining areas, courtyards, and double-storied living quarters for Buddhist monks. These institutions served as centers of learning and religious practice.
- ***Sculptures and Art:*** The distinctive Greco-Buddhist art style combining Hellenistic and local elements, depicting Buddha's life stories, Jataka tales, and various Buddhist deities.

- ***The Shinkot Reliquary***

The Shinkot reliquary is one of the most significant archaeological discoveries in Bajaur and is considered among the earliest Buddhist reliquaries in the Gandhara region, dating to the time of Emperor Ashoka (3rd century BCE). The casket inscription provides crucial information about the Apracharaja dynasty, documenting King Vijayamitra's restoration of a damaged structure approximately half a century after its initial construction by Vijayakamitra. This artifact is now housed in the Peshawar Museum collection.

[11] https://kparchaeology.gkp.pk/publications/books/book-1445449626584.pdf

6.5.1.2 Heritage Sites in District Bajaur

Table 74: Heritage Sites in Bajaur[12],[13],[14]

Site Name	Location	Historical / Cultural Significance & Description
Koh-i-Mor (Mount Meros)	Tehsil Salarzai	Highest peak in Bajaur and identified with ancient *Mount Meros* mentioned by Arrian. Associated with Alexander the Great's campaigns (327–326 BCE) and the founding of the ancient city of Nysa. Linked to the Nysaeans who claimed descent from followers of Dionysus, supported by the presence of grapevines and ivy. Snow-covered in winter, rich in chenar trees and springs, and now a popular trekking and tourist destination (2–4 hours hike).
Simandaro (Sikandaro)	—	Historically associated with Alexander the Great's arrival in Bajaur; the name is derived from "Sikandar." Considered part of the ancient Nysaean territory. Archaeological remains from the Greco-Buddhist period have been discovered, making it an important cultural and historical landmark.
Gabar Cheena (Gabbar Cheena / Gabary)	Khar Sub-Division	Important archaeological site linked to Bajaur's Buddhist and Gandharan heritage. Evidence includes pottery shards, structural remains, and ancient settlement traces. Local tradition associates it with pre-Islamic settlements. Recognized today as a key heritage and tourist site.
Kohimore Hillock	Near Khar	Archaeological and tourist site offering panoramic views of surrounding valleys. Identified as containing remains from multiple historical periods, highlighting long-term human occupation in the area.
Seri-sar	Tehsil Barang	Historically significant and scenic tourist destination with natural springs. Popular during Ramadan and Eid. Equipped with a government rest house providing accommodation for visitors.
Ghakhi Pass (Nawapass)	Nawagai Sub-Division	Strategic mountain pass historically linking Bajaur with Afghanistan. Used as a trade and military route across centuries, including during Alexander the Great's campaigns and later Islamic conquests. A government rest house exists for visitors.
Navy Dhand (Naway Dhand)	Near Khar	Site of the tomb of Sakhi Arab Khan, Mughal-era governor of Bajaur. Represents the Islamic heritage of the district and reflects continuity of settlement from ancient to medieval times.
Raghagan Dam	Tehsil Salarzai	Modern water resource project that has become a tourist attraction. Located in an archaeologically rich region known for Gandharan artifacts. Boat facilities are available, enhancing its recreational value.

6.5.1.3 Religious and Spiritual Heritage Sites[15]

6.5.1.3.1 Islamic Shrines

[12] Arrian. *Anabasis Alexandri* (The Campaigns of Alexander). Various editions and translations.
[13] Khan, M. A. and Lone, M. A. (2004). "Gandhara Art and Architecture." *Journal of Asian Civilizations*.
[14] Rehman, E. S. (1996). "Archaeological Reconnaissance in Gandhara." Department of Archaeology & Museums, Government of Pakistan.
[15] Babur, Zahir-ud-din Muhammad. *Baburnama*. Translated by John Leyden and William Erskine.

Following the Islamic conquest of the region, numerous shrines were established in Bajaur commemorating Sufi saints and religious figures. These shrines continue to serve as important spiritual centers and attract pilgrims from throughout the region.

- ***Shrine of Ghazi Baba***

One of the most prominent spiritual sites in Bajaur, the shrine of Ghazi Baba is associated with a regional saint and holds significant local religious importance. The shrine attracts devotees seeking blessings and spiritual guidance.

- ***Shrine of Sakhi Baba***

The shrine of Sakhi Baba represents another important spiritual center in the district. Local tradition attributes various miracles and spiritual powers to this saint, and the shrine continues to be maintained by the local community.

- ***Shrine of Sheikh Baba***

Sheikh Baba's shrine serves as a place of worship and spiritual reflection for local communities. The site is particularly venerated during religious festivals and occasions.

- ***Shrine of Mir Ali Baba***

The shrine of Mir Ali Baba represents the rich Sufi tradition in Bajaur. These spiritual centers have played crucial roles in preserving Islamic teachings and cultural traditions throughout the centuries.

6.5.1.3.2 Historic Mosques

- ***Masjid Androon Khar***

Location: Khar

Description: The Masjid Androon Khar (Inner Mosque of Khar) is one of the historic mosques in the district headquarters. This mosque represents the Islamic architectural heritage of the region and continues to serve as an active place of worship.

- ***Eidgah Masjid***

Location: Khar

Description: The Eidgah Masjid serves as the primary location for Eid prayers in Khar. The mosque and its associated open prayer ground can accommodate large congregations during major Islamic festivals.

6.5.2 Tourist Site & Recreational Facilities

Bajaur experiences a continental climate with significant seasonal variations. Winter months (November through March) are characterized by extremely cold temperatures, often dropping below freezing, with substantial snowfall in higher elevations. The spring season (April through May) offers the most favorable conditions for tourism, featuring moderate temperatures, blooming flora, and accessible mountain trails. Summer brings warmer temperatures but remains pleasant due to the elevation. Autumn (September through October) provides another excellent window for visitors, with clear skies and comfortable temperatures.

6.5.2.1 Water Resources and Dams

- ***Raghagan Dam***

Raghagan Dam represents one of the most significant infrastructure developments in Bajaur District's recent history. Completed by the Khyber Pakhtunkhwa government in January 2025, this concrete gravity dam is located approximately 13 kilometers from the district headquarters of Khar. The dam has a storage capacity of 1,252 acre-feet and features an integrated 11-kilometer canal system designed to irrigate 4,616 acres of agricultural land. Beyond its primary agricultural function, Raghagan Dam has emerged as a major recreational destination. The reservoir created by the dam provides opportunities for boating, fishing, and water sports. The surrounding area features picnic facilities and scenic viewpoints that attract families and tourists throughout the year.

Figure 4: Raghagan Dam

- ***Taly (Talai) Dam***

Taly Dam serves as another prominent water resource and tourism destination within Bajaur District. Nestled amidst lush greenery and surrounded by rolling hills, this multipurpose dam provides essential services including irrigation, domestic water supply, and flood control. The dam's picturesque setting has made it a favored location for nature enthusiasts, photographers, and families seeking tranquil outdoor experiences.

The area surrounding Taly Dam features diverse flora and fauna, creating opportunities for ecological tourism and environmental education. Nature walks along the dam's perimeter offer visitors chances to observe local wildlife and appreciate the district's natural biodiversity. The calm waters of the reservoir provide suitable conditions for recreational fishing, while the surrounding landscape invites hiking and outdoor photography. The dam's integration of utility infrastructure with natural beauty exemplifies sustainable tourism development principles.

Figure 5: Taly (Talai) Dam Salarzai Bajaur

6.5.2.2 Mountains and Peaks[16]

- ***Koh-i-Mor (Three Peak Mountain)[17]***

Koh-i-Mor, literally meaning "***Three Peak Mountain***," stands as the highest elevation in Bajaur District, with peaks reaching approximately 3,000 meters above sea level. The mountain's three distinctive peaks remain snow-covered throughout winter months and are frequently shrouded in clouds, creating dramatic visual spectacles. On exceptionally clear days, Koh-i-Mor is visible from as far away as the Peshawar Valley, serving as a prominent geographic landmark for the entire region. The mountain's slopes are covered with dense forests, supporting diverse ecosystems and providing habitat for various wildlife species

- ***Kohimor Hillock***

Kohimor Hillock, located in the northern region of Bajaur District, has gained recognition as a popular tourist destination offering more accessible mountain experiences compared to the challenging Koh-i-Mor peak. This elevated terrain provides spectacular panoramic views of the surrounding landscape while requiring less technical climbing expertise, making it suitable for a broader range of visitors including families and casual hiker.

[16] Utmankhel. (2024). *Bajaur District: Geography, history and culture*. https://www.utmankhel.com/bajaur-district/
[17] Bajaur District Government. (2025). *District profile and tourist attractions*. Government of Khyber Pakhtunkhwa. https://bajaur.kp.gov.pk/page/about_us

Figure 6: Mountains and Top Peaks in District Bajaur (Koh-i-Mor)

6.5.2.3 Valleys and Natural Landscapes

- ***Khar-Nawagai Valley***

The Khar-Nawagai Valley constitutes the principal agricultural and population center of Bajaur District, extending through the central region and encompassing the district's administrative headquarters. This fertile valley is drained by the Rud Stream, which flows from southwest to northeast, providing essential water resources for agriculture and supporting the valley's renowned productivity. The valley's floor comprises rich alluvial soils that have sustained agricultural communities for centuries, producing wheat, maize, and various fruits including apples and apricots. The town of Khar, situated in the valley's heart, serves as both the district headquarters and the primary commercial center. Khar's historic bazaar represents a focal point of regional trade and cultural exchange, featuring traditional architecture, local handicrafts, and the vibrant commercial activity characteristic of Pashtun market towns.

- ***Gabar Cheena***

Gabar Cheena represents one of the notable scenic attractions in Bajaur District's northern area, recognized for its pristine natural landscapes and peaceful atmosphere. This location has gained popularity among tourists seeking to experience the district's natural beauty through outdoor activities and nature photography. The area's relatively accessible terrain makes it suitable for day trips and family excursions, contributing to its growing reputation as a recreational destination.

The landscape at Gabar Cheena features characteristic elements of Bajaur's natural environment, including verdant meadows, scattered woodland, and mountain vistas. Seasonal variations bring dramatic changes to the area's appearance, with spring wildflowers, summer greenery, autumn colors, and winter snow each creating distinct visual experiences. Photography enthusiasts particularly appreciate the location's diverse compositional opportunities and the quality of natural light at different times of day.

Bajaur District in Khyber Pakhtunkhwa, Pakistan, features a mix of natural, historical, and archaeological attractions, with the listed sites highlighting its scenic hills, passes, and ancient mounds. These spots offer opportunities for hiking, cultural exploration, and heritage tourism.

Table 75: Tourist Sites of Significance in Bajaur

Site Name	Type	Location/Tehsil	Description and Potential
Gabar Cheena	Natural/Tourist	Central Bajaur (near Khar Tehsil)	Scenic hill or valley known for panoramic views and natural beauty; ideal for hiking and picnics, serving as a popular day-trip spot from Khar.
Kohimor Hillock	Natural/Tourist	Khar Tehsil	Elevated hillock with rugged terrain; potential for adventure tourism like trekking and photography, offering views of surrounding valleys.
Bhaicheena	Natural/Tourist	Central Bajaur (near Khar Tehsil)	Picturesque natural area, likely a hill or stream site; suitable for eco-tourism and relaxation, with opportunities for birdwatching.
Nawapass	Natural/Tourist	Nawagai Tehsil (border area)	Mountain pass along scenic routes; high potential for adventure drives and border trekking (with permits), highlighting Bajaur's mountainous landscape.
Ghakhi Pass	Natural/Tourist	Nawagai Tehsil (near Afghanistan border)	Dramatic pass with thorny scrublands; ideal for off-road exploration and wildlife spotting, tying into border eco-trails.
Nawidand	Historical/Archaeological	Khar Tehsil (near Khar town)	Ancient mound or historical site in Khar area; significant for Gandhara-era artifacts, potential for archaeological tours and excavations.
Ghurbi Dand	Historical/Archaeological	Khar Tehsil (near Khar town)	Historic mound with cultural remnants; offers heritage potential for guided walks, linking to Bajaur's ancient trade routes.

6.5.3 Major Constraint in Tourism

Bajaur District, despite its rich attractions like Koh-e-Moor Mountain, Gabar Cheena, Nawapass, and Gandhara sites, faces significant barriers to unlocking its 15,000+ annual tourist potential by 2030. As a former FATA region bordering Afghanistan (52 km shared border), these constraints—rooted in security, infrastructure, and socio-economic factors.

Constraint	Description	Impact on Tourism
Security Risks	Ongoing militancy threats and proximity to Durand Line (e.g., Nawapass, Ghakhi Pass in Nawagai, 30.5 km from Khar) create travel advisories and permit requirements.	Deters 80%+ of domestic/international visitors; Koh-e-Moor trails remain underutilized due to perceived danger.
Poor Infrastructure	Narrow, unpaved roads (e.g., 27 km to Barang, 30.5 km to Nawagai); no signage, rest areas, or utilities at sites like Bhaicheena and River Front Parks (170.50 acres).	Limits access to remote gems; strong river currents at Salarzai (144.15 acres) unsafe without facilities, stranding adventure seekers.
Lack of Amenities	No eco-lodges, guides, or equipment rentals near Koh-e-Moor (455.56 acres) or Ghurbi Dand; base camp lacks safety gear for slippery trails.	Tourists stop at base camps, missing peaks; 87.14-acre Proposed Parks underused without swings/jogging tracks.
Low Awareness	Minimal promotion of sites like Nawidand vs. Swat; no digital presence or packages integrating Khar Bazar with Gandhara ruins.	Overshadowed by KP hotspots; potential 10,000+ heritage visitors untapped despite 2.2M population base.
Environmental Hazards	Slippery trails, flash floods at River Front Parks, and fragile ecosystems (45% Salarzai forests) risk accidents/degradation.	Dangerous rafting currents (>2 m/s) and monsoon trail closures limit 170.50-acre river tourism to 20% capacity.
Cultural Resistance	Conservative Pashtun norms in peripheral tehsils (33% literacy) resist external tourism; land disputes near Nawapass.	Homestays and female participation blocked; community fears economic exclusion from 500+ projected jobs.

6.5.4 Sports Facilities

District Bajaur currently has a limited number of sports and recreational facilities available. According to the Sports and Culture Department of Bajaur, the existing facilities include two

main playgrounds: the Bajaur Sports Complex and Larkholozo Ground.[18] Within the Bajaur Sports Complex, there are specialized grounds for various sports, including one cricket ground, one football ground, and one hockey ground. Additionally, there is an indoor game hall and a park available for recreational activities.
The district holds a variety of sports activities such as athletics, badminton, cricket, football, volleyball, boxing, gymnastics, tug of war, hockey, baseball, archery, and basketball. These activities provide opportunities for the local population to engage in different sports and stay physically active.

Active recreation comprises formal and informal, outdoor and indoor games. The more capital-intensive the facility is, the larger the catchment required for its viable operations. Sub-standard sizes may be considered for cricket and football where the games are limited to the pre-teen and early teen age group. The table below delineates the standards set forth by the National Reference Manual for Infrastructure and Planning[19], for the establishment of new active recreational facilities at various levels of settlements and threshold population:

Table 76: Active Recreation Facilities Allocation Criteria

Type of Facility	Population Criteria	Sports	Size
Metropolitan City Stadiums	Above 2,000,000	Cricket	2.5 hectares
		Hockey	2.8 hectares
		Football	1.5 hectares
City Stadium	Above 300,000	Cricket	2 hectares
	Above 200,000	Hockey	1.15 hectares
		Football	1.4 hectares
Community Level Playgrounds	Around 100,000	Combined Playground	2.14 hectares
Neighborhood Level Playgrounds	Around 25,000	Combined Playground	1.63 hectares

Source: National Reference Manual of Planning and Infrastructure Standards (NRM)

For the calculation of new sports facilities required for the current population to fill the backlog, a comprehensive assessment of facilities, ranging from stadiums to playgrounds, has been undertaken. This evaluation is grounded in the National Reference Manual standards for Active Recreation, considering the demographic data from the 2017 population census of District Bajaur and projecting it to 2024.

[18] https://bajaur.kp.gov.pk/page/sports_and_culture_department_of_bajaur
[19] 7 Government of Pakistan, Ministry of Housing and Works, Environment and Urban Affairs Division. National Reference Manual of Planning and Infrastructure Standards (NRM). Table 6.11 Active Recreation Standards

6.5.5 Proposed Recreational Zones

To enhance community well-being, promote social interaction, and strengthen the tourism potential of Bajaur District, a comprehensive network of recreational facilities is proposed across all tehsils. The plan envisions the creation of inclusive, accessible, and environmentally responsive recreational spaces that cater to varying population sizes, geographic settings, and local economies.

1. **Community Parks – Accessible Green Spaces for Every Tehsil**

To ensure equitable access to recreation across all localities, a series of **Community Parks** are proposed throughout the district.

- These smaller parks will be **strategically located within residential neighborhoods**, ensuring walkable access for local communities.
- Facilities will include **children's play areas, shaded seating, and jogging tracks**, promoting health and social well-being.
- Special emphasis will be given to **densely populated and underserved areas**, ensuring inclusion and balanced development.

Community parks will provide much-needed breathing spaces within growing settlements, improving environmental quality and fostering social cohesion.

Figure 7: Concept Design for Community Parks with Kids play area

Source: https://novostroycity.ru/journals/novosti-kompanij/sminex-novyj-biznes-klass-sportivnyj-detskij-komfortnyj

2. Large Recreational Zones – Sports, Tourism, and Eco-Leisure

To diversify outdoor activities, enhance quality of life, and attract regional tourism, **Large Recreational Zones are recommended** at **strategic locations** across the district. These zones **will function** as multi-purpose destinations supporting sports, leisure, family recreation, and eco-tourism, while respecting natural landscapes and cultural values.

These zones **will host** a wide range of recreational facilities, including:

➢ *Family and Community Recreation Areas*

- **Family-only picnic zones** with shaded seating and open lawns
- **Dedicated women-only recreational sections**, ensuring privacy and cultural comfort
- **Children's play areas** with safe, age-appropriate equipment
- **Joyland / amusement-style areas** with small rides and interactive attractions
- **Cafés, refreshment kiosks, and cake/tea corners** to support social gatherings
- **Prayer areas (open-air and covered)** integrated within recreational spaces

➢ *Sports and Fitness Zones*

- **Sports complexes** including football, volleyball, cricket, and multi-purpose grounds
- **Men-only fitness and sports areas**, where culturally appropriate
- **Open-air gyms** and exercise zones
- **Jogging, walking, and cycling tracks** with shaded pathways
- **Training grounds and youth sports facilities** to encourage healthy lifestyles

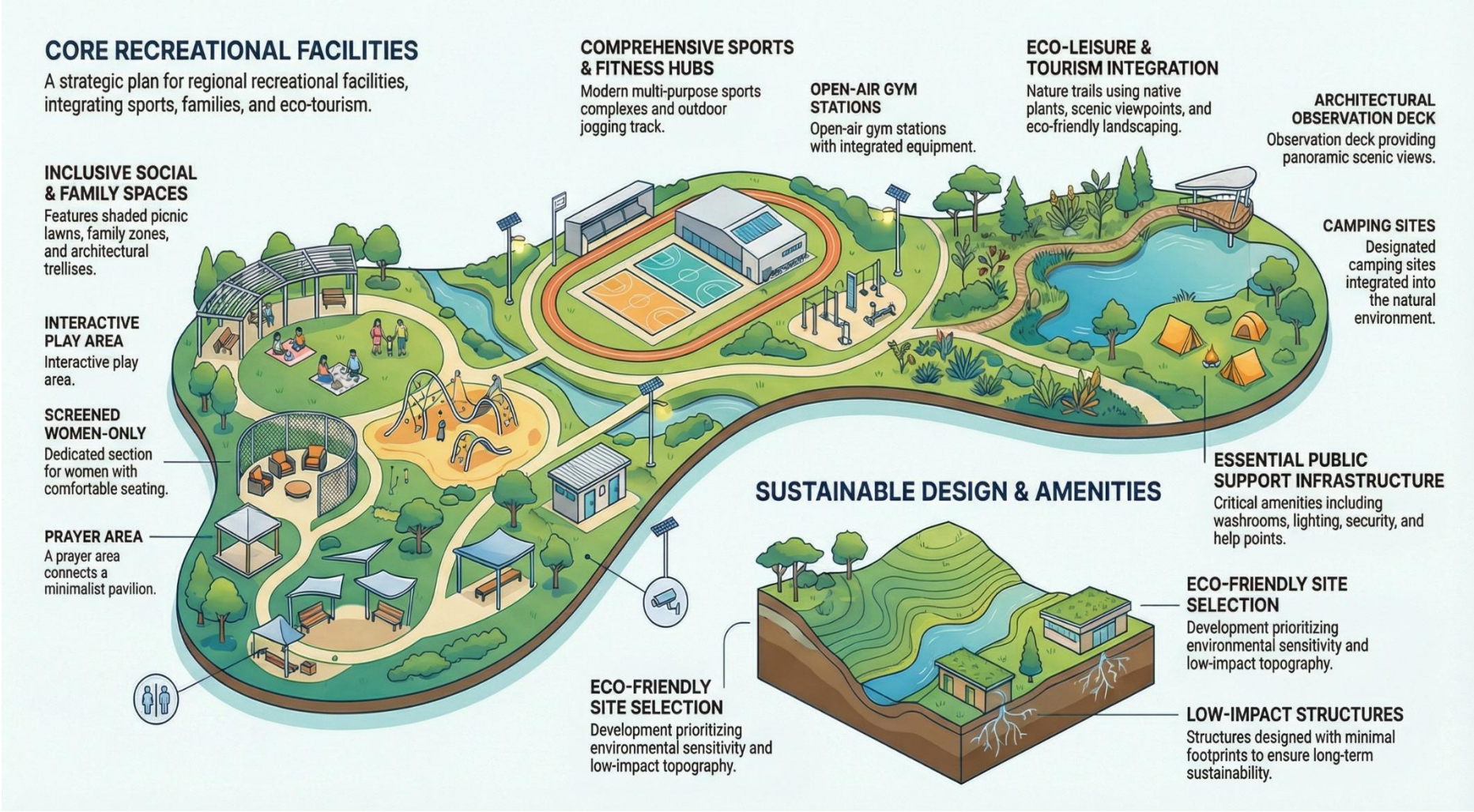
➢ *Eco-Leisure and Tourism-Oriented Spaces*

- **Eco-tourism trails**, nature walks, and interpretive paths
- **Camping and picnic sites** within landscaped natural settings
- **Scenic viewpoints, photography spots, and viewing decks**
- **Beautifully landscaped areas** featuring native plants, water features, and shaded groves
- **Seasonal event and festival grounds** for cultural and recreational activities

Site selection for these Large Recreational Zones **will be based on topography, accessibility, environmental sensitivity, and tourism potential**, ensuring long-term sustainability and minimal ecological disturbance. Development **will follow** eco-friendly design principles, prioritizing low-impact structures and native landscaping.

These **recommended recreational zones will not only support local participation** but **will also position District Bajaur as an emerging destination** for **eco-tourism, family tourism, and adventure-based recreation**, contributing to socio-economic development while preserving the district's natural character.

Figure 8: Proposed Recreational Zone Masterplan Concept



3. Riverfront Parks – Utilizing Natural Corridors

Drawing inspiration from successful dam-based recreation models, the proposed Riverfront Parks in Bajaur District aim to transform the natural corridors of the Swat River and its tributaries into vibrant leisure and adventure destinations. These parks will harmoniously blend nature, recreation, and tourism, offering both tranquility and thrill for residents and visitors alike.

Scenic and Recreational Landscape

- Pedestrian promenades and riverside walkways for scenic exploration.
- Landscaped sitting terraces and shaded picnic lawns for family gatherings.
- Observation decks offering panoramic views of the river and surrounding hills.

Water-Based Activities

To replicate the recreational success of leading dam-based tourist sites, the parks will include:

- Boating (short and long trips)
- Kayaking and wake tubing
- Cliff diving (small and large boats)
- Jet skiing and parasailing
- Wakeboarding, scuba diving, and water skiing

These water sports will be safely managed through trained personnel, ensuring enjoyable and secure experiences for visitors.

Land-Based Adventure Zones

- In addition to water recreation, designated areas will host:
- Archery and air shooting ranges
- Rock climbing and caving zones
- Camping sites and repelling stations for outdoor exploration

Such facilities will attract tourists and encourage local participation in physical and adventure-based activities.

Visitor Amenities

To ensure comfort and accessibility, the Riverfront Parks will provide:

- Refreshment kiosks and food courts
- Eco-friendly parking spaces
- Rest areas and viewing pavilions
- Guided tour points and information centers

Special focus will be given to Pindiali Tehsil (Palai Water Dam), where the natural topography, lush greenery, and proximity to the river make it an ideal site for eco-tourism development. The Riverfront Parks proposed in Recreational zone will serve as both community leisure spaces and tourism anchors, promoting local employment opportunities and sustainable tourism practices.

By combining scenic beauty with recreational vibrancy, the Riverfront Parks / recreational Zone will not only enhance the district's visual and environmental quality but also position Bajaur as an emerging destination for water sports, adventure tourism, and nature-based recreation.

Figure 9: Activities for Riverfront Park (concept)

Source: Google Images (inspired from Khanpur Dam)

The ***Urban Centre of Khar*** currently contains 67.66 acres of parks and playgrounds, which are fragmented and insufficient to serve projected urban growth. To address this gap, dedicated Recreational Zones are proposed covering 85.83 acres, intended to accommodate multi-functional open spaces, including public parks, playgrounds, sports fields, community open grounds, and buffer green areas along major urban corridors. This increases the total recreational land to 153.49 acres by 2045 and ensures structured, accessible, and centrally connected recreational spaces within the urban fabric.

In the ***Potential Urban Centres***, recreational provision is largely informal and limited in scale. In Mamund, the existing 7.54 acres of parks and playgrounds are strengthened through the designation of 10.79 acres as Parks and an additional 7.25 acres as Recreational Zones, allowing flexibility for future facilities such as sports complexes, open grounds, and event spaces, bringing the total to 25.57 acres. Similarly, Gardai Utman Khel's existing 15.14 acres are expanded through the proposal of 12.77 acres of Parks and 11.09 acres of Recreational Zones, resulting in a total of 39.01 acres and supporting its transition into a secondary urban centre. Lara Dandokaii currently lacks formal recreational spaces; therefore, 7.53 acres of

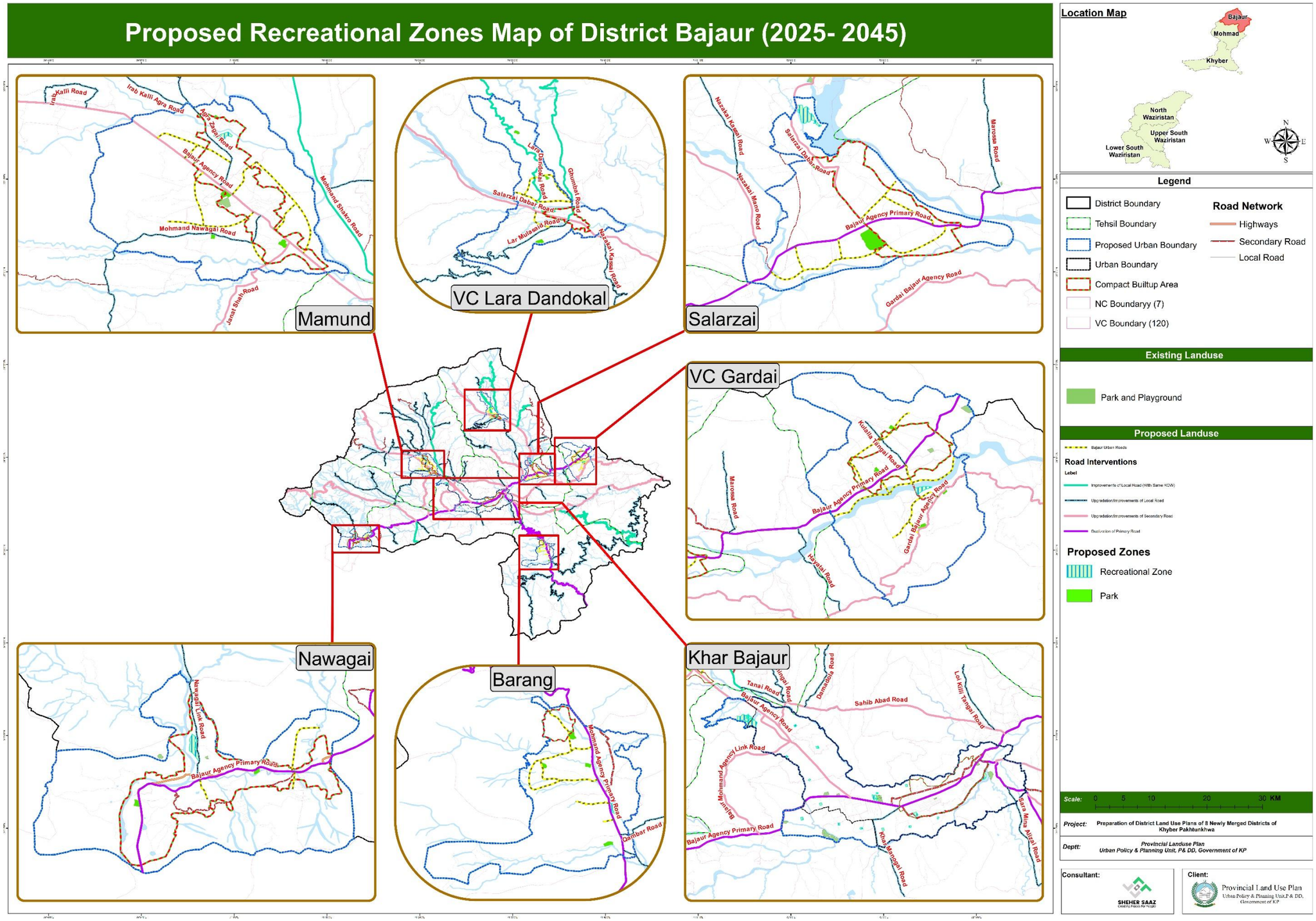
Parks and 8.22 acres of Recreational Zones are proposed to establish a minimum open-space structure and integrate green areas within future urban expansion.

Within ***Potential Settlements***, recreational land use is almost entirely absent and is addressed proactively through zoning proposals. Salarzai, with negligible existing provision, is proposed to receive 28.47 acres of Parks and 18.90 acres of Recreational Zones, ensuring large contiguous open spaces that can also function as community gathering areas and environmental buffers, raising the total to 47.92 acres. Nawagai's recreational provision is increased through 2.94 acres of Parks and 10.12 acres of Recreational Zones, while Barang is proposed for 13.03 acres of Parks and 7.32 acres of Recreational Zones, establishing structured recreational land at an early stage to prevent future deficits. Overall, the designation of Recreational Zones across District Bajaur moves beyond isolated parks towards a zoning-based open space system that supports livability, environmental resilience, and long-term urban growth up to 2045.

Table 77: Type of Recreation al Activity- District Bajaur

Urban centre/Settlements	*Existing*	*Existing Recreational (Acres)*	*Proposed Zones*	*Proposed Recreational Zones (Acres)*	*Total (2025-2045) (Acres)*
Urban Centre					
Khar Urban Area	Park and Playground	67.66	Proposed Recreational Zone	85.83	153.49
Potential Urban Centre					
Mamund	Park and Playground	7.53738	Proposed Park	10.79	25.57
			Proposed Recreational Zone	7.25	
Gardai Utman Khel	Park and Playground	15.143978	Proposed Park	12.77	39.01
			Proposed Recreational Zone	11.09	
Lara Dandokaii			Proposed Park	7.53	15.75
			Proposed Recreational Zone	8.22	
Potential Settlement					
Salarzai	Park and Playground	0.546189	Proposed Park	28.47	47.92
			Proposed Recreational Zone	18.90	
Nawagai	Park and Playground	0.584512	Proposed Park	2.94	13.65
			Proposed Recreational Zone	10.12	
Barang			Proposed Park	13.03	20.35
			Proposed Recreational Zone	7.32	

Map 44: Proposed Recreational facilities/zone in District Bajaur



6.6 ENERGY & POWER

6.6.1 Review of National/ Provincial Policy Regarding Energy and Power

6.6.1.1 BajaurPakhtunkhwa Hydel Development Fund Ordinance 2001

Established a dedicated fund for hydropower development in KP. Financed mainly through provincial profits from federal hydel projects, with additional federal, provincial, or external contributions. At least 10% of project profits are reinvested into the Fund.

- Minimum project cost: PKR 500 million (smaller projects only through joint ventures).
- Managed by a Board with authority over project approval and fund investment.
- Proposals initiated by the Irrigation & Power Department, reviewed by PDWP, and approved by the Board.
- Financial controls include annual audits by the Auditor General and strict withdrawal protocols.

6.6.1.2 National Electricity Plan (NEP) 2023–2027

A strategic roadmap to reform Pakistan's power sector with six objectives: diversification, resilience, self-sufficiency, affordability, financial viability, and sustainability.

- **Diversification:** Integrated energy planning, renewables, cross-border trade.
- **Resilience & Access:** Transmission expansion, robust distribution, electrification of remote areas.
- **Self-Sufficiency:** Promote local resources and technologies.
- **Affordability & Viability:** Rationalized subsidies, cost-reflective tariffs, improved recovery.
- **Sustainability:** Decarbonization, efficiency, institutional strengthening, digitalization. Includes clear performance indicators, monitoring, and social protection measures to ensure inclusive energy access.

6.6.1.3 National Electricity Policy 2021

Provides a comprehensive framework for reliable, affordable, and sustainable electricity.

- **Goals:** Affordable access, energy security (via diversified local resources), and sustainability.
- **Guiding principles:** Efficiency, transparency, competition, financial viability, indigenization, and environmental responsibility.
- **Focus areas:** Generation, transmission, distribution, market development, tariffs, subsidies, energy efficiency, integrated planning, and governance. Stresses competitive capacity expansion, grid strengthening, loss reduction, cost-reflective tariffs, and renewable energy promotion. Includes monitoring and coordinated federal–provincial implementation.

6.6.1.4 Policy for Development of Renewable Energy (2006)

Launched to mainstream renewables (small hydro, wind, solar) into Pakistan's energy mix and attract private investment.

- **Short-term:** Incentives, simplified regulations, guaranteed power purchase, net metering, and wheeling.
- **Medium/Long-term:** Market consolidation, competitive frameworks, and sector self-sufficiency.
- Key incentives: Deregulation for small-scale projects, predictable tariffs, risk allocation to power purchasers, and carbon credit facilitation.
- Institutions: AEDB (one-window for RE), NEPRA (regulation), PPIB (private sector facilitation).

Aims to reduce fossil fuel dependence, enhance energy security, create jobs, and promote sustainability.

6.6.2 Identification of Proposed Projects[20]

The Bajaur district in Pakistan utilizes both renewable and non-renewable energy sources. Renewable sources include solar, wind, and potentially hydropower from small streams and rivers. Non-renewable sources primarily consist of natural gas (though availability and infrastructure may be limited in some areas) and potentially coal (though its use is less common). Additionally, biomass (like wood) is a significant energy source for cooking and heating, especially in rural areas. The energy and power sector's Annual Development Plan (ADP) 2024–25 outlines several initiatives that will be implemented.

S.No.	Name of Scheme	Cost (Rs. in Million)	Allocation for 2025-26 (Rs. in Million)
316	180492-Pilot Project for "installation of 13 no's of solar mini grids in merged areas" SUBCOMPONENT "Solar Electrification of 300 Masajid/Worship places for Non-Muslims in Merged Districts (erstwhile FATA) BajaurPakhtunkhwa". [MA]. (R)	673.230	0.001
317	170364 Installation of Micro Hydel Power Units in Tribal Districts. [MA]	99.961	14.361
328	Construction 132 KV Grid Station Mamund along with associated 20 KM 132 KV SDT, Transmission line with ACSR Lynx conductor (20 KM 132 KV SDT Transmission line with ACSR Lynx, Tower/Pole Foundations work, Erection of towers, Stringing of conductors) - Bajaur (A) /PDWP /13-01-2022	831.332	0.010

[20] Source: ADP 2024-2025 KPK

S.No.	Name of Scheme	Cost (Rs. in Million)	Allocation for 2025-26 (Rs. in Million)
331	Rehabilitation of existing network and electrification of un-electrified villages Merged Areas (A) /PDWP /02-12-2021	1,500.000	228.000
332	Provision of 11 kV independent feeders to commercial bazars along with distribution transformers, LT conductor/Aerial bundled cable (ABC).Installation of CAPACITORS for improvement of voltage profile and power factor of the system . Bifurcation of existing 11 kV feeders and provision of New Feeders to un-electrified areas in all Merged Districts (A) /PDWP /02-12-2021	845.000	100.000
335	Solarization of 2000 Masajid in Merged Areas (R)	2,848.190	954.000
337	Up-Gradation of 66KV Lakari Grid Station to 132KV Level along with Associated Transmission Line from 132KV Northern Mohmand & Khar Bajour Grid Station (B) /PDWP	1,739.588	30.000
338	Rehabilitation of existing Distribution Network and Electrification of remaining Un-Electrified areas of Newly Merged District (NMDs) (B) /PDWP	2,000.000	0.001

Source: ADP 2024-2025 KPK

The energy and power sector's Annual Development Plan (ADP) 2025–26 outlines several initiatives that will be implemented.

ADP S.No.	Name of Scheme	Cost (Rs. in Million)	Allocation for 2025-26 (Rs. in Million)
316	210366-Construction 132 KV Grid Station Mamund along with associated 20 KM 132 KV SDT, Transmission line with ACSR Lynx conductor (20 KM 132 KV SDT Transmission line with ACSR Lynx, Tower/Pole Foundations work, Erection of towers, Stringing of conductors) - Bajaur	831.33	797.152

Source: ADP 2025-2026 KPK

6.6.2.1 Available Energy Resources in Bajaur

While the district lacks significant conventional fossil fuel reserves (e.g., no major oil, gas, or coal deposits), it relies on the national grid for baseline thermal power and has emerging opportunities in renewables like hydropower and solar. Wind potential is limited, and biomass from agriculture supports small-scale use. Below is a summary table of available and potential energy sources, based on provincial assessments, KPK ADP projects (e.g., solar mini-grids, micro-hydel), and geographical features. Bajaur's energy strategy emphasizes off-grid renewables to address electrification gaps in remote areas (e.g., 132 kV Grid Station in Mamund Tehsil).

Table 78: Availability of Resources in District Bajaur

Energy Source	Availability/Status	Key Details and Potential
Hydropower	Moderate potential; underdeveloped but with micro-hydro projects.	Streams like Salarzai, Nawagai, and Mamund support micro-hydel units (e.g., 170364 scheme in KPK ADP 2024-25 for Tribal Districts). KPK's overall 45 GW hydro potential extends here; small dams could generate 10-50 MW locally.
Solar	High potential; emerging through off-grid initiatives.	8.5-9.5 hours daily sunlight; suitable for rooftop PV and mini-grids (e.g., 180492 pilot for 13 solar mini-grids in Merged Districts, Rs. 200M in 2024-25; solarization of 2,000 Masajid, Rs. 800M). National 2,900 GW solar potential applies; Bajaur could add 5-10 MW off-grid.
Biomass/Biogas	Moderate from agriculture; limited utilization.	Horticulture (plums, olives on 150,000+ acres) and livestock waste enable biogas digesters; KPK's 5,000-10,000 MW biomass potential includes Bajaur's ~9% cultivated land. Small plants for households/camps.
Wind	Low potential; not locally viable.	Inland hills lack consistent speeds (unlike Sindh's 50,000 MW corridor); KPK wind minimal. National 340 GW potential focused elsewhere.
Fossil Fuels (Thermal/Grid)	Available via national grid; no local reserves.	Relies on PESCO-supplied thermal (59% national mix, oil/gas/coal); no indigenous coal/gas. ADP projects like 132 kV Mamund Grid (Rs. 150M in 2024-25) improve distribution.

Other (Nuclear/Geothermal)	None available.	No nuclear (national 3,620 MW elsewhere); geothermal irrelevant to geography.

Source: Derived by the Consultant 2025

6.6.3 Dam Site Analysis & Methodology

6.6.3.1 Dam Site Suitability Analysis

Systematic identification of suitable dam sites is critical for effective water resource management and district infrastructure planning, directly impacting hydroelectric generation, irrigation supply, flood control, and regional development. Dam construction represents substantial capital investment with permanent hydrological and landscape alterations, making appropriate site selection essential for maximizing benefits while minimizing environmental, social, and economic costs. Poor site selection results in structural instability, excessive costs, ecological damage, involuntary resettlement, and suboptimal storage capacity, whereas well-selected sites offer enhanced foundation stability, favorable reservoir geometry, adequate water availability, and minimal land use conflicts. Traditional field-based selection methods were time-intensive with limited spatial coverage, often missing suitable sites in remote areas.

Contemporary geospatial technologies enable systematic district-wide evaluation through integration of satellite imagery, digital elevation models, hydrological datasets, and land cover information within GIS frameworks. This methodology employs Multi-Criteria Decision Analysis (MCDA) using the Analytic Hierarchy Process (AHP), which decomposes complex spatial problems into hierarchical criteria, establishes relative importance weights, and integrates quantitative and qualitative parameters in transparent, reproducible processes. The analysis utilizes Google Earth Engine (GEE) for cloud-based processing of terrain derivatives, hydrological parameters, and vegetation indices across regional extents. This desktop suitability analysis serves as preliminary screening to identify priority areas warranting detailed field investigation, focusing limited resources on promising candidate sites while systematically excluding fundamentally constrained areas.

6.6.3.2 Data Collection

The analysis integrates multiple satellite-derived and modeled datasets providing complementary information on topography, hydrology, land cover, and vegetation conditions. All datasets were acquired through Google Earth Engine's public data catalog, ensuring standardized processing and reproducibility. The Shuttle Radar Topography Mission (SRTM) Global 1 arc-second Digital Elevation Model provides seamless 30-meter coverage with ±16 meters vertical accuracy, serving as the foundation for terrain analysis. Secondary derivatives including slope gradient, aspect, and hillshade were computed using standard algorithms. Hydrological data derives from MERIT Hydro version 1.0.1 at 90-meter resolution, a hydrologically conditioned dataset that corrects vegetation biases, artifacts, and noise while enforcing hydrological consistency. The flow accumulation layer represents upstream

drainage area in square kilometers, enabling identification of perennial streams and main channels essential for assessing water availability.

Land surface characterization utilized Sentinel-2 multispectral imagery from the Copernicus program, with two polar-orbiting satellites providing 5-day global coverage at 10–20-meter resolution across 13 spectral bands. A cloud-filtered annual composite for 2024 was generated by computing median values across scenes with less than 20% cloud cover, minimizing atmospheric effects and seasonal variability. Land cover classification employed ESA WorldCover 2021, a global 10-meter product based on combined Sentinel-1 radar and Sentinel-2 optical data classified into 11 primary classes using machine learning algorithms. Watershed delineation utilized HydroSHEDS Level 7 sub-basins developed by World Wildlife Fund, providing standardized catchment boundaries validated against observed stream networks. Quality assurance procedures validated geometric consistency, coordinate system alignment (WGS84 / UTM Zone 43N), temporal consistency, and attribute accuracy across all datasets.

Table 79: Geospatial Data Sources and Specifications

Dataset	Resolution	Temporal Coverage	Source	Primary Parameters	Application
SRTM DEM	30 m	February 2000	USGS/SRTMGL1_003	Elevation (m above sea level)	Terrain analysis, elevation/slope suitability
MERIT Hydro	90 m	Multi-DEM derived	MERIT/Hydro/v1_0_1	Flow accumulation (km²), flow direction	Stream extraction, drainage area, hydrological suitability
Sentinel-2 SR	10-20 m	January-December 2024	COPERNICUS/S2_SR_HARMONIZED	13 spectral bands (visible-SWIR)	NDVI calculation, land surface characterization
ESA WorldCover	10 m	2021	ESA/WorldCover/v200	11 land cover classes	Land use suitability, constraint mapping
HydroSHEDS Basins	Vector (Level 7)	SRTM-derived	WWF/HydroSHEDS/v1/Basins/hybas_7	Sub-basin boundaries, drainage areas	Watershed delineation, catchment analysis

6.6.3.3 Analysis

The suitability assessment integrates six criteria through structured multi-criteria analysis comprising standardization, weighting, overlay, and classification stages. Each criterion was independently evaluated and standardized to a common 1-5 scale where higher values indicate more favorable conditions, enabling integration of heterogeneous data types within

a unified framework. Standardization employed threshold-based reclassification rules derived from civil engineering guidelines, hydrological requirements, and environmental considerations.

Elevation suitability reflects the balance between storage potential and construction feasibility, with maximum suitability (score 5) assigned to 1000-1500 meters where conditions optimize reservoir volume while maintaining reasonable construction access. Slope suitability inversely relates gradient to foundation stability and excavation requirements, with gentle slopes below 5 degrees rated highest (score 5) and slopes exceeding 35 degrees rated lowest (score 1) due to unstable foundations. Slope θ in degrees was computed from elevation z as:

$$\theta = \arctan\left(\sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2}\right) \times \frac{180}{\pi}$$

Flow accumulation suitability quantifies water availability based on upstream drainage area A_d, with areas exceeding 5000 km² rated highly suitable (score 5) and areas below 500 km² considered insufficient (score 1) for significant storage. Land use suitability preferentially sites dam in areas with minimal human occupation and ecological value, with barren land and water bodies receiving maximum scores (5) and urban areas receiving minimum scores (1) reflecting prohibitive resettlement costs. Vegetation density assessed through NDVI provides complementary information on land use intensity. NDVI was calculated from Sentinel-2 near-infrared (Band 8) and red (Band 4) reflectance as:

$$\text{NDVI} = \frac{\rho_{NIR} - \rho_{Red}}{\rho_{NIR} + \rho_{Red}} = \frac{B8 - B4}{B8 + B4}$$

where ρ denotes surface reflectance. NDVI values range from -1 (water, bare soil) to +1 (dense vegetation), with suitability inversely proportional such that barren areas (NDVI < -0.1) receive maximum scores (5) and densely vegetated areas (NDVI > 0.6) receive minimum scores (1). Stream proximity suitability reflects construction access requirements, with Euclidean distance d to nearest stream computed using fast distance transform. Locations within 500 meters receive maximum scores (5), declining to minimum scores (1) beyond 5000 meters. Criterion weights were established through AHP methodology reflecting relative importance for dam site selection.

Slope received the highest weight $w_{slope} = 0.25$ (25%) for structural safety primacy. Flow accumulation received $w_{flow} = 0.20$ (20%) recognizing water availability as necessary. Elevation, land cover, and stream proximity each received $w_{elev} = w_{lulc} = w_{prox} = 0.15$ (15%) balancing storage, environmental impacts, and access. NDVI received $w_{NDVI} = 0.10$ (10%) as supplementary to land cover. These weights satisfy normalization:

$$\sum_{i=1}^{6} w_i = w_{elev} + w_{slope} + w_{flow} + w_{lulc} + w_{NDVI} + w_{prox} = 1.0$$

The composite suitability index was computed through weighted linear combination, multiplying each standardized criterion value by its weight and summing products. For any

location (x, y), let $S_i(x, y)$ represent standardized suitability (1-5) for criterion i, and w_i the normalized weight.

Overall suitability $S_{total}(x, y)$ is:

$$S_{total}(x, y) = \sum_{i=1}^{n} w_i \cdot S_i(x, y)$$

where $n = 6$. Expanding with specific criteria:

$$S_{total} = w_{elev} \cdot S_{elev} + w_{slope} \cdot S_{slope} + w_{flow} \cdot S_{flow} + w_{lulc} \cdot S_{lulc} + w_{NDVI} \cdot S_{NDVI} + w_{prox} \cdot S_{prox}$$

Substituting established weights:

$$S_{total} = 0.15S_{elev} + 0.25S_{slope} + 0.20S_{flow} + 0.15S_{lulc} + 0.10S_{NDVI} + 0.15S_{prox}$$

This generates a continuous surface with theoretical values from 1.0 to 5.0, though actual ranges reflect spatial variation in how locations satisfy multiple criteria. The continuous index was classified into five discrete categories using natural breaks optimization maximizing between-class variance: Class 1 (Not Suitable, $S_{total} < 1.5$), Class 2 (Less Suitable, $1.5 \leq S_{total} < 2.5$), Class 3 (Moderately Suitable, $2.5 \leq S_{total} < 3.5$), Class 4 (Suitable, $3.5 \leq S_{total} < 4.0$), and Class 5 (Highly Suitable, $S_{total} \geq 4.0$). Priority candidate sites were identified by selecting Classes 4-5 areas within 1000 meters of streams with minimum area 0.5 km². High-suitability cells were vectorized to polygons attributed with identifier, area, drainage, elevation, slope, and suitability score. The resulting Dam Site Suitability Classification Map provides spatially explicit guidance for master planning, enabling systematic prioritization for detailed feasibility investigation while excluding fundamentally constrained locations.

Table 80: Dam Site Suitability Classification System

Class	Score Range	Classification	Color	Description	Recommended Action
1	< 1.5	Not Suitable	Red	Severe constraints: steep slopes (>35°), urban areas, insufficient water	Exclude from consideration
2	1.5 – 2.5	Less Suitable	Orange	Significant limitations: suboptimal elevation, moderate slopes (25-35°), dense vegetation	Low priority; consider only if alternatives absent
3	2.5 – 3.5	Moderately Suitable	Yellow	Acceptable with standard engineering: reasonable topography/hydrology	Secondary priority for detailed assessment
4	3.5 – 4.0	Suitable	Light Green	Good characteristics: favorable slope (5-15°), adequate drainage (>1000 km²), minimal conflicts	High priority for field verification
5	≥ 4.0	Highly Suitable	Dark Green	Optimal conditions: ideal topography, excellent water supply, minimal impacts	Highest priority for feasibility studies

6.6.4 Proposed Locations for Potential Energy Sources

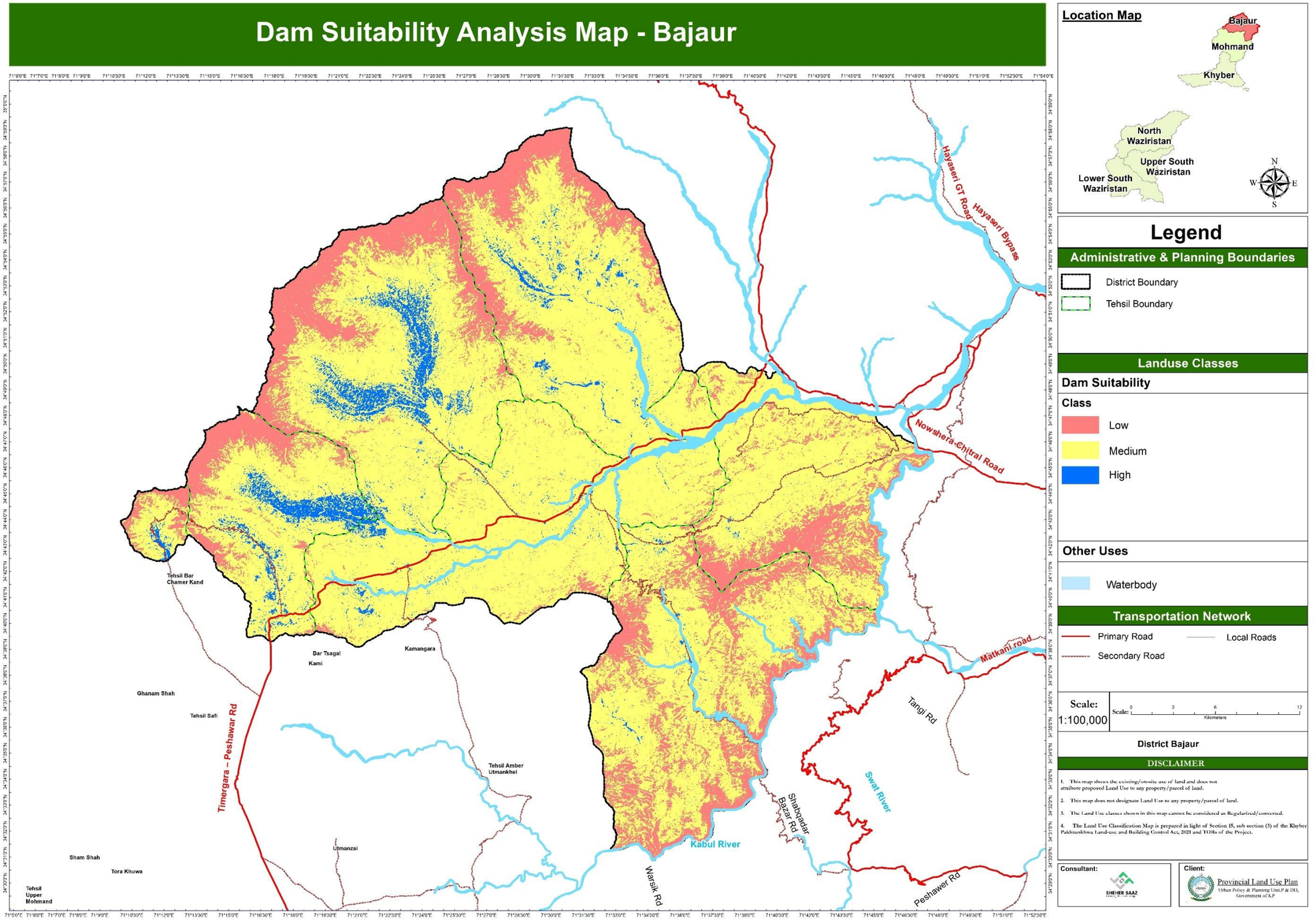
Bajaur District's proposed energy locations align its renewable potential (solar, micro-hydro, biomass) with commercial development (1,243.63 acres), recreational facilities (812.62 acres), and tourism sites (e.g., Koh-e-Moor, River Front Parks). Khar Urban Centre (577,450 population by 2045) serves as the central hub, while peripheral areas leverage terrain and rivers for decentralized generation, per gravitational analysis (breaking points > distances). These sites integrate with KPK ADP projects (e.g., 132 kV Mamund Grid, solar mini grids) to support 2.2M residents and economic growth in mining/agriculture by 2042. Below is a table of proposed locations with a rationale.

Table 81: Proposed Location for Energy in District Bajaur

Energy Source	Proposed Location	Rationale and Capacity
Hydropower (Micro-Hydel)	**Mamund Tehsil** (near Gandhara sites, 18 km from Khar)	Streams/tributaries support 5-10 units (50 kW each, total 0.5 MW); ties to ADP 170364 scheme (Rs. 20M, 2024-25).
	Salarzai Tehsil (near forests, 25 km from Khar)	Hilly streams for 4 units (0.4 MW); leverages 45% forest cover.
Solar (Mini-Grids & Rooftop)	**Khar Urban Centre** (Blue Area CBD, 1,024.91-acre commercial zone)	Rooftop PV on bazaars/shops (2 MW); ADP 180492 pilot (13 mini-grids, Rs. 200M).
	Nawagai Tehsil (near Koh-e-Moor base camp, 30.5 km from Khar)	1 MW mini-grid for 455.56-acre Tourist Site; sunny border hills.
	Utman Khel Tehsil (20 km from Khar)	500 kW rooftop on a 40.37-acre commercial zone.
Biomass/Biogas	**Barang Tehsil** (near River Front, 27 km from Khar)	100 kW digested from olive/livestock waste; 7.32-acre park adjacency.
	Salarzai Tehsil (agricultural areas)	200 kW plant near a 97.46-acre commercial zone.
Grid Enhancement (Thermal Support)	**Mamund Tehsil** (132 kV Grid Station)	New 132 kV station + 20 km line (ADP 328, Rs. 150M, 2024-25).
	Khar Bajaur (Lakari Grid upgradation)	66-132 kV upgrade (ADP 337, Rs. 33M, 2024-25).
Wind (Exploratory)	Nawapass/Ghakhi Pass (Nawagai)	Marginal 50 kW pilot on hills.

Source: Derived by the Consultant 2025

Map 45: Dam Suitability Analysis - District Bajaur



6.6.5 Constraints and Recommendations

Bajaur District's energy development, leveraging proposed sites (e.g., Mamund micro-hydro, Khar solar rooftops) and KPK ADP projects (Rs. 1,500M electrification in 2024-25), faces significant barriers due to its former FATA status, rugged terrain, and remoteness. Below is a table of major constraints with targeted recommendations, aligned with the Khar Urban Centre Master Plan (2024-2042), gravitational analysis (Khar's centrality), and tourism/commercial integration (1,243.63 acres commercial, 812.62 acres recreational).

Table 82: Constraint and Recommendation for Energy in District Bajaur

Constraint	Description	Recommendation
Security Risks	Militancy threats near border (Nawapass, 30.5 km from Khar); delays ADP projects like 132 kV Mamund Grid (Rs. 150M, 2024-25).	Engage tribal jirgas for site security; deploy KP Police units at Mamund/Salarzai hydro sites; prioritize "Safe Energy Corridors" with Rs. 50M ADP allocation by 2026.
Rugged Terrain & Access	Hilly streams (Salarzai, 25 km) and narrow roads hinder micro-hydro transport; 27-30.5 km distances from Khar.	Modular equipment for micro-hydro (PEDO specs); gravel upgrades on 50 km Khar-Nawagai route (Rs. 100M, 2025-26); heli-drop for Koh-e-Moor panels.
Funding Shortages	ADP allocations insufficient (Rs. 20M micro-hydro vs. Rs. 100M needed); competing priorities in Merged Districts.	Leverage NEPRA subsidies + Rs. 500M federal grants; PPP for Khar rooftops (1,024.91-acre zone); microfinance for 1,000 households (Rs. 200M, State Bank).
Technical Expertise Gap	No local solar/micro-hydro technicians; 33% literacy limits training.	PEDO training for 200 technicians in Khar by 2026 (Rs. 30M); vocational centers tied to 40.37-acre Utman Khel commercial zone; mobile repair units.
Grid Reliability Issues	Frequent outages (59% thermal national mix); weak 66 kV Lakari needs 132 kV upgrade (Rs. 33M, 2024-25).	Accelerate Lakari upgrade (complete 2026); 11 kV feeders for bazaars (Rs. 200M, 2024-25); solar backup for 50% recreational facilities by 2027.
Environmental/Seasonal Variability	Monsoon floods damage Mamund streams; dry	Run-of-river designs + storage reservoirs (Rs. 50M); hydrological study for Salarzai (2025); solar-

	winters cut hydro flow 60%.	hydro hybrid at Nawagai (1 MW by 2028).
Land Acquisition Disputes	Tribal land near Nawapass for a wind pilot; resistance to 455.56-acre Koh-e-Moor solar.	Jirga-mediated leases (70:30 revenue share); allocate 5% land for community parks; pilot in government land (114 vacant acres Khar).
Low Adoption Rates	Households resist solar costs; no awareness for biogas in Barang olive farms.	KP awareness campaigns via KP Tourism; 50% subsidies for 500 rooftops; pilot 10 biogas units in Salarzai (Rs. 10M, 2026).

Source: Derived by the Consultant 2025

6.7 TRANSPORTATION NETWORK EXISTING AND PROPOSED

6.7.1 Existing

In current times, the reliance of different mode of connectivity including transportation, air, railway and telecommunication systems is crucial for socio-economic growth and sustainability. Housing patterns, land use, and commercial hubs are all influenced by this communication system which facilitates the movement of people and goods between these areas. The following section of the provides detailed analysis of different communication system in Bajaur District.

6.7.1.1 Road Network

The transportation infrastructure of Bajaur District plays a pivotal role in supporting economic activities, promoting regional connectivity, and enhancing overall socio-economic development. This section provides a comprehensive assessment of the district's road network, including its regional linkages, major transport corridors, and intra-district connectivity.

6.7.1.2 Regional Connectivity

Bajaur District maintains strong regional linkages through a network of strategic roads that facilitate trade, mobility, and economic integration with the rest of Khyber Pakhtunkhwa. The district is primarily connected to Peshawar, the provincial capital, via the Bajaur–Jandola Road, Inayat Kallay–Munda Road, and Arang Road. These routes link Bajaur to major highways, notably the N-45 (Nowshera–Chitral), which intersects with the N-5 National Highway, providing access to major urban centers across Pakistan.

While Bajaur lacks an airport of its own, its proximity to Bacha Khan International Airport, Peshawar, ensures accessibility to both domestic and international air travel, including cargo services that support regional trade and logistics. Additionally, Saidu Sharif Airport offers domestic flight services, further enhancing connectivity between Bajaur and other major cities.

Although Torkham border terminal lies within BajaurDistrict, the development of customs and border infrastructure under the Central Asia Regional Economic Cooperation (CAREC) Corridors has significantly benefited Bajaur by facilitating cross-border trade and regional integration with Afghanistan and Central Asia.

6.7.1.3 Major Transport Corridors

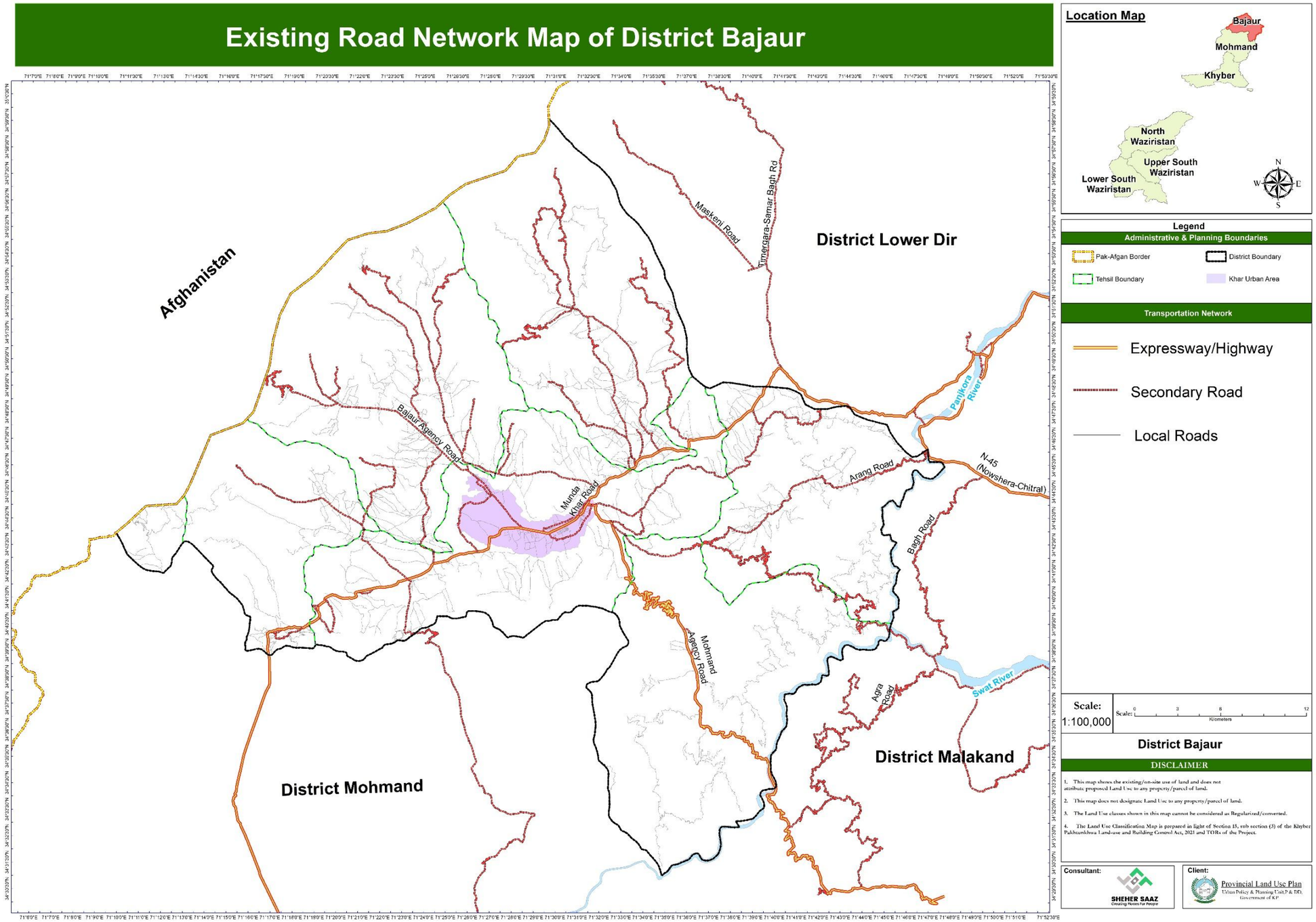
The N-45 National Highway serves as the primary transportation artery traversing Khar, the district headquarters, and extending toward Timergara and other key regional destinations. It

is instrumental in facilitating the movement of goods and people, thus strengthening Bajaur's connectivity with Peshawar and beyond.

In addition, the Khar–Inayat Kallay Road is another critical route linking Khar with border areas, supporting local trade and the transport of agricultural produce. The government's proposed Rs. 70 billion inter-district highway project aims to further improve connectivity across the merged districts, including Bajaur, by linking all tribal districts to provincial and national markets.

Historically, Bajaur has served as a vital trade route with Afghanistan. However, periodic border closures have disrupted cross-border commerce. Reopening and securing this trade routes would play a vital role in revitalizing local businesses, facilitating export and import activities, and stimulating regional economic growth.

Map 46: Existing Road Network Map District Bajaur



6.7.1.4 Existing Roads

Within the Bajaur District itself, several roads and trails connect various towns and villages, ensuring intra-district mobility. These include roads linking Khar, and other key settlements in the district. While some of these roads are well-paved and maintained, others are more rudimentary, reflecting the challenging terrain of the region. Efforts are ongoing to improve these internal roads to facilitate better access to services and markets for the local population. Improved intra-district connectivity is essential for fostering local economic development and ensuring that the benefits of regional connectivity extend to all parts of the Bajaur District.

Attributes of key roads within Bajaur district are presented in the following table:

Table 83: District Bajaur Roads

Sr. No.	Road Type	Length (Km)
1	Highways	89
2	Secondary Roads	375
3	Local Roads	1222

The following are the major roads of urban area of Bajaur District. Khar is mostly developed in a linear form along the Main Khar Road, which is used as the city's primary thoroughfare because it is home to significant land uses and buildings like the Bajaur Scouts Headquarters, Khar Colony, and numerous other significant offices and banks. The entire road is 76 kilometers long. There is space on the two-lane main road for two trucks to pass simultaneously in the opposite direction. Most residential districts are accessible from this main road through thoroughfares, alleyways, streets, or tracks. These are extremely narrow, making it only possible for walkers, bicycles, and motorcyclists to move through them; they accurately represent Khar's dirt streets and narrow access routes.

Table 84: District Bajaur Road Inventory

Sr. No.	Name of the Road	Total Length (km)	Width (ft)
Major Road			
1	Munda Road, Khar	13.7	30
Minor Roads			
2	Lt. Sajjad Khan Shaheed Bypass Road	4	26
3	Inayat Kalay Road	1.6	24
4	Ali Jan Qila Road	1	24
5	Duray Mandal Road	2.6	24
6	Sheikh Meeno Road	1.1	12
7	Other Secondary Roads	12.6	12-24
Streets			
8	Miscellaneous Roads & Streets	39.4	12
9	Total length of the Roads	76	-

Source: Calculated by Consultant

6.7.1.5 Existing Farm to Market Roads

Farm to market roads in Bajaur District are vital for the local economy, facilitating the movement of agricultural products from rural areas to major markets. These roads improve accessibility and reduce transportation costs for farmers, thereby boosting agricultural productivity and market connectivity. Enhancing these roads is essential for economic development in rural areas.

Key Farm-to-Market Roads

1. **Khar to Nawagai Road**
   - Connects the district headquarters (Khar) to Nawagai, passing through several agricultural areas.
   - Supports the transport of produce to the main market in Khar.

2. **Bajaur-Jandol Road**
   - Links Bajaur with Jandol in the adjacent district, facilitating inter-district trade.
   - Important for transporting grains, fruits, and vegetables.

3. **Pashat to Inayat Kallay Road**
   - Serves the agricultural areas around Pashat.
   - Direct access to the market town of Inayat Kallay.

4. **Bajaur Agency Road**
   - Links Kitkot and Khalozai with Khar, facilitating transportation of grains, fruits, and vegetables.

6.7.1.6 Traffic Surveys

As part of the transportation assessment in Bajaur District, a Manual Classified Count (MCC) Survey was conducted at MCC-1 (Bajaur to Munda), MCC-2 (Bajaur to Nawagi), and MCC-3 (Mohmand to Bajaur) to determine traffic flow and assess the Level of Service (LOS) on the roadway. The study analyzed peak-hour traffic conditions during both morning (AM) and afternoon (PM) periods to evaluate roadway efficiency and congestion levels.

Key Findings (MCC-1 – Bajaur to Munda)

1. Roadway Capacity & Traffic Volume

- The surveyed road segment has a capacity of 2,300 Passenger Car Units per hour (PCU/hr) across two lanes.
- **Observed traffic volumes:**
  - AM Peak (11:45 – 12:45 AM): 1,700 PCUs

- PM Peak (12:00 – 13:00 PM): 1,931 PCUs

2. Volume-to-Capacity (V/C) Ratio & Level of Service (LOS)

- **AM Peak:**
  - V/C Ratio = 0.74
  - LOS = C (Normal flow conditions, minimal delays)
- **PM Peak:**
  - V/C Ratio = 0.84
  - LOS = D (Higher traffic flow, delays)

Key Findings (MCC-2 – Bajaur to Nawagi)

1. Roadway Capacity & Traffic Volume

- The surveyed road segment has a capacity of 2,300 Passenger Car Units per hour (PCU/hr) across two lanes.
- **Observed traffic volumes:**
  - AM Peak (10:00 – 11:00 AM): 422 PCUs
  - PM Peak (12:00 – 13:00 PM): 459 PCUs

2. Volume-to-Capacity (V/C) Ratio & Level of Service (LOS)

- **AM Peak:**
  - V/C Ratio = 0.18
  - LOS = A (Smooth traffic flow, minimal congestion)
- **PM Peak:**
  - V/C Ratio = 0.20
  - LOS = A (Stable traffic conditions, no delays)

Key Findings (MCC-3 – Mohmand to Bajaur)

1. Roadway Capacity & Traffic Volume

- The surveyed road segment has a capacity of 2,300 Passenger Car Units per hour (PCU/hr) across two lanes.
- **Observed traffic volumes:**

- AM Peak (11:00 – 12:00 AM): 813 PCUs
- PM Peak (14:00 – 15:00 PM): 885 PCUs

2. Volume-to-Capacity (V/C) Ratio & Level of Service (LOS)

- **AM Peak:**
  - V/C Ratio = 0.35
  - LOS = A (Free-flow conditions, minimal delays)
- **PM Peak:**
  - V/C Ratio = 0.38
  - LOS = A (Similar free-flow conditions with slightly increased traffic)

Interpretation & Implications

- The road operates at LOS A during both peak hours, indicating excellent traffic conditions with negligible congestion.
- The V/C ratios remain low (below 0.85), suggesting that the roadway has sufficient capacity to accommodate additional traffic in the future.
- Traffic volumes are slightly higher in the afternoon, likely due to return trips from workplaces, markets, or business centers.

This study provides a strong baseline for traffic performance assessment and aids in future transportation planning efforts for Bajaur District.

Table 85: District Bajaur LOS Ratings

Sr.	Duration	Peak Hour	MCC Location No.	Location		No. of Lanes	Road Capacity (pcu/hr)	Peak Hour Volume V (PCUs)	V/C Ratio	LOS
				From	To		C			
1	AM	11:45-12:45	MCC-1	Bajaur	Munda	2	2,300	1700	0.74	C
2	PM	12:00-13:00		Bajaur	Munda	2	2,300	1931	0.84	D
3	AM	10:00-11:00	MCC-2	Bajaur	Nawagi	2	2,300	422	0.18	A
4	PM	12:00-13:00		Bajaur	Nawagi	2	2,300	459	0.20	A

5	AM	11:00-12:00	MCC-3	Mohmand	Bajaur	2	2300	813	0.35	A
6	PM	14:00-15:00		Mohmand	Bajaur	2	2300	885	0.38	A

Source: Data Collected in the Field

6.7.1.7 Origin Destination Surveys

As part of a comprehensive transport study in Bajaur District, an origin-destination (OD) survey was conducted to assess the movement patterns of travelers. The data collected provides insight into the primary urban centers contributing to travel demand within the district.

Key Findings (CP-1)

1. **Origin Distribution**

- Most travelers originate from Peshawar (31%), highlighting its significant role as a feeder city for Bajaur District.
- Nowshera (21%) and Mammad Gat (25%) follow, indicating their contribution to the overall travel demand.
- Attock (9%) and Charsadda (14%) contribute smaller shares, suggesting regional connectivity with moderate movement.

2. **Destination Distribution**

- Nawagai (36%) emerges as the primary destination, capturing the highest percentage of travel demand. This suggests strong socio-economic and trade links.
- Khar (23%) and Anayat Kala (17%) also receive a significant portion of travelers, indicating their role as important regional centers.
- Bajaur (14%) and Raghagan (10%) account for the remaining flows, highlighting their secondary but notable connectivity within the district.

Key Findings (CP-2)

1. **Origin Distribution**

- Most travelers originate from Nawagai (30%), highlighting its significant role as a feeder town for Bajaur District.
- Khar Bajaur (22%) and Utman Khel (19%) follow, indicating their contribution to the overall travel demand.

- Salarzai (13%) and Barang (16%) contributed smaller shares, suggesting regional connectivity with moderate movement.

2. Destination Distribution

- Mardan (47%) emerges as the primary destination, capturing the highest percentage of travel demand. This suggests strong socio-economic and trade links.
- Chitral (24%) and Swat (21%) also receive a significant portion of travelers, indicating their role as important regional centers.
- Dir (8%) accounts for the remaining flow, highlighting its secondary but notable connectivity within the district.

Key Findings (CP-3)

1. Origin Distribution

- Most travelers originate from Temer Gara (34%), indicating its strong connectivity with Bajaur District.
- Munda Dir Lower (21%) and Mardan (11%) follow, showing their role in regional travel demand.
- Faisalabad (18%) and Islamabad (16%) contributed smaller but notable shares, reflecting long-distance travel patterns.

2. Destination Distribution

- Khar Bajaur (76%) emerges as the primary destination, absorbing a significant portion of travel demand, suggesting strong socio-economic or familial ties.
- Nawagai (14%) also receives a notable share, highlighting its importance as a secondary hub.
- Rawalpindi (10%) accounts for the remaining flow, indicating interprovincial connectivity.

➢ ***Recommendations for Transport Planning***

- **Infrastructure Development:** Improving road networks between Peshawar, Nowshera, and key destinations in Bajaur to facilitate smoother transit.
- **Public Transport Enhancement:** Establishing intercity bus routes to accommodate frequent travelers between major OD points.
- **Traffic Management Strategies:** Optimizing key junctions and travel corridors based on the observed OD trends.

As part of a comprehensive transport study in Bajaur District, an origin-destination (OD) survey was conducted to assess the movement patterns of travelers. The data collected

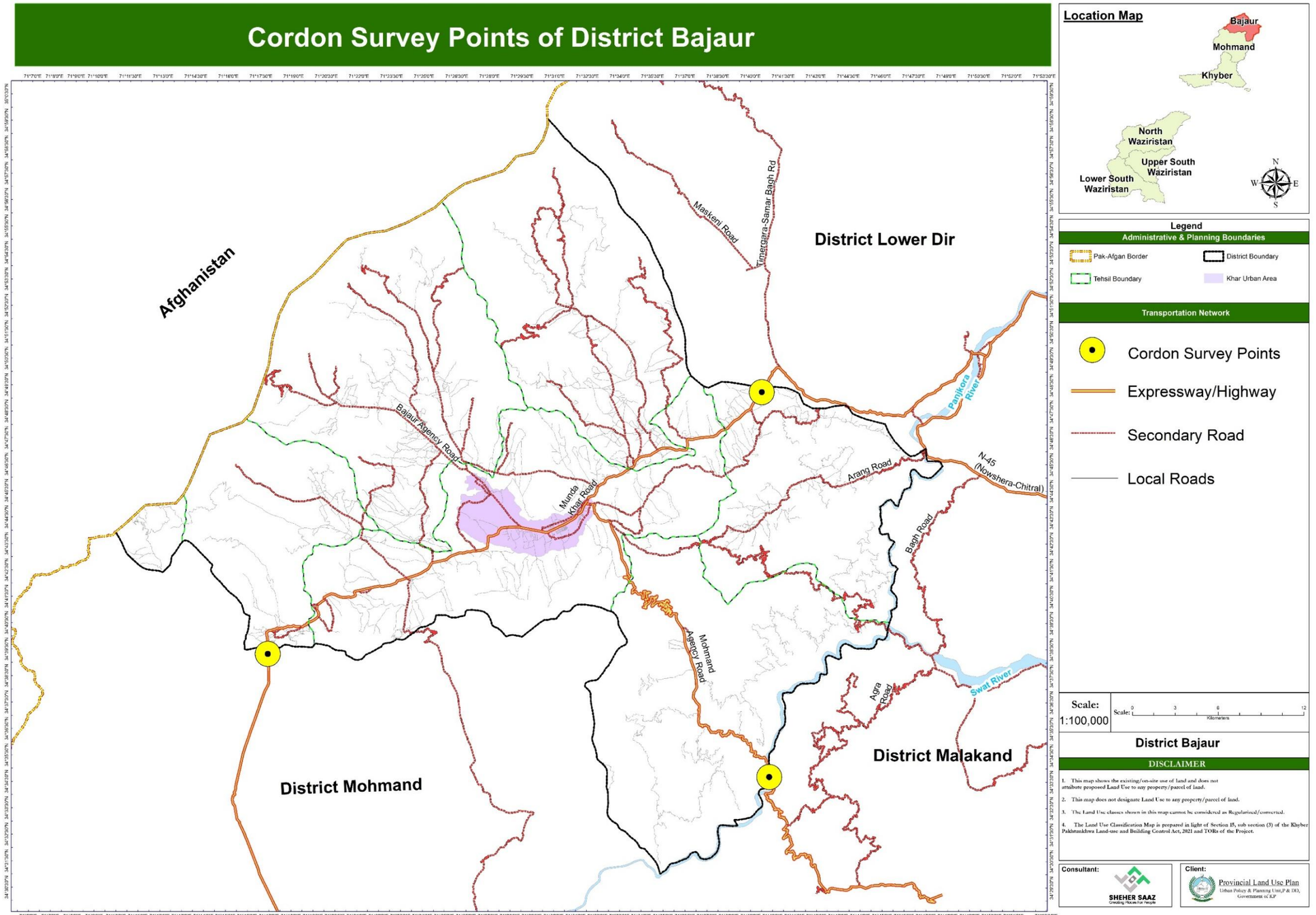
provides insight into the primary urban centers contributing to travel demand within the district.

Table 86: District Bajaur OD Survey Results

Point ID	Origin	Origin %age	Destination	Destination %age
CP-1	Peshawar	31	Nawagai	36
	Nowshera	21	Khar	23
	Attock	9	Anayat Kala	17
	Charsadda	14	Bajaur	14
	Mammad Gat	25	Raghagan	10
CP-2	Nawagai	30	Mardan	47
	Khar Bajaur	22		
	Salarzai	13	Chitral	24
	Utman Khel	19	Swat	21
	Barang	16	Dir	8
CP-3	Temer Gara	34	Khar Bajaur	76
	Munda dir lower	21		
	Mardan	11		
	Faisalabad	18	Nawagai	14
	Islamabad	16	Rawal Pindi	10

Source: Data Collected in the Field

Map 47: Cordon Survey Points - District Bajaur



Source: Developed by Consultant

6.7.2 Annual Development Plans, Planned and In Progress

The Annual Development Programme (ADP) 2025–2026 for District Bajaur outlines a comprehensive strategy for improving the district's road infrastructure, strengthening regional connectivity, and advancing socio-economic integration within the merged districts. The ongoing and planned projects emphasize the construction, rehabilitation, widening, and blacktopping of critical road corridors linking Khar, Nawagai, Barang, Mamund, Salarzai, and Utman Khel tehsils. These initiatives include both continuing infrastructure schemes and new feasibility and design-based projects, reflecting a coordinated approach that addresses existing mobility constraints while fostering future development opportunities. Through these focused investments, the district aims to enhance intra-district accessibility, promote trade and agricultural linkages, improve access to education and healthcare services, and reinforce connections with provincial and national road networks, thereby supporting sustainable economic growth and improving the overall quality of life for the people of Bajaur.

Table 87: On Going Programme - District Bajaur

ADP code	Project title	Status	Length
191791	Construction and Black Topping of Roads in District Bajaur.	Ongoing / PDWP (A)	Not specified
195257	Construction & B/Topping of Dando Bartrass Arang Pajegram via Dherai Road — Bajaur (FMR).	AIP / PDWP (A)	7 km
195260	Construction & B/Topping of Tang Khata — Dherai Road — Bajaur.	AIP / PDWP (A)	2 km
195276	Improvement & Rehabilitation of Black-Topped Road from Musa Khel to Rocha — Bajaur.	AIP / PDWP (A)	10 km
195279	Rehabilitation, Widening & B/Topping of Gatkai to Saparay Road — Bajaur.	AIP / PDWP (A)	7 km
210607	Rehabilitation of road from Haji Lawang to Pashat Road — Bajaur.	Ongoing / PDWP (A)	14 km
210608	Rehabilitation of road from Arrangai to Kolala Road — Bajaur.	Ongoing / PDWP (A)	10 km
210705	Rehabilitation of Road from Nawagai Bazar to Ghaljo Kamangara — Bajaur.	Ongoing / DDWP (A)	6 km
210741	Improvement, Widening & Rehab of roads: Kamar→Mena (6 km); Zagai (4 km); Kitkot (4 km) — Bajaur.	AIP / PDWP (A)	6 km; 4 km; 4 km
210782	Rehabilitation of Arrang Main Road — District Bajaur.	AIP / PDWP (A)	Not specified

Source: ANNUAL DEVELOPMENT PROGRAMME 2025-2026 Province of Khyber Pakhtunkhwa Fiscal Year: July 1, 2025 - June 30, 2026

Table 88: New Projects - District Bajaur

ADP code	Project title	Status	Length
250996	Construction of Black Top Road in Bajaur.	New programme / PDWP (B)	40 km
250998	Feasibility study & design of Farm-to-Market roads at Tehsils Salarzai, Utmankhel, Nawagai & Mamund — Bajaur.	New / PDWP (B)	Not specified
251133	F/S for construction of road from Main Bajaur Road to Dre Sre Safi.	New / DDWP (B)	Not specified
251398	Construction/Improvement/Rehab & Widening of BT Roads (multi-district incl. Khyber, Mohmand, Bajaur) Sub-Division Peshawar.	New / PDWP (B)	Not specified

Source: ANNUAL DEVELOPMENT PROGRAMME 2025-2026 Province of Khyber Pakhtunkhwa Fiscal Year: July 1, 2025 - June 30, 2026

6.7.3 Improvement/ upgradation of Roads:

The road network of District Bajaur serves as the backbone of its transportation system, linking its major tehsils Khar, Nawagai, Salarzai, Charmang, Utman Khel, and Mamund with the adjoining districts of Mohmand, Dir, Malakand, and the provincial capital, Peshawar. It provides vital connectivity to key economic corridors, local trade centres, and cross-border routes, thereby playing a crucial role in the district's economic growth and regional integration. The movement of agricultural produce, construction materials, marble, and forest products heavily relies on this network, making it essential for livelihoods, access to markets, and service delivery.

Despite its importance, the existing road network in Bajaur faces numerous challenges. Several key routes have limited right-of-way (ROW), deteriorated pavement, and inadequate drainage infrastructure. Narrow single lane stretches lead to congestion, unsafe overtaking, and high travel times, while mountainous terrain and seasonal erosion further damage road surfaces. Additionally, uncontrolled roadside encroachments and informal commercial activities in urban centres such as Khar exacerbate traffic inefficiencies and safety risks.

To address these issues, proposes a comprehensive program of road widening, geometric realignment, and surface improvement aimed at ensuring safety, reliability, and long-term serviceability. The planning and design approach has been aligned with UPPU's Geometric Design Manual and KP Highway Design Standards, while ROW determination is based on traffic demand projections derived from the ITE Trip Generation Manual and anticipated land-use transformations.

Strategic priority has been assigned to corridors that enhance inter-tehsil and inter-district connectivity, particularly those linking Khar–Salarzai–Nawagai–Charmang–Utman Khel, which facilitate the movement of agricultural and mineral goods toward external markets in

Peshawar and Malakand. Upgradation of these routes will significantly boost trade, reduce vehicle operating costs, and support regional development initiatives.

6.7.3.1 Primary Roads

The Mohmand Agency Primary Road functions as the district's core mobility spine, structuring movement between major settlements, economic activity zones, and administrative centers. Within the urbanized stretches, the corridor currently operates on a constrained 40 ft Right-of-Way (ROW), which is proposed to be widened to 65 ft to enable dualization, improve carrying capacity, and support future mixed-use and commercial intensification along the corridor.

Across rural sections, the existing 60 ft ROW is planned to be expanded to 80 ft, allowing full dualization along a total length of 63.35 km. This upgrade will enhance inter-tehsil connectivity, reduce travel times, and improve safety particularly on segments currently experiencing bottlenecks and roadside encroachment. Strengthening this primary road aligns with provincial spatial development priorities, positioning it as a strategic development corridor that can guide planned growth, support service delivery, and reinforce regional trade flows.

Table 89: Primary Road Proposals - District Bajaur

Sr. No.	Name	Road Hierarchy	Road Type	Existing ROW (ft)	Proposed ROW (ft)	Proposal	Length (km)
1	Bajaur Agency Primary Road	Primary Road	Urban + Rural	60	80	Dualization	46.12
2	Mohmand Agency Primary Road		Urban + Rural	40	65	Dualization	44.52

Source: Developed by the Consultant

6.7.3.2 Secondary Roads

The upgradation of key urban and rural road segments is planned to enhance regional connectivity, support economic activities, and improve access to social services. The Khar Bazar Road, classified as an urban secondary road, is proposed for widening and surface improvement from 45 ft to 50 ft, covering 1.67 km. In rural areas, strategic links including Bajaur Agency Road (27.78 km), Nawagai Road (31.11 km), Arang Road (34.22 km), and Salarzai Dabar Road (23.56 km) are targeted for capacity enhancement and surface upgrading. These improvements aim to facilitate smoother vehicular movement, reduce travel times, and improve safety standards, while fostering better integration of rural communities into the district's broader socio-economic network.

Table 90: Secondary Road Proposals - District Bajaur

Sr. No.	Name	Road Hierarchy	Road Type	Existing ROW (ft)	Proposed ROW (ft)	Proposal	Length (km)

1	Bajaur Agency Road	Secondary Road	Rural	40	50	Upgradation/Improvements	27.78
2	Salarzai Dabar Road		Rural	32	40	Upgradation/Improvements	23.56
3	Nawagai Road		Rural	25	40	Upgradation/Improvements	31.11
4	Janat Shah Road		Rural	22	40	Upgradation/Improvements	9.84
5	Bajaur Mohmand Agency Link Road		Rural	28	40	Upgradation/Improvements	8.00
6	Gardai Bajaur Agency Road		Rural	24	40	Upgradation/Improvements	25.33
7	Arang Road		Rural	30	40	Upgradation/Improvements	34.22
8	Sahib Abad Road		Rural	30	40	Upgradation/Improvements	9.37

Source: Developed by the Consultant

6.7.3.3 Local Roads

A set of rural local access roads has been identified for targeted improvements to enhance connectivity and support socio-economic activities in remote areas. Inarzai Road, Bar Safari Road, Mohmand Shakro Road, and Lara Dandokai Road are proposed for standard improvement works, including surface levelling, drainage enhancement, and minor widening, maintaining design widths between 22–30 ft over lengths ranging from 5.12 km to 40.79 km.

Roads such as Janat Shah Road, Bajaur Mohmand Agency Link Road, Mohmand Nawagai Road, and Gardai Bajaur Agency Road are slated for both upgradation and improvement to address capacity constraints and deteriorated conditions. These interventions aim to provide safer and more reliable access for local communities, facilitate agricultural and trade movement, and strengthen linkages with regional transport networks. Collectively, these measures are expected to significantly reduce travel time, enhance mobility, and support inclusive development across rural settlements.

Table 91: Local Road Proposals - District Bajaur

Sr. No.	Name	Road Hierarchy	Road Type	Existing ROW (ft)	Proposed ROW (ft)	Proposal	Length (km)
1	Tanai Road	Local Road	Rural	30	30	Improvements	1.74
2	Damadola Road		Rural	30	30	Improvements	4.16
3	Ghundo Road		Rural	30	30	Improvements	4.59
4	Dabarai Road		Rural	30	30	Improvements	4.64
5	Khar Manogai Road		Rural	30	30	Improvements	4.86
6	Sara Mina Alizai Road		Rural	30	30	Improvements	5.06
7	Inarzai Road		Rural	30	30	Improvements	5.12

8	Nazakai Mano Road		Rural	30	30	Improvements	9.20
9	Nazakai Kassai Road		Rural	30	30	Improvements	10.69
10	Bar Gatkai Wara Kharkhai Road		Rural	30	30	Improvements	11.02
11	Lara Dandokai Road		Rural	30	30	Improvements	17.23
12	Mohmand Shakro Road		Rural	30	30	Improvements	17.53
13	Bar Safari Road		Rural	30	30	Improvements	40.79
14	Naranj Road		Rural	12	30	Upgradation/Improvements	0.79
15	Badan Bar Kalli Road		Rural	16	30	Upgradation/Improvements	1.11
16	Kulalla Tangai Road		Rural	24	30	Upgradation/Improvements	1.65
17	Derago Road		Rural	20	30	Upgradation/Improvements	1.77
18	Irab Kalli Road		Rural	20	30	Upgradation/Improvements	1.99
19	Bado Bagh Road		Rural	18	30	Upgradation/Improvements	2.43
20	Lakiano Road		Rural	20	30	Upgradation/Improvements	2.49
21	Marossa Road		Rural	22	30	Upgradation/Improvements	2.60
22	Mina Sulaiman Khel Road		Rural	25	30	Upgradation/Improvements	2.80
23	Koka Road		Rural	24	30	Upgradation/Improvements	2.91
24	Kharai Kamar Road		Rural	26	30	Upgradation/Improvements	2.92
25	Gillai Irab Kalli Road		Rural	20	30	Upgradation/Improvements	2.97
26	Loi Sam Smasai Road		Rural	14	30	Upgradation/Improvements	3.10
27	Hayatai Road		Rural	20	30	Upgradation/Improvements	3.13
28	Loi Killi Tangai Road		Rural	20	30	Upgradation/Improvements	3.17
29	Nakhtar Bala Road		Rural	25	30	Upgradation/Improvements	3.17
30	Gillai Road		Rural	20	30	Upgradation/Improvements	3.33
31	Malkana Road		Rural	20	30	Upgradation/Improvements	3.64
32	Ghakhai Road		Rural	20	30	Upgradation/Improvements	3.96

33	Mato Chingai Road		Rural	12	30	Upgradation/Improvements	4.35
34	Qambar Road		Rural	25	30	Upgradation/Improvements	4.99
35	Irab Kalli Agra Road		Rural	25	30	Upgradation/Improvements	5.30
36	Lar Lako Road		Rural	25	30	Upgradation/Improvements	6.41
37	Lar Kalli Gabarai Road		Rural	25	30	Upgradation/Improvements	7.05
38	Hahsam Charmang Road		Rural	25	30	Upgradation/Improvements	7.96
39	Ghumbat Road		Rural	18	30	Upgradation/Improvements	8.36
40	Agra Zagai Road		Rural	25	30	Upgradation/Improvements	8.66
41	Nawa Charmang Road		Rural	25	30	Upgradation/Improvements	8.99
42	Mohmand Nawagai Road		Rural	24	30	Upgradation/Improvements	11.31
43	Lara Mukha Road		Rural	25	30	Upgradation/Improvements	11.77
44	Tar Road		Rural	26	30	Upgradation/Improvements	12.96
45	Nawagai Link Road		Rural	25	30	Upgradation/Improvements	15.89
46	Bar Safari Link Road		Rural	20	30	Upgradation/Improvements	20.82
47	Lar Mulasaid Road		Rural	15	30	Upgradation/Improvements	22.07
48	Qambar Panjkora Road		Rural	25	30	Upgradation/Improvements	30.62
49	Sharbatai Qambar Road		Rural	24	30	Upgradation/Improvements	44.93

Source: Developed by the Consultant

6.7.3.4 Urban Roads

Furthermore, urban road improvements are proposed within settlements proposed residential areas, focusing on improved circulation, safe pedestrian movement and efficient local transport integration. These measures will reduce bottlenecks in built-up areas, enhance freight movement, and ensure better access to emerging industrial and commercial hubs.

Impact:

The proposed network will not only strengthen Bajaur's economic base but also integrate its rural economy with broader regional trade and transport systems, positioning it as a key node in the north western connectivity framework of Khyber Pakhtunkhwa.

Map 48: Proposed Road Network Map – Bajaur District

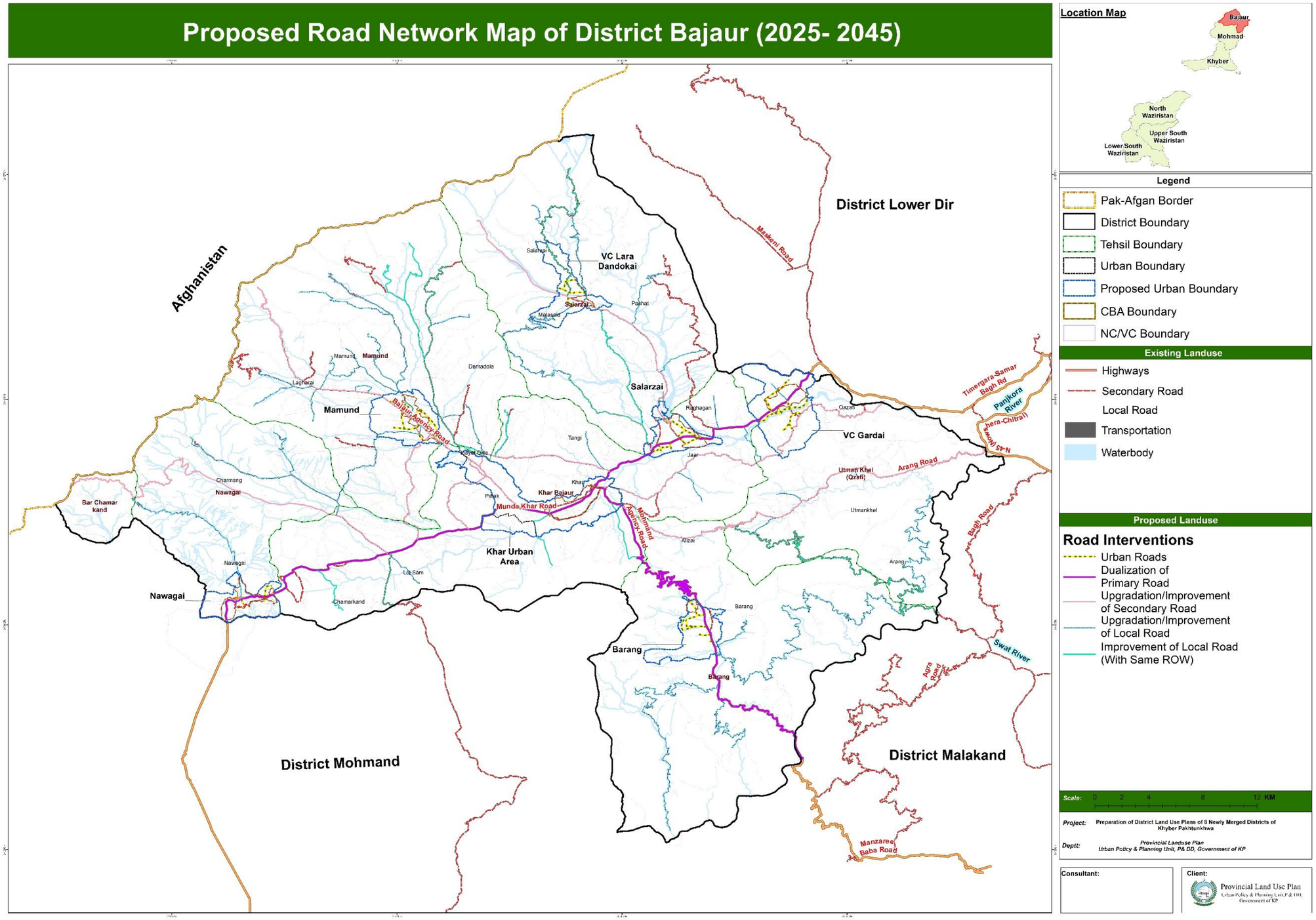
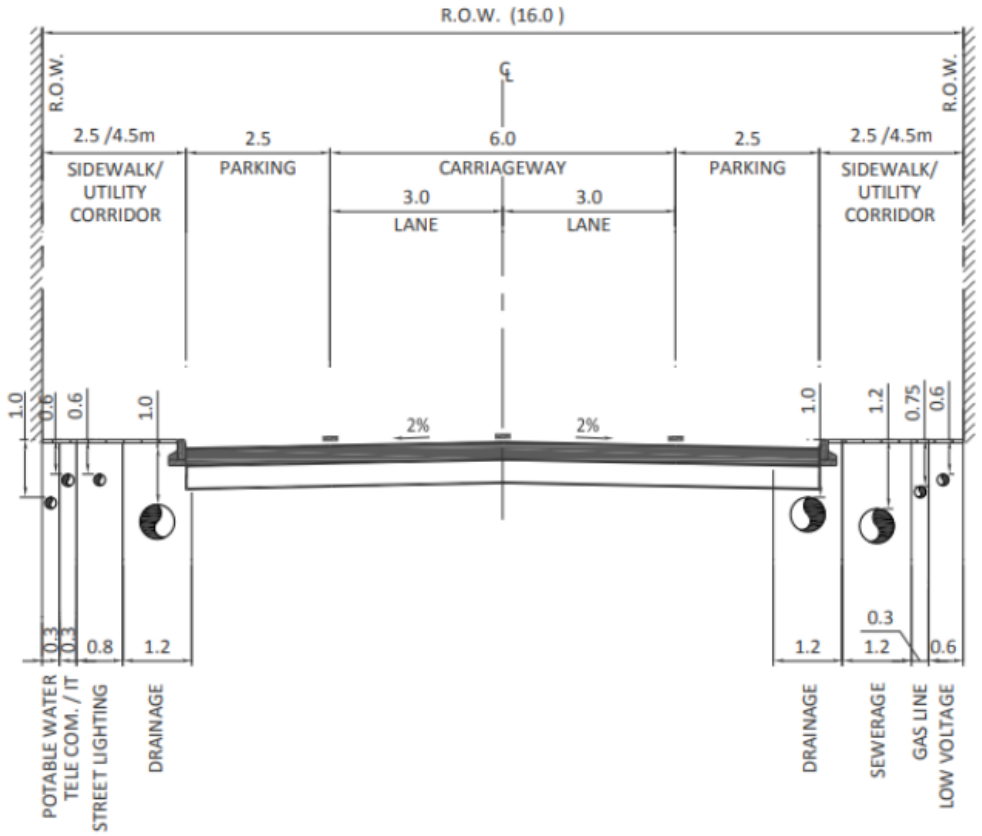
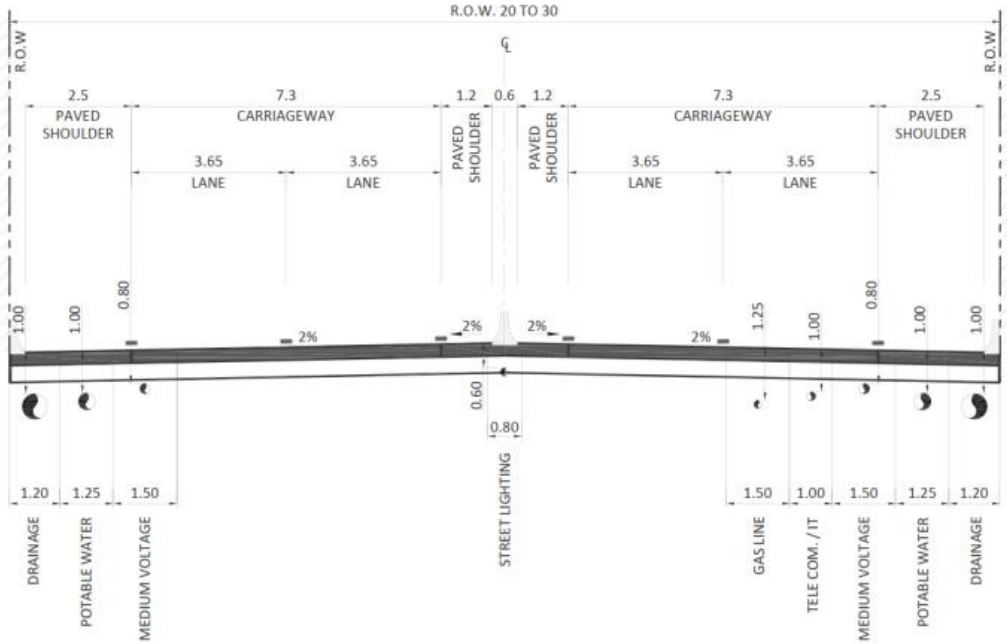


Figure 10: Typical Cross Section for Secondary and local Roads - Bajaur District



Source: Geometric Design Guidelines (UPPU)

Figure 11: Typical Cross Section for Primary Roads - Bajaur District



Source: Geometric Design Guidelines (UPPU)

6.7.4 Bus Terminal Proposals

The phasing and classification of proposed bus terminals across Bajaur District are guided by settlement hierarchy, local population concentrations, existing and forecasted transport demand, land availability and strategic network linkages. Primary and secondary centers such as Khar Urban Area, Mamund, Utman Khel and VC Lara Dandokaii exhibit the highest population densities and serve as key nodes for intra- and inter-district movement. These locations warrant prioritized investment in Class-B and Class-C terminals within the 2025–30 and 2025–35 planning horizons. Positioned along major transport corridors and functioning as regional service hubs, these terminals will be designed with organized bays, circulation space, passenger amenities, and integrated operations to support high passenger throughput and foster modal efficiency.

Tertiary/Potential settlements including Nawagai, Salarzai and Barang are characterized by smaller, more dispersed populations and lower projected passenger demand in the near term. Class-D bus terminals are therefore recommended for these localities in the 2030–40 period. These minimal-footprint facilities provide essential boarding, alighting, layover, and parking functions without over-investment, while maintaining future scalability as growth materializes.

Across all terminal classes, land requirements will adhere to provisions set out in the Motor Vehicles Ordinance 1965 and the Motor Vehicles Rules 1969, ensuring uniform regulatory compliance, operational safety, and compatibility with provincial transport planning standards. This phased and hierarchical implementation strategy ensures that Bajaur's bus terminal network is demand-responsive, technically robust, and fiscally prudent, thereby optimizing service provision for residents and supporting broader mobility objectives across the district.

Table 92: Bus Terminal Proposals - District Bajaur

Sr. No.	Project	Year	Land Required	Concerned Departments
1	Construction of Class-B Bus Terminal in Khar Urban Area (Primary Urban Centre)	2025–30	As per Motor Vehicles Ordinance 1965 & Motor Vehicles Rules 1969	Transport Department / Provincial & Regional Transport Authority
2	Construction of Class-C Bus Terminal in Mamund (Secondary Urban Centre)	2025–30		
3	Construction of Class-C Bus Terminal in Utman Khel (Secondary Urban Centre)	2025–35		

4	Construction of Class-C Bus Terminal in VC Lara Dandokaii (Secondary Urban Centre)	2025–30		
5	Construction of Class-D Bus Terminal in Nawagai (Tertiary/Potential Settlement)	2030–40		
6	Construction of Class-D Bus Terminal in Salarzai (Tertiary/Potential Settlement)	2030–40		
7	Construction of Class-D Bus Terminal in Barang (Tertiary/Potential Settlement)	2030–40		

Source: Developed by Consultant

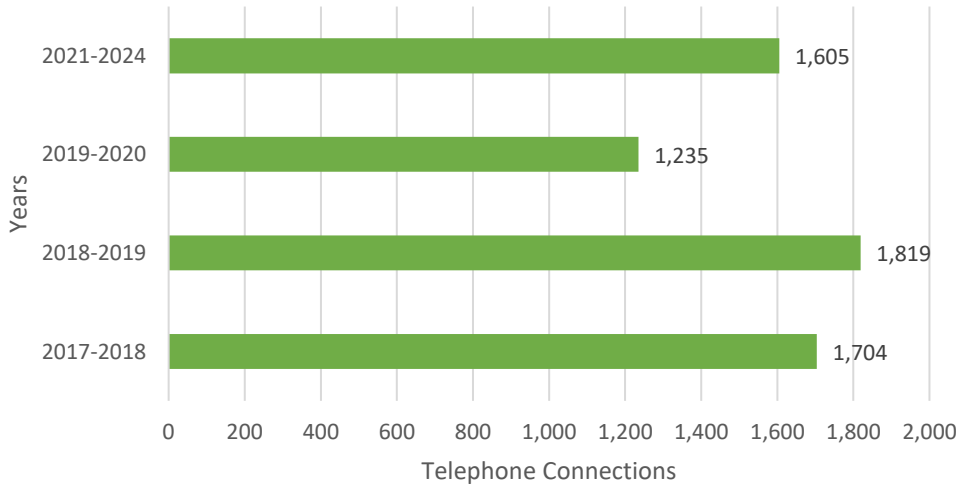
6.7.5 Telecommunication, Postal Services & Telegraphs.

Telecommunication services in District Bajaur are primarily provided by major national operators offering mobile, internet, and postal communication facilities. While coverage has expanded considerably in recent years, several remote and mountainous settlements still face intermittent or weak connectivity due to challenging terrain and infrastructure limitations.

6.7.5.1 Level of services and their coverage.

The level and quality of telecommunication services across Bajaur District vary spatially, reflecting both topographical constraints and infrastructure availability. According to the Khyber Pakhtunkhwa Development Statistics 2025, telecommunication operations in the district include both exchanges and multiple telephone connections. There are currently six (8) telephone exchanges operating in Bajaur, a figure that has remained constant since 2024.

Figure 12: Telephone Connections – Bajaur Districts



Source: KP Development Statistics 2025

In terms of telephone connections, a fluctuating trend is observed over the review period. In 2017–18, the district recorded 1,704 connections, which increased to 1,819 in 2018–19, representing a growth of approximately 6.8%. However, this was followed by a sharp decline in 2019–20, when the number of connections dropped to 1,235, marking a 32.1% reduction. Then in 2021-2025, the number of telephone connections maintained at 1605. This downturn indicates potential challenges such as a shift in demand from fixed line to mobile networks, infrastructure maintenance issues, or localized disruptions affecting service continuity.

Postal services in the district have remained relatively stable over the past three years. As shown in the table below, the total number of post offices increased from 18 in 2017–18 to 20 in 2018–19, maintaining the same figure till 2023–24. This indicates a consistent postal network, albeit without the presence of a Head Post Office, which limits administrative and operational efficiency at the district level.

Table 93: Number of Post Offices - District Bajaur

Year	Post Offices	Number
2021-22	Total	20
	Head Offices	-
	Sub Post Offices	1
	Branch Offices	19
2022-23	Total	20
	Head Offices	-
	Sub Post Offices	1
	Branch Offices	19
2023-24	Total	20
	Head Offices	-
	Sub Post Offices	1
	Branch Offices	19

Source: KP Development Statistics 2025

Given Bajaur's growing population and its strategic importance as a border district contributing to regional trade and socio-economic activity, the establishment of a Head Post Office is strongly recommended. This would enhance coordination, improve mail processing efficiency, and facilitate the introduction of modern postal and courier services.

To evaluate the adequacy of existing postal service coverage, an accessibility analysis was conducted. The analysis determined that areas located beyond a 40-minute travel time from the nearest post office fall outside the optimal service threshold. Such areas should be prioritized for the establishment of new postal facilities. Candidate locations were further assessed based on population density and settlement size, following the criteria defined in Pakistan's National Reference Manual for Postal Services.

6.7.5.2 Constraints

In Bajaur District, telecommunications face several constraints that hinder their effectiveness and accessibility. The region's underdeveloped network infrastructure, coupled with poor maintenance, limits connectivity, particularly in rural and remote areas. Geographic challenges, such as the rugged terrain and access issues due to security concerns, make the installation and upkeep of telecommunications equipment difficult and costly. Economic constraints, including limited funding and low market penetration, further exacerbate the situation, while the use of outdated technology and limited network coverage contribute to subpar service quality.

6.7.5.3 Requirement of new postal services in the district and recommendations

The expansion and modernization of postal services in District Bajaur are essential to meet the growing communication, administrative, and commercial needs of the district. Despite having a stable network of post offices, the absence of a Head Post Office and limited coverage

in peripheral tehsils particularly Utman Khel, Mamund, Barang, and Salarzai restrict efficient service delivery and administrative coordination.

With the district's population expanding and economic activities diversifying, postal services must evolve beyond traditional mail handling to incorporate digital, financial, and e-commerce support functions. The increasing adoption of online businesses, digital payments, and parcel logistics has created new service demands that the existing infrastructure cannot adequately fulfill.

An assessment indicates that several settlements remain beyond a 40-minute travel distance from the nearest post office, underscoring the need for additional facilities to ensure equitable access. Establishing new post offices in these underserved areas would improve inclusion, reduce travel time for postal users, and support government service delivery, particularly in remote border zones.

Recommendations

- Establishment of Head Post Office: Set up a central postal head office at Khar, the district headquarters, to oversee administrative coordination, mail routing, and integration with regional networks.
- Expansion of Branch and Sub-Post Offices: Introduce new postal outlets in Utman Khel, Salarzai, Mamund, and Barang tehsils to address identified coverage gaps.
- Digital Modernization: Upgrade existing facilities with electronic tracking, parcel management systems, and e-banking services to align with national postal reforms.
- Mobile Postal Units: Deploy mobile postal vans to provide periodic services in hard-to-reach mountainous settlements.
- Public–Private Partnerships (PPPs): Encourage collaboration with private courier and logistics companies to extend postal services, particularly for e-commerce distribution.
- Infrastructure Upgradation: Renovate existing branch offices with improved facilities, digital connectivity, and solar-powered systems to ensure uninterrupted operations.
- Community Awareness and Training: Conduct awareness sessions to promote the use of modern postal and financial services, especially in rural communities.

In summary, expanding postal infrastructure and modernizing service delivery mechanisms in District Bajaur are crucial for strengthening administrative reach, supporting digital commerce, and enhancing citizen access to communication and financial services. These interventions will significantly contribute to regional integration, inclusive growth, and improved service accessibility across the district.

6.8 WATER SUPPLY AND SANITATION NETWORKS

6.8.1 Barang Tehsil

6.8.1.1 Source(s) of drinking water supply in

Groundwater is extensively utilized through hand pumps, boreholes, and protected wells. These sources provide reliable drinking water, though the quality and quantity can vary across different parts of the district. Freshwater springs, particularly in rural and mountainous areas, are vital sources of clean and safe drinking water. Some regions also use untreated river and stream water for drinking, which requires proper filtration and purification. Rainwater harvesting is a common practice, with households and communities collecting rainwater in storage tanks and small dams, providing an alternative source of drinking water in water-scarce areas. Community water supply schemes, including piped water systems and water filtration plants, have been established by government and non-governmental organizations to ensure safe and treated drinking water for the local population.

6.8.1.2 Standards for Drinking Water Quality

Water quality is a crucial aspect of ensuring safe and reliable drinking water for communities. It encompasses various parameters, including microbial safety, chemical composition, and physical characteristics. Microbial contamination, often from pathogens like bacteria, viruses, and protozoa, poses significant health risks and requires effective treatment and monitoring. Chemical contaminants, such as heavy metals, pesticides, and industrial pollutants, can affect water safety and require stringent regulatory measures to control. Additionally, physical characteristics like turbidity and color can impact the aesthetic quality of water and indicate potential contamination. Following are the parameters and National Standards for Drinking Water Quality (NSDWG) adopted by Pakistan Environmental Protection Agency and WHO:

Table 94: National Standards for Drinking Water Quality (NSDWG)

Properties /Parameters	Standard Values For Pakistan	Who Standards
Bacterial		
All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample in case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12- month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12- month period.
Physical		

Colour	<15 TCU	<15 TCU
Taste	Non objectionable/Accept able	Non objectionable/Accept able
Odour	Non objectionable/Accept able	Non objectionable/Accept able
Turbidity	< 5 NTU	<5 NTU
Total hardness as CaCO3	< 500 mg/l	---
TDS	< 1000	< 1000
pH	6.5 - 8.5	6.5 - 8.5
Chemical		
Essential Inorganic	mg/Litre	mg/Litre
Aluminium (Al) mg/l	<0.2	0.2
Antimony (Sb)	<0.005 (P)	0.02
Arsenic (As)	0.05 (P)	0.01
Barium (Ba)	0.7	0.7
Boron (B)	0.3	0.3
Cadmium (Cd)	0.01	0.003
Chloride (Cl)	<250	250
Chromium (Cr)	<0.05	0.05
Copper (Cu)	2	2
Toxic	mg/Litre	mg/Litre
Fluoride (F)*	<1.5	1.5
Lead (Pb)	<0.05	0.01
Manganese (Mn)	< 0.5	0.5
Mercury (Hg)	<0.001	0.001
Nickel (Ni)	<0.02	0.02
Nitrate (NO3) *	<50	50
Nitrite (NO2) *	<3 (P)	3
Selenium (Se)	0.01 (P)	0.01
Residual chlorine	0.2-0.5 at consumer end 0.5-1.5 at source	--
Zinc (Zn)	5.0	3
Organic		
Pesticides mg/L		PSQCA No. 4639- 2004, Page No. 4 Table No. 3 Serial No. 20-58 may be consulted
Phenolic compounds (as Phenols) mg/L		< 0.002
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)
Radioactive		
Alpha Emitters bq/L or pCi	0.1	0.1
Beta emitters	1	1

Source: National Standards for Drinking Water Quality (NSDWG), Pakistan Environmental Protection Agency

6.8.1.3 Quantity of Drinking Water at Source as Per WHO/Local Standards

The World Health Organization (WHO) recommends that the amount of water supplied for personal and domestic use should be adequate to meet an individual's needs. These encompass drinking, personal hygiene, washing, food preparation, and other household

activities. WHO suggests a daily water allocation of 50 to 100 liters per person to satisfy these basic requirements.

The Public Health Engineering Department also provides guidelines for estimating the water needs when planning water supply infrastructure. This estimate is influenced by growth and directly correlates with the population size. The table below outlines the water demand based on population variations for city planning purposes.

Table 95: Per Capita Consumption of Water as per the PHED Design Criteria

Design Population	Per Capita Consumption Per Day (Inclusive of Unaccounted for Water)
Up to 5,000	10 Gallons
5,001 – 10,000	15 Gallons
10,001 – 20,000	20 Gallons
20,001 – 50,000	30 Gallons
50,001 – 100,000	40 Gallons
100,001 – 200,000	50 Gallons
200,001 – 300,000	55 Gallons
300,001 – 400,000	60 Gallons
400,001 – 500,000	65 Gallons
500,001 – 600,000	70 Gallons
600,001 – 700,000	75 Gallons
700,001 – 800,000	80 Gallons
More than 800,000	85 Gallons

The amount of water needed varies based on several factors. However, it's important to note that Pakistan is facing severe water shortages due to climate change. Therefore, water demand figures may need adjustment based on local terrain, climate conditions, and international climate regulations. Since Bajaur District is categorized by rural settings, the average water requirement is adjusted to 15 gallons per capita per day is considered suitable to meet the demand of the district.

6.8.1.4 Existing coverage of the water supply/gaps in demand in Barang.

This section presents the updated current and projected water requirements for Barang Tehsil, based on revised Village Council (VC)-wise population projections and applicable rural service level standards. Water demand has been estimated using a per capita requirement of 15 gallons per capita per day (GPCD), in accordance with rural water supply planning benchmarks.

Barang comprises the following Village Councils: Bar Targhau, Bataee Alizai, Miamool, Mor Dara, Nazar Mina, Panjkora, Qambar, Sharbatai Koz Kallai, and Tar. Based on the updated demographic projections, the combined rural population of Barang is approximately 90,229 in 2025, which is projected to increase steadily to 149,062 by 2045, driven by natural population growth and gradual regional development.

Based on these revised population figures, the average daily water demand for Barang is estimated at 1.35 million gallons per day (MGD) in 2025, increasing to approximately 2.24 MGD by 2045. Applying standard rural design factors, the maximum day demand is projected to rise from 2.03 MGD (2025) to 3.35 MGD (2045), while the peak hour demand is expected to increase from 3.05 MGD to 5.03 MGD over the same period. Correspondingly, storage requirements are projected to increase from approximately 1.02 MGD in 2025 to 1.68 MGD by 2045.

Given Barang's predominantly rural character, the majority of settlements currently rely on groundwater abstraction through hand pumps and shallow wells, with only limited access to organized piped water supply systems. However, the projected increase in population and water demand highlights the urgent need for structured, integrated, and sustainable rural water supply schemes, including source development, storage infrastructure, transmission networks, and community-based distribution systems. These interventions are essential to ensure equitable access, reliable service delivery, seasonal water security, and long-term resilience against groundwater depletion across all Village Councils of Barang Tehsil.

6.8.1.5 Rural Area Wise Existing and Proposed Water Demand of Barang

The rural settlements of Barang Tehsil depend primarily on groundwater abstraction through hand pumps and shallow wells, supplemented by limited community-based supply systems. Based on the revised population projections and a per-capita demand of 15 gallons per capita per day (GPCD), the average daily rural water requirement is now estimated at 1.35 MGPD in 2025. With sustained population growth and progressive service coverage, this demand is projected to rise to approximately 2.24 MGPD by 2045.

Design flows incorporating standard rural planning factors indicate that maximum day demand will increase from 2.03 MGPD (2025) to 3.35 MGPD (2045), while peak hour demand will rise from 3.05 MGPD to 5.03 MGPD over the same period.

Year	Rural Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	90,229	1.35	2.03	3.05
2030	102,295	1.53	2.3	3.45
2035	115,974	1.74	2.61	3.91
2040	131,482	1.97	2.96	4.44
2045	149,062	2.24	3.35	5.03

The updated analysis reinforces the need for integrated rural water supply planning, including phased development of water sources, storage reservoirs, treatment systems, and distribution networks. Priority should be given to improving service coverage, reducing groundwater stress, addressing seasonal shortages, and building climate-resilient water infrastructure,

ensuring sustainable and equitable water access for all rural communities of Barang Tehsil through 2045.

6.8.1.6 Proposed Water Supply System Barang Tehsil

To meet the projected water demand of Barang Tehsil (urban and rural areas) up to 2045, a phased and sustainable water supply system is required. The system design is based on per capita consumption 15 GPCD (rural VCs), accounting for maximum day demand and peak hour demand as per PHED & WASA.

6.8.1.7 Proposed Source (New Tube-Well)

- ***Design Basis***

Groundwater abstraction is based on the demonstrated safe yield of the Barang alluvial aquifer, ensuring sustainable utilization and long-term groundwater security for the tehsil's rural and semi-urban settlements.

- ***Unit Well Capacity:***

Each production well is designed to deliver a continuous yield of 0.20 MGD (0.31 cusec), considering local hydrogeological conditions and typical discharge rates from existing boreholes. Adequate provision has been made for standby operation and scheduled maintenance to ensure reliability and uninterrupted supply.

- ***Service Objective:***

The water supply system is designed to meet the projected average daily water demand of 2.44 MGD by 2045, while maintaining a 15 percent redundancy margin to account for operational downtime, peak hour fluctuations, and emergency supply requirements.

Stage	Implementation Period	Urban Demand to be Met (MGD)	New Production Wells*	Key Siting/Design Considerations
Immediate	2025 – 2030	up to 3.45	2 wells	Prioritize reduction of supply deficits and establish initial standby capacity. Wells to be located near major populated VCs such as Qambar and Sharbatai Koz Kallai, ensuring proximity to existing distribution lines.
Short-Term	2031 – 2035	up to 3.91	3 wells	Focus on extending service coverage to growing settlements like Bataee Alizai and Mor Dara, connecting to upgraded trunk mains and reservoir facilities.

Medium-Term	2036 – 2040	up to 4.44	4 wells	Develop deeper aquifer abstraction and integrate artificial recharge measures (e.g., recharge pits and infiltration galleries) to maintain groundwater balance.
Long-Term	2041 – 2045	up to 5.03	5 wells	Include strategic replacement of aging boreholes and expansion toward Nazar Mina, Panjkora, and Tar VCs to serve newly urbanized and high-demand areas.

6.8.1.8 Water Storage

- ***Rural Areas (VCs – 15 GPCD)***

For dispersed rural settlements in Barang Tehsil, smaller Overhead Reservoirs (OHRs) are proposed to ensure reliable and equitable water supply. The design prioritizes sustainable operations through localized balancing storage, minimizing dependence on continuous pumping and ensuring a 12-hour service buffer to accommodate power interruptions and peak-hour fluctuations.

➢ ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

Phased Capacities (based on projected demand):

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	2.03	1.015	1.0 – 1.1
2030	2.3	1.15	1.2 – 1.3
2035	2.61	1.305	1.3 – 1.5
2040	2.96	1.48	1.5
2045	3.35	1.675	1.6 – 1.8

- ***Location and Configuration:***

OHRs will be strategically located at intermediate elevated sites within Barang's key Village Councils (VCs) to facilitate gravity-fed distribution. Priority sites include Qambar, Sharbatai Koz Kallai, Mor Dara, Bataee Alizai, and Nazar Mina, enabling efficient coverage of surrounding

rural clusters. Reservoir design will adopt modular reinforced concrete structures, allowing phased expansion as demand increases through 2045.

6.8.1.9 Existing situation of the sanitation/drainage system in Tehsil Barang (Katcha, Pucca, open and covered etc.).

Wastewater generation in Barang Tehsil has been estimated based on 85% of the average daily water demand for the predominantly rural population. To this base flow, an additional 5% allowance for non-domestic usage (such as small-scale commercial and institutional activities) has been included.

For hydraulic design, peak sewage flow has been considered as twice the average daily sewage flow, while stormwater inflow is taken as 50% of the peak sewage flow to account for combined runoff entry into the system during monsoon events. Furthermore, infiltration losses have been incorporated at 10% of the average sewage flow, in line with regional hydrogeological and drainage conditions.

Considering the low-density rural settlement pattern and a per capita water demand of 15 gallons per capita per day (GPCD), the per capita sewage generation has been derived as 7.5 GPCD, reflecting typical domestic wastewater contribution in rural areas:

- ***Rural Area Wise Existing and Proposed Wastewater Demand – Barang VCs***

In the rural villages of Barang Tehsil, where household clusters are scattered and the terrain is uneven, a conventional gravity sewer network is neither economically nor technically feasible. Full-scale pipe sewers demand high capital investment, continuous flow velocities, and regular skilled maintenance requirements that are impractical in sparsely populated settlements.

Instead, decentralized on-site sanitation is recommended. A combination of household septic tanks with soakage pits (leach pits) provides a low-cost, low-maintenance, and environmentally sound solution. This approach is well-suited to Barang's permeable sandy–gravel soils, which facilitate infiltration, and to the region's limited water availability.

- ***Treatment Process***

Wastewater from each dwelling enters a sealed septic tank, where solids settle to form sludge and lighter materials form a scum layer.

The clarified effluent passes to a soakage pit, where it percolates through the surrounding soil for further natural filtration and pathogen reduction.

Typical performance of a well-maintained system:

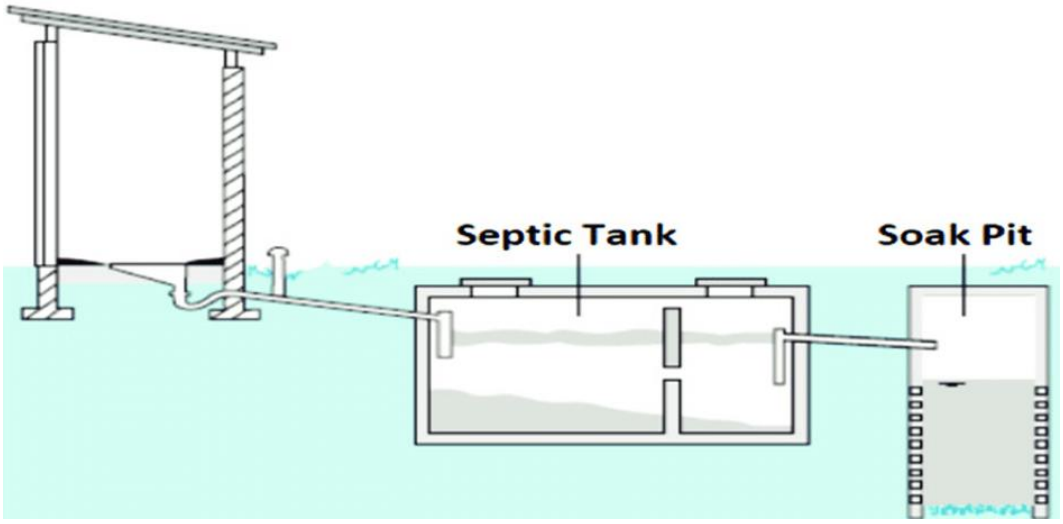
Suspended Solids (TSS): 80–90 % removal

Biochemical Oxygen Demand (BOD): 60–80 % reduction

Pathogens: 80–90 % reduction

Nutrients (N & P): 60–80 % reduction

This treatment level is adequate for protecting Barang's shallow aquifers and preventing nuisance conditions when tanks are properly sited and desludging.



- ***Wastewater quality & Treatment Barang***

The disposal of untreated wastewater into open drains, streams, and agricultural fields is a major cause of environmental degradation in Barang, contaminating both surface and groundwater resources. To address this challenge, a phased wastewater treatment strategy is proposed.

A centralized Wastewater Treatment Plant (WWTP) will be established near the Barang central plain, serving the urban NCs, while smaller decentralized treatment units (waste stabilization ponds or aerated lagoons) will be developed near rural clusters for VCs.

The WWTP design will follow international and national best practices, with process design based on average sewage flow and pollution loads, and hydraulic design based on peak flows. Treatment will target compliance with NEQS discharge limits (BOD < 80 mg/L, COD < 150 mg/L, TSS < 200 mg/L).

6.8.1.10Design of Soakage pit & Septic tank

The capacity of soakage pits has been determined based on the daily effluent generation and required retention time, considering local soil permeability and infiltration characteristics

Retention days for pit = 2 days

Void ratio = 0.35.

Worked results & recommended pit diameters

Calculated required gross pit volumes and approximate circular pit diameters for two practical depths (1.5 m and 2.0 m):

Household	Gross pit vol (m^3)	Gross vol (L)	Diameter for depth = 1.5 m (m)	Diameter for depth = 2.0 m (m)
4 p	0.993 m^3	993 L	0.92 m	0.80 m
6 p	1.489 m^3	1,489 L	1.12 m	0.97 m
8 p	1.986 m^3	1,986 L	1.30 m	1.12 m
10 p	2.482 m^3	2,482 L	1.45 m	1.26 m

Practical recommendation: use a cylindrical pit Dia 1.0–1.5 m and depth 1.5–2.0 m depending on household size/percolation — e.g.

4–6 persons - Ø 1.0 m, depth 1.5–2.0 m

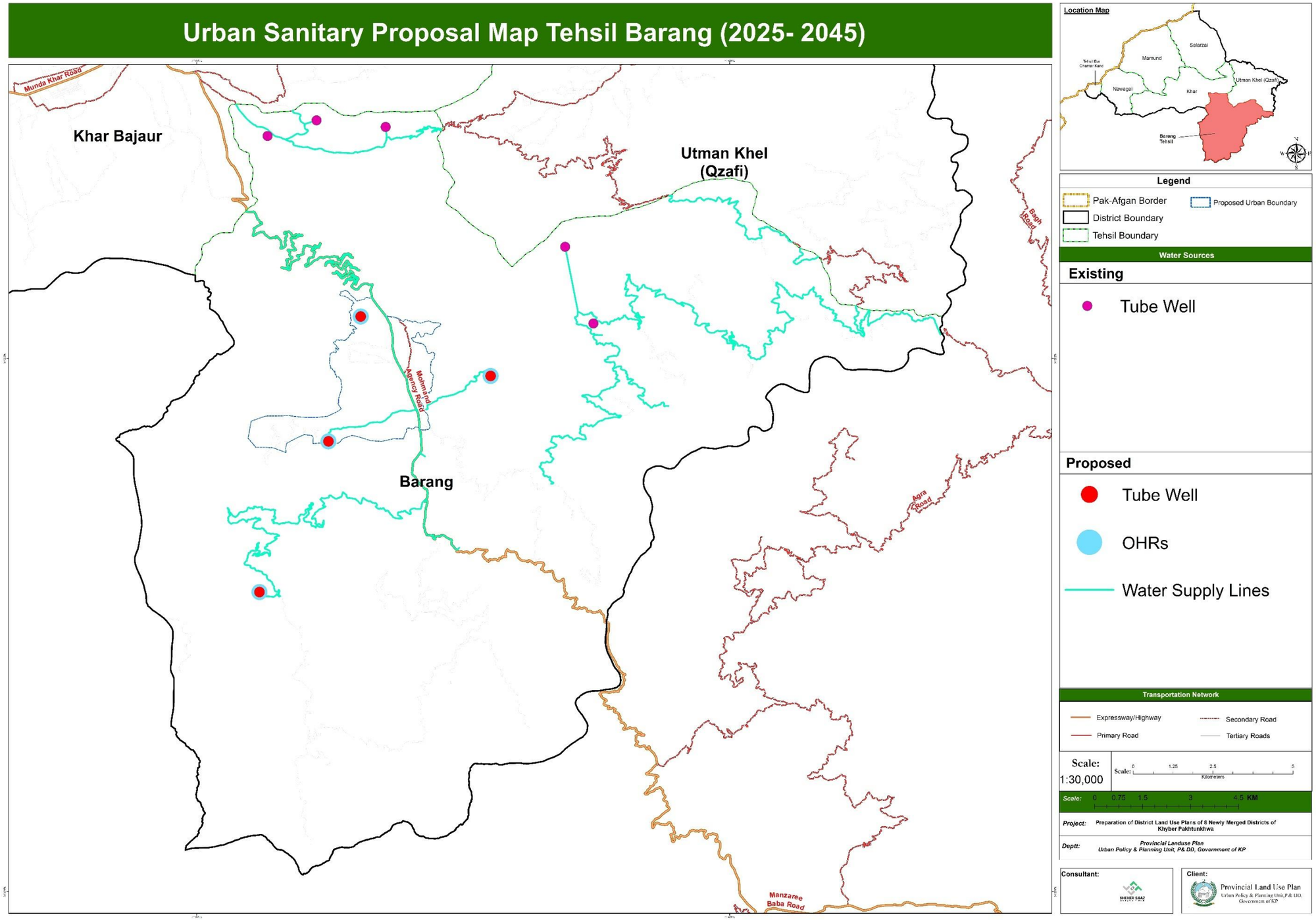
8–10 persons - Ø 1.2–1.5 m, depth 1.5–2.0 m

6.8.1.11Construction & installation

Each household within Barang Tehsil shall be equipped with an independent on-site sanitation system consisting of a two-chamber reinforced concrete septic tank followed by a soakage pit. The septic tank will be designed with inlet and outlet baffles, manhole access covers for periodic maintenance, and adequate structural cover and waterproofing to ensure durability. The inlet invert shall be positioned approximately 150 mm below the outlet invert to facilitate hydraulic flow and effective sedimentation. The effluent from the outlet chamber will discharge into a distribution box or soakage pit, incorporating a mosquito-proof vent to prevent vector breeding. Scheduled desludging every 3 to 5 years shall be carried out, depending on sludge accumulation and household load.

The soakage pit will be constructed using graded coarse aggregate (void ratio ≈ 0.35), enclosed with a geotextile lining to minimize silt ingress and maintain percolation efficiency. It shall be located at a minimum horizontal distance of 10 metres from any potable water source, preferably within a 15 to 30 metre buffer and positioned downslope of wells or boreholes to avoid contamination.

Map 49: Proposed Urban Sanitary Map - Tehsil Barang



6.8.2 Khar Tehsil

6.8.2.1 Existing coverage of the water supply/gaps in demand in Khar.

The Khar Urban Centre currently relies on multiple government- and VDO-operated water supply schemes (WSS), predominantly powered by solar-operated tube wells, with a limited number of electrically driven systems. These schemes typically operate for approximately 6–8 hours per day, delivering discharges in the range of 2,500–5,000 gallons per hour (GPH). While most schemes remain functional, several key installations—such as WSS Tauheed Abad Khar and WSS Jinnah Bus Terminal—are non-operational, adversely affecting overall service reliability and continuity.

At present, only about 34% of the urban population has access to piped water supply, while the remaining 66% remains unserved, primarily due to limited network coverage, aging infrastructure, insufficient storage, and constrained operational hours.

The existing sewage and drainage system in Khar Urban Centre is largely unplanned and inadequate, consisting mainly of open, undersized, and structurally damaged drains. Wastewater is frequently discharged directly into open drains or onto streets, resulting in unhygienic living conditions and public health risks. In the absence of a formal sewerage network and designated outfalls, households rely on individual septic tanks and soak pits, many of which contribute to groundwater contamination.

Although stormwater drains have recently been constructed along major corridors—such as Khar–Ghalanai Road, Inner Khar Bazaar, and Inayat Kali Bazaar—these drains are frequently clogged with solid waste and are hydraulically overloaded during rainfall events, leading to localized urban flooding. Overall, the lack of integrated sewerage and drainage infrastructure presents serious environmental and public health challenges, underscoring the urgent need for a comprehensive and sustainable WATSAN system for Khar Urban Centre.

6.8.2.2 Urban Area Wise Existing and Proposed Water Demand of KHAR

This section presents the updated current and projected urban water requirements for Khar, based on revised Neighborhood Council (NC)-wise population projections and applicable urban service level standards. Water demand has been estimated using a per capita requirement of 35 gallons per capita per day (GPCD), in accordance with PHED and WASA urban water supply guidelines.

The Khar Urban Centre comprises the following Neighborhood Councils:

- NC Wali Ahad Koroona
- NC Mir Ali Qilla Khar
- NC Inayat Killi / Miagano Koro
- NC Sadiq Abad-1.

Based on the revised population projections, the urban population of Khar is approximately 49,775 in 2025, which is projected to increase significantly to about 113,082 by 2045, driven by natural growth, densification, and urban expansion.

Accordingly, the average daily urban water demand is estimated to increase from 1.74 MGD in 2025 to approximately 3.96 MGD by 2045. Applying standard urban design factors, the maximum day demand is projected to rise from 2.61 MGD to 5.94 MGD, while the peak hour demand is expected to increase from 3.92 MGD to 8.91 MGD over the same period.

Year	Urban Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	49,775	1.74	2.61	3.92
2030	58,630	2.05	3.08	4.62
2035	69,027	2.42	3.63	5.45
2040	81,876	2.87	4.3	6.46
2045	113,082	3.96	5.94	8.91

The projected increase in urban population and demand highlights the need for capacity augmentation, system rehabilitation, extended supply hours, improved storage, and network expansion, with a focus on achieving equitable and reliable service coverage across all urban neighborhoods of Khar.

6.8.2.3 Rural Area Wise Existing and Proposed Water Demand of KHAR

The rural settlements of Khar Tehsil comprise multiple Village Councils (VCs) and rely predominantly on groundwater abstraction through hand pumps, shallow wells, and small community-operated schemes. These decentralized systems remain the primary source of domestic water supply, particularly in dispersed and peri-urban villages.

Based on revised VC-wise population projections, the rural population of Khar Tehsil is estimated at approximately 344,600 in 2025, projected to increase to about 556,900 by 2045. Using a rural per capita water demand of 15 GPCD, the average daily rural water requirement is estimated at 5.17 MGD in 2025, increasing to 8.35 MGD by 2045.

Applying standard rural design factors, the maximum day demand is projected to rise from 7.76 MGD to 12.53 MGD, while the peak hour demand is expected to increase from 11.64 MGD to 18.79 MGD over the planning horizon.

Year	RURAL Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	344,600	5.17	7.76	11.64
2030	406,100	6.09	9.13	13.7

2035	479,400	7.19	10.79	16.19
2040	514,800	7.72	11.58	17.37
2045	556,900	8.35	12.53	18.79

The analysis emphasizes the need for integrated rural water supply planning, focusing on sustainable groundwater management, phased development of small piped schemes, localized storage, and water quality protection to ensure reliable and equitable service delivery across all rural settlements.

6.8.2.4 Proposed Water Supply System Khar Tehsil

To meet the projected water demand of Khar Tehsil (covering both urban and rural areas) up to 2045, a phased and sustainable water supply system is proposed. The system design is based on a per capita consumption of 15 GPCD for rural areas and 35 GPCD for urban settlements, in accordance with PHED and WASA design standards. The projections incorporate maximum day and peak hour demand factors, ensuring system reliability, operational efficiency, and resilience to future population growth and service expansion across all areas of Khar Tehsil.

Proposed Source (New Tube-Well)

- ***Design Basis***

Groundwater abstraction is based on the demonstrated safe yield of the Khar alluvial aquifer, ensuring sustainable utilization and long-term groundwater security for the tehsil's rural and semi-urban settlements.

The future water supply system will primarily rely on deep tube wells tapping the alluvial aquifer, supplemented by spring-fed intakes and boreholes in areas with favorable hydrogeological conditions. Where feasible, solar-powered pumping units will be introduced to enhance energy efficiency and operational sustainability

- ***Unit Well Capacity:***

Each production well is designed to deliver a continuous yield of 0.64 MGD (1 cusec), considering local hydrogeological conditions and typical discharge rates from existing boreholes. Adequate provision has been made for standby operation and scheduled maintenance to ensure reliability and uninterrupted supply.

- ***Service Objective:***

The water supply system for Khar Tehsil is designed to meet the projected average daily water demand of 3.96 MGD by 2045, while maintaining a 15 percent redundancy margin to accommodate operational downtime, peak-hour variations, and emergency supply

requirements. This approach ensures a reliable, efficient, and resilient water supply network capable of sustaining the tehsil's growing urban and rural population.

Stage	Implementation Period	Urban Demand to be Met (MGD)	New Production Wells*	Key Siting/Design Considerations
Immediate	2025 – 2030	up to 1.74	3 wells	Prioritize reduction of supply deficits and establish standby capacity. Site wells in central Khar and Sadiqabad near existing trunk mains and OHRs to minimize transmission head and enable rapid connection.
Short-Term	2031 – 2035	up to 2.05	4 wells	Focus on expanding coverage to growing neighborhoods (e.g., Inayat Killi, Mirali Gilli). Integrate new wells with upgraded transmission mains and neighborhood OHTs; ensure access for maintenance and desludging.
Medium-Term	2036 – 2040	up to 2.42	5 wells	Target deeper aquifer zones and implement artificial-recharge measures (percolation tanks, recharge trenches) to sustain yields and avoid local drawdown. Balance well locations to distribute abstraction.
Long-Term	2041 – 2045	up to 3.96	7 wells	Include strategic replacement of ageing boreholes and expansion toward peripheral growth corridors (e.g., Wali Ahad Kor, Tangkhata). Coordinate with additional OHR storage for peak shaving and operational flexibility.

Stage	Implementation Period	Rural Demand to be Met (MGD)	New Production Wells*	Key Siting / Design Considerations
Immediate	2025 – 2030	up to 5.17	8 wells	Prioritise urgent deficit reduction across high-population VCs (e.g., Qambar, Sharbatai Koz Kallai, Panjkora). Use cluster siting near existing community intakes, favour solar-powered shallow/deep tube wells where feasible; ensure proximity to village OHRs for gravity distribution.
Short-Term	2031 – 2035	up to 6.09	10 wells	Expand coverage to additional dispersed VCs (e.g., Bataee Alizai, Mor Dara). Integrate wells with local storage (OHRs) and small distribution rings; provide access roads and maintenance points.

Medium-Term	2036 – 2040	up to 7.19	11 wells	Target deeper aquifer zones where sustainable; implement artificial recharge (percolation pits, recharge trenches) to protect groundwater levels; stagger drilling to monitor impacts.
Long-Term	2041 – 2045	up to 8.35	14 wells	Strategic replacement/augmentation of earlier installations and expansion to remaining VCs (e.g., Nazar Mina, Tar, Bar Targhau, Miamool). Coordinate with OHR network for peak shaving and ensure redundancy and operation/maintenance planning.

6.8.2.5 Water Storage

- ***Urban Areas (VCs – 35 GPCD)***

For Khar Urban Centre, overhead reservoirs (OHRs) are proposed to ensure consistent supply, operational flexibility, and adequate storage for emergency and maintenance situations. The OHRs are designed to maintain a 12-hour buffer, allowing for peak-hour fluctuations and power interruptions.

- ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	2.61	1.307	1.3 – 1.4
2030	3.08	1.539	1.5 – 1.6
2035	3.62	1.812	1.8 – 1.9
2040	4.30	2.149	2.2 – 2.3
2045	5.94	2.968	2.6 – 3.0

6.8.2.6 Location and Configuration

For urban Khar, OHRs will be sited within densely populated zones such as Khar Bazar, Inayat Killi, Sadiqabad, and Mirali Gilli, ensuring uniform pressure and reliable supply across the urban network.

6.8.2.7 Rural Areas (VCs – 15 GPCD)

For rural settlements in Khar Tehsil, smaller localized OHRs are proposed to ensure reliable and equitable service delivery. Each reservoir provides a 12-hour service buffer, reducing dependence on continuous pumping and mitigating the effects of power interruptions.

Purpose:

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	7.75	3.877	3.6 – 3.9
2030	9.14	4.569	4.2 – 4.6
2035	10.79	5.393	5.3 – 5.5
2040	11.58	5.792	5.7 – 6.2
2045	12.53	6.265	6.2 – 6.5

- ***Location and Configuration:***

For rural Khar, priority locations include major Village Councils such as Wali Ahad Kor, Chakorai Cham, Tangkhata, and nearby peripheral settlements, facilitating equitable water distribution to dispersed populations.

Each reservoir will be designed as a modular reinforced concrete structure, enabling phased expansion in line with future population growth and rising demand up to 2045. The configuration will include provisions for inlet and outlet control, water level monitoring, and maintenance access to ensure operational efficiency and long-term sustainability.

6.8.2.8 Existing situation of the sanitation/drainage system in Tehsil Khar (Katcha, Pucca, open and covered etc.).

Wastewater generation in Khar Tehsil has been estimated based on 85% of the average daily water demand for both urban and rural populations, with an additional 5% allowance for non-domestic usage such as small-scale commercial, institutional, and service-sector activities.

For hydraulic design purposes, peak sewage flow has been taken as twice the average daily sewage flow, while stormwater inflow has been considered as 50% of the peak sewage flow to account for incidental runoff and surface drainage entry into the system during monsoon

conditions. Infiltration losses are assumed at 10% of the average sewage flow, consistent with local soil permeability and groundwater conditions.

Based on per capita water demand values of 35 GPCD for urban and 15 GPCD for rural populations, the corresponding per capita sewage generation rates are derived as 29.75 GPCD for urban areas and 12.75 GPCD for rural areas, respectively. These rates reflect typical domestic wastewater production and are used for the design of localized sanitation systems across Khar Tehsil.

Given the dispersed settlement pattern in rural areas and partial coverage of the urban centre, wastewater management will primarily rely on a combination of household septic tanks with soakage pits in rural zones and gradual development of a sewerage network with decentralized treatment units in the urban core of Khar:

Urban Area Wise Existing and Proposed Wastewater Demand – khar NCs:

Year	Urban Population	Average Water Demand (MGD)	Wastewater Generation @ (85% + 5%) (MGD)	Peak Sewage Flow (MGD)	Stormwater Inflow (50% of Peak) (MGD)	Total Design Flow (MGD)
2025	49,775	0.75	0.67	1.34	0.67	2.02
2030	58,630	0.88	0.79	1.58	0.79	2.37
2035	69,027	1.04	0.93	1.86	0.93	2.80
2040	81,876	1.23	1.11	2.21	1.11	3.32
2045	113,082	1.70	1.53	3.05	1.53	4.58

Based on the revised urban population projections and corresponding water demand estimates, wastewater generation for Khar Urban Centre has been assessed using a standard return factor of 90% of average water demand (85% domestic wastewater generation plus 5% allowance for non-domestic and infiltration components). Peak sewage flows and stormwater inflow allowances have been incorporated to determine the total design flow for sewerage infrastructure.

The analysis indicates that the average daily wastewater generation in Khar Urban Centre is projected to increase from 0.67 MGD in 2025 to 1.53 MGD by 2045. For hydraulic design purposes, the peak sewage flow has been estimated at twice the average wastewater flow, while stormwater inflow and infiltration (I/I) has been assumed as 50% of peak sewage flow, in line with urban sewerage planning practices for mixed drainage environments.

Accordingly, the total design wastewater flow for Khar Urban Centre is projected to increase from approximately 2.02 MGD in 2025 to 4.58 MGD by 2045, reflecting the combined effect of population growth, increased water consumption, and inflow allowances.

- ***Proposed Sewerage System and Treatment Plant – Khar Urban Centre***

To address the growing wastewater load—projected to increase from approximately 2.02 MGD in 2025 to 4.58 MGD by 2045 (total design flow)—a centralized sewerage collection and treatment system is proposed for Khar Urban Centre. The proposed system is intended to ensure efficient wastewater conveyance, effective treatment, and environmentally safe disposal, thereby significantly improving urban sanitation, groundwater protection, and overall public health conditions.

- ***Sewerage Network***

The proposed sewerage system will comprise a gravity-based closed sewer network covering all urban neighborhoods, commercial areas, and institutional zones of Khar Urban Centre.

Primary, secondary, and trunk sewers will be aligned along natural ground slopes and existing drainage corridors to facilitate gravity flow and minimize pumping requirements. House connections will be provided to all residential, commercial, and institutional properties through lateral sewers equipped with inspection chambers. Pumping stations (lift stations) will be installed only where topographic constraints prevent gravity flow, ensuring uninterrupted wastewater conveyance.

Manholes and appurtenances will be constructed at standard intervals in accordance with PHED and WASA design guidelines, providing adequate access for operation, maintenance, and ventilation. The system will be designed to accommodate the ultimate design flow of 4.58 MGD, with appropriate allowances for infiltration, inflow, and future densification.

- ***Centralized Wastewater Treatment Plant (WWTP)***

A centralized Wastewater Treatment Plant (WWTP) is proposed on the southern periphery of Khar Urban Centre, strategically located downstream of the built-up area along a natural drainage course to facilitate gravity inflow and ensure safe effluent discharge. Based on the projected wastewater loads, the WWTP is planned with an initial treatment capacity of approximately 5.0 MGD, which will be expandable to about 6.0 MGD by 2045, thereby providing operational flexibility and accommodating future growth beyond the planning horizon. The selection of the treatment process will be guided by land availability, effluent quality requirements, and operational considerations, with Extended Aeration Activated Sludge Process (EA-ASP) or Waste Stabilization Ponds (WSP) envisaged as suitable options. The treated effluent will be designed to comply with National Environmental Quality Standards (NEQS-2023) for safe discharge into surface water bodies or controlled agricultural reuse. The facility will also incorporate provisions for sludge drying beds and/or mechanical dewatering units, ensuring safe handling, stabilization, and beneficial reuse of biosolids. Furthermore, reuse of treated wastewater for nearby agricultural lands is proposed to reduce freshwater abstraction, improve water resource efficiency, and promote environmentally sustainable urban development.

- ***Rural Area Wise Existing and Proposed Wastewater Demand – Khar Tehsil VCs***

In the rural villages of Khar, where household clusters are scattered and the terrain is uneven, a conventional gravity sewer network is neither economically nor technically feasible. Full-scale pipe sewers demand high capital investment, continuous flow velocities, and regular skilled maintenance requirements that are impractical in sparsely populated settlements.

Instead, decentralized on-site sanitation is recommended. A combination of household septic tanks with soakage pits (leach pits) provides a low-cost, low-maintenance, and environmentally sound solution. This approach is well-suited to Barang's permeable sandy–gravel soils, which facilitate infiltration, and to the region's limited water availability.

Treatment Process

Wastewater from each dwelling enters a sealed septic tank, where solids settle to form sludge and lighter materials form a scum layer.

The clarified effluent passes to a soakage pit, where it percolates through the surrounding soil for further natural filtration and pathogen reduction.

Typical performance of a well-maintained system:

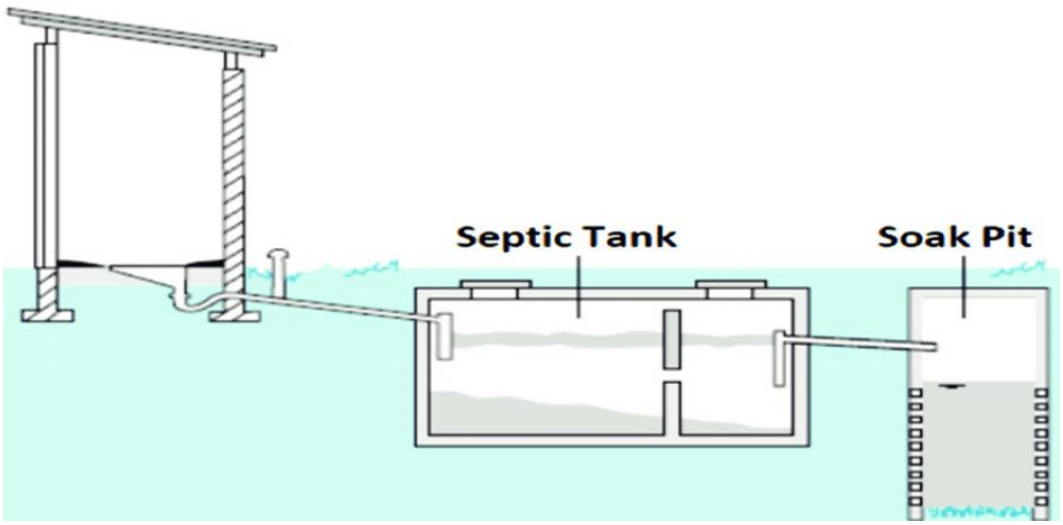
Suspended Solids (TSS): 80–90 % removal

Biochemical Oxygen Demand (BOD): 60–80 % reduction

Pathogens: 80–90 % reduction

Nutrients (N & P): 60–80 % reduction

This treatment level is adequate for protecting Barang's shallow aquifers and preventing nuisance conditions when tanks are properly sited and desludging.



Wastewater quality & Treatment Khar Tehsil

The disposal of untreated wastewater into open drains, streams, and agricultural fields is a major cause of environmental degradation in Khar Tehsil, contaminating both surface and groundwater resources. To address this challenge, a phased wastewater treatment strategy is proposed.

A centralized Wastewater Treatment Plant (WWTP) will be established near the Barang central plain, serving the urban NCs, while smaller decentralized treatment units (waste stabilization ponds or aerated lagoons) will be developed near rural clusters for VCs.

The WWTP design will follow international and national best practices, with process design based on average sewage flow and pollution loads, and hydraulic design based on peak flows. Treatment will target compliance with NEQS discharge limits (BOD < 80 mg/L, COD < 150 mg/L, TSS < 200 mg/L).

6.8.2.9 Design of Soakage pit & Septic tank

The capacity of soakage pits has been determined based on the daily effluent generation and required retention time, considering local soil permeability and infiltration characteristics

Retention days for pit = 2 days

Void ratio = 0.35.

Recommended pit diameters

Calculated required gross pit volumes and approximate circular pit diameters for two practical depths (1.5 m and 2.0 m):

Household	Gross pit vol (m^3)	Gross vol (L)	Diameter for depth = 1.5 m (m)	Diameter for depth = 2.0 m (m)
4 p	0.993 m^3	993 L	0.92 m	0.80 m
6 p	1.489 m^3	1,489 L	1.12 m	0.97 m
8 p	1.986 m^3	1,986 L	1.30 m	1.12 m
10 p	2.482 m^3	2,482 L	1.45 m	1.26 m

Practical recommendation: use a cylindrical pit Dia 1.0–1.5 m and depth 1.5–2.0 m depending on household size/percolation — e.g.

4–6 persons = Ø 1.0 m, depth 1.5–2.0 m

8–10 persons = Ø 1.2–1.5 m, depth 1.5–2.0 m

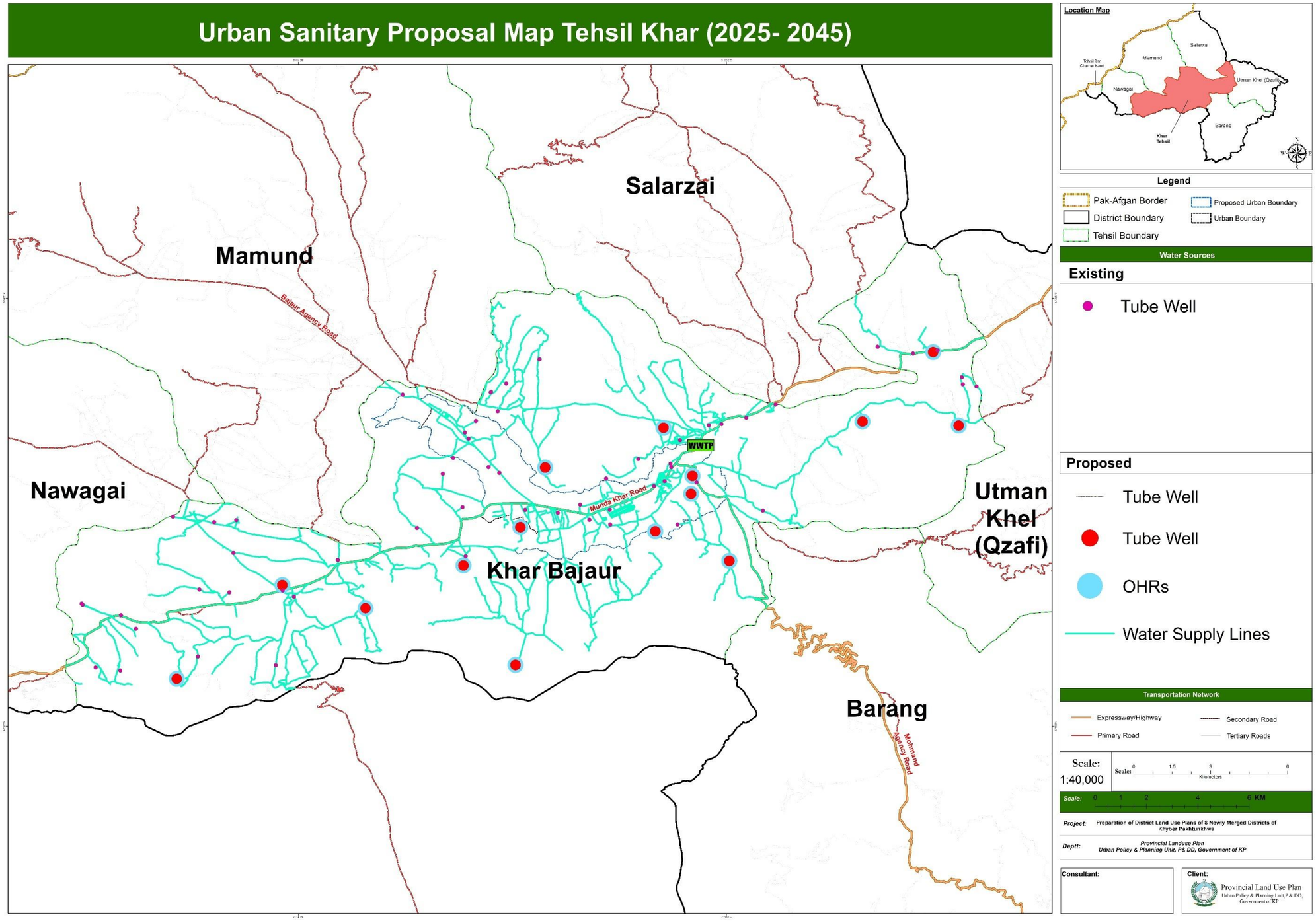
6.8.2.10 Construction & installation

Each household within Khar Tehsil's rural settlements will be provided with an independent on-site sanitation system comprising a two-chamber reinforced concrete septic tank followed by a soakage pit. The septic tank will include inlet and outlet baffles, manhole covers for

desludging and inspection, and sufficient structural cover and waterproofing to ensure long-term performance. The inlet invert will be positioned approximately 150 mm below the outlet invert to maintain proper hydraulic flow and effective sedimentation. Effluent from the outlet chamber will discharge into a distribution box or soakage pit, equipped with a mosquito-proof vent to prevent vector breeding. Desludging operations shall be undertaken every 3 to 5 years, depending on sludge accumulation and household usage.

The soakage pit will be filled with graded coarse aggregate (void ratio 0.35) and lined with geotextile fabric to prevent siltation and ensure sustained infiltration. The pit shall be located at least 10 metres away from any drinking water source, preferably within a 15 to 30 metre separation distance and positioned downslope of wells or boreholes to prevent contamination. A minimum vertical clearance of 1.0 metre shall be maintained between the pit base and the seasonal high groundwater table. Each pit will include a reinforced concrete collar and inspection access to prevent surface infiltration and allow maintenance. This decentralized on-site sanitation system provides a safe, sustainable, and low-maintenance wastewater management solution appropriate for Khar's dispersed rural communities, where centralized sewerage infrastructure is not feasible.

Map 50: Proposed Urban Sanitary Map - Tehsil Khar



6.8.3 Mamund Tehsil

6.8.3.1 Rural Area Wise Existing and Proposed Water Demand of Mamund Tehsil

The rural settlements of Mamund Tehsil primarily depend on groundwater abstraction through hand pumps, shallow wells, and small-scale community-operated water supply systems. These decentralized sources remain the principal means of meeting domestic water needs, particularly in scattered and remote villages where piped water supply systems are limited or absent.

Based on updated rural population projections and an adopted per capita water demand of 15 gallons per capita per day (GPCD), the average daily rural water demand is estimated at 5.86 MGD in 2025, increasing progressively to 10.33 MGD by 2045. The corresponding maximum day demand is projected to rise from 8.80 MGD to 15.49 MGD, while the peak hour demand is expected to increase from 13.19 MGD to 23.24 MGD over the same period.

Given the dispersed settlement pattern and reliance on individual or community-based groundwater sources, ensuring reliable, equitable, and safe water supply remains a key challenge. Future planning must prioritize groundwater conservation and recharge, strengthening of small-scale piped water supply schemes, and provision of adequate storage capacity to address peak demand and seasonal shortages.

Year	RURAL Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	390,962	5.86	8.80	13.19
2030	450,389	6.76	10.13	15.20
2035	518,848	7.78	11.67	17.51
2040	597,713	8.97	13.45	20.17
2045	688,566	10.33	15.49	23.24

The analysis underscores the urgent need for integrated rural water supply planning to ensure equitable service coverage, address seasonal shortages, and enhance resilience against groundwater stress.

6.8.3.2 Proposed Water Supply System Mamund Tehsil

To cater to the projected water demand of Mamund Tehsil—encompassing both urban and rural settlements—up to the year 2045, a phased and sustainable water supply system is proposed. The design framework is based on a per capita water consumption of 15 gallons per capita per day (GPCD) for rural areas , in line with PHED and WASA design standards.

The proposed system accounts for maximum day and peak hour demand factors, ensuring adequate system capacity, operational flexibility, and service reliability. This approach is intended to support future population growth, urban expansion, and improved service

coverage, while maintaining the long-term efficiency and sustainability of the water supply network across all urban and rural areas of Mamund Tehsil.

6.8.3.3 Proposed Source (New Tube-Well)

- ***Design Basis***

Groundwater abstraction in Mamund Tehsil will be guided by the sustainable yield potential of the local alluvial aquifer system, ensuring long-term groundwater security and balanced utilization across both rural and semi-urban areas.

The proposed future water supply system will predominantly depend on deep tube wells drawing from the alluvial aquifer, complemented by spring-fed intakes and boreholes in zones with suitable hydrogeological characteristics. To enhance energy efficiency and operational sustainability, solar-powered pumping systems will be adopted where feasible, thereby reducing dependence on grid electricity and supporting climate-resilient water supply operations throughout Mamund Tehsil

- ***Unit Well Capacity:***

Each production well is designed to deliver a continuous yield of 0.64 MGD (1 cusec), considering local hydrogeological conditions and typical discharge rates from existing boreholes. Adequate provision has been made for standby operation and scheduled maintenance to ensure reliability and uninterrupted supply.

- ***Service Objective:***

The water supply system for Mamund Tehsil is designed to meet the projected average daily water demand of 8.26 MGD by 2045, incorporating a 15 percent redundancy margin to ensure uninterrupted service during operational downtime, peak-hour fluctuations, and emergency situations. This design framework supports a reliable, efficient, and climate-resilient water supply network, capable of accommodating the tehsil's expanding urban and rural population through 2045.

Stage	Implementation Period	Rural Demand to be Met (MGD)	New Production Wells*	Key Siting / Design Considerations
Immediate	2025 – 2030	up to 8.80	19 wells	Address immediate supply shortfalls in high-density villages such as Kashmir Kor, Salarzai, and Khazina. Prioritize cluster-based tube wells near existing community schemes; adopt solar-powered pumping units where feasible; connect to local OHRs for gravity-fed distribution
Short-Term	2031 – 2035	up to 10.13	11 wells	Expand groundwater coverage to remote and dispersed settlements, integrating wells with new overhead reservoirs (OHRs) and local

				distribution loops. Ensure proper access, fencing, and O&M provisions at each site.
Medium-Term	2036 – 2040	up to 11.67	14 wells	Tap deeper and more productive aquifer zones; implement groundwater recharge interventions (e.g., recharge trenches, infiltration wells) to maintain aquifer sustainability. Monitor yield and quality trends to guide phased drilling.
Long-Term	2041 – 2045	up to 15.5	16 wells	Strengthen system resilience through strategic well replacement and augmentation; extend service to unserved villages such as Samar Bagh, Tangi, and Kamar Sar. Coordinate well with regional OHRs for balanced pressure management and operational redundancy

6.8.3.4 Water Storage

- ***Rural Areas (VCs – 15 GPCD)***

For rural settlements in Mamund Tehsil, smaller localized OHRs are proposed to ensure reliable and equitable delivery service. Each reservoir provides a 12-hour service buffer, reducing dependence on continuous pumping and mitigating the effects of power interruptions.

➢ ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	8.80	4.398	4.5
2030	10.13	5.067	5.0
2035	11.67	5.837	6.0
2040	13.45	6.724	6.8
2045	15.49	7.746	7.8

- ***Location and Configuration:***

For rural Mamund Tehsil, priority locations for Overhead Reservoirs (OHRs) include major Village Councils such as Kashmir Kor, Khazina, Salarzai, Tangi, Samar Bagh, and Kamar Sar,

along with other peripheral settlements to ensure equitable and reliable water distribution across dispersed rural communities.

Each OHR will be constructed as a modular reinforced concrete structure, allowing for phased expansion in accordance with population growth and rising water demand up to 2045. The reservoirs will incorporate inlet and outlet control systems, water level monitoring instruments, and maintenance access provisions to ensure operational efficiency, structural durability, and long-term sustainability of the rural water supply network.

6.8.3.5 Existing situation of the sanitation/drainage system in Tehsil Mamund (Katcha, Pucca, open and covered etc.).

Wastewater generation in Mamund Tehsil has been estimated at 85% of the average daily water demand for the entirely rural population, with an additional 5% allowance for non-domestic usage such as small-scale commercial, institutional, and service-sector activities typical of rural settings.

For design purposes, the peak sewage flow has been considered as twice the average daily sewage flow, while stormwater inflow is assumed to be 50% of the peak sewage flow to account for incidental runoff and surface drainage entry during monsoon events. Infiltration losses have been included at 10% of the average sewage flow, consistent with the local hydrogeological and soil conditions.

Based on a per capita water demand of 15 gallons per capita per day (GPCD), the corresponding per capita sewage generation rate is derived as 7.5 GPCD, representing typical domestic wastewater production in rural areas.

As Mamund Tehsil has no urban settlements or centralized sewerage network, wastewater management will continue to rely on on-site sanitation systems, primarily consisting of two-chamber reinforced concrete septic tanks followed by soakage pits. These systems are recommended for all households and communal facilities to ensure safe, sustainable, and environmentally compliant wastewater disposal, while protecting groundwater quality and improving overall sanitation conditions across the tehsil.

- ***Rural Area Wise Existing and Proposed Wastewater Demand – Mamund Tehsil VCs***

In the rural villages of Mamund Tehsil, where household clusters are scattered and the terrain is uneven, a conventional gravity sewer network is neither economically nor technically feasible. Full-scale pipe sewers demand high capital investment, continuous flow velocities, and regular skilled maintenance requirements that are impractical in sparsely populated settlements.

Instead, decentralized on-site sanitation is recommended. A combination of household septic tanks with soakage pits (leach pits) provides a low-cost, low-maintenance, and environmentally sound solution. This approach is well-suited to Barang's permeable sandy–gravel soils, which facilitate infiltration, and to the region's limited water availability.

➢ *Treatment Process*

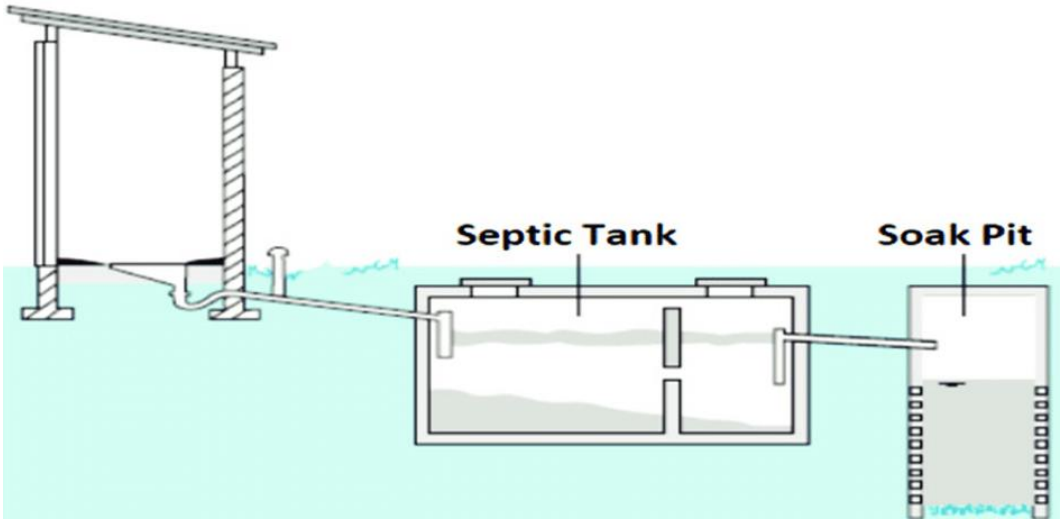
Wastewater from each dwelling enters a sealed septic tank, where solids settle to form sludge and lighter materials form a scum layer.

The clarified effluent passes to a soakage pit, where it percolates through the surrounding soil for further natural filtration and pathogen reduction.

Typical performance of a well-maintained system:

- Suspended Solids (TSS): 80–90 % removal
- Biochemical Oxygen Demand (BOD): 60–80 % reduction
- Pathogens: 80–90 % reduction
- Nutrients (N & P): 60–80 % reduction

This treatment level is adequate for protecting Barang's shallow aquifers and preventing nuisance conditions when tanks are properly sited and desludging.



Wastewater quality & Treatment Mamund Tehsil

The disposal of untreated wastewater into open drains, streams, and agricultural fields is a major cause of environmental degradation in Mamund Tehsil, contaminating both surface and groundwater resources. To address this challenge, a phased wastewater treatment strategy is proposed.

A centralized Wastewater Treatment Plant (WWTP) will be established near the Barang central plain, serving the urban NCs, while smaller decentralized treatment units (waste stabilization ponds or aerated lagoons) will be developed near rural clusters for VCs.

The WWTP design will follow international and national best practices, with process design based on average sewage flow and pollution loads, and hydraulic design based on peak flows.

Treatment will target compliance with NEQS discharge limits (BOD < 80 mg/L, COD < 150 mg/L, TSS < 200 mg/L).

6.8.3.6 Design of Soakage pit & Septic tank

The capacity of soakage pits has been determined based on the daily effluent generation and required retention time, considering local soil permeability and infiltration characteristics

Retention days for pit = 2 days

Void ratio = 0.35.

Recommended pit diameters

Calculated required gross pit volumes and approximate circular pit diameters for two practical depths (1.5 m and 2.0 m):

Household	Gross pit vol (m^3)	Gross vol (L)	Diameter for depth = 1.5 m (m)	Diameter for depth = 2.0 m (m)
4 p	0.993 m^3	993 L	0.92 m	0.80 m
6 p	1.489 m^3	1,489 L	1.12 m	0.97 m
8 p	1.986 m^3	1,986 L	1.30 m	1.12 m
10 p	2.482 m^3	2,482 L	1.45 m	1.26 m

Practical recommendation: use a cylindrical pit Dia 1.0–1.5 m and depth 1.5–2.0 m depending on household size/percolation — e.g.

- 4–6 persons = Ø 1.0 m, depth 1.5–2.0 m
- 8–10 persons = Ø 1.2–1.5 m, depth 1.5–2.0 m

6.8.3.7 Construction & installation

Each household within Mamund Tehsil's rural settlements will be equipped with an independent on-site sanitation system consisting of a two-chamber reinforced concrete septic tank followed by a soakage pit. The septic tank will be designed with inlet and outlet baffles, manhole covers for periodic desludging and inspection, and adequate structural reinforcement and waterproofing to ensure durability and watertight performance. The inlet invert level shall be maintained approximately 150 mm below the outlet invert to promote uniform flow and effective sedimentation of solids.

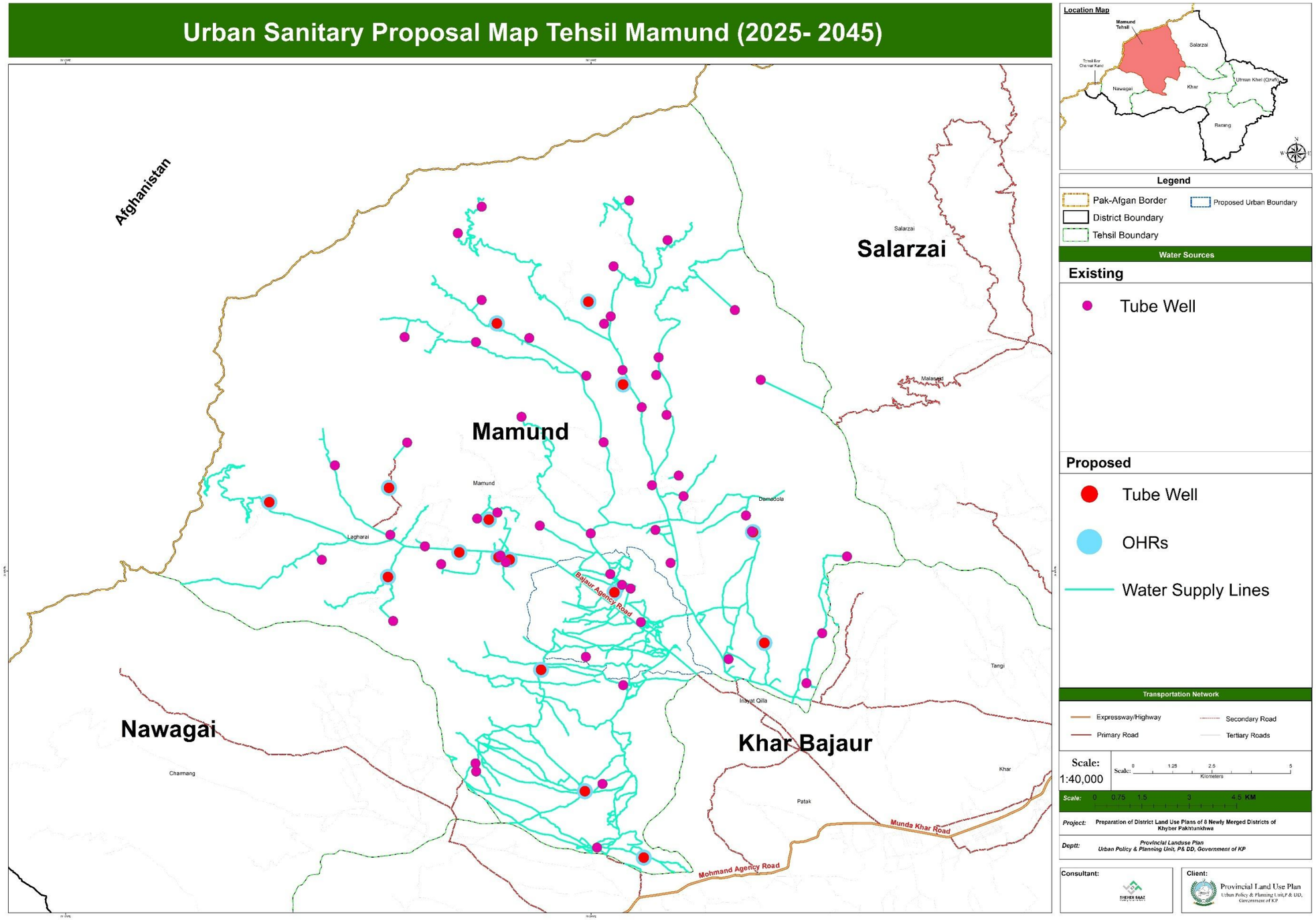
Effluent from the outlet chamber will be directed to a distribution box or soakage pit, provided with a mosquito-proof vent to prevent vector breeding. Desludging operations shall be carried out every 3 to 5 years, depending on sludge accumulation and household water usage patterns.

The soakage pit will be filled with graded coarse aggregate (void ratio ≈ 0.35) and lined with geotextile fabric to minimize siltation and ensure long-term infiltration efficiency. The pit shall

be located at least 10 meters away from any drinking water source, with a preferred separation of 15–30 meters and placed downslope of wells or boreholes to prevent groundwater contamination. A minimum vertical clearance of 1.0 metre shall be maintained between the pit bottom and the seasonal high groundwater table. Each pit will include a reinforced concrete collar and an inspection cover to prevent surface water ingress and facilitate maintenance.

This decentralized on-site sanitation system offers a safe, cost-effective, and environmentally sustainable wastewater management solution tailored to the rural context of Mamund Tehsil, where the absence of a centralized sewerage network and the scattered settlement pattern make individual household systems the most practical and hygienic option.

Map 51: Proposed Urban Sanitary Map - Tehsil Mamund



6.8.4 Nawagai Tehsil

6.8.4.1 Existing coverage of the water supply/gaps in demand in NAWAGAI.

The urban center of Nawagai Tehsil currently relies on multiple small-scale Water Supply Schemes (WSS), implemented by both government and community-based organizations. These schemes are primarily powered through solar energy, while a few operate on conventional electricity. Each system typically functions for 6–8 hours per day, delivering discharge rates between 2,500–5,000 gallons per hour (GPH). Although most schemes remain operational, several experience service interruptions due to mechanical breakdowns, seasonal groundwater depletion, and inconsistent power supply, resulting in unreliable water service.

Currently, approximately 35–40% of the urban population is connected to piped water networks, while the remaining 60–65% rely on private boreholes, hand pumps, dug wells, and spring sources. The existing infrastructure is thus insufficient to meet the current and projected demand.

With the urban population projected to increase from 88,434 in 2025 to 141,494 by 2045, the average daily water demand is expected to rise from 1.33 MGD in 2025 to 2.12 MGD in 2045, with maximum day and peak-hour demands reaching 3.18 MGD and 4.78 MGD, respectively. This growth underscores the need for a more reliable and expanded urban water supply system.

The sewerage and drainage network in Nawagai remains underdeveloped and largely unplanned, consisting mainly of open surface drains with inadequate gradients and cross-sections. Many drains are damaged, silted, or obstructed, and wastewater is frequently discharged into open channels, vacant plots, or natural depressions, creating stagnant and unsanitary conditions. Due to the absence of a centralized sewerage network, most households rely on individual septic tanks and soakage pits, which contribute to localized groundwater contamination.

Limited stormwater drains have been installed along selected routes; however, these are undersized and poorly maintained, leading to urban flooding during monsoon rainfall. The current situation highlights the urgent need for a comprehensive sewerage and drainage master plan, including the development of a centralized sewerage network and a Wastewater Treatment Plant (WWTP) to serve Nawagai's expanding urban population. This proposed system will ensure systematic collection, treatment, and environmentally safe disposal of wastewater in compliance with the National Environmental Quality Standards (NEQS 2023).

6.8.4.2 Rural Area Wise Existing and Proposed Water Demand of Nawagai

The rural settlements of Nawagai Tehsil predominantly rely on groundwater abstraction through hand pumps, dug wells, and small-scale community-operated water supply schemes. These decentralized sources remain the primary means of fulfilling domestic water needs,

particularly in dispersed and remote villages where piped supply systems are limited or absent.

Based on projected rural population and a per capita water demand of 15 GPCD, the average daily rural water requirement is estimated at 7.85 MGD in 2025, increasing to 15.54 MGD by 2045. Correspondingly, the maximum day demand is projected to rise from 11.78 MGD in 2025 to 23.31 MGD by 2045, while peak hour demand is expected to increase from 17.67 MGD to 35.0 MGD over the same period.

Given the highly scattered settlement pattern and the widespread reliance on individual groundwater sources, ensuring reliable and equitable access to safe drinking water is a major challenge. Future strategies should focus on groundwater conservation and recharge, expansion of small-scale piped distribution systems, and development of localized storage and disinfection facilities. These interventions will enhance supply reliability, ensure compliance with potable water standards, and support the long-term sustainability of rural water resources throughout Nawagai Tehsil.

Year	Rural Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	88,434	1.33	1.99	2.98
2030	99,460	1.49	2.24	3.36
2035	111,861	1.68	2.52	3.78
2040	125,808	1.89	2.83	4.25
2045	141,494	2.12	3.18	4.78

The analysis underscores the urgent need for integrated rural water supply planning to ensure equitable service coverage, address seasonal shortages, and enhance resilience against groundwater stress.

6.8.4.3 Proposed Water Supply System Nawagai Tehsil

To meet the projected water demand of Nawagai Tehsil—which comprises entirely rural settlements up to the year 2045, a phased, sustainable, and decentralized water supply system is proposed. The system design is based on a per capita consumption of 15 gallons per capita per day (GPCD), consistent with PHED design standards for rural areas.

The proposed framework incorporates maximum day and peak hour demand factors, ensuring sufficient capacity, operational flexibility, and reliable service delivery. This strategy is intended to accommodate future population growth, expand coverage to underserved villages, and enhance water security, while maintaining the long-term sustainability, efficiency, and resilience of the water supply network throughout Nawagai Tehsil.

6.8.4.4 Proposed Source (New Tube-Well)

- ***Design Basis***

Groundwater abstraction in Nawagai Tehsil will be guided by the sustainable yield potential of the local alluvial aquifer system, ensuring long-term groundwater security and balanced utilization across both rural and semi-urban areas.

The proposed future water supply system will predominantly depend on deep tube wells drawing from the alluvial aquifer, complemented by spring-fed intakes and boreholes in zones with suitable hydrogeological characteristics. To enhance energy efficiency and operational sustainability, solar-powered pumping systems will be adopted where feasible, thereby reducing dependence on grid electricity and supporting climate-resilient water supply operations throughout Nawagai Tehsil.

- ***Unit Well Capacity:***

Each production well is designed to deliver a continuous yield of 0.65 MGD (1 cusec), considering local hydrogeological conditions and typical discharge rates from existing boreholes. Adequate provision has been made for standby operation and scheduled maintenance to ensure reliability and uninterrupted supply.

- ***Service Objective:***

The water supply system for Nawagai Tehsil is designed to meet the projected average daily water demand of 8.26 MGD by 2045, incorporating a 15 percent redundancy margin to ensure uninterrupted service during operational downtime, peak-hour fluctuations, and emergency situations. This design framework supports a reliable, efficient, and climate-resilient water supply network, capable of accommodating the tehsil's expanding urban and rural population through 2045.

Stage	Implementation Period	Rural Demand to be Met (MGD)	New Production Wells*	Key Siting / Design Considerations
Immediate	2025 – 2030	up to 2	3 wells	Address immediate supply gaps in high-demand urban areas. Prioritize wells near existing community schemes and distribution networks. Consider solar-powered or energy-efficient pumping units where feasible; integrate with local overhead reservoirs (OHRs) for gravity-fed distribution.

Short-Term	2031 – 2035	up to 2.24	3 wells	Expand groundwater coverage to additional urban zones and peri-urban settlements. Integrate wells with new OHRs and distribution loops. Ensure proper fencing, access, and operation & maintenance (O&M) provisions..
Medium-Term	2036 – 2040	up to 2.52	4 wells	Tap deeper and more productive aquifer zones; implement groundwater recharge interventions (e.g., recharge trenches, infiltration wells) to maintain aquifer sustainability. Monitor yield and quality trends to guide phased drilling.
Long-Term	2041 – 2045	up to 3.2	5 wells	Strengthen system resilience through strategic well replacement and augmentation; extend service to unserved villages such as Samar Bagh, Tangi, and Kamar Sar. Coordinate well with regional OHRs for balanced pressure management and operational redundancy

6.8.4.5 Water Storage

- ***Rural Areas (VCs – 15 GPCD)***

For rural settlements in Nawagai Tehsil, smaller localized OHRs are proposed to ensure reliable and equitable service delivery. Each reservoir provides a 12-hour service buffer, reducing dependence on continuous pumping and mitigating the effects of power interruptions.

- ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	1.99	0.995	1.0 – 1.1
2030	2.24	1.119	1.2 – 1.3
2035	2.52	1.258	1.4 – 1.5
2040	2.83	1.415	1.5
2045	3.18	1.592	1.6 – 1.7

- ***Location and Configuration:***

For rural Nawagai Tehsil, priority locations for Overhead Reservoirs (OHRs) include major Village Councils such as Kashmir Kor, Khazina, Salarzai, Tangi, Samar Bagh, and Kamar Sar, along with other peripheral settlements to ensure equitable and reliable water distribution across dispersed rural communities.

Each OHR will be constructed as a modular reinforced concrete structure, allowing for phased expansion in accordance with population growth and rising water demand up to 2045. The reservoirs will incorporate inlet and outlet control systems, water level monitoring instruments, and maintenance access provisions to ensure operational efficiency, structural durability, and long-term sustainability of the rural water supply network.

6.8.4.6 Existing situation of the sanitation/drainage system in Tehsil Nawagai (Katcha, Pucca, open and covered etc.).

Wastewater generation in Nawagai Tehsil, has been estimated at 85% of the average daily water demand for the entirely rural population, with an additional 5% allowance for non-domestic usage such as small-scale commercial, institutional, and service-sector activities typical of rural settings.

For design purposes, the peak sewage flow has been considered as twice the average daily sewage flow, while stormwater inflow is assumed to be 50% of the peak sewage flow to account for incidental runoff and surface drainage entry during monsoon events. Infiltration losses have been included at 10% of the average sewage flow, consistent with the local hydrogeological and soil conditions.

Based on a per capita water demand of 15 gallons per capita per day (GPCD), the corresponding per capita sewage generation rate is derived as 7.5 GPCD, representing typical domestic wastewater production in rural areas.

As Nawagai Tehsil, has no urban settlements or centralized sewerage network, wastewater management will continue to rely on on-site sanitation systems, primarily consisting of two-chamber reinforced concrete septic tanks followed by soakage pits. These systems are recommended for all households and communal facilities to ensure safe, sustainable, and environmentally compliant wastewater disposal, while protecting groundwater quality and improving overall sanitation conditions across the tehsil:

- ***Rural Area Wise Existing and Proposed Wastewater Demand – Nawagai Tehsil, VCs***

In the rural villages of Khar, where household clusters are scattered and the terrain is uneven, a conventional gravity sewer network is neither economically nor technically feasible. Full-scale pipe sewers demand high capital investment, continuous flow velocities, and regular skilled maintenance requirements that are impractical in sparsely populated settlements.

Instead, decentralized on-site sanitation is recommended. A combination of household septic tanks with soakage pits (leach pits) provides a low-cost, low-maintenance, and

environmentally sound solution. This approach is well-suited to Barang's permeable sandy–gravel soils, which facilitate infiltration, and to the region's limited water availability.

Treatment Process

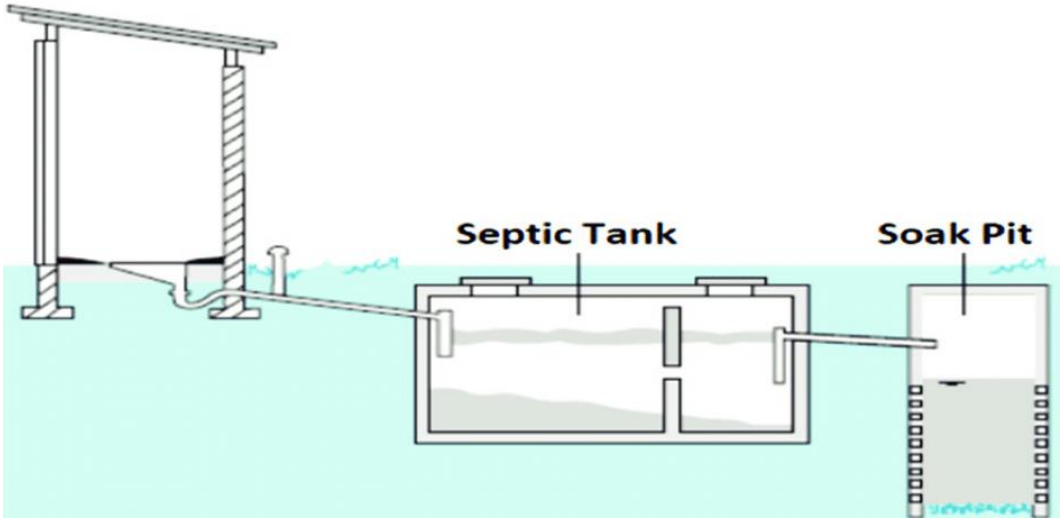
Wastewater from each dwelling enters a sealed septic tank, where solids settle to form sludge and lighter materials form a scum layer.

The clarified effluent passes to a soakage pit, where it percolates through the surrounding soil for further natural filtration and pathogen reduction.

Typical performance of a well-maintained system:

- Suspended Solids (TSS): 80–90 % removal
- Biochemical Oxygen Demand (BOD): 60–80 % reduction
- Pathogens: 80–90 % reduction
- Nutrients (N & P): 60–80 % reduction

This treatment level is adequate for protecting Barang's shallow aquifers and preventing nuisance conditions when tanks are properly sited and desludging.



Wastewater quality & Treatment Nawagai

The disposal of untreated wastewater into open drains, streams, and agricultural fields is a major cause of environmental degradation in Nawagai, contaminating both surface and groundwater resources. To address this challenge, a phased wastewater treatment strategy is proposed.

A centralized Wastewater Treatment Plant (WWTP) will be established near the Barang central plain, serving the urban NCs, while smaller decentralized treatment units (waste stabilization ponds or aerated lagoons) will be developed near rural clusters for VCs.

The WWTP design will follow international and national best practices, with process design based on average sewage flow and pollution loads, and hydraulic design based on peak flows. Treatment will target compliance with NEQS discharge limits (BOD < 80 mg/L, COD < 150 mg/L, TSS < 200 mg/L).

6.8.4.7 Design of Soakage pit & Septic tank

The capacity of soakage pits has been determined based on the daily effluent generation and required retention time, considering local soil permeability and infiltration characteristics

Retention days for pit = 2 days

Void ratio = 0.35.

Recommended pit diameters

Calculated required gross pit volumes and approximate circular pit diameters for two practical depths (1.5 m and 2.0 m):

Household	Gross pit vol (m^3)	Gross vol (L)	Diameter for depth = 1.5 m (m)	Diameter for depth = 2.0 m (m)
4 p	0.993 m^3	993 L	0.92 m	0.80 m
6 p	1.489 m^3	1,489 L	1.12 m	0.97 m
8 p	1.986 m^3	1,986 L	1.30 m	1.12 m
10 p	2.482 m^3	2,482 L	1.45 m	1.26 m

Practical recommendation: use a cylindrical pit Dia 1.0–1.5 m and depth 1.5–2.0 m depending on household size/percolation — e.g.

4–6 persons = Ø 1.0 m, depth 1.5–2.0 m

8–10 persons = Ø 1.2–1.5 m, depth 1.5–2.0 m

6.8.4.8 Construction & installation

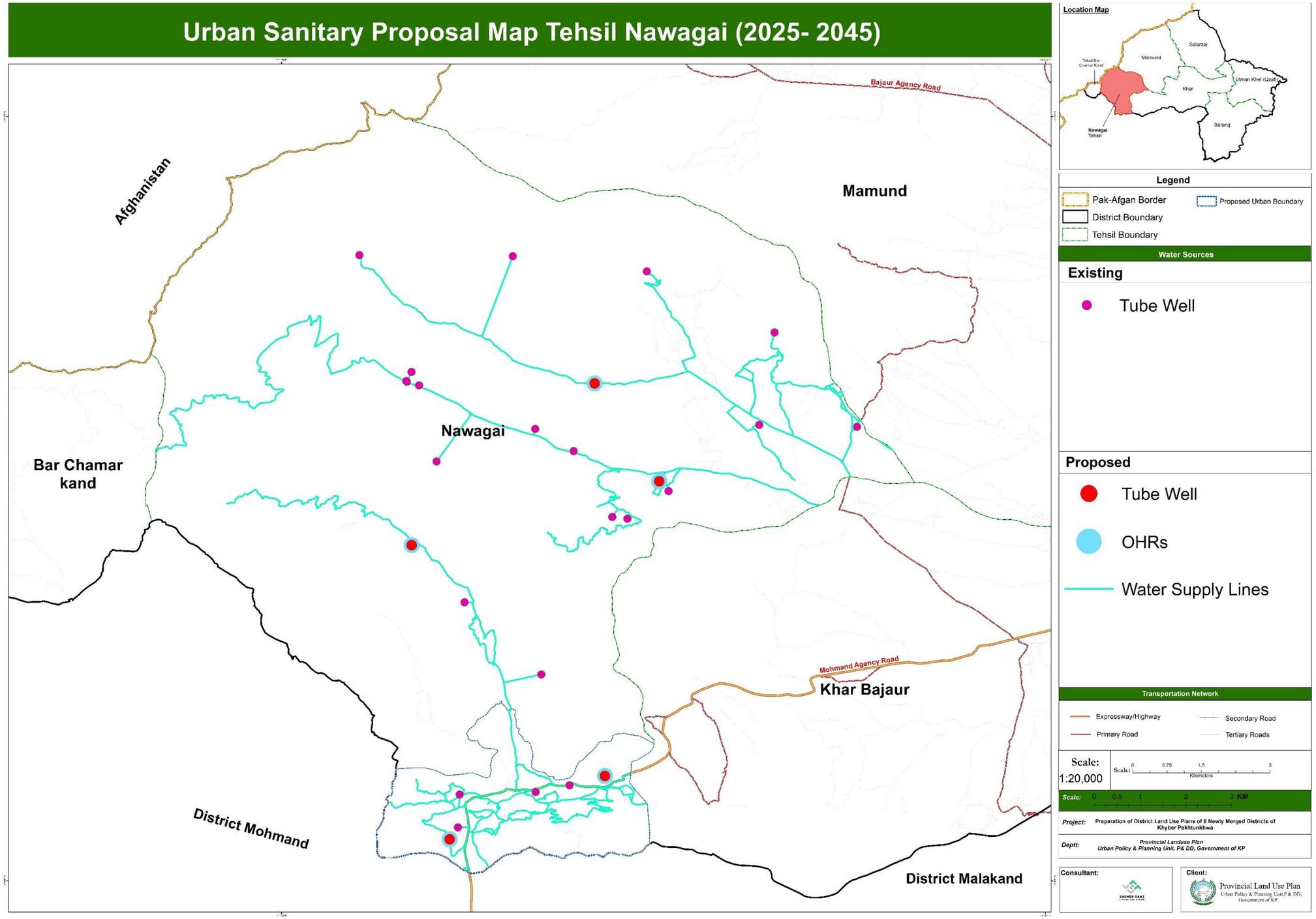
Each household within Nawagai Tehsil, rural settlements will be equipped with an independent on-site sanitation system consisting of a two-chamber reinforced concrete septic tank followed by a soakage pit. The septic tank will be designed with inlet and outlet baffles, manhole covers for periodic desludging and inspection, and adequate structural reinforcement and waterproofing to ensure durability and watertight performance. The inlet invert level shall be maintained approximately 150 mm below the outlet invert to promote uniform flow and effective sedimentation of solids.

Effluent from the outlet chamber will be directed to a distribution box or soakage pit, provided with a mosquito-proof vent to prevent vector breeding. Desludging operations shall be carried out every 3 to 5 years, depending on sludge accumulation and household water usage patterns.

The soakage pit will be filled with graded coarse aggregate (void ratio ≈ 0.35) and lined with geotextile fabric to minimize siltation and ensure long-term infiltration efficiency. The pit shall be located at least 10 metres away from any drinking water source, with a preferred separation of 15–30 metres and placed downslope of wells or boreholes to prevent groundwater contamination. A minimum vertical clearance of 1.0 metre shall be maintained between the pit bottom and the seasonal high groundwater table. Each pit will include a reinforced concrete collar and an inspection cover to prevent surface water ingress and facilitate maintenance.

This decentralized on-site sanitation system offers a safe, cost-effective, and environmentally sustainable wastewater management solution tailored to the rural context of Mamund Tehsil, where the absence of a centralized sewerage network and the scattered settlement pattern make individual household systems the most practical and hygienic option.

Map 52: Proposed Urban Sanitary - Tehsil Nawagai



6.8.5 Salarzai Tehsil

6.8.5.1 Existing coverage of the water supply/gaps in demand in Salarzai.

The Salarzai Urban Centre relies on a combination of government-operated and community-based water supply schemes, primarily solar-powered tube wells, with a few electrically operated units. Operational hours typically range between 6–8 hours per day, delivering discharges of approximately 2,000–4,000 GPH. While most schemes are functional, some, such as WSS Salarzai Bazar and WSS Dargai, are partially non-functional, affecting the reliability and consistency of service. Currently, only ~30% of the urban population has access to piped water, leaving a significant portion unserved due to coverage gaps and aging infrastructure.

The existing sewage and drainage system is largely unplanned and inadequate, consisting of open, undersized drains prone to overflow. Wastewater is often discharged directly into open drains or streets, causing unsanitary conditions. The lack of a formal sewerage network has resulted in the widespread use of household septic tanks and soakage pits, which, when poorly designed or located, risk groundwater contamination.

Stormwater management along major thoroughfares, such as Salarzai Khwazakhel Road and Inner Salarzai Bazaar, is compromised by clogged drains and insufficient capacity, leading to urban flooding during heavy rainfall. The overall lack of an integrated WATSAN system underscores the need for a comprehensive and sustainable approach in Salarzai Tehsil

6.8.5.2 Urban Area Wise Existing and Proposed Water Demand of Salarzai

The urban centre of Salarzai currently depends on a combination of tube wells, overhead reservoirs (OHRs), and localized distribution networks, operated by both government and community-based organizations. These systems provide the primary source of water to urban residents but face several operational challenges. Limited operational hours, aging infrastructure, and partial network coverage result in intermittent water supply, particularly during peak demand periods and periods of high population use.

With Salarzai's urban population projected to increase from 24,518 in 2025 to 45,851 by 2045, the average daily water demand is expected to grow from 0.86 MGD in 2025 to 1.60 MGD in 2045. Maximum day and peak-hour demands are projected to increase from 1.29 MGD to 2.41 MGD and 1.93 MGD to 3.61 MGD, respectively. This reflects the combined effects of population growth and urban expansion, highlighting the critical need for system expansion, modernization, and operational improvements.

The sewerage and drainage network in Salarzai remains underdeveloped, largely consisting of open drains with inadequate capacity and poor gradients. Many drains are damaged or silted, and wastewater is frequently discharged into open plots or natural depressions, creating unsanitary conditions and localized environmental hazards. In the absence of a centralized

sewerage network, most households rely on individual septic tanks and soakage pits, contributing to groundwater contamination.

The limited stormwater drainage system along major roads is insufficient, often resulting in urban flooding during rainfall events. Overall, Salarzai's water supply and sanitation infrastructure requires significant upgrades, including expansion of piped water networks, modernization of tube wells and OHRs, and development of a comprehensive sewerage and drainage system, including a centralized Wastewater Treatment Plant (WWTP) to ensure safe and sustainable water and wastewater management.

Year	Urban Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	24,518	0.86	1.29	1.93
2030	28,672	1.00	1.51	2.26
2035	33,529	1.17	1.76	2.64
2040	39,209	1.37	2.06	3.09
2045	45,851	1.60	2.41	3.61

The current system comprises a mix of tube wells, OHRs, and localized distribution networks operated by government and community organizations. Constraints such as limited operational hours, aging infrastructure, and partial coverage result in intermittent supply. Expansion and modernization of infrastructure are essential to meet projected demand.

6.8.5.3 Rural Area Wise Existing and Proposed Water Demand of Salarzai

The rural settlements of Salarzai Tehsil primarily rely on groundwater abstraction through hand pumps, shallow wells, and small community-operated water supply schemes. These decentralized sources constitute the main means of meeting domestic water requirements, particularly in dispersed and remote villages where piped water systems are limited or absent.

Based on a per capita demand of 15 gallons per capita per day (GPCD), the average daily rural water demand in Salarzai is projected to increase from 4.22 MGD in 2025 to 7.89 MGD by 2045. Maximum day and peak hour demands are expected to rise from 6.33 MGD to 11.83 MGD and 9.49 MGD to 17.75 MGD, respectively, reflecting population growth and increasing water requirements.

The scattered nature of rural settlements and reliance on individual or community-based groundwater sources presents challenges in ensuring reliable, equitable, and safe water supply. Future water supply planning should therefore focus on:

Groundwater sustainability and recharge interventions to maintain long-term aquifer health.

Expansion and improvement of small-scale piped water systems to provide better coverage.

Construction of localized storage and treatment facilities, including overhead reservoirs and simple disinfection units, to ensure continuous supply and potable water quality.

Given the scattered rural settlement pattern, the existing reliance on individual and communal groundwater sources poses challenges in ensuring equitable and continuous supply. Therefore, future planning must focus on improving groundwater sustainability, expanding small-scale piped systems, and introducing localized storage and treatment facilities to enhance water reliability, quality, and service coverage across all rural villages of Salarzai Tehsil.

Year	Rural Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	281,180	4.22	6.33	9.49
2030	328,815	4.93	7.40	11.10
2035	384,520	5.77	8.65	12.98
2040	449,662	6.74	10.12	15.18
2045	525,840	7.89	11.83	17.75

The analysis underscores the urgent need for integrated rural water supply planning to ensure equitable service coverage, address seasonal shortages, and enhance resilience against groundwater stress.

6.8.5.4 Proposed Water Supply System Salarzai Tehsil

To meet projected urban and rural water demand up to 2045, a phased and sustainable water supply system is proposed. Design standards adopt 35 GPCD for urban and 15 GPCD for rural areas, incorporating maximum day and peak hour factors to ensure reliability and resilience.

- ***Proposed Sources New Tube Wells:***

Groundwater abstraction from the alluvial aquifer of Salarzai is based on safe yield, ensuring long-term sustainability. Deep and shallow tube wells will be strategically located, supplemented by spring intakes where feasible. Solar-powered pumping units will be installed where practical to enhance energy efficiency.

- ***Unit Well Capacity:***

Each well is designed for 0.65 MGD (1 cusec) with standby capacity and scheduled maintenance for uninterrupted supply.

- ***Service Objective:***

The system aims to meet urban demand of 0.62 MGD and rural demand of 7.11 MGD by 2045, with a 15% redundancy margin to accommodate peak flows, operational downtime, and emergencies.

Stage	Implementation Period	Urban Demand to be Met (MGD)	New Production Wells*	Key Siting/Design Considerations
Immediate	2025 – 2030	up to 1.29	2	Reduce deficits in high-population villages; cluster wells near existing intakes; use solar-powered units where feasible.
Short-Term	2031 – 2035	up to 1.76	3	Expand coverage to dispersed villages; integrate wells with local OHRs and distribution rings.
Medium-Term	2036 – 2040	up to 2.06	3	Tap deeper aquifers; implement artificial recharge measures; stagger drilling to monitor impact.
Long-Term	2041 – 2045	up to 2.41	4	Strategic replacement/augmentation; expand to remaining villages; coordinate with OHR network for peak management.

Stage	Implementation Period	Rural Demand to be Met (MGD)	New Production Wells*	Key Siting / Design Considerations
Immediate	2025 – 2030	up to 7.4	12	Reduce deficits in high-population villages; cluster wells near existing intakes; use solar-powered units where feasible.
Short-Term	2031 – 2035	up to 8.65	14	Expand coverage to dispersed villages; integrate wells with local OHRs and distribution rings.
Medium-Term	2036 – 2040	up to 10.12	16	Tap deeper aquifers; implement artificial recharge measures; stagger drilling to monitor impact.
Long-Term	2041 – 2045	up to 11.83	18	Strategic replacement/augmentation; expand to remaining villages; coordinate with OHR network for peak management.

6.8.5.5 Water Storage

- ***Urban Areas (VCs – 35 GPCD)***

For Salarzai Urban Centre, overhead reservoirs (OHRs) are proposed to ensure consistent supply, operational flexibility, and adequate storage for emergency and maintenance situations. The OHRs are designed to maintain a 12-hour buffer, allowing for peak-hour fluctuations and power interruptions.

- ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.

- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	1.29	0.644	1
2030	1.51	0.753	1
2035	1.76	0.880	1
2040	2.06	1.029	1
2045	2.41	1.204	1.3

6.8.5.6 Location and Configuration

Central Salarzai, Salarzai Bazar, Dargai, and nearby densely populated zones to ensure uniform pressure and supply.

- ***Rural Areas (VCs – 15 GPCD)***

For rural settlements in Salarzai Tehsil, smaller localized OHRs are proposed to ensure reliable and equitable service delivery. Each reservoir provides a 12-hour service buffer, reducing dependence on continuous pumping and mitigating the effects of power interruptions.

- ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

Phased Capacities (based on projected demand):

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	6.33	3.163	3.0–3.2
2030	7.40	3.699	3.4–3.6
2035	8.65	4.326	4.0–4.3
2040	10.12	5.059	4.6–5.3
2045	11.83	5.916	5.3–6.0

- ***Location and Configuration:***

Localized reservoirs in priority VCs (e.g., Salarzai Kor, Panjkora, Chambarai) for equitable service.

Modular reinforced concrete structures with inlet/outlet control, water level monitoring, and maintenance access.

6.8.5.7 Existing situation of the sanitation/drainage system in Tehsil Salarzai (Katcha, Pucca, open and covered etc.).

Wastewater generation in Salarzai Tehsil has been estimated based on 85% of the average daily water demand for both urban and rural populations, with an additional 5% allowance for non-domestic usage such as small-scale commercial, institutional, and service-sector activities.

For hydraulic design purposes, peak sewage flow has been taken as twice the average daily sewage flow, while stormwater inflow has been considered as 50% of the peak sewage flow to account for incidental runoff and surface drainage entry into the system during monsoon conditions. Infiltration losses are assumed at 10% of the average sewage flow, consistent with local soil permeability and groundwater conditions.

Based on per capita water demand values of 35 GPCD for urban and 15 GPCD for rural populations, the corresponding per capita sewage generation rates are derived as 25.5 GPCD for urban areas and 7.5 GPCD for rural areas, respectively. These rates reflect typical domestic wastewater production and are used for the design of localized sanitation systems across Khar Tehsil.

Given the dispersed settlement pattern in rural areas and partial coverage of the urban centre, wastewater management will primarily rely on a combination of household septic tanks with soakage pits in rural zones and gradual development of a sewerage network with decentralized treatment units in the urban core of Khar:

Rural Area Wise Existing and Proposed Wastewater Demand – Salarzai:

Year	Urban Population	Average Water Demand (MGD)	Wastewater Generation @ (85% + 5%) (MGD)	Peak Sewage Flow (MGD)	Stormwater Inflow (50% of Peak) (MGD)	Total Design Flow (MGD)
2025	24,518	0.37	0.33	0.66	0.33	0.99
2030	28,672	0.43	0.39	0.77	0.39	1.16
2035	33,529	0.50	0.45	0.91	0.45	1.36
2040	39,209	0.59	0.53	1.06	0.53	1.59
2045	45,851	0.69	0.62	1.24	0.62	1.86

In the rural villages of Khar, where household clusters are scattered and the terrain is uneven, a conventional gravity sewer network is neither economically nor technically feasible. Full-scale pipe sewers demand high capital investment, continuous flow velocities, and regular skilled maintenance requirements that are impractical in sparsely populated settlements.

Instead, decentralized on-site sanitation is recommended. A combination of household septic tanks with soakage pits (leach pits) provides a low-cost, low-maintenance, and environmentally sound solution. This approach is well-suited to Barang's permeable sandy–gravel soils, which facilitate infiltration, and to the region's limited water availability.

- ***Treatment Process***

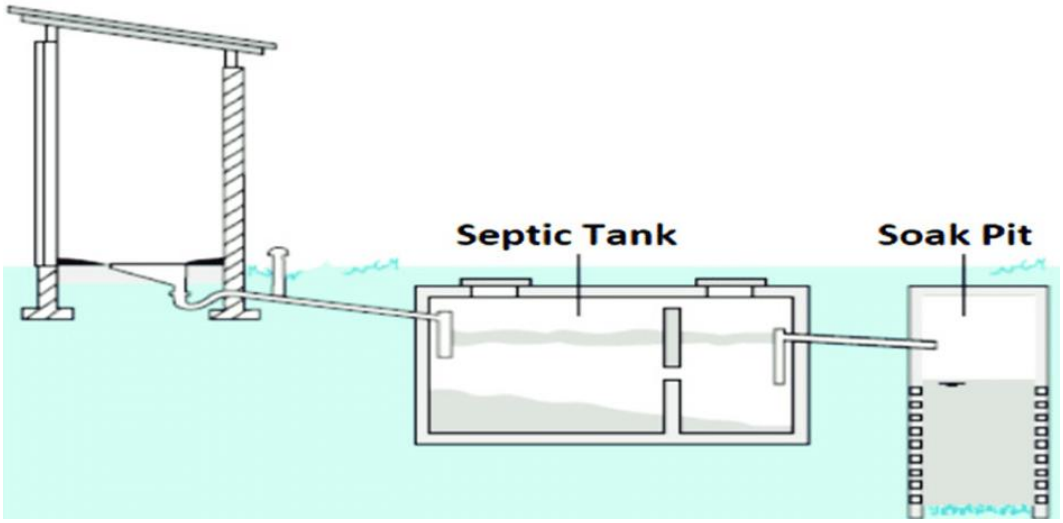
Wastewater from each dwelling enters a sealed septic tank, where solids settle to form sludge and lighter materials form a scum layer.

The clarified effluent passes to a soakage pit, where it percolates through the surrounding soil for further natural filtration and pathogen reduction.

Typical performance of a well-maintained system:

- Suspended Solids (TSS): 80–90 % removal
- Biochemical Oxygen Demand (BOD): 60–80 % reduction
- Pathogens: 80–90 % reduction
- Nutrients (N & P): 60–80 % reduction

This treatment level is adequate for protecting Barang's shallow aquifers and preventing nuisance conditions when tanks are properly sited and desludging.



6.8.5.8 Design of Soakage pit & Septic tank

The capacity of soakage pits has been determined based on the daily effluent generation and required retention time, considering local soil permeability and infiltration characteristics

Retention days for pit = 2 days

Void ratio = 0.35.

Recommended pit diameters

Calculated required gross pit volumes and approximate circular pit diameters for two practical depths (1.5 m and 2.0 m):

Practical recommendation: use a cylindrical pit Dia 1.0–1.5 m and depth 1.5–2.0 m depending on household size/percolation — e.g.

4–6 persons = Ø 1.0 m, depth 1.5–2.0 m

8–10 persons = Ø 1.2–1.5 m, depth 1.5–2.0 m

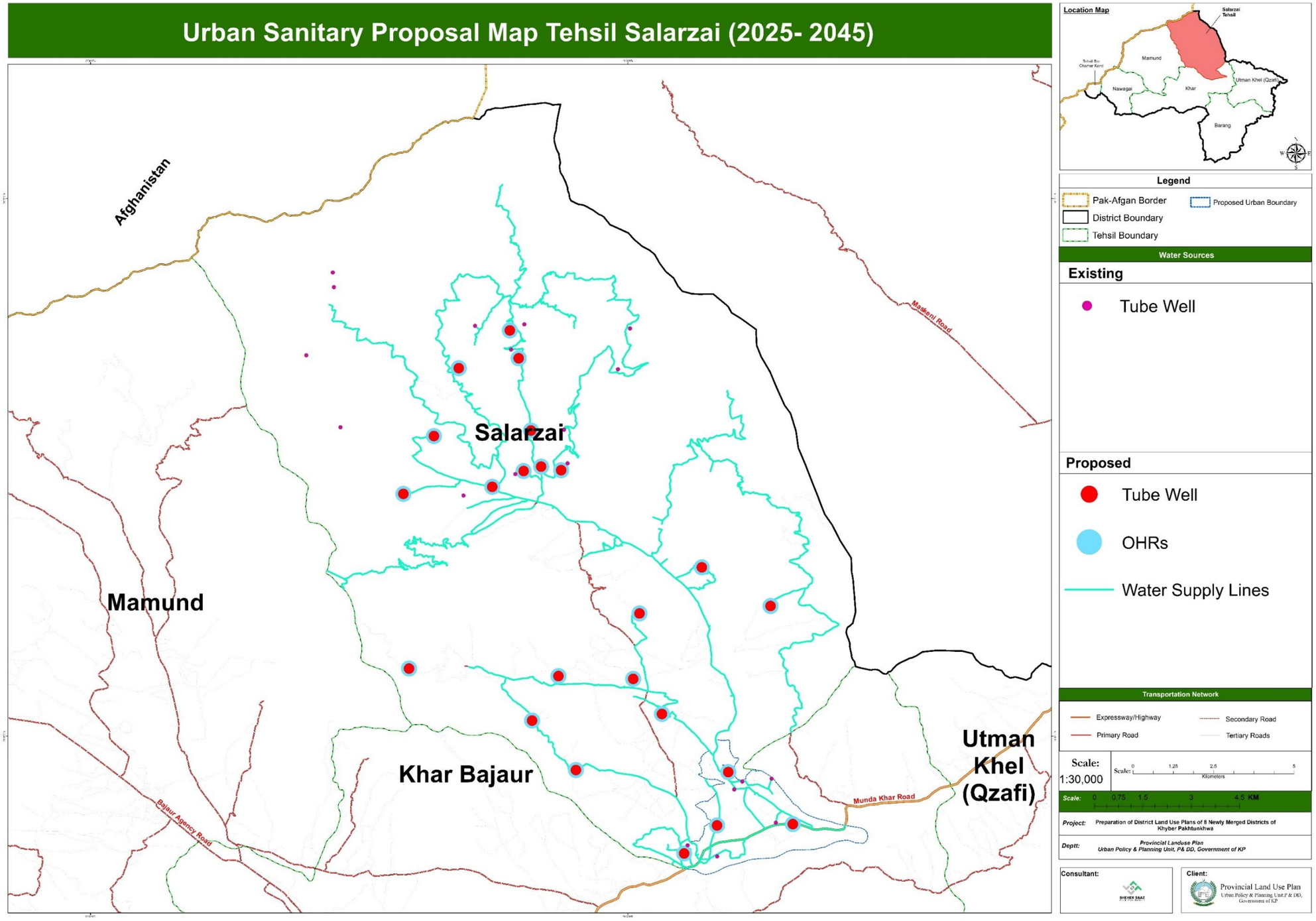
6.8.5.9 Construction & installation

Each household within Salarzai Tehsil's rural settlements will be provided with an independent on-site sanitation system, consisting of a two-chamber reinforced concrete septic tank followed by a soakage pit. The septic tank will be equipped with inlet and outlet baffles, manhole covers for desludging and inspection, and a structurally robust, waterproofed cover to ensure long-term durability. The inlet invert will be positioned approximately 150 mm below the outlet invert to maintain proper hydraulic flow and efficient sedimentation. Effluent from the outlet chamber will discharge into a distribution box or soakage pit, which will include a mosquito-proof vent to prevent vector breeding. Desludging should be carried out every 3 to 5 years, depending on sludge accumulation and household usage.

The soakage pit will be filled with graded coarse aggregate (void ratio 0.35) and lined with geotextile fabric to prevent siltation and ensure long-term infiltration. Pits should be located at least 10 metres from any drinking water source, preferably 15–30 metres away and positioned downslope of wells or boreholes to prevent contamination. A minimum vertical clearance of 1.0 metre must be maintained between the pit base and the seasonal high groundwater table. Each pit will include a reinforced concrete collar and inspection access to prevent surface infiltration and facilitate maintenance.

This decentralized on-site sanitation system offers a safe, sustainable, and low-maintenance wastewater management solution, well-suited to the dispersed rural communities of Salarzai Tehsil, where centralized sewerage infrastructure is neither practical nor economically feasible.

Map 53: Proposed Urban Sanitary Map - Tehsil Salarzai



6.8.6 Utman Khel Tehsil

6.8.6.1 Existing coverage of the water supply/gaps in demand in Utman Khel Tehsil

The rural settlements of Utman Khel Tehsil primarily rely on groundwater abstraction through hand pumps, shallow wells, and small community-operated water schemes. Operational reliability is limited by intermittent pumping, aging infrastructure, and scattered settlement patterns. Currently, there is no centralized piped water supply system, and many villages experience gaps in access, especially during peak demand periods or dry seasons.

Sanitation and drainage infrastructure in Tehsil is largely unplanned and inadequate. Open drains are common in denser village clusters, often resulting in overflow during rainfall events. Wastewater is frequently discharged into open drains or onto the ground, creating unsanitary conditions. In rural zones, households depend on individual septic tanks with soakage pits, though improper siting or construction may pose a risk to shallow groundwater sources.

The dispersed nature of settlements and lack of integrated WATSAN systems highlight the urgent need for sustainable, decentralized water supply and sanitation solutions in Utman Khel Tehsil.

6.8.6.2 Rural Area Wise Existing and Proposed Water Demand of Utman Khel Tehsil

The urban centre of Utman Khel Tehsil currently relies on a combination of tube wells, overhead reservoirs (OHRs), and localized distribution networks managed by government and community organizations. Most systems remain operational, but limited operating hours, aging infrastructure, and partial network coverage result in intermittent and unreliable water supply. Based on a per capita demand of 35 GPCD, the average daily urban water demand is projected to increase from 1.91 MGD in 2025 to 3.36 MGD by 2045, while maximum day and peak hour demands are expected to rise from 2.86 MGD to 5.05 MGD and 4.29 MGD to 7.57 MGD, respectively. This growth reflects ongoing population increases and urban expansion. To meet the projected demand, expansion and modernization of infrastructure are essential, including additional tube wells, OHRs, and looped distribution networks. Integration of solar-powered pumping systems, phased augmentation of storage, and improved operational management will ensure reliable, efficient, and sustainable water supply for the urban population through 2045.

Year	Urban Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	127,112	1.91	2.86	4.29
2030	146,506	2.20	3.30	4.94
2035	168,860	2.53	3.80	5.70
2040	194,624	2.92	4.38	6.57
2045	224,319	3.36	5.05	7.57

The current system comprises a mix of tube wells, OHRs, and localized distribution networks operated by government and community organizations. Constraints such as limited operational hours, aging infrastructure, and partial coverage result in intermittent supply. Expansion and modernization of infrastructure are essential to meet projected demand.

6.8.6.3 Proposed Water Supply System Utman Khel Tehsil

To meet projected urban and rural water demand up to 2045, a phased and sustainable water supply system is proposed. Design standards adopt 35 GPCD for urban and 15 GPCD for rural areas, incorporating maximum day and peak hour factors to ensure reliability and resilience.

- ***Proposed Sources New Tube Wells:***

Groundwater abstraction from the alluvial aquifer of Utman Khel Tehsil is based on safe yield, ensuring long-term sustainability. Deep and shallow tube wells will be strategically located, supplemented by spring intakes where feasible. Solar-powered pumping units will be installed where practical to enhance energy efficiency.

- ***Unit Well Capacity:***

Each well is designed for 0.65 MGD (1 cusec) with standby capacity and scheduled maintenance to ensure continuous supply.

- ***Service Objective:***

The system aims to meet rural demand of 5.05 MGD by 2045, with a 15% redundancy margin to accommodate peak flows, operational downtime, and emergencies.

Stage	Implementation Period	Demand to be Met (MGD)	New Production Wells*	Key Siting/Design Considerations
Immediate	2025 – 2030	3.30	5	Reduce deficits in high-population villages; cluster wells near existing intakes; use solar units where feasible.
Short-Term	2031 – 2035	3.80	6	Expand coverage to dispersed villages; integrate wells with local storage.
Medium-Term	2036 – 2040	4.38	7	Tap deeper aquifers; implement artificial recharge measures; stagger drilling to monitor impacts.
Long-Term	2041 – 2045	5.05	8	Strategic replacement/augmentation; expand to remaining villages; coordinate with storage network for peak management.

6.8.6.4 Water Storage

- ***Rural Areas (VCs – 15 GPCD)***

Utman Khel Localized Overhead Reservoirs (OHRs) are proposed for equitable service delivery, providing a 12-hour service buffer to reduce dependence on continuous pumping and mitigate the effects of power interruptions.

- ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	2.86	1.430	1.5–1.55
2030	3.30	1.648	1.7–1.75
2035	3.80	1.900	1.9–2.0
2040	4.38	2.190	2.2–2.25
2045	5.05	2.524	2.5-3.0

- ***Location and Configuration:***

Localized reservoirs to be installed in priority villages for equitable service (e.g., Utman Khel Kor, Chinarai, and Khelai). Modular reinforced concrete structures with inlet/outlet control, water level monitoring, and maintenance access.

6.8.6.5 Existing situation of the sanitation/drainage system in Tehsil Utman Khel (Katcha, Pucca, open and covered etc.).

Wastewater generation has been estimated at 85% of water demand for domestic use, with an additional 5% allowance for small-scale commercial or institutional activity. Peak sewage flow is considered twice the average, and stormwater inflow is 50% of peak flow. Infiltration losses are assumed at 10%.

Given the dispersed rural settlement pattern, wastewater management will rely primarily on household septic tanks with soakage pits. Centralized sewerage is not feasible due to low population density and scattered settlements.

Based on per capita water demand values of 35 GPCD for urban and 15 GPCD for rural populations, the corresponding per capita sewage generation rates are derived as 25.5 GPCD for urban areas and 7.5 GPCD for rural areas, respectively. These rates reflect typical domestic wastewater production and are used for the design of localized sanitation systems across Khar Tehsil.

Given the dispersed settlement pattern in rural areas and partial coverage of the urban centre, wastewater management will primarily rely on a combination of household septic tanks with

soakage pits in rural zones and gradual development of a sewerage network with decentralized treatment units in the urban core of Khar:

Rural Area Wise Existing and Proposed Wastewater Demand – Utman Khel Tehsil:

Year	Urban Population	Average Water Demand (MGD)	Wastewater Generation @ (85% + 5%) (MGD)	Peak Sewage Flow (MGD)	Stormwater Inflow (50% of Peak) (MGD)	Total Design Flow (MGD)
2025	119,973	1.8	1.62	3.24	1.62	4.86
2030	135,405	2.03	1.83	3.66	1.83	5.49
2035	152,821	2.29	2.06	4.12	2.06	6.18
2040	172,478	2.59	2.33	4.66	2.33	6.99
2045	194,663	2.92	2.63	5.26	2.63	7.89

- ***Wise Existing and Proposed Wastewater Demand – Utman Khel Tehsil VCs***

In the rural villages of Utman Khel, where household clusters are scattered and the terrain is uneven, a conventional gravity sewer network is neither economically nor technically feasible. Full-scale pipe sewers demand high capital investment, continuous flow velocities, and regular skilled maintenance requirements that are impractical in sparsely populated settlements.

Instead, decentralized on-site sanitation is recommended. A combination of household septic tanks with soakage pits (leach pits) provides a low-cost, low-maintenance, and environmentally sound solution. This approach is well-suited to Barang's permeable sandy–gravel soils, which facilitate infiltration, and to the region's limited water availability.

- ***Treatment Process***

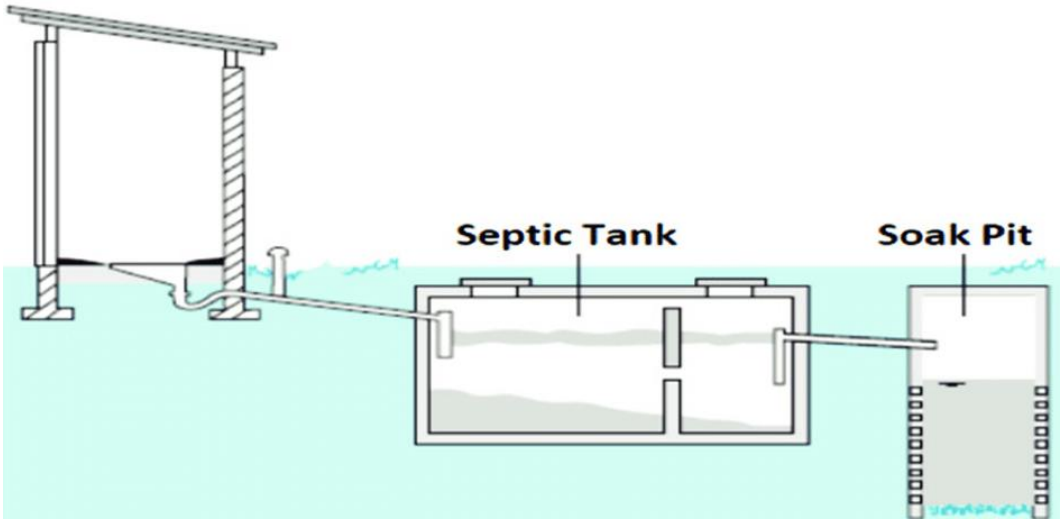
Wastewater from each dwelling enters a sealed septic tank, where solids settle to form sludge and lighter materials form a scum layer.

The clarified effluent passes to a soakage pit, where it percolates through the surrounding soil for further natural filtration and pathogen reduction.

Typical performance of a well-maintained system:

- Suspended Solids (TSS): 80–90 % removal
- Biochemical Oxygen Demand (BOD): 60–80 % reduction
- Pathogens: 80–90 % reduction
- Nutrients (N & P): 60–80 % reduction

This treatment level is adequate for protecting Barang's shallow aquifers and preventing nuisance conditions when tanks are properly sited and desludging.



6.8.6.6 Design of Soakage pit & Septic tank

The capacity of soakage pits has been determined based on the daily effluent generation and required retention time, considering local soil permeability and infiltration characteristics

Retention days for pit = 2 days

Void ratio = 0.35.

Recommended pit diameters

Calculated required gross pit volumes and approximate circular pit diameters for two practical depths (1.5 m and 2.0 m):

Household	Gross pit vol (m^3)	Gross vol (L)	Diameter for depth = 1.5 m (m)	Diameter for depth = 2.0 m (m)
4 p	0.993 m^3	993 L	0.92 m	0.80 m
6 p	1.489 m^3	1,489 L	1.12 m	0.97 m
8 p	1.986 m^3	1,986 L	1.30 m	1.12 m
10 p	2.482 m^3	2,482 L	1.45 m	1.26 m

Practical recommendation: use a cylindrical pit Dia 1.0–1.5 m and depth 1.5–2.0 m depending on household size/percolation — e.g.

4–6 persons = Ø 1.0 m, depth 1.5–2.0 m

8–10 persons = Ø 1.2–1.5 m, depth 1.5–2.0 m

6.8.6.7 Construction & installation

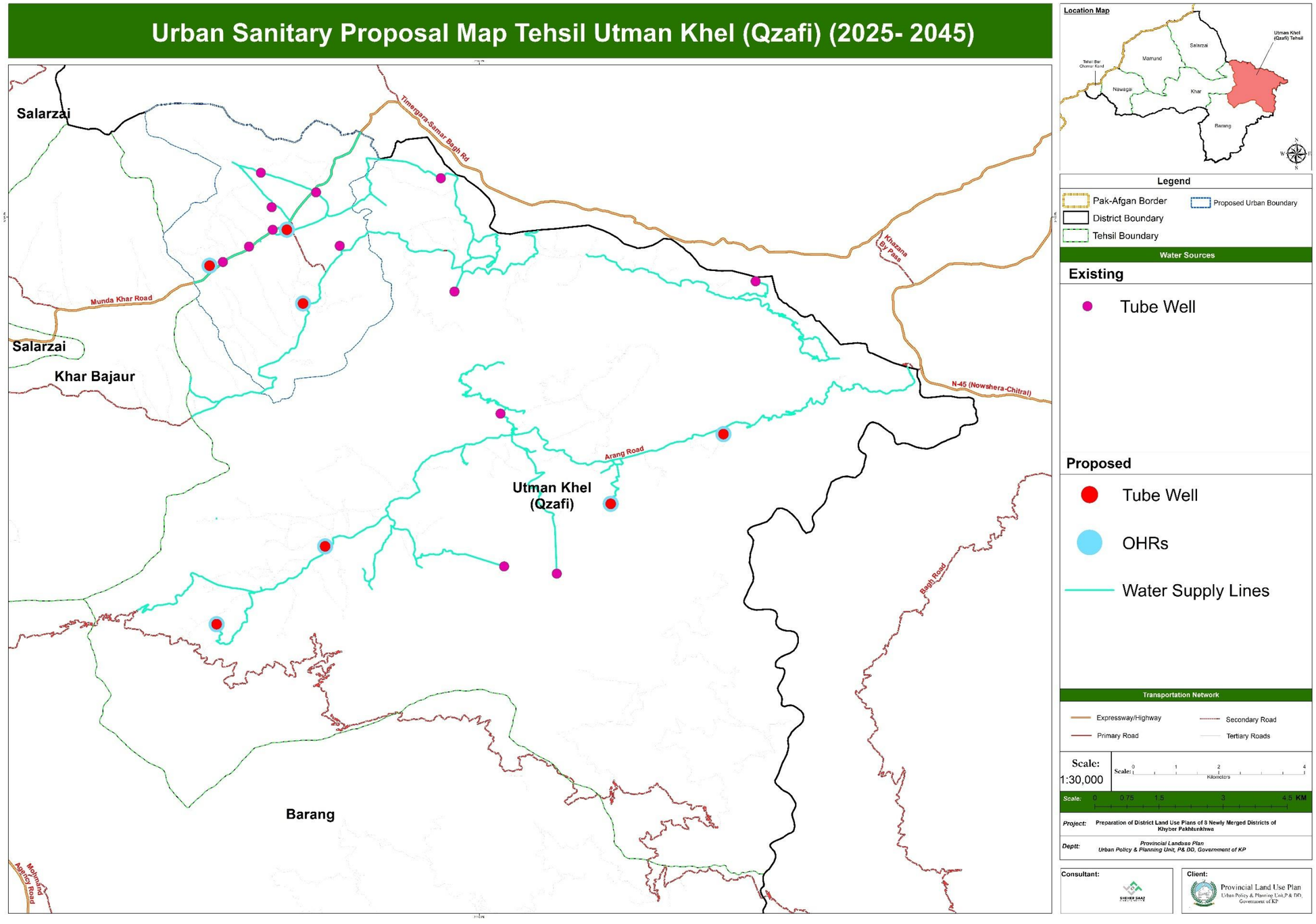
Each household within Utman Khel Tehsil's rural settlements will be provided with an independent on-site sanitation system, consisting of a two-chamber reinforced concrete

septic tank followed by a soakage pit. The septic tank will be equipped with inlet and outlet baffles, manhole covers for desludging and inspection, and a structurally robust, waterproofed cover to ensure long-term durability. The inlet invert will be positioned approximately 150 mm below the outlet invert to maintain proper hydraulic flow and efficient sedimentation. Effluent from the outlet chamber will discharge into a distribution box or soakage pit, which will include a mosquito-proof vent to prevent vector breeding. Desludging should be carried out every 3 to 5 years, depending on sludge accumulation and household usage.

The soakage pit will be filled with graded coarse aggregate (void ratio 0.35) and lined with geotextile fabric to prevent siltation and ensure long-term infiltration. Pits should be located at least 10 metres from any drinking water source, preferably 15–30 metres away and positioned downslope of wells or boreholes to prevent contamination. A minimum vertical clearance of 1.0 metre must be maintained between the pit base and the seasonal high groundwater table. Each pit will include a reinforced concrete collar and inspection access to prevent surface infiltration and facilitate maintenance.

This decentralized on-site sanitation system offers a safe, sustainable, and low-maintenance wastewater management solution, well-suited to the dispersed rural communities of Salarzai Tehsil, where centralized sewerage infrastructure is neither practical nor economically feasible.

Map 54: Proposed Urban Sanitary Map - Tehsil Utman Khel



6.9 SOLID WASTE MANAGEMENT

6.9.1 The existing condition of Solid Waste management exists in the settlement.

The solid waste management situation in District Bajaur mirrors the challenges prevalent in many developing areas, marked by substantial issues in managing and processing waste. Solid waste in Bajaur encompasses various types, including residential, commercial, industrial, and agricultural waste, with major contributors being urban centers such as Khar and Inayat Killi. Currently, waste management in these areas lacks the advanced recycling techniques found in more developed regions. Instead, waste disposal practices predominantly involve dumping in open spaces or designated dumpsites, leading to severe environmental repercussions such as soil contamination and potential harm to groundwater supplies.

The condition of waste disposal sites in Bajaur reveals noticeable environmental impacts, with changes in soil texture and composition compared to unaffected areas. The absence of a formal waste management system exacerbates these issues, as garbage is often discarded in roadside areas or open spaces in villages. The waste in Bajaur contains high levels of organic matter, especially in Khar and Inayat Killi. Plastic waste is consistently high across all monitored sites. Other components such as paper, glass, clothes, and metals are present in relatively uniform concentrations, though slightly lower concentrations of paper waste were noted in Sadiq Abad. The presence of heavy metals in the waste further exacerbates environmental concerns, affecting soil chemistry and potentially impairing plant growth. Addressing these issues is crucial for improving waste management practices in Bajaur and mitigating the associated environmental impacts.

In the primary urban center of Khar, the Tehsil Municipal Administration (TMA) is tasked with collection, transportation, and disposal, but faces severe constraints due to a lack of manpower, essential equipment, and financial resources. This results in an insufficient system where only 30-40% of waste is collected. The remaining waste accumulates on roads and streets and is often burned in the open, leading to air pollution and health hazards. The collection process relies on wheelbarrows and hand carts for primary collection and tractors and dumper trucks for secondary collection. The situation is inadequate, with only one authorized waste dumping site and no proper facilities to handle hazardous effluents from hospitals.

The survey findings highlight significant gaps in SWM and overall cleanliness across the Bajaur region. As illustrated in Figure 1, 65.92 percent of the assessed areas were reported as “cleaned,” while 34.08 percent remained “not cleaned.” This distribution underscores systemic challenges in municipal solid waste collection, disposal, and monitoring, with implications for public health, environmental sustainability, and community well-being. The data points to the urgent need for targeted investments in SWM infrastructure, strengthened capacity of municipal authorities, and the promotion of community-led cleanliness initiatives. Addressing these service delivery gaps will not only improve environmental outcomes but also

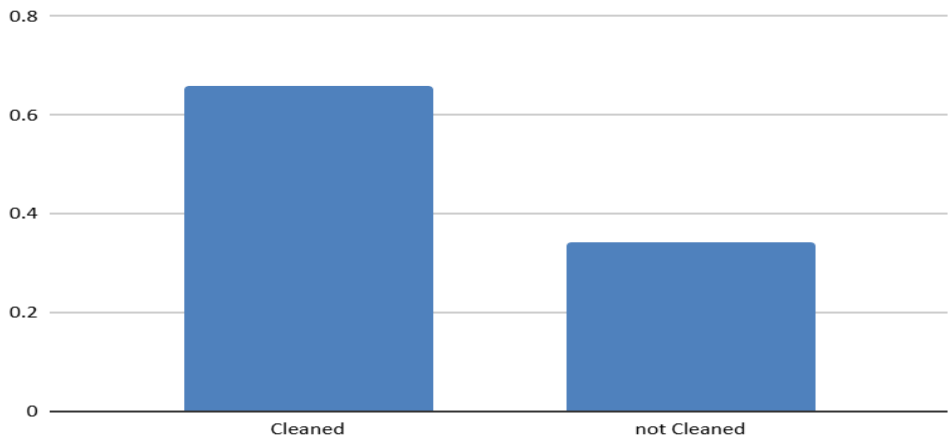
directly enhance the health, productivity, and resilience of urban and peri-urban populations in the Bajaur region.

Table 96: Community Perception on Solid Waste Management and Cleanliness (Survey Respondents, n=719)

SOLID WASTE AND CLEANLINESS			
Sr		no of respondents	Percentage
1	Cleaned	474	65.92%
2	not Cleaned	245	34.08%
3	total	719	100.00%

Source: Devised by Consultant

Figure 13: Community response for the Solid Waste and Cleanliness situation in Bajaur District

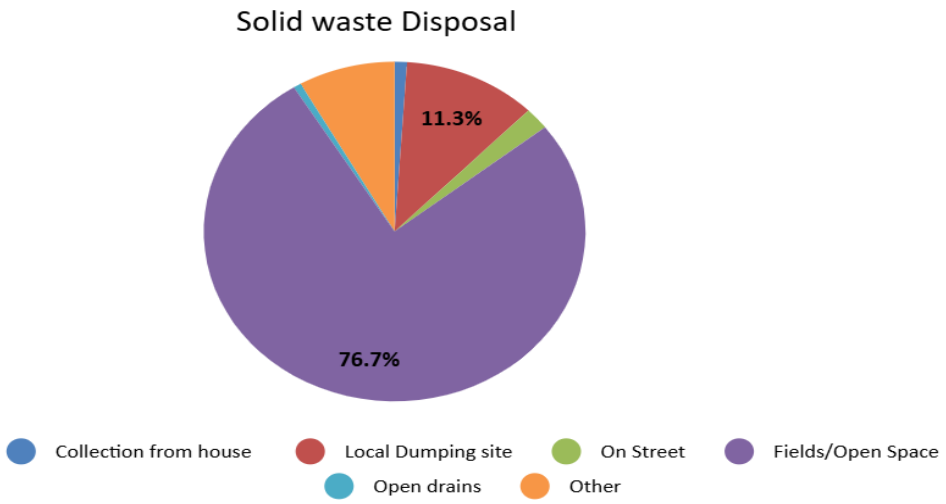


Source: Devised by Consultant

The data reveals a heavy reliance on a decentralized network of informal and environmentally harmful disposal sites. District Bajaur has identified ten solid waste disposal sites across various locations, including Khar, Sadiq Abad, Inayat Killi, Barkhalozu, Laghri, Lawi Sam, Nawagai, Raghagan, Pashat, and Qazafi. These locations serve as the primary dumping grounds for the district's waste, highlighting both the absence of an effective centralized municipal collection system and weak enforcement of waste management regulations. The management and operational standards of these sites vary significantly, with many lacking the necessary infrastructure and environmental safeguards. This situation further contributes to environmental degradation, including soil and water contamination, and heightened risks of vector-borne diseases. Formal waste management mechanisms appear almost non-existent, with no proper facilities to handle waste in a sanitary manner.

This pattern underscores an urgent need for systemic reforms. Scaling up municipal solid waste services, introducing community-level segregation and recycling initiatives, and establishing proper sanitary landfills are critical interventions. Without these measures, the current reliance on these local dumping sites will continue to erode environmental quality, increase health risks, and undermine local development objectives in the Bajaur region.

Figure 14: Solid Waste Disposal practices in Bajaur district



Source: Devised By Consultant

6.9.2 Identification of Solid Waste Disposal Sites.

In District Bajaur, field investigations have identified approximately ten locations across the district, primarily in and around major urban centers like Khar, Nawagai, and Inayat Killi, where garbage is regularly dumped. While these sites function as primary waste collection points, they are not officially designated or engineered sanitary landfills.

These informal dumping grounds lack the infrastructure and environmental safeguards necessary to manage waste effectively. Waste is disposed of in these local dumping sites, fields, open spaces, and on streets, contributing to pollution and creating unsanitary living conditions for the local population. The absence of proper waste disposal facilities, such as engineered lining or leachate management systems, poses significant environmental and public health risks, including soil and water contamination.

The reliance on these informal sites underscores the urgent need for a structured and sustainable waste management system in District Bajaur. Without official and properly managed disposal sites, the district faces escalating environmental challenges that must be addressed through comprehensive planning and resource allocation. Establishing proper waste disposal facilities and enhancing the capacity of the Tehsil Municipal Administrations (TMAs) to manage waste effectively are critical interventions.

6.9.3 Current and Projected Solid Waste Generation in the settlement/ district Bajaur

In Pakistan, solid waste generation ranges between 0.283 to 0.612 kg/capita/day, with an estimated annual growth rate of 2.4%. Using an average waste generation of 0.45 kg/capita/day, the current and future solid waste generation for District Bajaur has been projected based on updated population estimates.

As of 2025, the district produces approximately 527 tons of solid waste per day, which equals about 206,955 tons per year. With a projected population of 2283536 in 2045, annual solid waste generation is expected to increase to 703.3 tons/ day.

Table 97: Projected Population Growth and Solid Waste Generation (2025–2045)

Tehsil	Area	2025		2045	
	(Acres)	Population	Estimated Waste Generated (Tons/day)	Population	Estimated Waste Generated (Tons/day)
Barang Tehsil	57579	80794	34.66	138201	59.29
Khar Bajaur Tehsil	91486	296464	127.18	607586	21.61
Mamund Tehsil	65504	380340	163.17	681173	292.22
Bar Chamarkand Tehsil	25140	69188	29.68	116965	50.18
Salarzai Tehsil	61620	237766	102	436206	150.26
Utman Khel Tehsil	27110	84866	28.36	153250	65.74
Nawagai Tehsil	32343.35	98969	42	150155	64
sum	360782.4	1248387	527.05	2283536	703.3

- ***Strategic Approach for Solid Waste Management***

The proposed Solid Waste Management Plan (SWMP) is designed to provide broad guidelines to suggest measures to manage the growing solid waste in the Bajaur District. This has been determined after assessing the potential and constraints in the existing SWM of the tehsils in Bajaur, particularly the reliance on informal dumping sites and the absence of a controlled dumpsite or landfill. The proposed action plans aim to identify gaps in existing municipal services and address the needs for incremental population growth. Additionally, the plans include provisions for capacity building for the Tehsil Municipal Administrations (TMAs) to ensure effective operation and maintenance of municipal services.

The proposed solid waste management land-use zoning framework for Bajaur District is designed to support a phased, integrated, and climate-resilient waste system aligned with projected population growth and waste generation trends for 2025–2045. The zoning strategy follows international best practices promoted by the international standards for low-density, topographically constrained districts, emphasizing functional decentralization at the collection level and strategic centralization at the treatment and disposal stages.

Neighborhood-level collection and segregation zones are prioritized within walking distance (300–500 m) of residential clusters to reduce informal dumping, minimize collection costs, and enable early-stage waste separation at source. These zones are embedded within existing residential land use to avoid additional land take while ensuring social acceptance and operational efficiency.

At the secondary level, tehsil-scale transfer stations are proposed as dedicated municipal service zones, strategically located near arterial roads and outside flood-prone or environmentally sensitive areas. These facilities function as critical nodes for waste aggregation, compaction, and secondary segregation, enabling optimized long-haul transportation and reducing vehicle mileage and emissions. In line with World Bank guidance on economies of scale, a centralized District Resource Recovery Park is designated within an industrial or utility land-use zone, preferably near Khar Bajaur, to host material recovery facilities (MRFs), composting units, and temporary storage for recyclables. This zoning approach promotes circular economy outcomes by integrating recycling and organic waste treatment within a single controlled footprint, while also creating opportunities for private sector participation and green jobs.

For final disposal, a dedicated engineered landfill zone is reserved in a geologically stable, low-slope area with appropriate buffer distances from settlements, water bodies, and agricultural land, consistent with international environmental safeguard standards. The landfill zone incorporates provision for future expansion, leachate management infrastructure, gas venting, and isolated hazardous waste cells, ensuring long-term environmental protection and regulatory compliance. Collectively, this hierarchical land-use zoning framework ensures that solid waste infrastructure is spatially optimized, operationally efficient, and environmentally sustainable, while remaining adaptable to future growth and regulatory tightening. The approach directly supports improved municipal service delivery, reduced climate risk, and alignment with national and provincial waste management strategies, as well as the World Bank's emphasis on integrated planning, lifecycle costing, and resilience in municipal solid waste systems.

➢ *Objectives of the Waste Management Plan*

According to the developed vision, the following strategic objectives are to be achieved by 2045:

- Implement a comprehensive and sustainable approach to improve waste management in Bajaur District, including the collection, storage, transfer, disposal, and treatment of all types of waste, with a focus on eliminating open dumping at informal sites.
- Provide new, improved, economical, efficient, and cost-effective solutions for SWM to ensure minimal environmental and social impacts, considering the socio-cultural norms and the specific geographical challenges of the district.

- Establish Bajaur District as a Model District with minimum waste generation, plotting the state-of-the-art waste-to-energy, zero plastic, Material recovery through reuse, repurpose, and composting units, tailored to the local waste composition and economic opportunities.

➢ ***Capacity Building, Awareness, and Advocacy of the Local Community***

Strengthen the capacity of local communities through targeted training, awareness campaigns, and advocacy programs focused on sustainable waste practices. Emphasize behavior change, segregation at source, and the environmental and health risks of open dumping and burning. Engage local District offices, and TMAs, women, and youth as key agents of change to ensure community ownership and long-term impact.

➢ ***Capacity building of DOs, TMAs***

- Develop and implement a structured waste collection schedule across all four tehsils, ensuring regular pickup, designated storage points, and coverage of remote settlements.
- Invest in basic waste infrastructure, including litter bins, covered transport vehicles, and intermediate waste storage stations, in line with NEQS and KPEPA 2014.
- Establish a data-driven monitoring system for waste volumes, disposal practices, and service delivery efficiency to guide evidence-based planning and compliance reporting.

Table 98: Summarizing the Solid Waste Management Recommendations for Bajaur District

Sr. No.	Component	Required Corrective Action
1	Waste Storage	• Implement door-to-door collection to decrease littering on streets and improve waste collection efficiency. • Develop and implement effective behavior change communication programs to promote civic sense and encourage responsible waste disposal practices among citizens. • Consider the removal of roadside communal bins to encourage citizens to use household bins and discourage illegal dumping.
2	Waste Segregation	• Develop segregation and materials recovery facilities to facilitate waste separation and recycling. • Establish a system for the conversion of organic waste into compost, reducing the amount of waste sent to landfills. • Encourage source segregation by raising awareness and providing incentives for households and businesses to separate their waste.
3	Waste Collection	• Conducting behavior change communication programs to encourage citizens to properly dispose of waste. • Establishing a pool of collection vehicles for efficient waste collection. • Providing personal protective equipment (PPE) to all collection staff for their

		safety and well-being. • Ensuring citizen accountability in daily door-to-door waste collection.
4	Streets Sweeping	• Implementing a comprehensive door-to-door collection system would reduce the need for daily sweeping of all streets, allowing for more efficient and effective cleaning schedules, with a maximum frequency of twice a week.
5	Communal Storage	• All unnecessary communal storage points in residential areas would be removed; • Waste throwing in the streets should be banned and penalized;
6	Waste Transportation	• Commercial areas and institutions would have communal bins; • User charges would be levied to induce financial sustainability. • Waste would be carried in fully covered vehicles, in order to avoid any littering and pollution; • Number of vehicles would be minimized, with transfer stations and larger hauling containers; • Environment-friendly transfer facilities with dust & odor control.
7	Waste Disposal	• Landfill would be properly designed and operated; • Segregation, MRF, and Composting facilities would enhance the useful life of the Landfill;

Source: Devised by Consultant

6.9.4 Non-hazardous Waste Collection System Design Framework

Non-hazardous waste is waste that does not pose a direct threat to human health or the environment and does not meet the criteria for classification as hazardous waste under the Resource Conservation and Recovery Act (RCRA). It includes everyday waste generated from households, commercial establishments, and certain industrial activities, such as food waste, paper, plastics, and construction debris[21].

Non-hazardous waste is essentially the waste that causes no harm to human health or the environment. However, while these wastes generally don't cause immediate harm, they're still regulated, just not as strictly as hazardous wastes are.

The non-hazardous waste collection system for Bajaur District is designed as a hybrid decentralized–centralized model, recognizing the district's dispersed settlements, mountainous terrain, and varying population densities across tehsils. The system prioritizes door-to-door collection in dense and semi-urban areas, complemented by strategically located community bins in rural and hard-to-access settlements, with all collected waste routed through tehsil-level transfer stations before onward transportation to treatment and disposal facilities. This approach minimizes illegal dumping, improves service coverage, and reduces long-haul transport inefficiencies, consistent with World Bank recommendations for low-density and peri-urban regions.

[21] United States Environmental Protection Agency (USEPA). (n.d.). *Non-Hazardous Waste*. Retrieved from https://www.epa.gov/rcra/non-hazardous-waste

- ***Waste Minimization***

For the minimization of Solid waste generation at the village level, the community shall be highly encouraged to implement the 4Rs (Refuse, Reduce, Reuse, Recycle) plus composting and community education. Before purchasing any material, all alternatives for the least solid waste should be explored (for instance, plastic versus paper packaging).

- ***Labeling***

All non-hazardous waste shall be segregated from other types of hazardous waste at each villages community bins sites. At all facilities, the following types of containers, with color coding for easy identification, shall be kept to collect and segregate common wastes.

6.9.5 Phased Door-to-Door Waste Collection Plan

6.9.5.1 Short-Term Plan (2025–2030): Foundational & Rural-Realistic Approach

In the short term, door-to-door waste collection in Bajaur District will be implemented through a ***selective coverage model***, prioritizing urban cores and high-density settlements while adopting pragmatic alternatives for dispersed rural communities. Given the district's mountainous terrain, scattered housing patterns, and limited municipal resources, full door-to-door coverage in rural villages is neither operationally nor financially viable during this phase. Therefore, door-to-door services will focus on urban and peri-urban areas of Khar Bajaur, Mamund, and tehsil headquarters, covering approximately 50–60% of the district population.

In rural settlements, waste collection will rely on cluster-based community collection points supported by scheduled mobile collection rather than daily household pickup. Small-capacity handcarts, animal-drawn carts, or tractor-trolleys operated by locally recruited workers will collect waste from designated community bins two to three times per week, ensuring service continuity without excessive fleet expansion. This model aligns with World Bank guidance for low-density rural regions, where shared infrastructure and community-managed collection systems are considered more cost-effective than individualized services.

Source segregation during the short-term phase will be introduced on a voluntary and incentive-based basis, with households encouraged to separate organic and recyclable waste using simple color-coded bags rather than standardized bins. Municipal authorities will focus on awareness, route stabilization, and workforce training, while gradually formalizing informal collectors already active in recyclable recovery.

6.9.5.2 Long-Term Plan (2030–2045): Service Expansion & System Consolidation

In the long term, door-to-door waste collection will be progressively expanded as institutional capacity, financial sustainability, and settlement consolidation improve. By this phase, improved road connectivity, higher population densities in growth corridors, and operational experience will enable extension of door-to-door services to semi-urban and accessible rural

clusters, increasing coverage to 75–85% of the district population by 2045. Fully dispersed and high-altitude hamlets will continue to be served through enhanced community bin systems, recognizing the permanent logistical limitations of individualized collection in such areas.

The long-term system will transition toward standardized, scheduled collection, with organic waste collected daily in urbanized areas and alternate-day collection in rural clusters. Segregation at source will become mandatory for serviced households, supported by enforcement mechanisms, differential user charges, and integration with downstream recycling and composting facilities. Motorized mini-collection vehicles and compactors will gradually replace manual systems where road access permits, while shared inter-tehsil fleets will reduce operational redundancy and emissions.

Institutionally, the long-term phase will emphasize performance-based contracting, digital route monitoring, and community feedback mechanisms to ensure service quality. Importantly, the plan retains flexibility for rural realities, acknowledging that universal door-to-door collection is neither necessary nor optimal for achieving environmental outcomes. Instead, the focus shifts to waste capture efficiency, service reliability, and diversion from open dumping, consistent with international best practices for mountainous and rural districts.

Figure 15: Waste minimization Hierarchy suggested for Bajaur District, KP

Figure 16: Types of Containers for Segregation of Non-hazardous Waste

Source: Devised by Consultant

- ***Transportation Vehicles, and Collection Frequency***

Non-hazardous solid waste and recyclable materials shall be collected and transported frequently enough to prevent odor, vector breeding, and public nuisance.

- Food waste and other putrescible materials shall be collected at least once per week, while
- Bulky waste shall be collected once every three months or as per local need.

Collection frequency shall be established based on generation rates, waste composition, population density, and available storage capacity to ensure efficiency while minimizing operational costs and emissions. In areas with source segregation, collection schedules will be differentiated for organic, recyclable, and residual waste streams, ensuring timely recovery and maintaining the integrity of recyclable materials.

To ensure efficient, cost-effective, and environmentally responsible solid waste transportation by optimizing routes, utilizing shared vehicles, and integrating waste compaction and segregation protocols across the district the shared transportation vehicles requirements, and alternate collection schedules are mentioned in table below.

Table 99: Solid Waste transportation vehicular requirements

Tehsil	Vehicle Type	Short Term Vehicles (#)	Long Term Vehicles (#)	Trips per Vehicle per Day	Primary Function	Service Frequency	Shared / Alternate Use
Khar Bajaur	Mini-Dumper (2–2.5 t)	18	30	3	D-to-D Collection	Daily	Dedicated
	Small Compactor (8–10 t)	6	10	2	To transfer station	Daily	Dedicated
	Tractor-Trolley (3–4 t)	4	8	2	Peripheral rural collection	Alternate-day	Dedicated
	Hook Loader (15–20 t)	2	4	1	Transfer to landfill	Alternate-day	Shared district fleet
Mamund	Mini-Dumper (2–2.5 t)	14	22	3	D-to-D Collection	Daily	Dedicated
	Tractor-Trolley (3–4 t)	8	12	2	Rural villages	Alternate-day	Dedicated
	Small Compactor (8–10 t)	4	8	2	To transfer station	Daily	Shared with Khar
	Hook Loader (15–20 t)	2	3	1	Transfer to landfill	Alternate-day	Shared with Khar
Barang	Mini-Dumper (2–2.5 t)	8	18	3	Tehsil HQ collection	Daily	Dedicated
	Tractor-Trolley (3–4 t)	12	18	2	Rural clusters	Alternate-day	Dedicated
	Covered Tipper (6–8 t)	3	6	2	Long rural hauls	Alternate-day	Dedicated
	Medium Compactor (10–12 t)	2	4	2	Secondary transport	Alternate-day	Shared with Salarzai
Bar Chamarkand	Mini-Dumper (2–2.5 t)	6	15	3	Limited door-to-door	Alternate-day	Dedicated
	Tractor-Trolley (3–4 t)	10	14	2	Primary rural collection	Alternate-day	Dedicated
	Covered Tipper (6–8 t)	3	5	2	Community bins	Weekly/ Alternate	Dedicated
	Medium Compactor (10–12 t)	1	3	2	Secondary transport	Alternate-day	Shared (Utman Khel)

Tehsil	Vehicle Type	Short Term Vehicles (#)	Long Term Vehicles (#)	Trips per Vehicle per Day	Primary Function	Service Frequency	Shared / Alternate Use
Salarzai	Mini-Dumper (2–2.5 t)	7	15	3	Semi-urban pockets	Daily	Dedicated
	Tractor-Trolley (3–4 t)	11	16	2	Rural villages	Alternate-day	Dedicated
	Covered Tipper (6–8 t)	4	7	2	Long routes	Alternate-day	Dedicated
	Medium Compactor (10–12 t)	2	4	2	Secondary transport	Alternate-day	Shared (Barang)
Utman Khel	Mini-Dumper (2–2.5 t)	7	14	3	Limited door-to-door	Alternate-day	Dedicated
	Tractor-Trolley (3–4 t)	9	14	2	Primary rural system	Alternate-day	Dedicated
	Covered Tipper (6–8 t)	4	6	2	Community bins	Weekly / Alternate	Dedicated
	Medium Compactor (10–12 t)	1	3	2	Secondary transport	Alternate-day	Shared with Bar Chamarkand

6.9.5.3 Rationale for calculating the Vehicles and waste transportation

Vehicle Type	Functional Role in System	Key Calculation Basis	Trips Assumed (Avg.)	Justification for Quantity	International / Technical Rationale
Mini-Dumper (1.5–2.5 t)	Primary door-to-door collection in urban & semi-urban areas	• Waste density (kg/km²) • Households per route • Short haul distance	3–4 trips/day	Sized to ensure daily removal of organic waste and avoid on-street storage; numbers increase with density, not population alone	WB recommends small, maneuverable vehicles for narrow streets and high-frequency collection in constrained settlements

Tractor-Trolley (3–4 t)	Primary collection from rural clusters & villages	• Cluster population served • Longer haul distance •Lower collection frequency	2 trips/day	Quantity reflects rural coverage area and road quality; chosen to minimize CAPEX and allow local maintenance	WB & ADB endorse low-tech, terrain-appropriate vehicles for rural/mountain districts
Covered Tipper (6–8 t)	Secondary transport from community bins to transfer stations	• Bin capacity & clearance frequency • Medium haul distance	2 trips/day	Calculated to clear bins before overflow while avoiding compactor over-deployment	UNEP & WB discourage open transport; covered tippers reduce litter and health risks
Small Compactor (8–12 t)	Secondary haulage from transfer stations	• Daily inflow at transfer station • Compaction ratio (2.5–3:1)	1–2 trips/day	Limited number used only where waste volumes justify compaction; shared across tehsils	WB best practice: compactors only where throughput exceeds economic threshold
Hook Loader (15–20 t)	Long-haul transport to landfill / recovery park	• Peak daily waste flow • Container turnaround time • Haul distance	1 trip/day	Sized for peak conditions with district-level sharing to avoid idle assets	WB & ISWA recommend containerized systems for regional haulage efficiency
Shared / Standby Fleet	Backup during peak demand, breakdowns, seasonal access issues	• Vehicle availability factor (80–85%) • Sensitivity scenarios	As required	Reduces system failure risk without permanent over-investment	WB infrastructure guidance promotes redundancy through shared capacity, not asset duplication

Figure 17: Type of Vehicles suggested for waste transportation

6.9.5.4 Plan for waste Segregation

The waste segregation plan for Bajaur District is designed to maximize material recovery, reduce transportation and disposal loads, and improve environmental and public health outcomes, while remaining realistic for rural, mountainous, and low-density settlements. In line with World Bank best practices, the plan adopts a phased, source-led segregation approach, supported by enabling infrastructure, incentives, and downstream treatment capacity. Segregation is treated not as an isolated activity but as an integrated component of the waste service chain, directly linked to collection frequency, vehicle type, and end-use facilities.

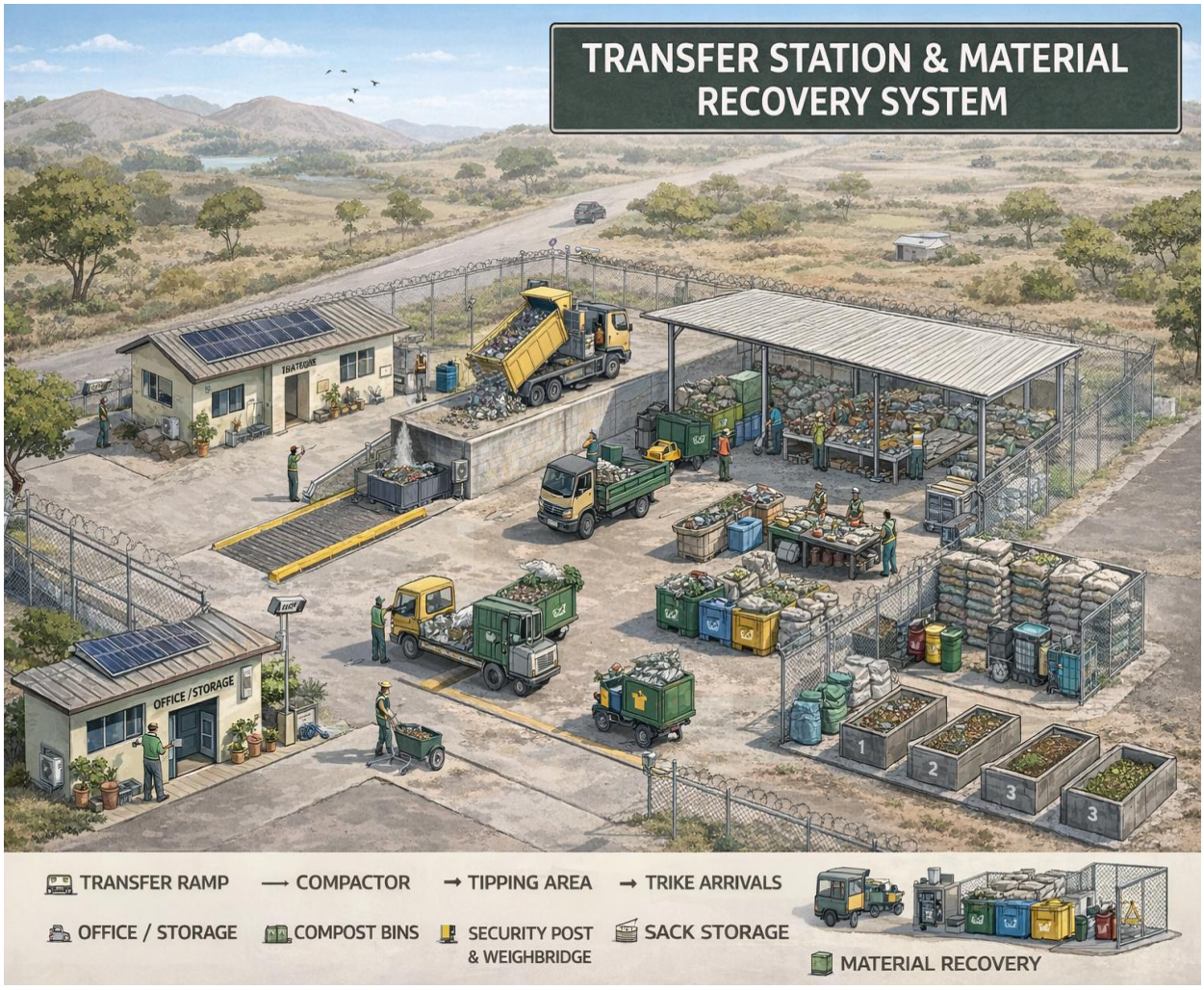
6.9.5.5 Transfer Stations (TS) – Localized Waste Consolidation

To reduce long-haul transport costs and improve efficiency, 6 strategically located transfer stations are proposed, one per tehsil, co-located along regional roads and within 10–15 km of major settlements. Each transfer station in the district will also function as a Material Recovery Facility (MRF), operating primarily as a manual sorting unit for separating valuable recyclables, compostable organics, and screening out potentially hazardous waste before final disposal. Key Functions of this facility are;

1. **Manual Sorting** of mixed dry waste (plastic, metal, paper, glass)
2. **Temporary Storage** of separated recyclables in color-coded bins/sacks
3. **Removal of Inert and Hazardous Materials** for separate handling
4. **Preparation of Compostable Organic Waste** for local composting units
5. **Transfer of Residual Waste** to central landfill

6.9.5.6 Material Recovery and Organic Waste Management Framework

Figure 18: Visualization of Transfer station and material recovery system in Bajaur District



➢ ***Plastic Waste Recovery and Recycling***

Plastic waste constitutes approximately 10–15% of the dry waste stream across the district. Key constituents include HDPE, LDPE, polyethylene bags, PET bottles, and food-grade plastic wrappers. In the short term, manual sorting will be adopted at transfer stations, utilizing sorting belts, gloves, and protective gear to ensure worker safety.

Recovered materials will be temporarily stored in shaded storage units using baled or bagged formats and subsequently routed to regional recycling value chains—leveraging both the informal sector and registered contractors.

➢ ***Essential equipment for each Material Recovery Facility (MRF) includes:***

- Sorting tables with rollers or static surfaces
- Digital weighing scales
- Durable sacks or cages for material storage
- Basic baling machines (recommended for larger nodes such as Ghalanai and Yake Ghund stations)

I. Record Keeping

The local TMA should keep all the records for SW generated in terms of quantities, characterization of waste, responsibilities in waste collection, segregation, transportation, and final disposal. The record for hazardous waste collection and protocols should also be maintained. The periodic training of staff, and monitoring shall be maintained and updated. In addition, the record for any emergency or incidents within the premises of Bajaur Tehsils due to solid waste or hazardous material contact should be maintained too.

6.9.6 Hazardous Waste Screening and Pre-Disposal Management

Each sorting station will be equipped to screen and isolate hazardous materials prior to transport to the designated engineered landfill. This will include:

- **Infectious medical waste** (e.g., syringes, gauze, sharps from BHUs and RHCs)
- **Sanitary products** (diapers, napkins)
- **Chemical and agro-waste** (e.g., pesticide containers, expired products)
- **Broken electronics or batteries**

Secure intermediate containment units (e.g., puncture-resistant bins with lids) will be stationed for temporary storage of these items until batch disposal is facilitated through approved landfill cells or third-party hazardous waste handlers.

I. Composting and Biodegradable Waste Management

Biodegradable materials constitute approximately 70–80% of the total municipal solid waste (MSW) generated, including food scraps, farm residues, vegetable waste, and leaf litter. Each transfer station will be equipped with 2–4 composting bins (1m³ each) following low-tech aerobic composting principles.

Design Specifications:

- Located behind the sorting/transfer slab
- Provided with **shaded roofing, natural aeration,** and **drainage channels**
- Made of masonry or durable polymer, as per local resource availability

The produced compost will be utilized for local agriculture, public parks, or roadside green belts, promoting circular economy principles. Pilot-scale implementation of this model is proposed for tehsils in the short term, based on their agriculture-dominated land use patterns and active farming communities.

I. Material Flow at Sorting Station

1. **Inbound Waste** → Mixed (from trike bins)
2. **Sorting Process** → Dry (plastic, paper, metal) separated on table
3. **Organic Waste** → Placed into composting bins
4. **Hazardous** → Manually removed, stored separately
5. **Residual Waste** → Sent to landfill (non-recyclable, non-compostable)

6.9.7 Waste Treatment and Disposal

- ***Reuse/ Repurpose***

In-situ reuse involves the reuse of raw materials, such as cutting scraps, as input to the same process from which they came, or using them in other processes in the facility (repurposing). This reduces the need for treatment or disposal and conserves energy and resources. The purpose of reuse/ repurpose involves the in-situ reuse of materials. This reduces the need for transportation, treatment, or disposal and conserves resources and energy.

- ***Recycling***

Recycling is a series of activities that includes collecting used, reused, or unused items that would otherwise be considered waste; sorting and processing the recyclable products into raw materials; and remanufacturing the recycled raw materials into new products. Atleast one recycling unit in each tehsil must be operational to reduce the plastic waste. The community must be encouraged to purchase the recycled items instead of virgin plastic.

➢ ***Material Recovery Units***

The Material Recovery of the constitutes from the waste stream ensures that the waste is appropriately segregated and no further component can be utilized for the same or any other purpose within the industry.

The in-situ waste management process includes collection, categorization and segregation, quantification, and storage, while the ex-situ process includes disposal, recycling, composting, landfill and incineration. All of these processes are explained in the sections below. The selection of process and its implementation criteria is highly based on the type of waste.

Table 100: Requirements for the Material recovery facility for Bajaur District

Tehsil	MRF Type (Short Term – 2025)	MRF Type (Long Term – 2045)	Required Area (Acres)	Key Resources Required	Hazardous Screening Arrangement	Composting Bins – 2025	Composting Bins – 2045
Barang	Small manual MRF	Small–medium semi-mechanized MRF	0.8 → 1.2	Sorting tables, baler, shed, PPE, weighing scale	Manual inspection + isolation drum	12	22
Khar Bajaur	Medium semi-mechanized MRF	Large semi-mechanized MRF	2.5 → 4.0	Conveyor, baler, plastic shredder, storage bays, weighbridge	Dedicated hazardous bay + sealed container	40	75
Mamund	Medium semi-mechanized MRF	Large semi-mechanized MRF	3.0 → 4.5	Conveyor, optional trommel, baler, sorting cabin, storage hall	Controlled screening zone + temporary hazardous store	50	95
Bar Chamarkand	Small manual MRF	Small–medium manual MRF	0.7 → 1.1	Sorting tables, baler, covered shed, PPE	Manual screening + labeled hazardous drum	10	18
Salarzai	Medium semi-mechanized MRF	Medium–large semi-mechanized MRF	2.0 → 3.2	Conveyor, baler, sorting tables, covered storage	Segregated hazardous cage + spill kit	30	55
Utman Khel	Small manual MRF	Medium manual / semi-mechanized MRF	1.0 → 1.8	Sorting tables, baler, shed, PPE	Manual screening + secure hazardous box	12	25

6.9.8 End of Life Treatment

- ***Composting***

The composting strategy for Bajaur District is designed as a dual-track system that combines community-based decentralized composting with centralized, market-oriented composting facilities, implemented through a structured Public–Private Partnership (PPP) model. This approach recognizes the district's high organic waste fraction, dispersed settlement pattern, and limited landfill capacity, while creating opportunities for private sector participation, local employment, and revenue generation. Composting is positioned not merely as a waste treatment option but as a resource recovery and soil restoration intervention, aligned with circular economy principles and climate-resilient land management.

In the short term (2025–2030), composting will primarily rely on community-based composting bins and pits located at village clusters, schools, mosques, markets, and near community collection points. These systems will handle source-segregated organic waste collected through the two-bin system and will be designed for low-tech, low-energy operation, using aerated bins or windrow pits with manual turning. Operation and routine maintenance will be contracted to local micro-entrepreneurs, CBOs, or social enterprises under performance-based PPP arrangements, where the local government provides land, bins, and oversight, while private operators manage day-to-day operations and retain a share of compost sales.

In the medium term (2030–2045), as waste volumes increase and segregation compliance improves, the system will be progressively complemented by centralized composting facilities located within District Resource Recovery Parks or near transfer stations. These facilities will adopt semi-mechanized windrow or aerated static pile systems, enabling higher throughput, quality control, and standardized compost production suitable for agricultural and horticultural markets. Under the PPP framework, private partners will be responsible for facility operation, quality assurance, packaging, and market linkage development, while the public sector ensures feedstock availability, regulatory compliance, and offtake facilitation with agriculture departments and local farmers. Revenue streams from compost sales, combined with tipping fee savings and potential carbon finance, will enhance the financial sustainability of the system.

Across both phases, composting facilities will incorporate basic environmental safeguards, including leachate management, odor control buffers, and routine quality testing to ensure compliance with national standards. Importantly, the phased integration of community-based and centralized composting under a PPP model ensures scalability, cost control, and risk sharing, allowing Bajaur District to transition from a low-cost, labor-intensive system to a more efficient, market-driven composting sector without disrupting service delivery.

Table 101: Tehsil-wise Composting Infrastructure & Quantification

Tehsil	Organic Waste (TPD) – 2025	Organic Waste (TPD) – 2045	Community Composting Bins (2025)	Community Composting Bins (2045)	Centralized Composting Capacity (TPD)	PPP Operating Model	Tehsil-Level Initiatives
Barang	~19	~33	12	22	10 → 20	CBO-led O&M + revenue share	Village compost pits, school compost gardens, farmer demo plots
Khar Bajaur	~70	~120	40	75	30 → 60	Private operator concession	Market waste composting, urban landscaping use, agri linkages
Mamund	~90	~160	50	95	40 → 80	PPP with agro-entrepreneur	Compost–fertilizer blending, orchard soil rehab
Bar Chamarkand	~16	~30	10	18	8 → 15	Community enterprise	Mosque-based compost hubs, kitchen waste focus
Salarzai	~56	~83	30	55	25 → 50	Private + TMA partnership	Compost for rainfed agriculture, women-led cooperatives
Utman Khel	~15	~36	12	25	10 → 20	Micro-PPP (local SME)	Compost–nursery linkage, roadside plantation

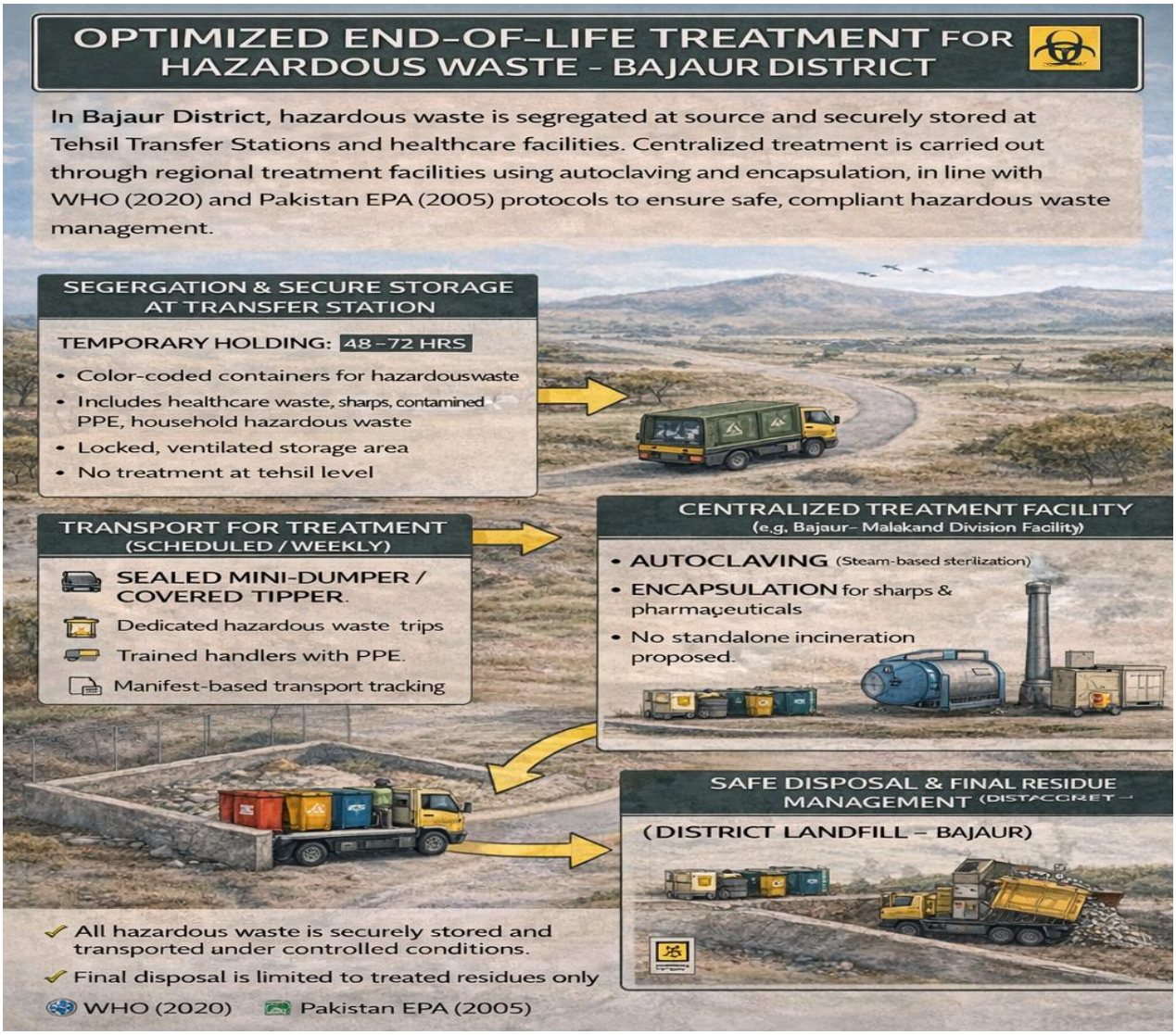
Key assumptions:

Organic fraction of MSW: 55–60%[22]
Compost recovery efficiency: 45–50%[2, 23]
Community compost bin capacity: 1.8 t/day/bin
Centralized facility scale: 20–60 t/day per module[24]
Landfill diversion target from composting: Short term: 25–30% of total waste; Long term: 40–45% of total waste

[22]World Bank (2018). *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*, UNEP (2015). *Global Waste Management Outlook*
[23] FAO (2013). *Toolkit on Composting and Organic Waste Management*.
[24] Asian Development Bank (2014). *Municipal Solid Waste Management in Asia and the Pacific*.

I. Incineration and hazardous waste Management

In Bajaur District, the optimized end-of-life treatment for hazardous waste involves a decentralized yet regulated approach tailored to the district's low waste volumes and dispersed settlements. Hazardous waste—primarily from small health units and limited agro-chemical use—will be segregated at source using color-coded containers and temporarily stored at secure, designated areas within each tehsil's transfer station for up to 48–72 hours. Centralized treatment will be conducted at a proposed facility in Nawagai and VC Loisam, equipped with autoclaving units and, where feasible, a small dual-chamber incinerator operating at WHO-recommended temperatures (≥850°C). Expired medicines, sharps, and chemical residues will be encapsulated in secure cement-lined pits, while residuals post-treatment will be disposed of at the district's engineered landfill. This system, aligned with WHO (2020) and Pakistan EPA (2005) protocols, ensures environmental safety, cost-effectiveness, and compliance with national hazardous waste regulations.



To safely dispose of infectious medical waste from the *operational hospital* in Bajaur District using a controlled, low-emission incinerator system that prevents open burning, toxic emissions, and groundwater contamination. The incinerator will be operationalized as per the guidelines of the Pakistan Hospital Waste Management Rules 2005[25].

It is recommended to install the dual-chamber design for complete combustion and control of atmospheric pollution. The wet scrubbers or dry filter system will ensure air quality. The ash removal tray will be installed for safe handling of the residue. As per the WHO guidelines[26] the chimney height will be a minimum of 10 meters. Incinerator will also be used for disposal of waste, but before burning the trash, plastics, metal, glass, and any other items that are not to be burned should be segregated first. Ash from the incinerator shall be buried in the lined landfill, as it may contain heavy metals.

II. Incineration and non-hazardous waste Management

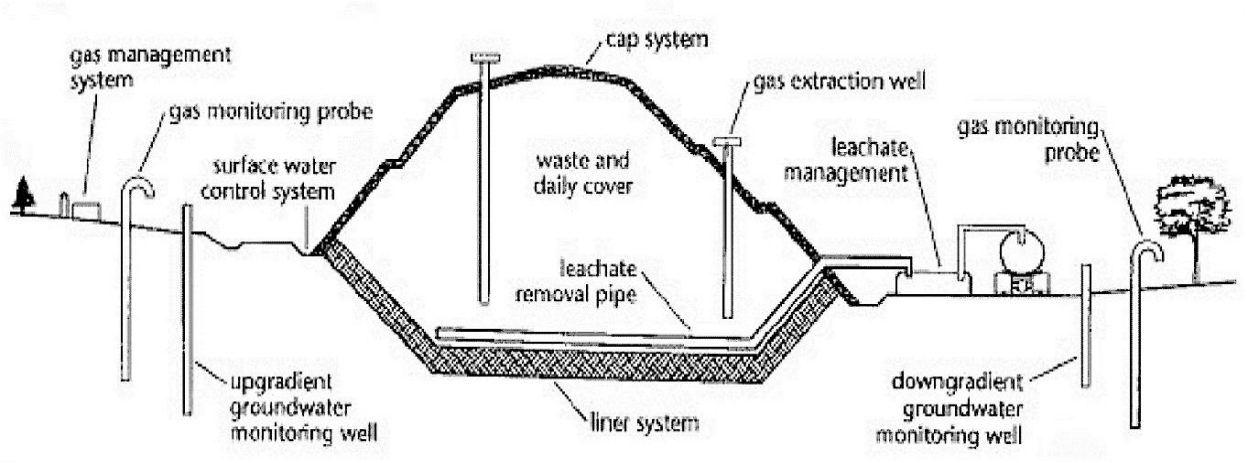
An integrated engineered landfill of approximately 45–50 acres is proposed for Bajaur District to serve short- and medium-term disposal needs. The site will be developed in phased cells, beginning with 12–15 acres for the initial period and expanding within the same footprint to accommodate future waste volumes. Site selection prioritizes geotechnical stability, environmental protection, and logistical efficiency, ensuring compliance with national regulations and World Bank environmental and social standards.

Table 102: Phase-wise Landfill Area Requirement

Planning Phase	Waste to Landfill (TPD)	Annual Waste (tons)	Design Life	Estimated Airspace (m^3)	Land Area Required (Acres)
Short Term (2025–2035)	200–230	73,000–84,000	5–7 yrs	~500,000	**12–15 acres**
Long Term (2035–2045)	260–310	95,000–113,000	15–20 yrs	~1,800,000	**30–35 acres**
TOTAL (Integrated Site)	—	—	20–25 yrs	—	**45–50 acres**

[25] Pakistan Hospital Waste Management Rules (2005).
[26] WHO (2014). *Safe Management of Wastes from Health-care Activities*.

Figure 19: layout for the Landfill site reflecting the GHG collection and leachate management to avoid environmental impacts



- ***Climate-Smart Organic Waste Management and Carbon Credit Potential***

District Bajaur's waste composition is predominantly organic, with approximately 70–80% of the total solid waste stream comprising biodegradable materials such as food waste, agricultural residues, leaf litter, and green waste. Given the district's semi-rural landscape and absence of formal landfill infrastructure, the improper disposal of organic waste poses a substantial risk for uncontrolled methane (CH_4) emissions—one of the most potent greenhouse gases (GHG), with a global warming potential (GWP) 28–34 times higher than CO_2 over a 100-year period (IPCC, 2021).

To address this, the proposed district-level strategy includes the installation of low-tech aerobic composting units at each transfer station. Each unit will comprise 2 to 4 bins (each 1 m^3) designed with basic drainage, ventilation, and shade structures, conforming to UN-Habitat (2010) and JICA (2005) recommendations for decentralized organic waste management in low-income and rural settings.

- ***GHG Mitigation Potential***

Aerobic composting reduces GHG emissions by avoiding the anaerobic decomposition of organic matter that typically occurs in open dumps or uncontrolled landfills. According to the CDM Methodology AMS-III.F (UNFCCC, 2006), composting 1 metric ton of organic waste can prevent the emission of 0.62 tons of CO_2-equivalent (tCO_2e).

- ***Calculation Example:***

Assuming a single tehsil facility processes:

- **6 tons/day of organic waste**
- Operating **300 days/year**
  → Annual organic waste processed: **1,800 tons**

Avoided GHG emissions = 1,800 tons × 0.62 tCO_2e = 1,116 tCO_2e/year
This mitigation can be monetized under voluntary carbon markets (e.g., **Gold Standard** or **Verra VCS**) at an average carbon price of:

- **$5 to $10 per tCO_2e**

→ **Estimated carbon revenue = $5,580 to $11,160 per facility/year**
Scaling this model across **7 tehsils**, total carbon credits could yield:

- **7,812 to 15,624 tCO_2e annually**
- **$39,060 to $156,240** in potential annual climate finance

➢ ***Methane Capture in Engineered Landfills (Long-Term Strategy)***

In the long term (post-2040), with the establishment of a centralized engineered landfill (proposed at Nawagai and Salarzai), provisions for methane gas capture and flaring will be integrated into the design. This includes:

- Gas venting pipes
- Leachate collection systems
- Optional flare units or small-scale bioenergy generation

These features enable further GHG reductions and qualify for additional landfill gas recovery credits under CDM AMS-III.G and similar VCS protocols.

III. Daily Environmental Inspection

To send waste off-site, TMAs must make appropriate arrangements. The following actions are recommended;

- All waste collection, transportation, and disposal activities must be tracked and carried out by designated staff members,
- The compliance of the environmental waste management plan must be strictly followed for the appropriate segregation, material recovery, hazardous waste segregation, and final disposal.

6.9.9 Solid Waste Management – Tehsil Wise

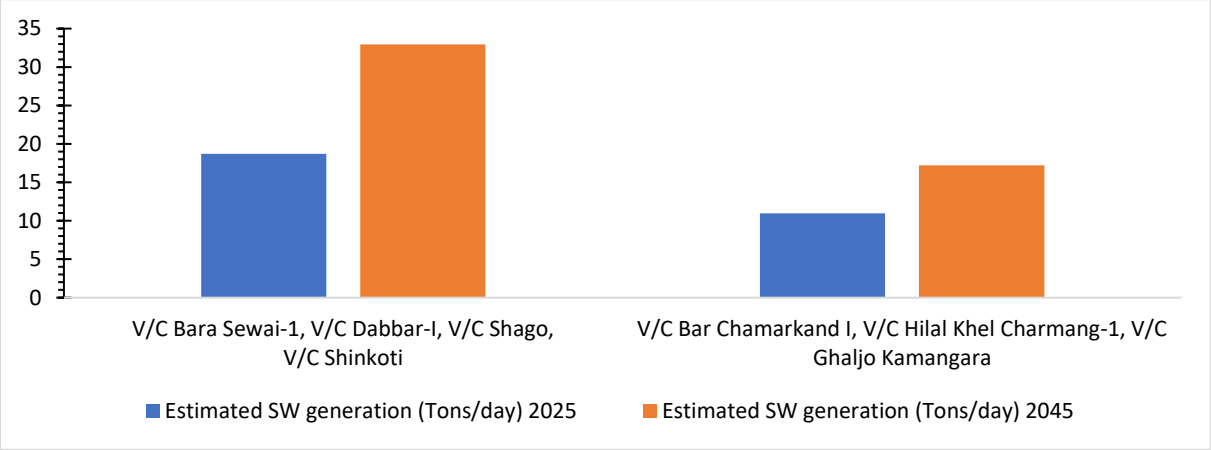
6.9.9.1 Bar Chamar Kand Tehsil

I. Estimated Waste Generation in Bar Chamar Kand Tehsil, Bajaur District

Waste generation in Bar Chamar Kand Tehsil remains relatively low and dispersed, reflecting its predominantly rangeland-dominated land use (≈90%) and very limited residential footprint (≈25

km²). Municipal solid waste is primarily generated from small rural settlements, local transport corridors, and agricultural activities, with negligible contributions from commercial or industrial sources. The presence of agriculture, minor mining activity, and scattered religious buildings contributes to localized organic and inert waste streams, while extensive rangelands and water bodies generate minimal waste. Consequently, waste generation is cluster-based rather than continuous, justifying decentralized collection, community-level segregation, and low-intensity treatment solutions consistent with World Bank recommendations for rural and low-density contexts

Figure 20: Estimated Waste Generated and Population in Bar Chamar Kand Tehsil, Bajaur District



Source: Devised by Consultant

II. Solid Waste Management Plan for short and long term for Bar Chamar Kand Tehsil, Bajaur District

Solid waste management in Bar Chamar Kand Tehsil is designed as a hybrid system combining communal storage, non-motorized/moterized primary collection, and motorized secondary transport, reflecting the tehsil's rangeland-dominated land use (≈90%) and clustered village settlements. In 2025, the VC clusters generate approximately 29.7 tons/day of municipal solid waste, rising to about 50.2 tons/day by 2045 due to population growth. Primary collection within villages is carried out through communal bins supported by trikes/hand carts, while motorized vehicles (mini-dumpers or covered tippers) are deployed for scheduled clearance of bins and transfer of waste to designated transfer points. The planned increase in communal bins, carts, and motorized collection capacity by 2045 ensures timely removal of waste, minimizes open dumping, and strengthens service reliability, in line with World Bank–recommended solid waste management approaches for rural and low-density areas.

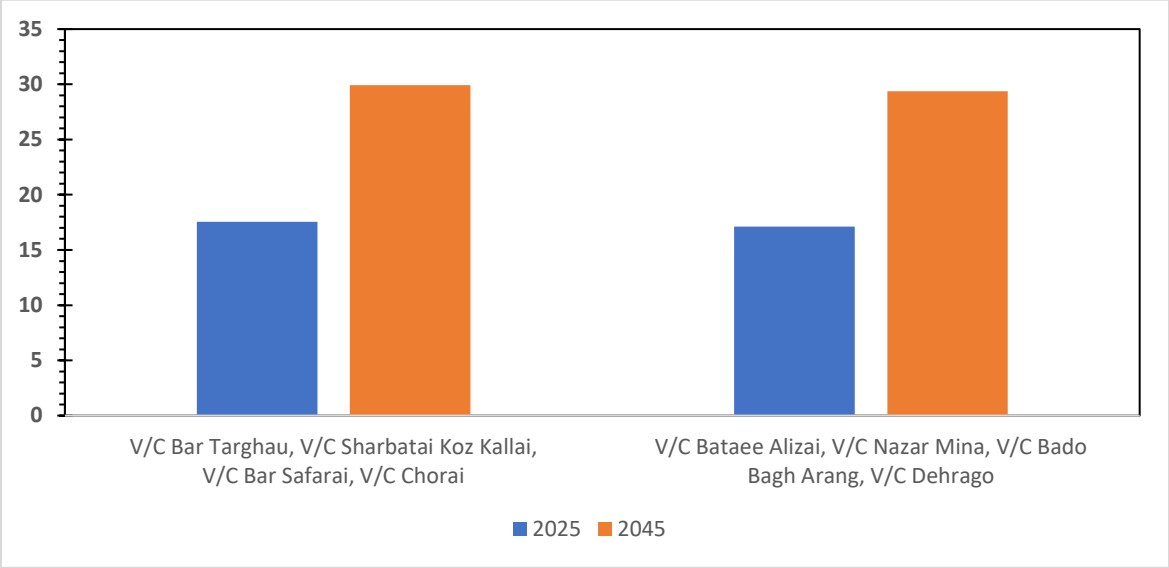
Table 103: Estimated Solid waste management in Bar Chamar Kand Tehsil

VC's	2025					2045				
	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts
V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	43614	17009.46	18.71041	94	9	76814	29957.46	32.953206	165	16
V/C Bar Chamarkandl, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	25574	9973.86	10.97125	55	5	40151	15658.89	17.224779	86	9
Total	69188	26983.32	29.68165	148	15	116965	45616.35	50.177985	251	25

6.9.9.2 Barang Tehsil

Barang Tehsil exhibits moderate but dispersed waste generation, increasing from approximately 17–18 tons/day in 2025 to nearly 30 tons/day by 2045, primarily driven by population growth across clustered village councils. Given the predominantly rural settlement pattern, solid waste management is structured around communal storage points, non-motorized primary collection, and scheduled motorized secondary transport (mini-dumpers/covered tippers) to ensure reliable evacuation of waste. This hybrid approach minimizes open dumping, optimizes costs, and aligns with World Bank–recommended practices for rural and low-density tehsils.

Figure 21: Estimated Waste Generated and Population in Barang Tehsil, Bajaur District



Source: Devised by Consultant

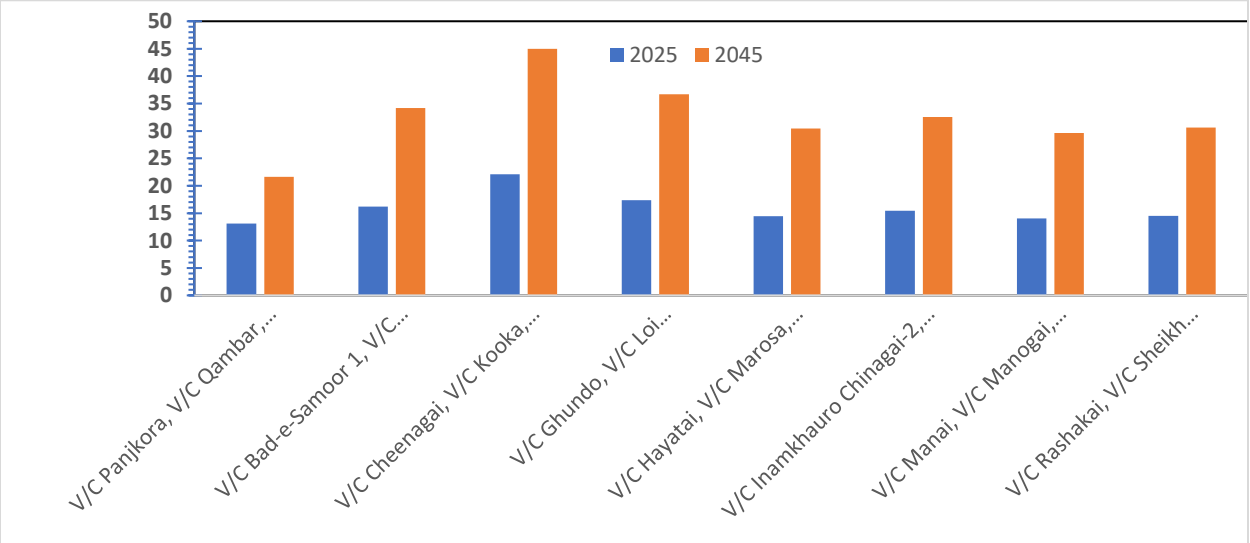
Table 104: Estimated Solid waste management in Barang Tehsil

VC's	2025					2045				
	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ carts
V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	40918	15958.0	17.6	87.8	8.8	69765.0	27208.4	29.9	149.6	15.0
V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	39876	15551.6	17.1	85.5	8.6	68436.0	26690.0	29.4	146.8	14.7
Total	80794	31509.7	34.7	173.3	17.3	138201.0	53898.4	59.3	296.4	29.6

6.9.9.3 Khar Bajaur Tehsil

Khar Tehsil represents the primary urban and service center of Bajaur District, with waste generation increasing from approximately 13–22 tons/day across major VCs in 2025 to about 21–45 tons/day by 2045, reflecting rapid population growth and higher service intensity. Solid waste generation is concentrated along residential areas, markets, transport corridors, and institutional zones, necessitating daily motorized collection using mini-dumpers and compactors, supplemented by communal bins in peripheral areas. The solid waste management system is therefore designed around high-frequency collection, centralized transfer, and downstream material recovery, consistent with World Bank–recommended approaches for urbanizing tehsils with mixed land-use profiles.

Figure 22: Estimated Waste Generated and Population in Khar Bajaur Tehsil, Bajaur District



Source: Devised by Consultant

The solid waste management system for Khar Tehsil is designed in response to its dominant agricultural land use (≈62%), substantial rangelands (≈26%), and a concentrated residential footprint (≈7%), which together shape a mixed urban–rural waste profile. Waste generation is primarily driven by residential areas, commercial pockets, transport corridors, public buildings, and institutions, requiring daily motorized collection using mini-dumpers and compactors, supported by communal bins in dense neighborhoods. Peripheral agricultural and rangeland areas are served through cluster-based communal storage and scheduled motorized clearance, minimizing transport costs while preventing open dumping. This differentiated, land-use-responsive approach aligns with World Bank best practices for managing solid waste in rapidly urbanizing tehsils with extensive rural hinterlands.

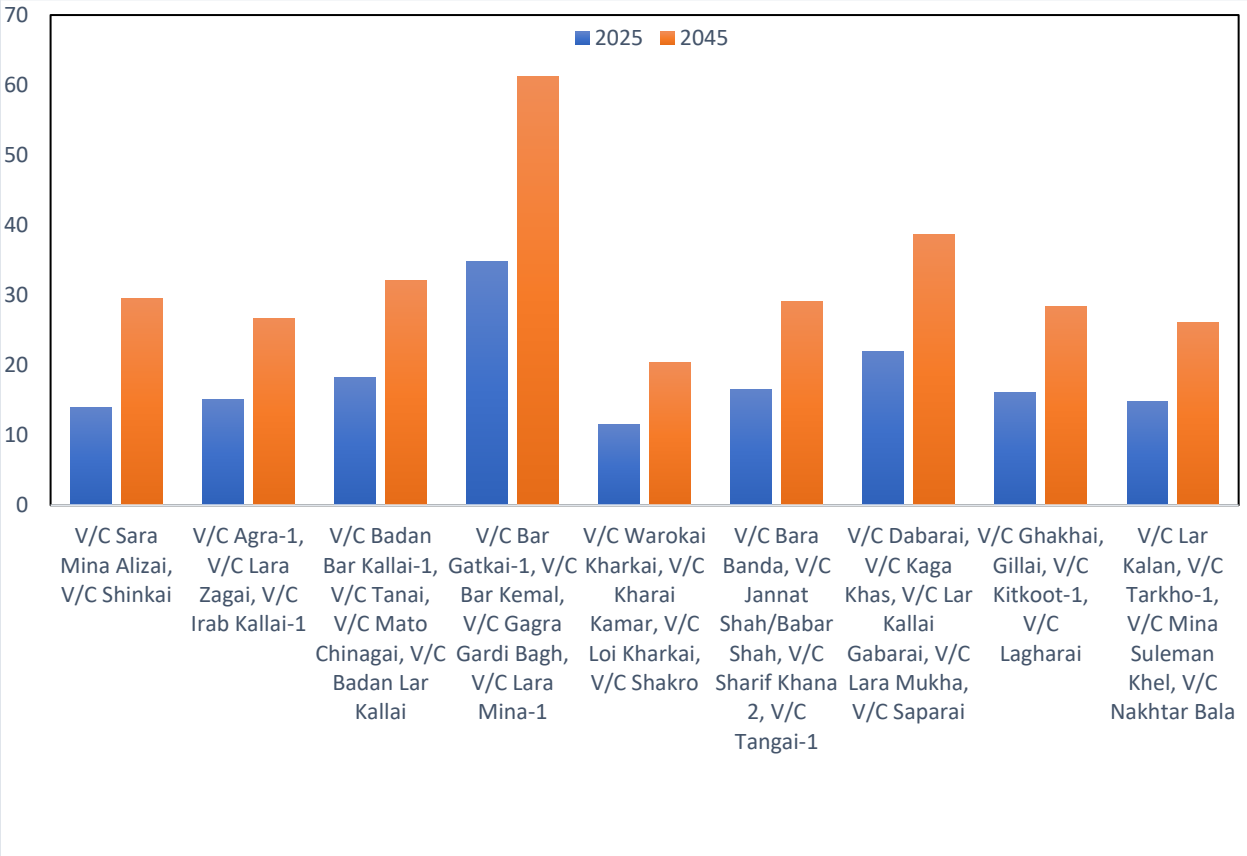
Table 105: Estimated Solid waste management in Khaer Tehsil, Bajaur District

VC's	2025					2045				
	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes / hand carts	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes / hand carts
V/C Panjkora, V/C Qambar, V/C Tar	30491	11891	13	65	7	50372	19645	22	108	11
V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	37791	14738	16	81	8	79684	31077	34	171	17
V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	51448	20065	22	110	11	104877	40902	45	225	22
V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	40531	15807	17	87	9	85461	33330	37	183	18
V/C Hayatai, V/C Marosa, V/C Sikandaro	33618	13111	14	72	7	70886	27646	30	152	15
V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	35950	14021	15	77	8	75802	29563	33	163	16
V/C Manai, V/C Manogai, V/C Top	32773	12781	14	70	7	69104	26951	30	148	15
V/C Rashakai, V/C Sheikh kallai, V/C Smasai	33862	13206	15	73	7	71400	27846	31	153	15
	296464	115621	127	636	64	607586	236959	261	1303	130

6.9.9.4 Mamund Tehsil

Mamund Tehsil shows a consistently high and rapidly increasing solid waste generation, rising from approximately 15–35 tons/day across village council clusters in 2025 to about 20–61 tons/day by 2045, reflecting both population growth and expanding settlement density. Waste generation is concentrated in larger residential clusters and along key movement corridors, necessitating a hybrid collection system comprising communal bins, trikes/hand carts for primary collection, and regular motorized evacuation using mini-dumpers and covered tippers. This phased, motorized-supported approach ensures service coverage across dispersed VCs while remaining aligned with World Bank–recommended practices for high-growth, semi-rural tehsils.

Figure 23: Estimated Waste Generated and Population in Mamund Tehsil, Bajaur District



Source: Devised by Consultant

Mamund Tehsil's solid waste generation is shaped by its predominantly agricultural (≈47%) and rangeland (≈41%) land use, with waste generation concentrated in discrete residential clusters (≈7%) and along transport corridors. VC-wise estimates indicate a significant increase in waste generation from about 116 tons/day in 2025 to over 200 tons/day by 2045, driven by population growth rather than industrial expansion. Accordingly, the solid waste management system adopts a cluster-based approach, combining communal bins and trikes/hand carts for primary collection

with scheduled motorized evacuation (mini-dumpers and covered tippers) for secondary transport to transfer and treatment facilities. This differentiated, land-use-responsive system ensures service coverage across dispersed settlements while remaining cost-effective and aligned with World Bank best practices for high-growth rural tehsils.

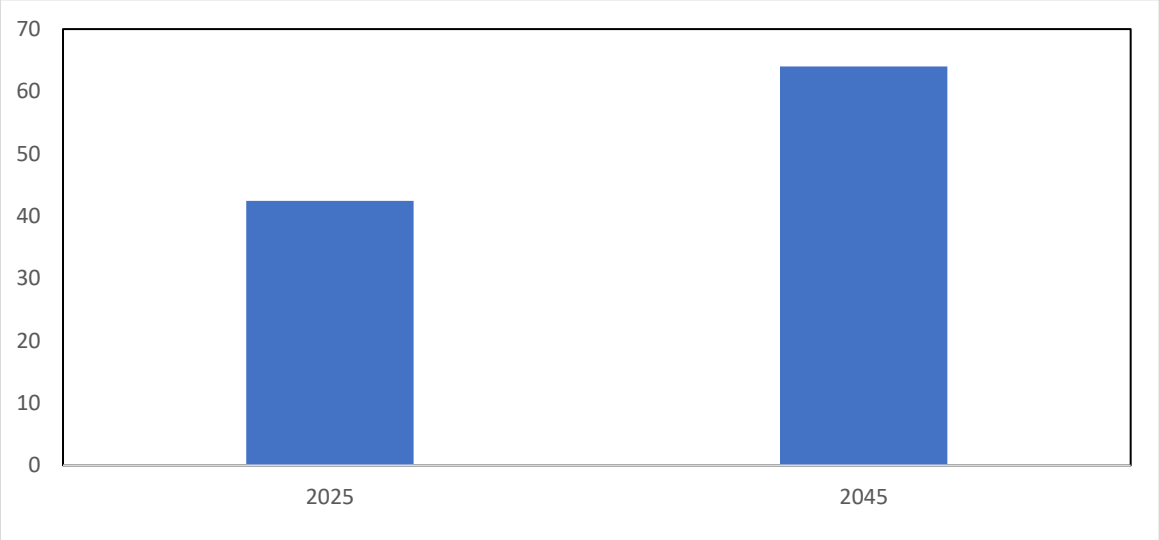
Table 106: Estimated Solid waste management in Mamund Tehsil, Bajaur District

VC's	2025					2045				
	Population	Waste Generated (kg/day)	ESW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts	Population	Waste Generated (kg/day)	Estd. SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts
V/C Sara Mina Alizai, V/C Shinkai	32577	12705.03	13.97	69.88	7	68689	26788.71	29.467581	147	15
V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	35371	13794.69	15.17	75.87	7	62296	24295.44	26.72	134	13
V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	42408	16539.12	18.19	91	9	74689	29128.71	32.04	160	16
V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	81015	31595.85	34.75	173.	17	142684	55646.76	61.21	306	31
V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	26949	10510.11	11.56	58	6	47463	18510.57	20.36	102	10
V/C Bara Banda, V/C Jannat Shah/Babar Shah, V/C Sharif Khana 2, V/C Tangai-1	38588	15049.32	16.55	83	8	67961	26504.79	29.15	145.776345	14
V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	51210	19971.9	21.96909	109.8455	10.98	90192	35174.88	38.692368	193.46184	19
V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	37630	14675.7	16.14327	80.71635	8.07	66274	25846.86	28.431546	142.15773	14
V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	34592	13490.88	14.83997	74.19984	7	60925	23760.75	26.136825	130.684125	13
Total	**380340**	**148332.6**	**163.1659**	**815.8293**	**81**	**681173**	**265657.5**	**292.223217**	**1461.116085**	**146**

6.9.9.5 Nawagai Tehsil

Nawagai Tehsil demonstrates a moderate but steadily increasing solid waste generation trend, rising from approximately 42 tons/day in 2025 to about 64 tons/day by 2045, largely driven by population growth and settlement expansion. Given its predominantly rural character, solid waste management is structured around communal storage, non-motorized primary collection, and scheduled motorized secondary transport, ensuring efficient service delivery across dispersed villages. This approach aligns with World Bank-recommended practices for medium-growth, rural tehsils where cost efficiency and operational reliability are key priorities.

Figure 24: Estimated Waste Generated and Population in Nawagai Tehsil, Bajaur District



Source: Devised by Consultant

Nawagai Tehsil is characterized by extensive rangelands (≈58%) and agricultural areas (≈28%), with a limited residential footprint (≈2.6%), resulting in a moderate but steadily rising solid waste generation from about 42.5 tons/day in 2025 to 64.4 tons/day by 2045. Waste generation is concentrated in settlement clusters, transport corridors, and small commercial pockets, rather than being uniformly distributed across the tehsil. Accordingly, the solid waste management plan emphasizes communal bins and trikes/hand carts for primary collection, supported by scheduled motorized secondary transport for timely evacuation to transfer and treatment facilities. This land-use-responsive, cluster-based system ensures cost-effective service delivery while remaining aligned with World Bank best practices for rural and semi-rural tehsils with dispersed settlements.

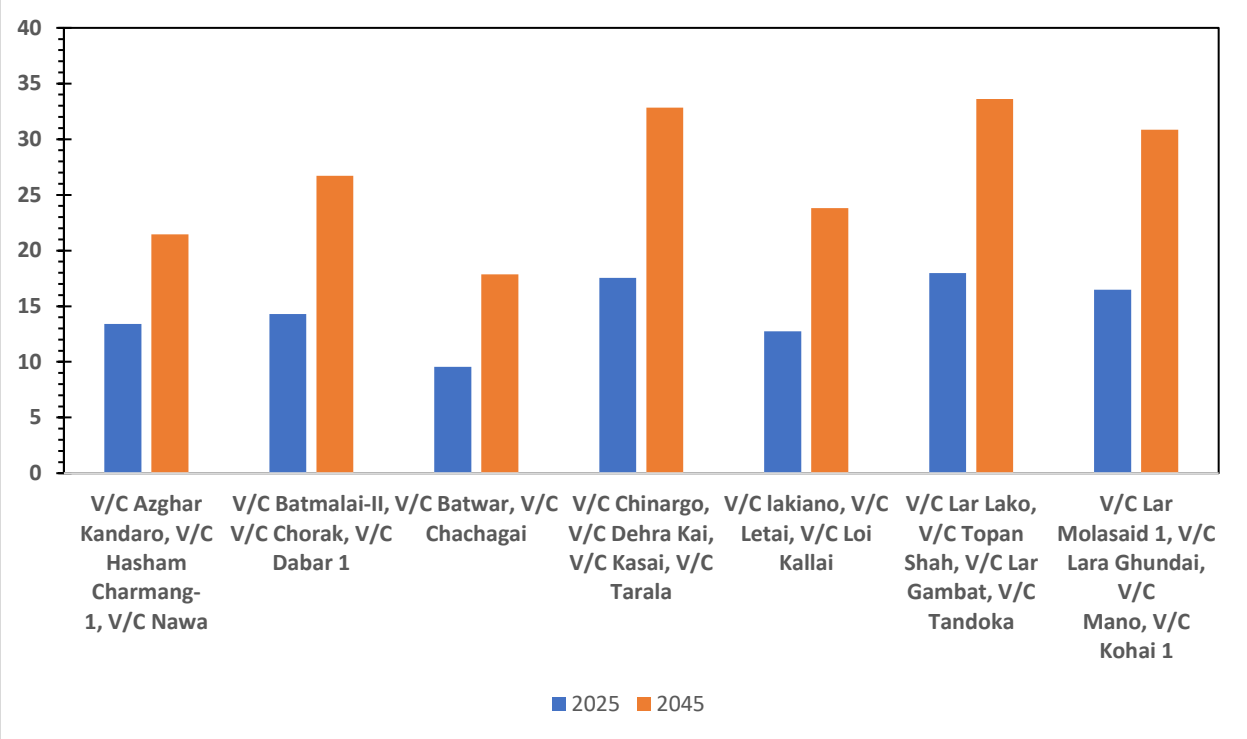
Table 107: Estimated Solid waste management in Mamund Tehsil, Bajaur District

Year	*Population*	*Waste Generated (kg/day)*	*Estimated SW generation (Tons/day)*	*Communal Bins (#)*	*Trikes/ hand carts*
2025	98968.67	38597.78	42.45	212.28	21.29
2045	150155	58560.45	64.4	322.08	32.20

6.9.9.6 Salarzai Tehsil

Salarzai Tehsil exhibits a moderate-to-high and steadily increasing waste generation pattern, rising from approximately 10–18 tons/day across VC clusters in 2025 to about 18–34 tons/day by 2045, driven by population growth in dispersed settlements. Waste generation is largely cluster-based, associated with residential areas and local transport corridors rather than continuous urban development. Accordingly, the solid waste management system is planned around communal bins and non-motorized primary collection, complemented by regular motorized secondary transport (mini-dumpers/covered tippers) to ensure timely evacuation and prevent open dumping, in line with World Bank–recommended practices for semi-rural tehsils.

Figure 25: Estimated Waste Generated and Population in Salarzai Tehsil, Bajaur District



Salarzai Tehsil is predominantly agricultural (≈47%) and rangeland-based (≈36%), with a moderate residential footprint (≈6%), resulting in clustered waste generation concentrated within village councils rather than continuous urban sprawl. VC-wise estimates indicate total solid waste generation increasing from approximately 102 tons/day in 2025 to about 187 tons/day by 2045, driven primarily by population growth across dispersed settlements. Accordingly, the solid waste management plan adopts a cluster-based service model, combining communal bins and trikes/hand carts for primary collection with scheduled motorized secondary transport (mini-dumpers and covered tippers) to evacuate waste to transfer and treatment facilities.

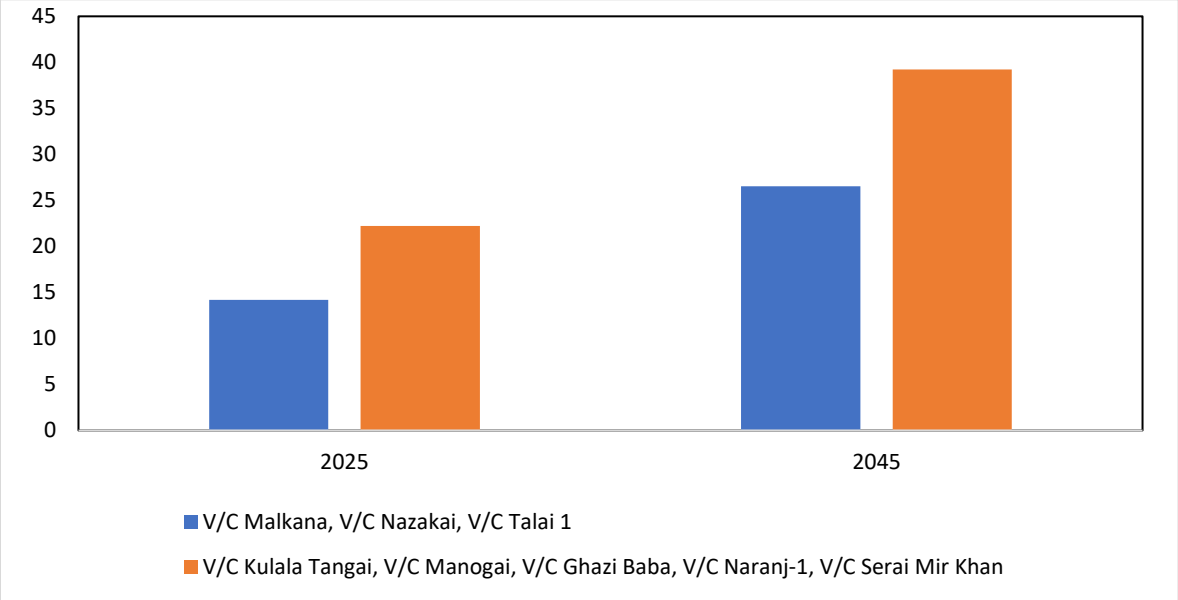
Table 108: Estimated Solid waste management in Salarzai Tehsil, Bajaur District

VC's	2025					2045				
	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts
V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	31271	12196	13	67	7	50034	19513	21	107	11
V/C Batmalai-II, V/C Chorak, V/C Dabar 1	33304	12989	14	71	7	62283	24290	27	134	13
V/C Batwar, V/C Chachagai	22270	8685	10	48	5	41648	16243	18	89	9
V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	40916	15957	18	88	9	76518	29842	33	164	16
V/C lakiano, V/C Letai, V/C Loi Kallai	29686	11578	13	64	6	55516	21651	24	119	12
V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	41877	16332	18	90	9	78315	30543	34	168	17
V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	38442	14992	16	82	8	71892	28038	31	154	15
Total	**237766**	**92729**	**102**	**510**	**51**	**436206**	**170120**	**187**	**936**	**94**

6.9.9.7 Utman Khel Tehsil

Utman Khel Tehsil exhibits moderate but steadily increasing solid waste generation, rising from approximately 14 tons/day in 2025 to about 39 tons/day by 2045, reflecting population growth across clustered village councils. Waste generation is largely confined to discrete residential settlements, with limited commercial or industrial activity. Accordingly, the solid waste management system is designed around communal bins and non-motorized primary collection, supported by scheduled motorized secondary transport (mini-dumpers or covered tippers) to ensure efficient evacuation of waste in line with World Bank–recommended practices for low-density, rural tehsils.

Figure 26: Estimated Waste Generated and Population in Utman Khel Tehsil, Bajaur District



Source: Devised by Consultant

Utman Khel Tehsil is characterized by extensive rangelands (≈60%) and agricultural areas (≈33%), with a limited residential footprint (≈3.5%), resulting in moderate and spatially clustered waste generation. VC-wise estimates indicate an increase in municipal solid waste from approximately 36 tons/day in 2025 to about 66 tons/day by 2045, driven by population growth across village clusters rather than commercial or industrial expansion. The solid waste management plan therefore adopts a cluster-based collection system, utilizing communal bins and trikes/hand carts for primary collection, supported by scheduled motorized secondary transport (mini-dumpers/covered tippers) to ensure timely evacuation and prevent open dumping.

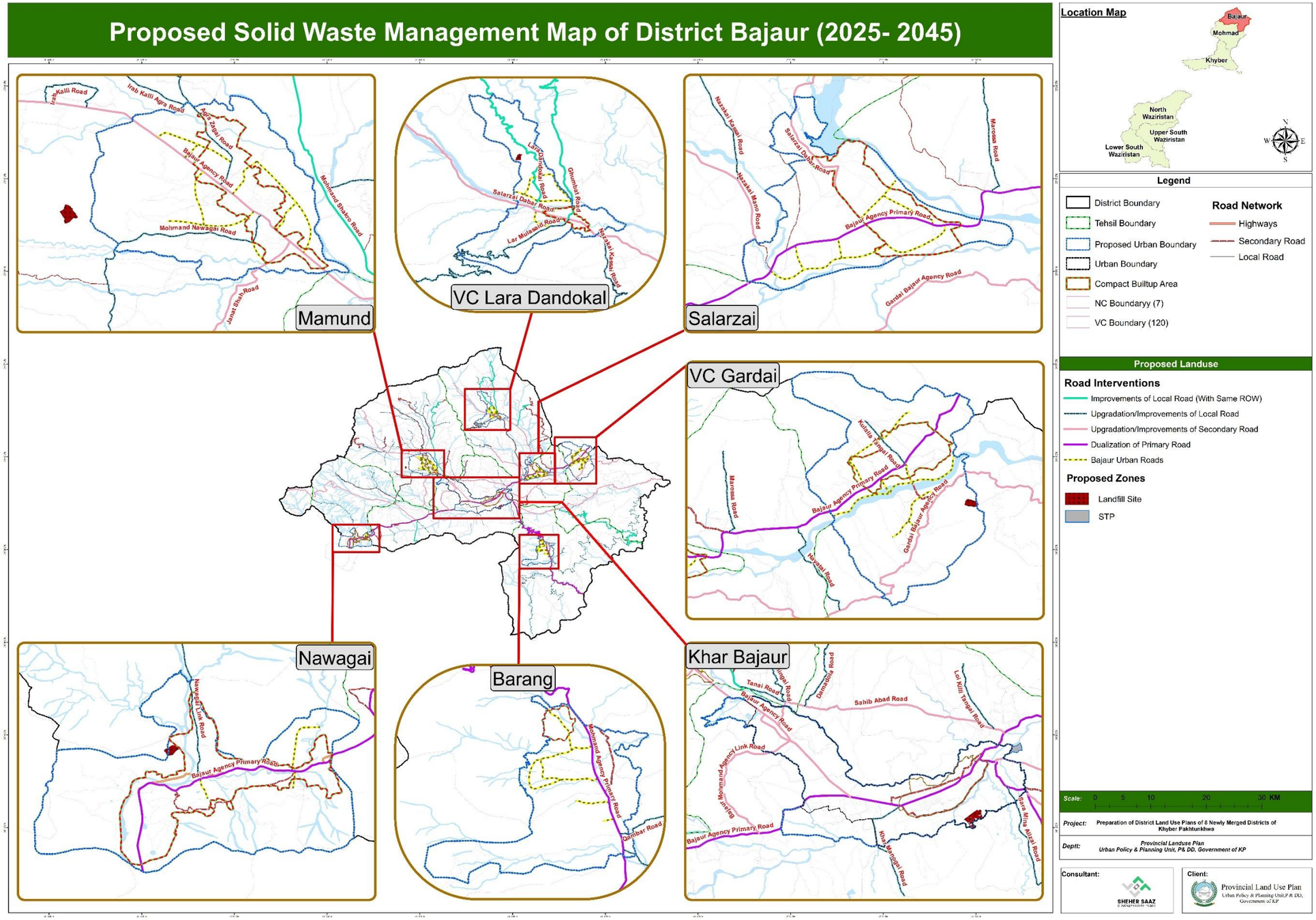
.

Table 109: Estimated Solid waste management in Utman Khel Tehsil, Bajaur District

VC's	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts	Population	Waste Generated (kg/day)	Estimated SW generation (Tons/day)	Communal Bins (#)	Trikes/ hand carts
V/C Malkana, V/C Nazakai, V/C Talai 1	33058	12893	14	71	7	61822	24111	27	133	13
V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	51808	20205	22	111	11	91428	35657	39	196	20
Total	84866	33098	36	182	18	153250	59768	66	329	33

Source: Devised by Consultant

Map 55: Proposed Solid Waste Management Map - District Bajaur



6.9.10 Constraints and recommendations

Table 110: Current gaps identified in Solid Waste Management of Bajaur District

Sr. No.	*Component*	*Current Practice and Issues*	*Priority of risk*
1	Institutional Framework & Planning	• Lack of a clear management vision and long-term strategic direction within local authorities, resulting in a reactive, day-to-day operational approach. • A significant communication gap and lack of coordination between different departments involved in SWM. • Absence of modern IT systems for management and monitoring.	High
2	Waste Generation	• Solid waste generation across the tehsils of Bajaur District shows significant variation, with current daily volumes ranging from approximately 1.26 tons in Bar Chamar Kand to over 137 tons in Khar Bajaur, and projections indicating steady growth. • The TMAs lack the financial and human resources to manage the current and projected waste loads effectively.	Medium
3	Storage of waste at source	• Widespread absence of household waste storage bins. • Lack of public awareness and poor civic sense, leading to littering. • Severe shortage of community bins in public areas and markets.	Medium
4	Waste Collection	• Heavy reliance on informal disposal in open spaces and unofficial dumpsites, indicating a severe lack of formal collection coverage. • No segregation of waste at source in current practices. • The existing collection mechanism is insufficient, with a critical shortage of sanitary workers and no social mobilization for community engagement.	High
5	Technical Capacity	• A critical shortage of technical expertise within the Tehsil Municipal Administrations (TMAs), preventing the implementation of advanced and effective SWM practices. • Insufficient resources, including machinery, equipment, and PPE for workers.	High
6	Hazardous waste	• There is no appropriate segregation, storage, or overall management pathway for hazardous waste (e.g., from hospitals), which is mixed with general municipal solid waste.	High
7	Sweeping of Streets	TMA capacity is insufficient for regular street sweeping. Resources are stretched thin, focusing on minimal core areas, leaving most streets and public spaces un swept.	High

8	Transportation	• A critical shortage of a dedicated, functional fleet of collection vehicles (e.g., trucks, compactors, trikes). • No formal scheduling or optimized routing for waste transportation. • Narrow lanes in many settlements are inaccessible to standard collection vehicles.	High
9	Disposal of waste	• A critical gap exists, with zero officially designated engineered landfills or controlled dumpsites in the district. • Total reliance on approximately ten identified informal dumpsites, which are uncontrolled and pose severe environmental and public health risks. • No formal systems for composting, material recovery, or sanitary landfilling	High

Source: Devised by Consultant

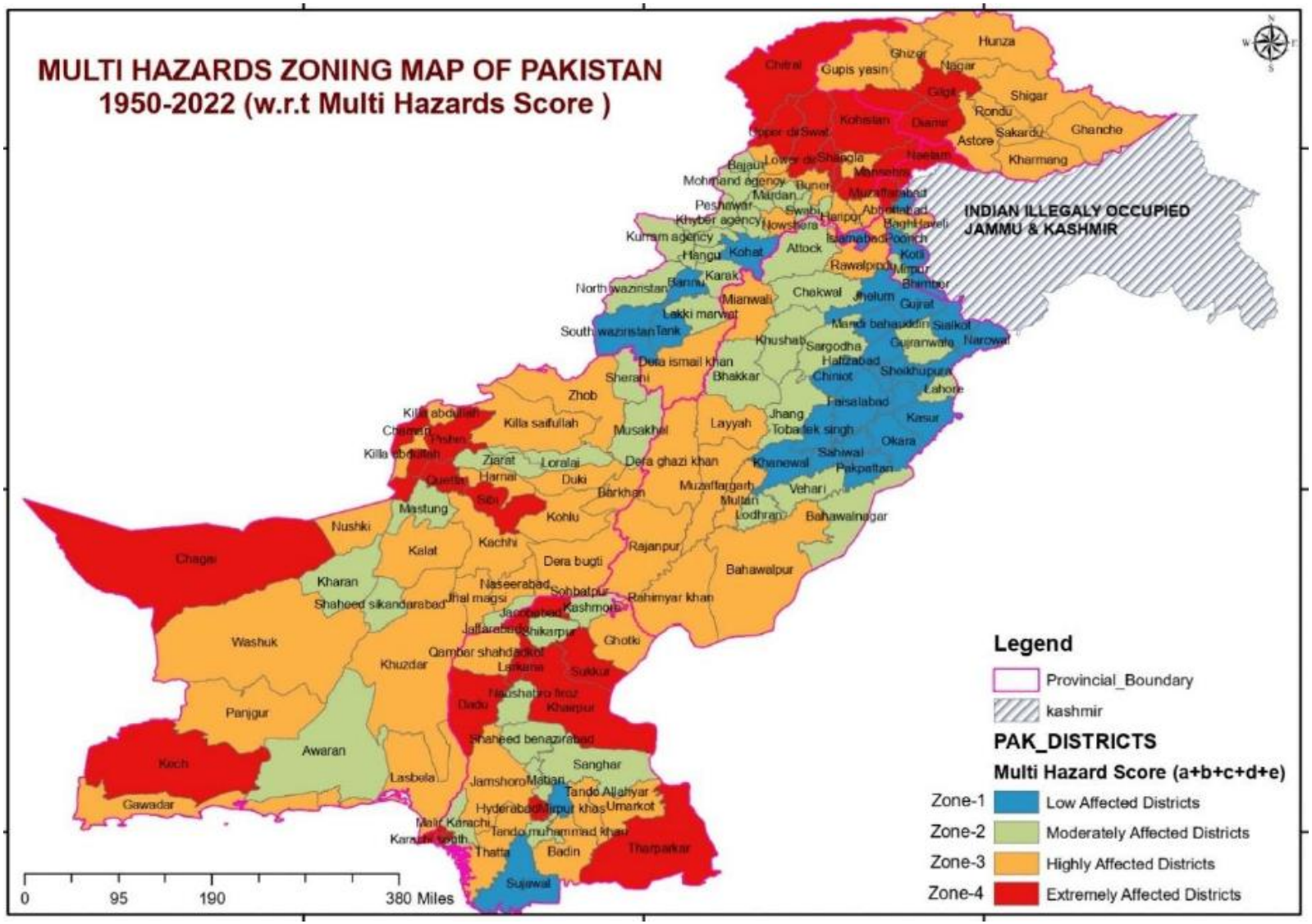
6.10 NATURAL HAZARDS

Climate change is intensifying natural disasters in Khyber Pakhtunkhwa, a region already strained by limited resources. Droughts, floods, and storms are becoming more frequent and severe, overwhelming communities. These extreme weather events threaten public health, ecosystems, food security, and displace people. Bajaur District has a population of 1,287,960 as per the census of 2023, residing over an area of 1,290 sq. km. Bajaur District experiences both scorching summers and harsh winters, further compounded by monsoon dangers. Similarly, its northern and western regions endure winter snowfall followed by summer floods, highlighting the diverse natural hazards the district faces. Vulnerable populations, particularly children, the elderly, and women, face heightened risks.

The Figure below is a multi-hazard map of Pakistan, which highlights the areas that are prone to multiple natural hazards. Bajaur District is moderately to highly vulnerable to multi-hazards, which primarily include earthquakes, floods, and landslides. Given these risks, a localized Natural Disaster Management Plan (NDMP) is essential to strengthen resilience, reduce disaster-induced losses, and align community-based preparedness with provincial and national frameworks. This plan is informed by the Sendai Framework for Disaster Risk Reduction (2015–2030), the National Disaster Management Plan of Pakistan (NDMA, 2019), and the Sustainable Development Goals (SDGs 11 and 13), which emphasize the need for resilient infrastructure, risk-informed governance, and community-centered approaches to disaster management.

The NDMP for Bajaur District adopts a multi-hazard, multi-sectoral approach, focusing on short-term preparedness, medium-term mitigation, and long-term resilience-building measures. It also emphasizes institutional coordination between the District Disaster Management Authority (DDMA), line departments, and community structures to ensure effective prevention, preparedness, response, and recovery.

Map 56: Multi-Hazard Map of Pakistan



6.10.1 Hazard Profile of Bajaur District

The major natural disaster risks identified in Bajaur district and their vulnerability is provided in the Table below;

Table 111: Hazard prioritization of Bajaur District, KP

Rank	Hazard Type	Severity / Frequency	Technical Justification	Priority Level
1	**Flash Floods / Cloudburst Floods**	Very High	Recurrent monsoon-induced flash floods (e.g., the 2023 event in the Bajaur Strait) cause fatalities, infrastructure damage, and displacement. Steep terrain, narrow valleys, and unplanned settlements intensify runoff impacts.	Critical Priority
2	**Landslides / Slope Failures**	High	Common along steep slopes of Utmankhel, Barang, and Charmang. Triggered by rainfall, deforestation, and seismic activity; frequent road blockages and housing losses reported.	High Priority
3	**Earthquakes**	Moderate–High	Located in the active Hindu Kush seismic belt (Zone III–IV). High vulnerability due to mud-brick housing and lack of seismic retrofitting.	High Priority (Preparedness Focus)
4	**Drought / Water Scarcity**	Moderate	Intermittent rainfall variability and over-reliance on rain-fed agriculture create seasonal water stress, particularly in Mamund and Nawagai tehsils.	Medium Priority
5	**Extreme Temperature (Heat / Cold Waves)**	Moderate–Low	Increasing temperature extremes projected under climate change; affects human health and crop yields but less immediate structural impact.	Medium Priority (Climate Adaptation)
6	**Forest Fires / Rangeland Fires**	Low–Moderate	Sparse forest cover limits spread, but dry scrublands are periodically affected by fire due to human negligence.	Low Priority (Monitoring Required)

- ***Earthquakes***

According to the 2023 Population Census, Bajaur District hosts a total population of 1,287,960, with an average population density of approximately 998 persons per square kilometer. This high density, concentrated primarily in the valley settlements of Khar, Nawagai, and Mamund, increases exposure to earthquake-induced structural collapse and secondary hazards such as landslides. The district lies within Seismic Zone III–IV, as classified in the Pakistan Seismic Hazard

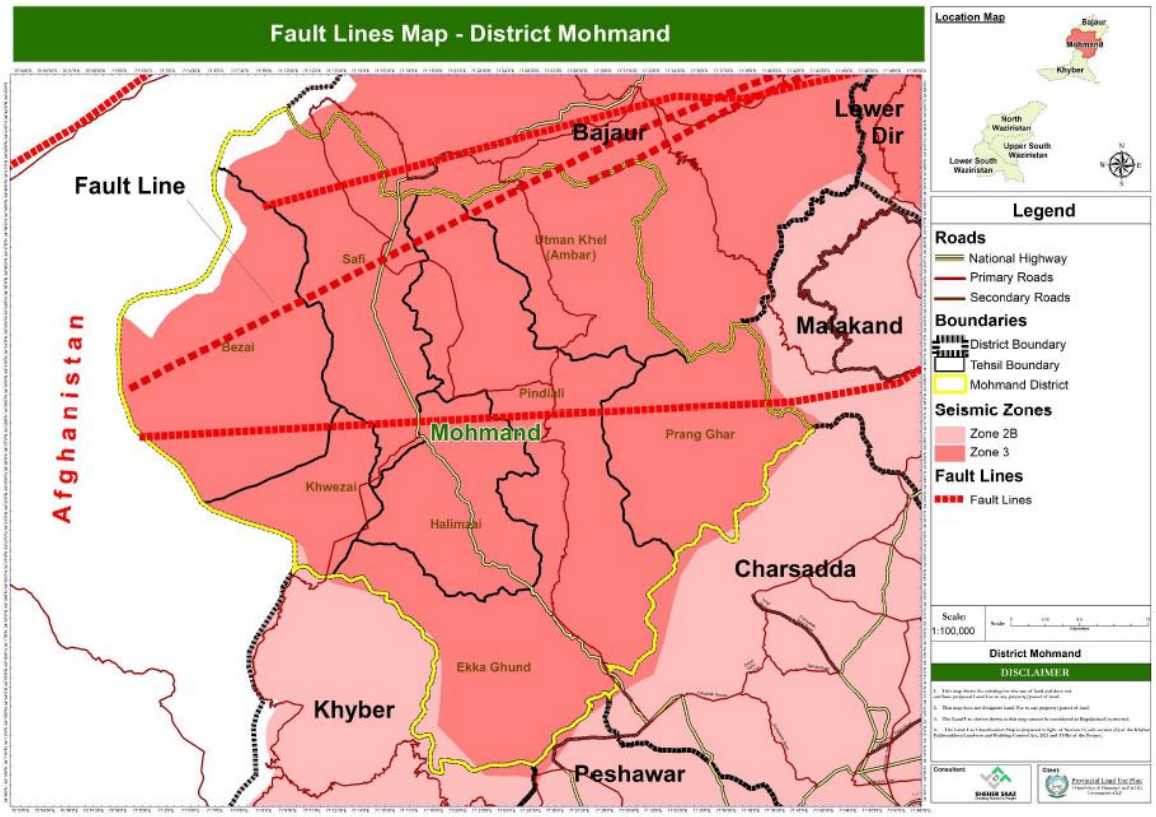
and Risk Assessment Atlas, making it part of the Himalayan seismic belt—a region of active crustal deformation due to the collision between the Indian and Eurasian plates. Tectonic stress generated along the Main Boundary Thrust (MBT) and Main Mantle Thrust (MMT), passing near the adjacent Mohmand and Malakand regions, frequently releases seismic energy that propagates through Bajaur's mountainous terrain.

The district has several identified active fault lines, with major thrusts crossing its central and northern parts. As per geological studies, the Pg velocity, which refers to the speed at which primary seismic waves (P-waves) travel through the upper part of the Earth's crust, is moderately low in the district. The lower Pg velocity suggests that the rocks in this area are less rigid and possibly more fractured or weathered than in regions with higher Pg velocities. Such geological conditions mean the area might experience stronger ground shaking during seismic events, potentially amplifying earthquake damage and increasing the likelihood of secondary hazards like landslides.

The Pn velocity refers to the speed of P-waves traveling through the upper mantle and Bajaur District has moderate to high Pn velocity which indicates typical rock properties for this depth. While not directly linked to earthquake frequency, a moderate Pn velocity indicates typical mantle conditions. This provides a baseline for comparison with other regions. Moho depth is the depth at which the Earth's crust transitions to the mantle and Bajaur district has high Moho depth which implies that the crust is thicker in this region compared to areas with lower Moho depths. A thicker crust can influence how seismic waves propagate and amplify ground shaking. In some cases, a thicker crust might trap seismic energy, leading to more intense ground shaking at the surface. The combination of low Pg velocity, moderate Pn velocity, and high Moho depth in the Bajaur District indicate a geological setting that could potentially contribute to a higher frequency or intensity of earthquakes. The figure 2 shows fault lines in Pakistan.

The district's vulnerability is exacerbated by the prevalence of unreinforced masonry and adobe structures, high household occupancy rates, and limited disaster-resilient infrastructure. With a population exposure index exceeding 0.75 (based on density and housing typology), even a moderate-magnitude earthquake (Mw 5.5–6.0) could result in significant structural damage and displacement, particularly in narrow valleys and densely clustered settlements. Limited access to emergency services and the absence of community-based early warning systems further amplify the social vulnerability of women, children, and low-income families.

Map 57: Fault lines of District Bajaur



Source: Devised by Consultant

- ***Land Sliding***

Bajaur District's steep mountainous terrain, combined with fragile lithology and erratic rainfall patterns, renders it highly susceptible to landslides and slope failures. The district lies within the Hindu Kush Mountain range, characterized by steep slopes (35–60°), loose sedimentary rock formations, and thin soil cover, which collectively contribute to slope instability. Areas such as Utmankhel, Bar Charmang Kand, Barang, and the northern parts of Nawagai are particularly prone to land sliding due to a combination of tectonic uplift, intense seasonal rainfall, deforestation, and unregulated quarrying activities.

With a total population of 1,287,960 and a density of ~998 persons/km² (PBS, 2023), the exposure of communities living along valley slopes and road corridors is significant. The vulnerability index rises in tehsils like Nawagai and Mamund, where marble extraction and slope excavation have altered the natural geomorphology, increasing the frequency of rockfalls, debris flows, and shallow landslides. The frequent landslides blocking the main Bajaur-Thall Road exemplify the

combined impact of anthropogenic destabilization and natural triggers such as monsoon rainfall (The Climate Watch, 2023)[27].

Technically, landslides in Bajaur are triggered by rapid infiltration of rainfall into fractured bedrock, which increases pore-water pressure and reduces shear strength along the slope interface. The seismic activity from nearby faults (Main Boundary Thrust and Main Mantle Thrust) further contributes to seismo-gravitational slope failures during or after moderate earthquakes. Spatial analysis using DEM-based slope gradient mapping and NDVI vegetation indices indicates a landslide susceptibility zone exceeding 40% of the district's land area, concentrated along the Utmankhel, Barang, Bar Charmang Kand corridor.

Severity and Vulnerability:

Bajaur District exhibits a high vulnerability to landsliding, particularly in the tehsils of Nawagai, Mamund, and the areas of Barang and Bar Charmang Kand. The frequent and disruptive landslides along the critical Bajaur-Thall road highlight how slope disturbance from both quarrying and infrastructure pressure compounds the underlying geological susceptibility. National assessments by NDMA consistently list landslides among the foremost risks in mountainous zones of Khyber Pakhtunkhwa (NDMA, 2021[28]; NDMA, 2024[29]), affirming that districts like Bajaur should be prioritized in slope stability planning. Furthermore, ongoing road construction and expansion projects in the district must integrate slope instability and runoff effects as critical risk factors, showing that landslide risk is integral even in major infrastructure strategy. Geospatially derived slope and mineral maps of Bajaur reveal substantial areas of steep terrain and altered land cover (e.g., clay, bare soils) which are common precursors to slope failure (Bilal et al., 2024). From a social vulnerability perspective, communities dependent on hill agriculture, fuelwood collection, and quarry labor are at greatest risk, with limited adaptive capacity and infrastructure resilience. Disruptions to road connectivity, especially along the Khar–Nawagai and main Bajaur-Thall routes, hinder both evacuation and emergency response.

To reduce landslide impacts, geotechnical slope stabilization along the Bajaur-Thall road corridor, afforestation on degraded slopes in Nawagai and Barang, and drone-assisted geospatial monitoring should be prioritized. Introducing community-based slope watch groups in high-risk villages like those in Bar Charmang Kand, coupled with rainfall threshold early warning systems, can significantly improve disaster readiness. Integration of these measures into the District

[27] World Resources Institute. (2023). *Climate Watch data: Historical GHG Emissions*. https://www.climatewatchdata.org/ghg-emissions
[28] National Disaster Management Authority. (2021). *National Monsoon Contingency Plan 2021*. Government of Pakistan. https://www.ndma.gov.pk/
[29] National Disaster Management Authority. (2024). *National Preparedness Plan for La Niña 2024*. Government of Pakistan. https://www.ndma.gov.pk/

Disaster Management Plan (DDMP) would ensure a proactive and data-driven approach to landslide mitigation.

- ***Floods***

The Bajaur District faces a high risk of flooding, primarily from sudden flash floods in its seasonal streams (locally known as khwars). The 2024 Summary Flood Risk Ranking by the PDMA categorizes Bajaur as "Medium to High Threat" with a likelihood score of 3 (on a scale of 1 to 5, with 5 being most frequent). While not an annual occurrence, the potential severity of a flood event is significant. The score of 3 reflects a moderate probability, meaning that damaging flash flood events are a recurring seasonal threat, particularly during intense monsoon rainfall.

The impact of potential floods on the population in Bajaur District is rated as Substantial, with a score of 3. This indicates that, in the event of a flood, the consequences for the population could be significant, particularly for riverside settlements. In alignment with the population impact, the potential impact on livelihood is also rated as Major, with a score of 4. This highlights that a flood event would have a severe effect on the livelihoods of the district's residents. The higher score reflects the acute vulnerability of local agriculture, livestock, and commerce to flash flooding, which could lead to considerable and recurring economic losses. The assessment rates the impact on infrastructure as Moderate Impact, with a score of 3. This suggests that the district's infrastructure, including key roads like the Bajaur-Thall route and bridges over seasonal streams, is vulnerable to damage from flash floods. The score of 3 implies that infrastructure in Bajaur District has significant vulnerability to flooding. The accessibility of the area during a flood is also rated as Major Impact, with a score of 4. This indicates that flood events are expected to significantly hinder access, as roads and transportation routes are often blocked or washed away, severely impeding emergency services and the supply of essential goods. The table below and figure below illustrate the flood risk ranking of Bajaur District. The PDMA ranking assigns a score of 45 out of 100, placing Bajaur in the "Medium to High Threat" category; the potential consequences for a significant portion of the population living near seasonal streams (khwars) cannot be disregarded. Proactive measures to address these vulnerabilities are essential to minimize the impact of potential flash floods on the community. The table below and figure below illustrate the flood risk ranking of Bajaur district.

Table 112: Flood Risk Ranking of 2024 – Bajaur District

District	Likelihood of flood event 1. Very Rare 2. Rare 3. Occasional 4. Frequent 5. Most Frequent	Impact on Population 1. Very Rare Impact 2. Rare Impact 3. Substantial 4. Major 5. Severe	Impact on Livelihood	Impact on Infrastructure	Accessibility of the Area	Risk Score	Risk Class
Bajaur	5	2	4	2	4	4.4	VERY HIGH

Source: Based on independent assessment of flood reports (2025 monson), adapted fron from PDMA KP mechoology.

- ***Forest Fires***

The Bajaur Forest Division reports that about 8,500 ha of forest / scrub land are under forest cover, which corresponds to approximately 6–7% of the district's area (129,000 ha). In Bajaur's dry-mountain environment, these forest patches are mainly thorn-scrub and sub-tropical scrub rather than dense woodland, which makes fire propagation less continuous, but also means individual patches may burn fully when ignition occurs.

At the provincial level, Khyber Pakhtunkhwa exhibits substantial forest-fire risk, with models indicating 53% of KP's area classified under high fire-risk zones using climatic and topographic predictors (temperature, wind, precipitation, slope) (Naseer et al., 2025). In KP's 2022 fire season, over 14,430 acres of forest and pasture lands were burned across multiple districts. Local reports from Bajaur have documented forest fire incidents in its eastern, scrub-covered hills, including firefighting efforts by local communities and Levies personnel to protect nearby villages.

Overall, while the absolute forest area in Bajaur is modest relative to other KP districts, the risk of forest fires remains moderate to high in vulnerable patches, especially during hot, dry months. The combination of climatic stressors, fuel buildup in scrubland, difficult access, and limited suppression capacity render these forested areas susceptible to fire.

6.10.2 Climate Change Risks

Bajaur District, sitting in the mountainous terrain of northern KP, is expected to experience intensifying thermal extremes under climate change, namely hotter summers (more frequent heatwaves) and milder winters (fewer cold extremes). A regional climate vulnerability assessment for the eastern Hindu Kush using CMIP6-driven climate projections indicates precipitation variability with more intense rainfall events and consistent temperature rises under SSP2/SSP5 by the end of the century (Masood et al., 2023). These changes translate into projected increased flash flood potential, with seasonal shifts and altered peak timing in its seasonal streams. This regional climate simulation provides a strong basis for expecting increased slope saturation, surface runoff stresses, and landslide triggering potential across

Empirical analyses in KP/ Northwest Pakistan also reveal shifting seasonal patterns: while mean rainfall shifts modestly, seasonal distribution and extreme events are becoming more erratic, and rising temperatures are affecting agro-ecology and human health (Nizami et al., 2020) researcherslinks.com. In Bajaur itself, climate change assessments within the regional infrastructure planning acknowledge that rising temperature extremes and shifts in precipitation patterns must be factored into hydrologic and infrastructure design (Bajaur Integrated Development Strategy, 2025) pecongress.org.pk[30].

Given Bajaur's elevation gradient and microclimatic variability, some tehsils at lower elevation (Nawagai, Khar) may face more severe heat stress (e.g. more days above 35–38 °C) than higher zones. Conversely, winter cold spells, including frost and very cold nights, may reduce in frequency, reducing risks of freeze damage but also affecting traditional cold-weather livelihoods, chilling needs, and snow-based hydrology. The combined effect is that differential vulnerability emerges: houses built for cold may become overheated; crop varieties suited for cold may lose viability; and vulnerable population groups (elderly, children, those without cooling or heating) will suffer more.

6.10.3 Winter Hazard Risk Assessment

About Winters, the Winter Contingency Plan 2023-24 puts Bajaur district at Low to Moderate Risk during the winters, however, the scoring is composite of various winter hazards. Table below illustrates the scoring different hazards in winter.

The winter hazard analysis gives Bajaur District the Composite Risk Score of 8. Snowfall, avalanches, and landslides are not significant threats, each scoring 0, indicating these events are either nonexistent or extremely rare in the district. Extreme cold and fog/smog both score 1, suggesting minimal impact on public health or transportation. The forecasted winter severity also holds a low score of 1, indicating mild overall winter conditions. However, heavy rainfall stands out with a score of 4, representing the highest risk among the hazards assessed, potentially leading to flash flooding in valleys. Despite this, the overall winter risk for Bajaur District remains Low to Moderate, reflecting a generally stable winter environment with limited but notable threats to infrastructure, livelihoods, and population safety.

Sr. No.	Winter Hazard	Score
1	Snowfall(A)	0
2	Extreme Cold, Cold Waves (B)	1

[30] Pakistan Engineering Congress. (n.d.). *Pakistan Engineering Congress*. Retrieved October 10, 2023, from https://www.pecongress.org.pk

3	Avalanches (C)	0
4	Landslides (D)	0
5	Heavy Rainfall (E)	4
6	FOG/SMOG (F)	1
7	Forecast- ed Winter Severity (G)	1
8	Composite Risk Score (A+B+C+D+E+F+G)	7
9	Risk Level	Low to Moderate

Source: Winter Contingency Plan 2023-24, Provincial Disaster Management Authority, KP

6.10.4 Vulnerability & Risk Assessment (Tehsil-wise)

Bajaur District exhibits multi-hazard vulnerability, primarily to flash floods, landslides, and cloudburst events, driven by its rugged topography, unregulated settlements, and intense monsoon precipitation. Nawagai, Mamund, and Khar tehsils demonstrate the highest exposure due to dense population clusters along steep valleys and flood-prone channels, while Utmankhel and Barang remain moderately vulnerable owing to limited drainage and weak slope stability. The district's overall resilience is constrained by fragile infrastructure, inadequate early warning systems, and poor land-use planning, necessitating integrated disaster risk reduction and climate adaptation interventions.

In Nawagai Tehsil, a cloudburst in 2023 triggered floods and landslides, destroying houses and causing reported deaths. In Nawagai & Mamund (within Bajaur), torrents and landslides swept through villages during intense rains, destroying infrastructure, cutting off roads, and damaging homes. The Watalai watershed study in Bajaur attributes flash floods to both intense rainfall and anthropogenic modifications (encroachment, poor infrastructure) — relevant as many tehsils likely share similar catchment vulnerabilities.

Table 113: Tehsil-wise Hazard Identification of Bajaur District

Tehsil	Major Natural Hazards	Key Vulnerability Factors / Observations	Vulnerable Areas / Groups
Bar Chamar Kand	• Flash floods • Cloudbursts • landslides	Small area; steep terrain; limited drainage capacity; vulnerable to sudden runoff from upstream	Small settlements, road segments, bridges
Barang Tehsil	• Flash floods • landslides	Rivers / streams passing through; slope margins; encroachment into flood plains	Communities near streams, terraced slopes
Khar Bajaur Tehsil	• Flash floods • landslides, • Urban inundation	As district HQ, higher density, mixed slope/valley, more infrastructure exposed	Town areas, critical infrastructure, schools, hospitals

Mamund Tehsil	• Flash floods • Landslides • drought	Upstream zones, steeper terrain, potential water scarcity in dry season	Remote villages, hillside farmers, pastoralists
Nawagai Tehsil	• Flash floods • landslides	Lower elevation relative to high slopes, but receiving drainage from upstream	Settlements in transition zones, floodplain dwellers
Salarzai Tehsil	• Flash floods • Cloudburst • flooding, • landslides	Steep catchment areas; highly vulnerable to sudden, intense rainfall events leading to rapid runoff	Villages in vulnerable catchment areas, infrastructure, poor housing
Utman Khel Tehsil	• Flash floods, • landslides, • runoff/slope failure	Eastern slopes draining toward Panjkora catchment; modest slope gradients but still exposed to runoff surges	Settlements near valley bottoms, roads, bridge crossings

Source: Devised by Consultant

6.10.5 Institutional Framework

The institutional framework for early warning system, disaster preparedness, mitigation and response are;

- District Disaster Management Authority (DDMA Bajaur) as lead.
- Coordination with PDMA KP, Rescue 1122, Health, Police, Education, Forest, and Local Government**.**
- **Community Disaster Management Committees (CDMCs) in each Tehsil**.
- Integration with NGOs, UN agencies, and civil society.

6.10.6 Available Relief Stock

According to PDMA every district is equipped with a certain amount of relief equipment which is available in case of emergency. Below is the list of available stock.

Table 114: Availability of Stock of District Bajaur

Stock	Quantity
Tables	116
Blankets	215
Cooler	50
Buckets	75

Net Mosquito	235
Quilts	225
Cylinder	53
Kitchen Set	200
Hygiene Kit	100
Plastic Matts	40
Daris	50
Tarpaulin Sheets	100

Although several items, such as tents, chairs, soap, and other essentials, are missing, the overall stock is reasonably well-equipped, as the district experiences relatively fewer hazards.

6.10.7 Interventions for reduction of Natural Hazards Vulnerability and Impacts in Bajaur District, KP

For effective management of natural disasters, the following interventions are required to be initiated and require continuous actions throughout the implementation period at District Bajaur;

Intervention 1: Strengthening the functional disaster management cell at the district level

Intervention 2: Prepare disaster management plans for each tehsil

Intervention 3: conduct hazards and vulnerability assessments

Intervention 4: infrastructure development for Disaster Risk Reduction

Intervention 5: Establish Emergency Response System

Intervention 6: Capacity Building for Post-Disaster Recovery

The detailed phase and disaster-specific proposal is provided in Table 5.

- ***Short Term***

- Install community-level early warning systems for flash floods.
- Conduct monthly disaster preparedness drills, especially in snow-affected southern areas.
- Fill critical gaps in relief stock (tents, soap, chairs, medical kits).
- Ensure decentralized storage for quick access in remote valleys.
- Awareness campaigns on earthquake safety and winter hazard preparedness.
- Train local volunteers as first responders for snow emergencies and landslides.

- ***Long Term***

- Develop a multi-hazard risk mapping system (GIS-based) for earthquakes, floods, and winter risks.
- Promote land-use planning to prevent settlements in high-risk flash flood zones.
- Support climate-resilient agriculture in Tirah and other valleys.
- Introduce alternative livelihoods to reduce dependency on vulnerable mountain farming.
- Invest in climate-smart housing and earthquake-resistant designs for new settlements.

Table 115: Detailed Natural Hazards Risk Management Framework for Bajaur District (2025–2045)

Hazard Type	Timeframe	Capacity Building	Infrastructure / Engineering	Afforestation / Environmental	Early Warning & ICT	Community Engagement	Responsible Department(s)
Earthquakes	Short-Term (2025–2030)	Train 500 volunteers & teachers in earthquake drills	Rapid safety audit of 50 schools & 10 health centers	N/A	Establish SMS & mosque-based alerts in 4 Tehsils	Awareness sessions in 30 villages	DDMA, Education, Health, Rescue 1122
	Medium-Term (2030–2035)	Advanced training for 200 engineers & masons in seismic construction	Retrofit 30 schools & 5 hospitals		Install seismic monitoring stations in each Tehsil	District-wide earthquake simulation exercises	PDMA, C&W Dept., Building Authority
	Long-Term (2035–2040)	Institutionalize DRM curriculum in all schools & colleges	100% new govt. buildings earthquake-resilient		Research & monitoring hub establishment in Peshawar/Bajaur	Regular district-wide preparedness campaigns	MoCC, Academia
Landslides	Short-Term	Train 200 locals as slope watch volunteers	Slope stability surveys in all Tehsils, and identification of high risk areas	Small-scale reforestation of 200 ha	GIS hazard mapping (pilot)	20 community workshops	DDMA, C&W, Forest Dept.
	Medium-Term	Training 50 technicians in slope stabilization methods	Build check dams & retaining walls	Reforest 1,000 ha on degraded slopes	Expand GIS mapping to all Tehsils	School awareness in high-risk zones	Forest Dept., PDMA
	Long-Term	Institutionalize slope risk management at DDMA	Climate-resilient road standards in all Tehsils	Reforest 5,000 ha by 2040	District-wide landslide monitoring	100% communities integrated in CDMCs	NHA, Forest, DDMA
Floods / Flash Floods	Short-Term	Train 1000 community members in evacuation drills	Identify 20 flood shelters; stockpile 3-month rations	Rehabilitate riverbank vegetation (50 km)	SMS alert pilot in Nawagai & Khar	Safe school programs	Irrigation, PDMA, Rescue 1122
	Medium-Term	Training 100 engineers in flood defense design	Build 15 embankments & 10 drainage improvements	Expand riverbank rehabilitation to 100 km	Install 20 hydrological monitoring stations	Community-based flood warning system	Irrigation, C&W
	Long-Term	Institutionalize flood response in DDMA	Large-scale flood protection covering 250 km	Integrated watershed management	District-wide flood forecast center	Annual flood preparedness drills	PDMA, Irrigation

Drought & Water Scarcity	Short-Term	Train 500 farmers in water conservation	Install 200 rainwater harvesting tanks	N/A	Awareness campaigns on water saving	Women water committees in 20 villages	Agriculture, PHE, NGOs
	Medium-Term	Training in climate-smart agriculture	Build 20 reservoirs & check dams	Plantation along water channels (500 ha)	Pilot groundwater monitoring	Youth mobilization programs	Irrigation, Agriculture
	Long-Term	Integrate drought management in education curricula	District-wide water supply network	Afforestation of 2,000 ha for water recharge	GIS-based water resource monitoring	100% union councils with water user associations	MoCC, Irrigation
Forest Fires	Short-Term	Train 200 volunteers in firefighting	Fire breaks in 100 ha	Reforest 500 ha with fire-resistant species	Community hotlines	Fire watch groups in 50 villages	Forest Dept., DDMA
	Medium-Term	Training of 100 forest guards	Watchtowers in 5 hotspots	Reforest 2,000 ha	Satellite-based monitoring pilot	Village-level fire management plans	Forest, PDMA
	Long-Term	Institutionalized fire training in KP Forest School	District fire risk monitoring system	Reforest 10,000 ha with resilient species	GIS + drones for fire detection	District-wide forest user committees	KP Forest Dept.
Snowfall / Extreme Weather	Short-Term	Train 200 responders in snow rescue	Pre-position 50 winter relief kits	N/A	Weather alerts through FM radios	Awareness in Mamund & Salarzai schools	C&W, DDMA
	Medium-Term	Build local capacity in snow clearance	Snow clearance equipment at 3 key passes	N/A	District weather stations	Community winter task forces	NHA, PDMA
	Long-Term	Establish mountain hazard training center	Climate-adaptive housing in uplands	N/A	Regional weather monitoring center	Institutionalized resilience programs	MoCC, C&W
Climate Change	Short-Term	Train 200 DDMA officials in adaptation, Establishing weather monitoring stations in each Tehsil	Developing regulations for vulnerability and high risk areas constructions	Pilot 200 ha afforestation	Awareness on climate change	Student eco-clubs	MoCC, PDMA
	Medium-Term	Establishing weather simulation laboratory, Academic training programs (climate resilience, adaptation, mitigation)	Mainstream resilience in 50% of projects	Expand afforestation to 2,000 ha	GIS-based climate data sharing	NGO-led campaigns	KP Climate Change Dept.
	Long-Term	adaptation to Climate resilience Farm practices, infrastructure development	atleast 80% infrastructure climate-proof	promoting urban forestry	Regional climate department	Youth-led climate action networks	MoCC, Academia

6.11 PHYSICAL ENVIRONMENTAL STUDY

6.11.1 Introduction

Increasing development and industrialization in global emerging markets have led to rapid migration from rural areas, escalating poverty and significantly undermining the environmental and social stability of underdeveloped regions. These issues are further exacerbated by political instability. At the same time, climate change, environmental challenges, and natural disasters are becoming more intense, increasing the vulnerability of people who rely on ecosystem goods and services for food and livelihood. These problems in rural and underdeveloped areas highlight the need for durable solutions to complex economic, political, environmental, and social challenges.

Pakistan inherited the Federally Administered Tribal Areas (FATA) in 1947 following partition. Spanning about 27,224 square kilometers along the northwestern border of the country, the FATA region along the Durand Line is considered one of the most volatile regions. Historical political conflicts and the presence of terrorist groups have hindered the region's development. Despite its beautiful landscape, the region has experienced environmental degradation and biodiversity loss due to high poverty levels, climate change, poor legal and governance structures, and urban sprawl.

In 2017, the federal government proposed merging FATA with the adjacent Pashtun-dominated Khyber Pakhtunkhwa (KP) province, a move supported by a majority of political parties and the tribal areas. The merger was officially accepted in 2018. Considering these developments, the Government of Khyber Pakhtunkhwa now aims to develop the urban areas of the merged districts into sustainable, livable, and well-managed engines of economic growth.

6.11.2 Environmental Governance Legal Framework

The 25th Constitutional Amendment serves as the legal foundation for integrating and expanding all state institutions and legislations into the Merged Districts. Finalized in May 2018, the FATA Reform Bill, known as the 25th Amendment, merged FATA with Khyber Pakhtunkhwa (KP), fundamentally changing FATA's constitutional status. The administrative system underwent significant changes following the merger, eliminating the colonial legacy of political administration under the discretionary powers of political agents. The offices formerly known as political agents were re-designated as Deputy Commissioner and Assistant Commissioner, and the oppressive Frontier Crimes Regulation (FCR) was abolished.

Before the merger, the executive authority over FATA was exercised by the governor of KP. Post-merger, this authority shifted to the chief minister and his cabinet, and the merged areas no longer retained a special status. All provincial laws now apply equally to these areas, and FATA received due representation in the provincial assembly with about 16 general seats out of 21, including 4 seats for women and 1 seat for non-Muslims. Prior to the merger, the 1973 Constitution provided FATA with a unique yet legally inferior status. According to Article 1, FATA was considered a separate entity within the country, like the four provinces. Article 246 placed the president of Pakistan as the constitutional head and chief executive of the tribal

areas. However, following the merger, Clause 'C' of Article 246, which dealt with the tribal areas, was omitted, and Article 247, which granted discretionary powers to the president, was also removed.

Before 2018, FATA was governed by the Frontier Crimes Regulations, a set of laws enacted in 1901 by the British Empire to manage Pashtun revolutionaries. Decades of conflict and poor administrative and governance setups had left the region vulnerable and deprived, affecting local people's health, education, and livelihoods. Since 2000, FATA's development priorities and resource allocation were primarily guided by various charters, but these efforts were often insufficient to address the region's complex challenges. The merger with KP marked a significant step towards improving governance, development, and integration of these historically neglected areas.

6.11.2.1Environmental Governance Legal Framework: Enforcement and Effectiveness

Following the 25th Constitutional Amendment, all environmental laws of Khyber Pakhtunkhwa, including the Khyber Pakhtunkhwa Environmental Protection Act, 2014, are now applicable in the Merged Districts. The Environmental Protection Agency (EPA) is mandated to enforce these regulations through mechanisms such as Environmental Impact Assessments (EIAs), pollution control measures, and regular monitoring. However, enforcement in the Merged Districts remains weak and inconsistent due to several challenges:

- Institutional limitations, such as inadequate staffing, lack of field presence, and insufficient funding for EPA operations in remote regions.
- Low public awareness about environmental laws and citizens' rights to a clean environment, leading to minimal community reporting or compliance.
- Limited coordination between district administration, EPA, and other line departments on land use, industrial development, and resource management.
- Absence of local-level environmental monitoring units or field offices in most tehsils, reducing the state’s ability to act on violations.

Critical Analysis of Enforcement Mechanisms: The EPA relies on quarterly inspections and EIAs, but with only 10 officers across Bajaur, coverage is limited to major sites like Khar, leaving remote areas unchecked. Fine imposition occurs in 20% of violations, yet collection rates are below 30% due to logistical delays and lack of follow-up, per 2024 EPA data. Funding shortages restrict monitoring to PKR 5 million annually, insufficient for 10 tehsils.

Effectiveness Assessment: Effectiveness is low, with illegal dumping reported at 5 of 10 disposal sites in 2023, and air pollution in Khar exceeding safe limits by 20% (KP EPA 2024). Political interference has delayed 40% of legal proceedings, undermining preventive measures. Weak enforcement contributes to a 15% annual degradation of forest cover, per satellite analysis.

Effectiveness is further constrained by informal power structures and political interference, which often obstruct legal proceedings or inspections. Without localized enforcement protocols and capacity-building for both officials and communities, the existing framework remains largely reactive rather than preventive. To improve effectiveness, the following steps are recommended:

- Establish 5 district-level EPA units by 2026, each with 5 trained staff and vehicles, targeting 80% violation coverage.
- Integrate environmental compliance requirements into local development planning and approval processes.
- Conduct bi-annual community awareness campaigns and school-level environmental education, aiming to increase awareness by 30% by 2027.
- Develop cross-sector enforcement teams involving local government, forest, irrigation, and public health departments for joint monitoring.

6.11.2.2Environmental Legal Landscape at National Scale

The Government of Pakistan has taken concrete steps towards the protection of the environment in the shape of passing the Pakistan Environmental Protection Act (PEPA), 1997. Later, after the passage of the 18th constitutional amendment in 2010 which devolved the subject of the environment from the federal government to the provincial government, the government of Khyber Pakhtunkhwa (KP) passed its own environmental protection law called Khyber Pakhtunkhwa Environmental Protection Act (KPEPA), 2014. The province got an exclusive power-related environment. All the provincial governments then subsequently passed their own environmental protection laws and the government of KP was the last to legislate its own KPEPA, in 2014. It is almost an amended and modified act of PEPA, 1997 with certain changes, keeping in view new experiences.

Critical Analysis of Enforcement Mechanisms:

- Add a paragraph linking national enforcement to MDs: "At the national level, PEPA 1997 mandates EPAs to enforce NEQS, but in MDs, this is hampered by the absence of local EPA offices, with only 5% of national monitoring resources allocated to Merged Districts as of 2024."
- Note inefficiencies: "The Ban on Polythene Bags Regulations 2019 is enforced in urban KP but lacks implementation in Bajaur, where 60% of markets still use plastic bags."

Effectiveness Assessment:

- Assess national policy impact: "The National Water Policy 2018 aims to improve conservation, but in Bajaur, water quality testing occurs only annually, missing 70% of contamination incidents due to limited EPA reach."
- Suggest a connection: "This gap suggests that devolved powers post-18th Amendment have not yet translated into effective local enforcement."

Enhanced Recommendations:

- Tie to MDs: "Allocate 10% of national EPA funding to MDs by 2026 to establish monitoring stations, targeting a 50% reduction in compliance gaps."

6.11.2.3Environmental Laws/ Rules/ Regulations/ Policies at National Level

Pakistan's Vision 2025 recognizes the vital role of creative, smart, and green cities in driving economic growth and achieving sustainable development. The vision acknowledges climate change as a significant threat, with its impacts including more frequent and intense floods, droughts, and a decline in biodiversity and natural resources. There is a strong national consensus, reflected in the manifestos of all leading political parties, to allocate substantial new resources through public and private sector collaboration to address these challenges. This commitment includes ensuring adequate production and storage capacities while focusing on conservation, efficient resource distribution, and usage, as well as preventing contamination and environmental degradation.

The Pakistan Penal Code addresses offenses that affect public or private property and human lives due to intentional or accidental misconduct by individuals or groups. Regarding environmental issues, the Penal Code empowers local authorities to regulate individuals based on relevant laws. The Pakistan Environmental Protection Act (PEPA) of 1997 was the first comprehensive environmental law in the country, establishing a regulatory framework for environmental protection, preservation, conservation, treatment, and rehabilitation. It aims to prevent or control pollution and promote sustainable development.

The Constitution of Pakistan has significantly redefined the division of legislative powers between the National and Provincial Assemblies, enhancing provincial autonomy. Following the approval of the 18th Amendment, environmental regulatory powers were delegated to the Provincial Environmental Protection Agencies and Departments (EPAs/EPDs). The table below outlines the various laws, rules, regulations, policies, strategies, and standards present at the national level (highlighted in light green) and their applicability to the provinces. The frameworks in grey color depict those which are either adopted as it is, or similar drafts are available at the provincial scale.

Table 116: Environmental Laws/ Rules/ Regulations/ Policies at National

Acts	Rules	Regulations	Policies	Strategies	Guidelines	Standards
Pakistan Environmental Protection Act 1997	The compound of Offences and Payment of Administrative Penalty Rules October 2015	Pakistan Environmental Protection Agency Ban on (Manufacturing, Import, Sale, Purchase, Storage, and Usage) Polythene Bags Regulations, 2019	National Environmental Policy, 2005	Pakistan National Conservation Strategy, 1992	Guidelines for Sensitive Areas	National Environment Quality Standards (NEQS) 2010
Cutting of Trees Act, 1975	Pakistan Biosafety Rules 2005	National Environmental Quality Standards (Certification of Environmental Laboratories) Regulations, 2000	National Climate Change Policy 2012	Clean Development Mechanism (CDM), National Operational Strategy	Guidelines for Public Consultation	
The Forest Act 1927	Self-Monitoring and Reporting by Industries Rules, 2001	Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000	National Forest Policy Pakistan, 2001			
Pakistan Trade Control of Wild Fauna and Flora Act, 2012	Hospital Waste Management Rules, 2005		National Water Policy, 201831			
	The Pollution Charge for Industry (Calculation and Collection) Rules, 2001					
	Environmental Samples Rules, 2001					
	Environmental Tribunal (Procedure and Functions) Rules, 1999					

[31] National Water Policy 2019, Section 21(1)

This structured approach reflects Pakistan's commitment to tackling environmental challenges through comprehensive legislation and collaborative efforts across different levels of government and the private sector.

6.11.2.4Environmental Legal Landscape at Provincial Scale

Environmental management and regulation have not been in practice in the MDs, as the ecological legislation has only recently been extended to the Areas after the 25th Constitution amendment. Therefore, an Environment Cell is established, as an ad hoc arrangement, at the NMD Secretariat, financed by the Swiss Agency for Development and Cooperation (SDC) and managed by IUCN Pakistan.[32] This Environment Cell is set up to provide the following tasks:

- Environmental review of public sector schemes
- Environmental awareness and education
- Baseline studies

Currently, a proposal (PC-1) to establish an Environment Directorate within the Khyber Pakhtunkhwa Environmental Protection Agency (KP EPA), dedicated to the Merged Districts (MDs), is in the approval process. [33]

In the MDs, the Forest Directorate of the FATA Secretariat[34] It primarily deals with forest management (including non-timber forest products) and wildlife conservation. However, the existing capacity of the technical staff is limited, and very few conservation and management efforts have been taken, except for an extensive tree plantation drive.[35] Moreover, community involvement in sustainable resource management and conservation efforts is low. A strong commitment at the local scale and participation of the private sector (public-private partnerships) are essential to achieve sustainable development in the region. Literature suggests that the mining, extractive, and manufacturing industries are operating without adhering to environmental quality standards due to the absence of a regulatory regime (institutions and legal framework) in all MDs (including Orakzai), which has negatively impacted the environmental quality of the area.[36] However, the KP-FATA merger is an opportunity to manage environmental resources under the ambit of KP and the national legal framework, when and where required.

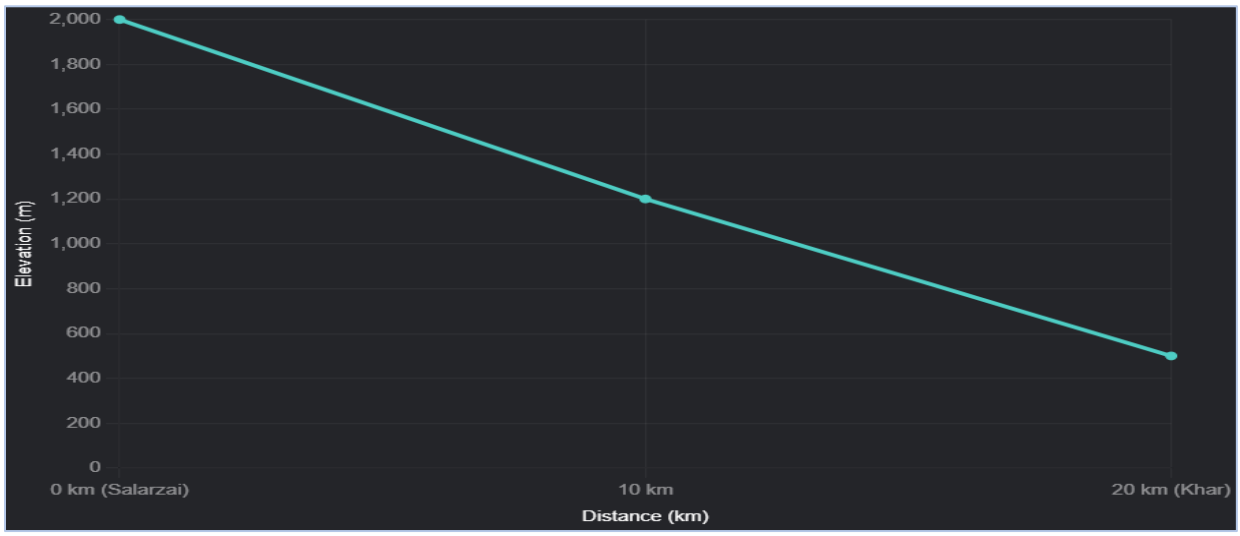
[32] Technical Studies of Water Resources in FATA. 2019. FATA Water Governance Project, FATA Environment Cell. IUCN. pp. 130.
[33] Government of Khyber Pakhtunkhwa. 2019. Tribal Decade Strategy (2020 -2030). Planning & Development Department, GoKP.
[34] Upgraded to the Directorate in 2006 from the FATA Forest Circle, which was there since 1976. It is headed by Conservator Forests. Government of Khyber Pakhtunkhwa. 2019. Tribal Decade Strategy (2020 -2030). Planning & Development Department, GoKP
[35] Government of Khyber Pakhtunkhwa. 2019. Tribal Decade Strategy (2020 -2030). Planning & Development Department, GoKP.
[36] ibid

6.11.3 Physical Characteristics

6.11.3.1Physiography and Geology

Bajaur District, formerly a part of the Federally Administered Tribal Areas (FATA), is situated in the northwestern part of Pakistan, adjacent to Afghanistan. The district spans approximately ***45 miles*** (72 km) in length and ***20 miles*** (32 km) in width, making it the smallest district in the region. The Bajaur District is mountainous and is probably most famous for its rugged elevations, which range from 500 meters in the Panjkora Valley to peaks, such as Koh-i-Mor, reaching up to 2,000 meters. The tehsils in the northern parts of the district, such as Salarzai, have steep slopes, whereas the southern part, for example, Khar, is flatter. Bajaur has some regional characteristics because it shares geology with the Kohistan Arc, within which sedimentary and metamorphic rocks dominate; significant deposits of marble are spread in areas like Nawagai. The Panjkora River runs through the valley, creating very fertile alluvial plains but also accompanying flood hazard risks during the monsoon.

To better depict the district in a delineated form, an extensive map showing the topography of the district would be included in the form of a topographic map with elevation contours at 100-meter intervals across Bajaur's 1,290 km² area. Such a map would portray major features, including the 2,000-meter Koh-i-Mor peak in Salarzai, the 500-meter lowlands near Khar, and the path of the Panjkora River. Likewise, a cross-sectional diagram below, showing elevation changes from north (Salarzai) to south (Khar), would help visualize the steep gradients, where slopes average 15% in the north versus 2% in the south.
For simplicity transmission, the chart below illustrates the variation of elevation along a 20 km north-south transect through Bajaur:



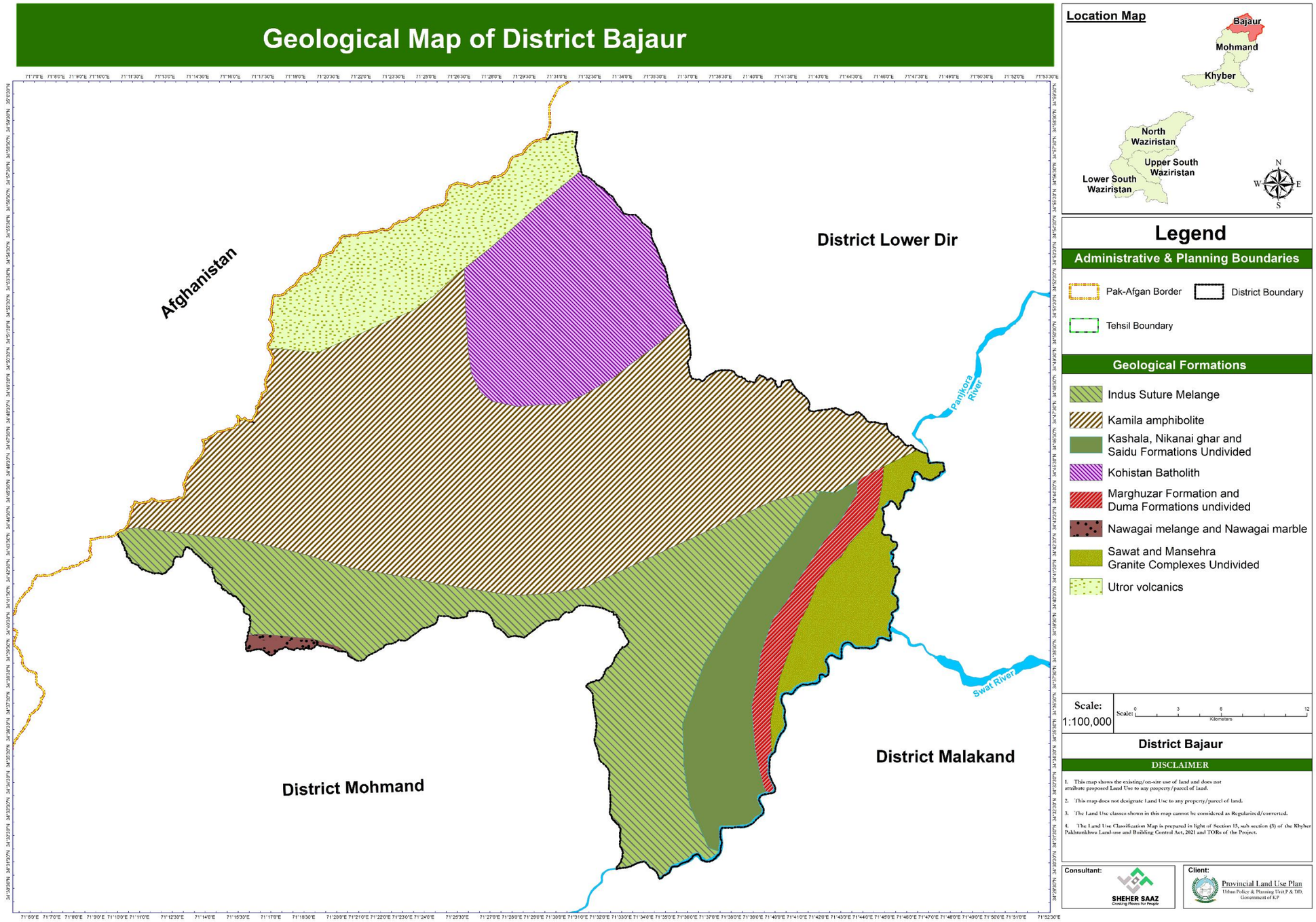
One of the prominent geographical features of Bajaur is the Panjkora Valley, through which the Panjkora River flows. This river is a significant water source for the district, supporting both agriculture and the local ecosystem. The district's topography is further defined by the mountain spurs from the Kunar range, which create a series of ridges and valleys. The drainage pattern in Bajaur is primarily eastward, with watercourses originating from the eastern slopes of the dividing ridge that overlooks the Kunar Valley in Afghanistan. These watercourses eventually converge into the Panjkora River, creating a natural slope that descends from the highlands towards the river.

In addition to its mountainous terrain, Bajaur also features fertile plains, particularly in the lower elevations. These plains are vital to the district's agricultural activities, as they provide suitable conditions for cultivating a variety of crops. The contrast between the high mountain peaks and the arable plains contributes to the district's diverse landscape.

The geological framework of Bajaur is significantly influenced by its location within the Hindu Kush Mountain range. The region's geology is complex, comprising a range of rock types that reflect its dynamic tectonic history. The mountains in Bajaur are primarily composed of metamorphic and sedimentary rocks, including schists, gneisses, and limestone. These geological formations are indicative of the area's ancient geological processes, including the collision and uplift associated with the Indian and Eurasian tectonic plates.

The Panjkora River and its tributaries have played a crucial role in shaping the district's geology. Over time, these rivers have carved out deep valleys and transported sediments, contributing to the development of fertile alluvial plains in certain areas. The district's soil composition varies, with more fertile soils found in the valleys and plains, supporting the local agriculture.
Bajaur's geology also includes significant mineral resources. The district is known for its deposits of marble, limestone, and chromite. These minerals are not only of economic importance but also contribute to the district's geological diversity. The extraction and processing of these minerals, however, requires careful management to minimize environmental impacts and ensure sustainable development.

Map 58: Geological Map - District Bajaur



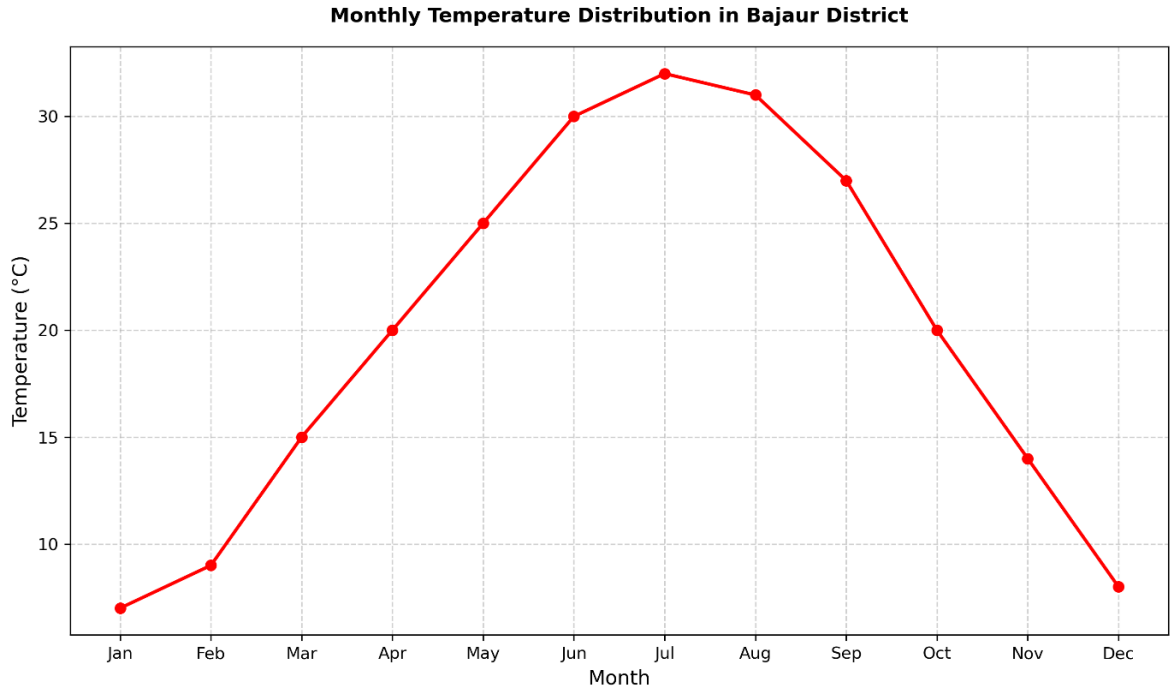
6.11.3.2Climate

The climate of District Bajaur is generally characterized as arid to semi-arid, with hot summers and cold winters. The summers are hot and dry, with temperatures often exceeding 40°C (104°F). The winters are cold, with temperatures dropping below freezing point, and the region occasionally experiences snowfall.

- ***Temperature***

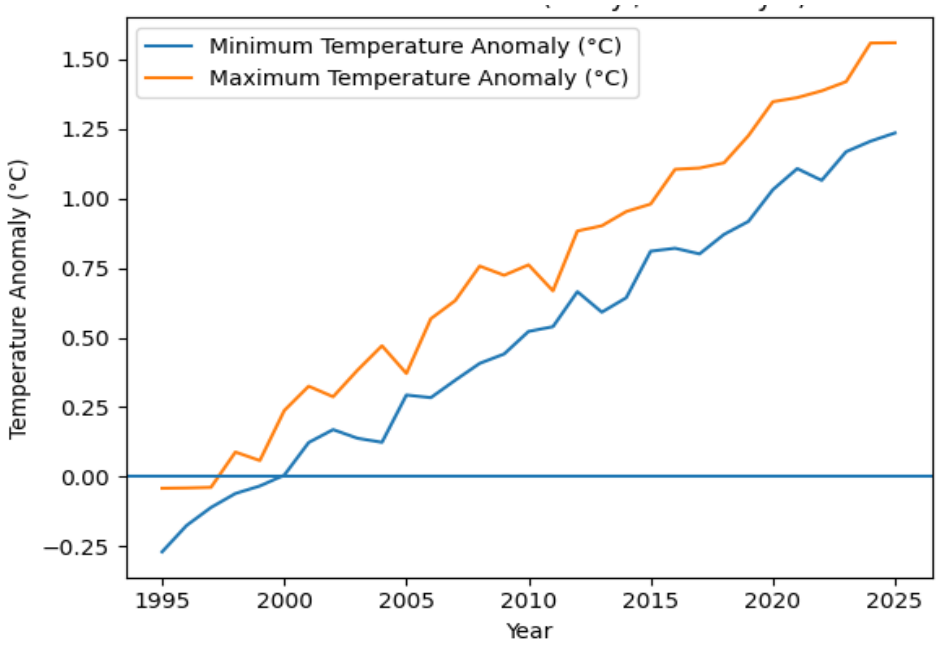
Temperature in Bajaur District is like that found in KP, being mild in the south but colder in the north which is mountainous. According to statistics, the yearly temperature in Bajaur increases from around 5°C in winter to 35°C during the summer months. Usually, January is the coldest month and the temperature in mountainous regions averages 5–10°C around this time. In June and July, temperatures in Khar, the main town in Bajaur, usually reach between 30 and 35°C. March–April and October–November are usually comfortable with daytime temperatures ranging from 15–25°C. Temperatures increase beginning in March, are at their highest in mid-summer and gradually fall toward December. With no complete monthly data from Bajaur, this pattern suggests the same pattern found across KP, where the north or Hindu Kush zones are much cooler than the south.[37]

Figure 27: Monthly Temperature distribution pattern – District Bajaur



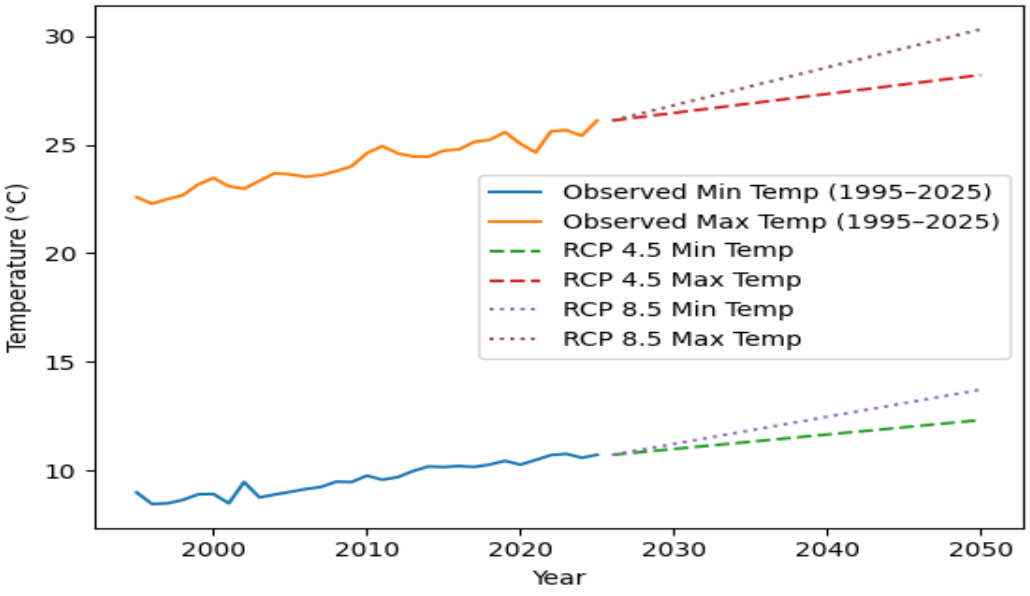
[37]Pakistan Meteorological Department.
Spatio-temporal characteristics of meteorological drought in Khyber Pakhtunkhwa, Pakistan
Wikipedia, Climate of Pakistan.
WorldData.info, Climate in Khyber Pakhtunkhwa.

Figure 28: Temperature Anomalies (1995-2015) (ERA5)



Under mid-century warming projections, Bajaur's rangeland-dominated and agriculture-based production systems are expected to experience systemic climate stress, driven by sustained increases in both minimum and maximum temperatures. Elevated maximum temperatures will intensify evapotranspiration rates, leading to soil moisture deficits, reduced rangeland biomass productivity, and increased risk of pasture degradation, particularly under RCP 8.5. Concurrent increases in minimum temperatures will reduce nocturnal cooling, affecting crop phenology, yield stability, and livestock heat stress thresholds, while increasing pest and vector survival rates

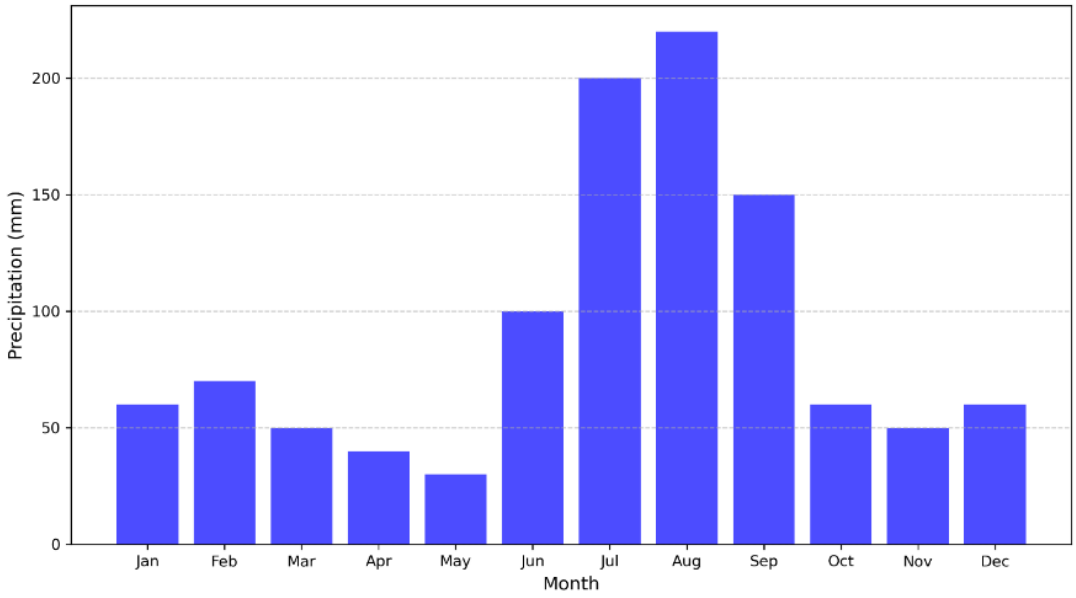
Figure 29: Temperature Projection for Mid-century scenario under RCP 4.5 and 8.5



- ***Precipitation***

The district's location is close to the Hindu Kush and in a monsoon-affected region which results in much greater seasonal changes in precipitation. Most rain in the district falls either during the summer monsoon (from June to September) or as winter western depressions. A normal year sees Bajaur's rainfall between 600 and 1000 mm. In July and August, the area typically gets a lot of rain, between 150 and 250 millimeters, mostly because of the monsoon season. In the winter, the months of December to February add 50 to100 mm per month and you may see snow falling in places at high elevations. The drier seasons, spring and autumn, have monthly rainfall from 30 to 60 mm, as average. In recent years, dry times have increased in KP due to climate change which could influence the farming industry in Bajaur.

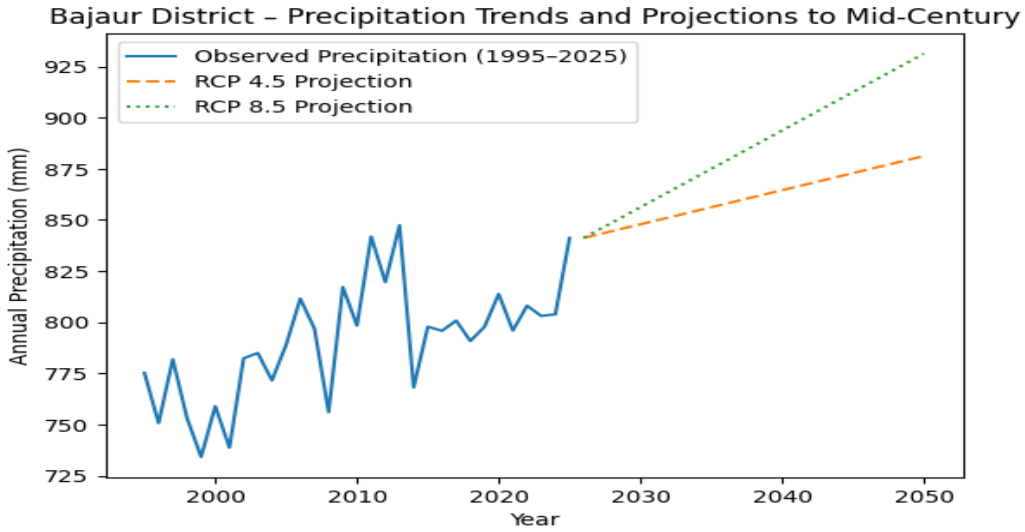
Figure 30: Monthly precipitation distribution pattern – District Bajaur[38]



Historical period (1995–2025) shows moderate inter-annual variability, typical of a semi-arid to sub-humid mountainous region, with precipitation largely concentrated in monsoon and winter westerly systems. Under RCP 4.5, projections indicate a gradual increase in average annual precipitation by mid-century, suggesting slightly wetter conditions but with continued seasonal concentration. Under RCP 8.5, precipitation increases are more pronounced, accompanied by greater variability, implying a higher likelihood of intense rainfall events interspersed with dry spells. This shift increases the risk of flash flooding, soil erosion, rangeland degradation, and runoff losses, particularly in steep catchments, while not necessarily improving effective soil moisture availability for agriculture.

Figure 31: Precipitation Projection for Mid century scenario under RCP 4.5 and 8.5

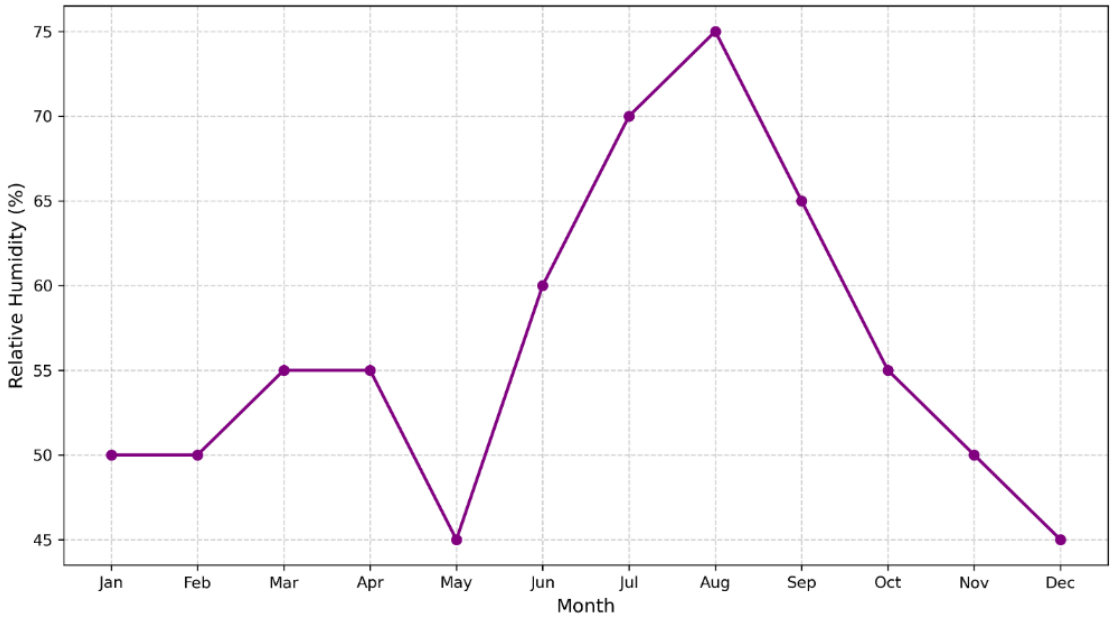
[38] Pakistan Meteorological Department.
Spatio-temporal characteristics of meteorological drought in Khyber Pakhtunkhwa, Pakistan
Wikipedia, Climate of Pakistan.
WorldData.info, Climate in Khyber Pakhtunkhwa.



- ***Humidity***

Because it has a monsoon-affected climate, Bajaur District experiences different levels of humidity throughout the year. According to the regions, the monsoon season (June–September) has the highest humidity, around 60–75%, because of the combination of heavy rain and warm weather that happens most in July and August.

Figure 32: Monthly humidity distribution pattern – District Bajaur[39]

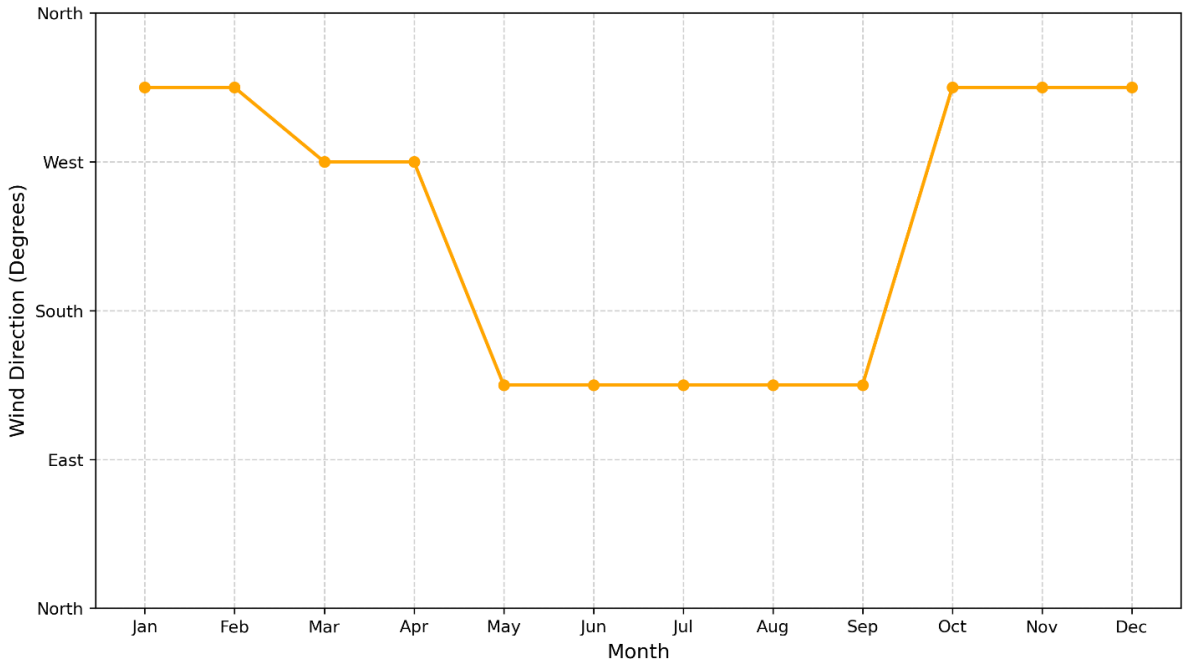


- ***Wind direction***

[39] Pakistan Meteorological Department.
Spatio-temporal characteristics of meteorological drought in Khyber Pakhtunkhwa, Pakistan
Wikipedia, Climate of Pakistan.
WorldData.info, Climate in Khyber Pakhtunkhwa.

Its highlands and seasonal turning of weather help design the wind direction of Bajaur District. Between June and September, warm, wet air from the Bay of Bengal, blown from the southeast, causes rainfall in the region. Winds from the northwest are dominant in December to February and in post-monsoon October to November, carrying dry air from Indo-Gangetic or Central Asia, according to studies of the KP region. During spring (March–May), there is a transition in sea breezes and their direction often shifts due to valley shapes, so they can flow in these places. Up-valley winds blow through the mountains in the day, whereas at night, down-valley winds take over.

Figure 33: Monthly wind direction – Bajaur District[40]

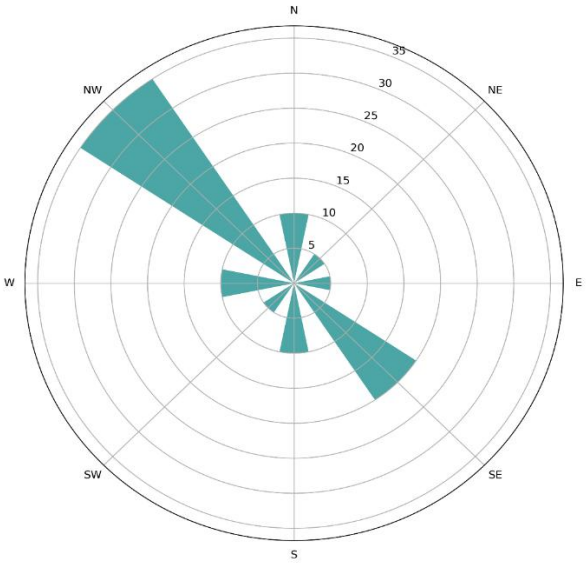


- ***Prevailing wind direction***

During the winter and post-monsoon times, the climate of KP shows that the main wind direction at Bajaur District is northwesterly as a result of local circulation and frequent western disturbances. In monsoon season, southwest winds are in charge, following the pattern of normal trade winds for South Asia. Climatic patterns in the KP region are in line with the main global wind systems which are controlled by mid-latitude westerlies and the monsoon. Certain topographical factors around Bajaur such as being close to the Hindu Kush and many valleys, can make the winds eddy and cause wild currents through the passes. Similar wind roses say northwesterly winds happen most often each year, while southeast winds reach their highest in summer.

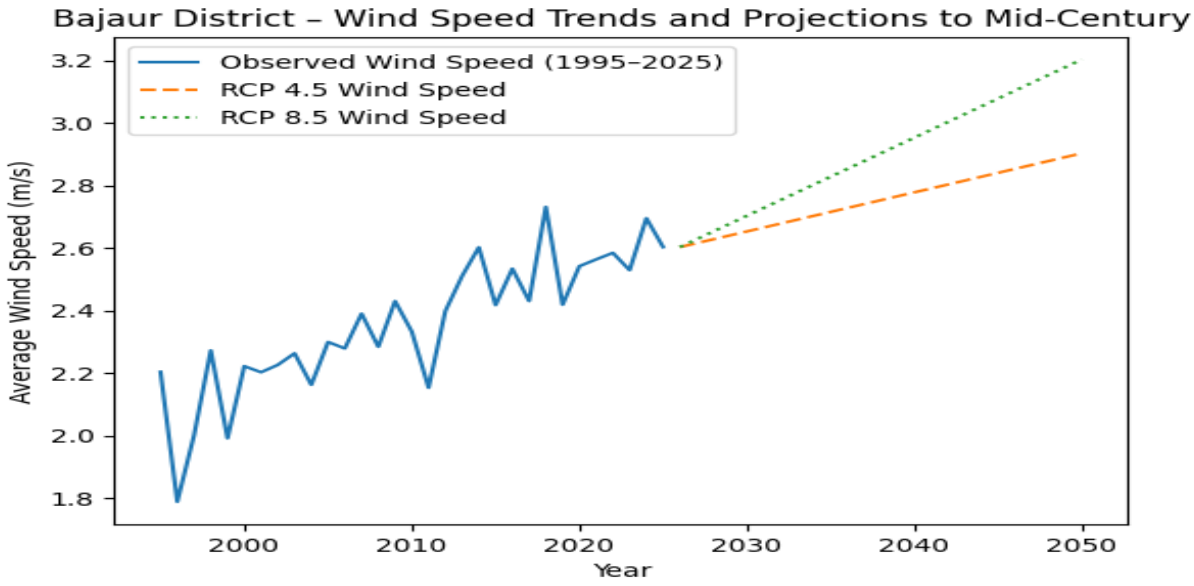
[40] Pakistan Meteorological Department.
Spatio-temporal characteristics of meteorological drought in Khyber Pakhtunkhwa, Pakistan
Wikipedia, Climate of Pakistan.
WorldData.info, Climate in Khyber Pakhtunkhwa.

Figure 34: Prevailing wind direction (annual) – Bajaur District[41]



Wind regime analysis for Bajaur District indicates a gradual increase in average wind speeds under both RCP 4.5 and RCP 8.5 scenarios, with more pronounced strengthening under the high-emissions pathway. Prevailing winds are dominantly from the north and northeast, which has direct implications for siting and design of solid waste infrastructure. Increased wind intensity may elevate dust and litter dispersion risks, necessitating reinforced operational controls, directional buffering, and climate-resilient facility layouts consistent with World Bank environmental safeguards.

Figure 35: Wind Speed Simulation for Mid-century under RCP 4.5 and RCP 8.5



[41] Pakistan Meteorological Department.
Spatio-temporal characteristics of meteorological drought in Khyber Pakhtunkhwa, Pakistan
Wikipedia, Climate of Pakistan.
WorldData.info, Climate in Khyber Pakhtunkhwa.

Bajaur and the Major Economic Effects of Climate Change: Climate change carries severe economic risk to Bajaur. A 2°C increase in temperature by 2040 could lead to a 15% reduction in agricultural productivity, costing approximately PKR 500 million annually, given that 70% of farmers rely on rain-fed crops. Tourism, which is on the rise and has the potential to attract approximately 50,000 visitors annually by 2030, may decline by 30% due to flood damage to some historical sites, such as Buddhist stupas. Mining, particularly marble mining in Nawagai, is expected to incur a 10% output loss due to water shortages and landslides, resulting in a loss of approximately PKR 100 million. The impact is indicative of a need for adaptation so that Bajaur's economy is cushioned against a possible 20% GDP contraction by 2050 if left unmitigated.[42]
These strategies and impact assessments would serve as the guiding principles for sustainable development planning in Bajaur, in line with the Khar Urban Centre Master Plan (2022-2042).

6.11.3.3Hydrology and Water Resources

Bajaur District's hydrology and water resources play a crucial role in the daily lives and economic activities of its residents. The region's water sources are diverse, including surface water, groundwater, and rainwater harvesting systems. The availability and quality of water are influenced by the district's geographical and climatic conditions, making water management a vital aspect of local governance.

In the major towns of Bajaur, the Public Health Engineering Department has established a piped water supply system, which serves about 19% of households. However, a significant proportion of the population still relies on more traditional water sources. Open wells are the primary source of drinking water for approximately 38% of households, particularly in rural and less urbanized areas. These wells are a crucial resource, providing a reliable supply of water despite potential concerns about water quality.
Ponds serve as a source of drinking water for about 5% of households. These ponds, which collect rainwater, are especially important during dry periods when other sources may be scarce. Additionally, hand pumps, which tap into shallow groundwater, are used by 3% of households. However, the installation and maintenance of hand pumps can be challenging, limiting their widespread use.

A significant 35% of households rely on other sources, including streams and rainwater harvesting. Streams, fed by the district's river systems and seasonal rainfall, provide a convenient water source for many communities. Rainwater harvesting, an adaptive response to the region's climate, enables households to collect and store rainwater for later use, ensuring water availability during dry spells.

[42] A Case Study of Pakistan (MDPI, 2020)

Table 117: Climate Risk Matrix for Bajaur District under RCP 4.5 and RCP 8.5

Climate Hazard	Observed Trend (1995–2025)	Projected Change (RCP 4.5)	Projected Change (RCP 8.5)	Exposure (Key Sectors)	Primary Risks	Risk Level	Priority Adaptation Measures
Increase in Maximum Temperature	Consistent warming trend	+2.0–2.2 °C by 2050	+4.0–4.5 °C by 2050	Rangelands, agriculture, SWM facilities	Heat stress on crops & livestock; accelerated waste decomposition; odour and fire risk at landfills	**High (RCP4.5) / Very High (RCP8.5)**	Heat-resilient facility design, shaded composting, fire breaks, adaptive cropping calendars
Increase in Minimum Temperature (Warmer Nights)	Rising night-time temps	+1.5–1.7 °C	+3.0 °C	Agriculture, livestock, public health	Reduced crop recovery, higher pest survival, increased landfill gas generation	**Medium–High / High**	Improved aeration in landfills, integrated pest management, livestock heat shelters
Precipitation Variability & Intensity	Moderate inter-annual variability	Slight increase, seasonal concentration	Higher intensity events, erratic	Agriculture, watersheds, landfills	Flash flooding, soil erosion, leachate overflow, rangeland degradation	**Medium / High**	Engineered drainage, leachate control, watershed management, erosion control
Wind Speed Increase	Gradual strengthening	+0.3 m/s	+0.6 m/s	SWM facilities, settlements	Dust and litter dispersion, odour transport, infrastructure stress	**Medium / Medium–High**	Wind fencing, covered transport, directional buffer zones
Wind Direction (N–NE Dominance)	Stable dominance	No major shift	No major shift	Settlements near SWM sites	Downwind nuisance (odour, dust)	**Medium**	Siting facilities away from N–NE downwind corridors, green buffers
Humidity Changes	Seasonal variability	Slight increase	Higher variability	Agriculture, composting	Increased pathogen activity, compost instability	**Low–Medium / Medium**	Controlled composting, covered windrows, improved hygiene protocols
Drought & Soil Moisture Stress	Periodic dry spells	Moderate risk	High risk	Rangelands, rainfed agriculture	Pasture degradation, reduced yields, livestock pressure	**Medium / High**	Drought-resilient pasture management, water harvesting, adaptive grazing

Despite these diverse sources, Bajaur District faces several challenges in water resource management. Seasonal variability significantly affects water availability, with fluctuations in both quantity and quality throughout the year. This variability can pose challenges for both domestic consumption and agricultural activities. The limited reach of piped water infrastructure highlights the need for further investment in expanding access to clean and reliable water sources, which is critical for public health and economic stability.

Water quality remains a concern, particularly for those relying on open wells, ponds, and streams. Contamination from natural and human activities can compromise the safety of these water sources. Thus, there is a pressing need for regular monitoring and proactive management to ensure that water remains safe for consumption.

6.11.3.4Forestry and Ecological Profile

Forestry of district Bajaur is mainly based on natural forests and plantations. According to the Forest Department, the total forest area of the district is 29,000 hectares, out of which 9,000 hectares are natural forests and 20,000 hectares are plantations. The natural forests are mostly located in the hilly areas of the district, such as Nawagai, Salarzai, Mamund and Charmang. The plantations are mostly located in the plain areas of the district, such as Khar, Utmankhel and Barawal. The main tree species found in the forests are pine, oak, juniper, acacia, eucalyptus and poplar. The forests provide timber, fuelwood, fodder, honey, medicinal plants and other non-timber forest products to the local people. They also provide environmental services such as soil conservation, water regulation, carbon sequestration and biodiversity conservation. The forest development will lead to timber, fuel wood, fodder, and their contribution to the local economy through tourism and recreation. This will create a huge impact on the economy of the under-study area.

6.11.3.4.1 Flora

The flora of Bajaur District comprises drought-resilient subtropical scrub and rangeland species that provide critical ecosystem services and livelihood support. While no endemic plant species are formally recorded, several native taxa of ecological and socio-economic importance are under increasing pressure from overgrazing, fuelwood extraction, and climate variability, necessitating precautionary management and habitat-sensitive planning.

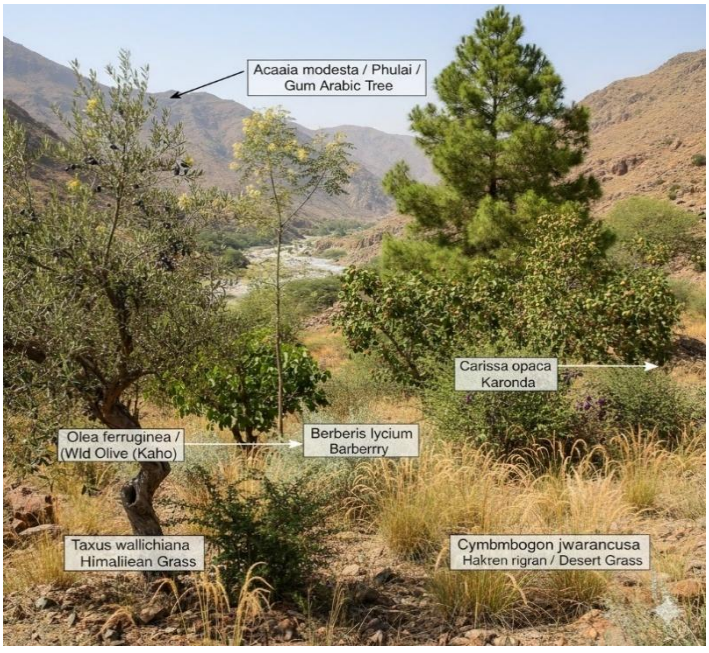
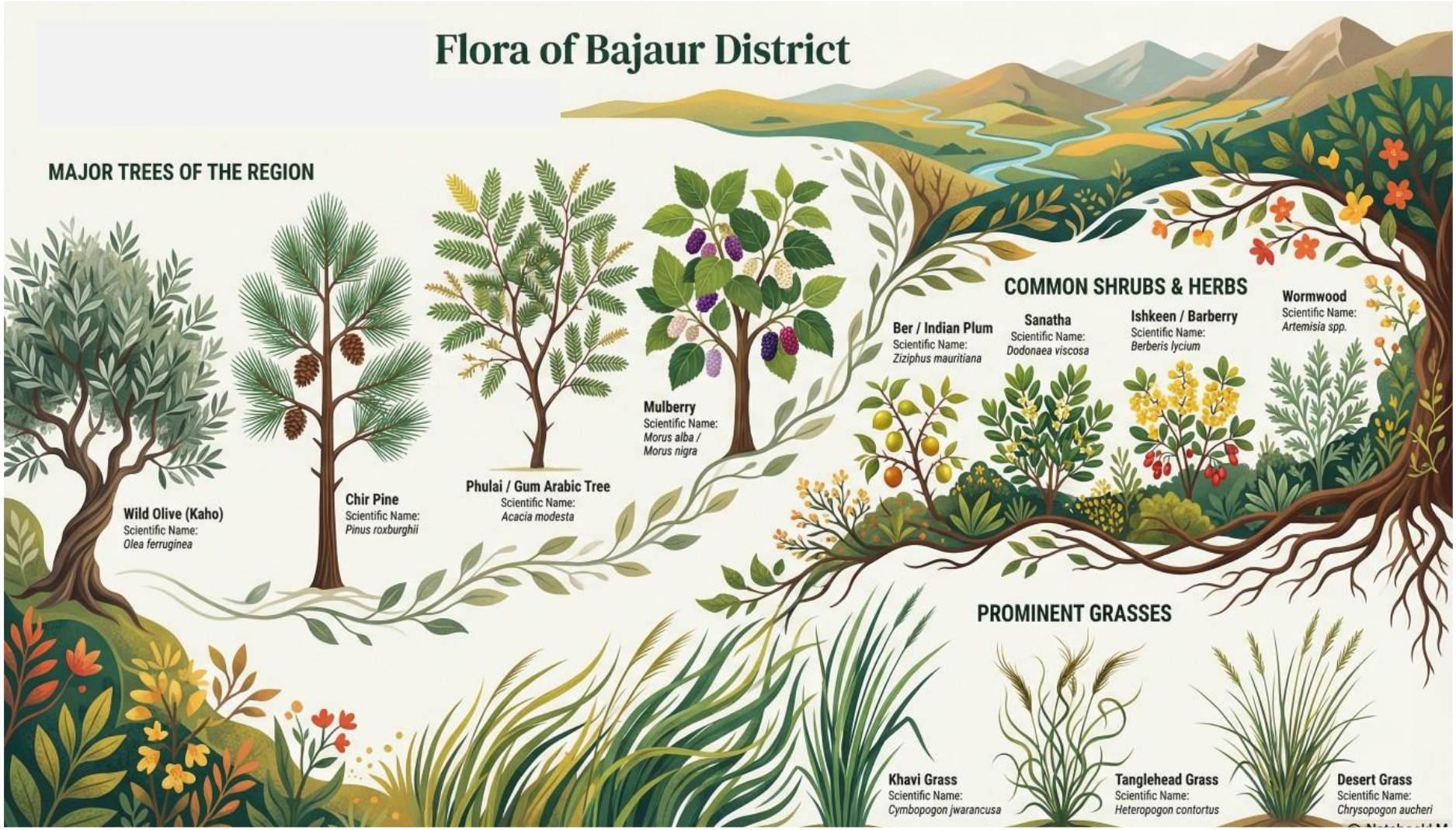


Table 118: Key Floral Species in Bajaur District, KP

Scientific Name	Common / Local Name	Ecological & Socio-economic Significance	Conservation Status / Threats
Olea ferruginea	Wild Olive (Kaho)	Keystone species; soil stabilization, slope protection, fodder, fuelwood, traditional oil extraction	Locally declining due to fuelwood cutting and land conversion
Acacia modesta	Phulai / Gum Arabic Tree	Nitrogen fixation, rangeland resilience, fodder, fuelwood	Overgrazing, excessive lopping, unsustainable fuelwood use
Pinus roxburghii	Chir Pine	Watershed protection, erosion control, timber, resin	Fire risk, illegal cutting in adjoining uplands
Ziziphus mauritiana	Ber / Indian Plum	Fruit production, wildlife food, agroforestry	Habitat fragmentation, agricultural expansion
Morus alba / Morus nigra	Mulberry	Livelihood support, silkworm feed, fruit, shade	Declining regeneration, land-use change
Dodonaea viscosa	Sanatha	Slope stabilization, erosion control, windbreak	Grazing pressure, removal during land clearing
Carissa opaca	Granda / Karonda	Fodder shrub, wildlife habitat, soil binding	Overgrazing, shrub clearance
Berberis lycium	Ishkeen / Barberry	Medicinal plant, soil conservation	Overharvesting for medicinal use
Artemisia spp.	Wormwood (local varieties)	Rangeland cover, medicinal and aromatic uses	Overgrazing, climate stress
Cymbopogon jwarancusa	Khavi Grass	Grazing resource, aromatic oils, erosion control	Overgrazing, drought sensitivity
Heteropogon contortus	Tanglehead Grass	Key pasture species for livestock	Rangeland degradation, soil erosion
Chrysopogon aucheri	Desert Grass	Drought-tolerant forage species	Climate variability, overstocking
Taxus wallichiana	Himalayan Yew	Medicinal (anti-cancer compounds), high conservation value	**Endangered (IUCN)**; potential presence only in isolated cooler micro-habitats

Figure 36: Visualization of common floral species in Bajaur



6.11.3.4.2 Fauna

Bajaur District supports a range of fauna adapted to subtropical scrub, rangeland, and agro-ecosystems, including several species of regional conservation concern. Large carnivores, raptors, and key herbivores play critical roles in maintaining ecological balance but face increasing threats from habitat degradation, human–wildlife conflict, and climate stress. Infrastructure planning and land-use interventions should therefore incorporate habitat-sensitive design and mitigation measures.

Table 119: Key Fauna Species in Bajaur District, KP

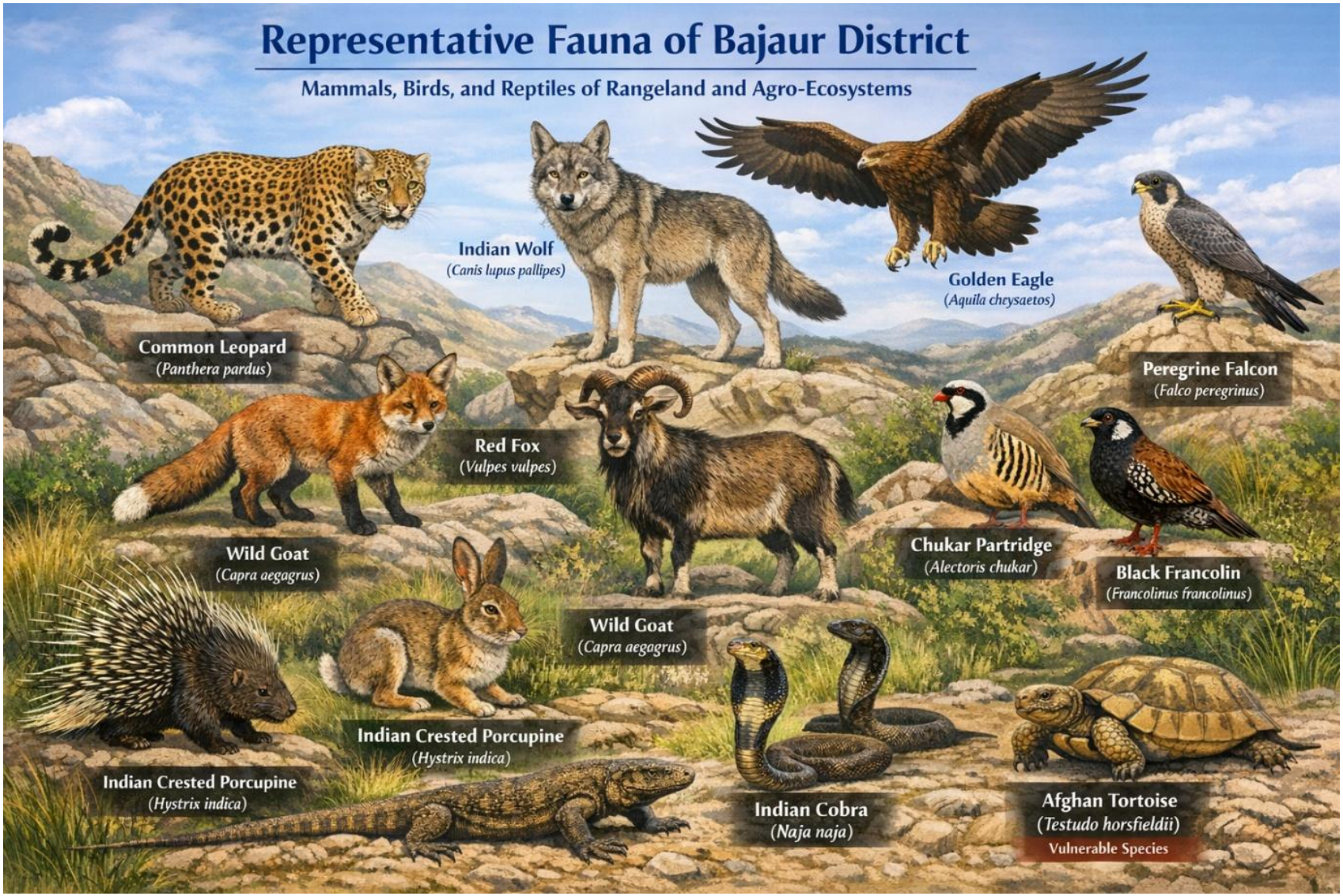
Scientific Name	Common / Local Name	Ecological & Socio-economic Significance	Conservation Status / Threats
Panthera pardus	Common Leopard	Apex predator; regulates herbivore populations; indicator of ecosystem health	**Vulnerable (IUCN)**; habitat loss, human–wildlife conflict
Canis lupus pallipes	Indian Wolf	Top carnivore; maintains trophic balance in rangelands	**Endangered (regional)**; persecution, habitat fragmentation
Vulpes vulpes	Red Fox	Scavenger; controls rodents; adapts to agro-rangelands	Habitat disturbance, road mortality
Herpestes edwardsii	Grey Mongoose	Controls snakes and rodents; common near settlements	Habitat loss, hunting
Hystrix indica	Indian Crested Porcupine	Seed disperser; soil aeration	Retaliatory killing due to crop damage
Lepus nigricollis	Indian Hare	Prey species; supports predator populations	Overhunting, habitat degradation
Capra aegagrus	Wild Goat	Keystone grazer; genetic stock for domestic goats	Habitat degradation, hunting
Sus scrofa	Wild Boar	Soil turnover; ecosystem engineering	Human conflict, culling
Alectoris chukar	Chukar Partridge	National bird; rangeland indicator species	Overhunting, habitat loss
Francolinus francolinus	Black Francolin	Seed disperser; agro-ecosystem species	Agricultural intensification
Columba livia	Rock Pigeon	Urban–rural interface species	Low threat
Falco peregrinus	Peregrine Falcon	Top avian predator; migratory species	**Near Threatened**; habitat disturbance

Aquila chrysaetos	Golden Eagle	Apex raptor; controls small mammals	Disturbance, prey decline
Varanus bengalensis	Bengal Monitor Lizard	Controls pests; scavenger	**Near Threatened**; illegal killing
Naja naja	Indian Cobra	Controls rodents; ecological balance	Persecution, habitat loss
Testudo horsfieldii	Afghan Tortoise	Soil health; seed dispersal	**Vulnerable (IUCN)**; illegal trade, habitat loss

- ***Ecological Profile***

The ecological profile of the study area will be thoroughly considered. The forest department will play a key role. Sustainable development goals will be incorporated in the study area considering the IPCCC regulations for ecological sustainable development. Sustainable forest management practices, such as community-based approach, ecotourism and agroforestry will be of major concern.

- landslides or infrastructure damage, disrupting **cross-border economic activity**.


Representative Fauna of Bajaur District
Mammals, Birds, and Reptiles of Rangeland and Agro-Ecosystems
Common Leopard
(Panthera pardus)
Indian Wolf
(Canis lupus pallipes)
Golden Eagle
(Aquila chrysaetos)
Peregrine Falcon
(Falco peregrinus)
Red Fox
(Vulpes vulpes)
Wild Goat
(Capra aegagrus)
Chukar Partridge
(Alectoris chukar)
Black Francolin
(Francolinus francolinus)
Wild Goat
(Capra aegagrus)
Indian Crested Porcupine
(Hystrix indica)
Indian Crested Porcupine
(Hystrix indica)
Indian Cobra
(Naja naja)
Afghan Tortoise
(Testudo horsfieldii)
Vulnerable Species

6.11.3.5Proposed Intervention

There are four specific proposals given to maintain the physical characteristics in the area and promote greenery in the area. These include green space, plantation, riparian zone, and green belt.

- ***Green Space/Buffers***

According to the Khyber Pakhtunkhwa Urban Policy, a mandatory green buffer zone of approximately 61 meters must be established around all designated industrial zones to mitigate environmental impacts, reduce pollution exposure for nearby communities, and preserve ecological balance. This standardized green space requirement is strictly implemented in the proposed and existing industrial zones, where the buffer serves as a critical barrier between industrial activities and residential or agricultural areas. However, in the areas, which experiences significantly higher population density compared to the other tehsils, the green buffer has been intentionally expanded beyond the standard 61-meter width. This augmented green space not only enhances environmental protection but also provides additional recreational areas, improves air quality, and supports urban heat island mitigation in a more densely populated setting. Such adaptive planning reflects a responsive approach to local demographic pressures while upholding the core objectives of sustainable industrial development and public health safeguards across the region.

- ***Plantation***

To foster a healthier urban environment and enhance ecological resilience, extensive plantations are mandated within the major cities of the region, in full alignment with sustainable development goals. These afforestation initiatives will employ the renowned Miyawaki method, a proven technique for creating dense, native, multi-layered forests that rapidly establish biodiversity, improve air quality, sequester carbon, and stabilize soil within just a few years. By mimicking natural forest ecosystems, Miyawaki plantations promote self-sustaining green cover that requires minimal maintenance after the initial establishment phase, thereby ensuring long-term environmental stability across urban and peri-urban landscapes.

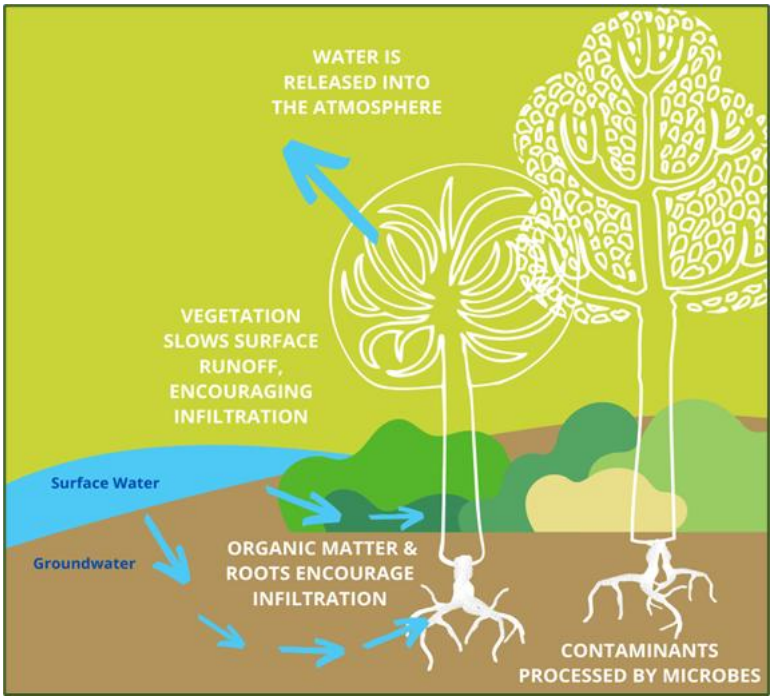
Figure 37: Miyawaki Methods and approaches[43]

The selection of plant species will prioritize locally adapted, indigenous, and ecologically significant trees and shrubs that are well-suited to the region's soil, climate, and topography. The plantation should be done given the area most frequently grown plants such as the kikar (Prosopis juliflora), phulai (Acacia modesta), kao (Olea cuspidata), ber (Ziziphus; Ziziphus numularia), gurgura (Monotheca boxifolia), blue pine (Pinus wallichiana), cedar (Cedrus deodara), oak (Quercus incana), sanatha (Dodonea viscosa), eucalyptus (Eucalyptus camaldulensis), poplar (Populas sp), mulberry or toot (Morus alba), shisham (Dalbergio sissoo), and farash (Tamarix articulate).[44]

[43] https://currentaffairs.chetanbharat.com/miyawaki-plantation-method/
[44] November 7, 2025. Almanac, https://pakistanalmanac.com/kp-khyber/#1633497144852-f0a014d6

- ***Green Belt***

A green belt is strategically established around each settlement wherever the need arises, primarily to impose a definitive boundary that curtails uncontrolled urban sprawl, preserves agricultural land, and safeguards natural ecosystems from encroachment.



A robust 500-meter-wide green belt has been mandated to encircle these areas, serving as both a physical and ecological barrier. This expansive buffer not only prevents the merging of settlements but also enhances biodiversity, improves groundwater recharge, and acts as a natural shield against dust, noise, and industrial emissions. Furthermore, it promotes climate resilience by mitigating urban heat islands and provides potential space for community recreation and agroforestry, aligning with sustainable land-use principles under the KP Urban Policy.

- ***Riparian Zone***

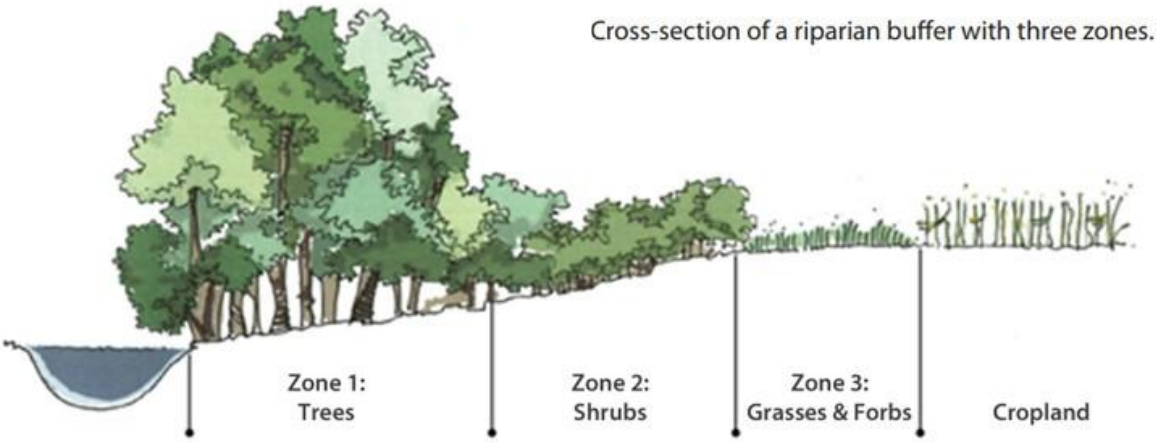
A riparian buffer is a transitional zone between land and water where a mixture of trees, shrubs, grasses, and wildflowers grow. Riparian buffers are located along streams, rivers, lakes, and reservoirs. They perform essential ecological functions that support local plant and animal biodiversity, water quality, and soil quality.[45]

A riparian buffer zone is mandated around all water bodies within the project area to prevent infiltration of pollutants, control erosion, and maintain water quality by filtering sediments, nutrients, and contaminants before they enter the stream. These protective corridors are specifically proposed along the rivers, as well as key watercourses that traverse the designated industrial and urban development zones. A minimum 50-meter-wide riparian zone is established on both banks of these water bodies, comprising dense native vegetation

.

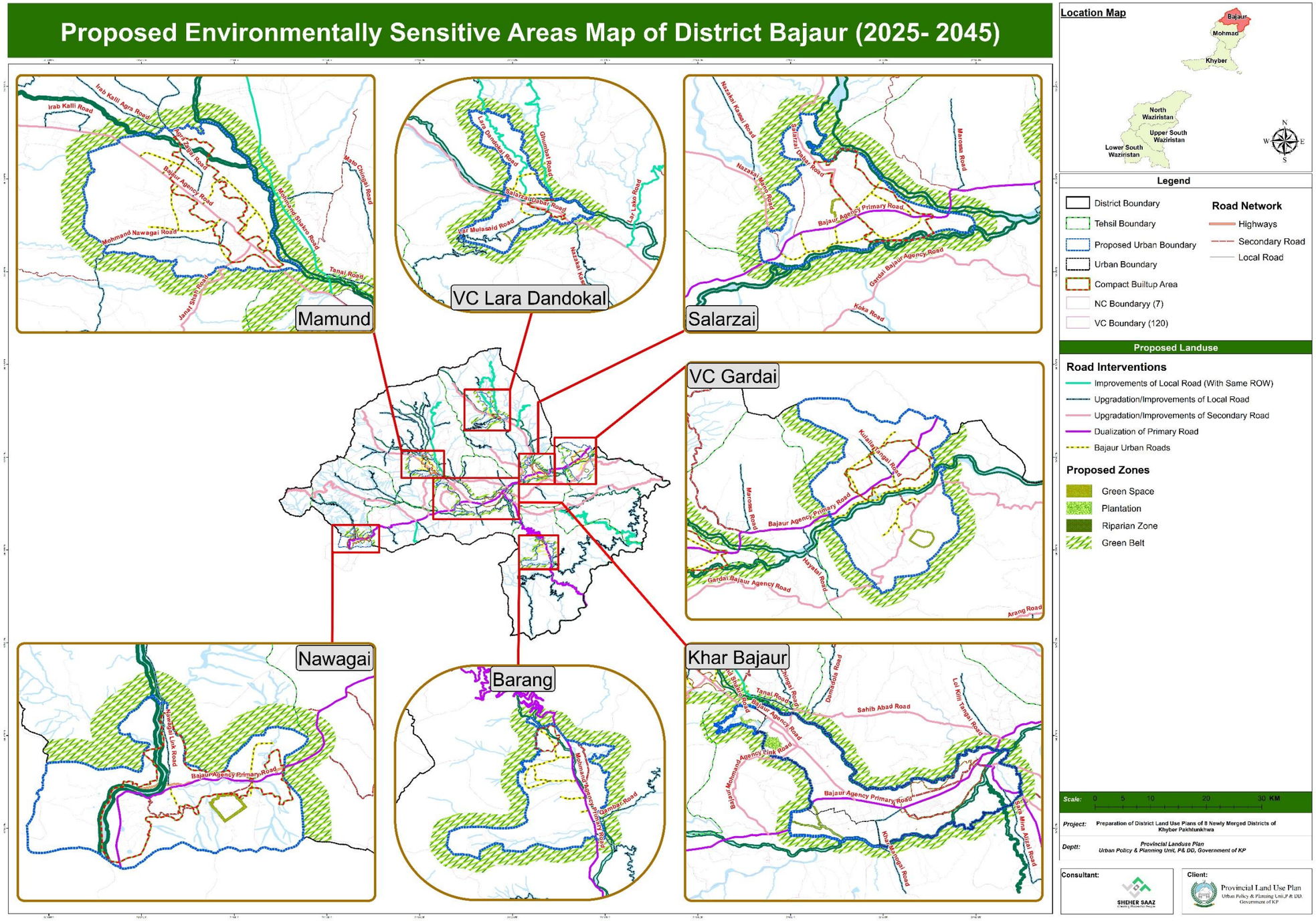
Figure 38: Concept Design for Riparian Zone[46]

[45] https://riparian.utk.edu/why-riparian-zones/
[46] https://www.herefordshire.gov.uk/directories/nutrient-neutrality-private-mitigations/riparian-buffer/



This buffer not only safeguards aquatic ecosystems and groundwater recharge but also aligns with the Khyber Pakhtunkhwa Environmental Protection Act and National Water Policy standards.

Map 59: Environmentally Sensitive Areas - District Bajaur



6.11.3.6Environmental and Climate Change Management Plan for Bajaur

A systematic, data-driven, and climate-resilient environmental management framework for Bajaur District, recognizing its rangeland- and agriculture-dominated landscape, increasing climate variability, and rising pressures from population growth and infrastructure development. The plan responds to documented warming trends, precipitation variability, wind intensification, and biodiversity sensitivity, and aligns with World Bank Environmental and Social Framework (ESF) and Climate and Disaster Risk Screening requirements.

Table 120: Environmental Monitoring Plan

Component	Short Term (0–3 Years)	Quantity	Long Term (3–10 Years)	Quantity	Purpose / Output
A. Environmental Monitoring & Infrastructure					
Environmental Laboratory – Basic Unit	Portable lab (water, soil, SWM testing)	1	Fully equipped, fixed district lab (ISO-ready)	1	Pollution monitoring, SWM compliance, soil & water testing
Lab Equipment Sets	Basic field & bench equipment	1 set	Advanced analytical instruments (GC, spectro, incubators)	1 set	Regulatory enforcement & climate impact analysis
Automatic Weather Stations (AWS)	Pilot AWS (temperature, rainfall, wind, humidity)	2	District-wide AWS network	4–6 total	Localized climate data & early warning
Air Quality Monitoring Units	Portable AQ monitors ($PM_{2.5}$ / PM_{10})	2	Fixed continuous AQ stations	2	Urban & landfill air quality tracking
Soil Testing (Agro-Climate)	Soil Testing (Agro-Climate)	Soil Testing (Agro-Climate)	Soil Testing (Agro-Climate)	Soil Testing (Agro-Climate)	Soil Testing (Agro-Climate)
Data Management System	Centralized environmental database	1	Integrated GIS–climate dashboard	1	Evidence-based planning & reporting
Soil Testing (Agro-Climate)	Soil fertility & moisture tests	300 samples/year	Integrated soil–climate monitoring	Annual program	Climate-smart agriculture

Component	Short Term (0–3 Years)	Quantity	Long Term (3–10 Years)	Quantity	Purpose / Output
B. Solid Waste Management					
Waste Characterization Studies	Baseline seasonal assessments	2 cycles	Periodic update studies	Every 3–5 yrs	Climate-sensitive SWM planning
Climate-Resilient Landfill Controls	Wind fencing, leachate testing kits	For 1 landfill	Advanced leachate treatment & gas control	Full system	Reduced climate & pollution risks
Compost Quality Testing Kits	Basic compost testing	1 set	Certified compost testing facility	1	Support circular economy
Buffer Plantation	Native species plantation	20–30 ha	Expanded ecological buffers	80–100 ha	Climate adaptation & biodiversity protection
C. Governance and PPP					
District Environment & Climate Cell	Establishment & staffing	1	Fully operational unit	1	Coordination & policy integration
PPP Contracts	Pilot PPPs (lab, composting)	2–3	Scaled PPP operations	5–7	Financial sustainability

6.12 AGRICULTURAL AND LIVESTOCK

6.12.1 Agriculture

6.12.1.1Existing Condition

Agriculture constitutes the backbone of District Bajaur's economy, with nearly 80 percent of households directly or indirectly dependent on it for their livelihoods. Nationally, agriculture contributes about 22.9 percent to the Gross Domestic Product (GDP) and employs 37.4 percent of the workforce. In Khyber Pakhtunkhwa, the sector accounts for 19.2 percent of provincial GDP and provides employment to nearly one-third of the labor force, with almost 80 percent of the population residing in rural areas and engaged in farming activities. In Bajaur, agriculture not only ensures food security but also sustains household income, provides raw material for small-scale agro-industries, and supports local trade and employment.

District Bajaur's cultivated land lies mainly within fertile valleys such as Mamund, Salarzai, and Khar, where soils range from light to medium loams, well-suited for wheat, maize, pulses, fodder, vegetables, and fruit crops. The Panjkora River, along with hill torrents, karezes, and natural springs, forms the major surface water network, while tube-wells and dug wells supplement irrigation in low-lying areas. However, a significant proportion of upland terraces remains barani (rain-fed), making crop yields vulnerable to seasonal rainfall and climate variability.

Bajaur's agriculture is characterized by both food crops (wheat, maize, barley, and pulses) and cash/market crops (vegetables, onion, tomato, potato), complemented by high-value horticulture. The district is particularly known for its olives, pomegranates, figs, peaches, apricots, and persimmons, which offer strong potential for commercial expansion and value-added processing. Small-scale vegetable farming is also widespread, with Bajaur supplying fresh produce to nearby regional markets, including Peshawar.

Livestock plays a vital complementary role in the district's agrarian economy, with cattle, goats, sheep, and poultry providing nutrition, household savings, and a marketable surplus. Women are actively engaged in livestock care, dairy production, and fodder collection, contributing significantly to rural household income and food security.

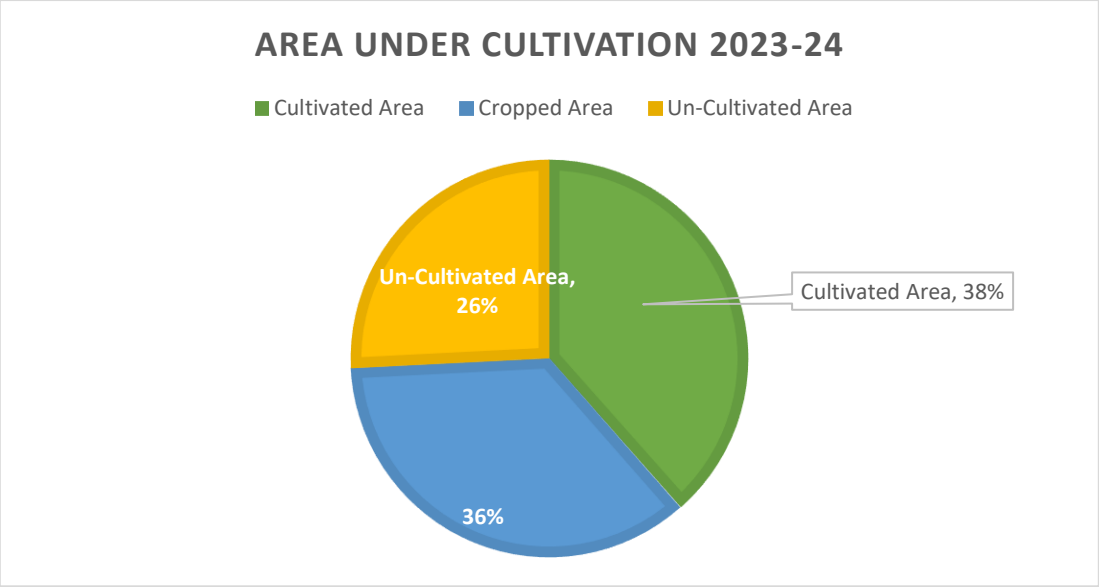
Despite its strong agricultural base, rapid conversion of farmland to urban and non-agricultural uses poses a serious challenge. Expanding settlements and infrastructure have increased land prices, reduced cultivable area, and led to declines in crop production. As a result, food shortages and unemployment pressures are rising, prompting many residents to migrate to other districts in search of livelihoods. These trends underscore the urgent need for land-use regulation, sustainable farming practices, and rural livelihood diversification to preserve Bajaur's agricultural economy.

6.12.1.2Area Under Cultivation

According to the existing land-use classification, District Bajaur covers a total reported area of 318,852.43 acres, of which about 190,896.32 acres, representing approximately 59.8 percent of the district's land, are classified as agricultural. Within this agricultural area, approximately 141,408.6 acres (57,227 hectares) are net sown in the current year, while about 49,483.2 acres (20,026 hectares) remain fallow or under other agricultural uses. In addition, 23.62 acres are recorded as orchards, reflecting a modest but growing potential for specialized fruit cultivation.

This land distribution highlights both the constraints imposed by Bajaur's rugged topography and limited water availability and the opportunities to enhance productivity through improved irrigation practices, adoption of high-yield varieties, soil conservation measures, and efficient resource management within the existing agricultural footprint.

Figure 39: Area Under Cultivation in District Bajaur[47]



6.12.1.3Crop Production Profile

Agricultural activities in District Bajaur, similar to other parts of Khyber Pakhtunkhwa, are carried out in two principal seasons. Rabi crops, sown before winter and harvested in early summer, include wheat, barley, grams, oilseeds, and pulses. Kharif crops, grown in summer and harvested in early winter, include maize, rice, and a variety of vegetables.
Wheat continues to be the dominant crop of Bajaur, with production rising from 35,370 tons in 2021-22 to over 70,861 tons in 2023-24. Yields nearly doubled during this period, improving from 395 kg per acre to 712 kg per acre, reflecting better crop management and favorable climatic conditions.

[47] District wise land use utilization in KPK, Development Statistics of KPK, 2025

Maize, the leading Kharif cereal, has shown stable production between 9,551 and 9,714 tons, supported by yields of about 531 to 532 kg per acre. Rice also contributes consistently, producing between 7,548 and 7,561 tons annually with yields ranging from 638 to 641 kg per acre.

Barley, another traditional Rabi cereal, contributes 5,186 to 5,508 tons annually. However, yields remain relatively low at 259 to 285 kg per acre, as it is mostly cultivated on marginal and rain-fed lands. Mustard, a traditional oilseed crop, produces close to 1,000 tons each year, with yields improving modestly from 134 kg per acre in 2021-22 to 146 kg per acre in 2023-24.

Overall, Bajaur's agriculture remains dominated by food grains, particularly wheat and maize, which form the staple crops of the district. The rapid improvements in wheat productivity in recent years highlight the potential of improved seed varieties and better farming practices. At the same time, the low yields of barley and mustard underline the persistent challenges of rain-fed farming, limited irrigation infrastructure, and reliance on traditional cultivation methods. Expanding the use of high-yield, drought-resistant varieties, coupled with investments in irrigation efficiency and diversification into high-value crops, could significantly strengthen agricultural productivity and food security in Bajaur.

Table 121: Crop Production Profile – District Bajaur

Year	Indicator	Crops				
		Wheat	Maize	Rice	Barley	Mustard
2021-22	Area (Acre)	89,604	17,999	11,820	21,285	7,365
	Production (Tons)	35,370	9,551	7,548	5,508	984
	Yield per Acre (Kg)	395	531	639	259	134
2022-23	Area (Acre)	98,443	18,087	11,829	18,799	7,152
	Production (Tons)	69,943	9,597	7,551	5,342	1,014
	Yield per Acre (Kg)	710	531	638	284	142
2023-24	Area (Acre)	99,476	18,285	11,792	18,168	6,819
	Production (Tons)	70,861	9,714	7,561	5,186	994
	Yield per Acre (Kg)	712	532	641	285	146

Source: Khyber Pakhtunkhwa Development Statistics 2025, Bureau of Statistics, KP

6.12.1.4Water Management and Type of Irrigation

According to the Food and Agriculture Organization (FAO), OECD, and World Bank (2025), Pakistan's renewable internal freshwater resources stood at approximately 1,253 cubic meters per person per year in 2017. This level places the country firmly in the "high water-stress" category, as it falls below the widely recognized threshold of 1,700 m^3/person/year. The decline is driven by population growth, urbanization, industrial expansion, and climate variability, all of which exert increasing pressure on limited water resources. In many regions, over-extraction of groundwater has led to lowered water tables, while pollution and salinity further constrain water quality and availability.

In District Bajaur, agriculture depends on a mix of surface and groundwater irrigation systems, with traditional methods complementing modern sources. The total irrigated area has remained steady, rising slightly from 68,421 acres in 2021-22 to 68,552 acres in 2023-24, reflecting the district's sustained reliance on multiple water supplies. Canal irrigation plays a central role, with government canals covering about 2,933 to 2,992 acres, while private canals dominate, irrigating nearly 35,000 acres annually, highlighting strong community-driven investment in water management. Wells remain another major source, serving 21,725 to 21,802 acres, showing continued dependence on shallow groundwater. Tube-wells, by contrast, cover only a very small share, declining from 79 acres in 2021-22 to almost negligible levels by 2023-24, due to high operational costs and groundwater limitations. Lift-pumps contribute 3,672 to 3,714 acres, while other localized systems such as small channels and traditional karez provide an additional 4,841 to 4,870 acres.

This balance between surface and groundwater use illustrates both resilience and vulnerability: while community-led systems expand irrigation coverage, they also face risks from declining water tables, seasonal variability, and climate stress. Improving water-use efficiency through lined channels, modern irrigation technologies (e.g., drip and sprinkler systems), and small-scale storage structures will be essential to ensure sustainable agriculture in Bajaur's semi-arid setting.

There are two dams in District Bajaur, namely Raghagan Dam and Tali Dam, which play a vital role in supplementing local irrigation. However, most of the district remains rainfed, relying heavily on seasonal rainfall for cultivation. The major sources of irrigation continue to be tube wells and wells, though water conservation schemes are few, and pakkā (lined) irrigation channels are very limited. Strengthening these facilities and introducing new water conservation and harvesting projects can significantly enhance agricultural resilience in the district.

Table 122: Year-wise Irrigated Area in Bajaur District through Different Sources

Year	Total	Canals	Tanks	Tubewells	Wells	Lift-pumps	Others

		Govt.	Private					
2021-22	68,421	2,933	34,857	79	21,755	3,672	277	4,848
2022-23	68,480	2,983	34,884	40	21,725	3,692	287	4,870
2023-24	68,552	2,992	34,948	0	21,802	3,714	255	4,841

**Area is in acres*

Source: Khyber Pakhtunkhwa Development Statistics 2025, Bureau of Statistics, KP

6.12.1.5 Plans and Future Direction

6.12.1.5.1 Plans and Strategies by Government

Agriculture and horticulture form the backbone of District Bajaur's rural economy, supporting livelihoods, food security, and socio-economic stability across the district. The district's valleys, plains, and irrigated areas exhibit significant agricultural productivity, while selected pockets possess favorable climatic and soil conditions for orchard-based farming. Recognizing the importance of these land uses, the District Land Use Plan adopts a protection-led approach through the designation of Preserve Agriculture Zones and Preserve Orchards Zones, ensuring sustainable rural development and preventing unplanned land conversion.

- ***Preserve Agriculture Zones (Total Area: 126,081.86 Acres)***

District Bajaur contains extensive cultivated land that plays a critical role in sustaining rural livelihoods and meeting local food requirements. Existing farming patterns demonstrate strong potential for continued agricultural production, particularly for staple and seasonal crops. The designation of Preserve Agriculture Zones covering 126,081.86 acres is intended to safeguard these productive lands exclusively for agricultural use, thereby restricting their conversion to urban, commercial, or industrial activities.

These zones will primarily support the cultivation of staple and high-value crops, including wheat, maize, vegetables, pulses, and fodder, with their spatial distribution guided by soil fertility, water availability, and access to markets. In addition to land protection, the zoning framework encourages the adoption of modern and climate-resilient agricultural practices, such as efficient irrigation systems, soil conservation measures, water harvesting techniques, and the use of high-yield and drought-tolerant crop varieties. By preserving agricultural land and enhancing productivity, the plan ensures long-term food security, stabilizes rural incomes, and strengthens the economic resilience of farming communities across the district.

- ***Preserve Orchards Zones (Total Area: 270.03 Acres)***

Complementing traditional agriculture, horticulture represents a high-value and income-diversifying activity in District Bajaur. The district's agro-climatic conditions are suitable for fruit cultivation, and existing orchards indicate considerable potential for expansion of orchard-based farming. To protect and promote this activity, Preserve Orchards Zones covering 270.03 acres have been designated for exclusive horticultural use.

These zones focus on high-value fruit crops such as apples, peaches, apricots, plums, and grapes, with site selection based on reliable water sources, favorable microclimatic conditions, and proximity to transport and market access routes. The zoning framework supports the adoption of modern horticultural practices, including improved planting methods, orchard management, pest and disease control, and efficient irrigation systems. Furthermore, the protected orchard areas provide a basis for future value-addition and post-harvest infrastructure, such as cold storage, grading, packaging, and transportation facilities, reducing post-harvest losses and improving market competitiveness.

Integrated Rural Land-Use Outcome

Together, the Preserve Agriculture and Preserve Orchards Zones establish a coherent rural land-use structure that balances food security with income diversification. This integrated approach protects productive land resources, supports sustainable livelihoods, and promotes climate-resilient farming systems. By maintaining clear functional separation while ensuring policy coherence, the plan strengthens rural development, enhances agricultural productivity, and supports long-term economic stability in District Bajaur.

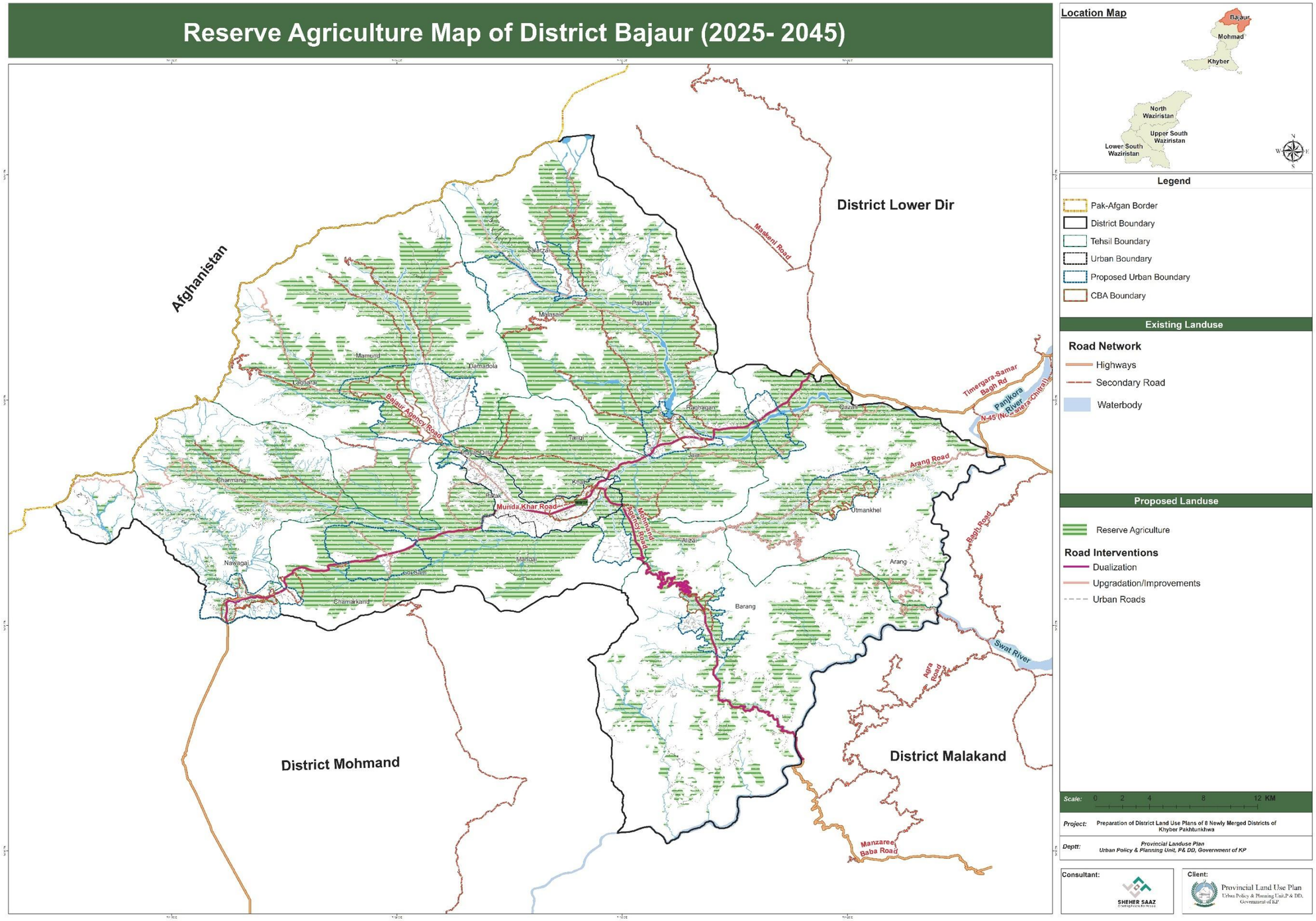
Table 123: Proposal for Preserve Agriculture & Orchard Zone

Land Use Category	Area (Acres)	Detailed Description & Planning Considerations
Preserve Agriculture	**126,081.86**	This zone is designated to safeguard productive agricultural land across District Bajaur, which underpins rural livelihoods and district-level food security. The primary objectives include protecting arable land from unplanned urban expansion, maintaining long-term soil fertility, and supporting sustainable and climate-resilient farming systems. **Permissible activities** include crop cultivation, irrigation infrastructure, farm-based enterprises, seed storage, and agricultural training facilities. **Planning considerations include:** • Strict protection from urban, commercial, and industrial encroachment. • Implementation of soil and water conservation measures, including efficient irrigation and water harvesting. • Promotion of modern farming technologies, high-yield and drought-tolerant crop varieties. • Ensuring functional connectivity with rural settlements and markets to support labour access and agricultural trade.
Preserve Orchards	**270.03**	This zone is reserved exclusively for orchard-based and horticultural activities to support high-value fruit production and income diversification in rural areas of District Bajaur. The objective is to protect existing orchards and encourage

		sustainable expansion of fruit cultivation as a long-term economic asset. Priority crops include apples, peaches, apricots, plums, and grapes. **Planning considerations include:** • Protection of orchard land from fragmentation and conversion to non-horticultural uses. • Promotion of horticulture extension services, efficient irrigation, and improved orchard management practices. • Encouragement of value-added activities such as cold storage, grading, packaging, and small-scale processing facilities. • Integration with local and regional markets to enhance profitability, reduce post-harvest losses, and strengthen rural economies.

Source: Proposed District Bajaur Land Use Plan, 2025

Map 60: Reserve Agriculture in District Bajaur



6.12.1.5.2 Recommendations

- Promote modern and more productive agricultural practices to maximize yields from limited landholdings, with emphasis on precision farming, improved input management, and sustainable soil use.
- Implement soil and water conservation measures such as contour bunding, terracing, and vegetative barriers to prevent erosion and maintain fertility on sloping lands.
- Line and concrete irrigation channels and tube-well outlets to minimize seepage losses, enhance water-use efficiency, and reduce pumping costs in command areas.
- Introduce modern irrigation systems, including drip, sprinkler, and trickle irrigation, to make optimal use of scarce water resources, particularly in rainfed (barani) and upland zones.
- Establish small water reservoirs, rainwater harvesting structures, and check dams across hilly and semi-arid areas to store runoff and improve water availability for off-season and high-value crops.
- Encourage vertical farming and tunnel farming technologies to intensify production of vegetables and horticultural crops in small plots, improving land productivity and early market supply.
- Promote adoption of high-yielding and climate-resilient crop varieties of wheat, maize, pulses, onion, and potato that perform well under limited irrigation.
- Reclaim and cultivate idle or underused lands through land leveling, soil rehabilitation, and improved irrigation and drainage practices to expand the productive agricultural area.
- Encourage multiple cropping and efficient crop rotation systems (e.g., wheat–maize, wheat–vegetables) to maintain soil fertility and improve overall farm income.
- Expand cultivation of high-value crops such as onions, potatoes, tomatoes, and orchard fruits (apricot, peach, fig, persimmon, and pomegranate) to increase profitability and support agro-based enterprises.
- Promote organic farming and compost preparation to enhance soil health and reduce dependence on chemical fertilizers and pesticides.
- Support value chain development by linking farmers with local markets and agro-industries, promoting grading, packaging, and processing facilities to reduce post-harvest losses.
- Encourage agricultural industrialization, including small-scale processing units, cold storage facilities, and packaging centers, to add value to local produce and create rural employment.
- Strengthen agricultural extension services through regular farmer training, demonstration plots, and mobile advisory units on pest management, irrigation scheduling, and modern cultivation methods.
- Ensure timely access to certified seeds, fertilizers, and pesticides at affordable rates, with proper monitoring of quality standards.

- Expand credit and microfinance facilities through commercial banks and community-based institutions to support smallholders in adopting new technologies and purchasing quality inputs.
- Improve farm-to-market road networks and transport services to facilitate timely delivery of perishable goods and improve farmers' access to urban and regional markets.
- Promote agroforestry and integrated farming systems combining crops, trees, and livestock to improve soil fertility, control erosion, and diversify incomes.
- Enhance women's participation in agriculture by providing targeted training, access to inputs, and support for small-scale agribusiness ventures to strengthen household livelihoods.

6.12.1.5.3 Zoning Regulation for Agriculture Land Use

Here are the guidelines developed for Agricultural zone development:

Category	Regulations / Activities
Permitted Uses	• Development of land strictly for agricultural purposes in designated areas. • Crop cultivation, horticulture, orchards, and greenhouse farming. • Livestock farming, poultry, and related animal husbandry. • Aquaculture and small-scale fish farming (where suitable). • Establishment of farmer's markets and direct sale outlets for agricultural products. • Construction of basic storage facilities (silos, cold storage, warehouses) directly linked to farming activities.
Permissible Uses	• Agro-processing and value addition industries (e.g., food processing, packaging). • Renewable energy generation integrated with farming (e.g., solar panels, biogas units). • Rural tourism initiatives (e.g., farm stays, guided agro-tours, demonstration farms). • Agroforestry and sustainable land management practices. • Agricultural research and demonstration centers. • Accommodation and housing for farmers and farm labor (subject to local authority approval).
Prohibited Uses	• Conversion of agricultural land to non-agricultural uses such as residential, commercial, or industrial development. • Cultivation of crops or rearing of livestock not suitable for the local climate or requiring excessive water/resources.

- Use of harmful agrochemicals or practices that degrade soil quality, reduce productivity, or pollute water sources.
- Encroachment or fragmentation of reserved agricultural areas for unplanned development.
- Any activity harmful to public health, the natural environment, or biodiversity.

6.12.2 Livestock Sector

6.12.2.1Existing Available Livestock and Services

In Khyber Pakhtunkhwa (KP), the total livestock population stands at an impressive 47,911,692 animals. Bajaur District, despite being an integral part of KP, holds a relatively small share of this population, accounting for approximately 2.05% of the total. Among the various livestock categories, Bajaur District exhibits notable diversity. For instance, it represents 3.20% of KP's cattle population, reflecting a significant presence in this category. However, the district's contribution to the buffalo population is minimal at just 0.30%. The sheep population in Bajaur District is also relatively modest, comprising 1.39% of KP's total sheep. Goats, on the other hand, make up 1.57% of KP's goat population, indicating a moderate level of goat farming. Poultry farming is relatively strong in Bajaur, with the district contributing 2.39% to KP's total poultry numbers. Conversely, camel and horse populations are quite limited, with Bajaur District accounting for only 0.64% and 0.07% of these populations, respectively. Donkeys are somewhat more prevalent, representing 0.70% of KP's donkey population. Mules are rare in Bajaur, with the district holding only 0.03% of KP's mule population. Interestingly, the "other" livestock category shows a significant representation in Bajaur District, comprising 9.10% of KP's total. Overall, while Bajaur District's share of KP's total livestock is relatively small, it plays a noteworthy role in certain categories, especially in cattle, poultry, and "other" livestock. The table 11.6 provides an overview of the livestock population in the province and the district.

Table 124: Existing Livestock Population in 2021 – Bajaur District

Animal	Khyber Pakhtunkhwa	Bajaur District	Portion of Bajaur District (%)
Total	47,911,692	982,300	2.05%
Cattle	8,837,227	283,148	3.20%
Buffaloes	3,402,135	10,312	0.30%
Sheep	4,219,238	58,567	1.39%
Goats	10,041,678	157,948	1.57%
Poultry	19,100,442	456,697	2.39%
Camel	124,663	803	0.64%
Horse	268,953	195	0.07%

Animal	Khyber Pakhtunkhwa	Bajaur District	Portion of Bajaur District (%)
Donkey	502,821	3,522	0.70%
Mules	3,022,101	885	0.03%
Other	112,325	10,223	9.10%

Source: Khyber Pakhtunkhwa Development Statistics 2022, Bureau of Statistics, KP

According to the Livestock and Dairy Development Department of Khyber Pakhtunkhwa, Bajaur District hosts around 134 private poultry farms in addition to a network of veterinary and animal husbandry services. The district is equipped with civil veterinary hospitals, dispensaries, centers, artificial insemination facilities, and diagnostic labs that support livestock health and productivity. However, compared with some other merged districts, the overall number of service facilities in Bajaur remains moderate, highlighting the need for expansion and modernization.

Table 125: Existing Animal Husbandry Facilities and Level of Services

Sr. No	*District*	*CVH*	*CVD*	*CVC*	*AIC*	*District MVC*	*Mobile Milk Lab*	*Diag. Lab*	*SPU*	*Model Dairy Farm*	*Total*
1	*Bajaur*	*3*	*32*	*27*	*27*	*2*	*-*	*1*	*–*	*1*	*93*

Key:

CVH = Civil Veterinary Hospital, CVD = Civil Veterinary Dispensary, CVC = Civil Veterinary Centre, AIC = Artificial Insemination Centre, MVC = Mobile Veterinary Centre, SPU = Semen Production Unit

Source: Livestock and Dairy Development Department of Khyber Pakhtunkhwa

6.12.2.2Fisheries Sector

District Bajaur possesses modest yet promising freshwater resources for fisheries development, with two main water bodies, Raghagan Dam and Tali Dam, serving as the primary sites for existing fishery activities. Both dams have been recently auctioned by the Fisheries Department, generating revenue and promoting regulated fish farming under official supervision. The district also offers several potential sites for the establishment of a fish hatchery, which could support local and neighboring farmers through seed production, income generation, and employment opportunities. The local community has shown strong interest in establishing small-scale fish ponds, and feasibility assessments under the Accelerated Implementation Program (AIP) Scheme have confirmed their suitability; however, implementation has been delayed due to funding constraints. With appropriate investment and technical support, Bajaur's dams, springs, and valley streams can be effectively developed into productive aquaculture hubs, contributing to livelihood diversification, food security, and sustainable rural development.

6.12.2.3Existing and Future plans

- *Existing Plans by Government*
- ***Existing and Ongoing Projects***

The government has been actively working on the establishment, construction, and reconstruction of veterinary facilities to strengthen the livestock sector in tribal districts. These projects include the provision of de-wormers, vaccines, and medicines for all existing veterinary institutions. This initiative, approved in November 2019, aims to improve the overall animal health infrastructure and ensure better veterinary services in the merged areas.

- ***AIP (Accelerated Implementation Program) Projects***

Under the AIP framework, several projects have been launched to boost livestock development in merged areas. These include the Integrated Livestock Development Project (approved on August 26, 2020), which focuses on improving productivity and sustainability in livestock farming.

Another project involves the introduction of semi-environmentally controlled poultry housing systems and the revival of existing poultry farms, approved on October 12, 2021. Additionally, the Establishment of Veterinary Facilities project, approved on September 10, 2021, seeks to expand veterinary coverage in rural and remote regions.

To support economic uplift, a Poverty Alleviation Program through the Enhancement of Milk and Meat Value Chains has also been initiated in merged areas to generate income and employment opportunities.

- ***New Projects***

New initiatives include the Strengthening of Disease Preparedness and Response Mechanisms (Project No. 240227), which aims to improve disease control systems and emergency response in livestock management. Another key project, Employment Opportunities through Climate Smart and Gender Sensitive Livestock Interventions (Project No. 240228), focuses on promoting inclusive and sustainable livestock practices in merged areas, especially targeting women's participation and climate adaptation.

- ***In Process / Future Projects***

Several projects are in the pipeline to ensure long-term growth of the livestock sector. These include the solarization of veterinary institutes to preserve vaccines and medicines effectively across 44 centers. Plans are also underway to provide vehicles for district livestock directors and motorcycles for technical staff to enhance field operations.

Future developments include the establishment of sheep and goat farms through public-private partnerships, and the creation of vaccine banks at the tehsil level to ensure disease prevention and timely vaccination. Moreover, slaughterhouses will be established at tehsil levels in Khar, Salerzo, Mamund, and Nawagai, while reconstruction and rehabilitation works will be carried out for DDL offices and various veterinary hospitals such as CVH Khar, CVH Inayet Killi, CVH Bandagai (B-Wall), and CVC Pashat.

6.12.2.4 Future Proposals

- ***Livestock and Dairy Development Zones (Total Area: 530.07 Acres)***

Livestock farming is a cornerstone of the rural economy in District Bajaur, playing a vital role in providing nutrition, generating income, and creating employment for local communities. Current practices indicate substantial potential to expand, modernise, and commercialise dairy and livestock production systems.

To harness this potential, the proposed Livestock & Dairy Development Zones, spanning 530.07 acres, will be dedicated to dairy farming, animal husbandry, fodder cultivation, and veterinary services. These zones are designed to support sustainable livestock development and improve productivity through modern practices.

In addition, the zones will support value-added activities, including milk collection, chilling, processing, and local distribution, which will not only enhance food security but also create new income streams for rural households. By concentrating livestock development in designated zones, District Bajaur can strengthen its rural economy, improve livelihoods, and promote agricultural diversification.

Table 126: Livestock and Dairy Development Zones – District Bajaur

Proposal Location	Area in acre
Khar Urban Area	96.66
Vc Lara Dandok	12.86
Vc Gardai	87.95
Mamund	111.16
Barang	213.96
Salarzai	7.48

Source: Proposed District Bajaur Land Use Plan, 2025

6.12.2.5 *Recommendations*

- ***Veterinary & Aquaculture Services Expansion:*** Strengthen veterinary hospitals and diagnostic labs to cover both livestock and fisheries. Introduce mobile aqua-vet units to remote valleys to support disease management and water-quality monitoring.
- ***Fodder–Feed Integration:*** Develop a dual-feed strategy, fodder crops for livestock and feed formulations for fish, using locally available grains and by-products. Encourage private-sector investment in feed-processing units.

- ***Market-Oriented Clusters:*** Create integrated livestock and fish markets with auction halls, cold storage, and hygienic slaughter/fish processing units in Jamrud (gateway hub) and Bara (production hub) to improve value addition and regional trade.
- ***Public–Private Partnerships (PPP):*** Attract private investors to set up eco-tourism-based trout farms, combining fish production with recreation to diversify income streams.
- ***Microfinance & Insurance:*** Extend credit facilities and livestock/fish insurance schemes to small farmers for investment in high-yielding breeds, improved feed, fish ponds, and hatcheries.
- ***Extension & Awareness:*** Train farmers in modern livestock husbandry and aquaculture practices, disease control, biosecurity, and market trends through regular extension programs, community workshops, and demonstration sites.

6.13 FOREST/RANGELAND ZONES

6.13.1 Existing Status of Forests and Rangelands

District Bajaur historically supported significant tracts of natural vegetation in Mamund, Salarzai, Charmang, and along its highland peripheries, but population growth, agricultural expansion, and heavy reliance on fuelwood and grazing have steadily reduced this cover. Today, forests occupy about 73,496.5 acres[48] (23%) of the district's total 318,852.43 acres, existing mostly as fragmented patches on rugged slopes, while 148591.39185acres (36.8%) constitute rangelands that serve as critical grazing grounds. These forest resources include natural oak, wild olive, and chilghoza stands at higher elevations; phulai and sanatha scrub on lower slopes; scattered plantations of eucalyptus, poplar, and shisham; and community woodlots established under initiatives such as the Billion Tree Afforestation Program (BTAP). However, most of Bajaur's forests remain unclassified under provincial categories, underscoring the need for updated mapping and sustainable management.

6.13.2 Regional Comparison

Compared to forest-rich districts of Khyber Pakhtunkhwa, such as Swat (952,983 acres), Dir Upper (716,141 acres), Kohistan (Upper, Lower, and Kolai Palas, 1,145,023 acres), and South Waziristan (1,211,808 acres), Bajaur's forest share is very limited. While those districts together account for a major portion of the province's 8.5 million acres of forest resources, Bajaur depends mainly on scattered natural vegetation and community-managed rangelands, highlighting its fragile ecological base.

6.13.3 Community Dependency and Traditional Practices

Traditionally, forest resources in Bajaur were managed through community systems with informal seasonal restrictions to prevent depletion. Timber and fuelwood were used primarily for household construction, heating, and cooking, while non-wood products such as wild fruits, fodder grasses, medicinal herbs, and resin contributed to subsistence. With population growth and unregulated cutting, commercially valuable timber species have declined, while fuelwood collection remains widespread as the primary household energy source. For low-income families, small-scale firewood sales in bazaars provide supplemental income during winter. Afforestation campaigns, particularly BTAP, have generated short-term employment and contributed to ecosystem recovery, but the absence of formally classified high forests limits revenue potential compared to northern KP. Beyond wood products, Bajaur's forest and shrub cover underpins livestock rearing, reduces soil erosion, improves water infiltration, and supports agriculture, linking directly to household resilience and livelihood systems

6.13.4 Environmental Impacts of Deforestation

The environmental impacts of deforestation in Bajaur extend well beyond the district. Loss of tree cover has contributed to higher surface temperatures, drier springs, more frequent dust storms, and erratic rainfall patterns. At the global scale, deforestation is a major driver of

[48] Department of Agriculture Extension, District Bajaur

greenhouse gas emissions, glacier retreat, and long-term water scarcity, leaving semi-arid, rain-fed districts like Bajaur highly vulnerable to flash floods, droughts, and soil fertility decline. Pakistan's overall forest cover is only around 5% of the land area, well below the 25% benchmark for ecological stability, while Khyber Pakhtunkhwa averages 17%, including farm forestry, placing Bajaur at a significant disadvantage.

6.13.5 Ecological Functions and Way Forward

Mitigation requires a sustained and locally adapted afforestation and forest management strategy. Plantation campaigns such as BTAP must be reinforced through community-based management, sustainable harvesting practices, and agroforestry measures like tree planting along farmlands, irrigation channels, and degraded slopes. Every hectare of restored vegetation in Bajaur strengthens watershed protection, grazing productivity, and climate resilience, ensuring ecological services that support agriculture, rural livelihoods, and long-term sustainability.

6.13.6 Plans and Future direction

6.13.6.1 Future Proposals

6.13.6.1.1 Proposal for Protected Forest Conservation Zone

Table 127: Protected Forest Conservation Zone – District Bajaur

Proposal Location	Proposed Zone	Area in acre
District Bajaur	Forest Land/Green Cover	24807.17
	Range Land	144777.22
	Proposed Plantation	104.30

Source: Proposed District Bajaur Land Use Plan, 2025

Tehsil	Types of Proposals	Proposed Rangeland Area for Conservation (Acres)
Tehsil Khar	Range Land	17587.64
	Proposed Plantation	104.30
Tehsil Utman Khel Qzafi	Range Land	18645.94
Tehsil Nawagai	Forest Land/Green Cover	1445.38
	Range Land	
Tehsil Mamund	Forest Land/Green Cover	36971.23
	Range Land	27548.49
Tehsil Barang	Forest Land/Green Cover	19655.56
	Range Land	29964.73

Tehsil Bar Chamar	Range Land	4243.49
Tehsil Salarzai	Forest Land/Green Cover	3407.53
	Range Land	21188.32

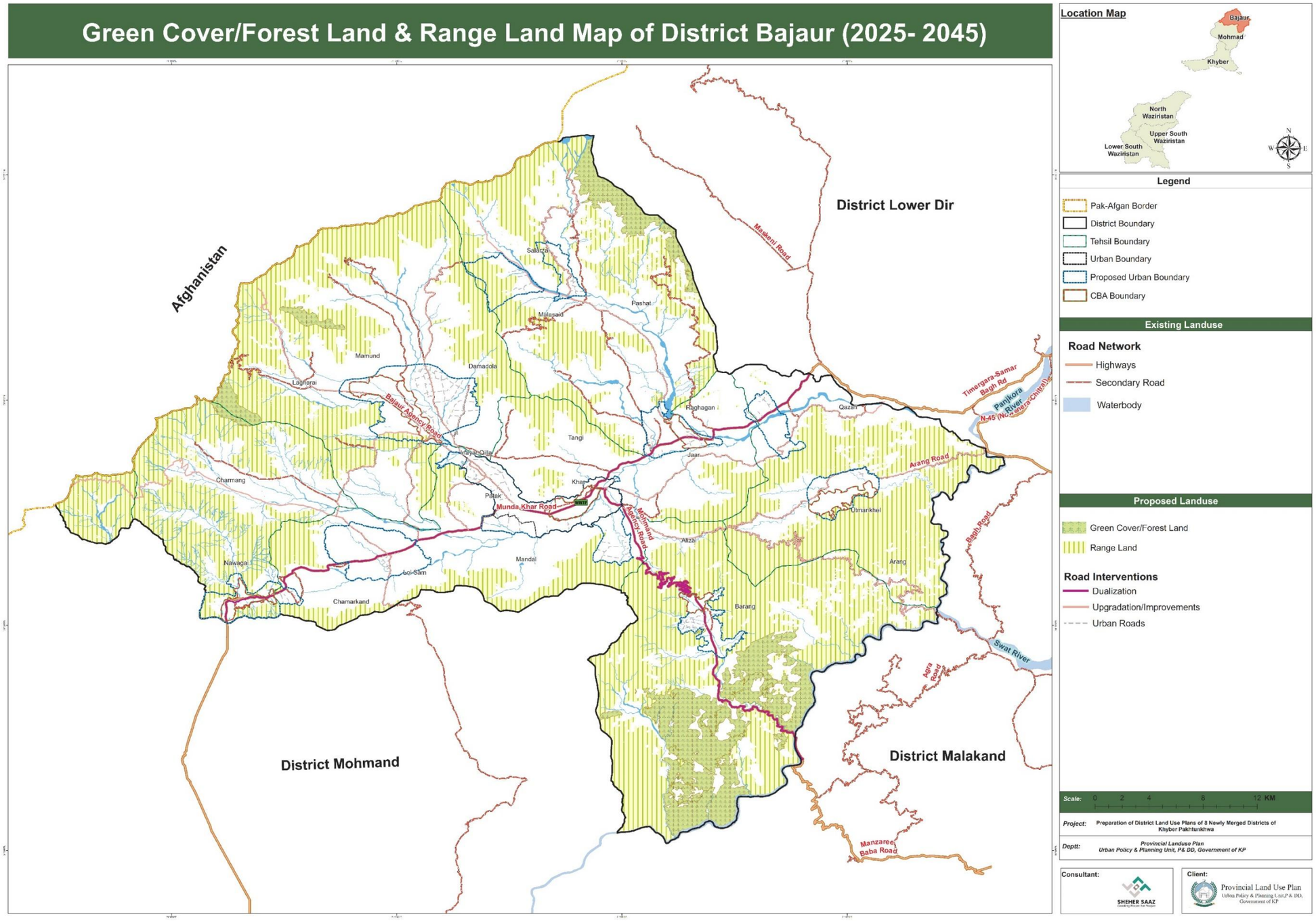
Sustainable management of rangelands and forested areas is vital for **environmental stability, biodiversity protection, and the livelihoods of rural communities** in District Bajaur. The district's proposed conservation interventions focus on protecting existing green cover.

Key Objectives of the Conservation Program:

1. **Restore and Protect Rangelands** – Enhance soil fertility, prevent overgrazing, and maintain sustainable livestock production.
2. **Afforestation and Green Cover Expansion** – Improve Forest density, stabilize ecosystems, and mitigate climate change impacts.
3. **Support Livelihoods** – Ensure sustainable use of natural resources for local communities dependent on livestock and forestry.
4. **Biodiversity and Environmental Resilience** – Safeguard native species and enhance carbon sequestration.

These targeted interventions will strengthen **ecological sustainability** while supporting **rural livelihoods and climate resilience** across District Bajaur.
Ehabilitating degraded lands, and promoting sustainable use of natural resources.

Map 61: Proposed Forest in District Bajaur



6.13.6.2Recommendations

- Strengthen and formalize traditional systems of selective cutting and seasonal grazing bans by developing community forest management committees. Linking these to the Forest Department will ensure sustainable use, fire prevention, and protection against overgrazing.
- To reduce pressure on fuelwood, promote renewable energy options such as solar panels, biogas units, and improved energy-efficient stoves. Targeted programs for low-income households should be introduced in forest-sensitive areas.
- Establish early warning and rapid response systems for forest fires in sensitive areas. Capacity building of local communities in fire management and provision of basic firefighting equipment is essential.
- Replantation efforts should prioritize native species (oak, wild olive, chilghoza, phulai, sanatha, acacia) over exotic species. This ensures biodiversity conservation and long-term ecological balance.
- Introduce programs for non-timber forest products (NTFPs) such as medicinal plants, wild fruits, honeybee keeping, and fodder cultivation. This will diversify income and reduce direct dependence on timber and fuelwood.
- Prepare and implement a comprehensive Forest and Rangeland Working Plan for District Bajaurunder the KP Forest Act (extended in 2022). This should include clear zoning of forests, rangelands, grazing areas, and conservation sites.
- Conduct awareness campaigns in schools, communities, and jirgas to highlight the importance of forests and rangelands in preventing soil erosion, regulating water cycles, and combating climate change.
- Forest and rangeland management should be mainstreamed into district-level climate change adaptation and disaster risk reduction strategies, recognizing their role in reducing flash floods, desertification, and land degradation.

6.13.6.3Zoning Regulation for Forest Land Use

Here are the guidelines developed for Forest zone development:

Category	Regulations / Activities
Permitted Uses	• Conservation and protection of natural forest cover. • Plantation and afforestation/reforestation activities. • Sustainable harvesting of non-timber forest products (NTFPs) such as medicinal plants, fruits, nuts, honey, and herbs. • Eco-tourism and recreational activities (e.g., guided trails, nature parks, camping areas) under controlled conditions. • Controlled grazing (only in designated forest-grazing zones and with proper management). • Wildlife conservation and establishment of natural habitats.

Permissible Uses	• Establishment of forest nurseries and research stations. • Agroforestry initiatives along forest edges. • Community-based Forest management programs. • Development of eco-education centers and awareness facilities. • Renewable energy projects that do not harm the ecosystem (e.g., small-scale solar, micro-hydel units within forest clearings).
Prohibited Uses	• Conversion of forest land to agricultural, residential, commercial, or industrial use. • Large-scale logging or unsustainable extraction of timber and fuelwood. • Illegal hunting, poaching, or wildlife trafficking. • Use of chemicals or practices harmful to forest soil, water, and biodiversity. • Encroachment, squatting, or expansion of settlements within forest boundaries. • Mining, quarrying, or other extractive activities within designated forest zones. • Any activity leading to deforestation, habitat destruction, or increased disaster risk (landslides, erosion, flooding).

7 CHAPTER VII: DISTRICT LAND USE PLAN

7.1 Overview

Bajaur District occupies a strategic position in the merged tribal areas of Khyber Pakhtunkhwa, serving as a vital hub for cross-border connectivity and accommodating a rapidly growing population. Despite this importance, the district has long operated without a coherent land use framework, resulting in ad-hoc decision-making, overlapping mandates of departments, and unsystematic conversion of land from one use to another. In particular, the absence of an integrated district-level land use plan has led to competing claims between agriculture, housing, industrial development, and ecological conservation, with each sector pursuing its priorities independently.

The preparation of the Bajaur District Land Use Plan provides the first structured framework for rationalizing competing demands on land resources and aligning them with provincial and national development objectives. The plan recognizes land as a finite and highly valuable resource that must be allocated based on suitability, sustainability, and long-term socio-economic benefits. Accordingly, prime agricultural land will be protected from urban encroachment and non-agricultural activities, while urban growth will be steered towards designated zones in Khar, Mamund, and Nawagai, with provisions for affordable housing, commercial expansion, and industrial estates linked to the Peshawar–Bajaur Economic Corridor.

The plan also considers the district's unique socio-economic context. Large areas are still dependent on rangelands for grazing, yet unregulated use has already degraded pasturelands, threatening local livelihoods. Similarly, deforestation and extraction pressures in mountainous zones require clear designation of conservation and ecological zones to preserve ecosystem services. At the same time, the return and resettlement of displaced populations, coupled with the demand for new housing schemes, necessitates careful allocation of residential and community infrastructure land to prevent unplanned sprawl.

By assigning each parcel of land to its most appropriate use, the Bajaur District Land Use Plan seeks to balance development and conservation. It serves as a guiding framework for provincial departments, local government authorities, and development partners to pursue integrated and coordinated planning. The plan also establishes a hierarchy of settlements, primary centers such as Khar and Mamund, intermediate settlements such as Salarzai and Utmankhel, and rural service centers in Nawagai and Barang, ensuring that growth is spatially distributed and pressure on larger cities like Peshawar is reduced. Ultimately, the Bajaur District Land Use Plan is envisaged as a roadmap for sustainable urban and rural development, economic diversification, and improved quality of life for local communities.

7.2 Planning Methodology and Settlement Hierarchy

The preparation of the District Land Use Plan for Bajaur District was based on a structured methodology that integrated settlement hierarchy analysis, review of existing master plans, and spatial planning tools at urban, rural, tehsil, and district levels.

Hierarchy of Human Settlements was established using multiple criteria, including population size and density, administrative status, education and health facilities, and accessibility through major roads. This analysis categorized Khar as the primary city, Mamund as the secondary city, Nawagai as a tertiary urban center, and Salarzai with other smaller settlements as potential growth nodes for future urbanization. The results highlighted a key imbalance: although Mamund functions as the district headquarters, it lacks the service base expected at this administrative level, while Khar has organically developed into the most dominant urban center.

To ensure continuity with ongoing initiatives, the approved Master Plans of Khar and Mamund were thoroughly reviewed and refined to align with recent ground realities and updated data. For Nawagai, Salarzai, Utmankhel, Barang, and emerging rural settlements projected to urbanize by 2045, new spatial frameworks were developed. These included delineation of compact settlement boundaries, land suitability analysis, growth trend assessments, and accessibility mapping for key services such as health and education.

At the district-wide scale, spatial zoning was carried out to distinguish between development zones and no-development zones, the latter including protected forests, reserved agricultural land, and environmentally sensitive areas. The zoning process prioritized the use of vacant or underutilized land for future growth, while also factoring in slope and terrain constraints to ensure sustainable expansion.

This integrated approach provided a coherent framework that balances urban consolidation, rural transformation, and environmental conservation, while also setting a staged direction for development up to the year 2045.

7.3 Framework for District Land Use Plan and Guidelines

Land use planning in Bajaur District requires a structured and integrated framework due to its complex socio-economic and institutional context. As a newly merged tribal district, Bajaur faces overlapping responsibilities among government departments, weak enforcement of building regulations, and limited institutional capacity at the Tehsil and local government level. Historically, Khyber Pakhtunkhwa lacked a unified institutional framework for land use planning. Prior to 2021, planning responsibilities were dispersed across multiple agencies. Tehsil Municipal Administrations (TMAs), under the Khyber Pakhtunkhwa Local Government Act 2013, were legally mandated to undertake land use planning and building control. However, due to limited technical capacity, resource constraints, and overlapping mandates, TMAs could only perform building regulation functions in urban centers, while broader spatial planning remained neglected. This institutional vacuum led to fragmented decision-making,

where departments-initiated projects without a common planning framework, resulting in inconsistent land allocations, ad-hoc approvals, and frequent inter-departmental conflicts.

Recognizing these challenges, the provincial government enacted the Khyber Pakhtunkhwa Land Use and Building Control Authority (LUBCA) Act, 2021, which established a dedicated authority to regulate and oversee land use planning at the district level. LUBCA was created to provide coherence, eliminate duplication, and ensure that district-level land use plans are prepared, implemented, and monitored systematically. The Act empowers LUBCA to develop District Land Use Plans (DLUPs), enforce zoning regulations, and rationalize the conversion of land from one use to another.

In practice, Urban Policy and Planning Unit (UPPU), P&D Department, plays a technical coordination role, guiding the preparation of DLUPs and ensuring consistency with the Provincial Land Use Plan (PLUP). At the local level, TMAs and line departments (Housing, Forests, Agriculture, Industries, etc.) remain key partners, responsible for sector-specific inputs and implementation within their jurisdictions. For the newly merged districts such as Bajaur, this framework is particularly significant, as institutional consolidation is still evolving after the 18th Amendment and the FATA merger.

This framework ensures that land use in Bajaur District transitions from an ad-hoc, fragmented approach to a coherent, legally backed, and evidence-based system. By anchoring the process within LUBCA's mandate while enhancing coordination with local institutions, the plan provides a sustainable mechanism for guiding urban expansion, protecting agricultural and forest resources, and accommodating industrial and commercial growth.

To operationalize this framework effectively in Bajaur District, the following guidelines are proposed:

Figure 40: Guidelines for District Land Use Plan

District Coordination Mechanism:	Establish a district-level steering/coordination committee chaired by the Deputy Commissioner, with representatives from TMAs, LUBCA, and line departments, to ensure alignment of sectoral projects with the approved DLUP.
Integration of Sectoral Plans:	All departmental plans (roads, housing schemes, industrial zones, forest reserves, irrigation, etc.) must be aligned with the designated land uses approved by LUBCA.
Monitoring and Review:	LUBCA, in coordination with UPPU, should conduct periodic reviews (every 5 years) of the DLUP for Khyber to incorporate demographic shifts, emerging economic opportunities, and climate-resilience needs.
Capacity Building:	Strengthening the technical capacity of TMAs and local line departments is essential for on-ground enforcement, GIS-based monitoring, and community awareness campaigns.
Stakeholder Engagement:	Community and private sector participation should be institutionalized through consultative forums, ensuring that planning decisions reflect both developmental priorities and local needs.

7.4 Economic/Transport Corridors (Roads, Trade Routes)

District Bajaur holds a unique geo-economic position as it functions as a vital hub in the merged tribal areas of Khyber Pakhtunkhwa, serving as a key connector for cross-border connectivity and regional trade through its proximity to Afghanistan. The district's transport corridors are not merely local roads but form part of strategic economic arteries that sustain commerce, cross-border linkages, and regional mobility.

The N-5 National Highway (Peshawar–Khar–Nawagai Corridor) serves as the backbone of economic and transport activity in the district. It connects Khar, Mamund, and Nawagai with Peshawar and onward to the national highway grid, facilitating high volumes of passenger movement and freight transport. This route is recognized as part of the Peshawar–Bajaur Economic Corridor, supported by international investment to improve road capacity, safety, and trade efficiency. Upon full development, this corridor is expected to significantly increase bilateral trade with Afghanistan and Central Asian Republics, while also enhancing accessibility for local settlements.

Supporting the N-5 are secondary economic corridors, such as the Khar–Salarzai road and Mamund–Utmankhel linkages, which connect the industrial and commercial centers of Mamund Tehsil with the main highway network. These corridors not only support industrial

freight (notably marble, minerals, and fruit produce) but also serve daily commuter flows between markets, industries, and surrounding settlements.

The Nawagai–Barang link provides direct connectivity to quarrying and mineral extraction areas, channeling goods towards both local processing units and external markets. Similarly, internal access routes within Khar and Mamund are emerging as feeder economic corridors, directing traffic towards the N-5 spine and ensuring integration of local markets with the regional trade system.

In the broader transport context, these corridors are not limited to goods movement; they also sustain public transport flows, with minibuses, coaches, and informal transport systems concentrated along the same trade routes. Their dual function as economic and mobility lifelines underscores the necessity of structured parking, freight handling areas, and dedicated bus terminals as part of corridor development.

Future corridor enhancement under the District Land Use Plan envisions: • Upgrading of N-5 and feeder roads for improved capacity and safety standards. • Integration of logistics and warehousing facilities near Nawagai and Khar to manage freight flows. • Strengthening of industrial–trade linkages through improved connectivity to Mamund and Salarzai clusters.

In sum, District Bajaur's economic and transport corridors are the lifeblood of its integration with national and regional economies. Prioritizing these routes ensures not only the facilitation of cross-border trade but also the uplift of local commerce, industrial development, and urban mobility across the district.

7.5 Proposed District Land Use Plan

The future land use plan for District Bajaur has been projected on the basis of comprehensive spatial analysis, population growth, economic needs, and environmental sustainability across the entire 312,586 acres of the district. For the plan period (2025–2045), the district is expected to allocate land across 28 diverse zones to balance urban development, agriculture, conservation, and infrastructure. Reserved Agriculture dominates at 123,580 acres (40% of total), protecting prime farmland from urban sprawl to sustain food security and rural livelihoods. Range Land follows at 148,591 acres (48%), preserving vast grazing areas essential for livestock-dependent communities, while Forest Land/Green Cover covers 21,898 acres (7%) to combat deforestation and maintain ecological balance.

It can be seen that residential development totals 8,473 acres, with Proposed Short-Term Residential Zone at 1,496 acres for immediate housing needs (2025-2030), Proposed Medium-Term Residential Zone at 2,271 acres (2031-2035), Proposed Long-Term Residential Zone at 2,182 acres (2036-2045), Infill Residential at 592 acres to fill urban gaps efficiently, and Proposed Residential Zone at 1,933 acres for flexible general housing—ensuring phased, affordable homes for 832,422 additional residents.

It can be seen that industrial and commercial growth requires 1,604 acres, including Proposed Industrial Zone at 357 acres and Proposed Industrial Park at 4 acres to accommodate 41,621 workers (urban needs: 280 acres), plus Proposed Commercial Zone at 1,244 acres for markets and trade hubs linked to the Peshawar-Bajaur Economic Corridor, boosting marble, fruit processing, and cross-border commerce.

It can be seen that community and civic infrastructure totals 862 acres, with Proposed Educational Zone at 307 acres for schools/universities, Proposed Health Care Zone at 167 acres for hospitals/clinics, Civic Amenities Zone at 104 acres for public facilities, Proposed Park and Green Space at 239 acres for recreation, Proposed Graveyard at 56 acres, and Proposed Transport Terminal at 24 acres for bus stations serving daily mobility along N-5 and feeder corridors.

It can be seen that environmental and utility zones cover 8,157 acres, including Riparian Zone at 5,868 acres along rivers for flood control and water recharge, Proposed Sewage Treatment Plant at 67 acres, Proposed Landfill Site at 256 acres, Proposed SWM (Solid Waste Management) at 54 acres, Proposed Plantation at 256 acres for reforestation, and River Front Park at 170 acres for eco-tourism.

It can be seen that specialized economic zones include the Livestock and Dairy Development Zone at 143 acres to modernize herding, the Reserved Orchard at 75 acres for fruit cultivation, the Slaughterhouse at 40 acres, and the Tourist Attraction Site at 456 acres to promote heritage and eco-tourism in mountainous areas.

Overall, for the entire 2025-2045 plan period, District Bajaur's 312,586 acres are strategically zoned with 88% conserved for agriculture/rangeland/forests, 3% for housing, 1% for industry/commerce, and 8% for infrastructure—creating a balanced blueprint that protects 70% of land from development while accommodating rapid urbanization in Khar, Mamund, and Nawagai. This projection clearly indicates a sustainable demand for integrated zoning to ensure economic diversification, environmental protection, and improved quality of life, preventing ad-hoc sprawl and aligning with the Khyber Pakhtunkhwa LUBCA Act 2021

7.5.1 Recommended Land Uses for Existing Urban Centre

Khar, the administrative headquarters of Bajaur District, is situated in the northwestern part of Khyber Pakhtunkhwa Province. Geographically, Khar lies approximately between 34°38' to 34°50' north latitudes and 71°30' to 71°45' east longitudes. The town holds a strategically important position due to its proximity to the Pakistan–Afghanistan border and its role as the primary administrative, commercial, and service hub of Bajaur District.

It is bordered by Mamund Tehsil to the north, Salarzai Tehsil to the east, Nawagai Tehsil to the west, and Afghanistan to the northwest. The total area of the Khar urban center spans approximately 22–24 square kilometers, forming a compact yet rapidly expanding urban footprint. Khar Bajaur is designated as the Urban Centre within the settlement hierarchy of Khar Bajaur **Tehsil**, reflecting its role as the primary administrative, commercial, and service hub of the district. As an urban centre, Khar Bajaur accommodates the highest concentration of population, economic activities, and public services within the tehsil, serving both its resident population and surrounding rural settlements.

Figure 41: Planning Boundary Khar Urban Centre

Source: Google Earth

According to the projected demographic data, Khar Bajaur Urban Centre had an estimated population of 125,694 in 2025, which is expected to increase significantly to approximately 265,713 by 2045. This represents more than a twofold increase over a 20-year period, indicating a high urban growth trajectory driven by natural population increase, rural-to-urban migration, and the consolidation of administrative and commercial functions.

The existing educational infrastructure in Khar reflects its role as the district's institutional center. Facilities include approximately **38 primary schools**, **5 middle schools**, and **9 high schools**, alongside several private educational institutions. While primary education coverage is relatively adequate, there remains a notable need to expand quality secondary and higher education facilities to meet the growing demand of the urban population and to reduce dependence on institutions in Peshawar and Mardan.

Despite rapid urbanization, Khar and its peri-urban areas continue to sustain active agricultural production, primarily based on seasonal cropping patterns. Major crops include maize and wheat, along with vegetables such as tomatoes, onions, chilies, cucumbers, and potatoes, which contribute significantly to local food security and support the district's informal agro-based economy.

Wildlife in the Khar region is modest yet ecologically significant, including foxes, jackals, wild boars, rabbits, monkeys, and birds such as chakor, partridge, quail, wild ducks, and winter migratory species. Despite habitat loss from urban expansion, these species persist in hills, riverine areas, and agricultural fields, underscoring the need for ecological conservation in urban planning.

- ***Proposed Land Uses of Khar***

The proposed Landuse Plan for Khar Settlement establishes a comprehensive and balanced land-use framework aimed at guiding future urban growth while reinforcing Khar's role as the administrative, commercial, and service hub of District Bajaur. The plan integrates existing land uses with new development proposals to ensure orderly spatial expansion, efficient service provision, environmental protection, and enhanced urban livability. Under the plan, a total of 4,786.83 acres has been allocated for proposed land uses which, when combined with the existing developed area of 6,939.23 acres, brings the total planned urban and peri-urban area of Khar Settlement to 11,726.05 acre

Residential development forms the backbone of the Khar Settlement Landuse Plan, reflecting current housing demand and anticipated population growth. Existing residential areas cover 1,245.17 acres, constituting 17.94**%** of the total existing land use. Under the proposed plan, 1,417.27 acres have been allocated for new residential development, complemented by 231.41 acres reserved as a Long-Term Residential Zone. This brings the total proposed residential area to 1,648.68 acres, accounting for 34.44**%** of all proposed land uses. When combined with existing residential areas, the overall residential footprint reaches 2,893.85

acres, ensuring sufficient land for planned neighborhoods, community facilities, and controlled urban expansion while minimizing informal sprawl.

Commercial and allied economic activities have been strategically planned to strengthen Khar's position as a district-level economic center. Existing commercial land covers 273.65 acres (3.94%). The Landuse Plan proposes a substantial expansion through 938.03 acres designated as Proposed Commercial Zone, along with 96.67 acres for a Livestock and Dairy Development Zone and 1.41 acres for a Slaughter House facility. Collectively, these uses form a total proposed economic land area of 1,036.11 acres, representing 21.64% of proposed land uses. Including existing commercial areas, the total commercial and economic footprint reaches 1,309.76 acres, supporting trade, services, agro-based industries, and employment generation while maintaining functional compatibility with surrounding land uses.

Industrial activities currently occupy a limited area, with scattered industries covering only 33.91 acres (0.49%). To promote structured industrial growth and minimize environmental and social conflicts, the Landuse Plan proposes a dedicated Industrial Zone of 112.52 acres, accounting for 2.35% of proposed land uses. With this addition, the total industrial area increases to 146.43 acres, enabling the development of light and service industries in an organized manner and supporting local economic diversification.

Institutional land uses form a critical component of the urban fabric, supporting governance, education, healthcare, and civic life. Existing institutional uses—including public buildings, religious facilities, educational institutions, and health facilities—occupy 169.16 acres (2.44%). To enhance social service provision, the plan proposes 24.25 acres for Civic Amenities, 146.63 acres for a Proposed Educational Zone, and 13.09 acres for a Proposed Health Care Zone. Together, these amount to 183.97 acres of proposed institutional land, constituting 3.84% of total proposed land uses. When combined with existing areas, institutional land reaches 353.13 acres, ensuring adequate provision for future population growth and improved access to public services.

Recreational and open spaces are integral to urban livability and environmental quality. Currently, parks and playgrounds occupy 67.66 acres (0.98%). The plan proposes 85.83 acres for Recreational Zones and an additional 61.49 acres for Green Spaces, resulting in a total proposed area of 147.32 acres (3.08%). Combined with existing open spaces, recreational land increases to 214.98 acres, promoting healthy lifestyles, social interaction, and ecological balance within the settlement.

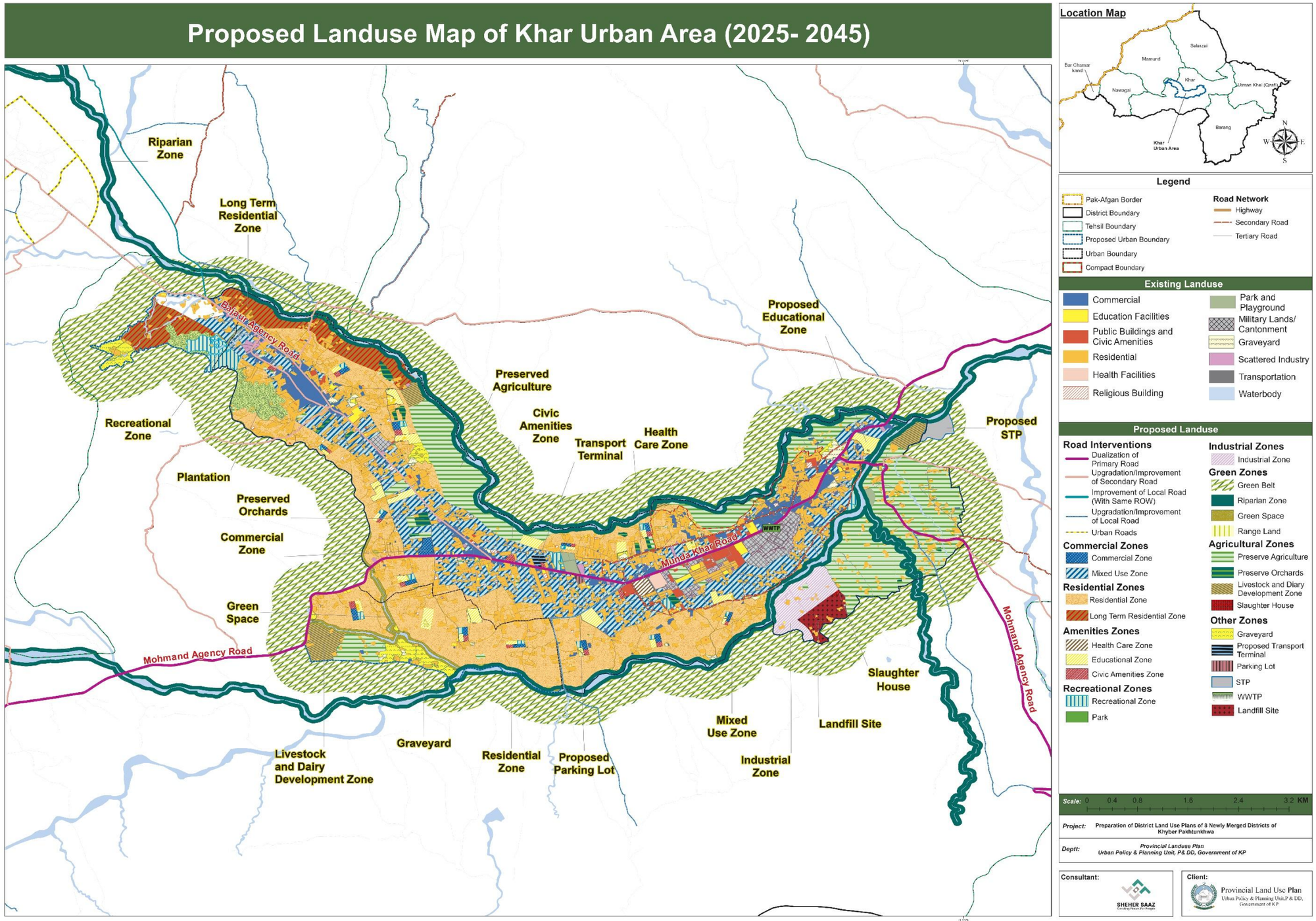
Transportation infrastructure currently covers 295.53 acres (4.26%), forming a vital component of urban connectivity. The Master Plan introduces a Proposed Transport Terminal covering 6.47 acres, raising the total transportation-related land to 302.00 acres. Although accounting for only 0.14% of proposed land uses, this terminal plays a strategic role in improving inter-city and intra-city mobility, traffic management, and passenger convenience.

The category of "Others" constitutes the largest share of existing land uses, occupying 4,791.90 acres (69.06%), including agriculture, orchards, rangeland, water bodies, military lands, and vacant areas. Under the proposed plan, this category has been rationalized and reorganized to cover 1,553.08 acres (32.44%) with a strong emphasis on environmental protection and utility services. Proposed allocations include 982.97 acres for Agriculture, 36.77 acres for Orchards, and a substantial 370.70 acres designated as a Riparian Zone to safeguard watercourses and reduce flood risks. Additionally, essential urban utilities have been incorporated, including 53.69 acres for a Landfill Site, 0.33 acres for a Sewage Treatment Plant (STP), 4.32 acres for Parking Lots, and 104.30 acres for Plantation. When combined with existing areas, the total land under this category reaches 6,344.98 acres, reflecting a strong commitment to environmental sustainability, food security, and climate resilience.

Table 128: Existing and Proposed Land Uses, Khar- Urban Center

Khar Settlement Existing Landuse					Khar Settlement Proposed Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	1245.168	1245.168	17.94%	Long Term Residential Zone	231.414	1648.684	34.44%	2893.852
					Proposed Residential Zone	1417.270			
Commercial	Commercial	273.650	273.650	3.94%	Livestock and Dairy Development Zone	96.667	1036.108	21.64%	1309.758
					Slaughter House	1.412			
					Proposed Commercial Zone	938.029			
Industrial	Scattered Industry	33.913	33.913	0.49%	Proposed Industrial Zone	112.521	112.521	2.35%	146.435
Institutional	Public Buildings and Civic Amenities	65.193	169.159	2.44%	Civic Amenities Zone	24.245	183.972	3.84%	353.131
	Religious Building	26.041							
	Education Facilities	47.714			Proposed Educational Zone	146.634			
	Health Facilities	30.212			Proposed Health Care Zone	13.093			
Graveyard	Graveyard	62.247	62.247	0.90%	Proposed Graveyard	98.665	98.665	2.06%	160.912
Recreational and Open Space	Park and Playground	67.660	67.660	0.98%	Proposed Recreational Zone	85.833	147.325	3.08%	214.985
					Green Space	61.491			
Transportation	Transportation	295.534	295.534	4.26%	Proposed Transport Terminal	6.468	6.468	0.14%	302.002
Others	Agriculture	4312.091	4791.895	69.06%	Agriculture	982.971	1553.083	32.44%	6344.978
	Orchard	63.460			Orchard	36.774			
	Range Land	101.487			Riparian Zone	370.695			
	Waterbody	175.693			Proposed Landfill Site	53.686			
	Military Lands/Cantonment	129.601			Proposed Parking Lot	4.322			
					Proposed STP	0.332			
	Vacant Area	9.564			Proposed Plantation	104.303			
Total		**6939.226**	**6939.226**	**100.00%**	**Total**	**4786.826**	**4786.826**	**100.00%**	**11726.053**

Map 62: Proposed Land Use Map – Khar Urban Center



7.5.2 Recommended Land Uses for Potential Urban Center

7.5.2.1 Mamund

Mamund Tehsil exhibits a predominantly rural settlement structure, with Mamund identified within the settlement hierarchy of Bajaur District as a Potential Urban Centre. This designation reflects its emerging role as a future growth node, with the capacity to evolve into a more structured urban centre, serving as a focal point for administration, commerce, and service provision for the surrounding areas.

According to demographic data, the rural population of Mamund Tehsil stands at 26,552, while the population of Mamund as a Potential Urban Centre is 47,120. The higher population concentration in Mamund highlights its significance as a local service and economic hub, likely to attract further inward migration from nearby rural settlements over time.

Figure 42: Planning Boundary Mamund Potential Urban Centre

From a planning perspective, Mamund's classification as a Potential Urban Centre emphasizes the need for forward-looking spatial planning and investment in infrastructure, including housing, road networks, water supply, sanitation, and social services. Strategic development in these areas will be critical to support its transition from a rural settlement into a functional urban node, thereby promoting balanced growth within Bajaur District.

Figure 43: Stadium Ground in Mamund

The existing educational infrastructure in Mamund includes three male and three female primary schools, one female middle school, and one male high school. While this network provides basic educational coverage, the limited availability of middle and secondary schools indicates a need for expansion to meet the demands of a growing population and to enhance access to post-primary education within the tehsil.

- ***Proposed Land Uses of Mamund***

The proposed Master Plan for Mamund Settlement presents a comprehensive and development-oriented land-use framework aimed at managing future urban expansion while preserving the settlement's agrarian base and environmental assets. The plan integrates existing land uses with future development proposals to ensure balanced growth, improved service provision, economic strengthening, and environmental sustainability. Under the plan, a total of 2,868.24 acres has been allocated for proposed land uses which, when combined with the existing land area of 3,357.88 acres, brings the total planned area of Mamund Settlement to 6,226.12 acres.

Residential development constitutes the primary focus of the Mamund Master Plan, reflecting both current housing shortages and projected population growth. Existing residential areas cover 394.31 acres, accounting for 11.74% of the total existing land use. The proposed plan

introduces a phased residential structure comprising 302.37 acres for Long-Term Residential, 276.13 acres for Medium-Term Residential, and 487.29 acres for Short-Term Residential development. Collectively, these residential allocations amount to 1,065.79 acres, representing 37.16% of total proposed land uses. When combined with existing residential areas, the overall residential footprint expands to 1,460.10 acres, ensuring adequate land supply for planned neighborhoods and discouraging informal urban sprawl.

Commercial activity in Mamund is presently minimal, with existing commercial land covering only 3.78 acres (0.11%). To transform Mamund into a functional sub-regional economic center, the Master Plan proposes a diversified commercial and agro-based economic framework. This includes 22.02 acres for a Proposed Commercial Zone, 111.16 acres for a Livestock and Dairy Development Zone, 3.49 acres for a Slaughter House, and 3.40 acres for a Proposed Grain Market. Together, these allocations form 140.07 acres of proposed commercial and allied economic land, accounting for 4.88% of proposed land uses. With the inclusion of existing areas, total commercial land increases to 143.86 acres, significantly strengthening local trade, agricultural marketing, and food supply chains.

While Mamund currently lacks a defined industrial area, the Master Plan introduces a Proposed Industrial Zone of 50.82 acres, representing 1.77% of proposed land uses. This allocation is intended to accommodate light and agro-based industries, promote local employment, and support value addition to agricultural produce, while maintaining compatibility with surrounding land uses.

Institutional land uses—including public buildings, religious facilities, educational institutions, and health facilities—currently occupy 28.67 acres, representing 0.85% of existing land uses. To enhance social service delivery, the Master Plan proposes 12.73 acres for Civic Amenities, 9.13 acres for a Proposed Educational Zone, and 8.02 acres for a Proposed Health Care Zone. These allocations collectively amount to 29.88 acres, representing 1.04% of proposed land uses. When combined with existing areas, total institutional land increases to 58.55 acres, ensuring improved access to governance, education, and healthcare services in line with future population needs.

Existing graveyard land in Mamund covers 8.89 acres (0.26%), which is insufficient to cater to long-term needs. The Master Plan therefore proposes an additional 15.00 acres for graveyard facilities, increasing the total graveyard area to 23.89 acres and accounting for 0.52% of proposed land uses. This ensures culturally appropriate and spatially planned burial grounds for future generations.

Recreational and open spaces are currently limited, with parks and playgrounds occupying only 7.54 acres (0.22%). To improve urban livability and environmental quality, the Landuse Plan proposes 10.79 acres for a Proposed Park and 7.25 acres for a Recreational Zone, collectively amounting to 18.04 acres or 0.63% of proposed land uses. When combined with existing open spaces, the total recreational land increases to 25.57 acres, providing much-needed community spaces for leisure and social interaction.

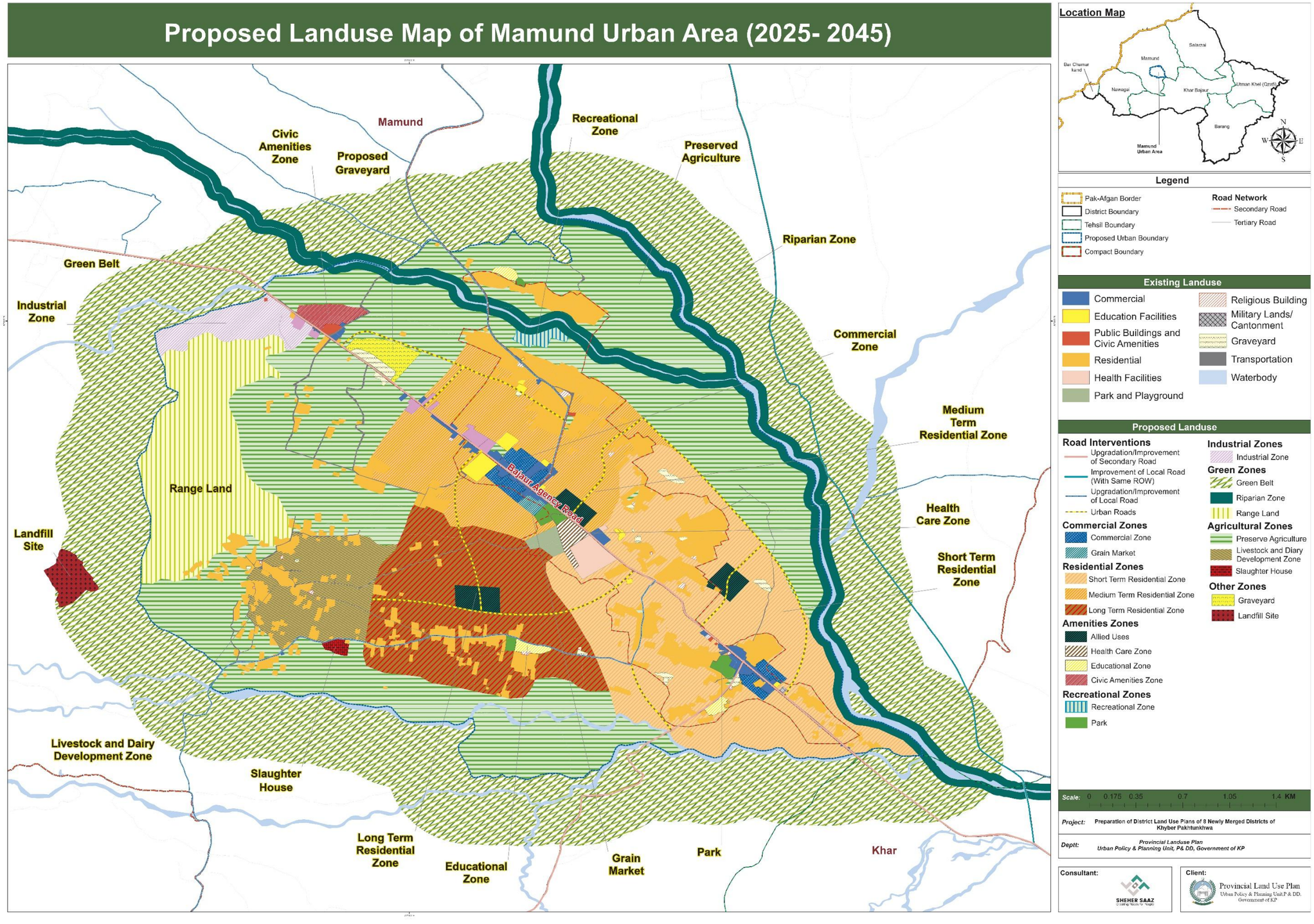
Transportation infrastructure presently covers 43.46 acres, accounting for 1.29% of existing land uses. The Landuse Plan retains this allocation without proposing additional land, indicating that the current transportation network is considered sufficient to support the planned urban expansion in the short to medium term.

The “Others” category dominates Mamund’s land-use structure, occupying 2,871.24 acres, or 85.51% of existing land uses, primarily comprising agriculture, rangeland, water bodies, and military lands. Under the proposed plan, this category is reorganized to cover 1,548.64 acres, representing 53.99% of proposed land uses, with a strong emphasis on productive land use and environmental protection. Proposed allocations include 1,150.86 acres for Agriculture, 269.71 acres for Range Land, and 128.08 acres designated as Riparian Zone to protect natural drainage corridors and reduce flood risk. When combined with existing areas, total land under this category reaches 4,419.88 acres, reaffirming Mamund’s role as a predominantly agrarian settlement with strong ecological foundations.

Table 129: Existing and Proposed Land Uses, Mamund- Urban Center

Mamund Settlement Existing Landuse					Mamund Settlement Proposed Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	394.314	394.314	11.74%	Long Term Residential Zone	302.367	1065.787	37.16%	1460.102
					Medium Term Residential Zone	276.131			
					Short Term Residential Zone	487.289			
Commercial	Commercial	3.783	3.783	0.11%	Proposed Commercial Zone	22.017	140.073	4.88%	143.856
					Slaughter House	3.487			
					Proposed Grain Market	3.405			
					Livestock and Dairy Development Zone	111.163			
Industrial Zone					Proposed Industrial Zone	50.821	50.821	1.77%	50.821
Institutional	Public Buildings and Civic Amenities	1.958	28.668	0.85%	Civic Amenities Zone	12.727	29.880	1.04%	58.548
	Religious Building	1.008							
	Education Facilities	12.236			Proposed Educational Zone	9.132			
	Health Facilities	13.466			Proposed Health Care Zone	8.021			
Graveyard	Graveyard	8.885	8.885	0.26%	Proposed Graveyard	15.001	15.001	0.52%	23.887
Recreational and Open Space	Park and Playground	7.537	7.537	0.22%	Proposed Park	10.785	18.036	0.63%	25.574
					Proposed Recreational Zone	7.251			
Transportation	Transportation	43.456	43.456	1.29%					43.456
Others	Agriculture	2580.311	2871.237	85.51%	Agriculture	1150.856	1548.644	53.99%	4419.881
	Range Land	269.706			Range Land	269.706			
	Waterbody	20.885			Riparian Zone	128.082			
	Military Lands/Cantonment	0.334							
Total		**3357.880**	**3357.880**	**100.00%**	**Total**	**2868.243**	**2868.243**	**100.00%**	**6226.123**

Map 63: Proposed Land Use Map – Mamund Urban Center

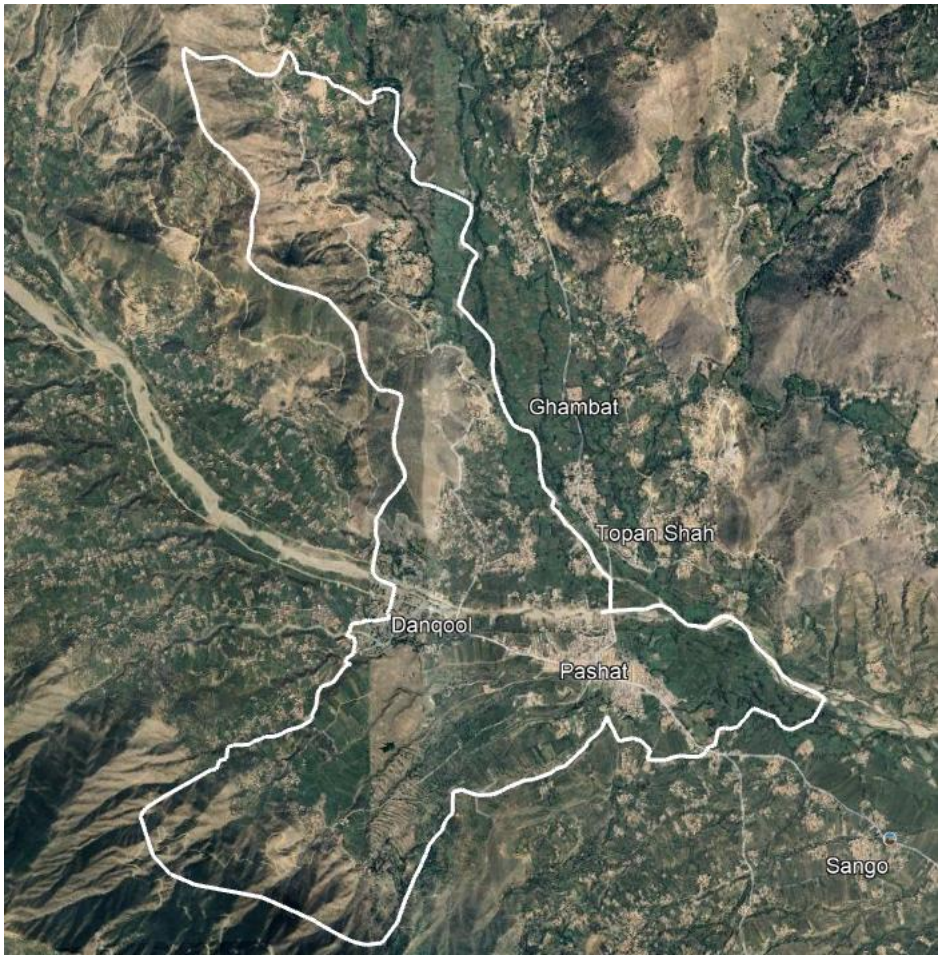


7.5.2.2 Lara Dandokai

Lara Dandokaii exhibits a predominantly rural settlement pattern, with Lara Dandokaii identified within the settlement hierarchy of Bajaur District as a Potential Urban Centre. This designation highlights its emerging role as a future growth node, with the capacity to develop into a more structured urban centre that can serve as a focal point for administration, commerce, and service provision for the surrounding rural areas.

According to demographic data, the rural population of the tehsil is 22,896, while the population of Lara Dandokaii as a Potential Urban Centre is 42,930. This population distribution underscores the settlement's significance as a local hub, likely to attract inward migration and increased economic activity over time.

Figure 44: Planning Boundary Lara Dandokai



From a planning perspective, Lara Dandokaii's classification as a Potential Urban Centre emphasizes the importance of proactive spatial planning and infrastructure development, particularly in housing, transportation, water supply, sanitation, and social services. Strategic investment in these sectors will be essential to support its transition from a predominantly rural settlement to a functional urban node, contributing to more balanced and polycentric development within Bajaur District.

The current educational infrastructure in Lara Dandokaii has not been specified; however, given the population size and its potential urban status, there is a likely need for adequate primary, middle, and secondary schools to ensure access to quality education and accommodate future population growth within the tehsil.

- ***Proposed Land Uses of Dandokai***

The proposed Landuse Plan for VC Lara Dandokai Settlement establishes a structured and sustainable land-use framework aimed at guiding future growth while preserving the area's agrarian base and environmental assets. The plan integrates existing land uses with future development proposals to promote controlled urban expansion, improved service delivery, economic diversification, and environmental protection. Under the plan, a total of 2,120.28 acres has been allocated for proposed land uses which, when combined with the existing land area of 2,601.91 acres, brings the total planned area of VC Lara Dandokai to 4,722.19 acres.

Residential development forms a central component of the VC Lara Dandokai Landuse Plan, addressing the currently low proportion of built-up residential land and accommodating future population growth in a phased manner. Existing residential areas cover 216.56 acres, accounting for 8.32% of total existing land uses. The proposed plan adopts a phased residential strategy comprising 153.89 acres for Long-Term Residential, 148.37 acres for Medium-Term Residential, and 273.58 acres for Short-Term Residential development. Collectively, these allocations amount to 575.84 acres, representing 27.16% of total proposed land uses. When combined with existing residential areas, the total residential footprint expands to 792.39 acres, ensuring adequate land availability for planned housing and discouraging informal and scattered development.

Commercial activity in VC Lara Dandokai currently occupies 48.00 acres, constituting 1.84% of existing land uses. To strengthen the local economy and support agro-based livelihoods, the Landuse Plan proposes a diversified set of commercial and allied uses, including 5.43 acres for a Proposed Commercial Zone, 12.86 acres for a Livestock and Dairy Development Zone, 2.91 acres for a Slaughter House, and 4.96 acres for a Proposed Grain Market. Together, these allocations form 26.16 acres of proposed commercial and agro-economic land, accounting for 1.23% of proposed land uses. With the inclusion of existing areas, total commercial land increases to 74.16 acres, enhancing market accessibility and supporting local agricultural value chains.

Industrial activity in VC Lara Dandokai is currently minimal and scattered, occupying only 4.33 acres (0.17%). To promote organized and environmentally compatible industrial growth, the Landuse Plan designates a Proposed Industrial Zone of 39.32 acres, representing 1.85% of total proposed land uses. This brings the total industrial land to 43.65 acres, facilitating the development of light and agro-based industries and contributing to local employment generation.

Institutional land uses—including public buildings, religious facilities, educational institutions, and health facilities—currently occupy 9.49 acres, accounting for 0.36% of existing land uses. To enhance social service provision, the Landuse Plan proposes 5.08 acres for Civic Amenities, 17.83 acres for a Proposed Educational Zone, and 8.41 acres for a Proposed Health Care Zone. These allocations collectively amount to 31.32 acres, representing 1.48% of proposed land uses. When combined with existing areas, total institutional land increases to 40.81 acres, ensuring improved access to education, healthcare, and civic services in line with future population needs.

Existing graveyard land in VC Lara Dandokai covers 22.16 acres, representing 0.85% of existing land uses. The Landuse Plan proposes an additional 3.90 acres for graveyard facilities, increasing the total graveyard area to 26.06 acres and accounting for 0.18% of proposed land uses. This ensures adequate and spatially planned burial grounds to meet future requirements.

VC Lara Dandokai currently lacks formally designated recreational and open spaces. To address this deficiency and improve urban livability, the Landuse Plan proposes 7.53 acres for a Proposed Park, 8.22 acres for a Recreational Zone, and 25.74 acres for Green Spaces. Together, these amount to 41.49 acres, representing 1.96% of total proposed land uses. These spaces are intended to serve as community gathering areas, promote healthy lifestyles, and enhance environmental quality.

Transportation infrastructure presently covers 59.34 acres, accounting for 2.28% of existing land uses. The Landuse Plan retains this allocation without proposing additional transportation land, indicating that the existing network is considered adequate to support the planned development in the short to medium term.

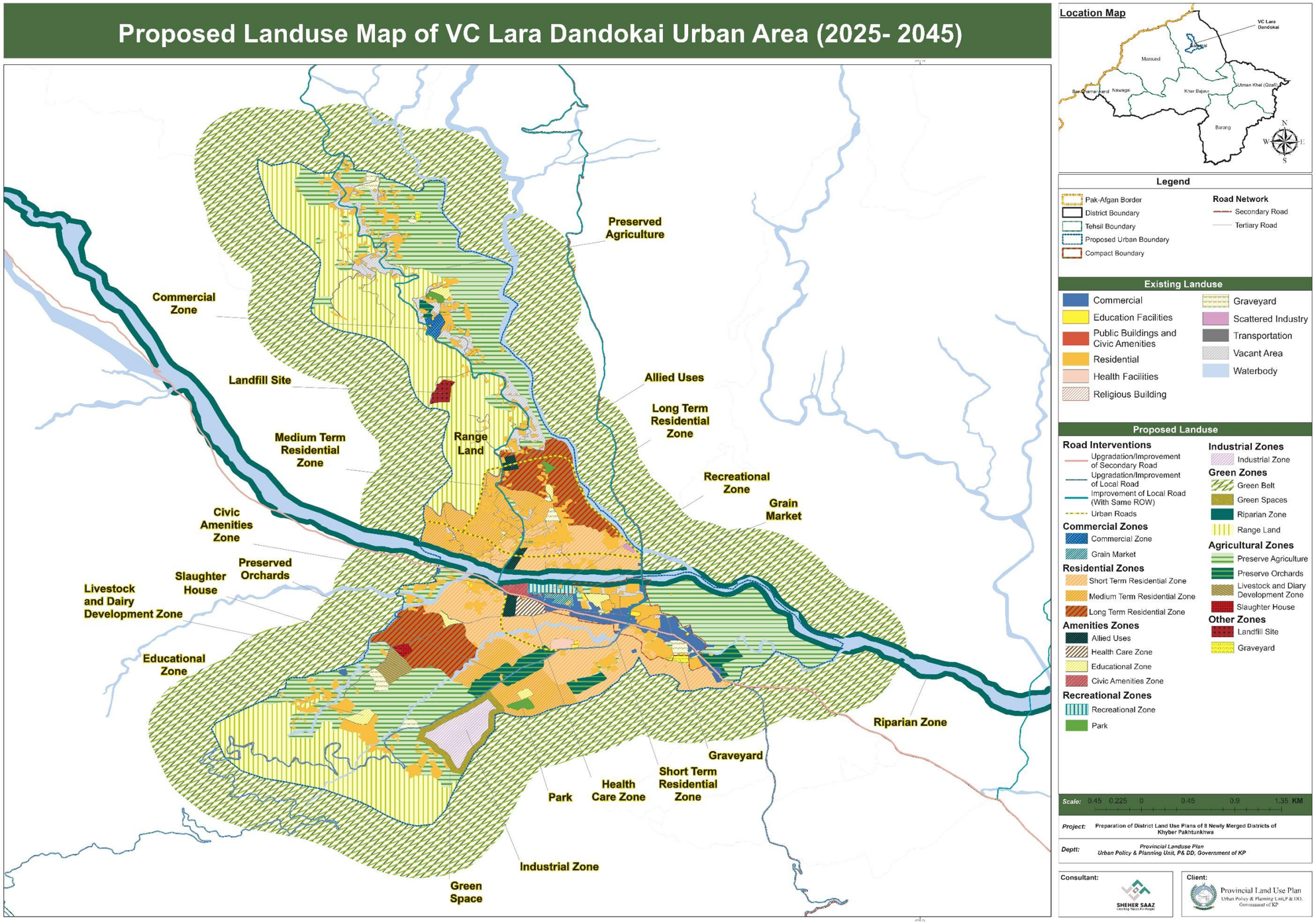
The “Others” category dominates the land-use structure of VC Lara Dandokai, occupying 2,242.03 acres, or 86.17% of existing land uses, primarily comprising agriculture, orchards, rangeland, water bodies, and vacant areas. Under the proposed plan, this category is rationalized to 1,402.25 acres, representing 66.14% of proposed land uses, with a strong emphasis on productive land use and environmental conservation. Proposed allocations include 621.21 acres for Agriculture, 48.22 acres for Orchards, 656.10 acres for Range Land, and 69.70 acres designated as Riparian Zone to protect natural drainage corridors and mitigate flood risks. Additionally, 7.02 acres have been reserved for a Proposed Landfill Site to ensure environmentally sound solid waste management. When combined with existing areas, total

land under this category reaches 3,644.28 acres, reaffirming the settlement's predominantly agrarian and environmentally sensitive character.

Table 130: Existing and Proposed Land Uses, Lara Dandokai- Urban Center

Lara Dandok Settlement Existing Landuse					Lara Dandok Settlement Proposed Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	216.555	216.555	8.32%	Long Term Residential Zone	153.893	575.84	27.16%	792.393
					Medium Term Residential Zone	148.367			
					Short Term Residential Zone	273.578			
Commercial	Commercial	48.005	48.005	1.84%	Proposed Commercial Zone	5.426	26.16	1.23%	74.163
					Slaughter House	2.907			
					Proposed Grain Market	4.961			
					Livestock and Dairy Development Zone	12.863			
Industrial	Scattered Industry	4.325	4.325	0.17%	Proposed Industrial Zone	39.322	39.32	1.85%	43.647
Institutional	Public Buildings and Civic Amenities	0.028	9.487	0.36%	Civic Amenities Zone	5.083	31.32	1.48%	40.807
	Religious Building	1.295							
	Education Facilities	3.641			Proposed Educational Zone	17.828			
	Health Facilities	4.524			Proposed Health Care Zone	8.409			
Graveyard	Graveyard	22.162	22.162	0.85%	Proposed Graveyard	3.903	3.90	0.18%	26.065
Recreational and Open Space					Proposed Park	7.530	41.49	1.96%	41.490
					Proposed Recreational Zone	8.219			
					Green Space	25.741			
Transportation	Transportation	59.344	59.344	2.28%					59.344
Others	Agriculture	1388.720	2242.030	86.17%	Agriculture	621.213	1402.25	66.14%	3644.283
	Orchard	48.217			Orchard	48.217			
	Range Land	663.038			Range Land	656.104			
	Waterbody	80.239			Riparian Zone	69.700			
	Vacant Area	61.815			Proposed Landfill Site	7.019			
Total		**2601.908**	**2601.908**	**100.00%**	**Total**	**2120.284**	**2120.28**	**100.00%**	**4722.192**

Map 64: Proposed Land Use Map Potential Urban Centre - VC Lara Dandokai



7.5.2.3 Gardai Utman Khel

Utman Khel Tehsil exhibits a predominantly rural settlement pattern, with Gardai Utman Khel identified within the settlement hierarchy of Bajaur District as a Potential Settlement. This classification reflects its emerging role as a local growth node, with the capacity to develop into a more structured settlement that can serve as a focal point for administration, commerce, and service provision for the surrounding rural areas.

According to demographic data, the rural population of Utman Khel Tehsil is 33,370, while the population of Gardai Utman Khel as a Potential Urban centre is 59,196. This distribution highlights its significance as a local hub, with the potential to attract inward migration and support increased economic and social activities over time.

From a planning perspective, Gardai Utman Khel's designation as a Potential Settlement underscores the need for strategic infrastructure development and spatial planning, particularly in the areas of housing, transportation, water supply, sanitation, and social services. Targeted investments in these sectors will be essential to facilitate its transition from a rural settlement into a functional local node, supporting balanced growth within Utman Khel Tehsil and the wider Bajaur District.

The existing educational infrastructure in Utman Khel comprises 19 primary schools, 2 middle schools, 1 high school, and 1 higher secondary school. While this network provides a broad foundation for basic and secondary education, planning for additional middle and higher secondary schools may be required to meet the educational needs of the growing population and ensure improved access to post-primary education.

- ***Proposed Land Uses of Gardai***

The Landuse Plan for VC Gardai Settlement establishes a comprehensive spatial framework to guide its transformation from a predominantly agrarian settlement into a structured, service-oriented and residentially balanced urban node. The plan rationalizes existing land uses while allocating adequate space for future residential expansion, economic development, social infrastructure, and environmental protection. The proposed land uses cover 4,342.05 acres,

which, when combined with the existing land area of 4,961.53 acres, bring the total planned area of VC Gardai to 9,303.58 acres.

Residential development constitutes the core focus of the VC Gardai Landuse Plan. Existing residential areas cover 452.86 acres, representing 9.13% of total existing land uses, reflecting a low-density and dispersed settlement pattern. To accommodate future population growth in a planned and phased manner, the Landuse Plan proposes a significantly expanded residential framework comprising 1,090.68 acres for Long-Term Residential, 684.42 acres for Medium-Term Residential, and 265.76 acres for Short-Term Residential development. These allocations collectively amount to 2,040.85 acres, accounting for 47.00% of the proposed land uses. With the inclusion of existing residential land, the total residential footprint increases to 2,493.72 acres, ensuring sufficient land for orderly urban expansion while discouraging informal and unregulated growth.

Commercial land use in VC Gardai is currently minimal, occupying only 10.89 acres or 0.22% of existing land uses. To strengthen the settlement's role as a local economic and service hub, the Landuse Plan proposes a diversified commercial structure, including 13.23 acres for a Central Business District (CBD), 33.07 acres for a Proposed Commercial Zone, 87.96 acres for a Livestock and Dairy Development Zone, 4.20 acres for a Proposed Grain Market, 5.53 acres for a Slaughter House, and 3.45 acres for Civic Amenities within the commercial framework. Collectively, these allocations form 147.44 acres, representing 3.40% of the proposed land uses. Combined with existing areas, total commercial land increases to 158.32 acres, substantially enhancing economic functionality and market accessibility.

Industrial activity in VC Gardai is currently negligible, with scattered industry occupying only 0.72 acres (0.01%). To promote organized industrial growth and local employment generation, the Landuse Plan designates 61.03 acres as a Proposed Industrial Zone, representing 1.41% of proposed land uses. This increases the total industrial land to 61.75 acres, providing space for light and agro-based industries compatible with the settlement's economic profile.

Institutional land uses—including religious buildings, educational facilities, and health services—currently cover 7.69 acres, accounting for 0.15% of existing land uses, indicating a shortage of formal social infrastructure. To address this deficit, the Landuse Plan proposes 5.46 acres for a Proposed Educational Zone and 6.96 acres for a Proposed Health Care Zone, collectively amounting to 12.42 acres or 0.29% of proposed land uses. When combined with existing facilities, total institutional land increases to 20.10 acres, strengthening access to essential social services in line with the planned residential expansion.

Existing graveyard land in VC Gardai occupies 9.14 acres, representing 0.18% of existing land uses. The Landuse Plan allocates an additional 23.88 acres for Proposed Graveyard facilities, increasing the total graveyard area to 33.02 acres and accounting for 0.55% of proposed land uses. This ensures adequate provision for burial grounds in accordance with future demographic needs and cultural requirements.

Recreational and open spaces are currently limited to 15.14 acres (0.31%), reflecting a deficiency in public open spaces. To enhance urban livability and environmental quality, the Landuse Plan proposes 12.77 acres for a Proposed Park, 11.09 acres for a Recreational Zone, and 25.64 acres for Green Spaces. Together, these amount to 49.50 acres, representing 1.14% of proposed land uses. With existing spaces included, total recreational and open space increases to 64.65 acres, providing much-needed public spaces for leisure, social interaction, and ecological balance.

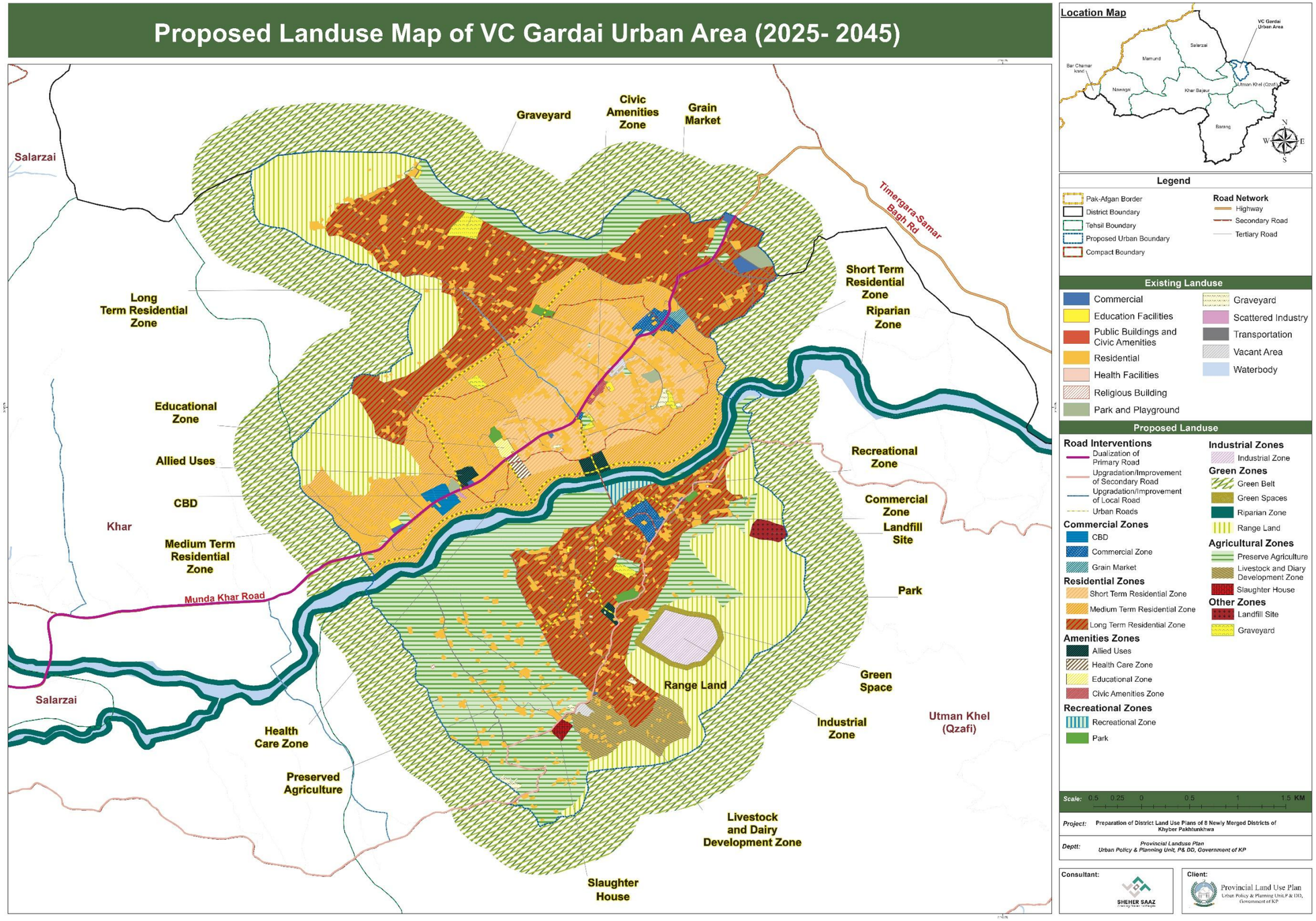
Transportation infrastructure currently covers 82.05 acres, accounting for 1.65% of existing land uses. The Landuse Plan retains this allocation without proposing additional transportation land, indicating that the existing road and circulation network is considered adequate to support the projected growth, subject to capacity enhancement and network upgrading within the existing right-of-way.

The “Others” category dominates the land-use structure of VC Gardai, occupying 4,383.04 acres, or 88.34% of existing land uses, primarily consisting of agriculture, rangeland, water bodies, and vacant land. Under the proposed plan, this category is rationalized to 2,006.93 acres, representing 46.22% of proposed land uses, reflecting a significant but controlled conversion of agricultural land to urban uses. Proposed allocations include 989.33 acres for Agriculture, 886.52 acres for Range Land, 104.05 acres for Riparian Zones to protect natural drainage corridors and floodplains, and 13.52 acres for a Proposed Landfill Site to ensure environmentally sustainable solid waste management. When combined with existing areas, total land under this category reaches 6,389.97 acres, preserving VC Gardai’s agrarian base while integrating environmental safeguards.

Table 131: Existing and Proposed Land Uses, Gardai- Urban Center

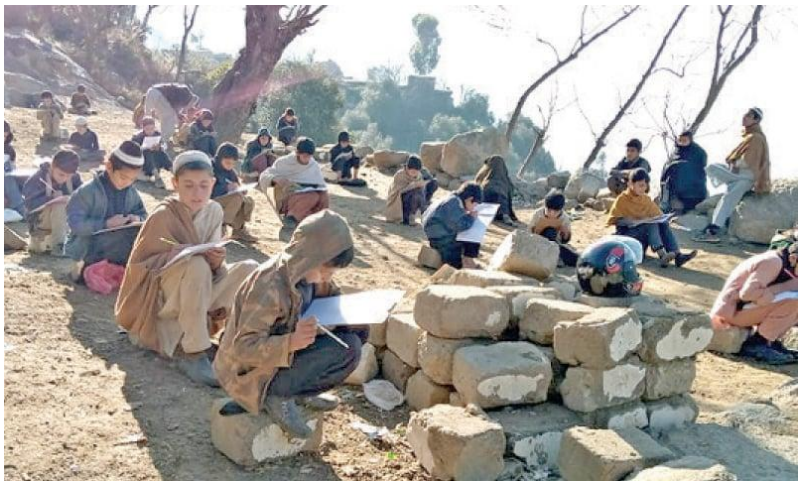
Gardai Settlement Existing Landuse					Gardai Settlement Proposed Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	452.861	452.861	9.13%	Long Term Residential Zone	1090.679	2040.854	47.00%	2493.715
					Medium Term Residential Zone	684.415			
					Short Term Residential Zone	265.761			
Commercial	Commercial	10.886	10.886	0.22%	CBD	13.228	147.438	3.40%	158.323
					Proposed Grain Market	4.196			
					Slaughter House	5.528			
					Proposed Commercial Zone	33.074			
					Livestock and Dairy Development Zone	87.959			
					Civic Amenities Zone	3.453			
Industrial	Scattered Industry	0.717	0.717	0.01%	Proposed Industrial Zone	61.035	61.035	1.41%	61.752
Institutional	Religious Building	1.924	7.687	0.15%	Proposed Educational Zone	5.456	12.415	0.29%	20.102
	Education Facilities	5.361							
	Health Facilities	0.402			Proposed Health Care Zone	6.959			
Graveyard	Graveyard	9.140	9.140	0.18%	Proposed Graveyard	23.876	23.876	0.55%	33.016
Recreational and Open Space	Park and Playground	15.144	15.144	0.31%	Proposed Park	12.769	49.505	1.14%	64.649
					Proposed Recreational Zone	11.093			
					Green Space	25.642			
Transportation	Transportation	82.054	82.054	1.65%					82.054
Others	Agriculture	3225.105	4383.042	88.34%	Agriculture	989.331	2006.931	46.22%	6389.973
	Range Land	985.122			Range Land	886.519			
	Waterbody	163.151			Riparian Zone	104.047			
	Vacant Area	9.664			Proposed Landfill Site	13.517			
					Proposed Landfill Site	13.517			
Total		**4961.530**	**4961.530**	**100.00%**	**Total**	**4342.054**	**4342.054**	**100.00%**	**9303.584**

Map 65: Proposed Land Use Map Potential Urban Centre – Gardai Utman Khel



7.5.3 Recommended Land Uses for Potential Settlements

7.5.3.1 Salarzai



Salarzai, an important tehsil and emerging urban centre of Bajaur District, is situated in the southeastern part of Khyber Pakhtunkhwa Province. Geographically, Salarzai lies approximately between 34°30′ to 34°45′ north latitudes and 71°35′ to 71°55′ east longitudes. The area holds strategic importance due to its location along the southern corridor of Bajaur District and its functional linkage with Khar, as well as its proximity to Mohmand District, making it a transitional zone between the core urban centre of Bajaur and adjoining districts.

Within the settlement hierarchy of Bajaur District, Salarzai is designated as a Secondary Urban Centre, reflecting its role as an emerging administrative, commercial, and service node serving the southeastern part of the district. As a secondary urban centre, Salarzai accommodates a moderate concentration of population, local economic activities, and basic public services, while also catering to a wide rural hinterland comprising numerous villages and hamlets.

Salarzai Tehsil exhibits a predominantly rural settlement structure, comprising numerous villages and dispersed hamlets that constitute the principal residential fabric outside the urban core. Within the district settlement hierarchy, these are classified as **Rural Potential Settlements**, denoting their capacity for future growth, service upgrading, and progressive functional integration into the broader urban system of Bajaur District.

Based on demographic projections, the population of Rural Salarzai (Potential Settlements) was estimated at 21,259 in 2025, and is expected to increase significantly to approximately 39,861 by 2045. This growth trajectory over the 20-year period is primarily driven by natural population increase and the gradual consolidation of rural settlements along major access corridors and resource-based locations.

The existing educational infrastructure in Salarzai reflects its semi-urban and predominantly rural character. Facilities include approximately 7 primary schools, and 2 high schools, along with a limited number of private schools and religious institutions.

The projected growth of these rural settlements underscores the importance of adopting a rural development and spatial integration strategy, focusing on:

- Provision of basic infrastructure (water supply, sanitation, and rural roads),
- Strengthening primary education and health facilities,
- Supporting agro-based livelihoods and value chains,
- Controlling ribbon development and unplanned sprawl, and
- Gradual upgrading of selected villages into service nodes to support surrounding communities.

From a planning perspective, these rural potential settlements in Salarzai present an opportunity to guide growth in a **balanced and sustainable manner**, reducing excessive pressure on Khar Urban Centre while promoting equitable regional development within Bajaur District.

Raghagan Dam[49] is a concrete gravity dam located in the potential urban settlement of Salarzai, Bajaur District, Khyber Pakhtunkhwa. The dam has an approximate height of 17 meters and a crest length of about 80 meters, with a storage capacity of nearly 2,600 acre-feet (around 3.2 million cubic meters). It is designed primarily for irrigation, supplying water to an estimated 4,600 acres of agricultural land through an associated canal network of about 11 km, while also contributing to flood moderation, groundwater recharge, and local water management, supporting both the surrounding agricultural lands and the emerging urban settlement.

Figure 45: Raghagan Dam

2025 ***2021***

[49] https://aroundus.com/p/9163948-raghagan-dam

Raghagan Dam Resort, located within the Salarzai urban settlements, serves as an emerging recreational and leisure destination for the surrounding population. Developed around the Raghagan Dam, the area offers scenic views, picnic spaces, and informal tourism activities, contributing to local recreation and small-scale economic activity. The site holds potential to be enhanced as an organized recreational zone supporting urban livability and community well-being.

Figure 46: Raghagan Dam Resort - Salarzai Potential Settlement

- ***Proposed Land uses of Salarzai- Urban Settlement***

The proposed landuse Plan for Salarzai Settlement presents a structured land-use framework aimed at guiding controlled urban development while preserving the settlement's agrarian character and ecological assets. The plan integrates existing land uses with future development proposals to ensure balanced growth, efficient service delivery, environmental protection, and improved urban livability. Under the plan, a total of **1,415.04 acres** has been allocated for proposed land uses which, when combined with the existing developed and undeveloped area of 2,075.62 acres, brings the total planned area of Salarzai Settlement to 3,490.66 acres.

Residential development constitutes the most dominant land use in the Salarzai Master Plan, reflecting the need to accommodate future population growth in a phased and orderly manner. Existing residential areas cover 376.74 acres, representing 18.15% of the total existing land use. The proposed plan introduces a phased residential strategy, allocating 94.69 acres for Long-Term Residential, 293.85 acres for Medium-Term Residential, 272.20 acres for Short-Term Residential development, along with 42.46 acres for Infill Residential areas. Collectively, these residential proposals amount to 703.20 acres, accounting for 49.69% of total proposed land uses. When combined with existing residential areas, the overall residential footprint

expands to 1,079.93 acres, ensuring adequate land for planned neighborhoods while discouraging unregulated sprawl.

Commercial land use in Salarzai currently occupies 71.62 acres, which constitutes 3.45% of the existing land uses. To strengthen local economic activity and service provision, the Master Plan proposes 25.05 acres for a Proposed Commercial Zone, supported by 7.49 acres for a Livestock and Dairy Development Zone and 2.66 acres for a Slaughter House facility. These allocations collectively form 35.21 acres of proposed commercial and allied economic land, representing 2.49% of total proposed land uses. With the inclusion of existing commercial areas, the total commercial footprint increases to 106.83 acres, supporting neighborhood-level markets, agro-based trade, and essential services for the local population.

Existing industrial activity in Salarzai is limited and scattered, covering only 15.68 acres (0.76%). To promote organized and environmentally compatible industrial growth, the Master Plan designates a Proposed Industrial Zone of 34.26 acres, accounting for 2.42% of proposed land uses. With this addition, the total industrial land increases to 49.94 acres, enabling the development of light and small-scale industries while minimizing land-use conflicts with residential and agricultural areas.

Institutional land uses—including public buildings, religious facilities, educational institutions, and health facilities—currently occupy 25.35 acres, representing 1.22% of the existing land uses. To enhance social infrastructure, the plan proposes 10.08 acres for Civic Amenities, 1.19 acres for a Proposed Educational Zone, and 8.03 acres for a Proposed Health Care Zone. Together, these allocations amount to 19.30 acres, constituting 1.36% of proposed land uses. With these additions, the total institutional land increases to 44.65 acres, ensuring improved access to education, healthcare, and civic services in line with projected population growth.

Existing graveyard land covers 9.86 acres (0.47%), which is inadequate for long-term needs. The Master Plan therefore proposes an additional 14.34 acres for graveyard facilities, increasing the total area to 24.19 acres and accounting for 1.01% of proposed land uses. This ensures culturally appropriate and spatially planned burial grounds for future generations.

Recreational and open spaces in Salarzai are currently extremely limited, with parks and playgrounds occupying only 0.55 acres (0.03%). Recognizing this deficiency, the Master Plan significantly enhances this sector by proposing 28.47 acres for a Proposed Park, 18.90 acres for a Recreational Zone, and 16.48 acres for Green Spaces. Together, these constitute 63.85 acres of proposed recreational and open space land, representing 4.51% of total proposed land uses. When combined with existing open spaces, the total recreational land increases to 64.40 acres, greatly improving urban livability, environmental quality, and community well-being.

Transportation infrastructure presently covers 95.20 acres, accounting for 4.59% of existing land uses. The Master Plan retains this allocation, maintaining a total transportation area of

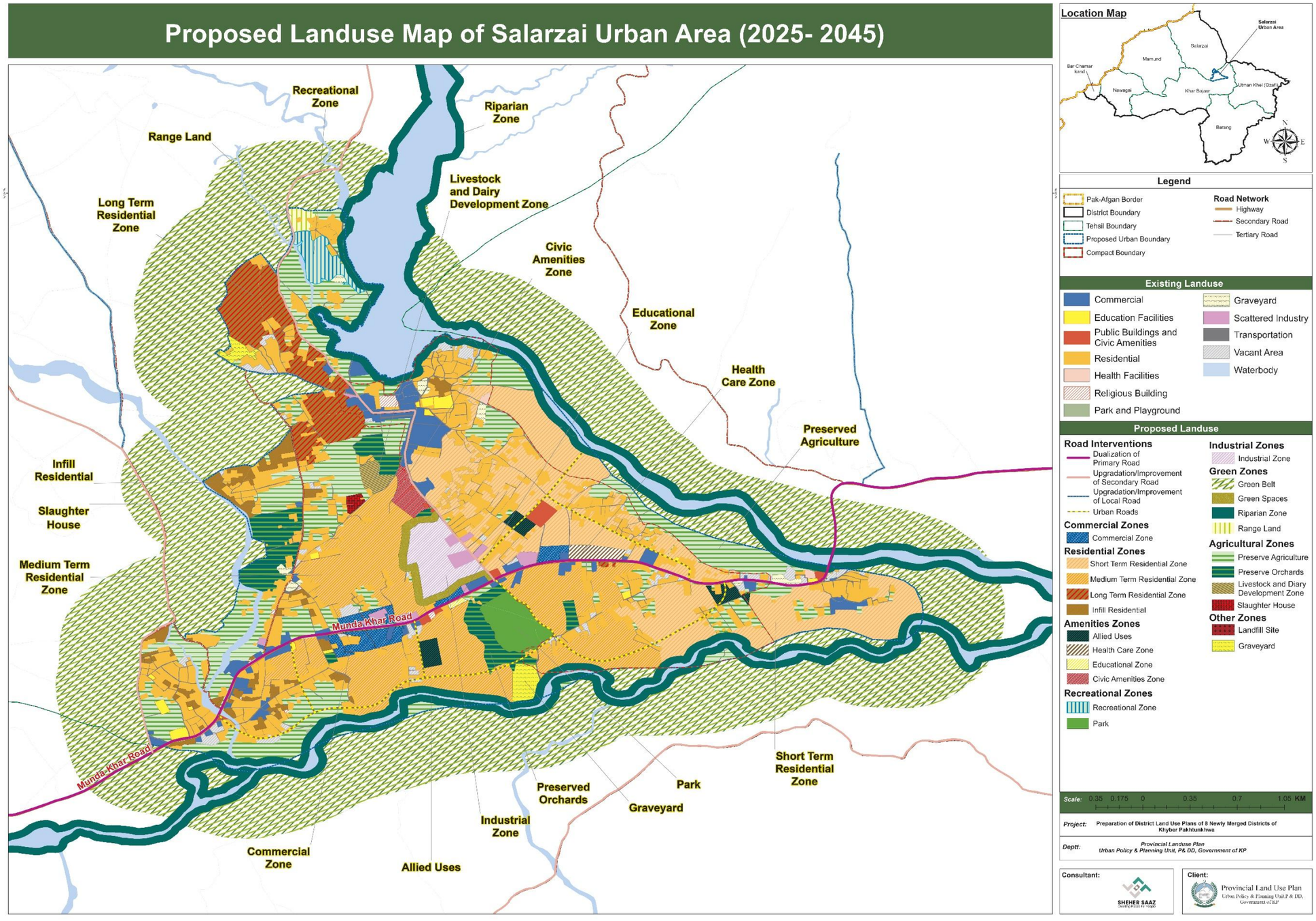
95.20 acres, ensuring adequate provision for roads and mobility infrastructure to support both existing and future urban development.

The “Others” category represents the largest share of existing land uses in Salarzai, occupying 1,480.62 acres, or 71.33%, primarily comprising agriculture, orchards, rangeland, water bodies, and vacant land. Under the proposed plan, this category is rationalized to 544.88 acres (38.51%), with a strong focus on environmental protection and productive land use. Proposed allocations include 352.99 acres for Agriculture, 70.12 acres for Orchards, 5.25 acres for Range Land, and a significant 116.52 acres designated as Riparian Zone to protect natural drainage corridors and reduce flood risk. When combined with existing areas, total land under this category reaches 2,025.50 acres, reflecting a balanced approach between urban development and ecological preservation.

Table 132: Existing and Proposed Land Uses, Salarzai- Urban Settlement

Salarzai Settlement Existing Landuse					Salarzai Settlement Existing Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	376.738	376.738	18.15%	Long Term Residential Zone	94.690	703.196	49.69%	1079.934
					Medium Term Residential Zone	293.848			
					Short Term Residential Zone	272.196			
					Infill Residential	42.462			
Commercial	Commercial	71.622	71.622	3.45%	Proposed Commercial Zone	25.052	35.205	2.49%	106.827
					Slaughter House	2.664			
					Livestock and Dairy Development Zone	7.489			
Industrial	Scattered Industry	15.680	15.680	0.76%	Proposed Industrial Zone	34.264	34.264	2.42%	49.944
Institutional	Public Buildings and Civic Amenities	9.022	25.351	1.22%	Civic Amenities Zone	10.080	19.302	1.36%	44.653
	Religious Building	3.618							
	Education Facilities	10.910			Proposed Educational Zone	1.187			
	Health Facilities	1.801			Proposed Health Care Zone	8.034			
Graveyard	Graveyard	9.857	9.857	0.47%	Proposed Graveyard	14.338	14.338	1.01%	24.194
Recreational and Open Space	Park and Playground	0.546	0.546	0.03%	Proposed Park	28.465	63.851	4.51%	64.397
					Proposed Recreational Zone	18.903			
					Green Space	16.482			
Transportation	Transportation	95.203	95.203	4.59%					95.203
Others	Agriculture	1243.705	1480.622	71.33%	Agriculture	352.989	544.881	38.51%	2025.503
	Orchard	88.905			Orchard	70.123			
	Range Land	25.897			Range Land	5.251			
	Waterbody	39.318			Riparian Zone	116.518			
	Vacant Area	82.798							
Total		**2075.619**	**2075.619**	**100.00%**	**Total**	**1415.036**	**1415.036**	**100.00%**	**3490.655**

Map 66: Proposed Land Use Map – Salarzai Urban Settlement

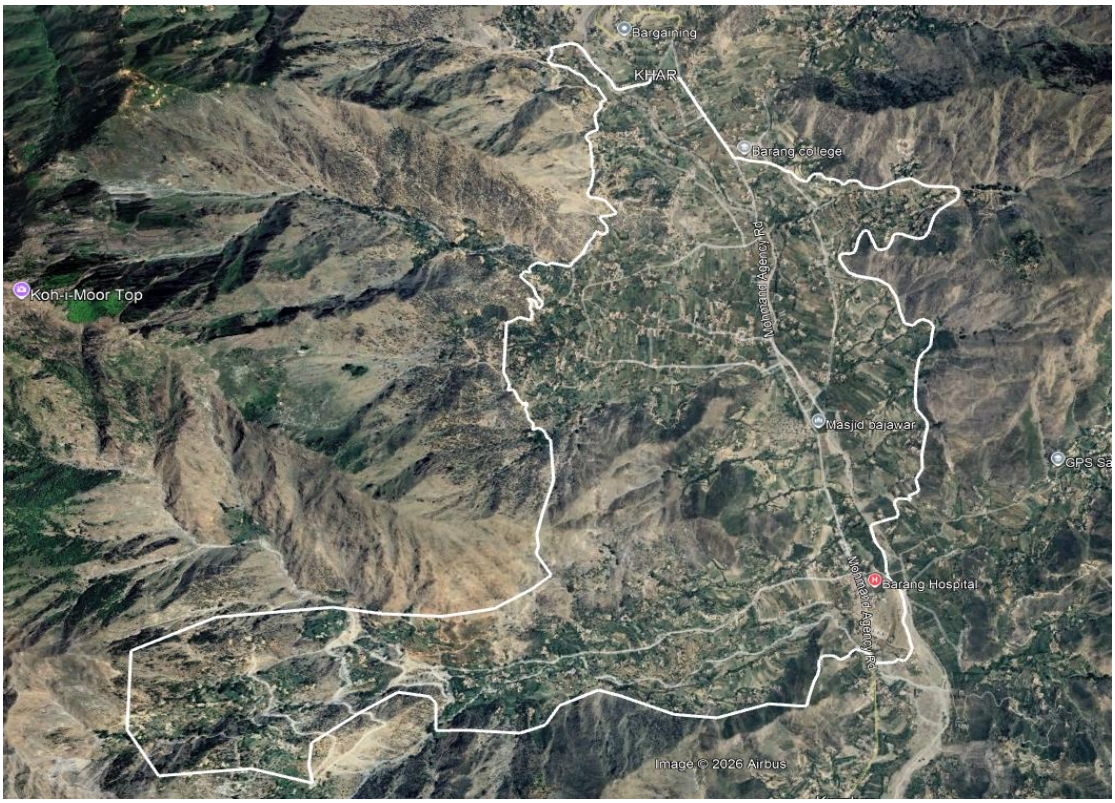


7.5.3.2 Barang

Barang Tehsil is characterized by a predominantly rural settlement pattern, with villages and dispersed hamlets forming the core residential fabric outside the urban areas. Within the settlement hierarchy of Bajaur District, these are classified as Rural Potential Settlements, reflecting their capacity for demographic growth, service upgrading, and gradual functional integration into the wider urban system.

According to demographic projections, the population of Rural Barang (Potential Settlements) was estimated at 16,703 in 2025, and is expected to increase to approximately 27,636 by 2045. This growth trend over the 20-year period is driven primarily by natural population increase and the progressive consolidation of rural settlements along key access corridors and resource-based locations.

Figure 47: Barang Planning Boundary



From a planning perspective, this projected growth highlights the need for targeted rural development interventions, particularly in basic infrastructure provision, primary education and health facilities, and the strengthening of agro-based livelihoods, in order to guide sustainable and balanced spatial development within Barang Tehsil.

The existing educational infrastructure in Barang reflects its semi-urban and predominantly rural character. Facilities include approximately 6 primary schools, 2 middle schools and 2 high schools, along with a limited number of private schools and religious institutions.

Koh-i-Mor Top, located approximately **2 km from the potential urban settlement of Barang** in **Bajaur District, Khyber Pakhtunkhwa**, is the highest and most prominent mountain peak in the district. Rising to about **2,438 meters**, this three-peaked landmark often called the "***Mountain of the Peacock***" offers panoramic views of the surrounding valleys and is visible from distant plains on clear days. Koh-i-Mor holds historical and cultural significance, with local tradition identifying it with the ancient Mount Meros described in the campaigns of Alexander the Great. The area around the summit features rugged terrain and has long been a focus for local hiking and nature visits, with trails connecting to Barang and nearby villages. Its natural beauty, seasonal snow cover, and proximity to Barang give it potential for eco-tourism and outdoor recreation linked to the emerging urban settlement.

Figure 48: Koh-i-Moor Top - Barang Potential Settlement

- ***Proposed Land Uses of Barang***

The proposed Master Plan for Barang Settlement presents a structured and environmentally sensitive land-use framework aimed at managing future growth while preserving the settlement's predominantly rural and ecological character. The plan integrates existing land uses with future development proposals to promote controlled urban expansion, economic diversification, environmental conservation, and improved quality of life. Under the plan, a total of 2,329.47 acres has been allocated for proposed land uses which, when combined with the existing land area of 2,666.42 acres, brings the total planned area of Barang Settlement to 4,995.89 acres.

Residential development forms a key component of the Barang Master Plan, addressing the currently low proportion of built-up residential land and preparing for future population growth. Existing residential areas cover 172.26 acres, representing only 6.46% of total existing land uses. The proposed plan adopts a phased residential strategy, allocating 213.97 acres for

Long-Term Residential, 326.60 acres for Medium-Term Residential, and 103.22 acres for Short-Term Residential development. Collectively, these allocations amount to 643.79 acres, accounting for 27.64% of total proposed land uses. When combined with existing residential areas, the overall residential footprint expands to 816.05 acres, ensuring sufficient land for planned housing while discouraging unregulated and scattered development.

Commercial activity in Barang is currently minimal, with existing commercial land covering only 3.98 acres (0.15%). To strengthen the local economy and support agro-based livelihoods, the Master Plan proposes a diversified set of commercial and allied uses, including 27.20 acres for a Proposed Commercial Zone, 51.98 acres for a Livestock and Dairy Development Zone, 4.76 acres for a Slaughter House, and 2.81 acres for a Proposed Grain Market. Together, these allocations form 86.75 acres of proposed commercial and agro-economic land, accounting for 3.72% of proposed land uses. With the inclusion of existing areas, total commercial land increases to 90.73 acres, significantly improving market access, agricultural value chains, and local employment opportunities.

Barang currently does not have a defined industrial area. The Master Plan introduces a Proposed Industrial Zone of 37.60 acres, representing 1.61% of total proposed land uses. This allocation is intended for light and agro-based industries, supporting economic diversification and job creation while ensuring compatibility with surrounding rural and residential areas.

Institutional land uses including public buildings, religious facilities, educational institutions, and health facilities currently occupy only 10.52 acres, representing 0.39% of existing land uses. To improve social service provision, the Master Plan proposes 10.06 acres for Civic Amenities, 3.56 acres for a Proposed Educational Zone, and 4.20 acres for a Proposed Health Care Zone. These allocations collectively amount to 17.82 acres, accounting for 0.76% of proposed land uses. When combined with existing areas, total institutional land increases to 28.34 acres, ensuring improved access to education, healthcare, and civic services.

Existing graveyard land in Barang covers 32.27 acres, accounting for 1.21% of existing land uses. No additional graveyard land has been proposed under the current plan, indicating that the existing provision is considered sufficient to meet the settlement's long- to medium-term burial needs.

At present, Barang lacks formally designated recreational and open spaces. To address this deficiency and enhance urban livability, the Master Plan proposes 13.03 acres for a Proposed Park and 7.32 acres for a Recreational Zone. Together, these amount to 20.35 acres, representing 0.87% of total proposed land uses. These spaces are intended to serve as community gathering areas, promote healthy lifestyles, and improve the overall environmental quality of the settlement.

Forest land currently occupies 3.06 acres, representing 0.11% of existing land uses. The Master Plan retains this allocation and designates an equivalent area under proposed land uses (3.06 acres, or 0.13%), increasing the total forest land to 6.11 acres. This reflects a conscious effort

to preserve and enhance ecological assets and promote environmental sustainability within the settlement.

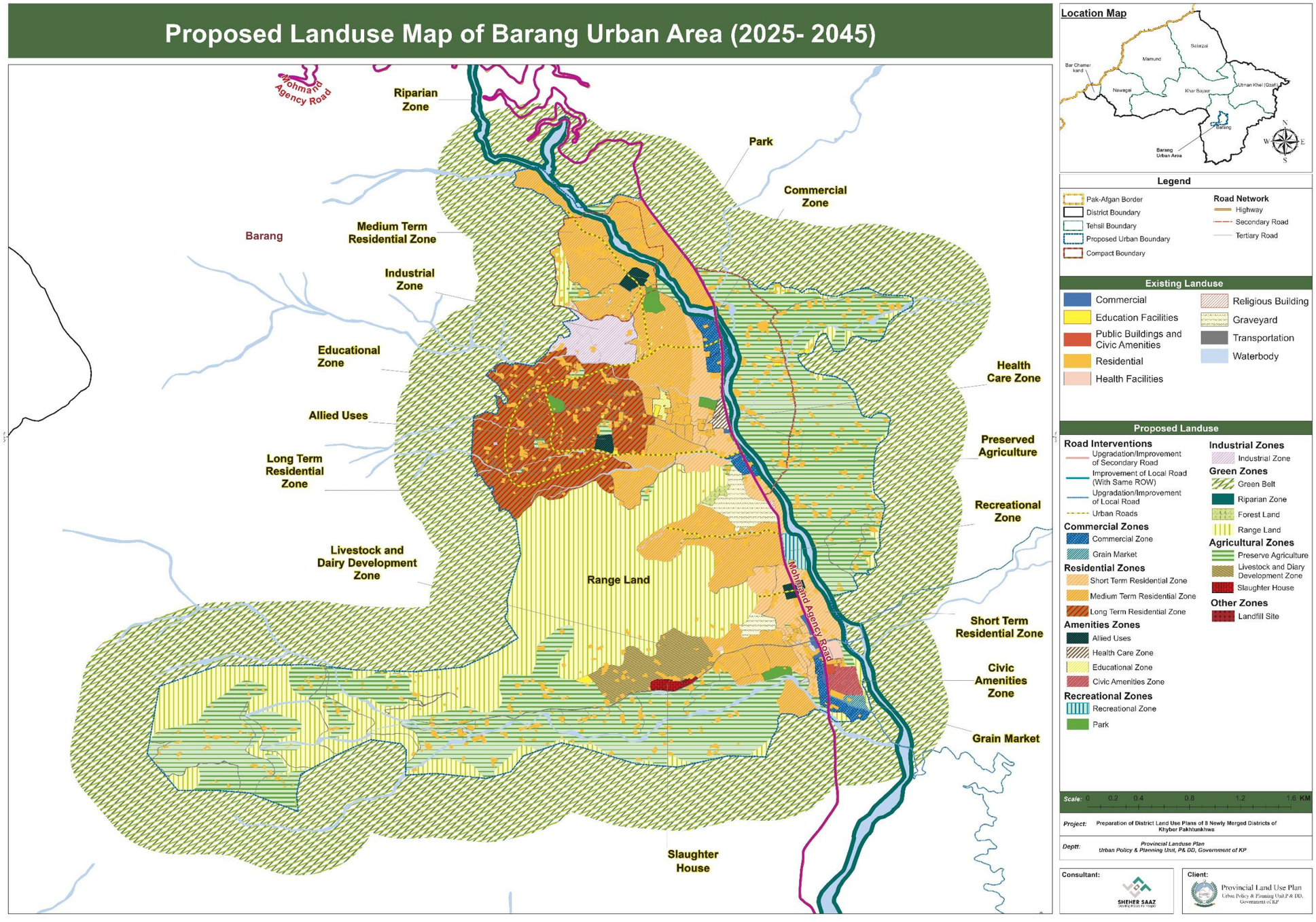
Transportation infrastructure presently covers 55.38 acres, accounting for 2.08% of existing land uses. The Master Plan retains this allocation without proposing additional transportation land, indicating that the existing network is considered adequate to support the planned development in the short to medium term.

The “Others” category dominates Barang’s land-use structure, occupying 2,388.96 acres, or 89.59% of existing land uses, primarily comprising agriculture, rangeland, water bodies, and vacant land. Under the proposed plan, this category is reorganized to cover 1,520.11 acres, representing 65.26% of proposed land uses, with a strong emphasis on productive land use and environmental conservation. Proposed allocations include 820.62 acres for Agriculture, 649.09 acres for Range Land, and 50.40 acres designated as Riparian Zone to protect natural drainage corridors and mitigate flood risks. When combined with existing areas, total land under this category reaches 3,909.07 acres, reaffirming Barang’s predominantly agrarian and environmentally sensitive character.

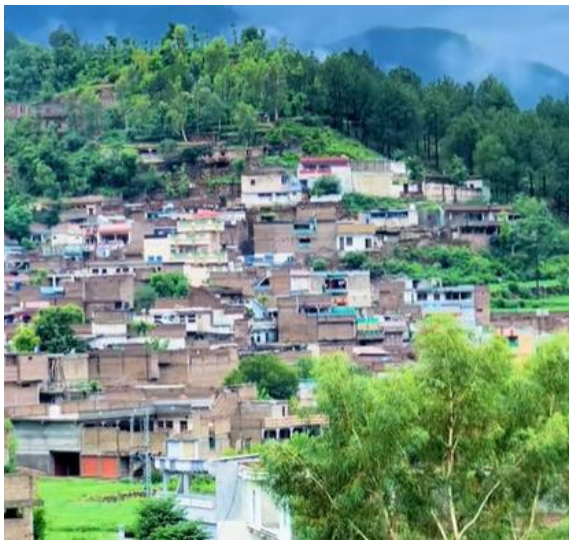
Table 133: Existing and Proposed Land Uses, Barang- Urban Center

Barang Settlement Existing Landuse					Barang Settlement Proposed Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	172.264	172.264	6.46%	Long Term Residential Zone	213.965	643.785	27.64%	816.049
					Medium Term Residential Zone	326.605			
					Short Term Residential Zone	103.215			
Commercial	Commercial	3.980	3.980	0.15%	Proposed Commercial Zone	27.202	86.750	3.72%	90.730
					Proposed Grain Market	2.808			
					Slaughter House	4.758			
					Livestock and Dairy Development Zone	51.981			
Industrial Zone					Proposed Industrial Zone	37.597	37.597	1.61%	37.597
Institutional	Public Buildings and Civic Amenities	1.201	10.518	0.39%	Civic Amenities Zone	10.063	17.820	0.76%	28.338
	Religious Building	0.699							
	Education Facilities	3.685			Proposed Educational Zone	3.560			
	Health Facilities	4.933			Proposed Health Care Zone	4.197			
Graveyard	Graveyard	32.269	32.269	1.21%					32.269
Recreational and Open Space					Proposed Park	13.027	20.346	0.87%	20.346
					Proposed Recreational Zone	7.319			
Forest Land	Forest Land	3.056	3.056	0.11%	Forest Land	3.056	3.056	0.13%	6.111
Transportation	Transportation	55.379	55.379	2.08%					55.379
Others	Agriculture	1626.380	2388.955	89.59%	Agriculture	820.619	1520.113	65.26%	3909.068
	Range Land	693.697			Range Land	649.092			
	Waterbody	65.185			Riparian Zone	50.401			
	Vacant Area	3.693							
	Total	**2666.420**	**2666.420**	**100.00%**	**Total**	**2329.467**	**2329.467**	**100.00%**	**4995.887**

Map 67: Proposed Land Use Map – Barang Urban Settlement



7.5.3.3 Nawagai



Nawagai Tehsil exhibits a predominantly rural settlement structure, with Nawagai identified within the settlement hierarchy of Bajaur District as a **Potential Urban Settlement**. This designation reflects its emerging role as a future growth node with the capacity to evolve into a more structured urban centre, serving as a focal point for administration, commerce, and service provision for the western part of the district.

According to demographic projections, the population of **Nawagai (Potential Urban Centre)** was estimated at **24,421 in 2025**, and is expected to increase significantly to approximately **39,726 by 2045**. This projected growth over the 20-year period is driven by natural population increase, inward migration from surrounding rural settlements, and the gradual concentration of economic and service functions.

Figure 49: Nawagai Planning Boundary

From a planning perspective, Nawagai's classification as a Potential Urban Centre underscores the need for proactive spatial planning and infrastructure development, particularly in the areas of housing, road connectivity, water supply, sanitation, and social services. Strategic

investment in these sectors will be essential to facilitate its transition from a predominantly rural settlement into a functional urban node, thereby contributing to a more balanced and polycentric development pattern within Bajaur District.

The existing educational infrastructure in Nawagai comprises **12 primary schools, 1 middle school, and 2 high schools**, including **one boy's high school and one girl's high school**. While this network provides basic educational coverage, the limited number of middle and secondary institutions indicates a need for expansion, particularly to accommodate projected population growth and to improve access to post-primary education within the tehsil.

- ***Proposed and Uses of Nawagai***

The proposed Landuse Plan for Nawagai Settlement establishes a coherent land-use framework aimed at managing future urban growth while safeguarding the area's predominantly rural and ecological character. The plan integrates existing land uses with future development proposals to promote controlled expansion, environmental conservation, and improved service provision. Under the plan, a total of 2,020.17 acres has been allocated for proposed land uses which, when combined with the existing land area of 2,562.20 acres, brings the total planned area of Nawagai Settlement to 4,443.82 acres.

Residential development constitutes a major focus of the Nawagai Master Plan, addressing the current low proportion of built-up residential land and anticipating future population growth. Existing residential areas cover 246.67 acres, accounting for only 9.63% of the total existing land use. The proposed plan introduces a phased residential strategy comprising 221.15 acres for Long-Term Residential development, 380.74 acres for Medium-Term Residential, 92.73 acres for Short-Term Residential, and 0.78 acres for Infill Residential. Collectively, these allocations amount to 695.39 acres, representing 34.42% of total proposed land uses. When combined with existing residential areas, the total residential footprint expands to 942.07 acres, ensuring adequate land availability for planned housing and preventing unregulated sprawl.

Commercial activity in Nawagai is currently limited, with existing commercial land covering 37.54 acres, or 1.46% of existing land uses. The Master Plan proposes 2.36 acres for a Proposed Commercial Zone, accounting for 0.12% of total proposed land uses. Although modest in scale, this provision is intended to meet local-level commercial needs and support basic service delivery. With the inclusion of existing areas, total commercial land increases to 39.90 acres, reinforcing Nawagai's role as a small service center rather than a major commercial hub.

Industrial activity is presently minimal and scattered, occupying only 11.25 acres (0.44%). To accommodate future light and small-scale industrial growth in an organized manner, the plan designates a Proposed Industrial Zone of 39.94 acres, representing 1.98% of proposed land uses. This brings the total industrial land to 51.20 acres, facilitating local employment generation while minimizing adverse environmental and social impacts.

Institutional land uses—including public buildings, religious facilities, educational institutions, and healthcare facilities—currently occupy 29.05 acres, accounting for 1.13% of the existing land uses. The Master Plan strengthens this sector by proposing 8.96 acres for Civic Amenities, 4.44 acres for a Proposed Educational Zone, and 4.70 acres for a Proposed Health Care Zone. These allocations collectively amount to 18.10 acres, representing 0.90% of proposed land uses. With these additions, the total institutional land reaches 47.15 acres, ensuring improved access to governance, education, and health services in line with future needs.

Existing graveyard land covers 28.17 acres, representing 1.10% of existing land uses. While no additional graveyard land has been proposed under the current plan, the existing allocation is considered sufficient to meet medium-term burial needs, subject to future reassessment based on population growth trends.

Recreational and open spaces are currently extremely limited, with parks and playgrounds occupying only 0.58 acres, or 0.02% of existing land uses. To address this critical deficiency, the Master Plan proposes 2.94 acres for a Proposed Park, 10.12 acres for a Recreational Zone, and 23.49 acres for Green Spaces. Together, these amount to 36.55 acres of proposed recreational and open space land, accounting for 1.81% of total proposed land uses. With these additions, total recreational land increases to 37.13 acres, significantly improving urban livability and environmental quality.

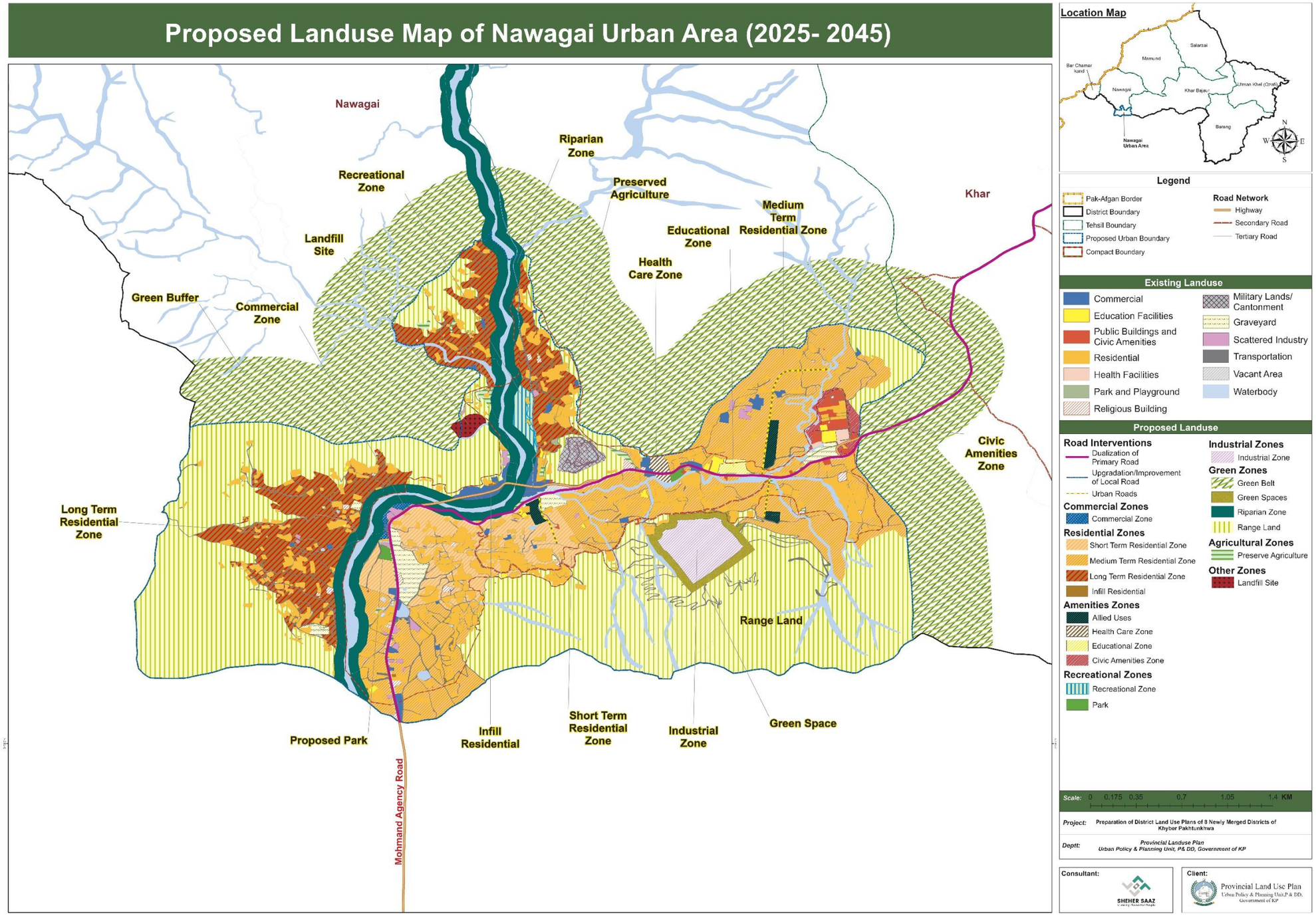
Transportation infrastructure currently occupies 110.37 acres, accounting for 4.31% of existing land uses. The Master Plan retains this allocation without additional proposed land, indicating that the existing road network and transportation corridors are considered adequate to support the planned urban expansion in the short to medium term.

The “Others” category dominates Nawagai’s land-use structure, occupying 2,098.56 acres, or 81.90% of existing land uses, comprising agriculture, rangeland, water bodies, military lands, and vacant areas. Under the proposed plan, this category is reorganized to cover 1,227.82 acres, representing 60.78% of proposed land uses, with a strong emphasis on environmental protection and natural landscape preservation. Proposed allocations include 1,082.18 acres for Range Land, 135.45 acres for Riparian Zones to safeguard natural drainage corridors and mitigate flood risks, 4.95 acres for Agriculture, and 5.24 acres for a Proposed Landfill Site. When combined with existing areas, the total land under this category reaches 3,326.38 acres, underscoring Nawagai’s continued role as an environmentally sensitive and predominantly rural settlement within District Bajaur.

Table 134: Existing and Proposed Land Uses, Nawagai- Urban Center

Nawagai Settlement Existing Landuse					Nawagai Settlement Proposed Landuse				
Land Uses	**Existing land Uses**	**Existing Land Uses Area in Acres**	**Total Existing land Uses Area in Acres**	**Existing land Uses %**	**Proposals**	**Areas In Acres**	**Total Proposed Land Use**	**Total Proposed Land Use %**	**Sum of Existing & Proposed Area**
Residential	Residential	246.675	246.675	9.63%	Long Term Residential Zone	221.151	695.391	34.42%	942.066
					Medium Term Residential Zone	380.737			
					Short Term Residential Zone	92.725			
					Infill Residential	0.777			
Commercial	Commercial	37.536	37.536	1.46%	Proposed Commercial Zone	2.361	2.361	0.12%	39.896
Industrial	Scattered Industry	11.253	11.253	0.44%	Proposed Industrial Zone	39.944	39.944	1.98%	51.197
Institutional	Public Buildings and Civic Amenities	10.321	29.050	1.13%	Civic Amenities Zone	8.963	18.100	0.90%	47.151
	Religious Building	8.098							
	Education Facilities	7.873			Proposed Educational Zone	4.438			
	Health Facilities	2.759			Proposed Health Care Zone	4.699			
Graveyard	Graveyard	28.174	28.174	1.10%					
Recreational and Open Space	Park and Playground	0.585	0.585	0.02%	Proposed Park	2.944	36.550	1.81%	37.135
					Proposed Recreational Zone	10.120			
					Green Space	23.486			
Transportation	Transportation	110.373	110.373	4.31%					
Others	Agriculture	577.529	2098.557	81.90%	Agriculture	4.950	1227.822	60.78%	3326.379
	Military Lands/Cantonment	12.344			Range Land	1082.179			
	Range Land	1217.411			Riparian Zone	135.454			
	Waterbody	93.339			Proposed Landfill Site	5.238			
	Vacant Area	197.934							
	Total	**2562.201**	**2562.201**	**100.00%**	**Total**	**2020.169**	**2020.169**	**100.00%**	**4443.824**

Map 68: Proposed Land Use Map – Nawagai Urban Settlement



8 CHAPTER VIII: REGIONAL CONTEXT OF PLANNING

Bajaur District has a population of 1,287,960 as per population census for year 2023.The overall population of the district is divided into seven tehsils. The district has only one urban center, Khar, located in Khar Bajaur Tehsil . Khar also serves as the district headquarters of Bajaur. Total area of district Bajaur is 1290 sq. km. as per population census 2023. The rural character is dominating with 42 % range land and 40% agricultural land of the entire area of the district. While keeping in view the predominant rural character, it is quite crucial to preserve the agricultural, range land, natural features and environmentally sensitive areas in the district.

The detailed narrative regarding hierarchy of settlements has already been elaborated in chapter 4 wherein the overall process and methodology for declaring existing settlements as urban, potential urban and potential settlements is explained. After going through multi-criteria analysis for delineating the status of settlements, the figures came out as 04 potential urban centers, 02 potential settlements which have the potential and possibility to transform into urban settlements in the near future. Hence, there are total 07 urban settlements including main urban center Khar in District Bajaur. Although Khar is the only core urban center, however, the whole district is divided into 07 Neighborhood Councils (NCs) and 120 Village Councils (VCs).

8.1 Rural Settlements in the District

In order to incorporate the integrated approach of regional planning into the project, it is very significant to align the urban and rural areas while proposing the future land use development strategy for the entire district Apart from identified 07 urban settlements mentioned above, rest of VCs form the rural area of the district. Excluding the NCs / VCs falling in the urban settlements, there are 101 VCs which are classified under the rural area of the district.

8.2 Clustering of the VCs in Rural Areas of District Bajaur

The assessment of existing conditions and future demand for public facilities in rural areas is as critical as that of urban settlements, particularly in districts such as Bajaur where a large proportion of the population resides in dispersed rural settlements. An individual analysis of each rural Village Council (VC) would neither support regional integration nor align effectively with national and local planning norms for the provision of public facilities. Therefore, a clustered planning approach was adopted to ensure efficiency, equity, and functional service delivery across the rural landscape.

8.2.1 Rationale for Clustering Approach

Keeping in view the multi-dimensional nature of rural development population distribution, accessibility, administrative coherence, and physical geography all rural VCs of Bajaur District

were grouped into a defined number of planning clusters. The primary objective of clustering was to:

- Enable regional-scale planning instead of fragmented VC-level interventions;
- Ensure provision of basic public facilities within reasonable service catchments;
- Reduce excessive dependency of rural populations on urban centers; and
- Align rural service provision with national and provincial planning standards and best practices.

Each cluster was designed to represent an average population threshold ranging between **60,000 and 70,000 persons**, reflecting a functional planning unit capable of supporting education, health, and administrative facilities at an appropriate scale.

8.2.2 GIS-Based Clustering Approach

A Geographic Information System (GIS)–based analytical framework was employed to form and validate rural clusters. The clustering process involved the following key steps:

- ***Population Threshold Analysis***

Population data at VC level were analyzed and aggregated to form clusters falling within the defined population range of 60,000–70,000. This ensured demographic viability for the provision of clustered public facilities.

- ***Road Network and Accessibility Analysis***

Network-based accessibility analysis was carried out using the existing road network to ensure physical connectivity within each cluster. Only those VCs and Neighborhood Councils (NCs) that demonstrated functional road access to one another were grouped together, ensuring realistic service delivery and mobility.

- ***Administrative Integration (NC and VC clustering)***

NCs and VCs were merged into clusters in a manner that respected existing administrative boundaries while minimizing fragmentation. The clustering ensured that administrative limits were rationalized, reducing boundary disparities, overlaps, and potential disputes, and enabling equitable access to public services within each cluster.

- ***Topographical and Physical Constraints Analysis***

Digital Elevation Model (DEM)–based analysis was conducted to assess terrain, slope, and physical barriers. Geographical features were carefully considered to avoid clustering areas with severe topographic disconnections, ensuring practical accessibility and feasible infrastructure development.

8.2.3 Cluster-Based Facility Assessment and Proposals

Following the formation of rural clusters, a comprehensive assessment of the **existing stock of public facilities** and **future demand projections** was carried out at the cluster level. This included education, health, and other basic services, in line with planning standards and best practices.

Cluster-level proposals were then formulated to:

- Ensure that each cluster is functionally self-sufficient for basic services
- Distribute facilities equitably across rural areas;
- Strengthen rural service centers and reduce pressure on urban settlements and
- Align spatial proposals with sectoral recommendations discussed in the **Education and Health chapters** of the plan.

The clusters have been divided in respective tehsils for workable and unambiguous governance & implantation support framework. The detail regarding clusters of VCs is given in table below:

Table 135: Clusters of Rural VCs in District Bajaur

Tehsil	Cluster	VC's	2025	2045
			Population 2025	Population 2045
Barang Tehsil	1	V/C Bar Targhau, V/C Sharbatai Koz Kallai, V/C Bar Safarai, V/C Chorai	40918	69765
	2	V/C Bataee Alizai, V/C Nazar Mina, V/C Bado Bagh Arang, V/C Dehrago	39876	68436
Khar Bajaur Tehsil	3	V/C Panjkora, V/C Qambar, V/C Tar	30491	50372
	4	V/C Bad-e-Samoor 1, V/C Sahibabad/Babarshah, V/C Sheikh Baba	37791	79684
	5	V/C Cheenagai, V/C Kooka, V/C Yousaf Abad, V/C Haji Laung	51448	104877
	6	V/C Ghundo, V/C Loi Sam/Khanano Kallai, V/C Tangi charmang	40531	85461
	7	V/C Hayatai, V/C Marosa, V/C Sikandaro	33618	70886
	8	V/C Inamkhauro Chinagai-2, V/C Loi Kallai Tangai, V/C Damadola	35950	75802
	9	V/C Manai, V/C Manogai, V/C Top	32773	69104
	10	V/C Rashakai, V/C Sheikh kallai, V/C Smasai	33862	71400

Mamund Tehsil	11	V/C Sara Mina Alizai, V/C Shinkai	32577	68689
	12	V/C Agra-1, V/C Lara Zagai, V/C Irab Kallai-1	35371	62296
	13	V/C Badan Bar Kallai-1, V/C Tanai, V/C Mato Chinagai, V/C Badan Lar Kallai	42408	74689
	14	V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1	81015	142684
	15	V/C Warokai Kharkai, V/C Kharai Kamar, V/C Loi Kharkai, V/C Shakro	26949	47463
	16	V/C Bara Banda, V/C Jannat Shah/Babar Shah, V/C Sharif Khana 2, V/C Tangai-1	38588	67961
	17	V/C Dabarai, V/C Kaga Khas, V/C Lar Kallai Gabarai, V/C Lara Mukha, V/C Saparai	51210	90192
	18	V/C Ghakhai, Gillai, V/C Kitkoot-1, V/C Lagharai	37630	66274
	19	V/C Lar Kalan, V/C Tarkho-1, V/C Mina Suleman Khel, V/C Nakhtar Bala	34592	60925
Bar Chamarkand Tehsil	20	V/C Bara Sewai-1, V/C Dabbar-I, V/C Shago, V/C Shinkoti	43614	76814
	21	V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara	25574	40151
Salarzai Tehsil	22	V/C Azghar Kandaro, V/C Hasham Charmang-1, V/C Nawa	31271	50034
	23	V/C Batmalai-II, V/C Chorak, V/C Dabar 1	33304	62283
	24	V/C Batwar, V/C Chachagai	22270	41648
	25	V/C Chinargo, V/C Dehra Kai, V/C Kasai, V/C Tarala	40916	76518
	26	V/C lakiano, V/C Letai, V/C Loi Kallai	29686	55516
	27	V/C Lar Lako, V/C Topan Shah, V/C Lar Gambat, V/C Tandoka	41877	78315
	28	V/C Lar Molasaid 1, V/C Lara Ghundai, V/C Mano, V/C Kohai 1	38442	71892
Utman Khel Tehsil	29	V/C Malkana, V/C Nazakai, V/C Talai 1	33058	61822

	30	V/C Kulala Tangai, V/C Manogai, V/C Ghazi Baba, V/C Naranj-1, V/C Serai Mir Khan	51808	91428

Source: Developed by Consultant

8.2.4 Cluster-wise Population Analysis (2025–2045)

The clustering of Village Councils (VCs) across tehsils has been carried out based on **average population size and projected growth trends (2025–2045)**. This approach helps in rationalizing service delivery, infrastructure planning, and phased development interventions.

- ***Barang Tehsil***

The analysis shows that **Barang Tehsil has 02 clusters**, each comprising four Village Councils. In 2025, the population of these clusters ranges between **approximately 39,800 and 40,900**, which is projected to increase to **around 68,400–69,800 by 2045**. The relatively balanced population distribution indicates moderate growth, making these clusters suitable for **phased infrastructure expansion and consolidation of basic services**.

- ***Khar Bajaur Tehsil***

Khar Bajaur Tehsil consists of 08 clusters, reflecting its role as a major population concentration and administrative hub. The 2025 population of clusters ranges from **about 30,400 to 51,400**, which is projected to grow significantly to **approximately 50,300–104,900 by 2045**. Notably, Clusters 4, 5, and 6 show **high growth intensity**, indicating increasing urbanization pressure. These clusters require **priority planning for housing, commercial activities, utilities, and transport infrastructure**.

- ***Mamund Tehsil***

The assessment indicates that **Mamund Tehsil has 09 clusters**, making it one of the most densely clustered tehsils. Cluster populations in 2025 range from **around 26,900 to 81,000**, increasing to **approximately 47,500–142,700 by 2045**. Cluster 14 emerges as a **high-population cluster**, while several others show steady growth. This variation highlights the need for **differentiated planning strategies**, including targeted social infrastructure, road connectivity, and service centers in high-growth clusters.

- ***Bar Chamarkand Tehsil***

Bar Chamarkand Tehsil comprises 02 clusters. The population in 2025 ranges between **approximately 25,600 and 43,600**, which is expected to increase to **around 40,100–76,800 by 2045**. The moderate growth pattern suggests the need for **strengthening basic facilities, education, and healthcare services**, rather than large-scale urban expansion.

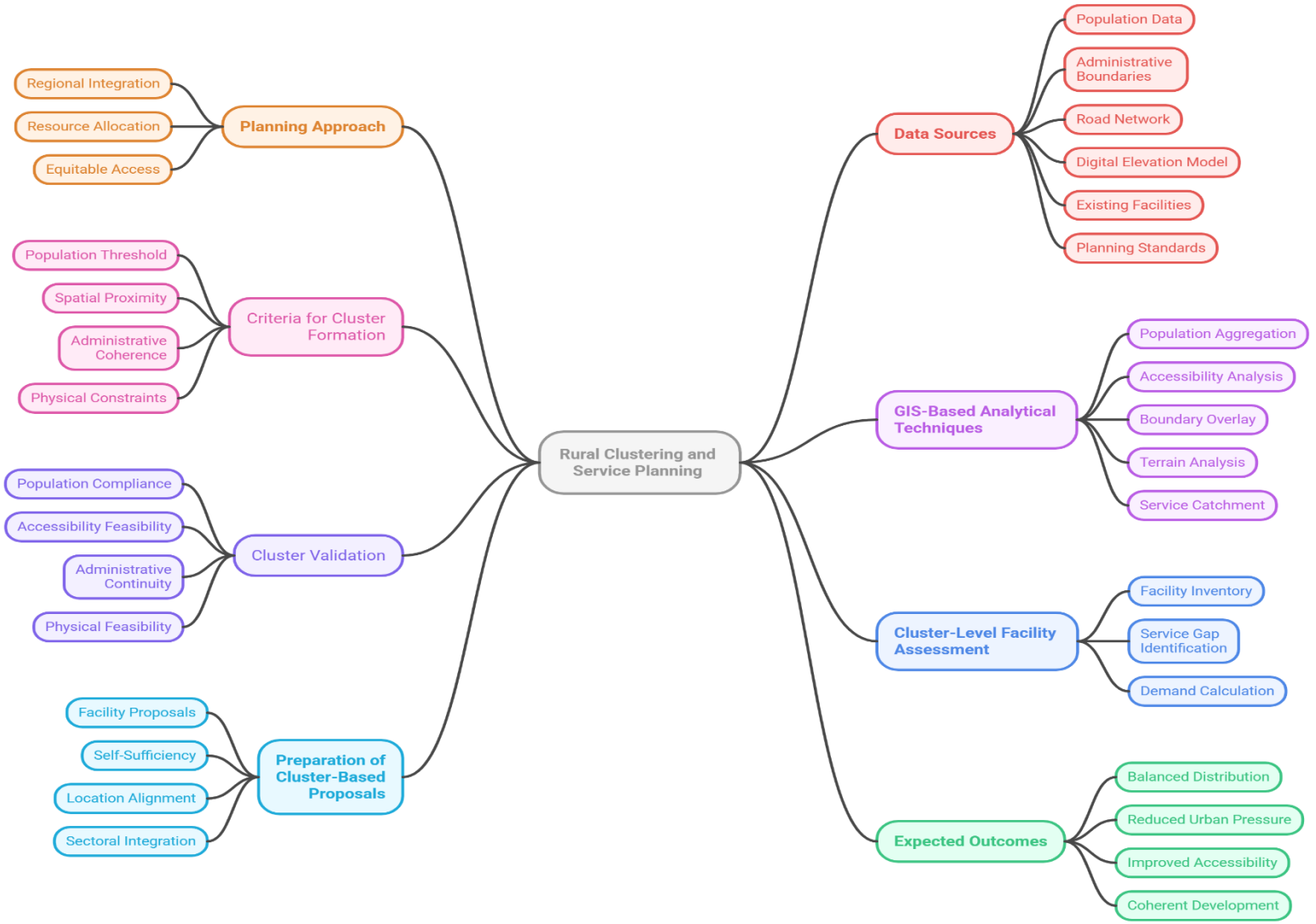
- ***Salarzai Tehsil***

The analysis shows that **Salarzai Tehsil has 07 clusters**, with 2025 populations ranging from **about 22,300 to 41,900**, projected to rise to **approximately 41,600–78,300 by 2045**. The relatively even growth across clusters supports **decentralized service provision**, village-level facilities, and improved inter-cluster connectivity.

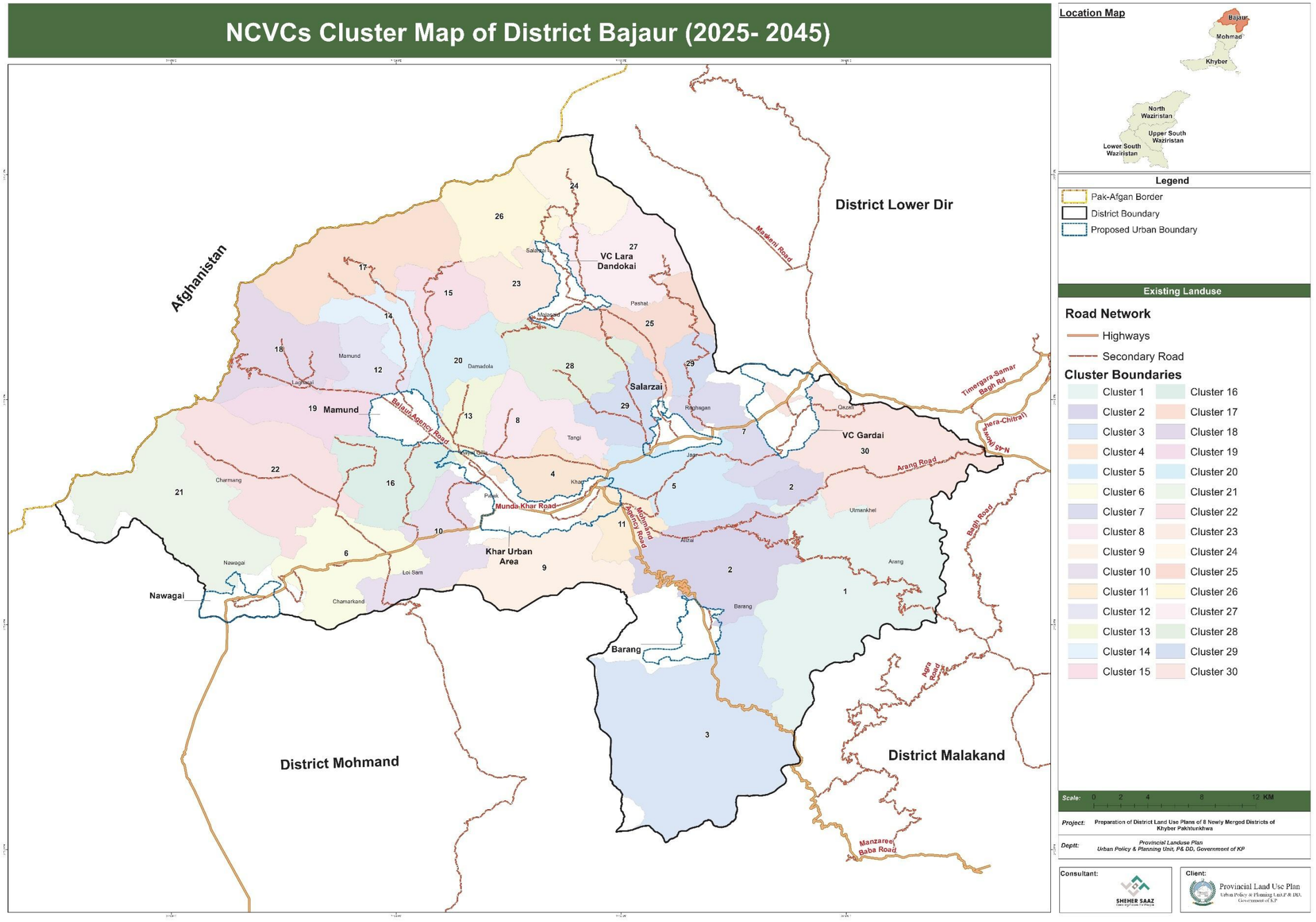
- ***Utman Khel Tehsil***

Utman Khel Tehsil consists of 02 clusters, with relatively high population levels. The clusters have a population of **approximately 33,100 and 51,800 in 2025**, which is projected to increase to **around 61,800 and 91,400 by 2045**. Given this growth trajectory, these clusters warrant **early interventions in infrastructure, land-use regulation, and public services** to manage future demand effectively.

Figure 50: Cluster Formation and Planning approaches



Map 69: Clusters Map of Rural Areas in District Bajaur



8.3 Sustainable Rural Development

Environment friendly and sustainable development of the district in general and rural areas in particular is very significant. It has now become imperative to ensure the development pattern which respects the natural rural landscapes and predominant agricultural character which contributes a major share in the economic development of the region. The objective of sustainable developments in rural areas is to raise the quality of life and the environment in rural areas while promoting:

- An integrated, eco-friendly development that respects the natural rural landscapes and predominant agricultural land while keeping the unique rural character intact.
- Continued protection of the open countryside, with the maximum protection for the valuable landscapes and environmental resources.
- To promote eco-friendly development
- Preventing urban sprawl
- Introducing the compatible land uses which suit both rural and urban features to maximize the potential benefits of the countryside fringing urban areas and providing appropriate leisure opportunities to urban and rural residents to enjoy their countryside.
- To promote sustainable, diverse and adaptable agriculture sectors where farming achieves high environmental standards, minimizing impact on natural resources, and preserves valued landscapes and biodiversity; contributes both directly and indirectly to regional economic development.

8.4 Model Village

Rural development is a multidimensional process aimed at improving the quality of life and economic wellbeing of rural populations. It involves not only enhancing agriculture and basic infrastructure but also expanding non-farm economic opportunities, improving governance, and integrating innovative technologies. Effective rural planning supports productivity, reduces poverty, and balances growth with environmental sustainability.

District Bajaur is characterized by agrarian livelihoods, dispersed settlements, and limited access to modern services. These conditions present both challenges and opportunities:

- Challenges such as under-served infrastructure, limited digital access, and economic leakage to urban centers can prevent local potential from being realized.
- Opportunities lie in leveraging agriculture, communal resources, geography, and emerging technologies to create self-sustaining and resilient rural settlements.

A Model Village in this context is not merely upgraded infrastructure, it is a holistic, integrated development framework that combines spatial planning, economic diversification, modern services, community empowerment, and sustainability. The Model Village is conceptualized as an agriculture-based rural growth system, where planned development is structured to directly support agricultural production, Agro-based value addition, and sustainable rural

livelihoods. The planning approach deliberately reinforces the existing agrarian economy while introducing organized spatial development to accommodate future population growth.

A Model Village comprises an overarching development framework to guide the future rural growth and development pattern that aspires to transform a rural settlement into an exemplar of sustainable, inclusive, and technology-enabled development. Unlike traditional rural clusters that evolve organically with limited planning, a Model Village is conceptualized and envisaged while integrating the following components:

- Planned spatial & land use distribution supported by provision of diversified public amenities in the order of hierarchy.
- Economic systems based on indigenous agrarian and agro-based industry to improve livelihoods and overall economic situation of the village.
- Improvise the public awareness among farmers and general public through training centers
- Basic and advanced infrastructure tailored to community needs
- Digital and technological platforms that bridge the urban–rural divide
- Environmental management strategies that protect natural resources.

It is a context-responsive planning framework that harnesses local strengths while introducing innovations that enhance quality of life. The Model Village framework is proposed for several reasons:

- Manageable population size: The cluster's **60,000 and 70,000** up to year 2045, population ensures that essential services are efficiently provided while remaining scalable for future growth.
- Rural character with development potential: Predominantly agricultural land use allows for structured interventions without compromising existing livelihoods.
- Availability of large land parcels: Facilitates integrated planning for residential zones, public services, green spaces and recreational areas, agro-industrial activities, well connected road and allied infrastructure.

Internationally, countries such as Indonesia (Cibodas Village, West Java) and India (Satnavri AI-Driven Village, Maharashtra) have successfully implemented rural development models that integrate agriculture, technology, and community governance. These examples demonstrate how digital tools, agro-industrial value chains, and participatory planning can transform rural settlements into resilient, productive, and livable communities.

8.4.1 Spatial Planning Concept and Settlement Hierarchy

The proposed Model Village in any identified clusters will be conceptualized as an agriculture-based rural growth system, where development will directly support agricultural production, agro-based value addition, and sustainable rural livelihoods. The suggested planning approach deliberately will reinforce the existing agrarian economy while introducing

recommended spatial organization to accommodate future population growth in a controlled and sustainable manner.

The recommended spatial structure will be derived from a multi-level growth centers model, ensuring functional efficiency, equitable access to services, and compatibility with the rural character of District Bajaur. Instead of imposing an artificial urban grid, the layout pattern needs to respond to natural topography, existing settlement typology, landscape features and other environmental considerations, available road network and allied services.

- ***Main Markaz and Sub Markaz Concept***

The model village will be organized around a functional service hierarchy comprising:

- High-Order Facilities: Central Main Growth Centre (Markaz)
- Low-Order Facilities: Secondary Sub-Centers (Sub-Markaz / Sub-Sector Clusters)

This recommended hierarchical arrangement will minimize unnecessary duplication of higher-order facilities, will rationalize land use distribution, and will ensure that essential services remain accessible within reasonable walking distances for surrounding residential clusters.

The High Order **Central Main Markaz** functions as the primary node of the model village, accommodating:

- Local administration and governance functions
- Major commercial services including grain, vegetable / fruit market etc.
- Storage facilities / Godowns
- Core public facilities like education and health services, central masjid etc.
- Communal farming areas accessible for the village dwellers
- Central Park and water front recreational zone
- Veterinary and Livestock Services
- Agricultural machinery repair workshops
- Post offices and banking services
- Revenue offices
- Agricultural support office & Farmers training center

The Low order facilities (**Sub-Centers)** serve as secondary service nodes catering to surrounding residential clusters. These areas are intended to host:

- Community-level social facilities (primary education, basic health units, mosques, community and recreational spaces)

- Neighborhood-scale commercial activities
- Local gathering and interaction spaces

This hierarchical arrangement ensures that daily needs are met locally, while higher-order services are centralized, thereby improving efficiency and reducing unnecessary travel.

8.4.2 Road Network and Connectivity

The internal circulation system will be based on a hierarchical road network to ensure efficient mobility, logical movement patterns, and seamless connectivity across the Model Village. The road hierarchy may comprise two to three categories of roads, generally ranging from 50 feet, 40 feet, and 30 feet in right-of-way, depending on local requirements and land availability.

A primary road corridor (approximately 50 feet wide) will function as the main circulation spine, providing linkage between the central activity node (Markaz), sub-centers, and the surrounding village road network. Secondary and tertiary roads (approximately 40 feet and 30 feet wide) will facilitate access to residential clusters, community facilities, and local activity areas. This hierarchical structure will support efficient circulation, improve accessibility, and encourage safe, walkable movement patterns suited to the rural village context.

This road hierarchy will ensure:

- Efficient vehicular and pedestrian movement
- Strong internal connectivity between residential areas and service centers
- Seamless integration with regional and village-level road networks

The alignment of roads respects existing paths and access routes, reinforcing continuity with current movement patterns while improving overall accessibility.

In accordance with rural development planning standards, the Model Village provides the following facilities across its hierarchy:

- Rural Health Centers and Community Hospital
- High / Higher Secondary School
- Community parks and playfields
- Police and emergency services

8.4.3 Proposed Concepts

The proposed land-use structure for the Model Village will be designed to support agriculture-led rural development, enhance livelihoods, and improve living standards while ensuring environmental protection and spatial efficiency. The framework integrates residential growth, Agro-economic activities, communal spaces, mobility infrastructure, and ecological conservation in a coherent and topography-responsive manner.

8.4.3.1 Residential

Residential development within the Model Village will be planned as a low-density settlement pattern, sensitively integrated with the surrounding rural and agricultural landscape. The intent is to maintain the village's rural character, visual openness, and productive land systems, while allowing for incremental residential growth in a controlled and sustainable manner. Residential areas will accommodate a range of plot sizes to respond to varying household needs and socio-economic groups, including extended families, middle-income households, and affordable housing options for lower-income and young households.
Housing development will be encouraged in compact clusters, allowing efficient service provision and minimizing land consumption. A phased development approach will be adopted to accommodate future population growth without disrupting existing settlements, while enabling infrastructure and services to be expanded gradually over time.

- ***Rural Residential and Farmhouse Concept***

Keeping in view the topography and rural character of the area, low-density housing including farm houses may be proposed for the model village. Farmhouse options may include kitchen gardens, small orchards, poultry or livestock sheds, on-plot rainwater harvesting systems, thereby linking housing with household-level food production and potential source of income. The proposed planned settlement will align with the natural landscapes and ensure the maximum preservation of agricultural land while supporting sustainable livelihoods.

Figure 51: Rural Residential and Farmhouse Concept

- ***Incremental and Expandable Housing***

Residential units **will be designed** to allow **horizontal or vertical expansion**, enabling households to upgrade their homes gradually as income levels improve.

- ***Climate-Responsive Building Orientation***

Plot orientation and street layouts **will be recommended** to maximize natural ventilation, daylight access, and shading, reducing reliance on mechanical cooling in a hot-climate rural setting.

- ***Use of Local Materials and Construction Techniques***

The **recommended use of locally available materials** (stone, brick, mud composites, and timber) **will reduce construction costs**, support the local economy, and maintain architectural continuity with traditional rural housing.

- ***On-Plot and Community-Level Water Management:***

In addition to rainwater harvesting, **greywater reuse for irrigation** and **community-level recharge pits will be encouraged** to strengthen water resilience.

- ***Pedestrian Priority and Safe Internal Streets***

Internal streets within residential clusters **will be designed** as low-speed, pedestrian-friendly environments, prioritizing children, elderly residents, and daily social activity.

- ***Disaster-Resilient and Seismic-Safe Housing Practices***

Housing design **will incorporate** basic disaster-resilient measures, particularly relevant to the seismic sensitivity of the region.

8.4.3.2 Service Center/Commercial

The recommended Service Center will provide space for secondary health services, vocational and skills development facilities, and agro-support institutions, strengthening the linkage between settlement development and the local agrarian economy. This node is suggested to serve not only the immediate residential clusters but also surrounding villages, thereby enhancing regional service accessibility.

Commercial activities within the Service Center will be organized to support local livelihoods, including agro-input supply, produce collection and storage, small-scale processing, and rural markets. The recommended mixed-use character will allow compatible commercial, institutional, and service functions to co-exist, ensuring economic vitality while maintaining the rural scale and character.

The spatial placement of the Service Center will ensure direct connectivity with the primary spine road, facilitating efficient movement of goods and people, while minimizing conflicts with purely residential areas.

8.4.3.3 Agriculture and Integrated Rural Production Zones

Agriculture will remain a core land use within the Model Village. Rather than relying solely on large continuous tracts, small agricultural pockets are suggested along rangeland areas, enabling diversified and multi-functional rural activities. These pockets will support:

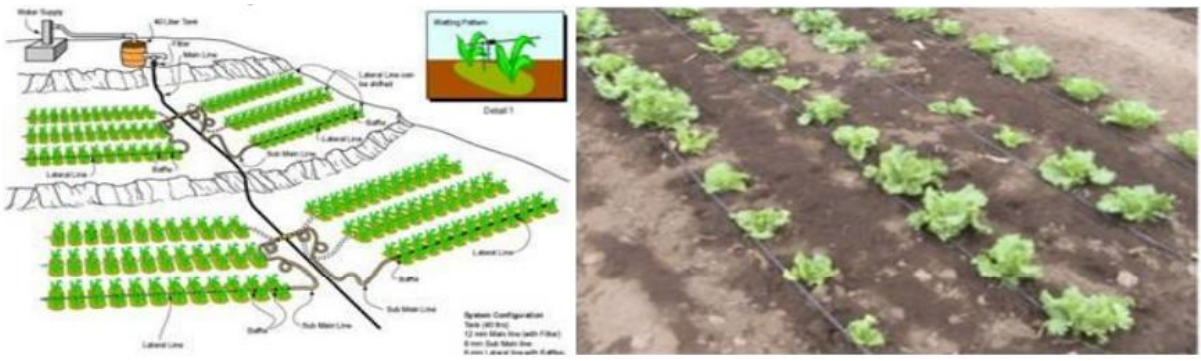
- Drip and sprinkler irrigation systems to optimize water use efficiency
- High-value crops, kitchen gardens, and horticultural plots for household and commercial purposes
- Fodder cultivation linked with livestock grazing in adjacent rangelands
- Demonstration farms showcasing modern, sustainable agricultural practices

Additional recommended interventions include:

- Agroforestry and mixed-cropping plots, combining timber, fruit, and fodder species for ecological and economic benefits
- Integrated pest management zones to reduce chemical inputs and improve crop resilience
- Soil and water conservation structures, such as contour bunding, check dams, and micro-catchments

This integrated approach will enhance productivity, optimize land use, and strengthen the linkage between agriculture and livestock-based livelihoods.

Figure 52: Low-Cost Drip Irrigation System for a Hilly Area



8.4.3.3.1 Communal Farming and Agro-Based Public Facilities

In addition to individual farming, communal farming zones are recommended as shared agricultural spaces linked to the main market and public amenities. These zones will promote cooperative farming models and collective economic activity. Proposed components within communal farming areas will include:

- Shared cultivation plots managed by local communities
- Seed banks, tool-sharing facilities, and equipment pools
- Training and extension centers for modern and climate-resilient farming techniques
- Collection points, cold storage, and processing facilities for agricultural produce
- Direct linkage with local markets to facilitate farm-to-market access

Further suggested interventions for communal areas:

- Community orchards and medicinal/herbal gardens to diversify income
- Agro-tourism plots demonstrating traditional and modern farming practices
- Cooperative livestock pens for dairy and poultry activities

These measures will enhance social cohesion, improve market access for small farmers, and support inclusive rural economic development.

8.4.3.3.2 Agro-Industry and Value Addition

A dedicated Agro-Industrial zone is recommended to support small-scale, non-polluting agro-based industries focused on value addition rather than heavy manufacturing. These facilities will include:

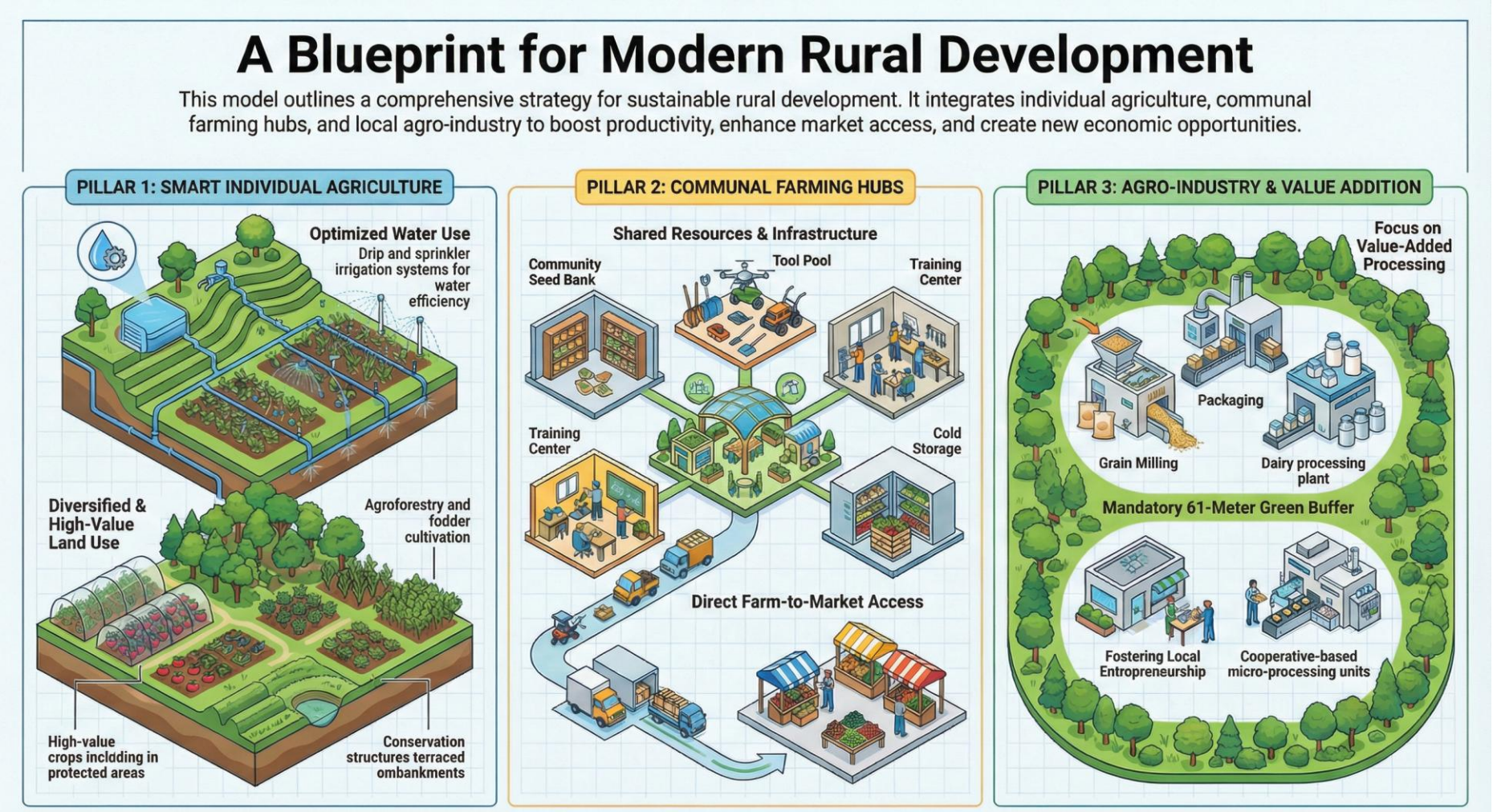
- Grain processing and milling units
- Fruit and vegetable grading, packaging, and cold storage units
- Dairy processing and meat chilling units
- Warehousing, logistics, and distribution facilities for agricultural products

Additional suggested interventions for enhancing the agro-industrial zone:

- Cooperative-based micro-processing units for community entrepreneurship
- Bioenergy and composting units utilizing agricultural residues
- Training and incubation centers for agro-entrepreneurs and youth employment

In compliance with Khyber Pakhtunkhwa Urban Policy, a mandatory green buffer of approximately 61 meters is recommended around the agro-industrial area to mitigate environmental impacts and ensure compatibility with surrounding residential and agricultural land uses.

Figure 53: Proposed Modern Agro-industrial Zone



Source: Design by Consultants

8.4.3.3.3 Traditionally Useful and Efficient Irrigation Systems for Slopy/Hill Agriculture

To enhance sustainable and context-sensitive water management, the Model Village will explore and recommend the adoption of traditional irrigation practices suitable for sloped or hilly terrain. These systems will support efficient water use, reduce dependency on external inputs, and strengthen resilience in agriculture. Examples include:

a) Zabo System of Irrigation (Nagaland, India):

- This traditional system will allow terrace farming in hilly regions while maintaining forested watersheds as sacred groves.
- Rainwater will successively irrigate terraces, with a pond or storage structure in the middle terraces to regulate flow.
- Water distribution will be enhanced through bamboo pipes to cover maximum agricultural area.
- The system will demonstrate integrated watershed management, combining forestry, irrigation, and sustainable farming.

b) Bamboo Drip Irrigation (Meghalaya, India):

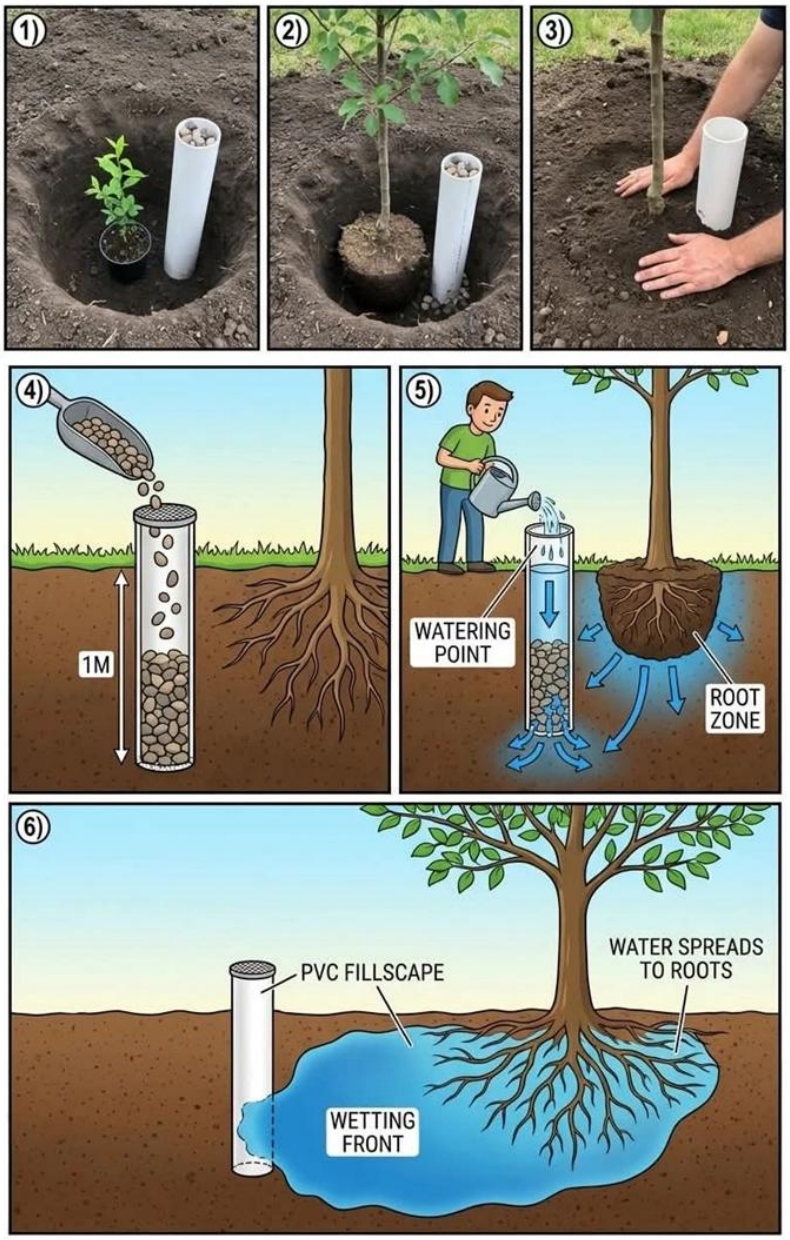
- Tribes of Khasi and Jaintia use bamboo pipes to tap water from streams and springs for hilltop black pepper plantations.
- Water flow will be controlled through pipe diameter adjustments, with slow drip rates of 20–80 drops per minute.
- Bamboo internodes are removed and smoothed to reduce friction, providing a gravity-driven irrigation solution that is low-cost, locally sourced, and sustainable.

Figure 54: Bamboo drip irrigation system

c) Deep Pipe Irrigation System:

- Pipes with a diameter of 2.5–5 cm are vertically installed 30–50 cm deep near tree seedlings, supplying water directly to the root zone.
- Openings will be covered with mesh to prevent animal intrusion, and small weep holes will distribute water evenly to roots.
- This system will support efficient water use, particularly for trees, orchards, and horticultural crops in areas with uneven rainfall.

Figure 55: Deep Pipe Irrigation System:



Source: Chowdhury, P., Meena, L. K., Ray, S. K., & Deka, B. (2016)[50]

4. **Kuhl System of Irrigation (Western Himalayas, India):**

- Diversion channels, known as Guhls or Kuhls, will direct water from streams to agricultural fields.
- Water user associations, led by a Kohli (water tender), will manage flow, maintain headwalls, and ensure equitable distribution.
- Flow control will be achieved by adjusting outlet widths between successive fields; temporary storage structures will store water for use during dry periods.

[50] Implication of feasible techniques for irrigation in hill agriculture. *ResearchGate*. https://www.researchgate.net/publication/341992310_Implication_of_Feasible_Techniques_for_Irrigation_in_Hill_Agriculture

- This system will encourage community participation, promote accountability, and strengthen traditional water governance.

Recommended Integration for the Model Village:

- Pilot implementation of bamboo drip irrigation for sloped orchards or horticulture zones
- Zabo- and Kuhl-inspired terracing and water-sharing systems for communal farms and rangeland areas
- Deep pipe irrigation for high-value crops, trees, and kitchen gardens
- Capacity-building programs and demonstration plots will educate farmers about the efficiency and maintenance of traditional irrigation methods

These practices will ensure that water is utilized efficiently, strengthen agricultural resilience, and maintain ecological balance, while respecting traditional knowledge and local cultural practices.

8.4.3.4 Riparian Zones and Water Resource Protection

In accordance with the Khyber Pakhtunkhwa Water Protection Act, a minimum 61-meter-wide riparian zone on both side will be established along both banks of all significant water bodies within the Model Village. These zones will be characterized by dense native vegetation and will serve multiple ecological, hydrological, and social functions, including:

- Protection of natural drainage systems and maintenance of water quality
- Flood risk reduction and stabilization of river or stream banks
- Preservation of biodiversity, wildlife habitats, and natural ecological corridors

Controlled and sustainable recreational uses are recommended within designated sections of the riparian buffer, including:

- Nature trails for walking and environmental education
- Camping sites and picnic areas
- Eco-tourism activities such as birdwatching, guided nature tours, and community-based experiences

These measures will promote tourism and community engagement while maintaining the ecological integrity of riparian areas and supporting long-term sustainability of water resources.

Additional recommendations for enhancing riparian functionality:

- Buffer vegetation zoning: Planting native species in layered strips to filter runoff, provide shade, and support habitat connectivity
- Community stewardship programs: Local participation in monitoring water quality and maintaining trails

- Low-impact infrastructure: Boardwalks, observation decks, and signage to minimize soil compaction and habitat disturbance

This integrated approach will ensure that riparian zones serve both environmental protection and community use objectives, aligning with regional water management and sustainable rural development goals.

8.4.3.5 Parks, Recreation, and Open Spaces

Parks and recreational areas are distributed across residential clusters and near community centers to ensure accessibility. These spaces accommodate:

- Playgrounds for children
- Sports facilities such as football and volleyball grounds
- Open-air gyms and jogging tracks
- Community event and cultural activity spaces

The availability of large open spaces within and along riparian buffers also allows for outdoor recreation, camping, seasonal festivals, and eco-tourism activities, further enhancing the socio-economic potential of the model village.

A Waterfront Park has been proposed along selected water bodies to enhance the visual quality of the settlement and provide recreational spaces for residents and visitors. The park integrates:

- Walking and cycling tracks
- Seating terraces and viewing decks
- Landscaped open lawns and shaded areas
- Informal gathering and cultural activity spaces

This waterfront development strengthens the blue-green infrastructure network and reinforces the relationship between the settlement and natural water systems.

8.4.4 Solid Waste Management Planning Model

Solid waste management remains a critical challenge in rural settlements due to the absence of organized collection systems, open dumping practices, and limited institutional capacity. The Model Village is therefore recommended to adopt a decentralized and integrated solid waste management system, aligned with rural socio-economic conditions and land availability.

The proposed model prioritizes waste reduction, resource recovery, and environmentally safe disposal, while encouraging community participation and local employment generation.Waste Segregation at Source

All residential, commercial, and institutional units within the Model Village should be encouraged to practice waste segregation at source, categorizing waste into:

- Biodegradable waste (kitchen waste, crop residues, animal waste)
- Recyclable waste (plastic, paper, metal, glass)

- Residual waste (non-recyclable materials)

Segregation at source is recommended to improve operational efficiency, reduce disposal volumes, and support downstream recycling and composting activities.

8.4.4.1 Community Composting and Organic Waste Management

Given the agrarian nature of rural settlements, biodegradable waste should be processed through community-level composting systems. These may include:

- Windrow composting units
- Enclosed compost pits
- Small-scale bio-gas digesters at cluster or neighborhood level

The resulting compost can be utilized for:

- Agricultural fields
- Kitchen gardens
- Public green spaces

Bio-gas production is recommended for communal cooking facilities or selected households, thereby contributing to renewable energy use and reducing reliance on conventional fuels.

8.4.4.2 Material Recovery and Recycling Facilities

A Material Recovery Facility (MRF) is recommended within or adjacent to the Service Center or Agro-Industrial Zone. This facility should function as a collection, sorting, and storage point for recyclable materials.

Key functions include:

- Manual sorting of recyclable waste
- Temporary storage and baling
- Linkage with regional recycling markets

This facility is expected to generate local employment and strengthen the circular economy within the village.

8.4.4.3 Final Disposal System

Residual waste that cannot be composted or recycled should be disposed of at a controlled rural disposal site, designed with:

- Lined disposal pits
- Periodic soil covering
- Vegetative buffers to reduce visual and environmental impact

This system is recommended to replace informal dumping practices and protect soil and groundwater quality.

8.4.5 Water Supply and Sanitation Networks – Model Village

8.4.5.1 Model Village with Maximum Population (Mamund Tehsil) V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1

8.4.5.1.1 Rural Area Wise Existing and Proposed Water Demand

Based on projected population growth trends, the combined rural population of the selected model villages comprising VC Bar Gatkai-1, VC Bar Kemal, VC Gagra Gardi Bagh, and VC Lara Mina-1 in Mamund Tehsil is expected to increase significantly over the planning horizon. The population is projected to rise from 81,015 persons in 2025 to 142,684 persons by 2045, reflecting natural population growth as well as planned consolidation and service improvement within the rural settlement framework.

In accordance with the adopted rural water supply design criteria (15 GPCD as per PHED/WASA standards), the average daily water demand for the model village cluster is projected to increase from 1.215 MGPD in 2025 to 2.140 MGPD by 2045. Correspondingly, the maximum day demand is expected to rise from 1.823 MGPD to 3.210 MGPD, while the peak hour demand is anticipated to increase from 2.734 MGPD to 4.816 MGPD over the planning period.

Year	Rural Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	81,015	1.215	1.823	2.734
2045	142,684	2.140	3.210	4.816

The substantial increase in projected water demand highlights the necessity for a planned, phased, and scalable rural water supply system for the model villages of Mamund Tehsil. Priority interventions include the development of new deep tube wells, augmentation of ground and overhead storage capacity, and systematic expansion of the piped distribution network to ensure equitable, reliable, and continuous water supply coverage. Emphasis shall also be placed on groundwater sustainability, reduction of non-revenue water, energy-efficient pumping solutions, and strict compliance with drinking water quality standards to ensure long-term system resilience.

8.4.5.1.2 Proposed Water Supply System in Model Village

To address the projected water demand of Yake Tehsil covering both rural and semi-urban settlements up to the year 2045, a phased and sustainable water supply system is proposed. The design is based on 15 GPCD for rural areas following PHED and WASA standards.

The system design integrates maximum day and peak hour demand factors, ensuring operational flexibility, resilience, and capacity for future population growth. Key elements of

the proposed scheme include sustainable groundwater abstraction, solar-powered pumping, and modular water storage reservoirs for reliable service delivery.

III. Proposed Source (New Tube-Well)

➢ Design Basis

Groundwater abstraction will be the principal source for the proposed water supply network in Yake Tehsil. Wells will tap into productive aquifer zones identified through hydrogeological surveys, ensuring long-term sustainability without over-extraction.
To promote energy efficiency, solar-powered pumping systems are recommended, especially for off-grid and remote settlements, minimizing operational costs and improving service continuity.

➢ Unit Well Capacity:

Each production well will be designed to yield a continuous discharge of 0.65 MGD (≈1 cusec). This capacity ensures efficient groundwater extraction, manageable maintenance, and operational redundancy to maintain continuous service during outages.

➢ Service Objective:

The proposed system is designed to meet a maximum day demand of 3.2 MGD by 2045, including a 15% redundancy margin for operational downtime and emergencies. This configuration ensures reliable and sustainable water service across all settlements.

Stage	Implementation Period	Rural Demand to be Met (MGD)	New Production Wells*
Long-Term	2041 – 2045	up to 3.21	5 wells

IV. Water Storage

Urban Areas (VCs – 15GPCD)

For rural settlements in Model (Mamund Tehsil) V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1, localized Overhead Reservoirs (OHRs) are proposed to provide consistent supply and operational reliability. Each OHR will provide a 12-hour service buffer, ensuring stable supply during power interruptions or maintenance shutdowns.

Purpose:

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

- ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	1.823	0.911	1.0
2045	3.210	1.605	1.7

8.4.5.1.3 Existing situation of the sanitation/drainage system

Wastewater generation for the Model Village cluster in Mamund Tehsil has been estimated based on 85% of the average daily water demand, with an additional 5% allowance for non-domestic uses, including small-scale commercial, educational, and institutional activities. This methodology reflects prevailing rural and semi-urban water use patterns and is consistent with standard sanitation planning and PHED design practices.

For hydraulic design purposes, the peak sewage flow has been assumed as three times the average daily wastewater generation to account for diurnal variations and peak usage conditions. Stormwater inflow and infiltration (I&I) have been considered at 50% of the peak sewage flow, reflecting the combined inflows experienced during monsoon rainfall events due to open drains, unlined sewers, and surface runoff intrusion. In addition, 10% infiltration losses have been incorporated to account for local soil permeability and prevailing hydrogeological conditions.

Based on a design per capita water demand of 15 GPCD, the corresponding per capita sewage generation is estimated at approximately 13.5 GPCD, which is typical for rural and semi-urban settlements within the region.

8.4.5.1.4 Rural Area Wise Existing and Proposed Wastewater Demand

Year	RURAL Population	Average Water Demand (MGD)	Wastewater Generation @ (85% + 5%) (MGD)	Peak Sewage Flow (MGD)	Stormwater Inflow (50% of Peak) (MGD)	Total Design Flow (MGD)
2025	81,015	1.22	1.09	3.28	1.64	4.92
2045	142,684	2.14	1.93	5.78	2.89	8.67

Based on population projections for the Model Village cluster in Mamund Tehsil, wastewater generation is expected to increase substantially over the planning horizon. The rural population is projected to increase from 81,015 persons in 2025 to 142,684 persons by 2045, resulting in an increase in average daily wastewater generation from 1.09 MGD to 1.93 MGD. The total design wastewater flow, including peak sewage flow and stormwater inflow, is projected to increase from 4.92 MGD in 2025 to 8.67 MGD by 2045. This significant increase reflects both population growth and increased hydraulic loading during peak usage and monsoon conditions.

These projections clearly highlight the need for a phased, integrated, and resilient rural sanitation and drainage strategy for the Model Village cluster of Mamund Tehsil. Key interventions should focus on:

Gradual transition from on-site sanitation to planned sewerage systems. Development of decentralized wastewater treatment facilities. Improvement and lining of open drains to reduce infiltration and inflow. Protection of groundwater resources from contamination

Strengthening of stormwater drainage infrastructure to manage monsoon runoff. Timely implementation of these measures will be essential to ensuring an environmentally sound, climate-resilient, and sustainable wastewater management system for the selected villages.

These projections highlight the need for a phased and integrated rural sanitation strategy for the model village cluster. Key interventions should focus on upgrading on-site sanitation systems, introducing decentralized wastewater treatment solutions, safeguarding groundwater resources, and strengthening rural drainage infrastructure. Timely implementation of these measures will be critical to ensuring environmentally sound, resilient, and sustainable wastewater management for Issa Khel VC-2, Issa Khel VC-4, and Tamanzai VC-1.

8.4.5.1.5 Proposed Wastewater Treatment Plants (WWTP)

To cater to the projected wastewater flows of the Model Village cluster comprising VC Bar Gatkai-1, VC Bar Kemal, VC Gagra Gardi Bagh, and VC Lara Mina-1, it is proposed to develop multiple decentralized Wastewater Treatment Plants (WWTPs) with a combined ultimate treatment capacity of approximately 9.0 MGD.

The proposed treatment capacity has been planned to adequately accommodate the ultimate design flow of 8.67 MGD by 2045, while also providing an operational buffer to manage peak flow variations, stormwater inflow, infiltration, and future uncertainties in population growth and water consumption patterns.

The WWTPs shall be strategically located within their respective catchments to minimize sewer conveyance lengths, reduce pumping requirements, and enhance operational efficiency. Each facility is recommended to adopt cost-effective, low-energy, and low-maintenance treatment technologies suitable for rural and semi-urban contexts, such as:

Waste stabilization ponds, Constructed wetlands, Anaerobic baffled reactors (ABRs) with polishing ponds, Compact modular treatment units (where land is constrained), All treatment systems shall comply with PHED Khyber Pakhtunkhwa guidelines and applicable National Environmental Quality Standards (NEQS).

Treated effluent may be safely discharged into natural drainage channels or reused for agricultural irrigation, plantation, and landscape watering, subject to compliance with effluent quality standards. The phased implementation of decentralized WWTPs will form the backbone of a sustainable and environmentally responsible sanitation system, ensuring long-term protection of both surface and groundwater resources for the Model Village cluster in Mamund Tehsil.

8.4.5.1.6 Proposed Rainwater Harvesting System for Model Village

In order to enhance water security, reduce pressure on groundwater resources, and improve system resilience during peak demand periods, it is proposed to introduce a Rainwater Harvesting (RWH) system for the Model Village cluster comprising VC Bar Gatkai-1, VC Bar Kemal, VC Gagra Gardi Bagh, and VC Lara Mina-1 in Mamund Tehsil. The proposed system will function as a supplementary water source, particularly during the monsoon season, and will contribute to sustainable and climate-resilient water resource management.

Rainwater harvesting is well suited to the rural and semi-urban context of Mamund Tehsil, where roof catchments of public buildings, community facilities, and clustered residential units can be effectively utilized to capture and store rainfall for non-potable and limited emergency potable uses, subject to appropriate treatment.

- ***Design Basis***

The proposed rainwater harvesting system has been designed based on the following assumptions. Collection from rooftops of public buildings (schools, mosques, health units) and selected residential clusters. Average annual rainfall in the area is considered adequate for seasonal harvesting. Runoff coefficient of 0.75 for roof surfaces. Storage designed to supplement 10–15% of average daily water demand. Provision of first-flush diversion and basic filtration prior to storage.

I. Proposed Rainwater Harvesting Storage Capacity

Based on the projected water demand and settlement pattern of the model village cluster, it is proposed to construct community-level rainwater harvesting tanks with phased storage capacities as summarized below.

Year	Average Water Demand (MGD)	Target Supplement (%)	Daily Supplement (MGD)	Recommended RWH Storage (MG)
2025	1.22	10%	0.12	1.2
2045	2.14	15%	0.32	3.2

The recommended storage volumes allow harvested rainwater to be utilized over several days following rainfall events, thereby reducing reliance on tube wells during peak demand periods.

- ***Utilization Strategy & Operational Benefits***

The proposed rainwater harvesting system for the Model Village cluster in Mamund Tehsil will consist of roof and paved surface catchments connected through a network of gutters

and downpipes. These will be supported by first-flush diversion chambers and sand-and-gravel filtration units to improve water quality prior to storage.

Harvested rainwater will be stored in reinforced concrete underground or semi-underground tanks, designed to minimize evaporation losses and protect water quality. Overflow arrangements will be connected to soak pits or recharge trenches to safely dispose of excess runoff while promoting groundwater recharge.

The collected rainwater will be utilized primarily for Non-potable domestic uses such as washing and cleaning Irrigation of public green spaces and plantation areas, Controlled aquifer recharge during monsoon periods

Limited emergency potable use may be permitted following basic treatment and disinfection, in accordance with public health guidelines. The rainwater harvesting tanks will remain hydraulically isolated from the main potable water supply system; however, controlled valving arrangements may be provided for emergency integration during extreme water shortages.

This system will complement the proposed tube-well-based water supply and storage reservoirs by providing an alternative water source during monsoon periods, power outages, and operational downtime. Overall, the phased implementation of rainwater harvesting infrastructure will:

- Reduce pressure on groundwater abstraction
- Lower energy consumption associated with pumping
- Improve long-term sustainability of rural water supply
- Enhance resilience to droughts and climate variability

The proposed RWH system will therefore contribute to a sustainable, resource-efficient, and climate-adaptive water supply framework for the Model Village cluster of Mamund Tehsil.

8.4.5.2 Model Village with Minimum Population (Bar Chamarkand Tehsil) V/C Bar Chamarkand I, V/C Hilal Khel Charmang-1, V/C Ghaljo Kamangara

8.4.5.2.1 Rural Area Wise Existing and Proposed Water Demand

Based on projected population growth trends, the combined rural population of the selected model villages comprising VC Bar Chamarkand-I, VC Hilal Khel Charmang-1, and VC Ghaljo Kamangara in Bar Chamarkand Tehsil is expected to increase steadily over the planning horizon. The population is projected to rise from 25,574 persons in 2025 to 40,151 persons by 2045, reflecting natural population growth along with gradual consolidation of settlements and improved access to basic municipal services within the rural framework.
In accordance with the adopted rural water supply design criteria of 15 GPCD, as prescribed by PHED/WASA standards, the average daily water demand for the model village cluster is projected to increase from 0.384 MGPD in 2025 to 0.602 MGPD by 2045. Correspondingly, the maximum day demand is expected to rise from 0.575 MGPD to 0.903 MGPD, while the

peak hour demand is anticipated to increase from 0.863 MGPD to 1.355 MGPD over the planning period.

Year	Rural Population	Water Demand (MGPD)	Maximum Day Demand (MGPD)	Peak Hour Demand (MGPD)
2025	25,574	0.384	0.575	0.863
2045	40,151	0.602	0.903	1.355

The substantial increase in projected water demand highlights the necessity for a planned, phased, and scalable rural water supply system for the model villages of Mamund Tehsil. Priority interventions include the development of new deep tube wells, augmentation of ground and overhead storage capacity, and systematic expansion of the piped distribution network to ensure equitable, reliable, and continuous water supply coverage. Emphasis shall also be placed on groundwater sustainability, reduction of non-revenue water, energy-efficient pumping solutions, and strict compliance with drinking water quality standards to ensure long-term system resilience.

8.4.5.2.2 Proposed Water Supply System in Model Village

To address the projected water demand of Yake Tehsil covering both rural and semi-urban settlements up to the year 2045, a phased and sustainable water supply system is proposed. The design is based on 15 GPCD for rural areas following PHED and WASA standards.
The system design integrates maximum day and peak hour demand factors, ensuring operational flexibility, resilience, and capacity for future population growth. Key elements of the proposed scheme include sustainable groundwater abstraction, solar-powered pumping, and modular water storage reservoirs for reliable service delivery.

I. Proposed Source (New Tube-Well)

- ***Design Basis***

Groundwater abstraction will be the principal source for the proposed water supply network in Yake Tehsil. Wells will tap into productive aquifer zones identified through hydrogeological surveys, ensuring long-term sustainability without over-extraction.
To promote energy efficiency, solar-powered pumping systems are recommended, especially for off-grid and remote settlements, minimizing operational costs and improving service continuity.

- ***Unit Well Capacity:***

Each production well will be designed to yield a continuous discharge of 0.65 MGD (≈1 cusec). This capacity ensures efficient groundwater extraction, manageable maintenance, and operational redundancy to maintain continuous service during outages.

➢ ***Service Objective:***

The proposed system is designed to meet a maximum day demand of 1 MGD by 2045, including a 15% redundancy margin for operational downtime and emergencies. This configuration ensures reliable and sustainable water service across all settlements.

Stage	Implementation Period	Rural Demand to be Met (MGD)	New Production Wells*
Long-Term	2041 – 2045	up to 1	2 wells

II. Water Storage

➢ ***Urban Areas (VCs – 15GPCD)***

For rural settlements in Model (Mamund Tehsil) V/C Bar Gatkai-1, V/C Bar Kemal, V/C Gagra Gardi Bagh, V/C Lara Mina-1, localized Overhead Reservoirs (OHRs) are proposed to provide consistent supply and operational reliability. Each OHR will provide a 12-hour service buffer, ensuring stable supply during power interruptions or maintenance shutdowns.

➢ ***Purpose:***

- Ensure consistent and reliable supply for rural communities.
- Provide a 12-hour operational buffer during outages or maintenance.
- Reduce stress on groundwater abstraction systems by regulating pumping cycles

➢ ***Phased Capacities (based on projected demand):***

Year	Maximum Day Demand (MGD)	12-Hour Buffer (MG)	Recommended OHR Capacity (MG)
2025	0.575	0.288	0.3
2045	0.903	0.452	0.5

8.4.5.2.3 Existing situation of the sanitation/drainage system

Wastewater generation for the Model Village cluster in Mamund Tehsil has been estimated based on 85% of the average daily water demand, with an additional 5% allowance for non-domestic uses, including small-scale commercial, educational, and institutional activities. This methodology reflects prevailing rural and semi-urban water use patterns and is consistent with standard sanitation planning and PHED design practices.

For hydraulic design purposes, the peak sewage flow has been assumed as three times the average daily wastewater generation to account for diurnal variations and peak usage

conditions. Stormwater inflow and infiltration (I&I) have been considered at 50% of the peak sewage flow, reflecting the combined inflows experienced during monsoon rainfall events due to open drains, unlined sewers, and surface runoff intrusion. In addition, 10% infiltration losses have been incorporated to account for local soil permeability and prevailing hydrogeological conditions.

Based on a design per capita water demand of 15 GPCD, the corresponding per capita sewage generation is estimated at approximately 13.5 GPCD, which is typical for rural and semi-urban settlements within the region.

8.4.5.2.4 Rural Area Wise Existing and Proposed Wastewater Demand

Year	RURAL Population	Average Water Demand (MGD)	Wastewater Generation @ (85% + 5%) (MGD)	Peak Sewage Flow (MGD)	Stormwater Inflow (50% of Peak) (MGD)	Total Design Flow (MGD)
2025	25,574	0.38	0.35	1.04	0.52	1.55
2045	40,151	0.60	0.54	1.63	0.81	2.44

Wastewater generation for the selected model village cluster in Bar Chamarkand Tehsil has been estimated based on 85% of the average daily water demand, with an additional 5% allowance for non-domestic uses, including small-scale commercial and institutional activities. This methodology reflects prevailing rural water-use patterns and is consistent with standard sanitation planning practices.

For hydraulic design purposes, the peak sewage flow has been assumed as three times the average daily wastewater generation to account for diurnal variations and peak usage conditions. Stormwater inflow and infiltration (I&I) have been considered at 50% of the peak sewage flow to reflect combined inflows during monsoon rainfall events. These assumptions are appropriate for rural settlements characterized by mixed sanitation systems and open drainage networks.

Based on a design per capita water demand of 15 GPCD, the corresponding per capita sewage generation is approximately 13.5 GPCD, which is typical for rural and semi-urban settlements in the region.

8.4.5.2.5 Proposed Rainwater Harvesting System

In order to enhance water security, reduce pressure on groundwater resources, and improve system resilience during peak demand periods, it is proposed to introduce a Rainwater Harvesting (RWH) system for the Model Village cluster comprising VC Bar Chamarkand-I, VC Hilal Khel Charmang-1, and VC Ghaljo Kamangara in Bar Chamarkand Tehsil. The proposed system will function as a supplementary water source, particularly during the monsoon season, and will contribute to sustainable and climate-resilient water resource management. Rainwater harvesting is well suited to the rural and semi-urban context of Bar Chamarkand Tehsil, where roof catchments of public buildings, community facilities, and clustered

residential units can be effectively utilized to capture and store rainfall for non-potable and limited emergency potable uses, subject to appropriate treatment.

- ***Design Basis***

The proposed rainwater harvesting system has been designed based on the following assumptions. Collection from rooftops of public buildings (schools, mosques, health units) and selected residential clusters. Average annual rainfall in the area is considered adequate for seasonal harvesting. Runoff coefficient of 0.75 for roof surfaces. Storage designed to supplement 10–15% of average daily water demand. Provision of first-flush diversion and basic filtration prior to storage.

8.4.5.2.6 Proposed Rainwater Harvesting Storage Capacity

Based on the projected water demand and settlement pattern of the model village cluster, it is proposed to construct community-level rainwater harvesting tanks with phased storage capacities as summarized below.

Year	Average Water Demand (MGD)	Target Supplement (%)	Daily Supplement (MGD)	Recommended RWH Storage (MG)
2025	0.38	10%	0.04	0.4
2045	0.6	15%	0.09	0.9

The recommended storage volumes allow harvested rainwater to be utilized over several days following rainfall events, thereby reducing reliance on tube wells during peak demand periods.

- ***Utilization Strategy & Operational Benefits***

The proposed rainwater harvesting system for the Model Village cluster in Bar Chamarkand Tehsil will consist of roof and paved surface catchments connected through a network of gutters and downpipes, supported by first-flush diversion chambers and sand-and-gravel filtration units to improve water quality prior to storage. Harvested rainwater will be stored in reinforced concrete underground or semi-underground tanks, designed to minimize evaporation losses and protect water quality. Overflow arrangements will be connected to soak pits or recharge trenches to safely dispose of excess runoff while promoting groundwater recharge.

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The collected rainwater will be utilized primarily for Non-potable domestic uses such as washing and cleaning Irrigation of public green spaces and plantation areas, Controlled aquifer recharge during monsoon periods

Limited emergency potable use may be permitted following basic treatment and disinfection, in accordance with public health guidelines. The rainwater harvesting tanks will remain hydraulically isolated from the main potable water supply system; however, controlled valving arrangements may be provided for emergency integration during extreme water shortages.

This system will complement the proposed tube-well-based water supply and storage reservoirs by providing an alternative water source during monsoon periods, power outages, and operational downtime. Overall, the phased implementation of rainwater harvesting infrastructure will:

- Reduce pressure on groundwater abstraction
- Lower energy consumption associated with pumping
- Improve long-term sustainability of rural water supply
- Enhance resilience to droughts and climate variability

The proposed RWH system will therefore contribute to a sustainable, resource-efficient, and climate-adaptive water supply framework for the Model Village cluster of Mamund Tehsil.

8.5 Regional Economic Development

8.5.1 Introduction

Regional economic development in Bajaur District is guided by its strategic location, human capital, natural resources, and growing infrastructure. Development efforts focus on fostering inclusive growth, improving connectivity, and integrating rural and urban economies to enhance socio-economic well-being. Key sectors include commerce, industry, agriculture, livestock, and services.

Regional economic development in Bajaur District is guided by its strategic location, human capital, natural resources, and growing infrastructure. Development efforts focus on fostering inclusive growth, improving connectivity, and integrating rural and urban economies to enhance socio-economic well-being. Key sectors include commerce, industry, agriculture, livestock, and services.

8.5.2 Commercial Development

- Bajaur District's commercial sector is concentrated in urban centres such as Khar, Nawagai, and Salarzai, which serve as hubs for retail, wholesale, and service activities. The district benefits from regional trade with neighbouring districts and cross-border markets in Afghanistan. Proposed commercial zoning and market expansion initiatives aim to:
- Strengthen local trade corridors.
- Enhance access to goods and services for rural communities.
- Support small and medium enterprises (SMEs) and entrepreneurship.

8.5.3 Industrial Development

- Industrial activities in Bajaur are largely focused on small-scale manufacturing, mineral processing (including marble and stone), and construction-related industries. Proposed measures for industrial development include:
- Establishment of Special Economic Zones (SEZs) and industrial estates.
- Improved access to raw materials and labour markets.
- Strengthening linkages with regional supply chains.

8.5.4 Agricultural Development

- Agriculture remains a key livelihood source, contributing to food security and income generation. Development priorities include:
- Preservation of fertile agricultural land and orchards.
- Promotion of high-value crops, horticulture, and modern farming technologies.

- Improvement of irrigation, drainage, and post-harvest infrastructure.

8.5.5 Livestock Development

- Livestock is an important economic activity, with potential for growth in dairy, meat, and wool production. Measures include:
- Expansion of veterinary and livestock support services.
- Strengthening animal health programs and breeding schemes.
- Integration with agricultural value chains through feed and market access improvements.

8.5.6 Rural and Village-Level Development

- Rural development interventions aim to reduce disparities, improve access to services, and integrate village economies with broader regional markets. Key initiatives include:
- Upgrading rural roads and farm-to-market connectivity.
- Improving water supply, sanitation, and electricity access.
- Establishing local marketplaces and service centres.

8.5.7 Human Capital and Service Access

- Improving human capital is essential to support economic growth. Strategies focus on:
- Expanding access to education, healthcare, and vocational training.
- Promoting skill development programs aligned with regional economic needs.
- Ensuring equitable service delivery in remote and border areas.

8.5.8 Transport Connectivity in Regional Economic Development – District Bajaur

- Transport connectivity is a fundamental enabler of regional economic development in Bajaur District. It supports the polycentric framework by linking urban centres, industrial estates, agricultural and livestock zones, and rural clusters. An efficient transport network reduces travel times, lowers logistics costs, and integrates rural and urban economies, fostering inclusive growth and sustainable development.

➢ *Existing Transport Network*

- Bajaur's current transportation system comprises primary, secondary, local, and urban roads connecting major tehsils (Khar, Nawagai, Salarzai, Utman Khel, Mamund, and Barang) with neighbouring districts (Mohmand, Dir, Malakand) and provincial hubs such as Peshawar. Key regional linkages include:
- **Primary Roads:** N-45 National Highway and Mohmand/Bajaur Agency roads connecting major urban centres and trade corridors.

- **Secondary Roads:** Links such as Bajaur Agency Road, Nawagai Road, Arang Road, and Salarzai Dabar Road supporting intra-district mobility.
- **Local & Farm-to-Market Roads:** Inarzai, Bar Safari, Mohmand Shakro, and Lara Dandokai roads facilitate agricultural trade and rural access.
- **Urban Roads:** Linear road networks in Khar and other settlements ensure circulation and access to commercial and administrative hubs.
- These roads are complemented by bus terminals at primary, secondary, and tertiary settlements, which support passenger mobility and access to services. Existing infrastructure supports socio-economic activity but faces challenges such as narrow ROWs, deteriorated pavements, seasonal erosion, and limited capacity for freight and passenger movement.

➢ ***Planned and Proposed Improvements***

- The Annual Development Programme (ADP) 2025–26 prioritizes construction, rehabilitation, widening, and blacktopping of critical roads across the district. Key planned interventions include:
- **Primary Roads:** Dualization of Mohmand Agency and Bajaur Agency primary roads with expanded Right-of-Way (ROW) to enhance inter-tehsil mobility and facilitate trade of agricultural and mineral products. Total proposed dualization length: 63.35 km.
- **Secondary Roads:** Upgradation of strategic links such as Bajaur Agency Road, Nawagai Road, Arang Road, and Salarzai Dabar Road to improve regional connectivity and access to social and economic services.
- **Local Roads:** Improvement of rural access roads including Inarzai, Bar Safari, Mohmand Shakro, and Lara Dandokai roads to support local economic activities and enhance mobility in remote settlements.
- **Urban Roads:** Proposed road network in Khar and emerging settlements focuses on safe pedestrian movement, improved circulation, and integration with commercial and industrial hubs.
- **Bus Terminals:** Phased development of Class B-D bus terminals across primary, secondary, and tertiary settlements, aligned with population density and projected transport demand, to strengthen intra- and inter-district connectivity.

➢ ***Transport Infrastructure Impacts***

- The planned transport interventions are expected to generate substantial economic and social benefits:
- **Commercial and Urban Centres:** Improved road networks strengthen access to CBDs and commercial corridors, enhancing trade efficiency and reducing rural–urban disparities.

- **Industrial Growth:** Efficient connectivity facilitates the movement of minerals, construction materials, and manufactured goods, supporting Special Economic Zones (SEZs) and industrial estates.
- **Agriculture and Livestock:** Upgraded farm-to-market roads and enhanced connectivity reduce post-harvest losses, promote high-value crops, and link livestock zones to processing units and markets.
- **Rural Connectivity:** Improved local roads and bus terminals integrate rural clusters into the district economy, expanding access to services, markets, and employment opportunities.
- **Labour Mobility:** Better transport infrastructure expands labour markets, reduces household transport costs, and improves access to education, healthcare, and jobs.

8.5.9 Economic Contribution:

Expands labour markets and supports human capital development.

➢ ***Integrated Regional Impact***

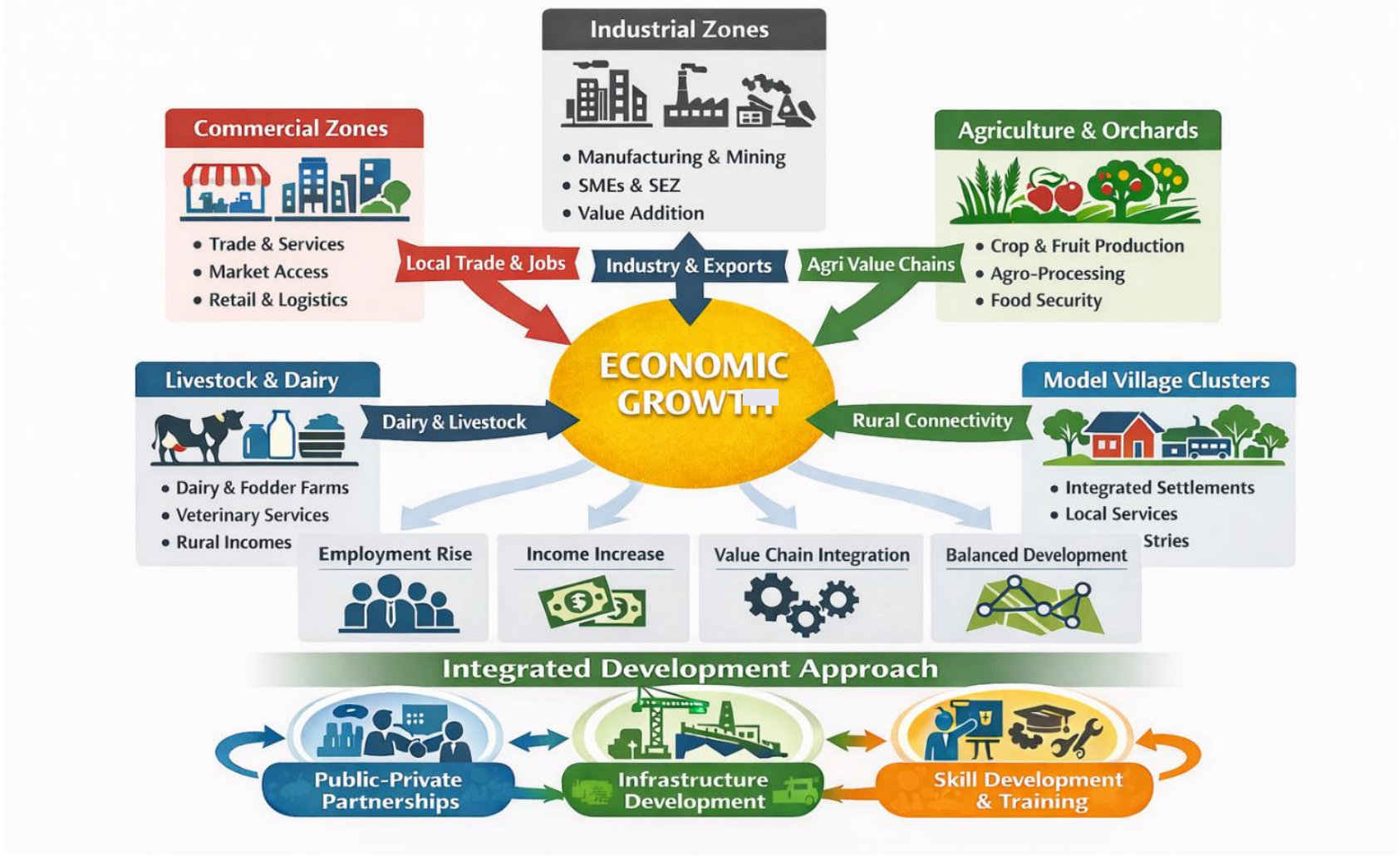
- Reinforces the polycentric development approach by connecting multiple economic nodes.
- Enables value chain integration across agriculture, livestock, industry, and commerce.
- Improves regional competitiveness by linking local production with provincial and cross-border trade routes.
- Supports sustainable development through planned ROWs, safer roads, and climate-resilient infrastructure.

8.5.10 District-Level Impacts

1. Balanced Economic Development: Polycentric hubs distribute economic activity across tehsils and clusters.
2. Employment Generation: Across the commercial, industrial, agricultural, and livestock sectors.
3. Integrated Development Approach: Combines commercial, industrial, agricultural, livestock, and rural settlements to ensure coordinated growth.
4. Inclusive Growth: Model Villages and rural commercial zones offer opportunities close to residents.
5. Value Chain Integration: Agricultural and livestock production supplies industrial and commercial centres.
6. Sustainable Resource Management: Preservation zones, green buffers, and riparian areas maintain ecological balance.

7. Regional Competitiveness: Leveraging minerals, agriculture, and transport corridors enhances trade and investment.

Figure 56: Economic Growth in Bajaur District



8.6 Regional Connectivity

The regional connectivity framework of Bajaur District is structured around a strategically layered road network that underpins mobility, economic activity and social integration across the district. The network links the major tehsils of Khar, Nawagai, Salarzai, Charmang, Utman Khel and Mamund with adjoining districts including Mohmand, Dir and Malakand, while also providing critical access to the provincial capital, Peshawar. Owing to Bajaur's geographical position and cross-border interface, this road system also supports regional trade movements and connectivity to local and trans-boundary economic corridors. The district's economy is highly dependent on this network for the movement of agricultural produce, forest products, construction materials and marble, as well as for access to markets, education, healthcare and administrative services.

Recognizing this role, the District Land Use Plan has adopted an accessibility-driven planning approach, with particular emphasis on strengthening linkages between Tehsil Headquarters, Village Councils (VCs), Neighborhood Councils (NCs) and dispersed rural settlements. The proposed road hierarchy ensures that every settlement within the district is connected through an all-weather road, improving last-mile access, reducing spatial isolation and promoting equitable development. Despite its strategic importance, the existing road network in Bajaur District faces significant structural and operational challenges. Several key corridors operate with constrained right-of-way (ROW), deteriorated pavement conditions and inadequate roadside drainage. Narrow single-lane sections result in congestion, unsafe overtaking and increased travel times, particularly along hilly and mountainous stretches prone to erosion and seasonal damage. In urban centers most notably Khar uncontrolled roadside encroachments and informal commercial activities further reduce effective carriageway width, leading to traffic inefficiencies and safety risks.

To address these challenges, the Plan proposes a comprehensive program of road widening, geometric realignment and pavement improvement, aimed at enhancing safety, resilience and long-term serviceability. The planning and design framework is aligned with UPPU's Geometric Design Manual and KP Highway Design Standards, while the determination of proposed ROWs is informed by traffic demand projections based on the ITE Trip Generation Manual and anticipated land-use transformations. Strategic priority has been assigned to corridors that strengthen inter-tehsil and inter-district connectivity, particularly those facilitating the movement of goods and passengers toward external markets in Peshawar and Malakand.

8.6.1 Primary Road Network

The primary road network forms the backbone of Bajaur District's regional connectivity, structuring movement between major settlements, administrative centers, economic zones and external trade corridors. The Bajaur Agency Primary Road and the Mohmand Agency Primary Road collectively function as the district's core mobility spines, carrying inter-tehsil,

inter-district and freight traffic. At present, these corridors operate under constrained ROW conditions, particularly within urbanized stretches where limited widths restrict capacity and compromise safety. Under the proposed plan, the Bajaur Agency Primary Road is planned for dualization with an enhanced ROW of 80 ft over a total length of 46.12 km, while the Mohmand Agency Primary Road is proposed to be widened from 40 ft to 65 ft over 44.52 km. These improvements will enable dual carriageways, improve traffic flow, reduce travel times and support planned mixed-use and commercial development along the corridor.

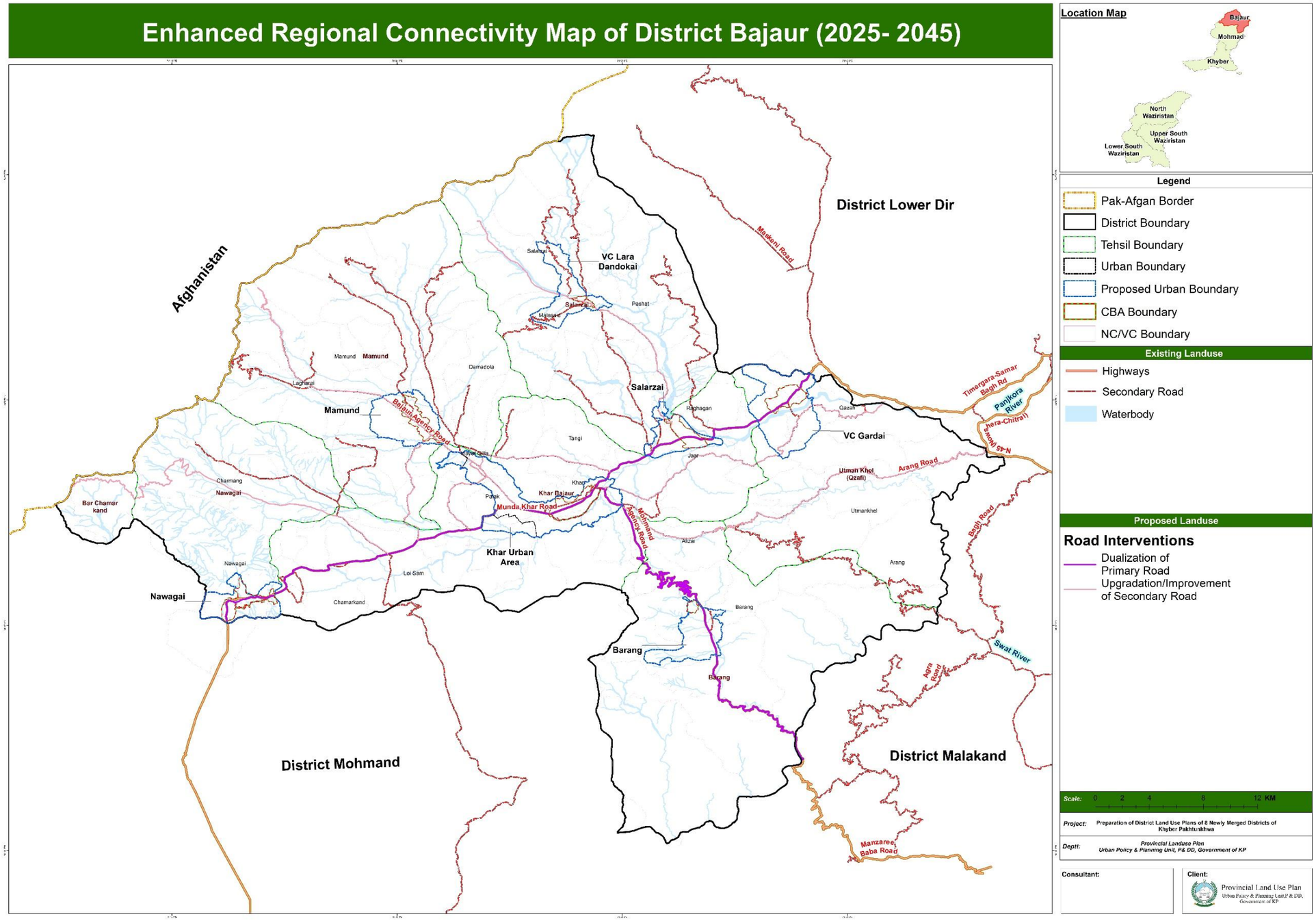
The upgradation of primary roads will significantly enhance inter-tehsil connectivity between Khar, Salarzai, Nawagai and adjoining districts, while also strengthening Bajaur's integration with regional economic corridors. By improving access to markets, industrial areas and service centers, the primary road network will act as a development corridor capable of guiding orderly growth and supporting long-term regional development objectives.

8.6.2 Secondary Road Network

The secondary road network plays a crucial role in strengthening intra-district connectivity, linking rural settlements, agricultural zones and economic activity areas to the primary road system. These roads ensure that traffic originating from Village Councils and Neighborhood Councils can efficiently access higher-order corridors, thereby supporting local livelihoods and service delivery. Currently, many secondary roads in Bajaur operate with limited ROWs ranging from 22 ft to 40 ft, which constrains two-way traffic movement and restricts freight operations, especially during peak agricultural and construction seasons. To address these constraints, the plan proposes systematic upgradation of key secondary corridors, with proposed ROWs standardized at 40–50 ft, depending on functional importance and surrounding land-use context. Key routes including Bajaur Agency Road, Nawagai Road, Salarzai Dabar Road, Arang Road, Janat Shah Road and Bajaur–Mohmand Agency Link Road are proposed for widening and surface improvement over a cumulative length exceeding 168 km. These interventions will improve geometric standards, enhance safety and reduce vehicle operating costs, while ensuring reliable connectivity between rural settlements and major service centers such as Khar and Nawagai.

Through the planned enhancement of primary and secondary roads, the Plan establishes a cohesive, hierarchical and fully accessible road network for Bajaur District. By ensuring that all VCs, NCs and settlements are connected through improved road infrastructure, the proposed network supports inclusive mobility, strengthens economic linkages and reinforces Bajaur's role within the broader regional and provincial transport system.

Map 70: Enhanced Regional Connectivity Map of District Bajaur (2025- 2045)



9 CHAPTER IX: LAND USE REGULATIONS & GUIDELINES

Land use regulations constitute the legal and procedural backbone of spatial governance, enabling the orderly transformation of land while safeguarding public interest, environmental assets, and urban form.
As part of the zoning framework, these regulations establish the functional character of each land parcel by defining what activities are allowable, conditionally approvable, or strictly restricted within designated zones. Central to this framework are three key categories:

• Permitted Uses refer to those land use activities that are inherently aligned with the primary intent and planning objectives of a specific zone. These uses are allowed by right and do not require discretionary approval, provided they comply with applicable building codes, design guidelines, floor area ratios (FAR), setbacks, and height restrictions. Permitted uses facilitate predictable development outcomes and ensure efficient processing of building permits and planning approvals.

• Permissible Uses represent a secondary tier of land use activities that may be allowed within a zone subject to certain conditions. These uses are not automatically permitted but may be approved through a special review process—often involving impact assessment, stakeholder consultation, and compliance with supplementary criteria. The intent is to provide flexibility while maintaining compatibility with surrounding uses and minimizing potential land use conflicts.

• Prohibited Uses encompass activities that are fundamentally incompatible with the intended function of a zone due to their adverse environmental impacts, socio-spatial externalities, or infrastructure demands. These uses are categorically disallowed to preserve the integrity of zoning objectives, protect public health and safety, and maintain functional coherence in urban and rural areas.

These regulatory distinctions are essential to preserving urban form, promoting functional integration, managing growth, and facilitating context-sensitive development. They also empower local planning authorities to enforce zoning compliance, monitor land use change, and guide investment in alignment with strategic spatial frameworks.
The zoning regulations apply uniformly across the district and are tailored to the land use character and development intensity of each zone. The regulatory structure covers the following major land use categories:

• Residential Zones
• Commercial Zone (CBD)
• Industrial Zones
• Agricultural Zones
• Mining Zones

- Forest Zones
- Institutional Zones (including Education, Health, and Governmental uses)
- Mixed Land Use Zones
- Recreation Zone

Each of these zones is governed by a specific matrix of permitted, permissible, and prohibited uses, as detailed in the following subsections. This structured approach ensures the development of an inclusive, sustainable, and resilient urban-rural fabric while balancing socio-economic development with environmental stewardship.

9.1 Residential Zone

Permitted Uses	Permissible Uses	Prohibited Uses
• Detached/semi-detached dwellings, • place of worship or prayer, • Social/cultural institutions, • Parks and playgrounds, • Apartment buildings, • Graveyard or place of burial, horticultural nursery. • Urban farm, • Old age home or orphanage, • Urban forest,	• Commercial offices and service, • Shops of local character, • Raising of poultry for non-commercial purposes, • Private community centre or club • Day-care centre or Pre-schools, • primary school; • secondary school; • Rehabilitation centres, • Petrol pump, • Gas filling station, • Taxi/rickshaw stand. • Guest houses offices of TMAs/other tiers of local Govt. • Offices of professionals with adequate parking facilities, • Local shopping areas/retail shops,	• Heavy, large and extensive industries: noxious, obnoxious and hazardous industries, • Warehousing, storage go-downs of perishables, hazardous, inflammable goods, • Workshops for buses, • Slaughter-housing, • wholesale mandis, • treatment Sewage plant/disposal work, • Water treatment plant, • Solid waste dumping yards, • Outdoor games stadium, • Indoor games stadium, shooting range, • Zoological botanical garden, garden, • Bird sanctuary, • Picnic hut,

9.2 Commercial Zone (CBD)

Permitted Uses	Permissible Uses	Prohibited Uses
• Commercial buildings, • Markets, shopping mall departmental stores and Outlets, • Shops except dealing in hazardous dangerous substances • Taxi/rickshaw stand. • Public Squares and Parks • Bakery or confectionary, • Clinic or polyclinic, • place of worship or prayer, • Courier service or logistics office, • Private exchange operation telephone or cable JO • mobile franchise offices, • Memorial and monument, • Hotel or motel, • Hostel • Car showroom, • Police station, post office and fire station, • Boutique or garment outlets or beauty parlour, • Restaurant,	• Pedestrian friendly streetscape, • Mixed-use buildings, • Technical vocational institution, and • Seasonal commercial fare site, • Stadium; amusement park /play land, • Bus terminal, • Fuel Stations, • Wholesale market, • Second hand goods market, • Coal, wood or Timber yard. • Education institution • Marriage or banquet hall, concert hall • petrol pump or gas or LPG or LNG station; • bus or truck terminal; • private hospital; • auto workshop; • athletic club, gymnasium, fitness centre or • indoor sport facility,	• Dwellings except those of service apartment, essential operational, watch and ward personnel, • Heavy, extensive, noxious, obnoxious, hazardous and extractive industrial units, • Hospitals/research laboratories treating contagious diseases, • Poultry farms/dairy farms, • Slaughter-houses, • Sewage sites, treatment/disposal • Agricultural uses, • Storage of perishable and inflammable commodities, • Quarrying of gravel, sand, clay and stone, • Zoological garden, botanical garden, • Bird sanctuary, • Forensic science laboratory and all other activities which may cause nuisance and are noxious and obnoxious in nature. • A local government shall not allow person to use land or building commercial area for any neither

• Social welfare institutions such as community centre, art gallery and museum, • Parking plaza or Parking site.		purpose which is permitted nor permissible.

9.3 Industrial Zone

Permitted Use	Permissible Use	Prohibited Use
• Small and Medium Scale Industries • vertical green industry, • construction equipment, building material store; • Processing Units • Manufacturing Activities • Warehouses storage or Go-down; • Workshops • Cold storage and Ice factory • Petro chemicals, petroleum and gas products • Loading and unloading space; • Parking lot • Industrial park or estate • Police station, fire station and post office; • restaurant: • green area, park or forest	• Showrooms • Mixed-buildings used • Residence for workers • Fuel stations and Oil depot; • Restaurant; • Hospital; • Power plant • Grid Station • Place of Worship • Essential residential, • commercial, health and educational facility for workers or employees • Auto workshop, service and station; garage service	• Private residential housing schemes • Large health, commercial and educational institutions • The land use for storing, packing, pursing, cleaning, preparing, and manufacturing of blushing power, ammunition, fireworks, gun powder, Sutphin, mercury, gases, nitro-compounds, phosphorous, 'dynamite, explosives, bombs or any other obnoxious hazardous material shall not be permissible In a declared industrial area. • A local government shall not allow person to use land or property in an

• bank or automated teller machine (ATM); • Industrial research institute; • Treatment or recycling plant; • Grid station; • Vocational training institute		industrial area for any purpose which is neither permitted nor permissible.

9.4 Agriculture Zone

Permitted Use	Permissible Use	Prohibited Use
• Crop, • Orchard, • Pastureland • livestock such as dairy or poultry farm • Forest, • or a green house, Nursery horticulture, • Tube well, • Existing rural settlement or village, • place of worship or prayer. • Agro-based industry • Public slaughterhouse • Storage activities of agricultural goods which are non-hazardous in nature.	• Milk Chilling and Pasteurization • Animal husbandry clinic, veterinary dispensary or hospital. • Agricultural workshop machinery • Basic health unit • clinic or hospital; • Country club, • Zoological garden, • Farmhouse • Slaughterhouses, • Dairy production, • Botanical garden, • recreational club or resort or country club; • Bird sanctuary, • Zoo or wildlife park, • Grain market • Cattle farm • Poultry Farm, • Cattle market	• Other than permitted and permissible

	• Fruit and vegetable market, • Agriculture, Livestock research institute • monument, Park, playground, gymnasium or sports complex • public or private recreational or theme park; • Vegetable, fruit and grain market • water filtration plant; • wastewater treatment plant; • Power plant • petrol pump or gas station or LPG or LNG storage and filling station. • Base trans-receiver station • Or communication tower. • shooting range; • swimming pool; • library; • Detached/semi-detached dwellings.	

9.5 Mining Zone

Permitted Use	Permissible Use	Prohibited Use
• Extraction of minerals (e.g., coal, sand, gravel, stone), quarrying, and other resource mining activities.	• Housing or colony for workers (including schools and corner shops, health facility) • Processing plants for mined materials,	• Housing or colony for workers (including schools and corner shops, health facility) • Processing plants for mined materials,

	• storage facilities for mined goods, • Industrial parks related to mining activities (Processing plants, Storage facilities • Workshops and manufacturing units, Logistics infrastructure), Transportation infrastructure. • Utilities for mining operations (water treatment plants, power plants for mining operations),	• storage facilities for mined goods, • Industrial parks related to mining activities (Processing plants, Storage facilities • Workshops and manufacturing units, Logistics infrastructure), Transportation infrastructure. • Utilities for mining operations (water treatment plants, power plants for mining operations),

9.6 Forest Zone

Permitted Use	Permissible Use	Prohibited Use
• Forestry activities such as timber extraction (sustainable logging), reforestation, ecotourism (e.g., hiking, agroforestry, camping), conservation efforts. controlled • Wildlife conservation and habitat national parks, nature restoration, reserves	• Forestry research institutes, sustainable wood processing industries (e.g., paper mills), eco-tourism facilities (lodges, visitor centers), and community-based forest management activities. • Educational and training centers focused on environmental conservation sustainable and forestry practices	• Urban development (residential, commercial, industrial), large-scale agriculture (e.g., crop farming), mining activities, infrastructure projects (e.g., roads, buildings), land clearing for non-forest related uses. • Any activities that lead to deforestation, illegal logging, or degradation of forest ecosystems

9.7 Institutional Zone (Health, Education, and Civic Amenities)

Permitted Use	Permissible Use	Prohibited Use
• Permitted Uses • Large Scale education zone • General education universities • Scientific research institutes • IT and Media institutes • City Level libraries, book banks, data information centers and • Large Scale Health Institutions; Hospitals, • Scientific research institutes, • Clinics, • Clinical Laboratory, • BHUs and RHCS, • Maternity Care Centres • Government government or semi-offices (District Secretariat, Town Hall etc. • Social welfare institution such as a community centre, art gallery, • museum and auditorium • • Local and zonal municipal • office	• Staff residences (teaching and non-teaching, health workers, employees) • Separate hostels for Boys and Girls • Auditoriums, seminar halls, workshop spaces, • Community facilities (Parks, Playgrounds, neighbourhood commercial) • Athletic club, gymnasium, Sports facilities, fitness center or indoor sport facility, • Banks or Automated Teller • Machine (ATM), • Departmental Store, • Taxi or bus stand. • Hotel or Motel, • Guest house,	

• • Police station, fire station • or post office • • Shelter home, • • Pannahgahh, • • Convention Centre		

9.8 Recreational Zone

Permitted Use	Permissible Use	Prohibited Use
• Public parks, • playgrounds, green • spaces • Sports facilities (fields, courts, pools) • Community/recreation • centers • Nature preserves • Accessory uses (parking, restrooms) • Educational facilities • (nature centres	• Commercial amenities (e.g., cafés) • Event venues (festivals, concerts) • Campgrounds/RV parks • Private recreational facilities (marinas) • Small-scale lodging (eco-lodges) • Temporary uses (farmers' markets	Industrial activities (factories) • Heavy commercial (malls) • Residential housing (high density • High-impact infrastructure (highways) • Polluting uses (landfills) • Intensive agriculture (livestock farming) • Waste disposal facilities • Transport depots/terminals

9.9 Mixed Land Uses Zone

Permitted Use	Permissible Use	Prohibited Use
• Detached/semi-detached homes • Residential apartments • Social institutions (schools, places of worship) • Retail shops, cafes, local businesses,	• Additional developments, Schemes, housing societies and residential apartments • Hotels, motels, restaurants,	• Large-scale housing projects incompatible with zoning. • Hazardous goods stores, large malls, or heavy industry shops.

offices for professionals (doctors, lawyers) • Schools, • Clinics, • Community centers, • Public parks, • Transportation hubs (bus stations and public transport terminals) • Small workshops, • Artisan businesses, • Local food production, local manufacturing units • Libraries, post offices,	specialized retail outlets. • Day-care centers, health centers, cultural centers. • Cottage industries, home-based businesses, small-scale production units. • Public sports complexes, recreation centers.	• Large hospitals, forensic labs, military facilities. • Large factories producing hazardous materials, heavy industrial operations. • Sewage plants, waste disposal sites, power plants

10 CHAPTER X: IMPLEMENTATION AND PHASING PLAN

10.1 Introduction and Purpose of the Implementation Framework

The Implementation and Phasing Framework constitutes a critical component of the District Land Use Plan (DLUP) for District Bajaur, translating the strategic vision, land use proposals, and policy directions into an actionable and time-bound development program. While the land use plan establishes the desired spatial structure and functional hierarchy of settlements, the implementation framework provides the institutional, regulatory, financial, and operational mechanisms required to realize these proposals on the ground.

Given the post-merger development context of District Bajaur, characterized by evolving governance systems, customary land tenure practices, infrastructure deficits, and increasing development pressures, a structured and phased implementation approach is essential. This framework ensures that land use interventions are undertaken in a coordinated, realistic, and resource-efficient manner, while maintaining flexibility to respond to emerging socio-economic and environmental dynamics.

10.1.1 Objective of the Implementation and Phasing Plan

The primary objective of the Implementation and Phasing Plan is to operationalize the District Land Use Plan by defining clear roles, responsibilities, priorities, and timelines for development interventions. It seeks to guide public and private sector actions in a manner that ensures orderly development, optimal utilization of land resources, and equitable provision of infrastructure and services across the district.

Specifically, the Implementation and Phasing Plan aims to:

- Translate land use proposals into implementable projects and sectoral action plans.
- Prioritize development interventions based on urgency, resource availability, and spatial development needs.
- Establish a phased development strategy that aligns short-, medium-, and long-term investments with the district's growth trajectory.
- Strengthen institutional coordination and development control mechanisms to support effective plan execution.

10.1.2 Linkage with District Land Use Vision and Policy Framework

The Implementation and Phasing Framework is directly derived from and aligned with the District Land Use Vision and Policy Framework. It serves as the operational extension of the vision, ensuring that the spatial development goals—such as compact settlement growth, protection of agricultural and environmentally sensitive areas, development of service centers, and balanced rural–urban integration—are systematically implemented.

All proposed actions, projects, and phasing priorities are anchored in the land use zoning plan, settlement hierarchy, and sectoral policies articulated in the DLUP. The framework ensures policy coherence by aligning implementation tools, development controls, and investment sequencing with the approved land use designations and regulatory provisions. This linkage safeguards the plan from ad-hoc development and reinforces its role as a guiding statutory document for decision-making by district and provincial authorities.

10.1.3 Alignment with Provincial and Federal Development Priorities

The Implementation and Phasing Plan is formulated in conformity with broader provincial and federal development agendas to ensure institutional compatibility, funding eligibility, and policy coherence. It aligns with the Khyber Pakhtunkhwa Urban Policy, Provincial Spatial Strategy, and sectoral policies related to housing, infrastructure, environment, and local governance. Additionally, it supports the objectives of post-merger district development, focusing on service delivery enhancement, economic integration, and spatial equity.

At the federal level, the framework complements national priorities outlined in development planning instruments, including sustainable development goals, climate resilience strategies, and infrastructure connectivity initiatives. By aligning district-level land use implementation with provincial and federal priorities, the framework enhances prospects for resource mobilization through Annual Development Programs (ADP), Public Sector Development Program (PSDP), and donor-supported initiatives, thereby ensuring the long-term viability and effectiveness of the District Land Use Plan for Bajaur.

10.2 Institutional and Governance Framework

Effective implementation of the District Land Use Plan (DLUP) for District Bajaur is contingent upon a clearly defined institutional and governance framework that delineates roles, responsibilities, and coordination mechanisms among relevant stakeholders. Given the multi-sectoral nature of land use planning and the post-merger administrative context of the district, strong institutional alignment and collaborative governance are essential to ensure coherent decision-making, regulatory compliance, and timely execution of planned interventions.

This framework establishes an integrated approach whereby district and tehsil-level institutions, provincial line departments, development authorities, the private sector, and local communities collectively contribute to the implementation of the land use plan within their respective mandates.

10.2.1 Roles and Responsibilities of Key Institutions

The implementation of the District Land Use Plan (DLUP) for Bajaur District is anchored in a clearly defined institutional framework that integrates provincial oversight, statutory land use regulation, district-level coordination, and local execution. At the provincial level, the Planning and Development Department, through the Urban Policy and Planning Unit (UPU), acts as the

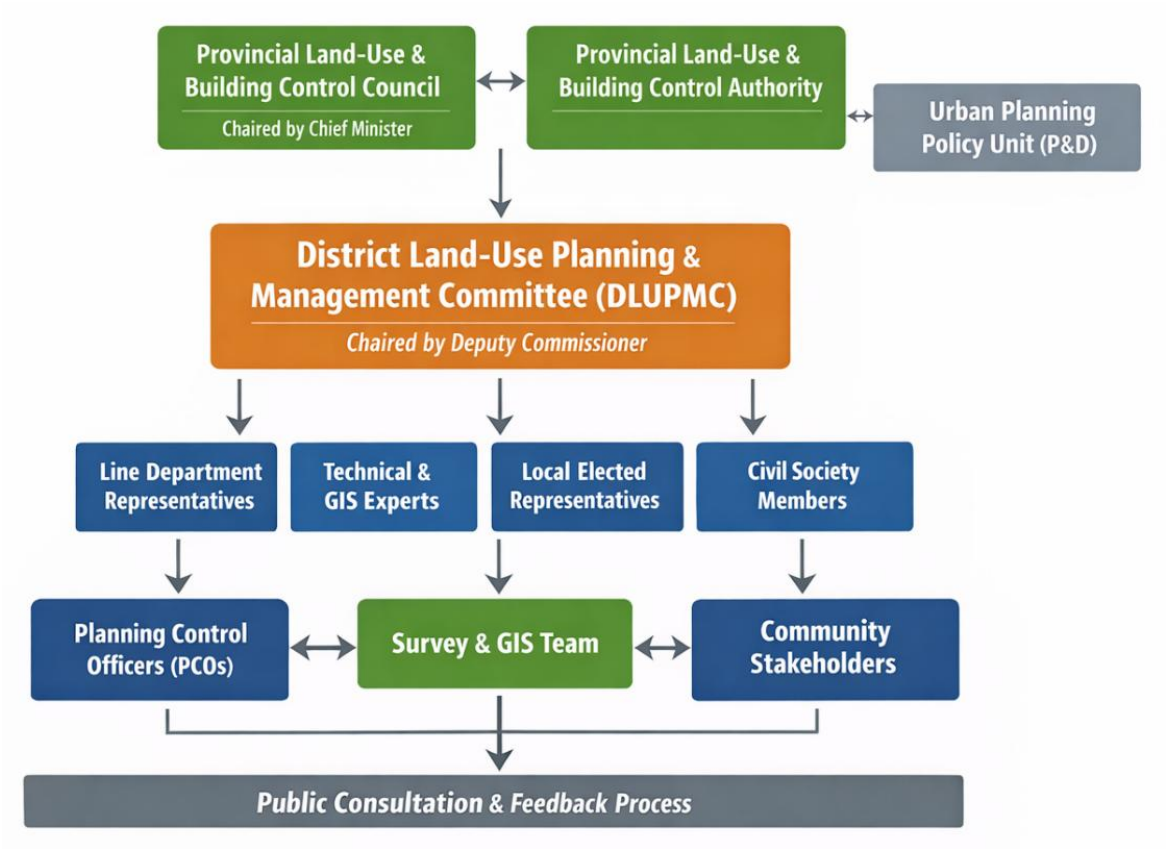
custodian of the DLUP, responsible for policy guidance, technical support, monitoring, and periodic review of the plan.

Statutory land use control and development regulation are exercised by the Land Use and Building Control Authority (LUBCA), operating under the Local Government Department. LUBCA is the most significant authority for enforcing zoning regulations, approving building plans, and ensuring compliance with the land use proposals of the DLUP.

At the district level, the Deputy Commissioner and District Administration play a central coordinating role through the District Planning and Coordination Committee (DPCC), ensuring alignment between sectoral departments and facilitating effective plan implementation. Assistant Commissioners and district offices provide tehsil-level oversight and administrative support.

Local Governments, including Tehsil Municipal Administrations and Village/Neighbourhood Councils, function as the primary executing agencies responsible for municipal infrastructure, service delivery, and community-level development in accordance with the approved land use framework. Sectoral line departments support implementation through provision of infrastructure, utilities, and services, ensuring integrated and sustainable spatial development across the district.

Figure 57: Hierarchy of all Relevant Departments



10.3 District land use plan implementation strategy / Framework

The Infrastructure and Services Implementation Framework provide the operational basis for translating the spatial proposals of the District Land Use Plan (DLUP) for District Bajaur into coordinated, phased, and service-oriented investments. Infrastructure development serves as both an enabler and a regulator of land use, ensuring that growth is directed toward designated settlements, economic zones, and service centres in accordance with the approved land-use hierarchy.

Given Bajaur's strategic location within the Peshawar Division, its emerging industrial base, cross-border trade potential, and predominantly rural settlement structure, infrastructure planning under the DLUP prioritizes regional connectivity, intra-district accessibility, and equitable service provision. The framework aligns infrastructure investments with projected land use demand, population growth, and economic activity, while ensuring resilience to terrain-related and environmental constraints.

- ***Existing District Land-Use Planning and Management Committee (as per LUBCA Act 2021, Section 13)***

Table 136: Existing District Land-Use Planning and Management Committee

Sr.no	Position / Designation	Status	Remarks / Section Reference
1	Deputy Commissioner, Bajaur District	Convener (Chairperson equivalent)	Leads the committee; standard administrative head in districts (Section 13(1)(a))
2	Chairman or Mayor of the concerned Tehsil Council / City Tehsil Council (in Bajaur)	Member	Represents local government / municipal functions (Section 13(1)(b))
3	Heads of district-level offices of: Environment; Agriculture; Transport; Communication and Works (C&W); Sports, Culture and Tourism; Irrigation; Housing; Public Health Engineering Department (PHED); Provincial Housing Authority (where applicable)	Members	Sectoral experts from line departments for integrated planning (Section 13(1)(c))
4	Head of the Urban Areas Development Authority in the district (if applicable in Bajaur)	Member	For urban-specific input (Section 13(1)(d))
5	Additional Deputy Commissioner (Finance and Planning), Bajaur	Member	Handles finance/planning coordination (Section 13(1)(e))
6	Assistant Commissioner of the concerned Tehsil / Sub-Division in Bajaur	Member	Local revenue/admin level (Section 13(1)(f))

7	Tehsil Municipal Officer (TMO) of the concerned Tehsil Municipal Administration	Member	Building control / municipal enforcement (Section 13(1)(g))
8	Chief Planning Control Officer (from the Local Planning and Enforcement Unit, Bajaur)	Member-cum-Secretary	Core technical/planning role; responsible for surveys, plan support, enforcement reporting (Sections 10–13(1)(h))

Additional Provisions from the Act:

- The committee can **co-opt** additional members voluntarily for expertise in areas like urban planning, environment, architecture, engineering, etc. (Section 13(2)). This is where gaps in the mandatory list (e.g., independent professionals) can be filled.
- Meetings: At least monthly; quorum is two-thirds of members; presided over by the Convener (Deputy Commissioner) (Section 13(3)– (5)).
- The committee reports to and is supervised by the Provincial Land-Use and Building Control Authority (via Director General) (Sections 7, 14).
-

Recommended Additions to Fill Gaps (via Co-option under Section 13(2))

To make it more robust for Bajaur (a merged/tribal district with unique terrain, community dynamics, environmental sensitivities, and limited urban expertise), co-opt the following independent/professional experts (mirroring your original example's emphasis on qualified professionals with 10+ years of experience):

- One **Town Planner** (registered with Pakistan Council of Architects and Town Planners – PCATP, minimum 10 years' experience) – to provide independent planning expertise.
- One **Architect** (PCATP registered, minimum 10 years' experience) – for building design and aesthetic/compatibility aspects.
- One **Structural/Civil Engineer** (registered with Pakistan Engineering Council – PEC, minimum 10 years' experience) – for structural safety, infrastructure resilience (critical in hilly/tribal areas).
- Representative(s) from local builders/developers' association (if active) or civil society/notables/jirga elders – for stakeholder/community input (essential in tribal context for acceptance and conflict avoidance).

Proposed District Land-Use Planning and Management Committee

Table 137: Proposed District Land-Use Planning and Management Committee

Sr.no	Position / Designation	Status	Remarks / Section Reference
1	Deputy Commissioner, Bajaur District	Convener (Chairperson equivalent)	Leads the committee; standard administrative head in districts (Section 13(1)(a))
2	Chairman or Mayor of the concerned Tehsil Council / City Tehsil Council (in Bajaur)	Member	Represents local government / municipal functions (Section 13(1)(b))
3	Heads of district-level offices of: Environment; Agriculture; Transport; Communication and Works (C&W); Sports, Culture and Tourism; Irrigation; Housing; Public Health Engineering Department (PHED); Provincial Housing Authority (where applicable)	Members	Sectoral experts from line departments for integrated planning (Section 13(1)(c))
4	Head of the Urban Areas Development Authority in the district (if applicable in Bajaur)	Member	For urban-specific input (Section 13(1)(d))
5	Additional Deputy Commissioner (Finance and Planning), Bajaur	Member	Handles finance/planning coordination (Section 13(1)(e))
6	Assistant Commissioner of the concerned Tehsil / Sub-Division in Bajaur	Member	Local revenue/admin level (Section 13(1)(f))
7	Tehsil Municipal Officer (TMO) of the concerned Tehsil Municipal Administration	Member	Building control / municipal enforcement (Section 13(1)(g))
8	Chief Planning Control Officer (from the Local Planning and Enforcement Unit, Bajaur)	Member-cum-Secretary	Core technical/planning role; responsible for surveys, plan support, and enforcement reporting (Sections 10–13(1)(h))
9	One **Town Planner** (registered with Pakistan Council of Architects and Town Planners – PCATP, minimum 10 years' experience) – to provide independent planning expertise.	Member	DLUP Proposals
10	One **Architect** (PCATP registered, minimum 10 years' experience) – for building design and aesthetic/compatibility aspects.	Member	DLUP Proposals
11	One **Structural/Civil Engineer** (registered with Pakistan Engineering Council – PEC, minimum 10 years' experience) – for	Member	DLUP Proposals

	structural safety, infrastructure resilience (critical in hilly/tribal areas).		
12	Representative from the **Power & Energy Department**	Member	DLUP Proposals
13	Representative(s) from **local builders/developers' association (if active) or civil society/notables/jirga elders – for stakeholder/community** input (essential in tribal context for acceptance and conflict avoidance).	Member	DLUP Proposals
14	Representative from the **Village Councils/NS**	Member	DLUP Proposals
15	Representative from **Forest/Wildlife Department** (if not already covered under Environment) – for land conservation in forested/hilly zones	Member	DLUP Proposals
16	Representative from **Political Background MNA/MP** (Optional)	Member	DLUP Proposals
17	Representative from the **Election Commission of Pakistan**	Member	DLUP Proposals
18	Representative from the **Revenue & Estate Department (Board of Revenue)**	Member	DLUP Proposals
19	Representative from the **Population Welfare Department**	Member	DLUP Proposals
20	Representative from Industries **& Commerce**	Member	DLUP Proposals
21	Representative from **Khyber Pakhtunkhwa Economic Zones Development and Management Company (KPEZDMC)**	Member	DLUP Proposals
22	Representative from the **KP Bureau of Statistics**	Member	DLUP Proposals

10.3.1 Short-Term Key Actions (2025–2030)

Table 138: Short-Term Key Actions (2025–2030)

Sector / Theme	Priority Areas / Locations	Short-Term Key Actions (2025–2030)	Lead / Supporting Agencies
Residential Development	Khar, Salarzai,Lara Dandokai, VC Gardai	Infill housing within existing built-up areas; regulation of informal expansion through zoning enforcement; upgrading of basic services; enforcement of building controls	TMAs, LG&RDD, District Administration
Industry & Mining	Khar, VC Gardai, Mamund, & Nawagai	Development of small-scale industrial clusters (marble, construction materials); provision of access roads, power and water; regulation of quarrying and mining through zoning and buffers	Industries Dept., Mines & Minerals, EPA
Trade & Commerce	Khar, VC Gardai, Mamund, & Vc Lara Dandokai	Enforcement of CBD zoning; regulation of ribbon commercial development; development of linear commercial corridors and grain markets	TMAs, Trade Dept., District Administration
Tourism & Recreation	Raghan Dam, Talai Dam	Development of urban parks; basic recreational facilities; initiation of eco-tourism and local cultural activities	Tourism Dept., TMAs
Agriculture & Livestock	Urban centers	Protection of prime agricultural land through zoning; establishment of grain markets; livestock support zones; improvement of farm-to-market access	Agriculture Dept., Local Governments
Environment & Natural Resources	Forests, rivers, slopes (Vc Lara Dandokai, VC Gardai, Nawagai, Barang)	Demarcation of ecologically sensitive zones; establishment of green buffers and riparian zones; community-based forest protection; plantation programs	Forest Dept., EPA
Watershed & Natural Resource Management	Upper catchments & valleys	Construction of small check dams and recharge pits; soil conservation works; plantation in erosion-prone areas	Irrigation Dept., Forest Dept.
Climate Change (Adaptation & Mitigation)	All tehsils; urban centers	Climate training for DDMA and line departments; installation of weather monitoring stations; pilot urban forestry and Miyawaki plantations	DDMA, EPA, Line Departments
Disaster Risk Reduction (DRR)	All urban Center	Establishment of functional DDMA cell; community-level early warning systems; pre-positioning of emergency stocks; first-responder training and preparedness drills	PDMA, DDMA, District Administration
Infrastructure & Utilities	Urban centers	Road rehabilitation; water supply, sanitation and drainage upgrades; stabilization of existing utility networks	C&W, PHED, Utilities
Solid Waste Management	All tehsil bazaars & dense settlements	Weekly door-to-door waste collection; two-stream source segregation; installation of community bins; site identification for storage, composting and disposal; capacity building of TMAs	TMAs, LG&RDD
Transport & Roads	Khar, Salarzai,Lara Dandokai, VC Gardai, Nawagai, Mamund & Barang	Upgradation of priority primary and secondary roads; access road improvements to service centers; safety and drainage works	C&W, District Administration
Social Infrastructure (Education & Health)	Urban & All Rural Clusters settlements	Upgrading of existing education and health facilities; service coverage improvement in priority settlements	Education Dept., Health Dept.
Governance & Capacity Building	District-wide	Institutional strengthening; zoning enforcement initiation; inter-departmental coordination; community participation mechanisms	District Administration, Local Governments

10.3.2 Medium-Term Key Actions (2030–2035)

Table 139: Medium-Term Key Actions (2030–2035)

Sector / Theme	Priority Areas / Locations	Long-Term Key Actions (2035–2045)	Lead / Supporting Agencies
Residential Development	Planned urban extensions	Development of compact, self-sustaining urban extensions; mixed-use and higher-density development	TMAs, LUBCA
Industry & Mining	Designated industrial zones	Transition to value-added and export-oriented industries; full environmental compliance and rehabilitation of mined areas	Industries Dept., EPA
Trade & Commerce	District commercial hubs	Regional-level wholesale and logistics hubs; integration with provincial and cross-border trade networks	Trade Dept., Private Sector
Tourism & Recreation	District-wide tourism circuits	Establishment of major tourism destinations; integration into provincial tourism economy	Tourism Dept.
Agriculture & Livestock	Agricultural belts	Modernization of agriculture; mechanization; climate-smart farming; large-scale agro-industry	Agriculture Dept.
Employment & Skills Development	District-wide	High-skill workforce development; linkage with regional markets; entrepreneurship ecosystems	TEVTA, Private Sector
Environment & Natural Resources	Ecological networks	Long-term ecological restoration; sustainable forest and rangeland management	Forest Dept., EPA
Water Resources	District-wide	Integrated water resource management; long-term water security infrastructure	Irrigation Dept.
Climate Change	All sectors	District-wide climate resilience mainstreamed into all planning and infrastructure	EPA, P&D
Disaster Risk Reduction (DRR)	High-risk zones	Fully climate-resilient settlements; disaster-proof infrastructure	PDMA, DDMA
Infrastructure & Utilities	Urban-rural systems	Smart infrastructure systems; sustainable energy and waste solutions	Utilities, TMAs
Solid Waste Management	District-wide	Zero-waste systems; circular economy approaches	TMAs
Transport & Mobility	Regional corridors	Integration with regional transport networks; logistics and freight hubs	C&W
Social Infrastructure	District-wide	Equitable access to advanced education, health, and social services	Line Departments
Governance & Planning	District-wide	Periodic DLUP review and updating; adaptive planning mechanisms	UPU, P&D, District Administration

10.3.3 Long-Term Key Actions (2035–2045)

Table 140: Long-Term Key Actions (2035–2045)

Sector / Theme	Priority Areas / Locations	Medium-Term Key Actions (2030–2035)	Lead / Supporting Agencies
Residential Development	Nawagai, Mamund & Barang	Development of planned residential neighbourhoods; upgrading of housing density with infrastructure support; expansion of municipal services to new growth areas	TMAs, LG&RDD, LUBCA
Industry & Mining	Nawagai, Lara Dandokai & Barang	Establishment of organized industrial estates and marble processing zones; shared facilities (power, water, waste management); stricter environmental compliance	Industries Dept., Mines & Minerals, EPA
Trade & Commerce	Khar, VC Gardai, Mamund, & Vc Lara Dandokai, Nawagai, Mamund & Barang	Development of structured wholesale markets; strengthening of CBDs; relocation and regulation of incompatible commercial uses	TMAs, District Administration
Tourism & Recreation	Vc Gardai, VC Lara Dandokai	Development of tourism facilities (lodges, viewpoints); promotion of eco-tourism circuits; private sector participation	Tourism Dept., Private Sector
Agriculture & Livestock	Rural clusters & valleys	Establishment of agro-processing units; cold storage and value-addition facilities; expansion of livestock markets and veterinary services	Agriculture Dept., Livestock Dept.
Environment & Natural Resources	Forests, rivers, slopes (All Rural Settlements)	Expansion of protected forest areas; biodiversity conservation programs; rehabilitation of degraded landscapes	Forest Dept., EPA
Climate Change	Urban & rural areas	Mainstreaming climate-resilient infrastructure; renewable energy pilots (solar, micro-hydel)	EPA, Energy Dept.
Disaster Risk Reduction (DRR)	Flood & landslide-prone areas	Construction of protective structures; strengthening early warning systems; district-level disaster preparedness planning	PDMA, DDMA
Infrastructure & Utilities	Growth corridors	Expansion of water supply, sewerage and drainage systems; upgrading of power distribution networks	PHED, Utilities
Solid Waste Management	Major urban centers	Development of transfer stations; controlled landfill sites; composting and recycling facilities	TMAs
Transport & Roads	Inter-tehsil corridors	Capacity enhancement of major roads; development of bypasses and freight movement corridors	C&W
Social Infrastructure	Urban expansion areas	Development of new education and health facilities in growing settlements	Education & Health Depts.
Governance & Institutions	Disstrict-wide	Full operationalization of zoning regulations; digital land and building approval systems	LUBCA, District Administration

10.4 Donor and Development Partner Funding

Development partners will be engaged to support the capital-intensive, reform-oriented, and environmentally sensitive components of the land-use plan.

10.4.1 Multilateral and Bilateral Development Partners

Potential areas for donor support include:

- Climate adaptation and mitigation (green infrastructure, urban forestry, watershed management)
- Disaster risk reduction and resilience-building
- Institutional strengthening of planning, land management, and environmental regulation
- Sustainable tourism and community-based livelihood programs
- Skills development and employment generation linked to industrial and agro-based sectors

Funding may be mobilised through grants, concessional loans, and technical assistance programs from institutions such as the **World Bank, ADB, UNDP, GIZ**, and bilateral donors.

11 CHAPTER XIX: MONITORING AND EVALUATION FRAMEWORK

The Monitoring and Evaluation (M&E) Framework for District Bajaur aims to provide a structured system for tracking progress, ensuring accountability, and guiding sustainable development across all key sectors of the district. By setting clear goals, indicators, and responsibilities, the framework will help decision-makers, local authorities, and communities measure achievements and identify gaps to refine policies and improve service delivery.

Education

In the education sector, monitoring focuses on improving access, quality, and equity for all children, with special attention to girls' education. Key indicators include the number of schools constructed or rehabilitated, teacher-student ratios, enrollment and dropout rates disaggregated by gender, and the availability of essential facilities such as toilets, drinking water, and electricity. Progress will be verified through school inspections, Education Department reports, and household surveys. The District Education Department, in coordination with the local government and partner NGOs, will be responsible for monitoring, with annual and biannually field inspections to ensure sustained improvements.

Residential Development

The housing sector requires close monitoring to ensure safe, affordable, and sustainable residential growth. Indicators include the number of new housing units built or regularized, the proportion of the population with access to clean drinking water and sanitation, and compliance with building codes. Field surveys and housing authority records will be used to verify progress. The Municipal Administration will lead these efforts, with annual progress reviews to track trends in residential development and service delivery.

Commercial Development

Commercial activity is vital for local economic growth and requires effective oversight. Monitoring will assess the number of commercial units registered, growth in local business licenses, and increases in retail and wholesale trade volumes. These will be verified through district commerce records and data from local chambers of commerce. The Trade and Commerce Department will take responsibility, with quarterly monitoring and annual reporting to evaluate commercial growth and identify emerging challenges.

Health

In the health sector, the framework focuses on expanding accessibility and improving service quality. Key indicators include the number of health facilities constructed or upgraded, the doctor–patient, vaccination coverage rates, and improvements in maternal and child health indicators such as infant and maternal mortality rates. Verification will rely on District Health Information Systems (DHIS), health department records, and surveys. The District Health Department and Provincial Health Ministry will lead, supported by NGOs where relevant. Quarter monitoring and annual evaluations will ensure that health services remain aligned with population needs.

Forests and Environment

Environmental monitoring is crucial to maintaining ecological balance and natural resource sustainability in Bajaur. Indicators include changes in forest cover, the number of trees planted and their survival rate, the extent of protected areas maintained, and the incidence of illegal logging. Satellite imagery, Forest Department reports, and community monitoring initiatives will be used for verification. The Forest Department, supported by the Environmental Protection Agency and local councils, will be responsible for this sector, with bi-annual monitoring and annual reviews to ensure conservation objectives are met.

Industrial Development

Industrial growth must be balanced with sustainability to benefit the local economy. Monitoring will track the number of industrial units established or upgraded, employment generated, and compliance with environmental regulations related to emissions and waste disposal. Verification will come from Industrial Department records, labor force surveys, and environmental reports. The Provincial Industrial Department and District Government will lead monitoring, with quarterly reviews and annual reporting to assess industrial performance and impacts.

Tourism

Tourism has the potential to boost economic growth but needs structured monitoring to realize its full benefits. Indicators will include annual tourist arrivals (both domestic and international), revenue from tourism, the number of heritage sites and recreational facilities upgraded, and the installation of waste management systems at key tourist locations. Verification will depend on Tourism Department data, visitor surveys, and independent evaluations. The Tourism Department, working with local authorities and the private sector, will oversee the monitoring process. Progress will be reviewed quarterly, with in-depth evaluations every five years to measure tourism's impact on the economy.

Infrastructure

Monitoring infrastructure will improve accessibility, mobility, and utilities. Indicators include the kilometers of roads built or fixed, the percentage of people with access to electricity and clean water, and the coverage of internet and mobile services. Verification will come from Public Works Department records, utility provider data, and surveys. The District Works Department, PESCO, WASA, and PTA will share responsibilities, with quarterly progress updates and yearly reviews to evaluate connectivity and service quality.

Disaster Risk Reduction (DRR) and Emergency Management

Bajaur's vulnerability to natural and man-made hazards requires robust monitoring of disaster risk reduction initiatives. Indicators include the number of disaster management plans prepared or updated, the operational status of early warning systems, and the frequency of community training and awareness programs. Verification will rely on PDMA reports and feedback from local disaster committees. PDMA KP and the District Disaster Management Unit will lead these activities, supported by NGOs, with annual drills and bi-annual reporting to strengthen preparedness.

Cross-Sectoral Governance and Accountability

Good governance and accountability form the foundation of effective monitoring. Indicators include the number of community participation forums held annually, the rate of development budget utilization, and the results of citizen satisfaction surveys. Verification will be carried out through district administration records and independent evaluations. The District Government, civil society organizations, and independent auditors will play key roles. Annual reviews and mid-term as well as end-term evaluations will ensure transparency, inclusiveness, and responsiveness in governance.

Conclusion

This comprehensive M&E framework provides District Bajaur with a robust system to track development across education, housing, commerce, health, environment, industry, tourism, infrastructure, disaster management, and governance. Through clear indicators, transparent verification methods, and defined responsibilities, it ensures that progress is measurable, accountability is upheld, and corrective actions can be taken promptly. By institutionalizing this framework, District Bajaur can achieve sustainable growth while balancing social, economic, cultural, and environmental priorities.